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for
Potential Source of Contamination 47

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Naval Air Station Jacksonville
Jacksonville, Florida

Contract Task Order 0162

February 2008

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Naval Facilities Engineering Command
Southeast
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North Charleston, South Carolina 29406

TETRA TECH NUS, Inc.

Rev. 2
02/22/08

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY FOR POTENTIAL SOURCE OF CONTAMINATION 47

NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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PROFESSIONAL CERTIFICATION

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville, Florida

This Remedial Investigation/Feasibility Study was prepared in general accordance with FAC 62-770 under the direct supervision of the undersigned geologist using geologic and hydrogeologic principles standard to the profession at the time the report was prepared. If conditions are determined to exist that differ from those described, the undersigned geologist should be notified to evaluate the effects of additional information on the assessment described in this report. This report was developed specifically for the referenced site and should not be construed to apply to any other site.

Date: February 22, 2008
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FOREWORD

In order to meet its mission objectives, the United States Navy (Navy) performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills, leaks, and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense initiated various programs to investigate and remediate conditions related to suspect past releases of hazardous materials at their facilities.

One of these programs is the Navy and Marine Corps Installation Restoration Program (NIRP). This program complies with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). The Acts, passed by Congress in 1980 and 1986, respectively, established the means to assess and cleanup hazardous waste sites for both private sector and federal facilities. These Acts are the basis for what is commonly known as the Superfund Program.

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

The NIRP is conducted in several stages:

- The Preliminary Assessment (PA) in which potential sites are identified through record searches and interviews.

- A Site Inspection (SI) in which areas containing contamination are confirmed, constituting actual sites. (Together, the PA and SI steps were called the Initial Assessment Study under the Navy's NACIP program.)

- A Remedial Investigation and Feasibility Study (RI/FS) in which the type and extent of contamination is determined, criteria for cleanup is established, remedial action alternatives are identified and evaluated, and cost estimates for each alternative are developed. As part of the RI/FS, a risk assessment will be made to identify potential effects on human health and the environment in order to help evaluate remedial action alternatives.

- The remedial design and remedial action in which the selected alternative is planned and conducted. Monitoring is then performed to evaluate the effectiveness of the selected alternative.

The investigation of potential hazardous waste sites at Naval Air Station (NAS) Jacksonville in Jacksonville, Florida is presently being conducted under the NIRP and follows CERCLA guidelines. Earlier preliminary investigations had been conducted at NAS Jacksonville under the Navy's NACIP program. In 1990, in coordination with the United States Environmental Protection Agency (USEPA) and the Florida Department of Environmental Protection (FDEP), the investigation of hazardous waste sites was formalized under a Federal Facilities Agreement (FFA).

NAS Jacksonville is conducting the investigation and cleanup of hazardous waste sites at their facility by working through the Naval Facilities Engineering Command, Southeast (NAVFAC SE). USEPA and the FDEP oversee the Navy environmental program. All aspects of the program are conducted in compliance with State and Federal regulations, as ensured by the participation of these regulatory agencies. The NAS Jacksonville RCRA operating permit specifies cleanup in conjunction with a CERCLA program.

Questions regarding the NIRP Program at NAS Jacksonville should be addressed to Mr. Tim Curtin at (904) 542-4228.

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ACRONYMS

2,4-D	2,4-Dichlorophenoxyacetic Acid
2,4,5-T	2,4,5-Trichlorophenoxyacetic acid
2,4,5-TP	2,4,5-trichlorophenoxypropionic acid (Silvex)
ABB-ES	ABB Environmental Services
ABS	Absorption Efficiency
ACH	Air Changes per Hour
ARAR	Applicable or Relevant and Appropriate Requirement
AS	Air Sparging
AS^{3+}	Trivalent Arsenic
AS^{5+}	Pentavalent Arsenic
AST	Aboveground Storage Tank
ATI	Ambient Technologies, Inc.
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
BaPEq	Benzo(a)pyrene Equivalent
BCF	Bioconcentration Factor
BEHP	bis(2-ethylhexyl) phthalate
BEI	Bechtel Environmental, Inc.
BHC	Hexachlorocyclohexane (Lindane)
bls	Below Land Surface
BOD`	Biochemical Oxygen Demand
BRE	Brown and Root Environmental, Inc.
BTEX	Benzene, Toluene, Ethylbenzene, Total Xylenes
BW	Body Weight
°C	Degrees Celsius
CAA	Clean Air Act
CA EPA	California Environmental Protection Agency
CCTL	Clean Closure Target Level
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CF	Conversion Factor
CFR	Code of Federal Regulations
CKD	Cement Kiln Dust
cm	Centimeter
cm^2	Centimeters Squared
cm/sec	Centimeters per Second
CO2	Carbon Dioxide

ACRONYMS (Continued)

COC	Contaminant of Concern
COD	Chemical Oxygen Demand
CompQAP	Comprehensive Quality Assurance Plan
COPC	Constituent of Potential Concern
CSF	Cancer Slope Factor
CSM	Conceptual Site Model
CTL	Cleanup Target Level
CTO	Contract Task Order
CWA	Clean Water Act
days/year	Days per Year
DCE	Dichloroethene
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichlorethylene
DDT	2,2'-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DON	Department of Navy
DOT	Department of Transportation
DPT	Direct Push Technology
DQO	Data Quality Objective
DVECC	Disease Vector Ecology and Control Center
ED	Exposure Duration
EF	Exposure Frequency
Eh	Oxidation Reduction Potential of Groundwater
ENCO	Environmental Conservation Laboratories, Inc.
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESV	Ecological Screening Values
ET	Exposure Time
EV	Event Frequency
°F	Degree Fahrenheit
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FFA	Federal Facilities Agreement
FI	Fraction Ingested from Contaminated Source
FID	Flame Ionization Detector
f_{oc}	Organic Carbon

ACRONYMS (Continued)

FS	Feasibility Study
ft	Feet or Foot
ft^2	square feet
ft^3	cubic feet
ft/day	Feet (or Foot) Per Day
ft/yr	Feet (or Foot) Per Year
GAC	Granulated Activated Carbon
GCTL	Groundwater Cleanup Target Level
GGC	Groundwater Guidance Concentration
gpm	Gallons per Minute
GRA	General Response Action
HEAST	Health Effects Assessment Summary Tables
Hg	Mercury
HHRA	Human Health Risk Assessment
HI	Hazard Index
HLA	Harding Lawson Associates
HQ	Hazard Quotient
HRC	Hydrogen Releasing Compound
HRP	HRP Spectrum
HSA	Hollow Stem Auger
HSWA	Hazardous and Solid Waste Amendment
IC	Institutional Control
ICR	Incremental Cancer Risk
ILCR	Incremental Lifetime Cancer Risk
IR	Installation Restoration
IRIS	Integrated Risk Information System
k	Hydraulic Conductivity
K_d	Distribution Coefficient
kg/mg	Kilograms per Milligram
K_{oc}	Organic Carbon Partition Coefficient
K_{ow}	Octanol/Water Partition Coefficient
LDR	Land Disposal Restrictions
LOAEL	Lowest-Observed-Adverse-Effect-Level
LTTD	Low Temperature Thermal Desorption
LUC	Land Use Control

ACRONYMS (Continued)

M^3	Cubic Meters
MCL	Maximum Contaminant Level
MCPA	2-Methyl-4-chlorophenoxy acetic acid
MCPP	2-(2 methyl-4-chlorophenoxy)propionic acid
mg/cm^2	Milligrams per Centimeters Squared
mg/kg	Milligrams per Kilogram
mg/kg/day	Milligrams per Kilograms per Day
mg/L	Milligrams per Liter
mg/µg	Milligrams per Micrograms
MI	Mobility Index
mm	Millimeter
MMA	Monomethylarsenate
MRC	Metal Removal Compound
MRL	Minimal Risk Level
msl	Mean Sea Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
mV	Millivolts
NAAQS	National Ambient Air Quality Standards
NACIP	Navy Assessment and Control of Installation Pollutants
NADSC	Natural Attenuation Default Source Concentrations
NAS	Naval Air Station
NAT	Naval Aviation Trades
NAVFAC SE	Naval Facilities Engineering Command, Southeast
Navy	United States Navy
NCEA	National Center for Environmental Assessments
NCP	National Oil and Hazardous Substances Contingency Plan
NFA	No Further Action
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIRP	Navy and Marine Corps Installation Restoration Program
NL	No Listing
NM	Not Measured
NO_2	Nitrite
NO_3	Nitrate
NOAEL	No-Observed-Adverse-Effect-Level

ACRONYMS (Continued)

NPL	National Priority List
NPW	Net Present Worth
NS	Not Sampled
NSPS	New Source Performance Standards
NTU	Nephelometric Turbidity Unit
O&M	Operation and Maintenance
OP	Organophosphorus
ORC	Oxygen Releasing Compound
ORP	Oxidation Reduction Potential
OSHA	Occupational Health and Safety Administration
OU	Operable Unit
OVG	Organic Volatile Gases
PA	Preliminary Assessment
PAHs	Polynuclear Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PEF	Particulate Emission Factor
pg/L	Picograms per Liter
PID	Photo Ionization Detector
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
PPRTV	Provisional Peer Reviewed Toxicity Value
ppt	Parts Per Thousand
PRB	Permeable Reactive Barrier
PRG	Preliminary Remediation Goal
PSC	Potential Source of Contamination
PVC	Polyvinyl chloride
PWC	Public Works Center
QAPP	Quality Assurance Project Plan
RAD	Radiological
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action objective
RBC	Risk-Based Concentration
RBCA	Risk-Based Corrective Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design

ACRONYMS (Continued)

RF	Retardation Factor
RfD	Reference Dose
RFI	RCRA Facility Investigation
RGO	Remedial Goal Option
RI	Remedial Investigation
RI/FS	Remedial Investigation and Feasibility Study
RME	Reasonable Maximum Exposure
RMO	Risk Management Option
ROD	Record of Decision
RUST	RUST Environmental and Infrastructure
S	Solubility
SARA	Superfund Amendments and Reauthorization Act
SCG	Soil Cleanup Goals
SCTL	Soil Cleanup Target Level
SDWA	Safe Drinking Water Act
SER	Sampling Event Report
SI	Site Inspection
SMCL	Secondary Maximum Contaminant Level
SMDP	Scientific/Management Decision Points
SOP	Standard Operating Procedure
SPLP	Soil Precipitation Leaching Procedure
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TBC	To Be Considered
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEF	Toxicity Equivalence Factor
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TRV	Toxicity Reference Values
TSDF	Treatment, Storage, and Disposal Facility
TtNUS	Tetra Tech NUS, Inc.
UCL	Upper Confidence Limit
µg/kg	Micrograms per Kilogram

ACRONYMS (Continued)

µg/L	Micrograms per Liter
USDA	Unites States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
UST	Underground Storage Tank
uV	Ultra Violet
v	Velocity
VDEQ	Virginia Department of Environmental Quality
VE	Vapor Extraction
VF	Volatilization Factor
VOC	Volatile Organic Compound
VP	Vapor Pressure
Y^3	Cubic Yards
ZVI	Zero Valent Iron

EXECUTIVE SUMMARY

The Navy has implemented the NIRP to investigate and remediate releases of hazardous materials at Navy facilities. The NAS Jacksonville Partnering Team, established in 1993, guides the implementation of the NIRP at NAS Jacksonville. This team consists, in part, of representatives from USEPA, FDEP, the Navy, Tetra Tech NUS, Inc. (TtNUS), and CH2M Hill, Inc.

TtNUS was contracted by NAVFAC SE to conduct an RI/FS for Potential Source of Contamination (PSC) 47 at NAS Jacksonville in Jacksonville, Florida. The RI/FS has been completed in general accordance with Contract Number N62467-94-D-0888 as part of the NIRP. The activities and findings of the RI and associated Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) and the FS are discussed in this report. As requested by the USEPA, the site was given an Operable Unit (OU) designation (OU 8) to facilitate tracking in the USEPA database.

ES-1 REMEDIAL INVESTIGATION

PSC 47 consists of an area centered on the former Pesticide Shop (Building 536) and the Disease Vector Ecology and Control Center (DVECC) (Building 937). Waste materials previously stored or used in the vicinity of Buildings 536 and 937 include pesticides and volatile organic compounds (VOCs). Other regulated substances, including herbicides, semivolatile organic compounds (SVOCs), and inorganics (metals) have been identified at elevated concentrations in soil and/or groundwater samples during previous site investigations. Previously reported releases and the data obtained during the removal of the former “mixing tank” formerly located south of Building 937 resulted in the creation of PSC 47 and the inclusion of Building 937 in OU 8.

The geology of the PSC 47 area includes clastic sediments, consisting predominantly of sand, from land surface to the top of a weathered limestone, which occurs at a depth of 45 to 53 feet (ft) below land surface (bls) across the site. The weathered limestone prevents further downward migration of contaminants. There also is a downward gradient at this site based on water level measurements in well nests.

The primary contaminants detected and delineated during this RI were pesticides, VOCs, SVOCs, and arsenic. Contamination of surface soil, subsurface soil, and groundwater are documented in this report. Surface and subsurface soil pesticide contamination [defined as contaminant concentrations exceeding residential Soil Cleanup Target Levels (SCTLs)] is widespread around Building 536. Arsenic contamination is present in both the surface and subsurface soil around Building 536 but distribution

appears to be random. Limited surface soil contamination [pesticides and polynuclear aromatic hydrocarbons (PAHs)] is also present in the drainage swale located along the eastern site boundary.

The groundwater contamination is focused mostly in the upper portions of the shallow saturated unit (approximately 7 to 27 ft bls). There are two distinct areas (plumes) of shallow contamination that will be referred to as the southern plume and northern plume. The southern plume is an area of groundwater contamination south of Building 937 and the northern plume is an area of groundwater contamination approximately centered on Building 536.

The northern groundwater plume is contaminated predominantly with pesticides in the upper portion of the shallow aquifer. A small area of VOC/SVOC contamination is present within this shallow pesticide plume (located near the center of the north side of Building 536) and is most likely attributed to previous aboveground storage tanks (ASTs) and underground storage tanks (USTs) that had been located in the vicinity. One pesticide contaminant of concern (COC) was detected in deep monitoring well JAX47-MW13D (installed in the deeper portion of the surficial aquifer) located near the center of Building 536. Groundwater flow at Building 536 is in a general northwest direction.

The southern plume is a mixture of pesticides, VOCs, and arsenic that is located south of Building 937, but extends underneath the western end of the building. This plume is centered between monitoring wells JAX47-MW17S and JAX47-536-MW01S and located predominantly in the upper portion of the shallow aquifer. One pesticide COC was detected in a deep monitoring well (JAX47-MW17D). JAX47-MW17D also had four VOC compounds at concentrations exceeding Groundwater Cleanup Target Levels (GCTLs). Arsenic contamination is limited in the southern plume to a “hot spot” that is approximately a quarter acre in size and centered on wells JAX47-536-MW02 and JAX47-536-MW03S. The arsenic “hot spot” is in the approximate location of the former mixing tank. Groundwater flow at Building 937 is in a general northwest direction.

ES-2 HHRA

The results of an HHRA conducted at PSC 47 indicated that the potential for unacceptable risks to human health is present. Unacceptable risk is associated with direct contact to surface soil, subsurface soil and groundwater. The COCs for direct contact exposures (associated with any or all media) include benzene, cis-1,2-dichloroethene (DCE), trichloroethene (TCE), vinyl chloride, benzo(a)pyrene equivalents, 4,4’-dichlorodiphenyldichloroethane (DDD), 4,4’-dichlorodiphenyldichloroethylene (DDE), 4,4’-dichlorodiphenyltrichloroethane (DDT), alpha-chlordane, gamma-chlordane, dieldrin, heptachlor, heptachlor epoxide, alpha-hexachlorocyclohexane (BHC), beta-BHC, delta-BHC, gamma-BHC, and arsenic.

ES-3 ERA

The ERA concluded that VOCs and SVOCs pose negligible risk. However, organochlorine pesticides are present in some surface soil samples at extremely high concentrations and are known to be extremely persistent in soil. Pesticide concentrations in several samples pose risk to soil invertebrates, especially from the cumulative toxicity of multiple pesticides. In addition, organochlorine pesticides can bioaccumulate and biomagnify in the food chain, and the risk assessment suggests there is elevated risk to mammals and birds that consume soil invertebrates at the site. However, the poor habitat, the urban nature of the area, and the small size of PSC 47 results in an exposure pathway that is essentially negligible for wildlife species. Therefore, with the exception of receptors such as soil invertebrates, the potential for ecological impacts from site-related contaminants is lessened under current habitat conditions.

ES-4 FEASIBILITY STUDY

The Remedial Action Objectives (RAOs) identified for PSC 47 are as follows:

Soil RAO No. 1: Prevent unacceptable risk from exposure to surface and subsurface soil with concentrations of benzo(a)pyrene equivalent (BaPEq), pesticides, and arsenic greater than the FDEP SCTLs for direct residential exposure.

Soil RAO No. 2: Prevent migration of pesticides to groundwater from surface and subsurface soil with concentrations of these chemicals greater than the FDEP SCTLs for leachability to groundwater.

Groundwater RAO No. 1: Prevent unacceptable risk from exposure to groundwater with concentrations of VOCs, SVOCs, pesticides, and arsenic greater than the FDEP GCTLs and the USEPA maximum contaminant levels (MCLs).

Groundwater RAO No. 2: Prevent migration of groundwater COCs to surface water.

In order to implement the RAOs, the following remedial alternatives were evaluated.

Alternative S-1: No Action
Alternative S-2: Capping to Allow Industrial Use and Prevent Leaching, land use controls (LUCs), and Monitoring
Alternative S-3: Excavation and Off-Site Disposal to Allow Industrial Use, Capping to Prevent Leaching, LUCs, and Monitoring
Alternative S-4: Excavation and Off-Site Disposal to Allow Residential Exposure and to Prevent Leaching

Alternative GW-1:	No Action
Alternative GW-2:	Monitored Natural Attenuation and LUCs
Alternative GW-3A:	Northern Plume In-Situ Treatment (Enhanced Bioremediation), Monitored Natural Attenuation, and LUCs
Alternative GW-3B:	Southern Plume In-Situ Treatment (Chemical Oxidation & Precipitation), Monitored Natural Attenuation, and LUCs

1.0 INTRODUCTION

TtNUS, under contract to the Navy, NAVFAC SE, conducted an RI/FS at PSC 47, NAS Jacksonville located in Jacksonville, Duval County, Florida. PSC 47 is a former pesticide mixing, usage, and storage area that has been housed in Buildings 536 and 937. Other regulated substances previously identified in the area include herbicides, VOCs, SVOCs, and waste oil. This RI/FS has been completed in accordance with contract number N62467-94-D-0888, Contract Task Order (CTO) 0162 as part of the NIRP. The activities and findings obtained during the RI/FS are presented and discussed in this report.

1.1 ORGANIZATIONAL STRUCTURE

The Navy implemented the NIRP to investigate and remediate releases of hazardous materials at Navy and Marine Corps installations. NAS Jacksonville was listed on the CERCLA National Priority List (NPL) in December 1989 because of documented past releases of hazardous waste at the facility. Activities required under CERCLA regulations for NAS Jacksonville are being conducted under the FFA and the base's Installation Restoration (IR) Program. An integral portion of this program is the NAS Jacksonville Partnering Team, established in 1993, which guides the implementation of the NIRP at NAS Jacksonville. This team consists of representatives from the USEPA, the FDEP, NAVFAC SE and its consultants, the NAS Jacksonville Facilities Department, TtNUS, and CH2MHILL.

Fifty-two PSCs have been identified at NAS Jacksonville where hazardous materials may have been released to the environment. The area of the current investigation has been designated PSC 47.

1.2 PAST PRACTICES LEADING TO ESTABLISHMENT OF PSC 47

1.2.1 Pesticide Shop (Building 536)

The Pesticide Shop, which has occupied its current site since the mid/late 1960s, was identified as a PSC and added to NAS Jacksonville's Hazardous and Solid Waste Amendment (HSWA) permit in 1993 because past practices included the release of pesticides, storage of pesticides and herbicides, and calibration and testing of pesticide application equipment. Additionally, chlordane was applied to and around test slabs of concrete, cinder block, and brick in the southeast corner of the property during termite control training exercises [Harding Lawson Associates (HLA), 1999].

In 1991, approximately 30 empty, rusted 55-gallon drums were removed from the southwest corner of the property. According to waste handlers at NAS Jacksonville, the drums had once contained malathion and other pesticides. An unspecified amount of chlordane was reportedly spilled in the northwest corner of PSC 47 at an unknown date (HLA, 1999).

Other previously existing potential sources of contamination in the vicinity of Building 536 include soakage pits formerly located at the southeast and southwest corners of the building and one UST and two ASTs formerly located south of the building. The soakage pits were 2 ft square by 3 ft deep. The purpose of the pits is not known, although it is believed that the southeastern pit received drainage from inside the bays of Building 536. The UST and one of the ASTs reportedly contained diesel fuel and the other AST contained a mixture of diesel fuel and malathion for use as a "hot fogger" prior to 1972.

1.2.2 DVECC (Building 937)

Building 937 (DVECC) was dedicated on January 25, 1978. One of the functions performed at Building 937 is the development of effective pest management programs. Prior to 1978, these activities were conducted at the Pesticide Shop. From approximately 1978 to 1988, a pesticide mixing room with a sink and three floor drains was located in the south central portion of Building 937. Rinse water and excess liquids from the sink and floor drains discharged to a 1,000-gallon fiberglass UST known as the "DVECC Tank." The UST was taken out of service in 1989, the same year that representatives from DVECC and the Naval hospital met to discuss the historical inability of the insectary in Building 937 to support mosquito growth. At this meeting, participants expressed concern about the possibility of significant contamination on the grounds of Buildings 937 and 536 due to the long history of pesticide application training.

NAS Jacksonville prepared the DVECC tank for Resource Conservation and Recovery Act (RCRA) closure in a revised permit application submitted to the FDEP on October 13, 1993. FDEP issued the permit on September 21, 1995, authorizing closure of the DVECC tank as part of the Closure Permit for Hangar 1000. In April 1994, prior to issuance of the application, a residual volume (approximately 15 gallons) of liquid was removed from the tank and floor drains and the drains were capped with concrete.

Closure work was performed by Bechtel Environmental, Inc. (BEI) from October 16, 1995 through December 6, 1995 [RUST Environment and Infrastructure (RUST), 1996]. Confirmatory soil and groundwater samples collected after excavation and removal of the DVECC tank revealed the presence of pesticides in these environmental media, the most prevalent being chlordane. Since "clean closure" was not achieved, additional subsurface investigations were performed in December 1996 to evaluate the extent of contamination in the area. Soil samples were collected from 14 locations and groundwater samples were collected from 6 locations in and around the former DVECC tank excavation. Pesticide concentrations were again reported at values exceeding regulatory criteria in soil and groundwater samples, although the distribution of contaminants appeared random and was not centered on the location of the former DVECC tank. This random contaminant distribution in the vicinity of the DVECC tank cast uncertainty as to the source area for pesticide contamination in this area. Shortly after results of

the supplemental assessment were made known, the NAS Jacksonville Partnering Team agreed to incorporate DVECC into PSC 47, effectively removing the site from the RCRA Application for Closure Permit for Hangar 1000.

1.3 ASSESSMENT AND REMEDIAL ACTIONS PRIOR TO THE RI/FS

Actions performed at PSC 47 prior to initiation of the RI/FS, which were intended to either eliminate potential source areas of contamination, define the extent of contamination, or remove contaminated media are summarized in Table 1-1. Descriptions and results of these activities are described more fully in Section 3.0 of this report.

1.4 RI/FS SCOPE OF WORK AND OBJECTIVES

A formal data quality objective (DQO) process was conducted by the NAS Jacksonville Partnering Team in early 2000. Unabridged details of the seven-step DQO process implemented for PSC 47 RI/FS are described in Section 3 of the *Final RI/FS Work Plan for PSC 47* (TtNUS, 2000). During the DQO meetings, it was decided that field activities would be performed in phases in order to satisfactorily complete the RI. Also during the DQO process, the Partnering Team chose to consider groundwater, surface soils (0 to 2 ft bls), subsurface soils (base of vadose zone), surface water, and sediment during the RI.

The above referenced RI sampling was completed in two phases (Phase I and Phase II) and a Draft RI was submitted to FDEP on June 14, 2004. FDEP comments (dated September 29, 2004) on the Draft RI resulted in the need for additional assessment activities at PSC 47. The Partnering Team directed TtNUS to collect additional soil and groundwater data. This additional sampling data will be referred to as Phase III sampling.

1.4.1 Phase I Field Activities

The following activities were conducted during Phase I of the field investigation:

- Advancement of 31 Direct Push Technology (DPT) borings around the site perimeter and at several interior locations using a GeoProbe®. Additional locations as determined in the field were also proposed.

Table 1-1
Summary of Source Removal Actions, Assessment Activities, and Remedial Measures Performed at PSC 47 Prior to Initiation of RI/FS

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Date	Actions Performed	Summary of Results	Reference Document	Author
March to September 1994	Organizational chart and Work Plan for removal of DVECC pesticide tank prepared.	Scope of Work including waste management, Sampling and Analysis Plan, Safety and Health Plan, and Quality Control Plan accepted by Navy.	Remediation Work Plan	Bechtel Environmental, Inc. (September, 1995)
October 16, to December 6, 1995	• Excavation of DVECC tank and associated piping. • Removal of tank, associated piping, waste soil, concrete, and asphalt (33 55-gallon drums, 4 roll offs). • Laboratory analysis of 6 soil samples and 4 groundwater samples.	Pesticides (primarily chlordane) identified in soil and groundwater samples beneath excavation at concentrations exceeding regulatory criteria.	Closure Activities Report and Certification for DVECC Tank and Drains at Building 937	Rust Environmental and Infrastructure (December, 1996)
December 18, to December 27, 1996	• Installation of 5 shallow monitoring wells and 1 deep monitoring well around former DVECC tank location. • Collection of soil samples from 6 monitoring well borings and from 8 other soil borings. • Laboratory analysis of groundwater samples from monitoring wells for select pesticides and herbicides. • Laboratory analysis of 2 soil samples each from 14 borings for select pesticides and herbicides. • Slug testing of 3 monitoring wells.	Approximately 6 or 7 targeted pesticides reported at concentrations exceeding regulatory criteria in soil and groundwater samples. One herbicide (2,4,-D) also reported.	Draft RCRA Facility Investigation for Disease Vector Ecology and Control Center (Building 937)	Brown and Root, Inc. Environmental (January, 1999)

See notes at end of table.

Table 1-1 (Continued)
Summary of Source Removal Actions, Assessment Activities, and Remedial Measures Performed at PSC 47 Prior to Initiation of RI/FS

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Date	Actions Performed	Summary of Results	Reference Document	Author
April 9, to August 13, 1997	• Collection of 56 surface soil samples and 3 groundwater samples from areas surrounding Building 536 and behind (northwest of) Building 937. • Laboratory analysis of soil and groundwater samples for some or all of the following: TCL VOCs, SVOCs, pesticides/PCBs, herbicides, and TAL metals.	Soil: 13 pesticides and 3 herbicides detected at significant levels, 2 SVOCs detected at moderately high levels, no significant VOC detections; arsenic and lead reported at high levels in isolated cases. Groundwater: 15 pesticides, 1 herbicide, 2 SVOCs, 2 VOCs, and 5 inorganics (metals) reported at concentrations exceeding Florida GCTLs.	Sampling Event Report, Potential Source of Contamination 47, Pesticide Shop, Building 536	Harding Lawson Associates (February, 1999)
February to March 1999	• Area surrounding western half of Building 536 excavated to depths of 1, 2, or 3 ft. Approximately 1300 cubic yards of contaminated soil excavated and transported off-site for disposal. Contents of soakage pits stored in 55-gallon drums and also transported off-site for disposal. • Twenty-eight floor samples and 17 sidewall samples (soil) collected from excavation and 9 samples collected from soakage pit excavations for analysis of pesticides. • Excavated area backfilled with clean material, site returned to pre-construction condition.	Approximately 10 pesticide compounds detected at concentrations exceeding industrial SCTLs in soil samples. Highest concentrations were around the soakage pits and in the area to the south and southwest of the western half of Building 536.	Completion Report for Soil Removal at PSC 47, Pesticide Shop	Bechtel Environmental, Inc. (July, 1999)

Notes:
PSC = potential source of contamination
DVECC = Disease Vector Ecology and Control Center
RCRA = Resource Conservation and Recovery Act
TCL = target compound list
VOCs = volatile organic compounds
SVOCs = semivolatile organic compounds
PCBs = polychlorinated biphenyls
TAL = target analyte list
GCTLs = groundwater cleanup target levels
ft = feet
SCTLs = soil cleanup target levels

- Collection of soil samples from DPT or hand-augered borings at 1-ft vertical intervals until the water table is encountered, as required. The samples were analyzed in the mobile laboratory and additional vertical samples were only collected if the surface soil indicated the presence of COCs greater than residential SCTLs.

- Collection of groundwater grab samples at two or three intervals within the surficial aquifer to depths of approximately 50 ft bls at the 31 DPT boring locations.

- Collection of surface water and/or sediment samples, if present, from select locations in the ditch on the east side of the PSC.

- Mobile laboratory analysis of soil samples for TCL pesticides by USEPA Method 8081 and at select locations for TCL VOCs by USEPA Method 8260 beginning with the surface sample at each boring location and continuing downward until results are below residential SCTLs or until background was obtained.

- Mobile laboratory analysis of groundwater grab samples and surface water/sediment samples (if present) for these same constituents (pesticides, select locations for VOCs).

- Fixed-base laboratory analysis of 10 percent of the mobile laboratory samples (from all media) for an extended list of parameters, including polychlorinated biphenyls (PCBs), organophosphorous pesticides, herbicides, target compound list (TCL) SVOCs, and target analyte list (TAL) metals (select locations) in addition to TCL pesticides, and TCL VOCs.

The primary objective of Phase I, or the screening phase, was to evaluate the lateral and vertical extent of soil contamination and to establish a vertical profile of groundwater contamination so that permanent monitoring wells could be strategically placed during Phase II.

1.4.2 Phase II Field Investigation

The original scope of work for the Phase II field investigation called for the installation of six permanent shallow monitoring wells (total depth, 15 ft bls) and two deep monitoring wells (total depth, approximately 50 ft bls) at locations considered optimum based on results of the Phase I investigation. Wells were installed and developed in accordance with applicable state and federal guidelines. Groundwater flow direction maps were generated from surveyed top-of-casing elevations and depth-to-water measurements obtained at the newly-installed wells and from existing wells installed by previous consultants.

Groundwater samples collected from new and existing wells were analyzed by a certified fixed-base laboratory for TCL pesticides, organophosphorous pesticides, and TCL herbicides. Select samples would also be analyzed for TCL VOCs, TCL SVOCs, PCBs, and TAL metals. In addition to COC analyses, groundwater samples from each well were submitted to the laboratory for analysis of the following natural attenuation parameters: methane, ethane, ethene, hydrogen sulfide, chloride, nitrate, nitrite, sulfate, ammonia, total Kjeldahl nitrogen (TKN), dissolved iron, dissolved manganese, and total organic carbon (TOC). Other natural attenuation parameters, including carbon dioxide, dissolved oxygen, alkalinity, ferrous iron, hydrogen sulfide, and sulfides (as S^{-2}), were measured in the field during collection of groundwater samples.

1.4.3 Phase III Field Investigation

A third phase of sampling was completed to satisfy FDEP concerns on the completeness of soil and groundwater delineation at PSC 47. The objective of the sampling was to complete soil and groundwater delineation that had been previously identified at PSC 47. Additional horizontal and vertical delineation of pesticide impacted soil was needed around Building 536. Collection of arsenic soil data from the area of the aresenic hot spot in the southern plume was accomplished. A second round of groundwater data was collected for PSC 47 to verify prevously defined groundwater contamination. To address these issues, the following scope of work was completed.

- Fifty soil sample locations were proposed around Buildings 536 and 937. Surface soil (0-1 ft) and subsurface soil (immediately above water table, approximately 5 to 6 ft bls) samples were collected. Fourteen of the samples were collected at Building 937 and analyzed for arsenic only. The remaining 36 samples were collected around Building 536 and analyzed for TCL pesticides and arsenic. Synthetic precipitation leaching procedure (SPLP) analysis was performed on select samples following evaluation of laboratory results.
- Additional soil samples were collected as needed to complete delineation.
- Four new shallow and one deep monitoring well were installed.
- The five newly installed monitoring wells and 30 existing site wells were sampled and analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, and arsenic.

1.4.4 Objectives of the RI/FS

The objectives of the RI/FS are as follows:

- Develop an understanding of the geologic and hydrogeologic setting at PSC 47.
- Define the areal extent of impact to the media of concern.
- Collect natural attenuation parameters and evaluate the potential natural attenuation pathways.
- Identify the constituents of potential concern (COPCs) for the risk assessment process.
- Conduct HHRAs and ERAs.
- Evaluate and recommend remedial alternatives that may achieve a final remedy for the site.

1.5 REPORT SCOPE AND ORGANIZATION

This document contains results from the completed RI program and includes analytical results and conclusions from previous investigations. Previous reports are incorporated by reference to provide a comprehensive record of the investigative activities at PSC 47.

This report contains the following 13 sections:

1.0 Introduction, overview of the RI/FS approach and objectives, background information, and the scope and organization of the report.

2.0 Site background, location, descriptions, history of PSC 47, and physical characteristics of the region and PSC 47 including climate, soil, geology, and hydrogeology.

3.0 Previous site investigations and remedial actions.

4.0 RI/FS Field Program, a summary of the activities conducted for this remedial investigation.

5.0 Nature and extent of all contamination within each environmental media. Evaluation of the fate and transport of contaminants.

6.0 Chemical fate & transport, including an evaluation of natural attenuation processes. Summary of natural attenuation Results.

7.0 HHRA.

8.0 ERA.

9.0 Identification of the remedial action objectives.

10.0 Identification and screening of remedial technologies and development of remedial alternatives.

11.0 Detailed analysis of the remedial alternatives for surface soil and groundwater.

12.0 Comparative analysis of the remedial alternatives.

– References.

2.0 SITE BACKGROUND

2.1 SITE CHARACTERIZATION

The following sections provide a historical overview of the NAS Jacksonville facility and a physical description of PSC 47. Background information on the geography and demographics, physiography and topography, climate, soil, regional geology, and regional hydrogeology are also provided.

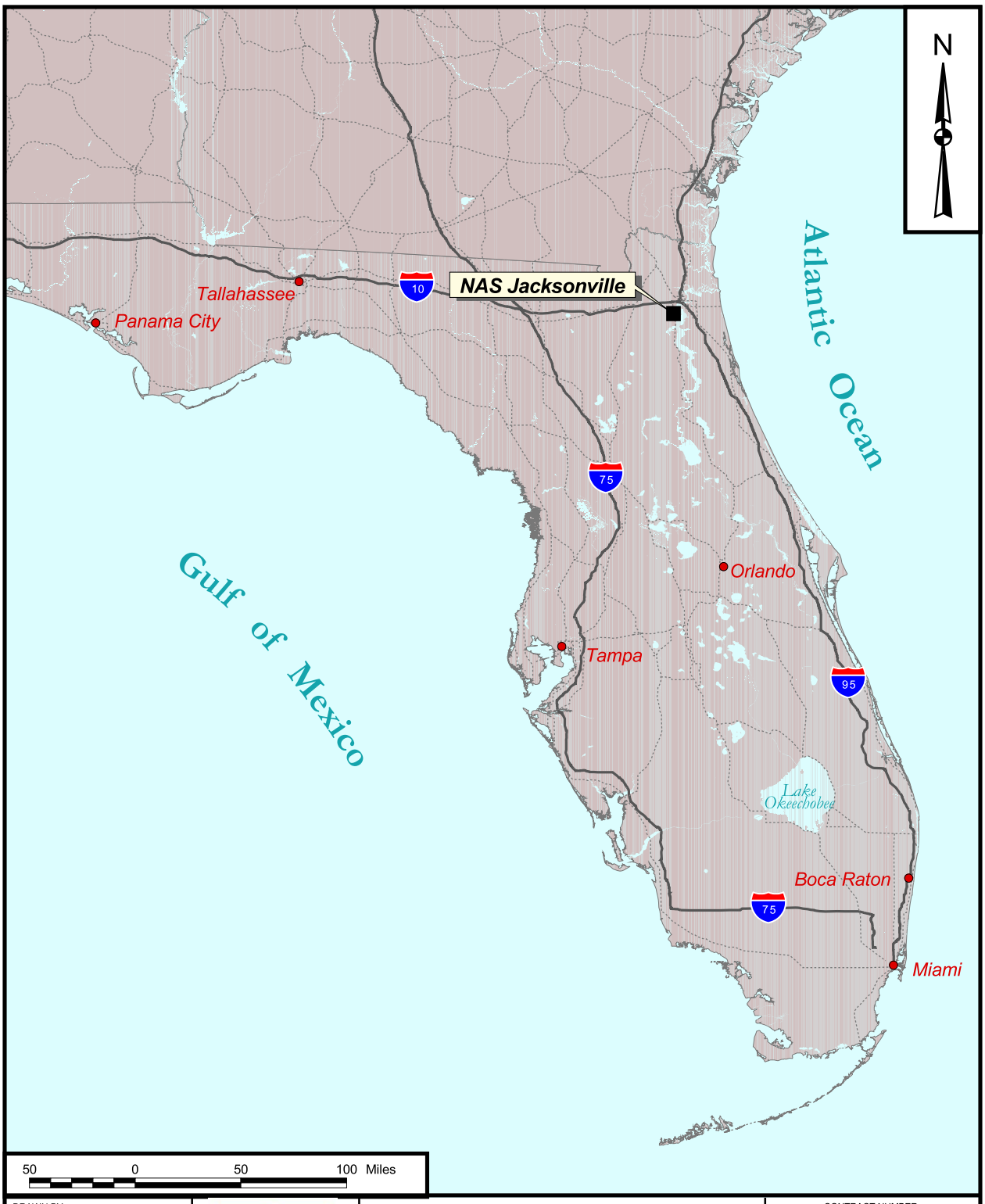
2.1.1 NAS Jacksonville Location and Description

NAS Jacksonville occupies approximately 3,896 acres in southeastern Duval County, Florida and is located approximately nine miles south of downtown Jacksonville. The facility is situated on the left (west) bank of the St. Johns River approximately 24 miles upstream of its outflow to the Atlantic Ocean as shown on Figure 2-1. The main portion of NAS Jacksonville is bordered on the north by Timuquana Country Club, on the east and northeast by the St. Johns River, on the south by a residential area, and on the west by Highway 17 (Roosevelt Boulevard). Land use to the north of NAS Jacksonville is primarily commercial (strip malls, small businesses, and housing), to the west mainly undeveloped (wooded) with some light industry, business, and single family housing, and to the south residential. PSC 47 is located in the west-central portion of the base on the west side of Child Street and approximately one block south of Birmingham Avenue as shown on Figure 2-2.

NAS Jacksonville is a multi-mission base hosting more than 100 tenant commands and employing more than 26,000 active duty and civilian personnel. The installation is home to long-range maritime surveillance aircraft, helicopters, and jet aircraft. The Naval Aviation Depot at NAS Jacksonville is the largest industrial employer in northeast Florida and performs maintenance, repair, and overhaul of Navy aircraft.

In addition to the many operational squadrons flying P-3, C-12, C-9 aircraft, and SH-60F helicopters, NAS Jacksonville is home to Patrol Squadron Thirty (VP-30), the Navy's largest aviation squadron. VP-30 is the only "Orion" Fleet Replacement Squadron that prepares and trains U.S. and foreign pilots, air crew, and maintenance personnel for further operational assignments.

Support facilities include an airfield for pilot training, a maintenance depot providing more than 150 trade skills from basic tire changing to total engine disassembly, a Naval Hospital, a Fleet Industrial Supply Center, a Navy Family Service Center, and recreational facilities.



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2.1.2 NAS Jacksonville History

NAS Jacksonville was commissioned on October 15, 1940 to provide facilities for pilot training and a Navy Aviation Trades (NAT) School for ground crewmen. With the advent of World War II, the physical size of NAS Jacksonville more than doubled to support wartime military operations. During 1942, the Navy phased out pilot training, and the station became the headquarters for the Chief of Naval Operational Training, the final training phase before fleet assignment. The NAT School became the Naval Air Technical Training Center under the Chief of Naval Air Technical Training, NAS Memphis. The operational areas of the station still maintained coastal protection with seaplanes. The facility reached a peak of 42,000 Navy personnel and 11,000 civilians by 1946.

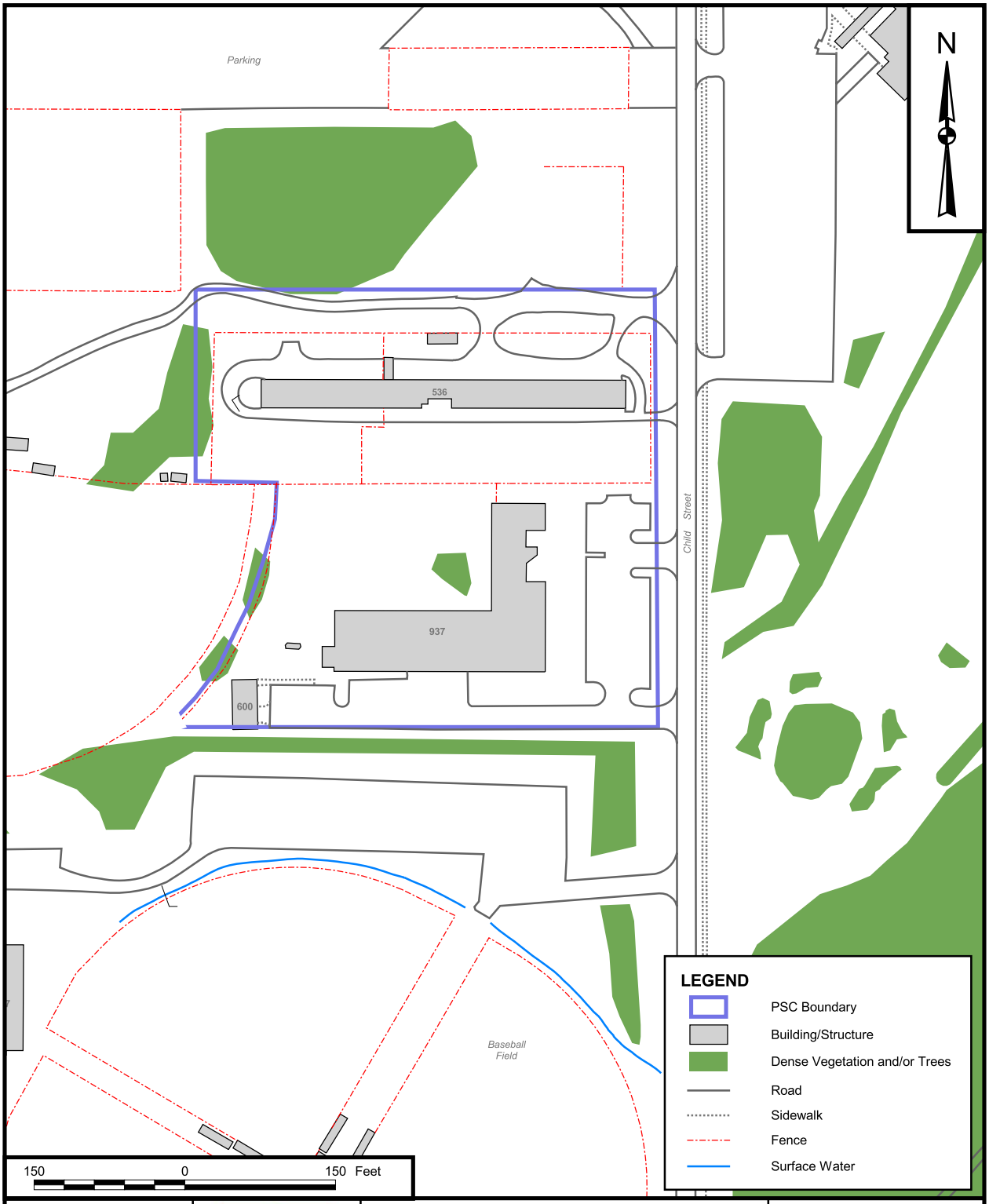
At the conclusion of World War II, NAS Jacksonville was used exclusively for aviation training. In 1945, Chief of Naval Operational Training was redesignated Chief Naval Air Advanced Training. In July 1946, the Seventh Naval District was transferred from Miami, Florida to NAS Jacksonville, as joint command with Chief Naval Air Advanced Training. On April 5, 1948, the Navy transferred the Chief Naval Air Training and all training facilities to NAS Corpus Christi, Texas.

By January 1949, the mission of NAS Jacksonville was to support the operational carrier squadrons with fleet squadrons assigned to Commander, Naval Air Bases, Sixth District and patrol squadrons assigned to Combat Patrol Wing Eleven. On January 1, 1951, the Navy reactivated the Naval Air Technical Training Center and Marine Air Division activities in support of the Korean conflict. This joint operational and training status continues to this time.

2.1.3 PSC 47 Location and Site Description

The Pesticide Shop (Building 536) and DVECC (Building 937) (PSC 47), as mentioned above and as illustrated on Figure 2-2, are located in the west-central portion of NAS Jacksonville on the west side of Child Street approximately one block south of Birmingham Avenue. A plan view of PSC 47 and surrounding properties showing prominent structures and features is provided as Figure 2-3. The entire PSC occupies an area of approximately 185,000 square ft. It is a relatively flat parcel bounded on the east by Child Street, on the north by a wooded parcel and grass area, and on the west and south by athletic fields (baseball diamonds). A south-flowing drainage ditch, dry except during rain events, is present along the eastern boundary of the PSC parallel with Child Street.

The Pesticide Shop (Building 536) is a long narrow structure, approximately 360-ft long and 28-ft wide. Its long dimension is oriented east to west. The interior is segmented into working bays and offices. Asphalt pavement approximately 10-ft wide abuts the building on the north and south. The surface outside the asphalt is covered with grass and/or soil. The premises are surrounded on all sides by a 6-ft high



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SCALE AS NOTED			DRAWING NO. FIGURE 2-3 / REV 0

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chain-link fence offset from the building at various distances ranging from 30 to 75 ft. The eastern portion of Building 536 is currently used by the NAS Jacksonville landscape contractor for administrative purposes and for storage, maintenance, and repair of its fleet of mowers and other landscaping equipment. Access to the facility is off of Child Street northeast of the building.

DVECC (Building 937) occupies the adjoining property to the south. A chain-link fence, situated approximately 75 ft south of the Pesticide Shop, separates the two properties. Building 937 is L-shaped with an eastern wing facing Child Street and a southern wing facing a pair of baseball diamonds located south of the facility. The northernmost extension of Building 937 is located approximately 95 ft south of the Pesticide Shop. The area inside the "L" and between Building 937 and the Pesticide Shop consists of a maintained lawn, landscaped shrubbery, and some large trees. A paved parking lot is present between Building 937 and Child Street. A paved, east-to-west entrance drive off of Child Street leading to work bays on the south wing of the building is present near the southern property boundary. Access to the rear (south side) of the building is protected by a security-coded chain-link fence/gate. An asphalt parking lot and the two baseball diamonds are located south of Building 937. A narrow strip of dense vegetation separates the DVECC grounds from the parking lot/softball complex. A chain-link fence is present along the western boundary of DVECC. A single baseball diamond is situated west of Building 937. A neutral grass area approximately 15 to 20 ft wide is present between the outfield fence of the baseball diamond and the chain-link fence marking DVECC's western property boundary.

Historical practices at Buildings 536 and 937, which pre-dated investigative history and are relevant to the current RI/FS were discussed in Section 1.2.

2.2 ENVIRONMENTAL SETTING

2.2.1 Geography, Demographics, and Land Use

PSC 47 is located on a relatively flat tract of land on the west side of Child Street. The Pesticide Shop (Building 536, constructed in 1977), or northernmost portion of the PSC, is located approximately 600 ft south of Birmingham Avenue, a main east-to-west artery at NAS Jacksonville. The area between the Pesticide Shop and Birmingham Avenue is comprised of dense woods and a parking lot to the west and a grass area to the east nearer Child Street. A golf course (Casa Linda Oaks) is located on the opposite side of Child Street from PSC 47. As previously mentioned, athletic fields (baseball diamonds) are present both to the south and west of the study area. Most of the surface water runoff at the site likely flows to the drainage ditch along the west side of Child Street and then to the south.

2.2.2 Physiography and Topography

NAS Jacksonville is located in the Coastal Plain physiographic province. The Coastal Plain is composed of marine sediments deposited in terraces which originated due to prehistoric fluctuations in sea level. The terrace deposits are in the form of ridges that tend to parallel the current coastline. The terrace deposits are characterized by very low relief with gentle slopes to the east-southeast. Seven terraces are present in northeast Florida with NAS Jacksonville located within the Pamlico terrace [10 to 25 ft above mean sea level (msl)].

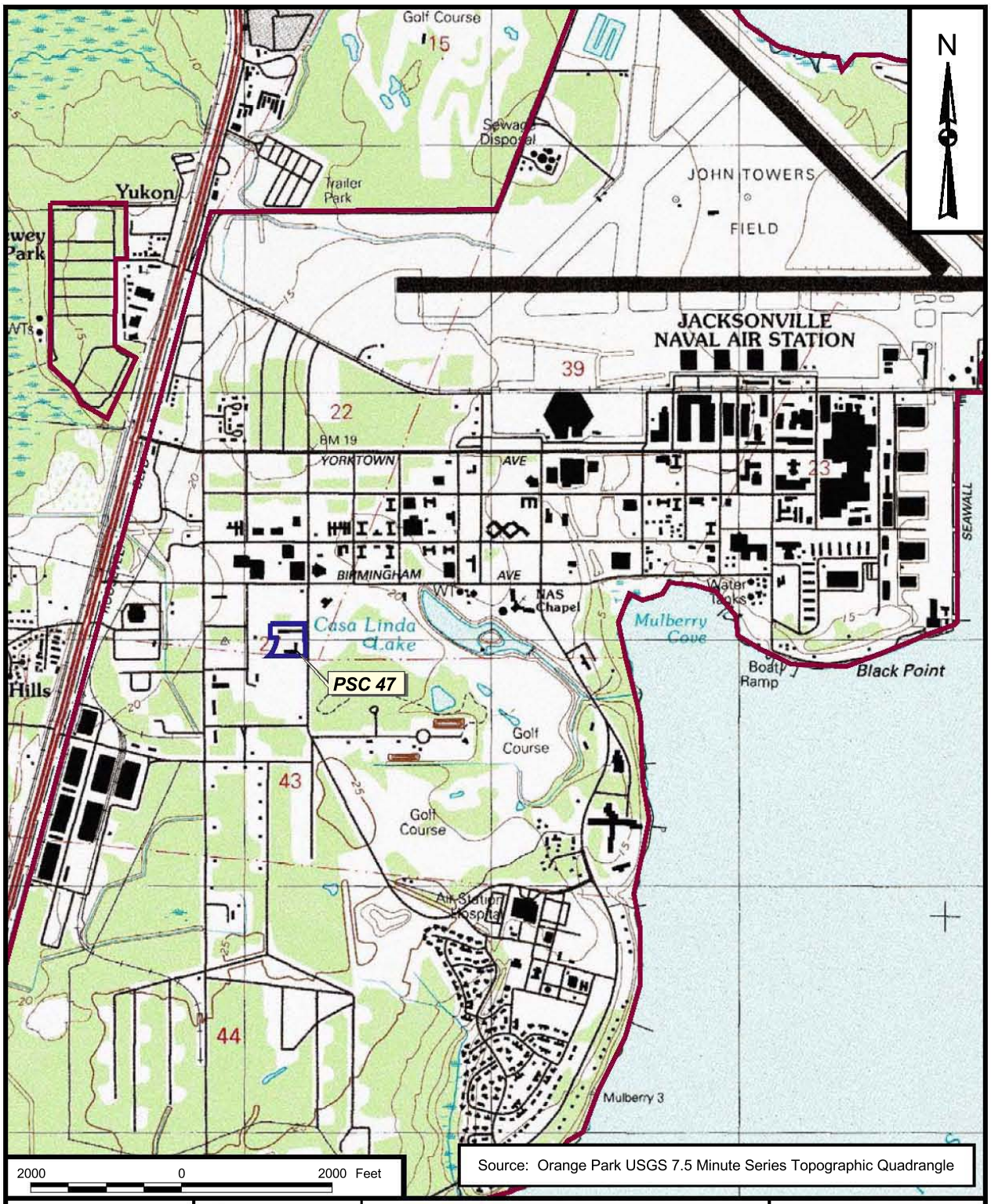
PSC 47 is virtually flat with a gentle slope to the east and southeast. Natural surface elevations range from slightly below 23 ft msl in the southeastern corner of the PSC to slightly above 24 ft msl in the southwestern, central, and north-central areas. A portion of the United States Geological Survey (USGS) Orange Park, Florida 7.5-minute quadrangle (USGS, 1993) has been reproduced as Figure 2-4 to illustrate the physiographic relationship of the subject parcel to its immediate surroundings.

2.2.3 Climate

The climate in northeast Florida approaches semi-tropical as it lies near the northern limit of the trade winds, the prevailing easterly winds that moderate summer and winter temperatures. The annual mean temperature is 68 to 70 degrees Fahrenheit (°F) with an average temperature in the summer of 82 to 83 °F and a winter average 56 to 57 °F. Summer highs reach the middle to upper 90s (°F), sometimes exceeding 100 °F. The winter lows can reach the upper teens, although temperatures seldom drop below freezing.

The region experiences an average of 53 to 54 inches of rainfall per year, most of which accumulates during frequent summer thunderstorms. Extended dry periods may occur throughout the year; however, they are most common in spring and fall. The relative humidity averages 87 percent and the average annual sunshine is 62 percent of the maximum.

Wind speed in northeast Florida averages eight miles-per-hour and direction is predominantly from the northeast in the winter and from the southwest in the summer. Winds of hurricane force can be expected once in five years with significant deviations from the average. Tropical storm activity mostly occurs from August through October, although the six-month period from June 1 through November 30 is officially considered the Atlantic hurricane season.



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2.2.4 Soil

Soil at NAS Jacksonville evolved from weathering of marine terrace clastic deposits. It is regionally classified by the United States Department of Agriculture (USDA), Soil Conservation Service as the Pelham-Mascotte-Sapelo soil series assocation. Soils in this association are nearly level and are characterized as poorly drained sands to a depth of 20 inches bls underlain by loamy sands (USDA, 1978).

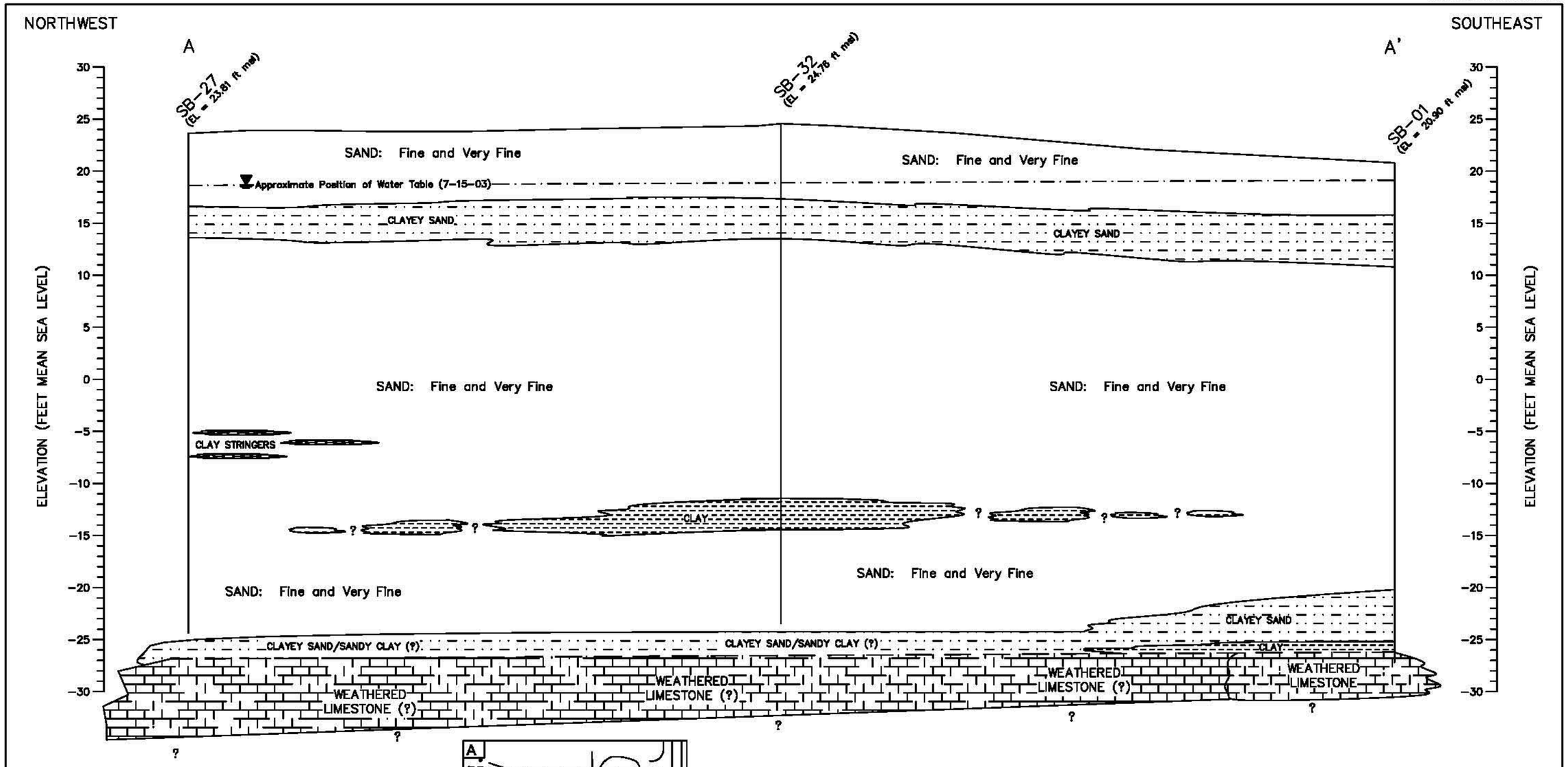
2.2.5 Regional Geology

The geologic profile at NAS Jacksonville consists of unconsolidated surficial clastic deposits ranging from clean medium- to fine-grained sands to silty fine sands to sandy and silty clay (Fairchild, 1972) underlain by thick deposits of phosphatic sands and clays of the Hawthorn Group (Scott, 1988) and limestones and dolomites of the Floridan aquifer system (Leve, 1966).

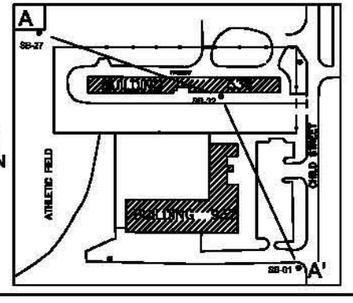
The Hawthorn Group is significant at NAS Jacksonville because it contains as much as 200 ft of low permeability, silty, sandy clay (Scott, 1988). This low permeability unit acts as an aquiclude for the underlying Floridan aquifer system. The Floridan aquifer system is the major source of potable water in the Jacksonville area and throughout much of northeastern and central Florida.

2.2.6 Site Specific Geology

Subsurface sediments at PSC 47 were described during RI field activities. In late June to early July 2001, during Phase I (i.e., the "DPT Phase") of the investigation, a site lithologic profile, including two cross-sections, were generated from five select DPT borings from which groundwater grab samples were collected. A full discussion of the groundwater grab sampling program, including an illustration showing sampling locations and depths, is provided below in Section 4.2.1.3. The borings selected for profiling were the ones nearest the corners of the PSC [JAX-47-SB27 (northwest), -SB21 (northeast), -SB01 (southeast), and -SB05 (southwest)] and one in the site interior (SB18). Continuous samples were collected from ground surface to a depth of 48 ft bls at each location using a 4-ft long, 2-inch diameter core barrel lined with acrylic sleeves attached to the GeoProbe® drill string. Samples were described by TtNUS' on-site field geologist. Boring logs generated from these descriptions are provided in Appendix A. A northwest-to-southeast cross-section (labeled A-A') through SB27, SB32, and SB01 depicting lithologic units encountered is presented as Figure 2-5 and a southwest-to-northeast cross-section (labeled B-B') through SB05, SB32, and SB21 is provided as Figure 2-6.



CROSS-SECTION LOCATION



60 0 60
HORIZONTAL SCALE in FEET

LEGEND

SB-27 Soil Boring Identification Number

EL = Elevation
ft msl = Feet Mean Sea Level

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SITE GEOLOGIC PROFILE A-A'
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 3966	
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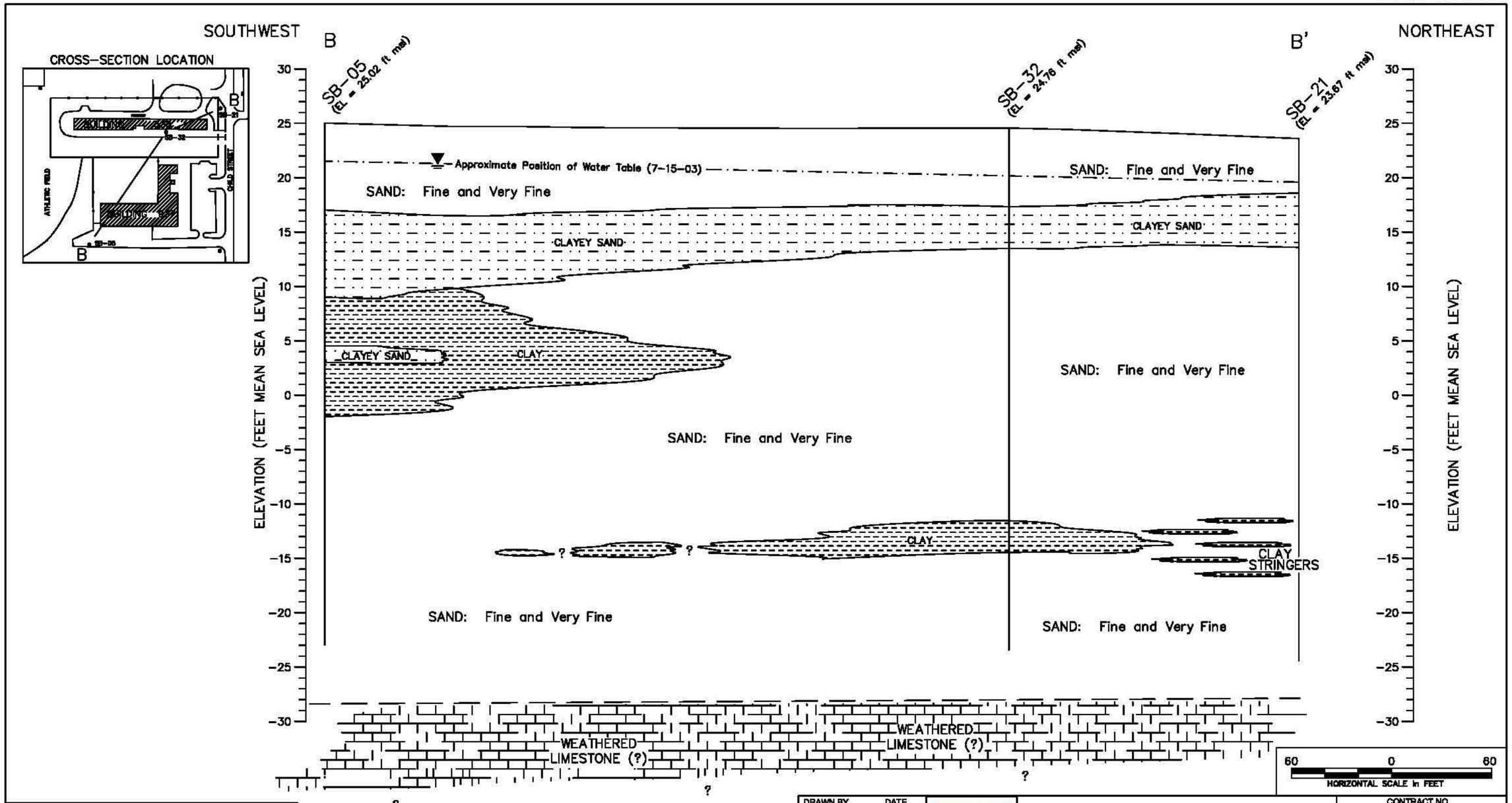

LEGEND

SB-21 Soil Boring Identification Number

EL = Elevation
ft msl = Feet Mean Sea Level

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SITE GEOLOGIC PROFILE B-B'
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 3966	
APPROVED BY	DATE
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Additional information describing materials encountered in the subsurface was recorded during installation of shallow monitoring wells (12 to 15 ft deep) and deep monitoring wells (42 to 63 ft deep) during Phase II of the investigation (late March-early April 2002, early November 2002, and January 2003). A complete narrative on field work performed during both phases of the RI investigation is provided in Section 4.0.

A weathered limestone unit is encountered beneath PSC 47 at a depth of 45 to 53 ft bls, or, in places, slightly shallower or slightly deeper than this. Shallowest occurrences of the limestone unit are present in the southern part of the study area and deepest occurrences are in the northern part. Clastic sediments, consisting predominantly of sand, are present from land surface to the top of the weathered limestone. In the few feet immediately overlying the limestone, sediments grade from sand to clayey sand to predominantly clay and are distinctively dark gray in color. Above this transition zone, the sediments are mainly fine and very fine grained sands with occasional clay stringers up to 2-inches thick interspersed. Small quantities of disseminated silt and clay are present in some sections of the sand, whereas at other horizons, sorting is better and the sand is virtually free of finer grained components. In the southwestern section of PSC 47 (SB05), appreciably more clay is present in the upper 25 ft than at the other four boring locations (see Figure 2-6). Color of the clastic sediments ranges from very pale brown to orange or yellowish brown to dark gray.

2.2.7 Regional Hydrology

2.2.7.1 Surface Water

Two principal waterways, the St. Johns and Ortega Rivers, are located near NAS Jacksonville. The St. Johns River forms the eastern boundary of NAS Jacksonville. The river is rated by the FDEP as a Class III water body, which is designated for fish and wildlife propagation and body contact recreational use. The river at this point is tidally influenced and can be considered part of the St. Johns River estuary (NAS Jacksonville, 1990). It is classified as a marine water body based on salinity measurements ranging from 7.0 to 8.8 parts per thousand (ppt), as reported in the OU 3 RI/FS. Salinity values greater than 2 ppt support marine vegetation and aquatic life.

2.2.7.2 Groundwater

Three aquifer systems are present in northeast Florida: the surficial aquifer, intermediate aquifer, and the Floridan aquifer system.

The surficial aquifer consists of sediments of Late Miocene to Recent age. The sediments are highly variable and include sand, shelly sand, coquina, silt, clay, shell beds, and in some parts of Duval County,

a basal limestone unit known as the Rock Aquifer. While the surficial aquifer is considered a single unit on a regional scale, localized clay layers or discontinuous lenses may divide the aquifer into distinct permable units [ABB Environmental Services (ABB-ES), 1995]. It averages 50-70 ft in thickness, but in places, exceeds 100 ft thick. The contact between the surficial aquifer and the underlying Hawthorn Group, containing the intermediate aquifer, is an unconformity generally identified by a coarse phosphatic sand and gravel bed (Leve, 1966). Average well yields in Jacksonville for the surficial aquifer were estimated by the City of Jacksonvlle Planning Department to be between 200 and 500 gallons per day (Toth, 1990). This groundwater is primarliy used for lawn irrigation, for heat exchange units in air conditioning and heating systems, and for other non-potable domestic purposes, although yield from the Rock Aquifer is sometimes used as a potable source of water.

The underlying Hawthorn Group of Miocene age is encountered at an average depth of approximately 50 to 70 ft bls in Duval County. Its thickness ranges from 250 ft in southern Duval County to about 500 ft in the north-central part of the county (Scott, 1988). Sediments of the Hawthorn Group consist primarily of gray, blue-green, and olive green clay, sandy clay, and sandy limestone with abundant phosphate granules and pebbles (Spechler, 1982). The most abundant clay minerals associated with Hawthorn Group sediments are smectite, illite, palygorskite, and kaolinite. Collectively, the Hawthorn Group acts as a confining unit between the surficial aquifer and the underlying Floridan aquifer, but water-bearing horizons of low to moderate yield are interlayered with the confining beds. Various terms have been applied to the aggregate of discontinuous, water-bearing strata within the Hawthorn, including “intermediate aquifer system” and “secondary artesian aquifer.”

The Floridan aquifer system underlies the Hawthorn Group. The top of the Floridan aquifer in the vicinity of NAS Jacksonville occurs at a depth of about 400 ft bls. Its average thickness in Duval County is 1500 ft (Leve, 1966). From top to bottom, the Floridan aquifer consists of the limestones of the Ocala Group (Crystal River, Williston, and Inglis Formations), the Avon Park Limestone, Lake City Limestone, and Oldsmar Limestone, all of Eocene age. The base of the aquifer is defined as the first continuous evaporite sequence in the underlying Cedar Keys Limestone. The Floridan aquifer system is the principal source of fresh water in northeast Florida. The water bearing zones consist of soft, porous limestone and porous dolomite beds. Published transmissivities of the Floridan aquifer in eastern Duval County range from approximately 85,000 to 160,000 gallons per day per foot (Leve, 1966). Groundwater in the Floridan aquifer in the vicinity of NAS Jacksonville is moving eastward toward areas of heavy pumping (Fairchild, 1977). Floridan aquifer wells in the vicinity of NAS Jacksonville are under sufficient artesian pressure to flow at the surface. Recharge to the Floridan aquifer is mainly through precipitation in areas where overlying units have been breached.

2.2.8 Site Hydrology

2.2.8.1 Surface Water

PSC 47 is situated approximately 4500 ft (5/6 mile) west of the St. Johns River. The only surface water body of significant dimension closer than this is Casa Linda Lake, located on the golf course roughly equidistant between PSC 47 and the St. Johns River, or about 2200 ft east of the site. A small perennial retention pond comprising an area of approximately 1000 sq ft is located 400 ft north of PSC 47 at the southwest quadrant of the intersection of Child Street and Birmingham Avenue.

2.2.8.2 Groundwater

The shallow aquifer at PSC 47 is composed predominantly of fine and very fine grained sand and clayey sand from land surface to approximately 15 ft bls. Shallow groundwater is present under unconfined conditions and is typically encountered at depths ranging from approximately 2 ft bls to 7 ft bls. Generally, the water table is encountered nearest to ground surface in the area south of DVECC and farthest from ground surface north of the Pesticide Shop. Sediments penetrated between the water table and top of the weathered limestone during the RI appeared to be saturated.

2.2.8.2.1 Horizontal and Vertical Gradient in the Surficial Aquifer

During the RI field investigation, 18 shallow monitoring wells (12 to 15 ft deep), 1 intermediate depth well (total depth 25 ft bls), and 10 deep monitoring wells (42 to 63 ft deep) were installed. Monitoring well installation and development procedures are described in detail in Section 4.2.2.2.1. Depth-to-water measurements were obtained from some or all of these wells and from some or all of nine previously existing wells at or near PSC 47 on four occasions during the RI to estimate direction of groundwater flow beneath the site. A full discussion of the methodology employed in generating groundwater elevation contour (potentiometric) maps from depth-to-water measurements in monitoring wells is presented below in Section 4.2.2.2.3.

Potentiometric maps included in this report were generated from depth-to-water measurements obtained on April 12, 2002, July 15, 2003, and November 28, 2006. These three sample sets were selected because they were the most complete. Two potentiometric maps were generated from each data set, one showing estimated groundwater flow direction in the upper zone of the surficial aquifer [based on depth-to-water measurements in the shallow (“S”) wells] and one showing flow direction in the deep zone of the surficial aquifer [based on depth-to-water measurements in the deep (“D”) wells). Potentiometric maps showing inferred groundwater flow direction in the shallow zone are provided as Figures 2-7, 2-8, and 2-9 and those depicting inferred groundwater flow direction in the deep zone are provided as Figures 2-10, 2-11, and 2-12.

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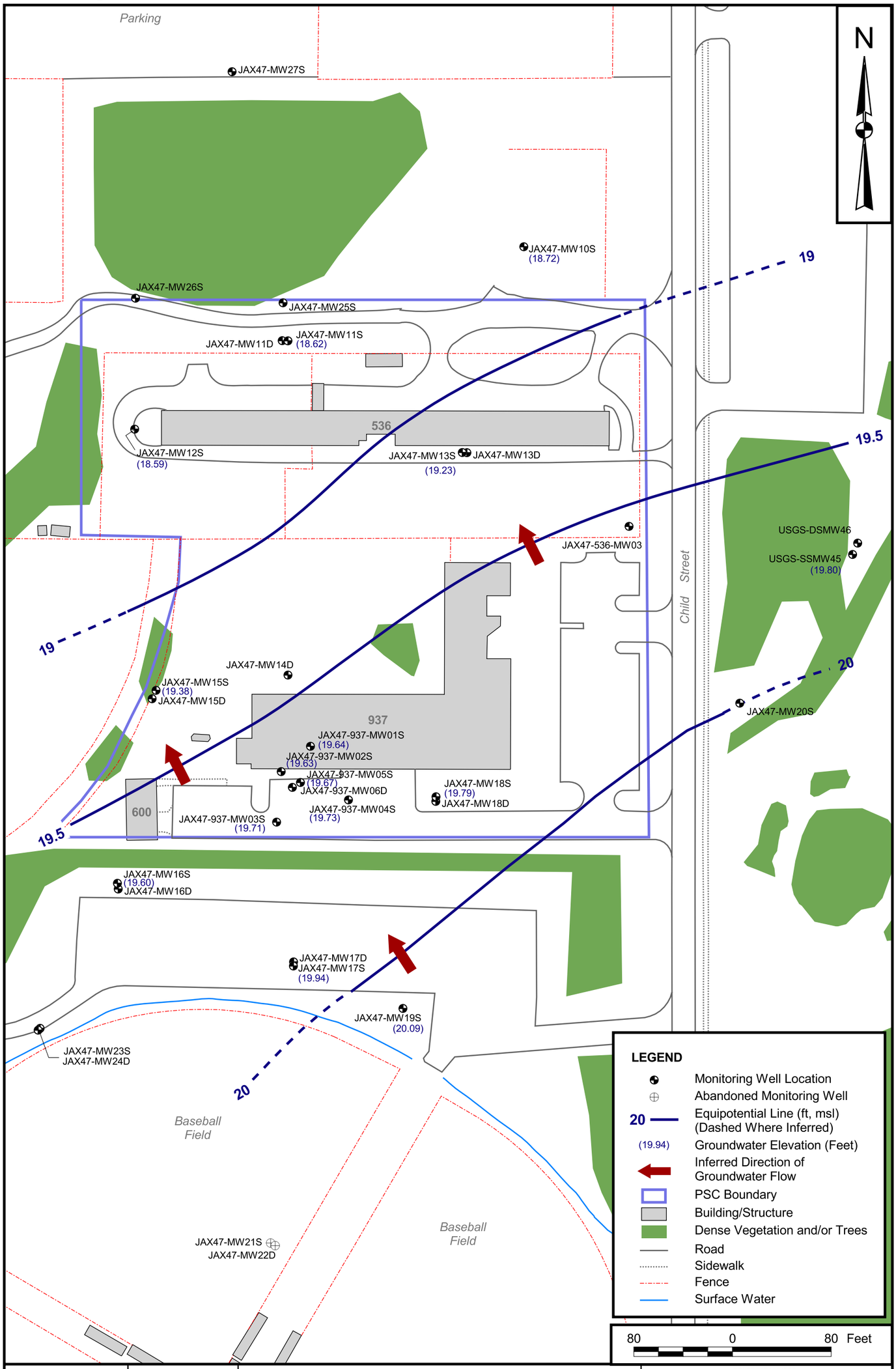

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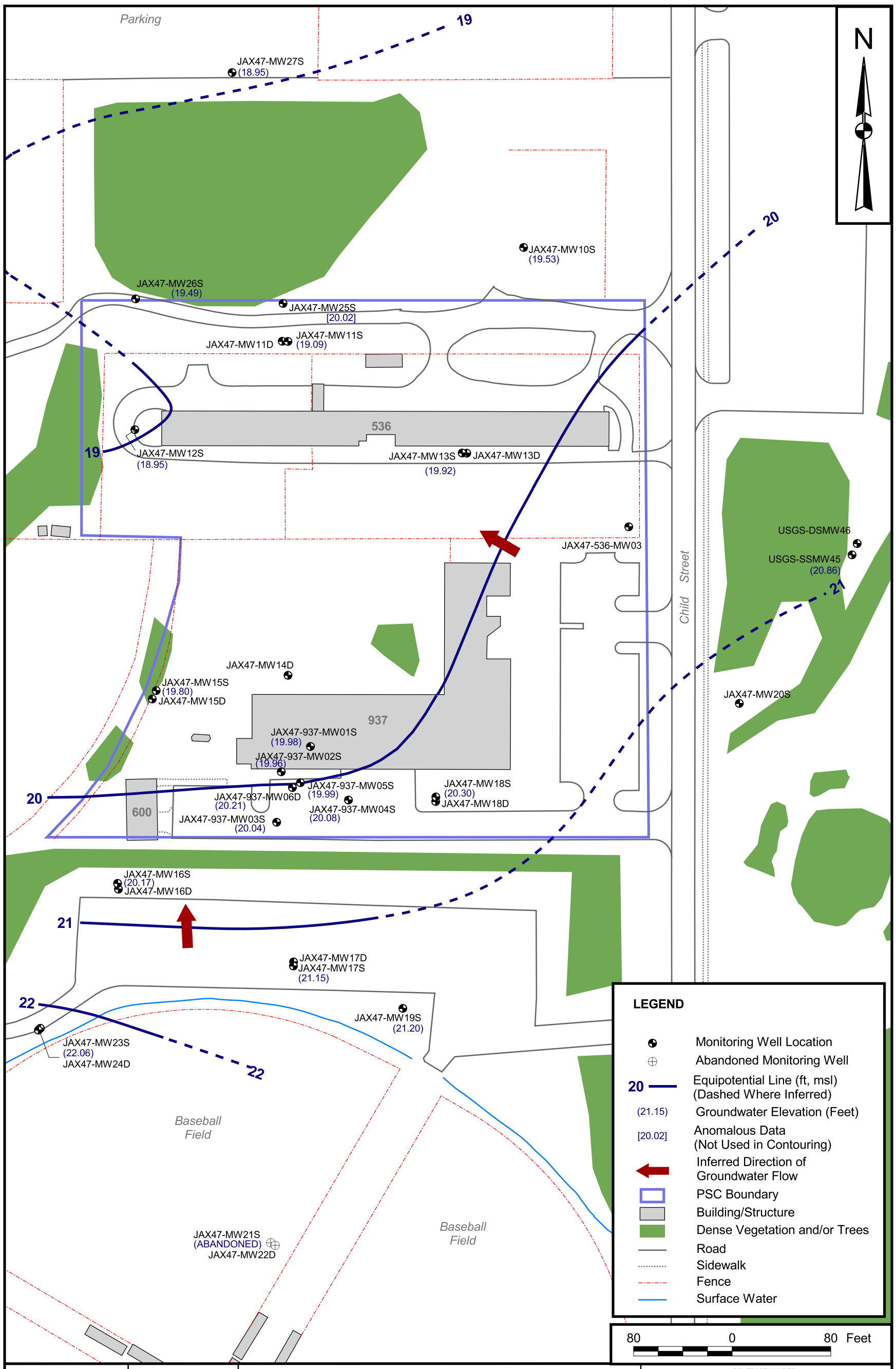

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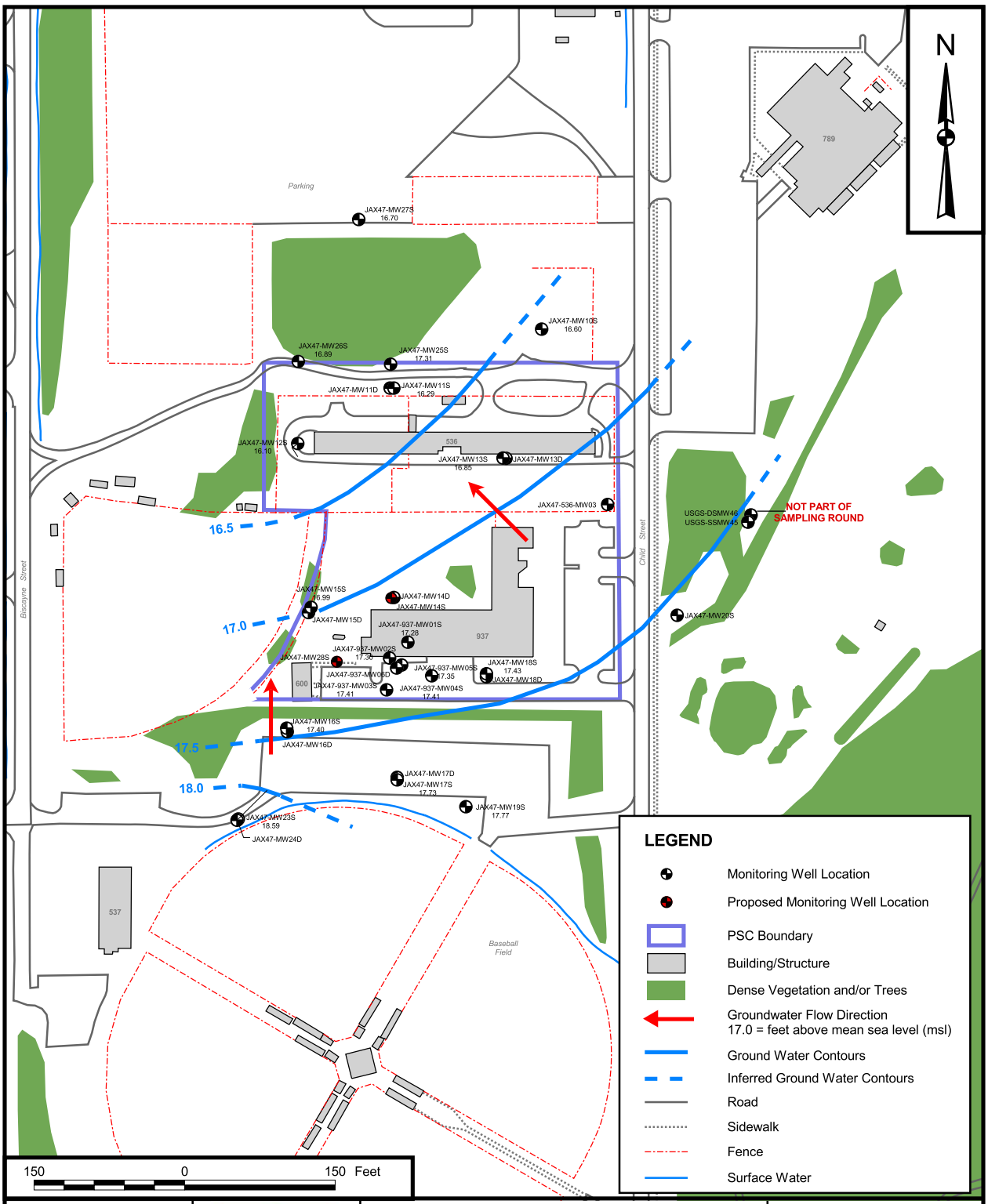

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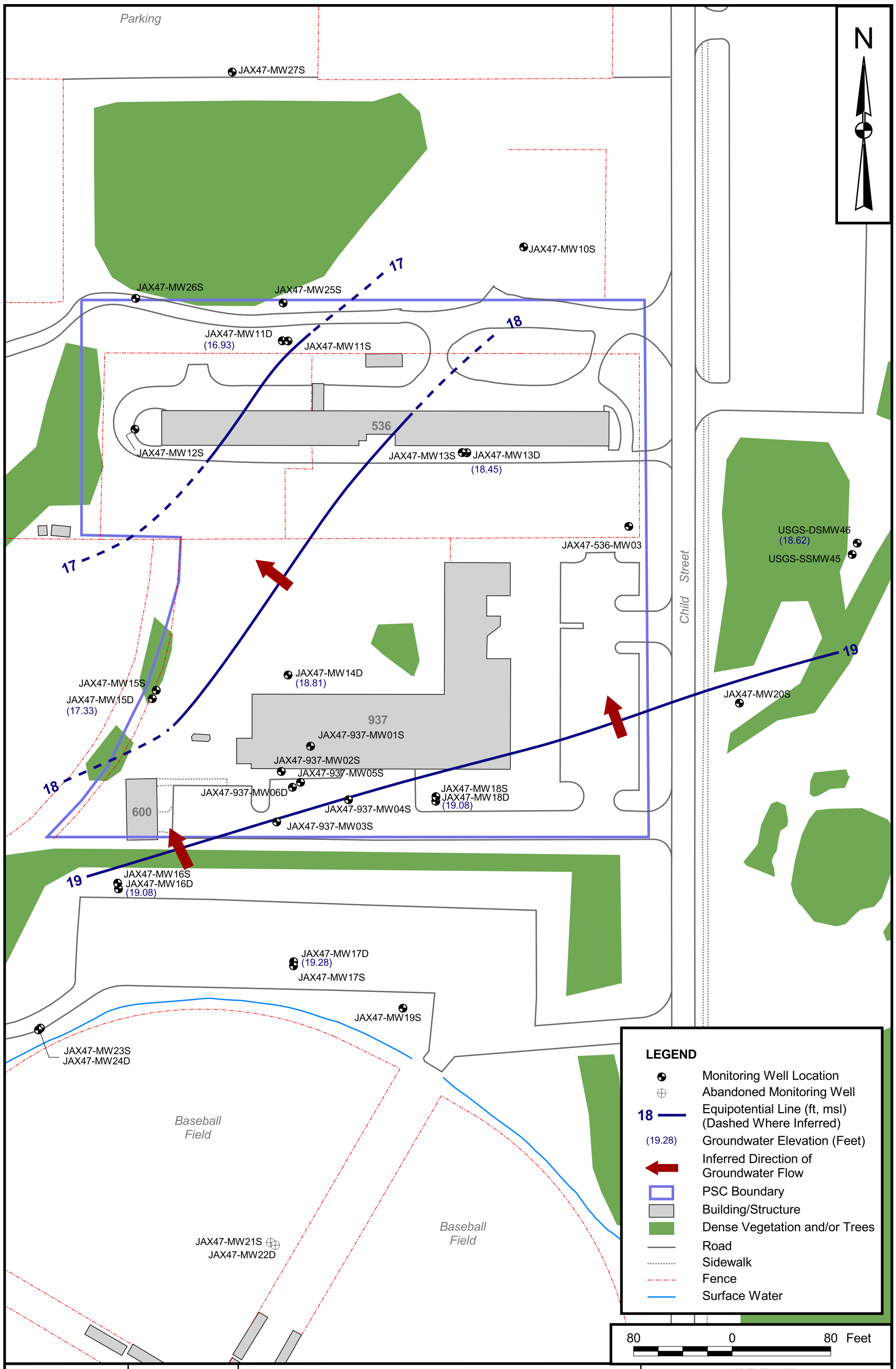

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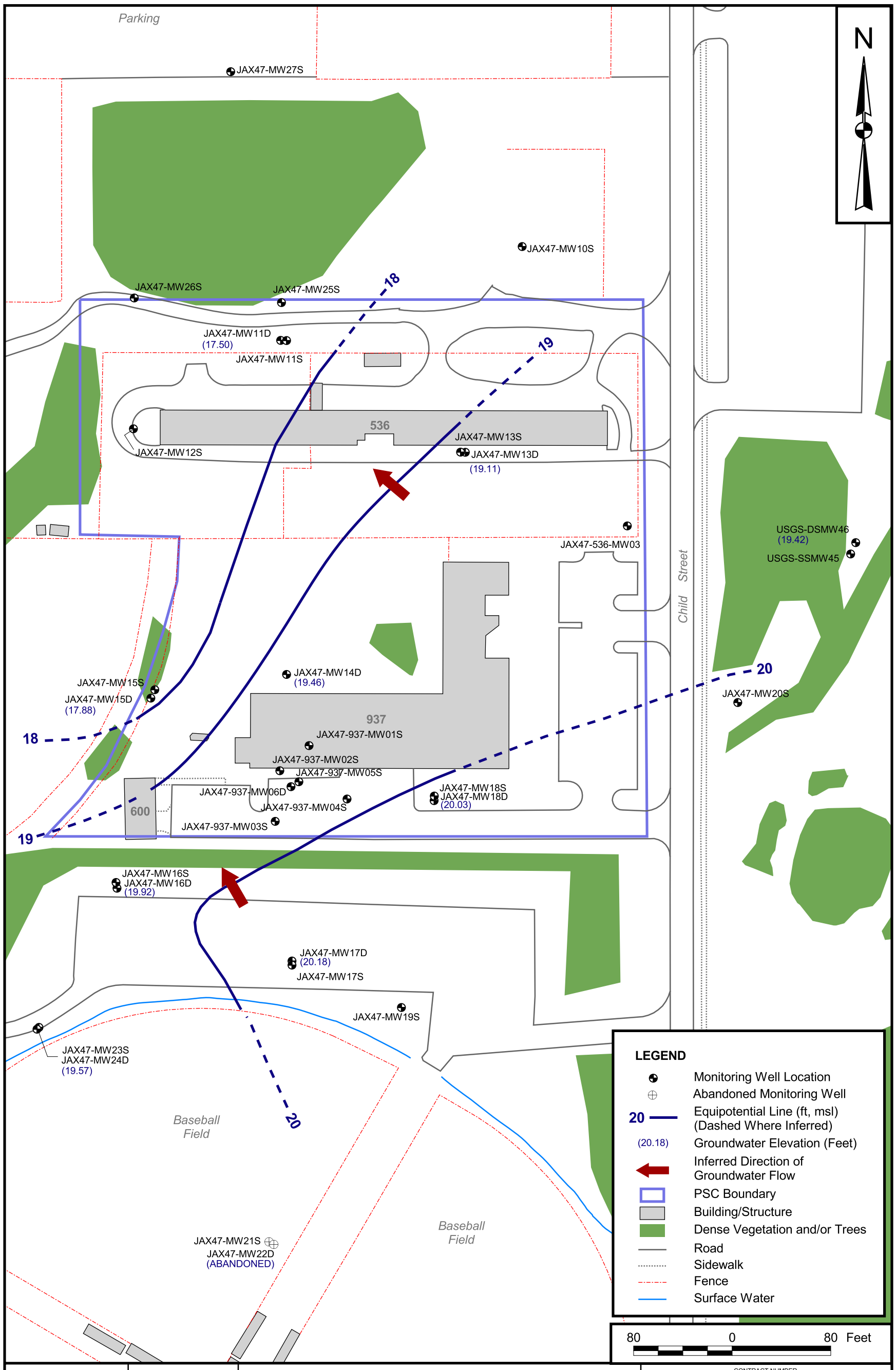

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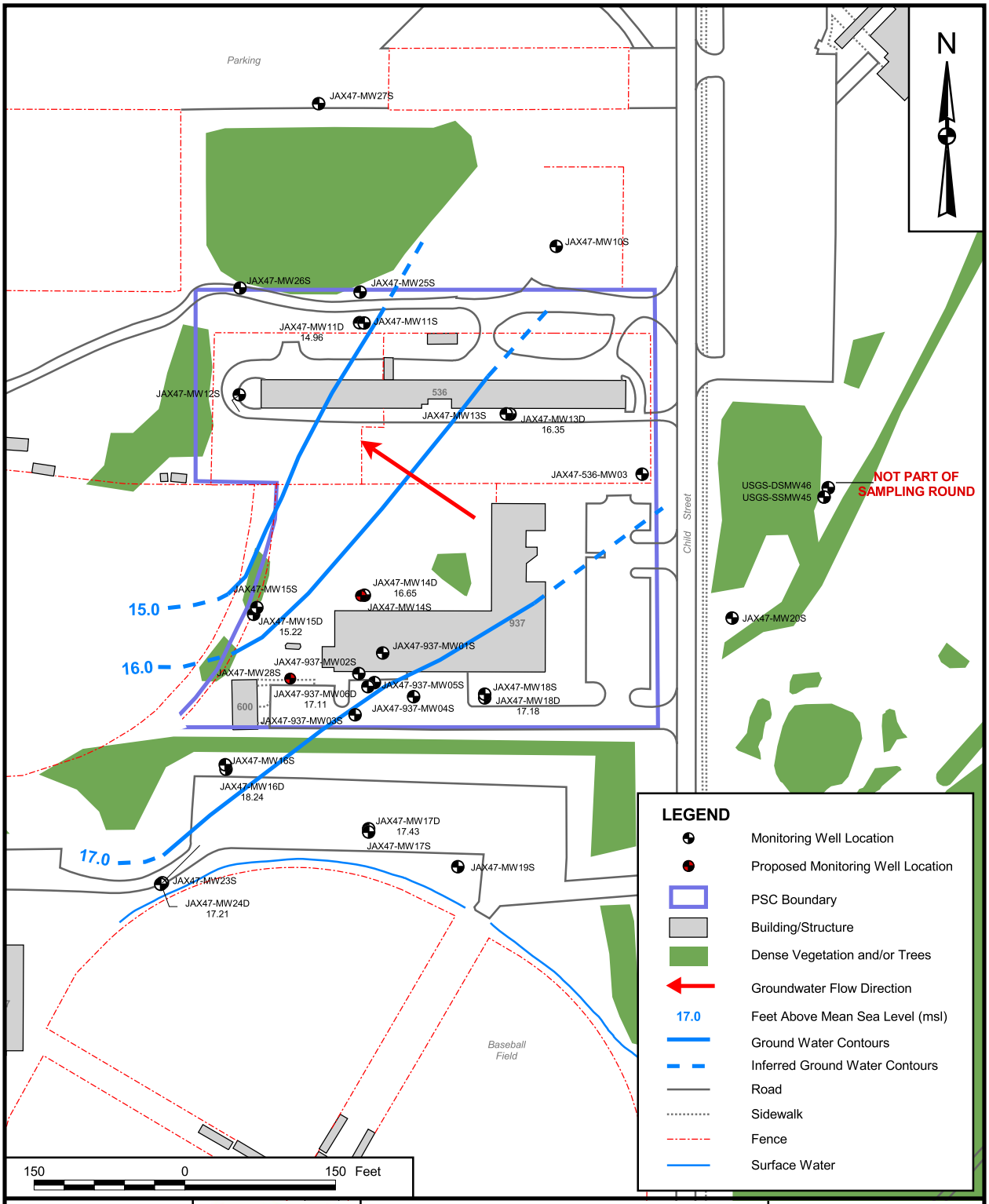

DRAWN BY	DATE			CONTRACT NUMBER
S. PAXTON	11/09/06			0497
CHECKED BY	DATE			APPROVED BY / DATE
C. METZ	10/18/07			— / —
COST/SCHEDULE-AREA				APPROVED BY / DATE
				— / —
SCALE		NAVFAC	GROUNDWATER ELEVATION CONTOURS - DEEP ZONE NOVEMBER 27, 2006 PSC 47 NAS JACKSONVILLE JACKSONVILLE, FLORIDA	DRAWING NO. / REV
AS NOTED				FIGURE 2 - 12 / 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR GW ELEVATION DEEP ZONE 11272006 LAYOUT 10/18/07 SP

Results shown on these figures are in agreement with flow models generated by the USGS (Davis *et al*, 1996), which show groundwater flow direction in the upper and lower surficial aquifer beneath PSC 47 to be northwesterly.

There is a downward gradient in the surficial aquifer underlying PSC 47. Water table elevations in shallow wells average 1 to 2 ft higher than those in adjacent deep wells. The difference at the MW16 pair is the smallest of all, averaging less than 1 ft. The biggest differences are in the northern part of the PSC (MW11 and MW13).

2.2.8.2.2 Aquifer Characteristics in Upper and Lower Zones of Surficial Aquifer

Aquifer (slug) tests were performed at PSC 47 by Hal Davis of the USGS and a TtNUS representative on February 12, 2003. Tests were performed on 10 shallow monitoring wells, one intermediate well, and 6 deep wells installed during the RI. Results of the tests were documented in a report prepared by Mr. Davis. A copy of this report is provided as Appendix B.

Hydraulic conductivity (k) values calculated on the 10 shallow zone wells ranged from 3 ft per day (ft/day) to 7 ft/day and averaged 3.9 ft/day.

Flow velocity was calculated using the formula $v = k(h1-h2)/L/n$, where

v = horizontal component of groundwater
k = hydraulic conductivity
h1 and h2 = groundwater elevation at arbitrary points 1 and 2, respectively
L = the horizontal distance between arbitrary points 1 and 2
n = porosity

and

(h1 – h2)/L = the average hydraulic gradient (in feet per foot) as calculated from groundwater elevation data from arbitrary points 1 and 2.

A porosity of 0.3 (Freeze/Cherry, 1979) was assumed since materials encountered during investigation of the surficial aquifer were sandy clay and silty sand. Monitoring wells MW17S and MW15S were selected as arbitrary points 1 and 2, respectively, for estimation of flow velocity in the shallow zone of the surficial aquifer. The horizontal distance between these two points is approximately 251 ft. Using these points and groundwater elevation data from three separate dates, the average hydraulic gradient was calculated to be 0.0036 feet per foot. Based on the above assumed values, the USGS hydraulic conductivity values, and the calculated hydraulic gradient, the flow velocity (v) in the shallow zone of the surficial aquifer at PSC 47 was estimated to be 0.0468 ft/day or 17.08 ft per year (ft/yr) toward the northwest.

Flow velocity in the deep zone of the surficial aquifer was estimated to be 0.067 ft/day or 24.48 ft/yr toward the northwest using the same computational methods as those described for the shallow zone, with MW17D and MW15D used as the arbitrary control points and an average hydraulic conductivity value of 2.34 ft/day based on slug test results conducted on five deep monitoring wells.

3.0 PREVIOUS SITE INVESTIGATIONS AND REMEDIAL ACTIONS

Historical investigations and remediation activities performed at PSC 47 are detailed in this section. The information presented below is by document and in dated order from the earliest activities to the most recent. A summary of activities discussed in the sections below is presented in Table 1-1. Select illustrations from the documents cited below, which show background information pertinent to development of the RI/FS work plan, are provided in Appendix C.

It should be noted that the investigations and remedial measures discussed in this section were completed from 1995 to 1999. As such, different regulatory standards and terms were used. Soil standards used in this document have changed from Soil Cleanup Goals (SCGs) to SCTLs and groundwater standards have changed from Groundwater Guidance Concentrations (GGCs) to GCTLs. In addition, Clean Closure Target Levels (CCTLs) are referenced in RCRA documents for this site. These concentrations are based on regulatory standards and included in the RCRA permit. Regulatory criteria for the RI/FS are discussed in later sections of this document.

3.1 REMEDIATION WORK PLAN DVECC USED OIL TANK REMOVAL, BEI (SEPTEMBER 1995)

The document "Remediation Work Plan DVECC Used Oil Tank Removal," Revision 1 (BEI, 1995), was prepared by BEI to guide the activities associated with removal and decontamination of the pesticide tank and piping, in accordance with the FDEP-approved closure permit. In the document, BEI summarized the major elements of the proposed scope of work for removal and decontamination of the DVECC pesticide tank and associated piping, even though the title of the document referred to it as the "DVECC used oil tank." Other elements addressed in the report included plans for waste storage, transportation, and disposal, a sampling and analysis plan, a safety and heath plan, and a quality control plan.

3.2 TANK CLOSURE REPORT, RUST (JANUARY 1996)

Removal activities performed by BEI are documented in "Closure Activities Report and Certification for DVECC Tank and Drains at Building 937" submitted by RUST in January 1996. According to this report, the closure work was performed by BEI between October 16 and December 6, 1995. The fiberglass DVECC UST and associated piping, the hold-down concrete slab, and soil from around the UST and piping were removed. No other soil was removed from the piping or UST excavations. Groundwater was encountered at approximately 7 ft bls. RUST reported that even though the ". . .tank had no apparent fractures and the soil in the excavations was not discolored, pesticide contamination was detected. . . From the results contamination does exist in the soil and ground-water at the site and 'clean closure' was not achieved."

In fact, however, no pesticide concentrations exceeding residential or industrial SCTLs were reported in seven confirmatory soil samples analyzed. One beta-BHC value and several dieldrin values were reported on samples collected from the tank excavation at concentrations slightly exceeding leachability SCTLs, the most stringent of the screening criteria for these two constituents.

Five groundwater samples were also collected from the open excavation after tank removal and analyzed for TCL pesticides. Results of these analyses are shown on Figure 2-8 of the RI/FS Work Plan, included in Appendix C of this report. At least six constituents were reported at concentrations exceeding GCTLs in each sample, although the majority of the exceedances were qualified either as estimated values, as values reported with uncertainty near detection limits, or as values associated with Matrix Spike/Matrix Spike Duplicate (MS/MSD) non-compliance.

3.3 DVECC RCRA FACILITY INVESTIGATION, BRE (JANUARY 1997)

The Work Plan for Site Investigation for DVECC, dated December 1996 and prepared by BRE was intended to guide the investigation to prepare a Site Investigation Report and support RCRA closure of the DVECC site. The scope of work for the RCRA Facility Investigation (RFI) was established in this document.

In the Draft RFI Report (BRE, 1997), it was stated that during a Basewide Relative Risk Site Evaluation performed in 1996, three surface soil samples were collected and analyzed for VOCs, SVOCs, pesticides/PCBs, and 24 inorganic compounds. Analytical results indicated the presence of chlordane, dieldrin, 4,4’-DDE, and 2,2'-DDT.

Phase I of the RFI (BRE, 1997) included the advancement of five shallow borings (less than 15 ft bls) and one deep boring (30 ft bls). Soil samples were collected for fixed-base laboratory analysis at depths of 1 ft bls and 1 ft above the water table (approximately 3 ft bls) at each boring location. Monitoring wells were installed at the boring locations and groundwater samples collected from the wells were analyzed by a fixed-base laboratory. Based on Phase I results, eight additional borings (numbered 8 through 15) were installed during Phase II. Following are key results and conclusions reported in the RFI:

- Groundwater flow direction in the shallow surficial aquifer beneath the site was determined to be northwesterly.

- Several pesticides and one herbicide (2,4-D) were detected in the soil samples. Pesticide and herbicide concentrations reported in the samples collected 1 ft bls at the 14 boring locations are shown on Figure 4-1 of the RFI and those reported in the 3-ft bls samples are shown on Figure 4-2. These two figures are provided in Appendix C. In the near-surface samples (1 ft bls), 4,4’-DDT and

heptachlor were reported at concentrations exceeding industrial SCTLs in soils collected underneath the mixing room floor near the sink (Boring 1). 4,4'-DDT concentrations exceeding industrial SCTLs were also identified in two near-surface samples collected approximately 30 ft southwest of the removed DVECC tank (Borings 3 and 9). Residential SCTL exceedances reported for the shallow samples included 4,4'- DDD in Boring 1 and 4,4'-DDD and 4,4'-DDE in Boring 3.

No COCs were identified in the 1-ft samples collected in the area of the removed pesticide tank (Borings 5 and 6), but low levels of 4,4'-DDD, 4,4'-DDT, 4,4'-DDE, and chlordane (exceeding laboratory reporting limits, less than residential SCTLs) were reported in the 3 ft bls samples collected from these two borings. Highest concentrations in subsurface samples (3 ft bls) were recorded at Boring 3, southwest of the removed tank, where dieldrin was reported at a concentration exceeding the industrial SCTL, and 4,4'-DDT and 4,4'-DDD were reported at concentrations exceeding residential SCTLs.

- Groundwater samples were collected from the six monitoring wells installed in December 1996 at the locations of Borings 1 through 6. Pesticide and herbicide concentrations reported in these samples are shown in Figure 2-8 of the RI/FS Work Plan (TtNUS, 2000) along with the pesticide concentrations reported in groundwater samples collected from the open excavation immediately after tank removal (discussed in preceding section). A copy of this figure is provided in Appendix C. The following pesticide compounds were detected at concentrations exceeding GGCs in samples collected from MW3: DDD, DDT, dieldrin, beta-BHC, gamma-BHC (lindane) and delta-BHC. Concentrations of 4,4'-DDT slightly exceeding GGCs were also reported in MW4 and MW5. The herbicide 2,4-D was reported at concentrations exceeding its GGC of 70 micrograms per liter (µg/L) in samples collected from wells MW2, MW3 (highest reported 2,4-D concentration of 8,700 µg/L), MW5, and MW6.

- It was unlikely that leakage from the UST contributed to contamination of the soils in the area around Building 937, based on the condition of the tank during its removal.

- Given the industrial land use of the area, the human health risks (assumed by TtNUS to be associated with the soils) were acceptable based on USEPA standards (less than 1E-04).

3.4 RCRA APPLICATION FOR CLOSURE PERMIT, HRP SPECTRUM (HRP) (SEPTEMBER 1998)

In September 1998, HRP submitted a document to NAVFAC SE entitled "Application for Closure Permit, T-56 Engine Wash Area, Hangar 1000, and DVECC – Building 937." Much of the information reported in this document was a re-statement of investigative results and removal actions detailed in the above

sections. Subjects discussed in detail by HRP, which have not been previously mentioned in this report, include RCRA waste code listings for materials transported offsite during tank removal, results of BRE slug testing on monitoring wells around the DVECC tank, and the ramifications that previously-reported analytical results would have on the closure permit application.

Following is a summary of information presented in the HRP document:

- The DVECC tank was removed from service in 1989. The single pipe, which connected the drains to the tank, was sealed at this time. On April 14, 1994, a residual volume (approximately 15 gallons) of waste was removed from the tank and floor drains and the drains were capped with concrete.

- In October 1995, BEI excavated and removed the DVECC tank and associated drain piping. There were no reported tank fractures or discolored soil observed in the tank and piping excavation. Confirmatory soil and groundwater samples were collected and analyzed for organochlorine pesticides and PCBs (USEPA Method 8080), organophosphorus (OP) pesticides (USEPA Method 8141), and chlorinated herbicides (USEPA Method 8151). According to the permit application, beta-BHC, chlordane, 4,4'-DDD, 4,4'-DDT, 4,4'-DDE, dieldrin, endosulfan I, endrin, heptachlor, heptachlor epoxide, and 2,4-D exceeded their respective soil target concentrations. In addition, chlordane, 4,4'-DDD, 4,4'-DDT, 4,4'-DDE, endosulfan I, and endosulfan sulfate were detected at concentrations exceeding the groundwater target concentrations listed in the application.

In December 1996, 14 soil borings were advanced to evaluate soil quality. Soil borings 1 through 6 were converted to monitoring wells. The results indicated that the highest COC concentrations were beneath the former mixing room and approximately 30 to 60 ft southwest of the DVECC tank. The highest concentrations in groundwater were from the monitoring well at location 3.

- Groundwater flow beneath the site was reported to be to the north-northeast toward the Pesticide Shop. Groundwater flow west of the site was determined to be northwesterly and groundwater flow east of the site was determined to be easterly. Based on groundwater measurements from 1996, groundwater flow was reported to have a slope of 0.0015 feet per foot. Groundwater velocity was estimated at 0.193 ft/day using Darcy's Law.

- It is stated in the permit application text that the pesticide contamination, discovered during the DVECC tank removal, was not due to releases from the tank because the highest concentrations were not adjacent to the tank. Instead, it (pesticide contamination) was related to historic operation of the Pesticide Shop. Herbicide presence (2,4-D) was attributed to the ball fields located to the south and west, and its normal use on grass at the two buildings, 536 and 937.

- The DVECC UST was used to receive spills and rinsate waters from the mixing and storage areas in Building 937.

  - The RCRA waste codes for this material were as follows:

    1. D017 – 2,4,5-TP (Silvex).

    2. F027 – Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing hexachlorophene synthesized from prepurified 2,4,5-trichlorophenol as the sole component.)

    3. P004 – Aldrin.

  - The soil, concrete, asphalt drain piping, and the UST were disposed of as follows:

    1. F027 – Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing hexachlorophene synthesized from prepurified 2,4,5-trichlorophenol as the sole component.)

    2. P004 – Aldrin.

    3. P050 – Endosulfan.

    4. P059 – Heptachlor.

    5. U060 – Benzene, 1,1'-(2,2-dichloroethyl-idene)bis[4-chloro-.

    6. U061 – DDD.

    7. U240 – Acetic acid (2,4-dichlorophenoxy)-, salts and esters.

    8. D017 – 2,4,5-trichlorophenoxypropionic acid [2,4,5-TP (Silvex)].

    9. D021 – Chlorobenzene.

    10. D030 – 2,4-Dinitrotoluene.

- Groundwater samples were analyzed for organochlorine pesticides and PCBs (USEPA Method 8080), OP pesticides (USEPA Method 8141), and chlorinated herbicides (USEPA Method 8151). Eleven compounds were identified. Six of these (chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan I and endosulfan II) were reported at concentrations exceeding groundwater CCTLs. The other five compounds detected were delta-BHC, dieldrin, heptachlor, 2,4-D, and 2,4,5-TP (a.k.a. silvex).

- Six wells were installed as part of the RFI (reported above). Total depth of the shallow wells was 15 ft bls or less, and the total depth of the deep well (MW6) was approximately 35 ft bls. Monitoring well locations were as follows:

  - MW1 – in the former mixing room
  - MW2 – 12 ft northwest of former tank location
  - MW3 – 32 ft southwest of former tank location
  - MW4 – 42 ft southeast of former tank location
  - MW5 – in center of former tank location
  - MW6 – 7 ft southwest of MW5

- On December 23, 1996, groundwater samples were collected from the wells. No targeted constituents were reported at concentrations exceeding GCTLs in MW1. Compounds identified in the other five wells at concentrations exceeding GCTLS were as follows:

  - MW2: 2,4-D
  - MW3: 4,4'-DDT; 2,4-D
  - MW4: 4,4'-DDT; 4,4'-DDD; 4,4'-DDE; dieldrin; 2,4-D; alpha-BHC; beta-BHC; and gamma-BHC
  - MW5: 2,4-D
  - MW6: 2,4-D

- Heptachlor epoxide and 2,4-D were detected in MW1 and alpha-BHC was detected in MW2, both less than the target levels.

- There are six water supply wells on NAS Jacksonville. They are located several thousand ft from DVECC and are installed to depths ranging from approximately 400 to 1,200 ft bls.

- In December 1996, BRE performed slug testing of three wells (MW2, MW3, and MW6) at DVECC. They used AQTESOLV (Version 1.1) to analyze the resulting data. The hydraulic conductivity (k) for MW2 and MW3 were calculated to be 3.89EE-4 and 2.05EE-4 ft per second, respectively. The

hydraulic conductivity for MW6 could not be determined because the well recovered too quickly to provide accurate information. The average hydraulic conductivity for the aquifer was calculated as 2.97EE-4 using an arithmetic mean, which is equivalent to 25.67 ft/day.

3.5 SAMPLING EVENT REPORT, HARDING LAWSON ASSOCIATES (HLA) (FEBRUARY 1999)

Between April and August 1997, HLA conducted a field investigation covering a broad area surrounding the Pesticide Shop, including the grass area inside the "L" of the DVECC building. Fifty-six soil samples were collected from 31 locations. At six of the soil sampling locations, one sample was collected from either 0 to 1 ft bls or from 1 to 2 ft bls, and at the other 25 locations, samples were collected from both of these intervals. One sludge sample was collected from each of the soakage pits located south of Building 536 and two soil samples were collected from the drainage ditch bordering Child Street. Additionally, groundwater samples were collected from three micro monitoring wells located to the northwest, southwest, and southeast of the Pesticide Shop. Soil and groundwater samples were analyzed for all or some of the following parameters: TCL VOCs, SVOCs, pesticides/PCBs, herbicides, and TAL inorganics. Results of the investigation are summarized below and documented in a Sampling Event Report (SER) dated February 1999.

3.5.1 Soil Analytical Results

3.5.1.1 Pesticides/PCBs

All 56 soil samples were analyzed for pesticide\PCB compounds. Twenty pesticides were detected, 13 of which were reported at elevated levels (i.e, concentrations exceeding SCGs). The most significant levels were reported on the following: aldrin, alpha and gamma-chlordane, alpha- and beta-BHC, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, heptachlor, and heptachlor epoxide. Of these, the most frequently reported were, in order: 4,4'-DDE (55 of 56 samples), 4,4-DDT (54 samples), 4,4'-DDD (53), alpha- and gamma-chlordane (50), dieldrin (43), and heptachlor (27).

3.5.1.2 Herbicides

Fifty-four of the soil samples were analyzed for herbicides and 10 of these compounds were detected. Three herbicides, dinoseb, 2-methyl-4-chlorophenoxyacetic acid (MCPA), and 2-(2-methyl-4-chlorophenoxy) propionic acid (MCPP) exceeded concentrations attributable simply to weed control measures, according to HLA. Dinoseb was identified in 42 of the 54 samples analyzed, MCPA in 36 samples, and MCPP in 32 samples. Seven of the highest concentrations were detected south of the Pesticide Shop behind Building 937. The highest MCPA concentration was reported in the sample collected from the eastern soakage pit.

3.5.1.3 VOCs

Twenty-nine soil samples were analyzed for VOCs and 10 of these compounds were detected. Eight VOCs were detected at low concentrations in 4 of the 29 samples and two of the compounds detected (acetone and methylene chloride) are common artifacts of laboratory or decontamination procedures.

3.5.1.4 SVOCs

Forty-seven of the soil samples were analyzed for SVOCs. Two compounds were reported at moderately high concentrations: benzo(a)pyrene (in five samples) and n-nitro-di-n-propylamine (1 detection in a duplicate sample).

3.5.1.5 Inorganic Constituents (TAL Metals)

All 56 soil samples were analyzed for inorganic constituents. Lead was reported at an elevated concentration in the eastern soakage pit sample and arsenic was detected at an elevated level in the western soakage pit sample. No other reported values were significantly above background.

3.5.2 Groundwater Analytical Results

Groundwater analytical results reported by HLA are illustrated on Figure 2-9 of the RI/FS Work Plan. A copy of this figure is provided in Appendix C. Fifteen pesticide compounds, one herbicide (MCPA), two VOCs (benzene and TCE), two SVOCs (2,4,5-trichlorophenol and naphthalene), and five TAL metals were reported at concentrations exceeding Florida GGCs in groundwater samples. Following is a summary of groundwater analytical results reported on each of the three samples analyzed.

- MW1 (northwest of Pesticide Shop) – three pesticides (4,4'-DDD, 4,4'-DDE and 4,4'-DDT) and one TAL metal (manganese) were reported at concentrations exceeding the GGCs.
- MW2 (southwest of Pesticide Shop) – 13 pesticides and 3 TAL metals (aluminum, antimony, and arsenic) were detected at levels exceeding GGCs.
- MW3 (southeast of Pesticide Shop) – six pesticides, MCPA, the two VOCs and two SVOCs mentioned above, and iron were detected at levels exceeding GGCs.

HLA performed prolonged low-flow purging prior to sampling the three monitoring wells and was unable to attain turbidity readings below 31 nephelometric turbidity units (NTUs) at MW02 or below 15 NTU at MW03. It is possible, therefore, that some of the detected pesticide levels reported in these two wells were elevated as a result of high turbidity and do not represent solubilized compounds. Similarly, metals exceedances reported in the samples may have been due to the presence of suspended solids.

3.6 SOIL REMOVAL AT PSC 47 PESTICIDE SHOP (BEI, 1999)

In early 1999, approximately 1300 cubic yards of surface soil was removed from an area surrounding the western half of the Pesticide Shop (Building 536) and transported offsite for disposal. The area excavated was adjacent to the asphalt apron surrounding the building. Material underlying the asphalt was not disturbed. Four separate areas were delineated for either 1-, 2-, or 3-ft deep excavation based upon previous soil analyses. The excavation areas and post-excavation soil sampling locations are shown on Figure 2-4 of the RI/FS Work Plan (TtNUS, 2000). A copy of this figure is provided in Appendix C. The removal action also included abandonment of two of the aforementioned shallow monitoring wells installed by HLA (MW01 and MW02), excavation and disposal of materials from the soakage pits, soil sampling for laboratory analysis, and site restoration. The objective of this action was to "reduce the risks posed by contaminants of concern to acceptable levels." Details of the work performed are described in the "Completion Report for Soil Removal at Potential Source of Contamination 47, Pesticide Shop", submitted to NAVFAC SE by BEI in July 1999.

Post-excavation soil samples were retrieved from the floor of the excavation based upon a 25-ft square grid and from the sidewalls based upon total excavation perimeter. In all, 28 floor samples and 26 sidewall samples were collected for analysis. One sample was collected from the floor of each soakage pit and several samples (seven total) were collected from the sidewalls of the soakage pits. Sidewall samples from the soil removal area were collected 6 inches above the floor of the excavation. All samples were analyzed for pesticide compounds by USEPA Method 8081. As shown in Figure 2-5 of the RI/FS Work Plan (Appendix C), several pesticide compounds, including various BHC isomers, heptachlor, heptachlor epoxide, dieldrin, endrin, 4,4-DDD, 4,4'-DDE, 4,4'-DDT, and chlordane, were detected in the soil samples. Concentrations exceeding industrial SCTLs are illustrated in Figure 2-6 of the RI/FS Work Plan (Appendix C), and concentrations exceeding leachability SCTLs (based on groundwater) are shown in Figure 2-7 of the RI/FS Work Plan (Appendix C).

3.7 PRELIMINARY ASSESSMENT

Information presented in this section is intended to provide a conceptual model of the contaminants documented in each environmental medium based upon historical operations, visual observations made prior to the RI field investigation, and previous assessment and remedial activities performed at the site.

3.7.1 Surface Water

Surface water at the site consists primarily of stormwater runoff that is transported via sheet flow to unpaved areas to the north, west, and south of PSC 47. During rain events, stormwater from the adjacent road and east side of PSC 47 is channeled to the south via the drainage ditch. During drier

periods, standing water is not typically present. Surface water samples have not been collected from this ditch in any previous investigations.

3.7.2 Sediment

Sediment is assumed to be a homogeneous layer beneath a fluid medium. Therefore, sediment is restricted to locations where water exists such as ditches, creeks, rivers, and lakes. The only location where sediment could be present at PSC 47 is in the stormwater ditch along Child Street. Samples have been collected from this ditch in the past (HLA, 1999), but since the samples were collected during dry periods, they were classified as *soil*, not *sediment*. As a result, sediment, per se, does not exist at the site.

3.7.3 Soil

Prior investigations at PSC 47 have revealed soil contamination. Previous removal/remedial actions associated with the DVECC tank and the surface soil contamination at the Pesticide Shop have eliminated some of the contamination in the surface and subsurface soil at PSC 47. However, post-excavation analyses on bottom and sidewall soil samples from the area surrounding the Pesticide Shop indicated that soil contamination remains at the site. Figure 2-5 of RI/FS Work Plan (Appendix C) presents the post-excavation pesticide concentrations in the floor and sidewall soil samples, Figure 2-6 (Appendix C) presents concentrations exceeding industrial SCTLs, and Figure 2-7 (Appendix C) presents concentrations exceeding leachability (based on groundwater) SCTLs.

Pesticide concentrations in soil samples collected in the DVECC tank area after removal of the tank are shown in Appendix C [Figures 4-1 and 4-2 of the RFI (BRE, 1997)]. One or more pesticide compounds were reported at concentrations exceeding SCTLs in near-surface soil (1 ft bls) collected approximately 20 ft north and 30 ft southwest of the former DVECC tank location, but no exceedances were reported in samples collected from the excavated area. Three exceedances were also documented by BRE in subsurface soil samples (3 ft bls) collected from the location 30 ft southwest of the removed tank.

3.7.4 Groundwater

Prior investigations conducted around the former DVECC tank location involved groundwater sampling from the open excavation after tank removal and from six monitoring wells (five shallow, one deep) subsequently installed in the area. Constituent concentrations exceeding current Florida GCTLs reported in these groundwater samples are shown in Figure 2-8 of the RI/FS Work Plan, included in Appendix C of this report. Groundwater in the vicinity of the Pesticide Shop was not thoroughly characterized, but analytical data presented by HLA (1999) from three widely-spaced monitoring wells (two of which are now

abandoned) provides an estimate of groundwater quality in this area (see Figure 2-9 of RI/FS Work Plan in Appendix C).

Analytical results indicate that pesticide and herbicide compounds in groundwater at concentrations exceeding FDEP GCTLs at PSC 47. VOC contamination has also been reported near the southeastern corner of the Pesticide Shop. The NAS Jacksonville Partnering Team required that additional groundwater sampling points (i.e., monitoring wells) be placed in and around the two properties to further assess groundwater quality.

3.8 RI ASSESSMENT ACTIVITIES

The Partnering Team agreed that the next logical step in addressing PSC 47 contamination was to perform an RI to delineate remaining areas of soil contamination, and to establish a better understanding of groundwater quality in the area by expanding the existing monitoring well network both laterally and vertically. RI assessment methods are presented in the following two sections.

4.0 RI/FS FIELD ACTIVITIES

4.1 RI/FS APPROACH

RI/FS field activities were conducted at PSC 47 in three phases. During Phase I, surface and near-surface soils were collected for laboratory analysis using a stainless hand auger assembly, and an extensive DPT investigation was performed to establish a site lithologic profile and to develop a vertical profile of groundwater quality. Soil samples from 6 inches below surface at each location were analyzed for TCL pesticides by a mobile laboratory. If contaminants were identified in the surface sample, additional samples were collected at 1-ft vertical intervals until no COCs were identified in a sample or until the water table was encountered. However, due to a larger than expected site screening effort, many samples collected during Phase I were submitted to a fixed-base laboratory.

Groundwater grab samples were collected from 4-ft vertical intervals during DPT operations. At most locations, samples were collected from three discrete depths labeled “shallow” (uppermost occurrence of groundwater), “intermediate”, and “deep” within the surficial aquifer. The surficial aquifer averages approximately 50 ft in thickness beneath PSC 47. All groundwater DPT grab samples were analyzed for TCL pesticides and a select number of samples were analyzed for other COCs. Most of the DPT groundwater samples were analyzed by a mobile laboratory.

Phase II entailed installation and sampling of 14 shallow monitoring wells, 1 intermediate depth monitoring well, and 9 deep monitoring wells in three separate site mobilizations. Samples were also collected from seven existing wells located at PSC 47 and two existing USGS wells located across Child Street from the subject site.

Phase III entailed installation and sampling of four shallow monitoring wells, 1 deep monitoring well, 29 existing site montioring wells, and 1 existing USGS monitoring well. The intent of the groundwater sampling was to confirm previously reported groundwtater concentrations and to further define the existing contaminant plume. Soil samples were collected from 58 different locations to complete the vertical and/or horizontal delineation of either pesticide and/or arsenic contamination.

All phases of the investigation involved multiple stages in which the network of sampling points was expanded based upon incoming results from previous stages. Phase I began on June 25, 2001 and concluded on December 21, 2001 and was completed in two site mobilizations. Phase II was completed in several stages spanning the time period from March 18, 2002 to July 15, 2003. Phase III was completed in sevaral stages spanning the time period from November 29, 2006 to April 3, 2007.

The scope-of-work and objectives of the RI/FS are presented in Section 1.4. In order to achieve the project objectives, the NAS Jacksonville Partnering Team devised an approach during the formulation of the project DQOs that would define the lateral and vertical presence of pesticide compounds in soil by expanding upon existing sampling performed by BEI (1999), HLA (1999), and BRE (1997) and generating a profile of COC (primarily pesticide, secondarily VOC/SVOC) contamination in groundwater underlying PSC 47.

Soil sampling conducted by BEI after the removal action in early 1999, and by HLA during a previous soil quality investigation, indicated that areas of pesticide-contaminated soil remained at the PSC. Historical groundwater analytical data was considered insufficient to characterize groundwater quality in the area potentially affected by historical site operations. As a result, the RI activities included “step out” soil sampling beginning at the perimeter of known contamination, and installation of an expanded monitoring well network to define the three-dimensional boundaries of degraded groundwater underlying PSC 47.

The analytical program was designed to screen media for known COCs. The most pervasive COCs identified at the site before initiation of the RI/FS were organochlorine (TCL) pesticides, followed by TCL VOCs/SVOCs and TCL herbicides. The NAS Jacksonville Partnering Team determined that screening of the site for OP pesticides, dioxins, PCBs, and TAL inorganic constituents (i.e., metals) should be performed on a small fraction of the samples to assure evaluation of all potential contaminants. The mobile laboratory was employed strictly to define the nature and extent of potential TCL pesticide contamination in soil and groundwater site-wide and to determine the magnitude and extent of VOC contamination (groundwater only) in limited areas near the southeast corner of Building 536 and in the vicinity of the DVECC tank. Split samples were collected from approximately 10 percent of the groundwater samples analyzed by the mobile laboratory and sent to a fixed-base laboratory for analysis of TCL pesticides and VOCs for verification purposes. Select samples were also analyzed by the fixed-base laboratory for additional COCs (i.e., OP pesticides, TCL herbicides, dioxins, TCL SVOCs, and PCBs), which were either previously reported at low concentrations or were only identified in a limited area. During Phase II, permanent monitoring wells were installed at locations and to total depths considered optimum based upon analytical data current at the time, and supplemental soil and groundwater sampling was performed as needed to bridge gaps in the analytical record.

4.2 RI FIELD ACTIVITIES

A summary of work performed during the RI field investigation is provided in Table 4-1.

Table 4-1
Summary of Assessment Activities Performed During RI

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Phase I		
Date(s)	**Field Activities**	**Laboratory Analyses**
June 25 through July 6, 2001	Completion of 38 DPT borings to 50 ft bls or less using GeoProbe®; collection of soil samples from DPT locations using hand auger and collection of groundwater grab samples from various depths using retractable screen attached to the DPT equipment.	MOBILE LABORATORY: • SOIL → 35 samples from 28 DPT locations collected above the water table and analyzed for TCL pesticides (Pest). • GROUNDWATER → 104 samples (34 shallow, 35 intermediate, 35 deep) analyzed from 35 DPT locations for TCL Pest. → 9 samples (3 shallow, 3 intermediate, 3 deep) analyzed for abbreviated list of VOCs. FIXED-BASE LABORATORY (Samples collected from 12 DPT locations.) • SOIL → no analyses. • GROUNDWATER → 14 samples analyzed (7 shallow, 4 intermediate, 3 deep) - All 14 for TCL Pest, OPPs, VOCs, SVOCs, and PCBs. - 10 (6 shallow, 1 intermediate, 3 deep) for TCL herbicides. - 4 (3 shallow, 1 deep) for dioxins.
December 18 to 20, 2001	Completion of 12 additional DPT borings to depths 42 ft bls or less for the purpose of groundwater grab sampling; collection of groundwater grab samples at 9 locations previously sampled and of soil samples at 5 locations previously sampled.	FIXED-BASE LABORATORY: • SOIL → 13 samples analyzed. - All 13 for TCL Pest. - 4 for VOCs, SVOCs, PCBs, and OPPs. • GROUNDWATER → 35 samples analyzed (15 shallow, 13 intermediate, 7 deep) - 15 for TCL VOCs only. - 14 for TCL Pest only. - 6 for TCL VOCs and TCL Pest.

See notes at end of table.

Table 4-1 (Continued)
Summary of Assessment Activities Performed During RI

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Phase II		
Date(s)	**Field Activities**	**Laboratory Analyses (Fixed-base Only)**
March 18 through April 12, 2002	Installation and development of 10 shallow (12 to 15 ft bls) monitoring wells and 7 deep (40 to 60 ft bls) monitoring wells; collection of groundwater samples from these wells, from 6 existing wells around the former DVECC pesticide tank, from 1 existing microwell southeast of the Pesticide Shop, and from 2 existing USGS wells east of Child Street.	GROUNDWATER: (26 sample sets analyzed) • All 26 sample sets analyzed for TCL Pest, OPP Pest, TCL VOCs, TCL herbicides and the following NA parameters: total organic carbon, methane/ethane/ethene, sulfide, anions (nitrate/nitrite/phosphate/sulfate/ chloride), total biological oxygen demand (TBOD), ammonia, TKN, chemical oxygen demand (COD), iron, and manganese. • 6 sample sets analyzed for additional parameters TCL SVOCs, PCBs, and TAL metals.
November 4 through November 12, 2002	Installation, development, and groundwater sampling of 5 additional monitoring wells (3 shallow and 2 deep) around perimeter of well network.	GROUNDWATER: • 5 sample sets analyzed for TCL Pest and TCL VOCs.
December 11, 2002	Completion of 5 shallow hand auger borings and collection of soil samples for laboratory analysis.	SOIL: • 6 samples analyzed for TCL Pest.
January 15 through January 20, 2003	Installation, development, and groundwater sampling of 2 additional shallow monitoring wells; collection of soil samples from 5 hand auger borings.	SOIL: • 5 surface samples analyzed for TCL Pest. GROUNDWATER: • 2 sample sets analyzed for TCL Pest and TCL VOCs.

See notes at end of table.

Table 4-1 (Continued)
Summary of Assessment Activities Performed During RI

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Phase II		
Date(s)	**Field Activities**	**Laboratory Analyses (Fixed-base Only)**
January 28 through January 30, 2003	Hand auger borings for supplemental soil sampling.	SOIL: • 3 samples analyzed for TCL Pest.
February 12, 2003	Slug tests performed on 9 monitoring wells.	No laboratory analyses.
March 3, 2003	Supplemental groundwater sampling of one shallow monitoring well.	GROUNDWATER: • 1 sample analyzed for TCL Pest.
July 15, 2003	Water levels measured at 30 monitoring wells in network for generation of groundwater flow maps.	No laboratory analyses.
November 27 through December 8, 2006	Installation and development of 2 shallow monitoring wells; collection of groundwater samples from these newly installed wells, from 29 existing wells around Buildings 536 and 937, and from 1 existing shallow USGS wells east of Child Street. Collected soil samples from 50 locations to further define pesticide and arsenic contamination.	GROUNDWATER: (26 sample sets analyzed) • All 26 sample sets analyzed for TCL Pest, OPP Pest, TCL VOCs, TCL herbicides and the following NA parameters: total organic carbon, methane/ethane/ethene, sulfide, anions (nitrate/nitrite/phosphate/sulfate/ chloride), total biological oxygen demand (TBOD), ammonia, TKN, chemical oxygen demand (COD), iron, and manganese. • 6 sample sets analyzed for additional parameters TCL SVOCs, PCBs, and TAL metals.

See notes at end of table.

Table 4-1 (Continued)
Summary of Assessment Activities Performed During RI

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Phase III		
Date(s)	**Field Activities**	**Laboratory Analyses (Fixed-base Only)**
March 2 through March 9, 2007	Installation, development, and groundwater sampling of 3 additional monitoring wells (2 shallow and 1 deep). Collected 10 soil samples from 7 locations to complete horizontal As and Pesticide delineation.	GROUNDWATER: • 2 sample sets analyzed for TCL VOCs, TCL SVOCs, TCL Pest, and arsenic. • 1 sample set analyzed for arsenic only. SOIL: • 9 samples analyzed for arsenic. • 1 sample analyzed for TCL Pest.
March 18, 2007	Collected 2 soil samples from 1 location beside wells MW17S and MW17D	SOIL: • 2 samples analyzed for TCL VOCs, TCL SVOCs, TCL Pest, and TCL Herb.
3-Apr-07	Sample 4 shallow wells at Building 937 with highest Arsenic concentrations	GROUNDWATER: • 4 sample sets analyzed for total As, As speciation, TSS, and TDS

Notes:
DPT = Direct Push Technology
ft = Feet or Foot
bls = Below Land Surface
TCL = Target Compound List
Pest = Pesticides
VOCs = Volatile Organic Compounds
OPPs = Organophosphorus Pesticides
SVOCs = Semivolatie Organic Compounds
PCBs = Polychlorinated Biphenyls
DVECC = Disease Vector Ecology and Control Center
USGS = United States Geological Survey
TAL = Target Analyte List
TBOD = Total Biological Oxygen Demand
COD = Chemical Oxygen Demand

4.2.1 Phase I Investigation

4.2.1.1 Soil Sampling

A total of 48 grab soil samples were collected and analyzed during Phase I. Sampling and decontamination procedures were performed in general accordance with TtNUS' approved Comprehensive Quality Assurance Plan (CompQAP) Number 980038 and TtNUS' site-specific Quality Assurance Project Plan (QAPP) for PSC 47. Borings from which soil and/or groundwater grab samples were collected were labeled sequentially beginning with "SB01". Soil sample designations included the PSC ID (prefix), boring number, depth to top of sampling interval, and date of collection (suffix). For example, the sample collected at SB10 between 2 and 3 ft bls on June 30, 2001 was designated JAX47-SB10-S-02-063001.

During the DQO process, the NAS Jacksonville Partnering Team selected 31 specific locations "and others as determined during field activities" for collection of soil samples and groundwater grab samples during Phase I. Some soil sampling locations were selected because of proximity to previously identified hotspots and others were selected to determine presence or absence of COCs in areas not previously investigated in and around PSC 47.

During the first stage of the Phase I investigation (June 25 to July 6, 2001), "surface soil" samples (0-6 inches bls) were collected at 28 of the 31 pre-selected boring locations and submitted to KB Labs (mobile laboratory) for TCL pesticide analysis. Surface soil samples were defined as 0 to 1 ft bls because some locations were covered with asphalt or gravel and samples were collected from the 6-inch to 1-ft interval. Results of these analyses necessitated the collection and analysis of seven subsurface samples (1 to 3 ft bls) from five of these locations. Thirteen (13) additional soil samples were collected during the second stage of the Phase I investigation (December 18 to December 20, 2001) and shipped to Katahdin Analytical Services, Inc. (fixed-base laboratory) for analysis. Seven were surface soil samples from locations other than DPT boring locations and were analyzed only for TCL pesticides, three were surface soil samples from locations previously sampled, and three were subsurface samples from locations previously sampled. Re-sampling of locations for TCL pesticides was performed to evaluate agreement between mobile and fixed-base laboratory analytical procedures. Other re-sampling was performed for the purpose of analyzing additional COCs.

4.2.1.2 Site Lithologic Profile – Continuous Core Sampling

During the Phase I investigation, continuous core samples were collected from ground surface to 48 ft bls at five site locations using the GeoProbe®. Please refer to Section 2.2.6 for a discussion describing sample locations and core sampling methodology and to Appendix A to examine the soil boring logs

generated from these five continuous core samples. Cross-sections generated from the boring logs are provided as Figures 2-5 and 2-6.

4.2.1.3 Groundwater Sampling

4.2.1.3.1 DPT Methodology and Sample Nomenclature

At each DPT location, including those selected for lithologic profiling, groundwater grab samples were collected, in order, from deepest to shallowest. Borings were advanced to maximum depths of 48 ft bls. Altogether, groundwater samples were collected by DPT at 51 locations during the Phase I investigation. These locations and the depth intervals from which groundwater samples were collected are shown on Figure 4-1. To collect samples, a 1-inch diameter, 4-ft long stainless steel retractable well screen was loaded into the lead section of drive rod attached to the end of the GeoProbe drill string. When the desired depth was reached, the 4-ft screen was retracted allowing influx of groundwater. Groundwater was then purged from the well screen using a peristaltic pump with attached Teflon® tubing until turbidity was low enough to allow for sample analysis (based on visual observation). If turbidity could not be lowered to acceptable levels, or if the sampling interval yielded insufficient water volume, the screen was pulled up 4 ft and another attempt was made to collect a sample. The process of pulling up in 4-ft increments was repeated until water volume and clarity were acceptable enough for sample analysis. It should be noted, therefore, that the terms *shallow, intermediate*, and *deep* in this discourse refer to relative groundwater sampling depths at particular locations and not to designated, non-overlapping depth zones within the surficial aquifer. Intervals designated as “deep” samples ranged from 27 ft bls to 48 ft bls, “intermediate” samples ranged from 15 to 19 ft bls and 32 to 36 ft bls and “shallow” samples ranged from 5 ft bls to 14 ft bls.

Groundwater grab samples were designated similarly to soil samples. The characters in the designation represented, in order, site name, soil boring ID number, sampling medium, top of 4-ft sampling interval, and date of collection. For example, the deep groundwater sample (32 to 36 ft bls) collected at SB15 on June 29, 2001 was designated JAX47-SB15-G-32-062901.

4.2.1.3.2 Stage One Investigation (June 25 through July 6, 2001)

Groundwater grab samples were collected at 38 locations using DPT (GeoProbe®) during Phase I/Stage I of the RI investigation. At most locations, groundwater samples were collected from three 4-ft intervals within the surficial aquifer using this method. The mobile laboratory analyzed groundwater samples collected from 35 of the DPT borings. Analysis was also performed by the mobile laboratory on samples collected from the seven existing permanent monitoring wells at PSC 47, six in the vicinity of the DVECC tank (MW01S through MW06D), and one located southeast of the Pesticide Shop (MW03S).

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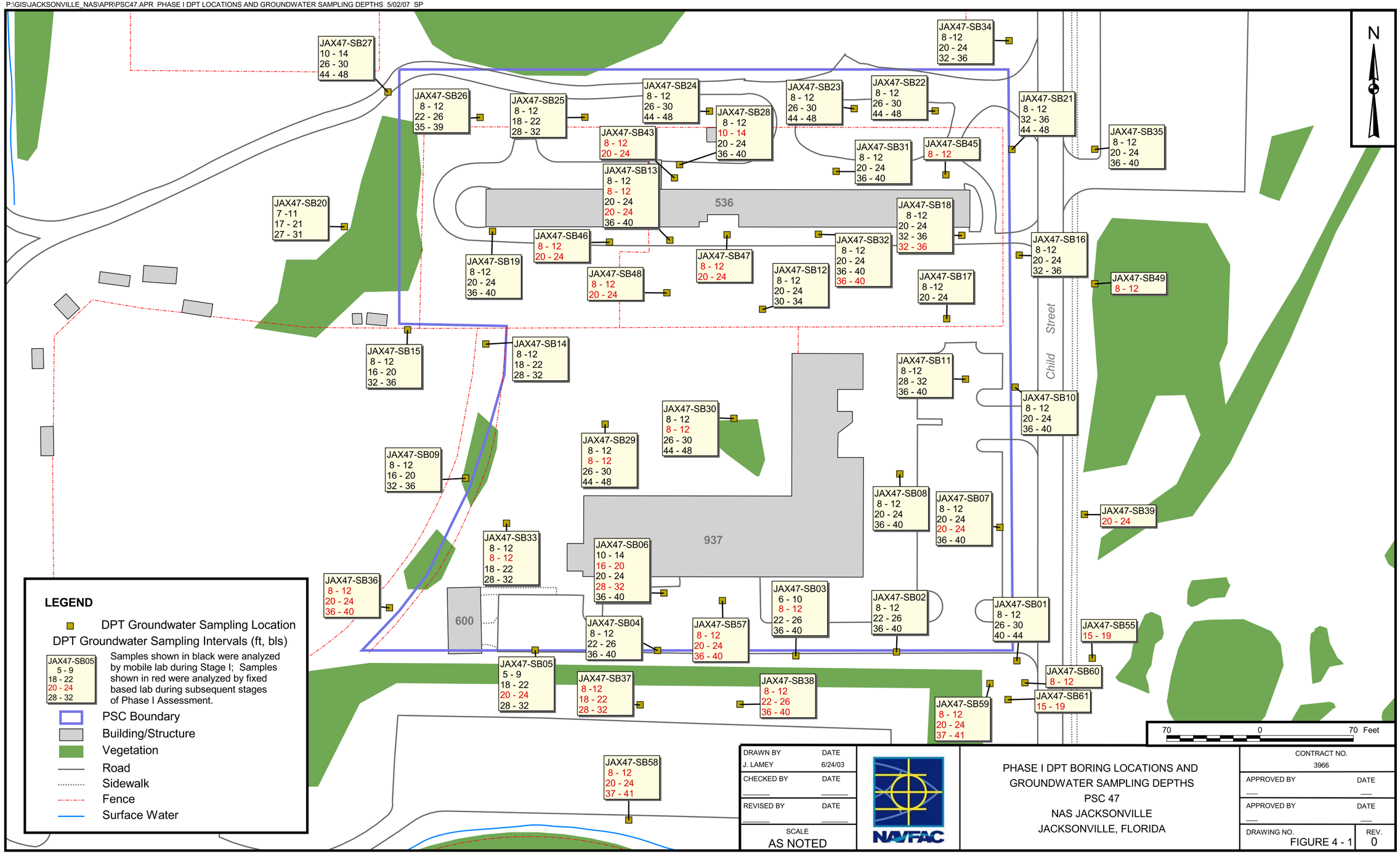

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PHASE I DPT BORING LOCATIONS AND GROUNDWATER SAMPLING DEPTHS
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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A total of 111 groundwater samples were analyzed by the mobile laboratory for TCL pesticides (USEPA Method 8081A). Samples from three select DPT borings and from the seven existing permanent monitoring wells were also analyzed for an abbreviated list of VOCs, including naphthalene compounds, chlorinated hydrocarbons [trans- and cis-DCE, TCE, tetrachloroethene (PCE), and vinyl chloride], and petroleum hydrocarbons [benzene, ethylbenzene, toluene, and total xylenes (BTEX)]. Samples from the remaining three DPT borings, completed during Stage I after departure of the mobile laboratory, were sent to a fixed-base laboratory for analysis of TCL pesticides, TCL VOCs, and some or all of the following: OP pesticides, TCL herbicides, dioxins, PCBs, and SVOCs.

4.2.1.3.3 Stage II Investigation (December 18 through 20, 2001)

Additional groundwater samples were collected and shipped to Katahdin Analytical Services, Inc. (Katahdin) for analysis during Phase I/Stage II of the RI field investigation (December 18 to 20, 2001). The objective of Stage II groundwater sampling was to define the lateral and vertical extent of contamination surrounding peripheral hotspots identified during Stage I, to obtain supplemental data in areas previously investigated to aid in data interpretation, and to complete replicate sample quotas as stated in the Sampling and Analysis Plan. In order to achieve these objectives, 35 groundwater samples (15 shallow, 13 intermediate, and 7 deep) were collected and analyzed for appropriate COCs using DPT sampling methods described above. Nine locations from Stage I sampling were re-visited and 12 new locations were investigated. Analyses performed by both mobile and fixed-base laboratories during the two stages of the Phase I investigation are provided in Appendix D, Table D-1.

4.2.2 Phase II Investigation

4.2.2.1 Soil Sampling

Fourteen (14) additional soil samples were collected for analysis of TCL pesticides during various stages of the Phase II investigation to fill gaps evident in the analytical record existing after the Phase I investigation. Six samples were collected on December 12, 2002, five on January 20, 2003, two on January 28, 2003 and one on January 30, 2003. Sample depths and procedures were the same as Phase I. A site plan showing locations and depths of all soil samples collected during Phases I and II of the RI investigation is provided as Figure 4-2. Analyses performed on soil samples are listed in Appendix D, Table D-2.

4.2.2.2 Groundwater Sampling

Twenty-four (24) monitoring wells [14 shallow (maximum total depth 15 ft bls), 1 intermediate (total depth 25 ft bls) and 9 deep (total depth from 41 to 60 ft bls)] were installed during Phase II of the RI field investigation. Six individual shallow wells, the intermediate well, one individual deep well, and eight well

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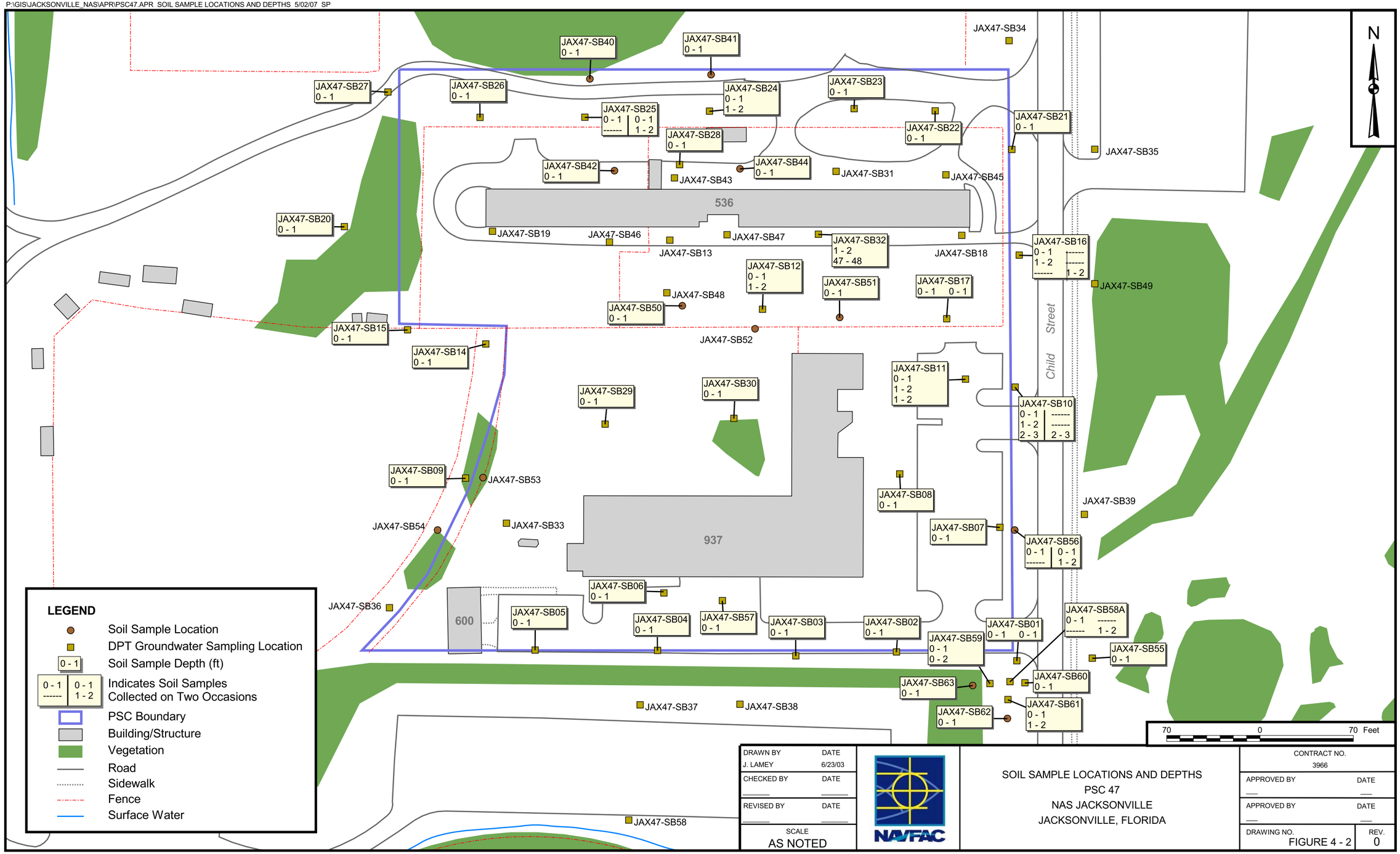

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SOIL SAMPLE LOCATIONS AND DEPTHS
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JACKSONVILLE, FLORIDA

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pairs (consisting of a shallow and deep well adjacent to one another) were installed. Between March 18 and March 28, 2002, six well pairs, one individual deep well, the intermediate well, and three individual shallow wells were installed by Ambient Technologies, Inc. (ATI). The wells were installed under TtNUS supervision at locations considered optimum based upon Phase I groundwater analytical results and pre-RI/FS analytical data. Two well pairs and three individual shallow wells were installed during two subsequent stages of the Phase II investigation (November 2002 and January 2003) by Partridge Well Drilling, Inc. (Partridge). As requested by the NAS Jacksonville Environmental Department, monitoring wells were labeled sequentially, beginning with JAX47-MW10S (MW10S). During Stage I, well pairs were given the same numerical identifier followed by "S" or "D" to differentiate "shallow" from "deep" wells. In subsequent stages, wells comprising a pair were given different numerical identifiers. The designation of the last well installed during the RI was JAX47-MW27S. For brevity, the prefix "JAX47" will be omitted when referring to monitoring wells. A site plan showing existing and newly-installed monitoring wells is provided as Figure 4-3.

4.2.2.2.1 Monitoring Well Installation

The shallow wells, intermediate well, and three of the deep wells were installed using the hollow stem auger (HSA) drilling method. Six deep wells were installed using the mud rotary technique. Monitoring wells MW21S (shallow) and MW22D (deep) were installed in the playing area of a baseball diamond south of PSC 47 (see Figure 4-3). As such, they were installed as temporary wells with no grout in the annular space and no surface completion, and were abandoned shortly after collection of groundwater samples so that the playing field could be restored to pre-existing conditions.

The upper 4 ft at each monitoring well location was excavated with posthole diggers to determine presence or absence of underground utilities. Boreholes were then advanced from 4 ft bls to total depth by machine drilling. Eight-inch outer diameter augers were used for wells drilled by the HSA method and a 5.875-inch tricone drill bit attached to AW rod was used to drill deep wells installed by the mud rotary technique. Monitoring wells constructed of 2-inch diameter, 0.010-inch mill slotted Schedule 40 polyvinyl chloride (PVC) screen and riser were inserted into the boreholes after attaining total depth. The wells were constructed with either a 10-ft or 5-ft section of screen. In general, shallow wells were installed with 10-ft screens and deep wells with 5-ft screens, although there were some exceptions to this rule. The intermediate well (MW20S) was constructed with a 5-ft screen. A filter pack consisting of 20/30 graded silica sand was installed in the annular space between borehole and monitoring well. For wells installed by HSA, the silica sand was poured between the PVC well and the augers while the augers were being removed from the borehole. For wells drilled by mud rotary, a 1-inch diameter PVC tremie pipe with funnel attached was used to install the filter pack after removal of the drillstring and bit. If the top of the screen was 4 ft bls or deeper, the filter pack was poured to approximately 2 ft above the top of the screen. If the top of the screen was less than 4 ft bls, 20/30 sand was poured 12 to 18 inches above the top of

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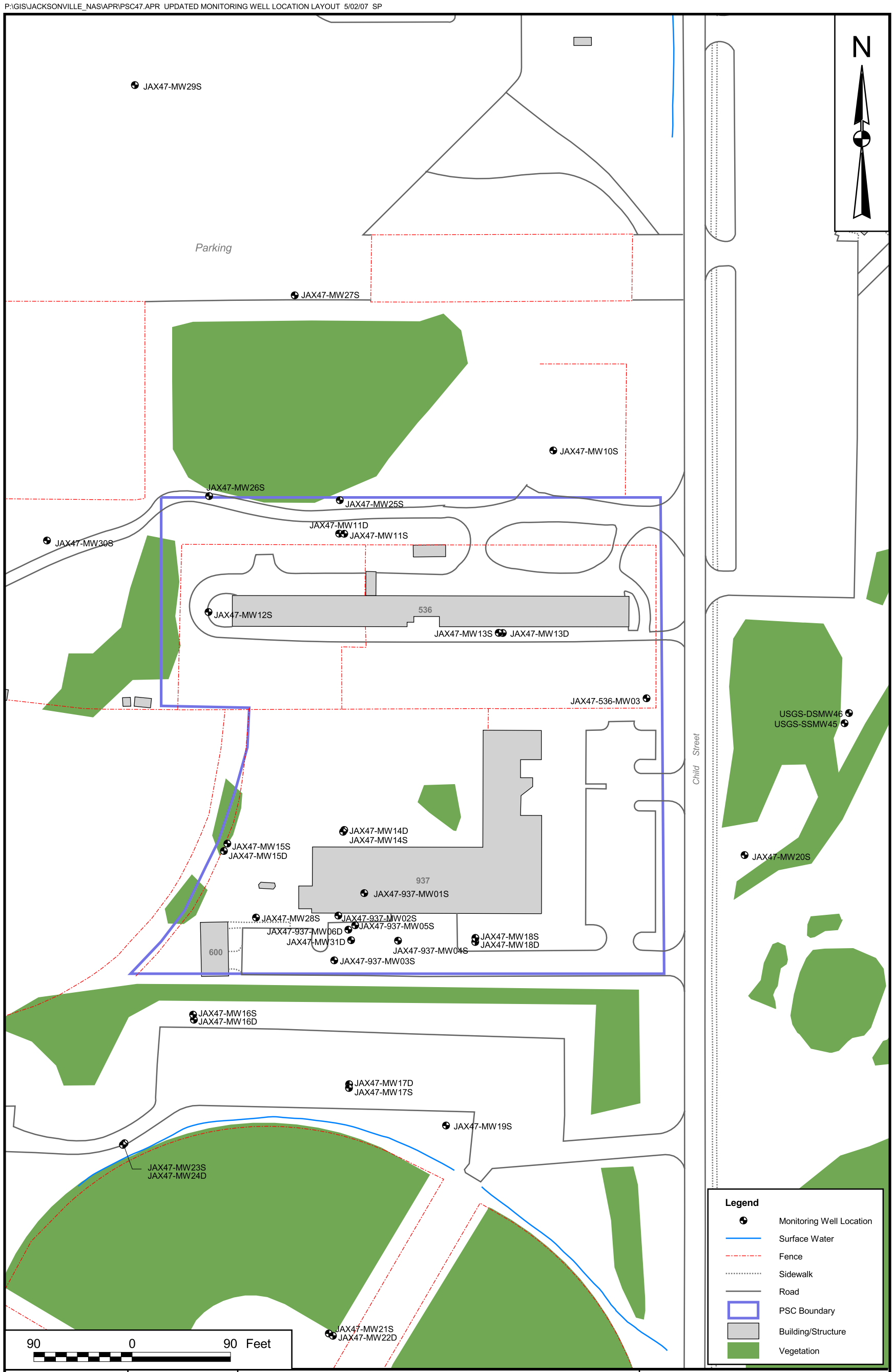

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the screen, depending on the amount of working space available between ground surface and top of screen to allow for surface completion. Approximately 1 to 2 ft of fine sand (30/65) was poured atop the filter pack, again the thickness of the fine sand seal depending on available working space between ground surface and the top of the screen. Generally, thicker fine sand seals (approximately 2 ft) were installed in the deep wells. The remainder of the annular space from the top of the fine sand to within 6 inches of ground surface was filled with Type I portland cement grout. Wells were completed at the surface with 10-inch diameter steel manholes equipped with boltdown covers. Concrete pads, approximately 6 inches thick and 2-ft square, were poured around the manholes.

A generalized schematic diagram showing construction details of a typical shallow well and a typical deep well installed at PSC 47 is presented as Figure 4-4. Construction details of the 24 monitoring wells installed during the RI are provided in Table 4-2. Soil Boring Logs describing subsurface soil encountered during drilling are provided in Appendix E-1, and diagrams depicting construction details of the individual wells are provided in Appendix E-2. Cuttings and fluid generated during drilling activities were containerized in labeled Department of Transportation (DOT) approved 55-gallon drums, properly classified, and disposed by the NAS Jacksonville Public Works Center (PWC) under supervision of the NAS Jacksonville Environmental Department.

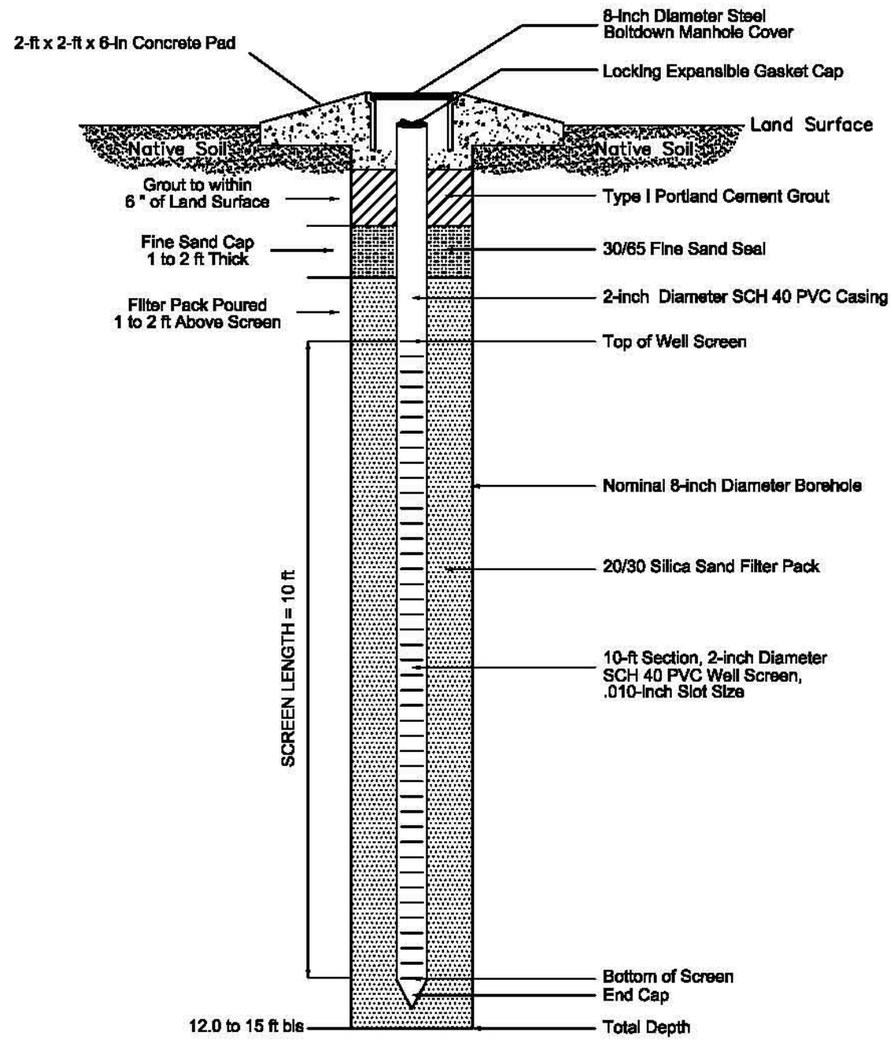
4.2.2.2.2 Monitoring Well Development

The 17 monitoring wells installed during Stage I of the Phase II investigation were developed by the drilling subcontractors (ATI) using a centrifugal pump. Wells were pumped until the water was virtually sediment free. The volume of water pumped from the wells during development ranged from 25 gallons to 150 gallons.

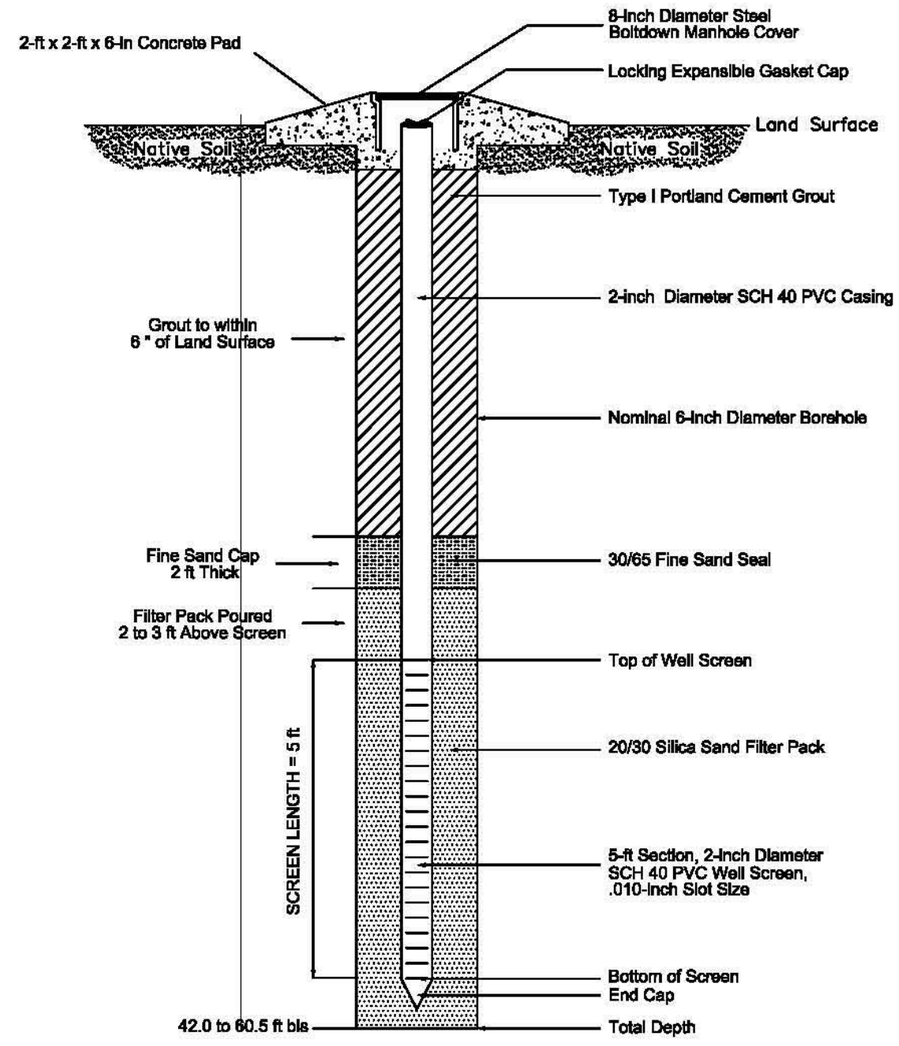
Wells installed in later stages of the Phase II investigation (MW21S through MW27S) were developed by TtNUS personnel using a submersible pump. Monitoring well development records from these seven wells are provided in Appendix F. Development water and purge water (collected prior to sampling of the wells) was containerized in DOT 55-gallon drums and disposed by PWC in the same manner as waste generated during drilling operations.

4.2.2.2.3 Water Table Elevation Determination and Groundwater Flow Direction Maps

The top-of-casing elevations of the monitoring wells at PSC 47 were surveyed relative to a known USGS benchmark and depth-to-water was measured from the surveyed top-of-casing elevations of the wells on four occasions. The water table elevation relative to msl was calculated at each monitoring well location by subtracting the measured depth-to-water values from the surveyed top-of-casing elevations. Groundwater elevation data obtained during the four events is provided in Table 4-3. During each water



TYPICAL CONSTRUCTION DETAIL
OF SHALLOW MONITORING WELL



TYPICAL CONSTRUCTION DETAIL
OF DEEP MONITORING WELL

EXCEPTIONS TO CONSTRUCTION DETAILS SHOWN ABOVE:

1) Well labeled "MW-20S" is of intermediate depth (25 ft) and is constructed like a deep well with 5-ft screen (20-25 ft bls)
2) Borehole diameter for deep wells MW-13D and MW-22D were 8" because they were drilled using hollow stem augers. Boreholes for other deep wells were drilled using mud rotary and had nominal 6" diameters.
3) Deep wells MW-13D and MW-11D were constructed with 10-ft screens; all other deep wells were constructed with 5-ft screens

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Table 4-2
Monitoring Well Construction Details

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Well Identification Number JAX47-	Installation Date	Well Depth (ft bls)	Top of Casing Elevation (msl)	Screened Internval Depth (ft bls)	Well Diameter (inches)
MW10S	3/20/2002	15.0	23.58	4.5 - 14.5	2
MW11S	3/18/2002	15.0	23.97	4.5 - 14.5	2
MW11D	3/22/2002	60.5	23.91	50.0 - 60.0	2
MW12S	3/18/2002	15.0	24.40	4.5 - 14.5	2
MW13S	3/19/2002	15.0	24.67	4.5 - 14.5	2
MW13D	3/19/2002	49.0	24.63	39.0 - 49.0	2
MW14S	12/6/2006	13.5	24.26	3.0 - 13.0	2
MW14D	3/26/2002	47.5	24.19	42.5 - 47.5	2
MW15S	3/20/2002	13.5	24.32	3.0 - 13.0	2
MW15D	3/26/2002	47.5	23.96	42.0 - 47.0	2
MW16S	3/20/2002	13.5	23.77	3.0 - 13.0	2
MW16D	3/28/2002	42.0	23.76	36.5 - 41.5	2
MW17S	3/20/2002	13.0	22.72	2.5 - 12.5	2
MW17D	3/25/2002	42.5	22.86	37.0 - 42.0	2
MW18S	3/19/2002	14.5	24.64	4.0 - 14.0	2
MW18D	3/28/2002	46.6	24.51	41.0 - 46.0	2
MW19S	3/18/2002	13.0	22.68	2.5 - 12.5	2
MW20S	3/21/2002	25.5	23.30	20.0 - 25.0	2
MW21S[1]	11/4/2002	12.5	25.29	2.0 - 12.0	2
MW22D[1]	11/4/2002	46.5	25.47	41.0 - 46.0	2
MW23S	11/4/2002	15.5	25.28	5.0 - 15.0	2
MW24D	11/5/2002	45.5	25.31	40.0 - 45.0	2
MW25S	11/4/2002	14.5	25.05	4.0 - 14.0	2
MW26S	1/15/2003	13.5	24.64	3.0 - 13.0	2
MW27S	1/15/2003	13.5	24.38	3.0 - 13.0	2
MW28S	12/6/2006	13.5	25.37	3.0 - 13.0	2
MW29S	3/2/2007	13.5	21.62	3.0 - 13.0	1.5
MW30S	3/5/2007	13.5	23.07	3.0 - 13.0	1.5
MW31D	3/5/2007	53.5	24.95	48.0 - 53.0	0.75

Notes:

[1] Installed as temporary well; abandoned after sampling, 11-06-02.

All monitoring wells were constructed of schedule 40 polyvinyl chloride (PVC) with 0.010 inch slotted screen.

ft bls - feet below land surface

msl - mean sea level

Table 4-3
Water Table Elevation Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Well Number	Screened Interval (ft bls)	Total Depth of Well (ft bls)	Top of Casing Elevation (ft msl)	April 12, 2002		November 6, 2002		January 20, 2003		July 15, 2003		November 27, 2006	
				Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)	Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)	Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)	Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)	Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)
JAX-47-													
MW10S	4.5 - 15.0	14.5	23.58	4.86	18.72	4.53	19.05	NM	NM	4.05	19.53	6.98	16.60
MW11S	4.5 - 15.0	14.5	23.97	5.35	18.62	5.24	18.73	NM	NM	4.88	19.09	7.68	16.29
MW11D	50.0 - 60.5	60.	23.91	6.98	16.93	7.1	16.81	NM	NM	6.41	17.50	8.95	14.96
MW12S	4.5 - 15.0	14.5	24.40	5.81	18.59	NM	NM	NM	NM	5.45	18.95	8.30	16.10
MW13S	4.5 - 15.0	14.5	24.67	5.44	19.23	5.39	19.28	NM	NM	4.75	19.92	7.82	16.85
MW13D	39.0 - 50.0	49.0	24.63	6.18	18.45	6.35	18.28	NM	NM	5.52	19.11	8.28	16.35
MW14D	42.5 - 48.0	47.5	24.19	5.38	18.81	5.42	18.77	NM	NM	4.73	19.46	7.54	16.65
MW15S	3.0 - 13.5	13.0	24.32	4.94	19.38	4.91	19.41	NM	NM	4.52	19.80	7.33	16.99
MW15D	42.0 - 47.5	47.0	23.96	6.63	17.33	6.8	17.16	NM	NM	6.08	17.88	8.74	15.22
MW16S	3.0 - 13.5	13.0	23.77	4.17	19.6	4.26	19.51	NM	NM	3.6	20.17	6.37	17.40
MW16D	36.5 - 42.0	41.5	23.76	4.68	19.08	4.91	18.85	NM	NM	3.84	19.92	5.52	18.24
MW17S	2.5 - 13.0	12.5	22.72	2.78	19.94	2.51	20.21	2.57	20.15	1.57	21.15	4.99	17.73
MW17D	37.0 - 42.5	42.0	22.86	3.58	19.28	3.63	19.23	3.2	19.66	2.68	20.18	5.43	17.43
MW18S	4.0 - 14.5	14.0	24.64	4.85	19.79	NM	NM	4.43	20.21	4.34	20.30	7.21	17.43
MW18D	41.0 - 47.0	46.0	24.51	5.43	19.08	NM	NM	4.98	19.53	4.48	20.03	7.33	17.18
MW19S	2.5 - 13.0	12.5	22.68	2.59	20.09	2.51	20.17	NM	NM	1.48	21.20	4.91	17.77
MW20S	20.0 - 25.5	25.0	23.30	3.48	19.82	NM	NM	NM	NM	2.44	20.86	5.78	17.52
MW21S	2.0 - 12.0	12.0	25.29	NYI	NM	4.44	20.85	Abandoned	NM	Abandoned	NM	Abandoned	NM
MW22D	41.0 - 46.5	46.0	25.47	NYI	NM	6.71	18.76	Abandoned	NM	Abandoned	NM	Abandoned	NM
MW23S	5.0 - 15.0	15.0	25.28	NYI	NM	4.79	20.49	4.23	21.05	3.22	22.06	6.69	18.59
MW24D	40.0 - 45.0	45.0	25.31	NYI	NM	6.59	18.72	5.9	19.41	5.74	19.57	8.10	17.21
MW25S	4.0 - 15.0	14.0	25.05	NYI	NM	5.35	19.70	4.97	20.08	5.03	20.02	7.74	17.31
MW26S	3.0 - 14.0	13.0	24.64	NYI	NM	NYI	NM	4.9	19.74	5.15	19.49	7.75	16.89
MW27S	3.0 - 14.0	13.0	24.38	NYI	NM	NYI	NM	4.92	19.46	5.43	18.95	7.68	16.70

See notes at end of table.

Table 4-3 (Continued)
Water Table Elevation Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Well Number	Screened Interval (ft bls)	Total Depth of Well (ft bls)	Top of Casing Elevation (ft msl)	April 12, 2002		November 6, 2002		January 20, 2003		July 15, 2003		November 27, 2006	
				Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)	Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)	Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)	Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)	Depth to Water Below Top of Casing (ft)	Water Table Elevation (ft msl)
JAX-47-536													
MW03[1]	2.0-12.0*	12.0*	23.43	NM	NM	NM	NM	NM	NM	NM	NM	NM*	NM*
JAX-47-937													
MW1S	5.0 - 15.0	15.0	25.71	6.07	19.64	NM	NM	NM	NM	5.73	19.98	8.43	17.28
MW2S	4.0 - 14.0	14.0	25.38	5.75	19.63	5.66	19.72	NM	NM	5.42	19.96	8.08	17.30
MW3S	3.0 - 13.0	13.0	24.41	4.70	19.71	4.67	19.74	NM	NM	4.37	20.04	7.00	17.41
MW4S	3.0 - 13.0	13.0	24.54	4.81	19.73	4.85	19.69	NM	NM	4.46	20.08	7.13	17.41
MW5S	3.0 - 13.0	13.0	25.06	5.39	19.67	5.3	19.76	NM	NM	5.07	19.99	7.71	17.35
MW6D	30.0 - 35.0	35.0	25.02	5.67	19.35	5.72	19.3	NM	NM	4.81	20.21	7.91	17.11
JAX-47-USGS													
SSMW45	6.0 - 16.0	16.0	26.38	6.58	19.8	NM	NM	NM	NM	5.52	20.86	8.81	17.57
DSMW46	39.0 - 44.0	44.0	26.58	7.96	18.62	NM	NM	NM	NM	7.16	19.42	NM	NM

Notes:

NM - Not measured

NYI - Not yet installed

ft msl - feet mean sea level

ft bls - feet below land surface

[1] Microwell - Depth-to-water not measured because probe diameter larger that well diameter.

* Estimated Depths

level measuring event (April 12, 2002, November 6, 2002, January 20, 2003, and July 15, 2003), the sequence of events was as follows.

- Visit each well, remove the bolt-down manhole cover (flush-mount wells), or unlock/open hinged cap of protective casing (stickup wells), remove expansible well cap, take wellhead photo ionization detector (PID) reading, leave well open.
- Revisit wells in same order that they were unlocked, measure and record depth-to-water, and lock well.

By following this procedure, the most reliable data is obtained because water levels in wells are given time to equilibrate before depth-to-water measurements are taken, and potential fluctuations in water levels due to natural factors, such as changes in barometric pressure, are minimized by obtaining the data set in the shortest possible time period.

4.2.2.2.4 Groundwater Sampling Points

Between April 4 and April 12, 2002, groundwater samples were collected from the 17 permanent monitoring wells installed during Phase II/Stage I of the RI (MW10S, MW11S/11D, MW12S, MW13S/13D, MW14D, MW15S/15D, MW16S/16D, MW17S/17D, MW18S/18D, MW19S, and MW20S), from the 6 existing DVECC wells (JAX47-937-MW01S, -MW02S, -MW03S, -MW04S, -MW05S, and -MW06D), from the existing microwell southeast of the Pesticide Shop (JAX47-536-MW03), and from 2 existing USGS wells east of Child Street [1 shallow (USGS-SSMW45) and 1 deep (USGS-DSMW46)]. In early November 2002, five wells (MW21S, MW22D, MW23S, MW24D, and MW25S) were added to the network and groundwater samples were collected on November 6 and 7, 2002. Shortly after sample collection, wells MW21S and MW22D were abandoned because of their location in the playing area of a baseball field. Two downgradient wells (MW26S and MW27S), located northwest of the Pesticide Shop, were installed on January 15, 2003 and sampled on January 20, 2003.

On February 27, 2004, TtNUS mobilized to PSC 47 to delineate arsenic in groundwater. During this event, seven wells (JAX47-937-MW01S, JAX47-937-MW02S, JAX47-937-MW04S, JAX47-MW12S, JAX47-MW14D, JAX47-15S, and JAX47-MW18S) were sampled for arsenic only. Due to detections during the first sampling event a second groundwater sampling event was performed on March 26, 2004 to complete the delineation. This event included sampling of JAX47-937-MW03S, JAX47-MW16S, and JAX47-MW17S.

4.2.2.2.5 Groundwater Sampling Procedures

During each stage of the Phase II investigation, groundwater samples were collected by the low flow purge technique using a peristaltic pump with attached Teflon® tubing. Prior to purging, depth to static water level was measured to the nearest 0.01 ft. Tubing intake was set approximately at the middle of well screens. Pumping rates were variable depending on recharge rates of the wells and were ideally set such that drawdown did not exceed 0.3 ft.

Prior to sample collection, a minimum of three well volumes of groundwater were removed from wells in which the well screen intersected the water table. If the screen was submerged, a minimum three screen length volumes were removed. During purging, field parameters [pH, specific conductance, turbidity, dissolved oxygen, temperature, and oxidation-reduction potential (ORP)] were measured and recorded periodically using a Horiba U-22 instrument. If, after purging of three well (or screen) volumes, one or more field parameters did not stabilize, purging would continue until a maximum of five well (or screen length) volumes were removed. Stabilization is defined as follows: pH $\pm$0.1 unit; specific conductance $\pm$10 percent; temperature $\pm$1.0 degrees Celsius (°C); and turbidity, less than 10 NTUs. Neither dissolved oxygen nor ORP is used to determine aquifer stabilization. Groundwater Sampling Logs and Low Flow Purge Sheets compiled during purging and sampling of these wells, are provided in Appendix H.

After collection, the samples were immediately placed on ice and shipped via overnight courier under proper chain-of-custody to Katahdin for analysis.

4.2.2.2.6 Field Natural Attenuation Measurements

During the Stage I (Phase II) groundwater sampling event of April 4 through 12, 2002, sample aliquots were analyzed in the field for the following natural attenuation parameters:

- Carbon Dioxide (CHEMetrics)
- Alkalinity (CHEMetrics)
- Ferrous Iron (HACH DR/890 + Color Wheel)
- Hydrogen Sulfide (HACH HS-C)
- Sulfide (HACH DR/890)
- Manganese (HACH DR/890)

Results of the natural attenuation field analyses were recorded on the Groundwater Sampling Logs and Low Flow Purge Sheets provided in Appendix H. Natural attenuation parameters were not measured in the field during subsequent stages of Phase II groundwater sampling (MW21S through MW27S).

4.2.2.2.7 Laboratory Analytical Program

Laboratory analyses, performed during the Phase II RI investigation, are listed in Appendix D, Table D-3. Groundwater samples collected from the 26 monitoring wells during Stage I of the Phase II RI (April 4 through April 12, 2002) were analyzed for TCL VOCs by USEPA Method 8260B, TCL pesticides by USEPA Method 8081A, OP pesticides by USEPA Method 8141A, TCL herbicides by USEPA Method 8151A, and for the following natural attenuation parameters:

- Methane/ethane/ethene [organic volatile gases (OVG)] by Method MOD RSK-175
- TOC by USEPA Method 415.1
- Filtered and unfiltered iron and manganese by USEPA Method 6010B
- Dissolved sulfide by USEPA Method 376.1
- Ammonia by USEPA Method 350.1
- TKN by USEPA Method 351.2
- Chemical Oxygen Demand (COD) by USEPA Method 410.4
- Nitrate (NO_3) and nitrite (NO_2) by USEPA Method 353.2
- Chloride by USEPA Method 325.2
- Sulfate by USEPA Method 375.4
- Biochemical Oxygen Demand (BOD) by USEPA Method 405.1

Samples from six of the wells [MW13S and -MW13D, the two USGS wells (SSMW45 and DSMW46), and two of the DVECC wells (JAX47-937-MW01S and –MW06D)] were analyzed for the additional parameters SVOCs (USEPA Method 8270C), TCL PCBs (USEPA Method 8082), and TAL metals (USEPA Method 6010B) (except mercury by Method 7470 and thallium by Method 6020). Detections of arsenic in JAX47-937-MW01S generated the need for additional arsenic analysis of 10 groundwater samples in February and March 2004.

Groundwater samples collected from the seven monitoring wells added to the network in subsequent stages of the Phase II investigation (MW21S through MW27S) were only analyzed for TCL VOCs by USEPA Method 8260B and TCL pesticides by USEPA Method 8081A. No field or laboratory natural attenuation analyses were performed on these samples.

4.2.3 Phase III Investigation

4.2.3.1 Soil Sampling

A total of 112 soil samples were collected from 58 locations and analyzed for TCL pesticides and/or arsenic during the Phase III investigation. There was one exception, SB118 was analyzed for TCL VOCs,

TCL SVOCs, TCL pesticides, and TCL herbicides. One hundred samples (from 50 locations – SB64 through SB113) were collected between November 27, 2006 and December 1, 2006, 10 samples [from 7 locations – SB114 through SB 121 (excluding SB118)] were collected on March 9, 2007, and 2 samples (from one location – SB118) were collected on March 18, 2007. A site plan showing locations of soil samples collected during all phases of the RI investigation is provided as Figure 4-5. Sample depth and analyses performed for each sample are listed in Appendix D, Table D-4. Soil Sediment Sampling Logs are provided in Appendix G.

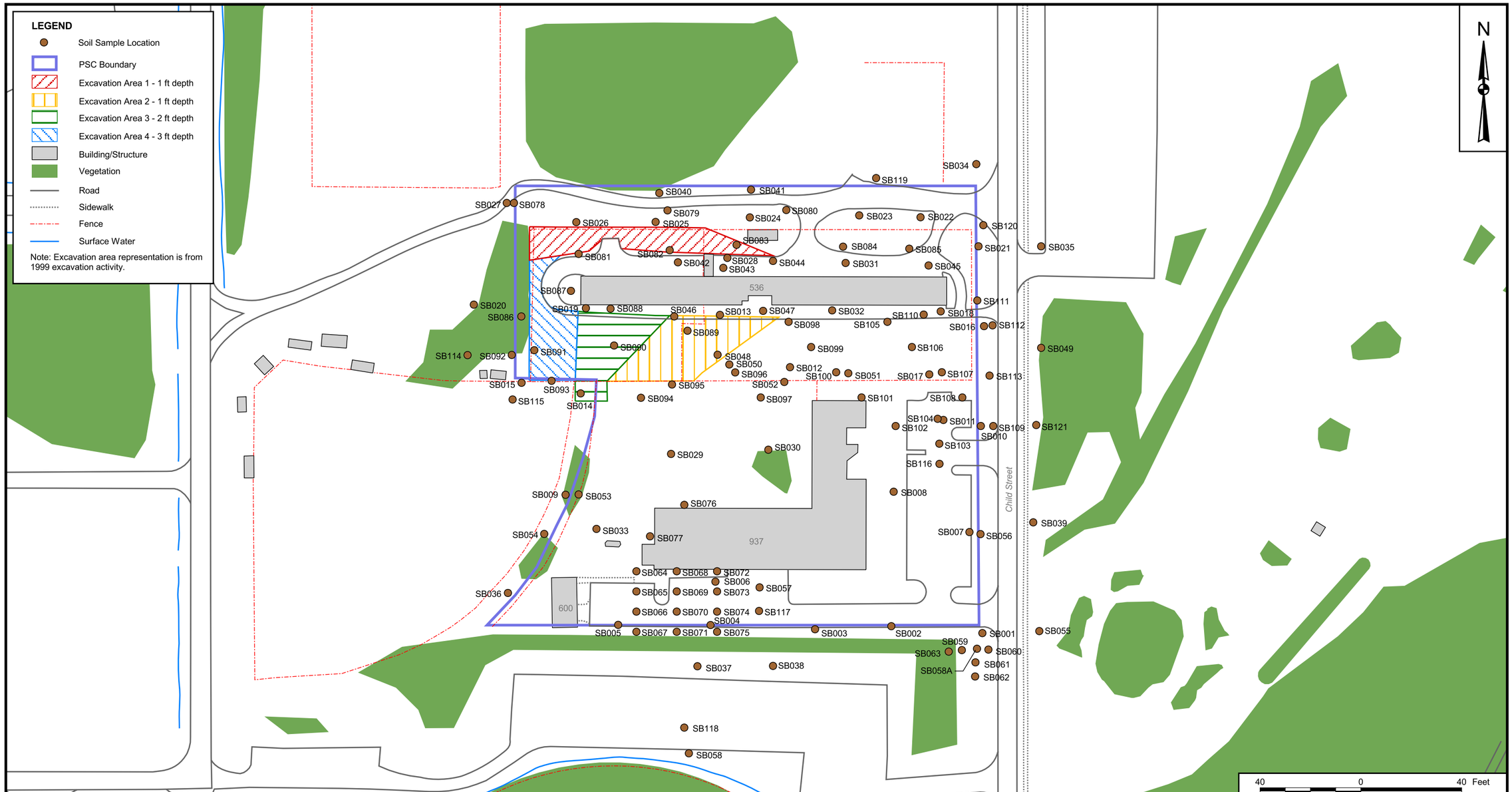
Sampling and decontamination procedures were performed in general accordance with FDEP Standard Operating Procedures (SOPs) (FDEP, 2004) and TtNUS' RI/FS Sampling and Analysis Plan Addendum for PSC 47 (TtNUS, 2006). Borings from which soil and/or groundwater grab samples were collected were labeled sequentially beginning with "SB01". Soil sample designations included the PSC ID (prefix), boring number, depth to bottom of sampling interval, and date of collection (suffix). For example, the sample collected at SB77 between 5 and 6 ft bls on November 28, 2006 was designated JAX47-SB77-06-112806.

During the first field event of the Phase III investigation (November 27 to December 1, 2006), 100 samples (from 50 locations – SB64 through SB113) were collected via a stainless steel hand auger. All samples were hand delivered to Environmental Conservation Laboratories Inc. (ENCO) in Jacksonville, Florida. Each sample location had a surface (0-12 inch) and subsurface (immediately above water table) soil grab sample collected. Soil borings SB64 through SB77 were only analyzed for arsenic as they were intended to verify if arsenic contaminated soil was contributing the groundwater arsenic plume present near Building 937.

A second field event was conducted on March 9, 2007 and a total of 10 samples were collected from seven soil borings [SB114 through SB121 (excluding SB118]. A surface and/or subsurface soil grab sample was collected from SB114 through SB120 (excluding SB118) and analyzed for arsenic. A surface soil sample was collected from SB121 and analyzed for pesticides. All samples were hand delivered to ENCO in Jacksonville, Florida.

The third and final field event for soil delineation was conducted on March 13, 2007. A surface (0-12 inches) and subsurface (immediately above water table) soil grab sample were collected from SB118. Both samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, and TCL herbicides by ENCO in Jacksonville, Florida. Soil boring SB118 was located immediately beside monitoring well MW17S, which had reported VOCs, SVOCs, and pesticides concentrations exceeding FDEP GCTLs. Because there was no soil data near this well and it is located upgradient to the known source (Building 937) for this area, these samples were collected for completeness of the data set.

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR SOIL SAMPLE LOCATION LAYOUT 5/02/07 SP



Note: Sample location names have been abridged. The prefix to each sample location is "JAX47-".

DRAWN BY	DATE
S. PAXTON	4/05/07
CHECKED BY	DATE
C. METZ	5/02/07
REVISED BY	DATE
SCALE	
AS NOTED	

NAVFAC

SOIL SAMPLE LOCATION MAP
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO.	
CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 4 - 5	REV. 0

4.2.3.2 Groundwater Sampling

Five monitoring wells [4 shallow (maximum total depth 13.5 ft bls) and 1 deep (total depth 53 ft bls)] were installed during two separate events of the Phase III RI field investigation. Two of the shallow wells (MW14S and MW28S) were installed on December 6, 2006 by Florida Southern Downhole, Inc. Both of these wells were installed to further define the arsenic hot spot located southwest of Building 937. The three remaining wells (MW29S, MW30S, and MW31D) were installed on March 2 and 5, 2007 by Zebra Environmental, Inc. Wells MW29S and MW30S were installed as downgradient "clean" wells for the northern pesticide plume located around Building 536. A site plan showing existing and newly-installed monitoring wells is provided as Figure 4-3.

4.2.3.2.1 Monitoring Well Installation

Both of the shallow wells (MW14S and MW28S) installed on December 6, 2006 were installed using the HSA drilling method. The remaining three wells (MW29S, MW30S, and MW31D) were installed using DPT and prepacked well screens. Each of these five wells was completed as described in Section 4.2.2.2.1 of this report.

Construction details of these five monitoring wells is provided in Table 4-2. Diagrams depicting construction details of the individual wells are provided in Appendix E-2. Cuttings and fluid generated during drilling activities were containerized and labeled in DOT approved 55-gallon drums, properly classified, and disposed by the NAS Jacksonville PWC under supervision of the NAS Jacksonville Environmental Department.

4.2.3.2.2 Monitoring Well Development

Monitoring wells MW14S and MW28S were developed by the drilling subcontractors (Florida Southern Downhole, Inc.) using a centrifugal pump. Monitoring wells MW29S, MW30S, and MW31D were developed by TtNUS personnel using a peristaltic pump. All wells were pumped until the water was virtually sediment free. Development water and purge water (collected prior to sampling of the wells) was containerized in DOT 55-gallon drums and disposed by PWC in the same manner as waste generated during drilling operations.

4.2.3.2.3 Water Table Elevation Determination and Groundwater Flow Direction Maps

Groundwater elevations were recorded on November 27, 2006 and are summarized in Table 4-3. Procedures followed for collecting groundwater levels were the same as those presented in Section 4.2.2.2.3 of this report.

4.2.3.2.4 Groundwater Collection

Groundwater samples were collected from the 35 permanent monitoring wells at PSC 47 between November 27, 2006 and March 9, 2007. A complete list of Phase III monitoring wells with sample date and analysis for each well is included in Appendix D as Table D-5.
On April 4, 2007, four additional samples were collected from monitoring wells JAX47-937-MW02S, JAX47-937-MW03S, JAX47-937-MW04S, and JAX47-937-MW05S. These four wells were re-sampled to confirm arsenic concentrations and provide speciation data as to the type(s) of arsenic present.

4.2.3.2.5 Groundwater Sampling Procedures

All samples were collected in strict accordance with FDEP SOPs for groundwater sampling. Groundwater Sampling Logs compiled during purging and sampling of these wells, are provided in Appendix H. After collection, the samples were immediately placed on ice and hand delivered to ENCO in Jacksonville, Florida.

4.2.3.2.6 Laboratory Analytical Program

Laboratory analyses, performed during the Phase III RI investigation, are listed in Appendix D, Table D-5. Groundwater samples collected from the 35 monitoring wells during Phase III were analyzed for TCL VOCs by USEPA Method 8260B, TCL SVOCs by USEPA Method 8270C, TCL pesticides by USEPA Method 8081A, and arsenic by USEPA Method 6010B. Select wells also had a filtered arsenic sample collected. All samples were hand delivered to ENCO in Jacksonville, Florida.

Samples from four of the wells (MW02S, MW03S, MS04S, and MW05S) with the highest arsenic concentrations were collected again on April 3, 2007. These four samples were shipped to Accutest Laboratories in Orlando, Florida and were analyzed for arsenic by USEPA Method 6010B, arsenic speciation by HPLC-HG-AFS (high-performance liquid chromatography-hydride generation-atomic fluorescence spectrometry), total suspended solids by USEPA Method 160.2, and total dissolved solids by USEPA Method 160.1.

5.0 NATURE AND EXTENT OF CONTAMINATION

Results of the sampling activities supporting the RI as described in Sections 3.0 and 4.0 are summarized in this section. The quality of the chemical analytical data generated during the investigation of PSC 47 has been documented. The analytical data validation process was completed for the laboratory data packages in accordance with the USEPA Functional Guidelines for Organic Data Validation (February 1994), the USEPA Functional Guidelines for Inorganic Data Validation (February 1994), and the PSC 47 RI/FS Work Plan (TtNUS, 2000). The data set compiled using these guidelines is considered acceptable for use in this RI in support of the FS.

Discussion of the nature and extent of contamination at PSC 47 is structured according to the RI/FS guidance (USEPA, 1988). Sources of contamination are discussed first (Section 5.1), followed by a summary of NAS Jacksonville background screening concentrations for COCs (Section 5.2). Assessment results are presented in Section 5.3. The nature and distribution of chemical contamination identified in soil and groundwater is presented in Sections 5.3.1 and 5.3.2, respectively. Discussion of results for both media are subdivided chronologically into phases and stages as the RI investigation progressed. For both soil and groundwater, COC analytical results are discussed in the following order: TCL pesticides, followed by (where applicable) TCL VOCs and SVOCs, TCL herbicides, dioxins, OP pesticides, PCBs, TAL metals, and natural attenuation parameters. A discourse on the significance of the reported data is accompanied by tables showing concentrations of each fraction within a particular medium and graphic illustrations showing contaminant distributions in the various media.

5.1 SOURCES OF CONTAMINATION

Suspect sources of contamination at PSC 47, broadly speaking, are the location of the former DVECC tank south of Building 937 and the areas around Building 536 where pesticides were once mixed and stored, pesticide application equipment was tested and calibrated, chlordane was applied to concrete slabs for termite control training, drums of unknown content were stored, chlordane was allegedly spilled, and diesel and diesel-malathion mixtures were stored in ASTs or USTs. Previous investigations by HLA (1999) and BEI (1999) indicated that greatest pesticide concentrations in soils are present south of the western half of Building 536. The former soakage pit locations near the southeast and southwest corners of Building 536 are additional areas where COCs have been identified at elevated levels. The distribution of COCs in groundwater has previously been documented in the area surrounding the DVECC pesticide tank, but only widely-spaced data points were investigated in the northern half of the PSC in the vicinity of the Pesticide Shop.

The Phase I sampling and analysis locations were designed to define the breadth of soil contamination, to obtain a profile of groundwater contamination sitewide, and to acquire information in areas lacking in soil and groundwater quality data. Seventeen permanent monitoring well locations were selected based upon information provided in investigations pre-dating the RI and upon results of the DPT investigation performed in Phase I of the RI. Locations of five additional monitoring wells (MW21S, MW22D, MW23S, MW24D, and MW25) were selected based upon groundwater analytical data reported from the initial Phase II (April 2002) sampling event, which included data from the 17 new monitoring wells and 9 existing monitoring wells. Locations of two wells (MW26S and MW27S) were selected to delineate the northwestern (downgradient) boundary of contaminated groundwater based upon data reported in previous stages of the Phase II investigation. Phase III sampling was analysis locations were designed to complete horizontal delineation of soils and confirm previously reported (2002/2003) groundwater contamination concentrations. Samples were collected from 58 soil locations and 34 monitoring wells (29 existing wells and 5 newly installed wells) during Phase III. Locations of the five wells (MW14S, MW28S, MW29S, MW30S, and MW31D) were selected to delineate the boundaries of contaminated groundwater based upon data reported in the Phase III investigation.

5.2 BACKGROUND SCREENING CONCENTRATIONS

Stationwide background concentrations for organic and inorganic compounds in various environmental media were previously established and approved by FDEP and USEPA for NAS Jacksonville during the OU 1 RI/FS. These concentrations were developed using data gathered in areas believed not to have been impacted by historical NAS Jacksonville operations (ABB-ES, 1996).

Concentrations in all media sampled under this RI were evaluated against stationwide background values. No other site-specific background sampling was performed. The background concentrations for each COPC along with the detections are presented in analytical data tables in the subsections to Section 5.3 below.

5.3 CONTAMINATION ASSESSMENT

During the DQO process, regulatory screening criteria were selected for each medium of concern. For soils, selected criteria include FDEP residential, industrial and leachability SCTLs, Region 9 Preliminary Remediation Goals (PRGs), and NAS Jacksonville background values. For groundwater, screening criteria include FDEP GCTLs, USEPA MCLs, and NAS Jacksonville background screening values. Data tables provided in the following sections include each of the screening criteria identified above by media type.

In development of the site DQOs, the NAS Jacksonville Partnering Team made the decision to select the lower regulatory level between FDEP SCTLs (both residential and industrial) and Region 9 PRGs as the primary soil screening criteria for the purposes of the RI. As a result, exceedances of these criteria are used for visual presentation of results on figures in this section. This decision was based on the relatively dry conditions encountered in the drainage ditch bordering the east side of PSC 47 and the lack of a connection of storm water conveyance features to a surface water body.

Phase I and II data were originally compared to 2004 FDEP cleanup target levels (CTLs) and was the basis for guiding additional RI field investigation efforts. The FDEP promulgated new CTLs on April 17, 2005 that resulted in changes in the permissible concentrations (often lower limits) of many contaminants. As a result, the Phase I and II data were compared to current FDEP CTLs (2005) prior to planning and collecting Phase III data. Several of the figures in the coming sections will show tag maps with SCTLs that are no longer correct but are being shown because they supported the decisions that were made during the initial phases of the RI investigation. Updated tag maps, compared to current (2005) FDEP CTLs, are provided to show current SCTL exceedances at all sampling locations (Phase I through III).

5.3.1 Soil Quality Assessment

A detailed discussion of the rationale and objectives of the soil sampling scheme designed for the RI is provided in Section 4.2.1.1. A total of 62 surface (0 to 1 ft bls) and subsurface (2 ft bls or deeper) soil samples were collected during Phase I and II at the locations and depths shown on Figure 4-2. As described in Section 4.2.2.1, the majority of the samples (35) were collected and analyzed by the mobile laboratory during Phase I of the RI. Supplemental samples were collected for analysis by the fixed-base laboratory in several follow-up visits to the site for either further COC delineation or as duplicate samples to compare with mobile laboratory data. An additional 112 surface and subsurface soil samples were collected during Phase III at the locations shown on Figure 4-5.

5.3.1.1 Surface Soil

TtNUS collected 59 surface soil samples (0-1 ft bls) during Phases I and II of the RI field investigation (2002/2003), as discussed in previous sections. Twenty-six (26) samples were analyzed by the mobile laboratory (KB Labs) during the initial stage of the investigation, and 33 samples were analyzed by the fixed-base laboratory during subsequent stages. Each surface soil sample collected was analyzed for TCL pesticides by USEPA Method 8081, three were analyzed for VOCs, SVOCs, and PCBs by USEPA Methods 8260B, 8270C, and 8082, respectively, and two samples were analyzed for OP pesticides by USEPA Method 8141A. Analyses other than TCL pesticides were all performed by the fixed-base laboratory. Please refer to Appendix D, Table D-2 for a listing of soil samples and the laboratory analyses performed on each sample.

Fifty-eight (58) surface soil samples (0-2) ft bls) were collected by TtNUS personnel during Phase III of the RI field investigation (2006/2007). All 58 samples were analyzed by a fixed-base laboratory (ENCO). Fifty-seven (57) samples were analyzed for TCL pesticides by USEPA Method 8081 and/or arsenic by USEPA Method 6010B. One sample was analyzed for TCL pesticides, herbicides, VOCs, and SVOCs by USEPA Methods 8081, 8151A, 8260B, 8270C, respectively. Please refer to Appendix D, Table D-4 for a listing of soil samples and the laboratory analyses performed on each sample.

Twenty-three (23) surface soil samples were collected by BEI from the floor and sidewalls of the 1 to 3-ft deep excavation following the 1999 soil removal event. The samples were analyzed by ENCO of Jacksonville, Florida (a fixed-base laboratory) for TCL pesticides by USEPA Method 8081. TtNUS is unsure of the validation efforts performed on the BEI data. The BEI pesticide data is provided in Appendix C as Table C-1.

5.3.1.1.1 TCL Pesticides

TCL pesticide concentrations reported in the surface soil samples discussed above are listed in Table 5-1. Comprehensive (BEI and RI samples) figures showing surface soil exceedances of current residential, industrial, and leachability SCTLs are provided as Figures 5-1, 5-2, and 5-3, respectively. Soil analytical data reports produced by the mobile laboratory are provided in Appendix I and validated fixed-base laboratory reports listing soil analytical results on samples collected are provided in Appendix J.

Six TCL pesticide compounds were reported at concentrations exceeding residential criteria (see Figure 5-1) in the surface soil samples analyzed, including samples collected by BEI (after the 1999 soil removal event) and by TtNUS during RI field activities. The most commonly reported pesticide compounds exceeding residential criteria were 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, heptachlor, and heptachlor epoxide. Four (4,4'-DDT, dieldrin, heptachlor, and heptachlor epoxide) of the six TCL pesticides exceeding residential criteria also exceeded industrial criteria. Industrial exceedances of pesticides are shown on Figure 5-2. Highest concentrations and locations of the these most-frequently reported pesticide compounds were: 4,4'-DDD (17,000 micrograms per kilogram (µg/kg), 4,4'-DDT (2,700,000 µg/kg), and heptachlor (3,400 µg/kg) in SB96; 4,4'-DDE (28,000 µg/kg) in BEI sample JX01216; dieldrin (3,400 µg/kg) in SB50 and SB106; and heptachlor epoxide (920 µg/kg) in SB94.

Seven TCL pesticides were detected at concentrations exceeding leachability criteria in surface soil samples. Pesticide leachability exceedances are shown on Figure 5-3. Three (alpha-BHC, beta-BHC, and endrin) of the seven TCL pesticides exceeded only leachabilty criteria while the remaining four (4,4'-DDD; 4,4'-DDT; dieldrin; and heptachlor epoxide) also exceeded residential and/or industrial criteria.

Table 5-1
Summary of Detected Pesticide Concentrations in Soil Samples

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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB001 S-00 06/29/01	SB001 S-00 12/19/01	SB002 S-00 06/29/01	SB003 S-00 06/29/01	SB004 S-00 06/29/01	SB005 S-00 07/02/01	SB006 S-01 07/02/01
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	890	300 J	12.5 U	12.5 U	51.1	12.5 U	12.5 U
4,4'-DDE	2900	15000	18000	1700	7000	630	190 J	12.5 U	15.1	162.1	17.8	16
4,4'-DDT	2900	15000	11000	1700	7000	2800	680 J	15.2	21.9	122.3	15.3	12.5 U
ALDRIN	60	300	200	29	100	12.5 U	51 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ALPHA-BHC	100	600	0.3	90	360	12.5 U	51 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	13	110 J	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
BETA-BHC	500	2400	1	320	1300	12.5 U	51 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
DELTA-BHC	24000	490000	200	90	360	12.5 U	51 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
DIELDRIN	60	300	2	30	110	12.5 U	99 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	12.5 U	51 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	12.5 U	99 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	12.5 U	99 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ENDRIN	25000	510000	1000	18000	180000	15.9	99 UJ	14.5	12.5 U	32.3	12.5 U	12.5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	12.5 U	99 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	12.5 U	28 J	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	12.5 U	51 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	28.7	75 J	23.8	12.5 U	47.6	12.5 U	12.5 U
HEPTACHLOR	200	1000	23000	110	380	12.5 U	51 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	12.5 U	51 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	12.5 U	510 UJ	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB007 S-00 06/30/01	SB008 S-00 06/30/01	SB009 S-00 06/27/01	SB010 S-00 06/30/01	SB010 S-01 06/30/01	SB010 S-02 06/30/01	SB010 S-02 12/19/01
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	101.9	12.5 U	12.5 U	2500	3000	**5300 [R]**	620
4,4'-DDE	2900	15000	18000	1700	7000	142.8	12.5 U	60.3	930	650	1200	560
4,4'-DDT	2900	15000	11000	1700	7000	164	12.5 U	21.6	**14000 [R,L]**	**6600 [R]**	**30000 [R,I,L]**	1900
ALDRIN	60	300	200	29	100	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	260 U
ALPHA-BHC	100	600	0.3	90	360	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	260 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	12.5 U	12.5 U	12.5 U	42.2	680	75.5	120 J
BETA-BHC	500	2400	1	320	1300	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	260 U
DELTA-BHC	24000	490000	200	90	360	12.5 U	12.5 U	12.5 U	12.5 U	22.2	23.2	260 U
DIELDRIN	60	300	2	30	110	12.5 U	12.5 U	12.5 U	**15.2 [L]**	**1000 [R,I,L]**	**66.6 [R,L]**	500 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	260 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	500 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	500 U
ENDRIN	25000	510000	1000	18000	180000	12.5 U	12.5 U	12.5 U	29.9	50.5	24.6	500 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	500 U
ENDRIN KETONE	NC	NC	NC	18000	180000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	20.5	500 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	260 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	12.5 U	12.5 U	12.5 U	65.6	750	81.1	260 U
HEPTACHLOR	200	1000	23000	110	380	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	260 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	13.7	260 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	12.5 U	25.4	12.5 U	12.5 U	12.5 U	13.5	2600 U

Table 5-1
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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB011 S-00 06/25/01	SB011 S-01 06/26/01	SB011 S-01 07/01/01	SB012 S-00 06/25/01	SB012 S-01 07/01/01	SB014 S-00 06/27/01	SB015 S-00 06/27/01
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	3800	81.7	12.5 U	1200	12.5 U	12.5 U	12.5 U
4,4'-DDE	2900	15000	18000	1700	7000	240	43	12.5 U	1050	17.6	12.5 U	69.8
4,4'-DDT	2900	15000	11000	1700	7000	370	60.9	12.5 U	1200	20.3	12.5 U	16
ALDRIN	60	300	200	29	100	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ALPHA-BHC	100	600	0.3	90	360	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	330	12.5 U	12.5 U	300	12.5 U	12.5 U	12.5 U
BETA-BHC	500	2400	1	320	1300	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
DELTA-BHC	24000	490000	200	90	360	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
DIELDRIN	60	300	2	30	110	**260 [R,L]**	12.5 U	12.5 U	**200 [R,L]**	12.5 U	12.5 U	12.5 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	200	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
ENDRIN	25000	510000	1000	18000	180000	200	12.5 U	12.5 U	220	12.5 U	12.5 U	12.5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	42.5	12.5 U	12.5 U	35.1	12.5 U	12.5 U	12.5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	550	12.5 U	12.5 U	530	12.5 U	12.5 U	12.5 U
HEPTACHLOR	200	1000	23000	110	380	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	12.5 U	12.5 U	12.5 U	15	12.5 U	12.5 U	12.5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	13.4	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB016 S-00 06/25/01	SB016 S-01 06/25/01	SB016 S-02 12/11/02	SB017 S-00 06/25/01	SB017 S-00 12/19/01	SB020 S-00 06/27/01	SB021 S-00 06/25/01
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	0.00 U	12.5 U	4.1	48.5	11 J	12.5 U	16
4,4'-DDE	2900	15000	18000	1700	7000	680	12.5 U	3 J	37.3	72	29.4	30.8
4,4'-DDT	2900	15000	11000	1700	7000	310	14.3	5.1	121.2	210	12.5 U	37
ALDRIN	60	300	200	29	100	12.5 U	12.5 U	2.1 U	12.5 U	11 U	12.5 U	12.5 U
ALPHA-BHC	100	600	0.3	90	360	12.5 U	12.5 U	2.1 U	12.5 U	11 U	12.5 U	12.5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	62.6	12.5 U	2.1 U	12.5 U	14	12.5 U	12.5 U
BETA-BHC	500	2400	1	320	1300	12.5 U	12.5 U	2.1 U	12.5 U	11 U	12.5 U	12.5 U
DELTA-BHC	24000	490000	200	90	360	12.5 U	12.5 U	2.1 U	12.5 U	11 U	12.5 U	12.5 U
DIELDRIN	60	300	2	30	110	**83 [R,L]**	12.5 U	0.81 J	12.5 U	**6.4 J [L]**	12.5 U	12.5 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	2.1 U	12.5 U	11 U	12.5 U	12.5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	4.1 U	12.5 U	22 U	12.5 U	12.5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	4.1 U	12.5 U	22 U	12.5 U	12.5 U
ENDRIN	25000	510000	1000	18000	180000	82.2	12.5 U	4.1 U	12.5 U	22 U	12.5 U	12.5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	12.5 U	50	4.1 U	12.5 U	22 U	12.5 U	54.3
ENDRIN KETONE	NC	NC	NC	18000	180000	12.5 U	12.5 U	4.1 U	12.5 U	22 U	12.5 U	12.5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	12.5 U	12.5 U	2.1 U	12.5 U	11 U	12.5 U	12.5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	860	12.5 U	2.1 U	14.6	11 U	12.5 U	12.5 U
HEPTACHLOR	200	1000	23000	110	380	12.5 U	12.5 U	2.1 U	12.5 U	11 U	12.5 U	12.5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	12.5 U	12.5 U	2.1 U	12.5 U	11 U	12.5 U	12.5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	12.5 U	12.5 U	21 U	12.5 U	110 U	12.5 U	12.5 U

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Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	57.1	14.1	840	21.4	440	35 U	3.6 U
4,4'-DDE	2900	15000	18000	1700	7000	520	36.8	840	40	1200	160	44
4,4'-DDT	2900	15000	11000	1700	7000	140	50.9	2300	67.2	1420	190	67
ALDRIN	60	300	200	29	100	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	18 U	1.9 U
ALPHA-BHC	100	600	0.3	90	360	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	18 U	1.9 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	12.5 U	12.5 U	1400	12.5 U	1380	190	47
BETA-BHC	500	2400	1	320	1300	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	18 U	1.9 U
DELTA-BHC	24000	490000	200	90	360	12.5 U	12.5 U	16.8	12.5 U	82.5	18 U	1.9 U
DIELDRIN	60	300	2	30	110	12.5 U	12.5 U	**93.4 [R,L]**	12.5 U	**116 [R,L]**	**27 J [L]**	**6 [L]**
ENDOSULFAN I	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	18 U	1.9 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	35 U	3.6 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	35 U	3.6 U
ENDRIN	25000	510000	1000	18000	180000	12.5 U	12.5 U	**1210 [L]**	30.7	**1020 [L]**	35 U	3.6 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	60.4	53.8	40.4	12.5 U	12.5 U	35 U	3.6 U
ENDRIN KETONE	NC	NC	NC	18000	180000	17.2	21.1	127.9	12.5 U	31.2	35 U	3.6 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	18 U	1.9 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	26.9	12.5 U	2400	37.4	2600	160	39
HEPTACHLOR	200	1000	23000	110	380	12.5 U	12.5 U	12.5 U	12.5 U	13.3	18 U	1.9 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	12.5 U	12.5 U	12.5 U	12.5 U	91.5	24	6.7
METHOXYCHLOR	420000	8800000	160000	310000	3100000	12.5 U	12.5 U	21	12.5 U	12.5 U	180 U	19 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB026 S-00 06/27/01	SB027 S-00 06/27/01	SB028 S-00 06/30/01	SB029 S-00 06/26/01	SB030 S-00 06/26/01	SB032 S-01 07/01/01	SB032 S-47 12/19/01
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	12.5 U	12.5 U	**5400 [R]**	30.2	12.5 U	1100	3.5 J
4,4'-DDE	2900	15000	18000	1700	7000	21.8	17.2	2300	104.6	24.8	340	4.3 U
4,4'-DDT	2900	15000	11000	1700	7000	12.5 U	15.7	2700	56.7	16.5	100.3	4.3 U
ALDRIN	60	300	200	29	100	12.5 U	12.5 U	12.5 U	13.9	12.5 U	12.5 U	2.2 U
ALPHA-BHC	100	600	0.3	90	360	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	2.2 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	12.5 U	12.5 U	360	12.5 U	12.5 U	60.7	2.2 U
BETA-BHC	500	2400	1	320	1300	12.5 U	**12.7 [L]**	12.5 U	12.5 U	12.5 U	12.5 U	2.2 U
DELTA-BHC	24000	490000	200	90	360	12.5 U	12.5 U	19	12.5 U	12.5 U	12.5 U	2.2 U
DIELDRIN	60	300	2	30	110	12.5 U	12.5 U	**122.3 [R,L]**	12.5 U	12.5 U	**14.6 [L]**	4.3 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	2.2 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	4.3 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	4.3 U
ENDRIN	25000	510000	1000	18000	180000	12.5 U	12.5 U	64.6	12.5 U	12.5 U	27.1	4.3 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	4.3 U
ENDRIN KETONE	NC	NC	NC	18000	180000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	4.3 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	2.2 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	12.5 U	12.5 U	280	12.5 U	12.5 U	60.3	2.2 U
HEPTACHLOR	200	1000	23000	110	380	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	2.2 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	2.2 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	12.5 U	22 U

Table 5-1
Summary of Detected Pesticide Concentrations in Soil Samples

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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB040 S-00 12/20/01	SB041 S-00 12/18/01	SB042 S-00 12/20/01	SB044 S-00 12/20/01	SB050 S-00 12/18/01	SB051 S-00 12/18/01	SB055 S-01 12/11/02
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	4.6	3.8 U	760 J	800 J	10000 U	510	3.6 U
4,4'-DDE	2900	15000	18000	1700	7000	46	39	**13000 [R]**	**9600 [R]**	**12000 [R]**	1500	2.7 J
4,4'-DDT	2900	15000	11000	1700	7000	46	34	**7500 [R]**	**3600 [R]**	**180000 [R,I,L]**	2300	4.1
ALDRIN	60	300	200	29	100	2.2 U	2 U	1000 U	900 U	5300 U	240 U	1.9 U
ALPHA-BHC	100	600	0.3	90	360	2.2 U	2 U	1000 U	900 U	5300 U	240 U	1.9 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	2.1 J	5.2	2700	760 J	**14000 [R,L]**	1300	1.9 U
BETA-BHC	500	2400	1	320	1300	2.2 U	2 U	1000 U	900 U	5300 U	240 U	1.9 U
DELTA-BHC	24000	490000	200	90	360	2.2 U	2 U	1000 U	900 U	5300 U	240 U	1.9 U
DIELDRIN	60	300	2	30	110	4.4 U	1.9 J	2000 U	1800 U	**3400 J [R,I,L]**	**380 J [R,I,L]**	3.6 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	2.2 U	2 U	1000 U	900 U	5300 U	240 U	1.9 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	4.4 U	3.8 U	2000 U	1800 U	10000 U	470 U	3.6 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	4.4 U	3.8 U	2000 U	1800 U	10000 U	470 U	3.6 U
ENDRIN	25000	510000	1000	18000	180000	4.4 U	3.8 U	2000 U	1800 U	10000 U	470 U	3.6 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	4.4 U	1.8 J	2000 U	1800 U	10000 U	470 U	3.6 U
ENDRIN KETONE	NC	NC	NC	18000	180000	4.4 U	3.8 U	2000 U	1800 U	10000 U	470 U	3.6 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	2.2 U	2 U	1000 U	900 U	5300 U	240 U	1.9 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	2.8	5.6	2300	850 J	**9700 [R,L]**	520	1.9 U
HEPTACHLOR	200	1000	23000	110	380	2.2 U	2 U	**430 J [R]**	900 U	5300 U	240 U	1.9 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	2.2 U	0.82 J	1000 U	900 U	5300 U	96 J	1.9 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	22 U	20 U	10000 U	9000 U	53000 U	2400 U	19 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB056 S-00 12/18/01	SB056 S-01 12/11/02	SB056 S-02 12/11/02	SB057 S-01 12/11/02	SB058A S-01 12/11/02	SB058A S-02 01/20/03
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	42	3.6 U	3.7 U	1.5 J	2400 J	4.6 U
4,4'-DDE	2900	15000	18000	1700	7000	59	3.6 U	3.7 U	1.6 J	2200 J	4.6 U
4,4'-DDT	2900	15000	11000	1700	7000	57	1.8 J	1 J	55	**53000 [R,I,L]**	4.6 U
ALDRIN	60	300	200	29	100	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
ALPHA-BHC	100	600	0.3	90	360	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
BETA-BHC	500	2400	1	320	1300	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
DELTA-BHC	24000	490000	200	90	360	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
DIELDRIN	60	300	2	30	110	4.8 U	3.6 U	3.7 U	4.2 U	4400 U	4.6 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	4.8 U	3.6 U	3.7 U	4.2 U	4400 U	4.6 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	4.8 U	3.6 U	3.7 U	4.2 U	4400 U	4.6 U
ENDRIN	25000	510000	1000	18000	180000	4.8 U	3.6 U	3.7 U	4.2 U	4400 U	4.6 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	4.8 U	3.6 U	3.7 U	4.2 U	4400 U	4.6 U
ENDRIN KETONE	NC	NC	NC	18000	180000	4.8 U	3.6 U	3.7 U	4.2 U	4400 U	4.6 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
HEPTACHLOR	200	1000	23000	110	380	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	2.5 U	1.8 U	1.9 U	2.1 U	2300 U	2.4 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	25 U	18 U	19 U	21 U	23000 U	24 U

Table 5-1
Summary of Detected Pesticide Concentrations in Soil Samples

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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB059 S-01 01/20/03	SB059 S-02 01/28/03	SB060 S-01 01/20/03	SB061 S-01 01/20/03	SB061 S-02 01/28/03	SB062 S-01 01/20/03	SB063 S-01 01/30/03
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	2.6 J	12	4.2 U	1.4 J	4.3 U	0.89 J	3.6 U
4,4'-DDE	2900	15000	18000	1700	7000	3.2 J	23	4.2 U	2.2 J	2.1 J	1.1 J	3.6 U
4,4'-DDT	2900	15000	11000	1700	7000	23	94	4.2 U	12	4.7	2.5 J	3.6 U
ALDRIN	60	300	200	29	100	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
ALPHA-BHC	100	600	0.3	90	360	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
BETA-BHC	500	2400	1	320	1300	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
DELTA-BHC	24000	490000	200	90	360	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
DIELDRIN	60	300	2	30	110	3.6 U	3.9 U	4.2 U	3.9 U	4.3 U	3.8 U	3.6 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	3.6 U	3.9 U	4.2 U	3.9 U	4.3 U	3.8 U	3.6 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	3.6 U	3.9 U	4.2 U	3.9 U	4.3 U	3.8 U	3.6 U
ENDRIN	25000	510000	1000	18000	180000	3.6 U	3.9 U	4.2 U	3.9 U	4.3 U	3.8 U	3.6 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	3.6 U	3.9 U	4.2 U	3.9 U	4.3 U	3.8 U	3.6 U
ENDRIN KETONE	NC	NC	NC	18000	180000	3.6 U	3.9 U	4.2 U	3.9 U	4.3 U	3.8 U	3.6 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
HEPTACHLOR	200	1000	23000	110	380	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	1.9 U	2 U	2.2 U	2 U	2.2 U	1.9 U	1.9 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	19 U	20 U	22 U	20 U	22 U	19 U	19 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB078 S-01 12/01/06	SB078 S-06 12/01/06	SB079 S-01 12/01/06	SB079 S-06 12/01/06	SB080 S-01 12/01/06	SB080 S-05 12/01/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	3.4 J	0.33 U	0.63 J	0.34 U	0.31 UJ	0.33 UJ
4,4'-DDE	2900	15000	18000	1700	7000	13	0.36 U	12 J	0.37 U	0.34 UJ	0.77 J
4,4'-DDT	2900	15000	11000	1700	7000	14 J	0.37 U	3.5 J	0.15 U	0.28 U	0.96 U
ALDRIN	60	300	200	29	100	0.21 U	0.22 U	0.21 UJ	0.22 U	0.21 UJ	0.22 UJ
ALPHA-BHC	100	600	0.3	90	360	0.24 J	0.15 U	0.14 UJ	0.15 U	0.14 UJ	0.15 UJ
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	0.38 J	0.29 U	19 J	0.64 J	0.45 J	7.7 J
BETA-BHC	500	2400	1	320	1300	0.34 U	0.36 U	0.35 UJ	0.37 U	0.34 UJ	0.36 UJ
DELTA-BHC	24000	490000	200	90	360	0.48 J	0.18 U	0.17 UJ	0.19 U	0.17 UJ	0.18 UJ
DIELDRIN	60	300	2	30	110	0.24 U	0.25 U	**2.3 J [L]**	0.26 U	0.24 UJ	0.25 UJ
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.27 U	0.29 U	0.28 UJ	0.30 U	0.27 UJ	0.40 J
ENDOSULFAN II	450000	7600000	3800	370000	3700000	0.24 U	0.25 U	0.24 UJ	0.26 U	0.24 UJ	0.25 UJ
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	0.45 J	0.29 U	0.28 UJ	0.30 U	0.27 UJ	0.29 UJ
ENDRIN	25000	510000	1000	18000	180000	0.38 U	0.40 U	0.38 UJ	0.41 U	0.38 UJ	0.40 UJ
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.17 UJ	0.18 UJ	0.17 UJ	0.76 J	0.17 UJ	0.18 UJ
ENDRIN KETONE	NC	NC	NC	18000	180000	0.31 U	0.33 U	0.31 UJ	0.34 UJ	0.31 UJ	0.33 UJ
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.17 U	0.18 U	0.17 UJ	0.19 U	0.17 UJ	0.18 UJ
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	0.76 J	0.26 J	17 J	0.34 J	0.38 J	10 J
HEPTACHLOR	200	1000	23000	110	380	0.24 U	0.25 U	0.24 UJ	0.26 U	0.24 UJ	0.29 J
HEPTACHLOR EPOXIDE	100	500	600	53	190	0.58 U	0.62 U	3.4 J	0.64 U	0.58 UJ	1.5 UJ
METHOXYCHLOR	420000	8800000	160000	310000	3100000	0.45 J	0.36 UJ	0.46 J	0.37 U	0.34 UJ	0.36 UJ

Table 5-1
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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB081 S-02 12/01/06	SB081 S-05 12/01/06	SB082 S-02 12/01/06	SB082 S-05 12/01/06	SB083 S-01 12/01/06	SB083 S-05 12/01/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	0.42 UJ	0.37 UJ	0.32 U	0.40 UJ	55 J	3.9 J
4,4'-DDE	2900	15000	18000	1700	7000	2.3 J	0.41 UJ	8.1	0.45 UJ	130	7.7
4,4'-DDT	2900	15000	11000	1700	7000	1.1 U	0.66 U	4.1 J	0.18 UJ	1200	25
ALDRIN	60	300	200	29	100	0.28 UJ	0.25 UJ	0.22 U	0.27 UJ	0.21 U	0.21 U
ALPHA-BHC	100	600	0.3	90	360	0.19 UJ	0.16 UJ	0.14 U	0.18 UJ	0.14 U	0.14 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	0.56 J	0.33 UJ	120	0.36 J	210	11
BETA-BHC	500	2400	1	320	1300	0.46 UJ	0.41 UJ	0.36 U	0.45 UJ	**1.4 J [L]**	0.71 J
DELTA-BHC	24000	490000	200	90	360	0.23 UJ	0.20 UJ	0.18 U	0.22 UJ	0.18 U	0.18 U
DIELDRIN	60	300	2	30	110	0.33 UJ	0.29 UJ	**28 [L]**	0.31 UJ	**11 J [L]**	0.81 J
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.37 UJ	0.33 UJ	0.29 U	0.36 UJ	7.2	0.32 J
ENDOSULFAN II	450000	7600000	3800	370000	3700000	0.33 UJ	0.29 UJ	0.25 U	0.31 UJ	0.25 U	0.25 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	0.37 UJ	0.33 UJ	0.33 J	0.36 UJ	0.50 J	0.28 U
ENDRIN	25000	510000	1000	18000	180000	0.51 UJ	0.45 UJ	0.40 U	0.49 UJ	0.39 U	0.39 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.23 UJ	0.20 UJ	0.18 U	0.22 UJ	0.18 UJ	0.57 J
ENDRIN KETONE	NC	NC	NC	18000	180000	0.42 UJ	0.37 UJ	0.32 UJ	0.40 UJ	0.32 U	0.71 UJ
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.23 UJ	0.20 UJ	0.18 U	0.22 UJ	0.18 U	0.18 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	0.70 J	0.29 UJ	140	0.32 J	300	14
HEPTACHLOR	200	1000	23000	110	380	0.33 UJ	0.29 UJ	0.25 U	0.31 UJ	0.96 J	0.25 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	0.79 UJ	0.70 UJ	3.3 J	0.76 UJ	15 J	0.60 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	0.46 UJ	0.41 UJ	0.36 U	0.45 UJ	0.35 U	1.1 J

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB084 S-01 11/29/06	SB084 S-05 11/29/06	SB085 S-01 11/29/06	SB085 S-05 11/29/06	SB086 S-01 11/29/06	SB086 S-06 11/29/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	6.4 J	0.33 U	5 J	0.34 UJ	2.4 J	0.31 UJ
4,4'-DDE	2900	15000	18000	1700	7000	240	0.88 J	55	0.37 UJ	44	0.98 J
4,4'-DDT	2900	15000	11000	1700	7000	150	1.2 J	73 J	0.38 J	27 J	0.77 U
ALDRIN	60	300	200	29	100	0.21 U	0.22 U	0.23 U	0.22 UJ	0.20 U	0.21 UJ
ALPHA-BHC	100	600	0.3	90	360	0.14 U	0.15 U	0.16 U	0.15 UJ	0.13 U	**3.2 J [L]**
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	**7900 J [R]**	28 J	16 J	0.30 UJ	0.27 U	0.70 J
BETA-BHC	500	2400	1	320	1300	1 J	0.36 U	0.39 U	0.37 UJ	**2.6 J [L]**	**250 [L]**
DELTA-BHC	24000	490000	200	90	360	0.17 U	0.18 U	0.20 U	0.19 UJ	0.34 J	**360 [L]**
DIELDRIN	60	300	2	30	110	**130 J [R,L]**	0.25 U	1.9 J	0.26 UJ	0.44 J	0.67 J
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.27 U	0.29 U	0.31 U	0.30 UJ	0.27 U	0.28 UJ
ENDOSULFAN II	450000	7600000	3800	370000	3700000	57 J	0.25 U	0.27 U	0.26 UJ	0.23 U	0.24 UJ
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	2.3 J	0.29 U	1.7 J	0.30 UJ	1.4 J	0.28 UJ
ENDRIN	25000	510000	1000	18000	180000	87 J	0.40 U	1.1 J	0.41 UJ	0.61 J	0.38 UJ
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.17 U	0.18 J	1.1 J	0.19 UJ	0.47 J	0.17 UJ
ENDRIN KETONE	NC	NC	NC	18000	180000	0.66 J	0.33 U	0.35 U	0.34 UJ	0.30 U	0.42 J
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	1.2 J	0.18 U	0.20 U	0.19 UJ	0.17 U	8 J
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	**4900 [R]**	19	3.4	0.26 UJ	0.71 J	9.2 J
HEPTACHLOR	200	1000	23000	110	380	52	0.40 J	0.27 U	0.26 UJ	0.23 U	0.24 UJ
HEPTACHLOR EPOXIDE	100	500	600	53	190	**850 [R,I,L]**	5.2	0.83 J	0.63 UJ	0.57 U	0.98 J
METHOXYCHLOR	420000	8800000	160000	310000	3100000	12 J	0.36 U	2.8	0.37 UJ	1.6 J	0.49 J

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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB087 S-01 12/01/06	SB087 S-05 12/01/06	SB088 S-03 12/01/06	SB088 S-06 12/01/06	SB089 S-02 11/30/06	SB089 S-05 11/30/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	0.42 UJ	5.1	0.33 U	0.33 UJ	260 J	0.31 UJ
4,4'-DDE	2900	15000	18000	1700	7000	510 J	44 J	5.1 J	1.2 J	97 J	1 J
4,4'-DDT	2900	15000	11000	1700	7000	**3800 J [R]**	400 J	2.1	6.1 J	**5500 J [R]**	0.84 U
ALDRIN	60	300	200	29	100	0.28 UJ	0.26 U	0.22 U	0.22 UJ	0.21 UJ	0.21 U
ALPHA-BHC	100	600	0.3	90	360	**0.33 J [L]**	0.17 U	0.15 U	0.14 UJ	**0.91 J [L]**	**2.8 [L]**
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	9.9 J	1.1 J	0.29 UJ	0.29 UJ	540 J	18 J
BETA-BHC	500	2400	1	320	1300	**1.5 J [L]**	0.43 U	0.37 U	0.36 UJ	**110 J [L]**	**160 J [L]**
DELTA-BHC	24000	490000	200	90	360	1.1 J	0.22 U	0.18 U	0.18 UJ	1.5 J	**230 J [L]**
DIELDRIN	60	300	2	30	110	**83 J [R,L]**	**6.3 J [L]**	0.26 UJ	0.25 UJ	**160 J [R,L]**	0.42 J
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.37 UJ	0.35 UJ	0.29 UJ	0.29 UJ	0.28 UJ	0.28 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	220 J	39 J	0.26 UJ	0.58 J	14 J	0.31 J
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	6 J	0.35 U	0.29 U	0.29 UJ	0.95 J	0.28 U
ENDRIN	25000	510000	1000	18000	180000	0.80 J	0.48 U	0.40 U	0.40 UJ	0.38 UJ	0.38 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.23 UJ	0.22 UJ	0.18 UJ	0.18 UJ	0.17 UJ	0.17 U
ENDRIN KETONE	NC	NC	NC	18000	180000	0.89 J	0.39 U	0.33 U	0.33 UJ	3 J	0.91 J
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.28 J	0.22 U	0.18 U	0.18 UJ	3 J	7.2 J
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	11 J	1.3 J	0.30 J	0.33 J	710 J	6.4
HEPTACHLOR	200	1000	23000	110	380	0.33 UJ	0.30 U	0.26 U	0.25 UJ	15 J	0.24 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	3.9 J	0.74 UJ	0.62 UJ	0.61 UJ	42 J	1.1 J
METHOXYCHLOR	420000	8800000	160000	310000	3100000	3 J	0.43 U	0.37 U	0.36 UJ	0.35 UJ	0.35 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB090 S-03 12/01/06	SB090 S-03 12/01/06	SB090 S-06 12/01/06	SB091 S-01 12/01/06	SB091 S-04 12/01/06	SB091 S-04 12/01/06	SB091 S-06 12/01/06
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	0.32 U	0.67 J	3.6	1.9	14 J	11	0.35 UJ
4,4'-DDE	2900	15000	18000	1700	7000	2.3	3.8	0.35 U	5.2	83 J	32	0.67 J
4,4'-DDT	2900	15000	11000	1700	7000	2 J	6.4 J	0.60 U	8	250 J	210 J	1.3 J
ALDRIN	60	300	200	29	100	0.21 U	0.21 U	0.21 U	0.22 U	0.26 UJ	0.21 U	0.24 UJ
ALPHA-BHC	100	600	0.3	90	360	0.14 U	0.14 U	0.14 U	0.15 U	**0.40 J [L]**	**0.87 J [L]**	0.16 UJ
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	0.28 U	1.4 J	0.53 J	0.59 J	4.5 J	5.3	0.31 UJ
BETA-BHC	500	2400	1	320	1300	0.35 U	0.35 U	0.85 J	0.37 J	**240 J [L]**	**420 J [L]**	**1.9 J [L]**
DELTA-BHC	24000	490000	200	90	360	0.18 U	0.18 U	0.18 U	0.18 U	**230 J [L]**	**430 J [L]**	1.3 J
DIELDRIN	60	300	2	30	110	0.25 U	0.42 J	0.43 J	0.29 J	**39 J [L]**	0.24 U	0.48 J
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.28 U	0.39 J	0.28 U	0.29 U	0.35 UJ	0.27 U	0.31 UJ
ENDOSULFAN II	450000	7600000	3800	370000	3700000	0.25 U	1.1 J	0.25 U	0.25 U	0.31 UJ	0.24 U	0.27 UJ
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	0.28 U	0.28 U	0.28 U	0.29 U	0.67 J	0.42 J	0.31 UJ
ENDRIN	25000	510000	1000	18000	180000	0.39 U	0.38 U	0.39 U	0.40 U	0.49 UJ	0.80 J	0.43 UJ
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.18 U	0.17 UJ	0.18 U	0.29 J	0.49 J	0.17 J	0.20 UJ
ENDRIN KETONE	NC	NC	NC	18000	180000	0.32 U	0.31 U	0.60 J	0.33 U	1.1 J	1.1 J	0.35 UJ
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.18 U	0.18 U	0.18 U	0.18 U	0.49 J	0.56 J	0.20 UJ
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	0.43 J	1.7 J	0.25 U	0.77 J	3.5 J	5.9	0.27 UJ
HEPTACHLOR	200	1000	23000	110	380	0.25 U	0.25 U	0.25 UJ	0.25 U	0.31 UJ	0.24 U	0.27 UJ
HEPTACHLOR EPOXIDE	100	500	600	53	190	0.60 U	0.59 U	0.60 U	0.62 U	2.3 J	1.8 J	0.67 UJ
METHOXYCHLOR	420000	8800000	160000	310000	3100000	0.35 U	0.35 UJ	0.35 UJ	0.36 U	0.44 UJ	5.6 UJ	0.39 UJ

Table 5-1
Summary of Detected Pesticide Concentrations in Soil Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB092 S-01 11/29/06	SB092 S-06 11/29/06	SB093 S-01 11/29/06	SB093 S-06 11/29/06	SB094 S-01 11/28/06	SB094 S-06 11/28/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	1.6 J	0.31 UJ	9.6 J	0.35 U	380 J	1900 J
4,4'-DDE	2900	15000	18000	1700	7000	70 J	1.6 J	550 J	0.39 U	540	55 J
4,4'-DDT	2900	15000	11000	1700	7000	22 J	1.3 U	360 J	1.4 U	2000	**4900 J [R]**
ALDRIN	60	300	200	29	100	0.20 UJ	0.21 UJ	0.20 UJ	0.23 U	0.20 U	0.24 J
ALPHA-BHC	100	600	0.3	90	360	0.13 UJ	0.14 UJ	0.13 UJ	0.16 U	**0.31 J [L]**	0.16 UJ
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	1.6 J	0.27 UJ	0.27 U	0.31 U	**50000 J [R,I,L]**	52 J
BETA-BHC	500	2400	1	320	1300	1 J	0.76 J	**1.1 J [L]**	0.39 U	**1.4 J [L]**	0.39 UJ
DELTA-BHC	24000	490000	200	90	360	0.17 UJ	0.17 UJ	0.17 UJ	0.19 U	0.17 U	0.20 UJ
DIELDRIN	60	300	2	30	110	1.3 J	0.24 UJ	1.1 J	0.27 U	**1100 J [R,I,L]**	0.28 UJ
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.40 UJ	0.27 UJ	0.27 U	0.31 U	400 J	0.32 UJ
ENDOSULFAN II	450000	7600000	3800	370000	3700000	1.3 J	0.24 UJ	0.24 U	0.27 U	4.7 U	0.28 UJ
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	0.57 UJ	0.27 UJ	11 J	0.31 U	110 J	0.32 UJ
ENDRIN	25000	510000	1000	18000	180000	0.37 UJ	0.38 UJ	0.37 U	0.43 U	**1400 [L]**	0.64 J
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.17 UJ	0.17 UJ	0.17 U	0.19 U	80 J	0.20 UJ
ENDRIN KETONE	NC	NC	NC	18000	180000	0.30 UJ	0.31 UJ	0.30 U	0.35 U	3.1 J	0.36 UJ
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.20 UJ	0.17 UJ	0.37 UJ	0.19 U	3.1 J	0.20 UJ
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	0.23 UJ	0.24 UJ	1.1 J	0.28 UJ	**37000 [R,I,L]**	52 J
HEPTACHLOR	200	1000	23000	110	380	0.23 UJ	0.24 UJ	0.24 UJ	0.27 U	150	0.60 J
HEPTACHLOR EPOXIDE	100	500	600	53	190	0.57 UJ	0.58 UJ	3.4 J	0.66 U	**920 J [R,I,L]**	12 J
METHOXYCHLOR	420000	8800000	160000	310000	3100000	2.6 J	0.34 UJ	1.5 J	0.39 U	56 J	0.39 UJ

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB095 S-01 11/28/06	SB095 S-06 11/28/06	SB096 S-01 11/30/06	SB096 S-05 11/30/06	SB097 S-01 11/28/06	SB097 S-06 11/28/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	110 J	0.35 U	**17000 J [R,L]**	0.90 J	5.9	0.37 U
4,4'-DDE	2900	15000	18000	1700	7000	860 J	0.39 U	**6100 J [R]**	1.9	130	0.54 J
4,4'-DDT	2900	15000	11000	1700	7000	**8000 J [R]**	0.44 J	**2700000 J [R,I,L]**	180	140	0.45 J
ALDRIN	60	300	200	29	100	0.21 UJ	0.24 U	0.20 UJ	0.20 U	0.21 U	0.25 U
ALPHA-BHC	100	600	0.3	90	360	**0.32 J [L]**	0.16 U	**3.7 J [L]**	0.14 U	0.14 U	0.16 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	550 U	0.32 U	**4200 J [R]**	1.1 J	0.28 U	0.33 U
BETA-BHC	500	2400	1	320	1300	**2.9 J [L]**	0.39 U	**24 J [L]**	0.34 U	0.49 J	0.41 U
DELTA-BHC	24000	490000	200	90	360	0.74 J	0.20 U	8.7 J	0.17 U	0.17 U	0.20 U
DIELDRIN	60	300	2	30	110	**800 J [R,I,L]**	0.28 U	**590 J [R,I,L]**	0.24 U	1.7 J	0.29 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.28 UJ	0.32 U	150 J	0.27 U	0.28 U	0.33 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	44 J	0.28 U	130 J	0.24 U	0.24 U	0.29 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	44 J	0.32 U	57 J	0.27 U	2.6 J	0.33 U
ENDRIN	25000	510000	1000	18000	180000	150 J	0.43 U	150 J	0.37 U	0.38 U	0.45 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	14 J	0.20 U	130 J	0.17 U	0.98 J	0.20 U
ENDRIN KETONE	NC	NC	NC	18000	180000	4 J	0.52 J	39 J	0.31 U	0.31 U	0.37 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	2.8 J	0.20 U	4.5 J	0.17 U	0.17 U	0.20 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	490 U	0.28 U	**5900 J [R]**	1.8	6.2 J	0.29 U
HEPTACHLOR	200	1000	23000	110	380	1.1 J	0.28 U	**3400 J [R,I]**	0.45 J	0.24 U	0.29 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	**140 J [R]**	0.67 U	**740 J [R,I,L]**	0.58 U	1.7 J	0.70 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	140 J	0.91 J	210 J	0.34 U	1.6 J	0.41 UJ

Table 5-1
Summary of Detected Pesticide Concentrations in Soil Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB098 S-01 11/30/06	SB098 S-05 11/30/06	SB099 S-01 11/30/06	SB099 S-05 11/30/06	SB100 S-01 11/30/06	SB100 S-05 11/30/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	2.4	0.77 J	280 J	1.4 J	460 J	1000
4,4'-DDE	2900	15000	18000	1700	7000	28	0.35 U	2200 J	3.6	530	8.4 J
4,4'-DDT	2900	15000	11000	1700	7000	64	2	**5100 J [R]**	8.5 J	1300 J	14 J
ALDRIN	60	300	200	29	100	0.22 U	0.21 U	0.21 UJ	0.23 U	0.31 J	0.21 U
ALPHA-BHC	100	600	0.3	90	360	0.14 U	0.14 U	0.18 J	0.15 U	**2 J [L]**	**22 [L]**
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	2.7	0.28 U	610 J	0.86 J	0.49 J	0.49 J
BETA-BHC	500	2400	1	320	1300	0.36 UJ	0.35 UJ	**2.9 J [L]**	0.39 U	**3.5 J [L]**	**2.1 [L]**
DELTA-BHC	24000	490000	200	90	360	0.18 UJ	0.17 UJ	0.85 J	0.19 U	3.7 J	13
DIELDRIN	60	300	2	30	110	1 J	0.24 U	**320 J [R,I,L]**	0.35 J	**53 J [L]**	0.60 J
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.29 U	0.28 U	0.28 UJ	0.31 U	0.28 UJ	0.28 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	0.25 U	0.24 U	0.25 UJ	0.27 U	0.24 UJ	0.24 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	0.29 U	0.28 U	28 J	0.31 U	2.2 J	0.28 UJ
ENDRIN	25000	510000	1000	18000	180000	0.40 U	0.38 U	0.39 UJ	0.42 U	9.9 J	0.38 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.18 U	0.17 U	0.18 UJ	0.19 U	0.17 UJ	0.25 J
ENDRIN KETONE	NC	NC	NC	18000	180000	0.32 U	0.31 U	0.32 UJ	0.35 UJ	0.31 UJ	0.31 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.18 U	0.17 U	0.53 J	0.19 U	1.1 J	0.32 J
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	2.9 J	0.24 U	540 J	0.82 J	120 J	1.1 J
HEPTACHLOR	200	1000	23000	110	380	0.25 U	0.24 U	0.85 J	0.27 U	0.24 UJ	0.24 UJ
HEPTACHLOR EPOXIDE	100	500	600	53	190	1.7 J	0.59 U	**130 J [R]**	0.66 U	24 J	1.2 J
METHOXYCHLOR	420000	8800000	160000	310000	3100000	0.36 U	0.35 U	30 J	0.39 U	38 J	0.35 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB101 S-01 11/29/06	SB101 S-05 11/29/06	SB102 S-01 11/29/06	SB102 S-05 11/29/06	SB103 S-01 11/29/06	SB103 S-05 11/29/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	1.1 J	2.2 J	3.2	0.31 U	0.33 UJ	0.40 U
4,4'-DDE	2900	15000	18000	1700	7000	18	0.40 UJ	66	0.34 U	0.36 UJ	1.8 J
4,4'-DDT	2900	15000	11000	1700	7000	13	73 J	180	2.9	0.48 U	2.7
ALDRIN	60	300	200	29	100	0.28 U	0.24 UJ	0.20 U	0.20 U	0.22 UJ	0.27 U
ALPHA-BHC	100	600	0.3	90	360	0.18 U	0.16 UJ	0.14 U	0.14 U	0.15 UJ	0.18 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	1.7 J	0.32 J	0.27 U	0.27 U	0.29 UJ	0.85 J
BETA-BHC	500	2400	1	320	1300	0.46 U	0.40 UJ	0.34 U	0.34 U	0.36 UJ	0.45 U
DELTA-BHC	24000	490000	200	90	360	0.23 U	0.20 UJ	0.17 U	0.17 U	0.18 UJ	0.22 U
DIELDRIN	60	300	2	30	110	0.32 U	0.28 UJ	0.24 U	0.24 U	0.25 UJ	0.31 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.37 U	0.32 UJ	0.27 U	0.27 U	0.29 UJ	0.36 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	0.32 U	0.28 UJ	0.24 U	0.24 U	0.25 UJ	0.31 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	0.37 U	0.32 UJ	0.27 U	0.27 U	0.29 UJ	0.36 U
ENDRIN	25000	510000	1000	18000	180000	0.51 U	0.43 UJ	0.37 U	0.37 U	0.40 UJ	0.49 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.23 U	0.20 UJ	0.17 U	0.17 U	0.18 UJ	0.22 U
ENDRIN KETONE	NC	NC	NC	18000	180000	0.41 U	0.36 UJ	0.30 U	0.31 U	0.33 UJ	0.40 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.23 U	0.20 UJ	0.17 U	0.17 U	0.18 UJ	0.22 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	0.42 J	0.36 J	0.34 J	0.24 U	0.33 UJ	0.85 J
HEPTACHLOR	200	1000	23000	110	380	0.32 U	0.28 UJ	0.24 U	0.24 U	0.25 UJ	0.31 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	0.78 U	0.67 UJ	0.58 U	0.58 U	0.62 UJ	0.76 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	0.46 U	0.40 UJ	0.34 U	0.34 U	0.36 UJ	0.45 U

Table 5-1
Summary of Detected Pesticide Concentrations in Soil Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB104 S-01 11/29/06	SB104 S-05 11/29/06	SB105 S-01 11/30/06	SB105 S-05 11/30/06	SB106 S-01 11/30/06	SB106 S-05 11/30/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	2.5	0.33 U	300 J	0.68 J	820 J	0.31 U
4,4'-DDE	2900	15000	18000	1700	7000	13	0.37 U	1400	2.9	1600 J	0.35 U
4,4'-DDT	2900	15000	11000	1700	7000	84 J	0.22 U	**4400 J [R]**	3.9 J	**27000 J [R,I,L]**	6.2 J
ALDRIN	60	300	200	29	100	0.22 U	0.22 U	0.21 U	0.22 U	1.7 J	0.21 U
ALPHA-BHC	100	600	0.3	90	360	0.15 U	0.15 U	**0.56 J [L]**	0.15 U	**3 J [L]**	0.14 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	0.33 J	0.30 U	520 J	1.4 J	1700	0.28 U
BETA-BHC	500	2400	1	320	1300	0.37 U	0.37 U	**11 J [L]**	0.37 U	**27 J [L]**	0.35 U
DELTA-BHC	24000	490000	200	90	360	0.18 U	0.19 U	0.94 J	0.19 U	1.5 J	0.17 U
DIELDRIN	60	300	2	30	110	0.26 U	0.26 U	**400 [R,I,L]**	0.26 J	**3400 [R,I,L]**	0.49 J
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.29 U	0.30 U	0.28 U	0.30 U	0.27 U	0.28 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	0.26 U	0.26 U	0.24 U	0.26 U	0.24 U	0.24 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	0.29 U	0.30 U	27 J	0.30 UJ	7.7 J	0.28 U
ENDRIN	25000	510000	1000	18000	180000	0.40 U	0.41 U	23 J	0.41 U	200	0.38 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.18 U	0.19 U	0.17 UJ	0.19 UJ	0.17 UJ	0.17 U
ENDRIN KETONE	NC	NC	NC	18000	180000	0.33 U	0.33 U	8.2 J	0.34 U	1.3 J	0.31 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.18 U	0.19 U	0.80 J	0.19 U	2.4	0.17 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	0.45 J	0.30 UJ	400	1.3 J	1300	0.28 J
HEPTACHLOR	200	1000	23000	110	380	0.26 U	0.26 U	12 J	0.26 UJ	2.9 J	0.24 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	0.62 U	0.63 U	98 J	0.64 U	**170 [R]**	0.59 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	0.37 U	0.37 U	36 J	0.37 U	89 J	0.35 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB107 S-01 11/30/06	SB107 S-05 11/30/06	SB108 S-01 11/29/06	SB108 S-06 11/29/06	SB109 S-01 11/29/06	SB109 S-06 11/29/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	60 J	0.31 U	280	120	110 J	3.9 J
4,4'-DDE	2900	15000	18000	1700	7000	670	1.4 J	290	26	440	11
4,4'-DDT	2900	15000	11000	1700	7000	1400 J	2.9 J	650	37	**4200 [R]**	28
ALDRIN	60	300	200	29	100	0.20 U	0.21 U	0.20 U	0.21 U	0.21 U	0.22 U
ALPHA-BHC	100	600	0.3	90	360	**0.41 J [L]**	0.14 U	0.14 U	0.14 U	0.14 U	0.15 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	750 J	1.3 J	56	94	98	12
BETA-BHC	500	2400	1	320	1300	**2.6 [L]**	0.35 U	0.69 J	0.35 U	0.80 J	0.37 U
DELTA-BHC	24000	490000	200	90	360	0.41 J	0.17 U	0.17 U	0.18 U	0.17 U	0.18 U
DIELDRIN	60	300	2	30	110	**820 [R,I,L]**	1.5 J	**29 [L]**	**40 [L]**	**40 [L]**	**3 [L]**
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.27 U	0.28 U	0.27 U	0.28 U	0.27 U	0.29 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	3.3 J	0.24 U	0.24 U	0.97 J	0.24 U	0.26 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	3.6 J	0.28 U	3 J	0.28 U	3.4 J	0.29 U
ENDRIN	25000	510000	1000	18000	180000	52	0.38 U	1.1 J	12 J	1.8 J	0.40 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.17 UJ	0.17 U	3.7 J	0.18 U	0.17 U	0.18 U
ENDRIN KETONE	NC	NC	NC	18000	180000	1.4 J	0.31 U	0.31 U	0.32 U	0.35 J	0.33 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	1.3 J	0.17 U	0.17 U	0.18 U	0.17 U	0.18 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	500	1.2 J	74	100	82	11
HEPTACHLOR	200	1000	23000	110	380	2.1	0.24 U	0.24 U	0.25 U	0.24 J	0.26 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	82 J	0.59 U	18 J	0.60 U	19 J	0.85 UJ
METHOXYCHLOR	420000	8800000	160000	310000	3100000	25 J	0.35 U	0.69 J	0.35 U	0.55 J	0.37 U

Table 5-1
Summary of Detected Pesticide Concentrations in Soil Samples

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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB110 S-01 11/30/06	SB110 S-05 11/30/06	SB111 S-01 11/29/06	SB111 S-05 11/29/06	SB112 S-01 11/29/06	SB112 S-05 11/29/06
Pesticides/PCBs (ug/kg)											
4,4'-DDD	4200	22000	5800	2400	1000	65 J	**55000 J [R,I,L]**	3.6	0.41 U	1.3 J	0.40 UJ
4,4'-DDE	2900	15000	18000	1700	7000	1300 J	2300 J	98	0.45 U	26 J	2.1 J
4,4'-DDT	2900	15000	11000	1700	7000	1400 J	**59000 J [R,I,L]**	34	0.50 U	9.3 J	2.2 U
ALDRIN	60	300	200	29	100	0.20 UJ	0.22 UJ	0.21 U	0.27 U	0.27 UJ	0.27 UJ
ALPHA-BHC	100	600	0.3	90	360	0.27 J	0.15 UJ	0.14 U	0.18 U	0.18 UJ	0.18 UJ
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	230 J	560 J	1 J	0.36 U	0.36 UJ	0.49 J
BETA-BHC	500	2400	1	320	1300	**1.7 J [L]**	**3 J [L]**	0.34 U	0.45 U	0.44 UJ	0.44 UJ
DELTA-BHC	24000	490000	200	90	360	0.58 J	2.3 J	0.17 U	0.23 U	0.22 UJ	0.22 UJ
DIELDRIN	60	300	2	30	110	**160 J [R,L]**	0.26 UJ	1.6 J	0.32 U	0.31 UJ	0.31 UJ
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.27 UJ	0.29 UJ	0.27 U	0.36 U	0.36 UJ	0.36 UJ
ENDOSULFAN II	450000	7600000	3800	370000	3700000	0.24 UJ	10 J	0.24 U	0.32 U	0.31 UJ	0.31 UJ
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	10 J	7.2 J	0.90 UJ	0.36 U	0.36 UJ	0.36 UJ
ENDRIN	25000	510000	1000	18000	180000	46 J	49 J	0.38 U	0.50 U	0.49 UJ	0.49 UJ
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	13 J	0.18 UJ	0.24 J	0.23 U	0.22 UJ	0.22 UJ
ENDRIN KETONE	NC	NC	NC	18000	180000	9.7 J	0.33 UJ	0.31 J	0.41 U	0.40 UJ	0.40 UJ
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.96 J	0.18 UJ	0.17 U	0.23 U	0.22 UJ	0.22 UJ
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	220 J	1000 J	3.1	0.32 U	0.54 J	0.58 J
HEPTACHLOR	200	1000	23000	110	380	0.41 J	190 J	0.24 J	0.32 U	0.31 UJ	0.31 UJ
HEPTACHLOR EPOXIDE	100	500	600	53	190	34 J	**280 J [R]**	3.6	0.77 U	0.76 UJ	0.76 UJ
METHOXYCHLOR	420000	8800000	160000	310000	3100000	12 J	0.37 UJ	1.2 J	0.45 UJ	0.44 UJ	0.44 UJ

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	SB113 S-01 11/29/06	SB113 S-06 11/29/06	SB118 S-01 03/13/07	SB118 S-03 03/13/07	SB120 S-01 03/09/07
Pesticides/PCBs (ug/kg)										
4,4'-DDD	4200	22000	5800	2400	1000	0.42 U	6.1	0.33 U	0.34 U	0.40 U
4,4'-DDE	2900	15000	18000	1700	7000	65	3.6	0.37 J	0.38 U	0.45 U
4,4'-DDT	2900	15000	11000	1700	7000	99	3.4	0.33 J	0.15 U	0.18 U
ALDRIN	60	300	200	29	100	0.28 U	0.26 U	0.22 U	0.23 U	0.27 U
ALPHA-BHC	100	600	0.3	90	360	0.19 U	0.17 U	0.14 U	0.15 U	0.18 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	0.38 UJ	7.9 J	0.29 U	0.31 U	0.36 U
BETA-BHC	500	2400	1	320	1300	0.47 U	0.44 J	0.36 U	0.38 U	0.45 U
DELTA-BHC	24000	490000	200	90	360	0.23 U	0.22 J	2.2 U	0.19 U	0.22 U
DIELDRIN	60	300	2	30	110	1.3 J	**2.5 [L]**	1.9 J	0.27 U	0.31 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	0.38 U	0.35 U	0.29 U	0.31 U	0.36 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	0.33 U	0.31 U	0.25 U	0.27 U	0.31 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	0.90 J	0.35 U	0.29 U	0.31 U	0.36 U
ENDRIN	25000	510000	1000	18000	180000	0.95 J	0.48 U	0.40 U	0.42 U	0.49 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	0.23 UJ	0.22 UJ	0.18 U	0.19 U	0.22 U
ENDRIN KETONE	NC	NC	NC	18000	180000	0.42 U	0.39 U	0.33 U	0.34 U	0.40 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	0.23 U	0.22 U	0.18 U	0.19 U	0.22 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	0.52 J	2.1 J	0.25 U	0.27 U	0.31 U
HEPTACHLOR	200	1000	23000	110	380	0.33 UJ	0.31 UJ	0.25 U	0.27 U	0.31 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	0.80 U	0.74 U	0.62 U	0.65 U	0.76 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	0.47 U	0.44 U	0.36 U	0.38 U	0.45 U

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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	JX01215 S-02 02/23/99	JX01216 S-02 02/23/99	JX01217 S-02 02/23/99	JX01218 S-02 02/23/99	JX01219 S-01 02/23/99	JX01220 S-02 02/23/99	JX01221 S-02 02/23/99
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4,4'-DDE	2900	15000	18000	1700	7000	**4200 [R]**	**28000 [R,I,L]**	320	210	**8000 [R]**	74	21
4,4'-DDT	2900	15000	11000	1700	7000	5 U	**44000 [R,I,L]**	620	2000	**56000 [R,I,L]**	170	73
ALDRIN	60	300	200	29	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-BHC	100	600	0.3	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	55
BETA-BHC	500	2400	1	320	1300	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DELTA-BHC	24000	490000	200	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIELDRIN	60	300	2	30	110	**730 [R,I,L]**	5 U	**120 [R,L]**	**57 [L]**	5 U	**14 [L]**	**6 [L]**
ENDOSULFAN I	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN	25000	510000	1000	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	43
HEPTACHLOR	200	1000	23000	110	380	**570 [R]**	5 U	**780 [R]**	5 U	190	5 U	5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	5 U	5 U	5 U	5 U	5 U	5 U	5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	JX01222 S-02 02/23/99	JX01223 S-02 02/23/99	JX01228 S-02 02/24/99	JX01229 S-01 02/24/99	JX01230 S-02 02/24/99	JX01231 S-02 02/24/99	JX01232 S-01 02/24/99
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4,4'-DDE	2900	15000	18000	1700	7000	39	38	**7200 [R]**	150	2.5	57	180
4,4'-DDT	2900	15000	11000	1700	7000	140	58	**13000 [R,L]**	350	20	470	920
ALDRIN	60	300	200	29	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-BHC	100	600	0.3	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BETA-BHC	500	2400	1	320	1300	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DELTA-BHC	24000	490000	200	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIELDRIN	60	300	2	30	110	**29 [L]**	**2.6 [L]**	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN	25000	510000	1000	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR	200	1000	23000	110	380	3.7	5 U	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	5 U	5 U	5 U	5 U	5 U	5 U	5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	5 U	5 U	5 U	5 U	5 U	5 U	5 U

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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	JX01233 S-04 02/24/99	JX01234 S-01 02/24/99	JX01246 S-04 02/25/99	JX01247 S-04 02/25/99	JX01248 S-03 02/25/99	JX01249 S-03 02/25/99	JX01250 S-04 02/25/99
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
4,4'-DDE	2900	15000	18000	1700	7000	6.8	18	82	**4000 [R]**	1200	5.6	3.1
4,4'-DDT	2900	15000	11000	1700	7000	16	5 U	98	**130000 [R,I,L]**	**7800 [R]**	370	96
ALDRIN	60	300	200	29	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-BHC	100	600	0.3	90	360	5 U	5 U	5 U	**2500 [R,I,L]**	5 U	**14 [L]**	**5.7 [L]**
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BETA-BHC	500	2400	1	320	1300	5 U	5 U	5 U	**4200 [R,I,L]**	**560 [R,L]**	**19 [L]**	**13 [L]**
DELTA-BHC	24000	490000	200	90	360	5 U	5 U	5 U	**30000 [R,L]**	**6100 [L]**	53	31
DIELDRIN	60	300	2	30	110	5 U	5 U	**5.8 [L]**	5 U	5 U	5 U	**1300 [R,I,L]**
ENDOSULFAN I	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN	25000	510000	1000	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	4.1
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	5 U	5 U	5 U	**4000 [R,I,L]**	**220 [L]**	**49 [L]**	8.8
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR	200	1000	23000	110	380	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	5 U	5 U	8.2	5 U	5 U	5 U	5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	JX01251 S-04 02/25/99	JX01252 S-04 02/26/99	JX01253 S-04 02/26/99	JX01254 S-01 02/26/99	JX01255 S-03 03/01/99	JX01256 S-03 03/01/99	JX01257 S-01 03/01/99
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	5 U	1400	5	5 U	2.2	340	5 U
4,4'-DDE	2900	15000	18000	1700	7000	4.5	680	5 U	3	18	280	2
4,4'-DDT	2900	15000	11000	1700	7000	85	**3600 [R]**	5	5 U	4.2	1100	5 U
ALDRIN	60	300	200	29	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-BHC	100	600	0.3	90	360	**5 [L]**	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BETA-BHC	500	2400	1	320	1300	**7 [L]**	**41 [L]**	5 U	5 U	5 U	**7.4 [L]**	5 U
DELTA-BHC	24000	490000	200	90	360	20	140	5 U	5 U	5 U	5 U	5 U
DIELDRIN	60	300	2	30	110	**2.4 [L]**	**640 [R,I,L]**	5 U	5 U	2	**31 [L]**	5 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN	25000	510000	1000	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	3.4	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR	200	1000	23000	110	380	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	5 U	5 U	5 U	5 U	2	5 U	5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	5 U	5 U	5 U	5 U	5 U	5 U	5 U

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Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	JX01258 S-01 03/01/99	JX01259 S-01 03/01/99	JX01260 S-01 03/01/99	JX01261 S-04 03/01/99	JX01262 S-03 03/01/99	JX01263 S-01 03/01/99	JX01264 S-01 03/01/99
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	17	3.1	13	**5000 [R]**	**20000 [R,L]**	11	10
4,4'-DDE	2900	15000	18000	1700	7000	64	5.6	10	510	**4300 [R]**	38	25
4,4'-DDT	2900	15000	11000	1700	7000	5 U	6.6	6.5	320	**39000 [R,I,L]**	20	22
ALDRIN	60	300	200	29	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-BHC	100	600	0.3	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BETA-BHC	500	2400	1	320	1300	5 U	5 U	5 U	5 U	5 U	5 U	**46 [L]**
DELTA-BHC	24000	490000	200	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIELDRIN	60	300	2	30	110	5 U	5 U	5 U	**140 [R,L]**	**700 [R,I,L]**	**14 [L]**	**23 [L]**
ENDOSULFAN I	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN	25000	510000	1000	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	38	5 U	5 U	**3900 [R]**	5 U	5 U	5 U
HEPTACHLOR	200	1000	23000	110	380	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	5 U	5 U	5 U	5 U	5 U	5 U	5.6
METHOXYCHLOR	420000	8800000	160000	310000	3100000	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	JX01265 S-03 03/01/99	JX01266 S-03 03/01/99	JX01274 S-02 03/02/99	JX01275 S-02 03/02/99	JX01276 S-02 03/02/99	JX01277 S-02 03/02/99	JX01278 S-01 03/02/99
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	1800	**91000 [R,I,L]**	140	5 U	5 U	**12000 [R,L]**	90
4,4'-DDE	2900	15000	18000	1700	7000	2000	**25000 [R,I,L]**	62	280	9.9	**5400 [R]**	120
4,4'-DDT	2900	15000	11000	1700	7000	**26000 [R,I,L]**	**420000 [R,I,L]**	290	140	5.6	**74000 [R,I,L]**	530
ALDRIN	60	300	200	29	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-BHC	100	600	0.3	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BETA-BHC	500	2400	1	320	1300	5 U	5 U	5 U	5 U	5 U	5 U	**72 [L]**
DELTA-BHC	24000	490000	200	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIELDRIN	60	300	2	30	110	5 U	5 U	5 U	**59 [L]**	**23 [L]**	**560 [R,I,L]**	**21 [L]**
ENDOSULFAN I	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN	25000	510000	1000	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	430	360	5 U	5 U	5 U
HEPTACHLOR	200	1000	23000	110	380	5 U	5 U	170	5 U	5 U	**210 [R]**	5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	5 U	5 U	5 U	5 U	5 U	5 U	5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Table 5-1
Summary of Detected Pesticide Concentrations in Soil Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	JX01279 S-01 03/02/99	JX01283 S-02 03/03/99	JX01284 S-02 03/03/99	JX01285 S-02 03/03/99	JX01286 S-01 03/03/99	JX01290 S-03 03/04/99	JX01291 S-01 03/04/99
Pesticides/PCBs (ug/kg)												
4,4'-DDD	4200	22000	5800	2400	1000	60	49	4200	**10000 [R,L]**	120	5 U	81
4,4'-DDE	2900	15000	18000	1700	7000	46	210	1900	2500	360	5 U	20
4,4'-DDT	2900	15000	11000	1700	7000	160	940	**17000 [R,I,L]**	**22000 [R,I,L]**	1600	5 U	340
ALDRIN	60	300	200	29	100	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-BHC	100	600	0.3	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BETA-BHC	500	2400	1	320	1300	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DELTA-BHC	24000	490000	200	90	360	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIELDRIN	60	300	2	30	110	5 U	**320 [R,I,L]**	**180 [R,L]**	5 U	5 U	5 U	5 U
ENDOSULFAN I	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN	25000	510000	1000	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U	5 U	5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	5 U	5 U	5 U	**210 [L]**	5 U	5 U	5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR	200	1000	23000	110	380	5 U	110	**260 [R]**	5 U	5 U	5 U	5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	5 U	55	5 U	5 U	5 U	5 U	5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Boring JAX47- Sample ID SAMPLE DATE	FDEP SCTL RESIDENTIAL	FDEP SCTL INDUSTRIAL	FDEP SCTL LEACHABILITY	REGION 9 PRGs RESIDENTIAL	REGION 9 PRGs INDUSTRIAL	JX01292 S-04 03/08/99	JX01293 S-03 03/08/99	JX01294 S-01 03/08/99	JX01295 S-01 03/08/99	JX01296 S-03 03/08/99
Pesticides/PCBs (ug/kg)										
4,4'-DDD	4200	22000	5800	2400	1000	**170000 [R,I,L]**	**4300 [R]**	3.1	22	**220000 [R,I,L]**
4,4'-DDE	2900	15000	18000	1700	7000	**5100 [R]**	2400	5 U	5 U	**7500 [R]**
4,4'-DDT	2900	15000	11000	1700	7000	2600	**30000 [R,I,L]**	5 U	5 U	**6500 [R]**
ALDRIN	60	300	200	29	100	5 U	5 U	5 U	5 U	5 U
ALPHA-BHC	100	600	0.3	90	360	5 U	5 U	5 U	5 U	5 U
ALPHA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	**37000 [R,I,L]**
BETA-BHC	500	2400	1	320	1300	5 U	5 U	5 U	5 U	5 U
DELTA-BHC	24000	490000	200	90	360	**3100 [L]**	5 U	5 U	5 U	**7800 [L]**
DIELDRIN	60	300	2	30	110	**6200 [R,I,L]**	5 U	5 U	**6.5 [L]**	**9000 [R,I,L]**
ENDOSULFAN I	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN II	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U
ENDOSULFAN SULFATE	450000	7600000	3800	370000	3700000	5 U	5 U	5 U	5 U	5 U
ENDRIN	25000	510000	1000	18000	180000	5 U	5 U	5 U	5 U	5 U
ENDRIN ALDEHYDE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U
ENDRIN KETONE	NC	NC	NC	18000	180000	5 U	5 U	5 U	5 U	5 U
GAMMA-BHC (LINDANE)	700	2500	9	440	1700	5 U	5 U	5 U	5 U	5 U
GAMMA-CHLORDANE	2800	14000	9600	1600	6500	5 U	5 U	5 U	5 U	**47000 [R,I,L]**
HEPTACHLOR	200	1000	23000	110	380	5 U	5 U	5 U	5 U	5 U
HEPTACHLOR EPOXIDE	100	500	600	53	190	5 U	5 U	5 U	5 U	5 U
METHOXYCHLOR	420000	8800000	160000	310000	3100000	5 U	5 U	5 U	5 U	5 U

Notes:
Concentrations in bold exceed Florida SCTL
SCTL = Soil Cleanup Target Levels (Chapter 62-777 F.A.C.)

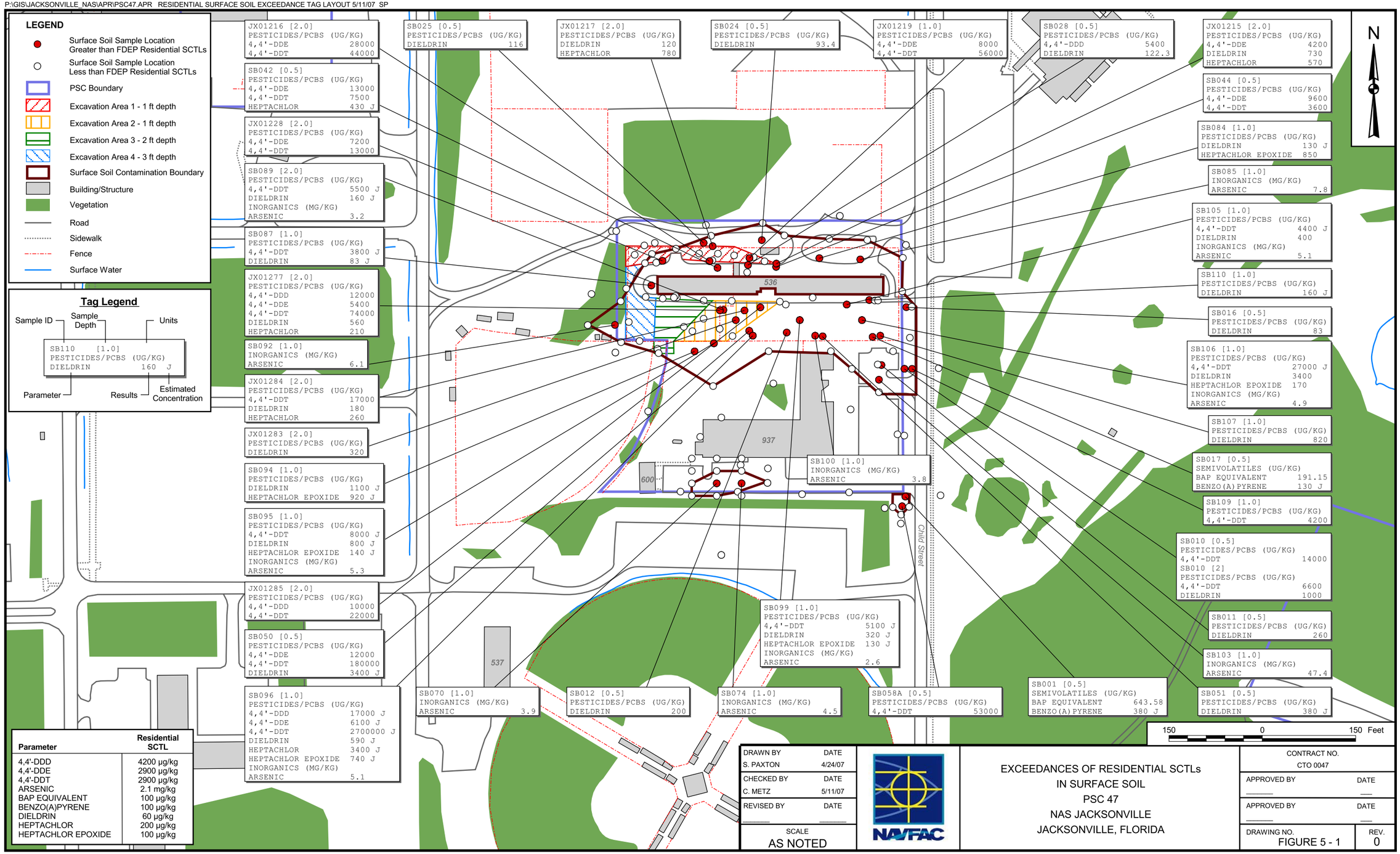
R - Residential
I - Industrial
L - Leachability

µg/kg - milligrams per kilogram
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene

DDT - dichlorodiphenyltrichloroethane
BHC - benzene hexachloride
PCB - polychlorinated biphenyl

U - less than laboratory method detection limit
J - estimated

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR RESIDENTIAL SURFACE SOIL EXCEEDANCE TAG LAYOUT 5/11/07 SP



Parameter	Residential SCTL
4,4'-DDD	4200 µg/kg
4,4'-DDE	2900 µg/kg
4,4'-DDT	2900 µg/kg
ARSENIC	2.1 mg/kg
BAP EQUIVALENT	100 µg/kg
BENZO(A)PYRENE	100 µg/kg
DIELDRIN	60 µg/kg
HEPTACHLOR	200 µg/kg
HEPTACHLOR EPOXIDE	100 µg/kg

DRAWN BY	DATE
S. PAXTON	4/24/07
CHECKED BY	DATE
C. METZ	5/11/07
REVISED BY	DATE
SCALE	
AS NOTED	

NAVFAC

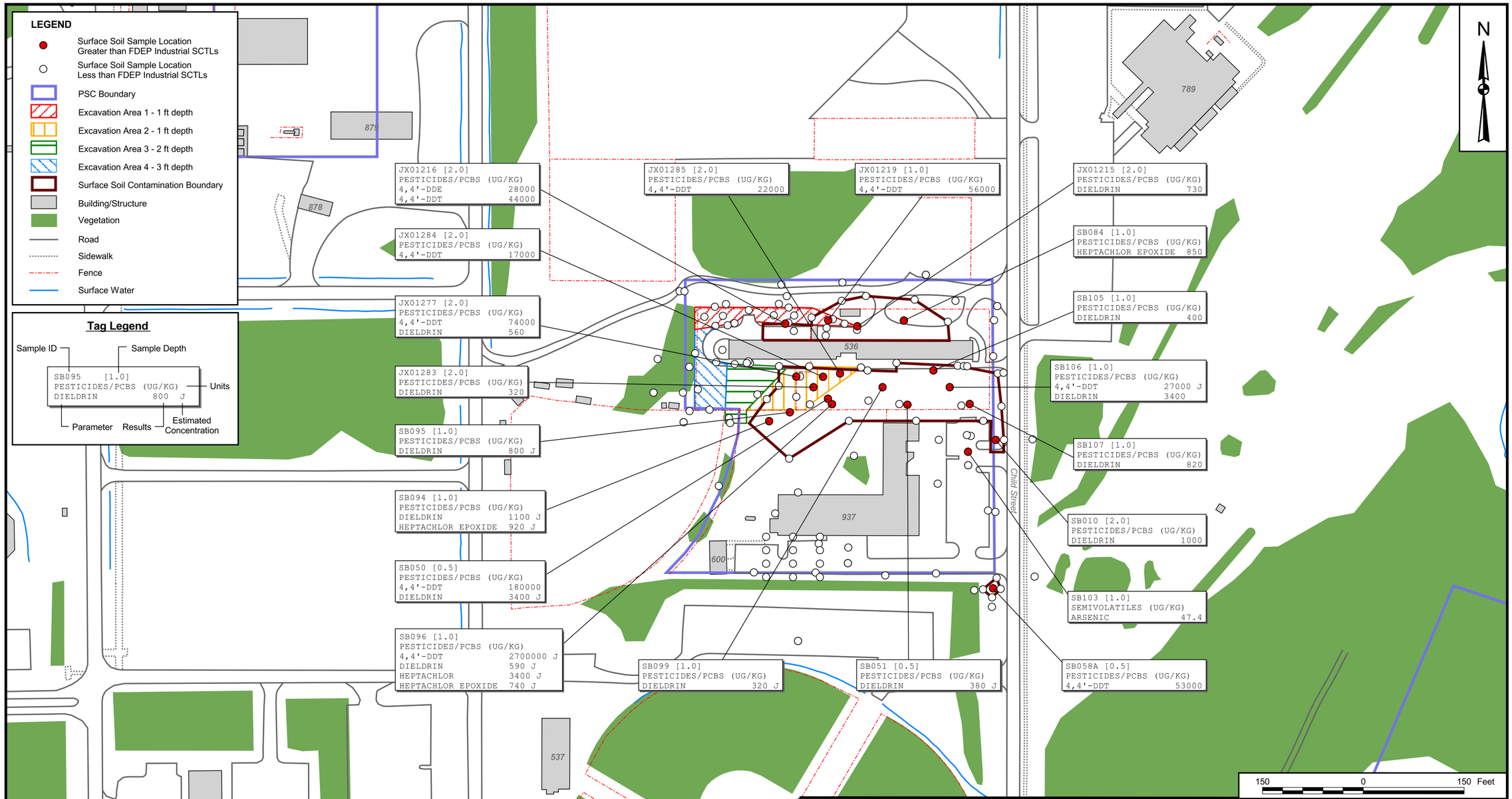
EXCEEDANCES OF RESIDENTIAL SCTLs
IN SURFACE SOIL
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO.
CTO 0047

APPROVED BY	DATE
APPROVED BY	DATE

DRAWING NO.	REV.
FIGURE 5 - 1	0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR INDUSTRIAL SURFACE SOIL EXCEEDANCE TAG LAYOUT 5/11/07 SP



Parameter	Industrial SCTL
4,4'-DDE	15000 µg/kg
4,4'-DDT	15000 µg/kg
ARSENIC	12 mg/kg
DIELDRIN	300 µg/kg
HEPTACHLOR	1000 µg/kg
HEPTACHLOR EPOXIDE	500 µg/kg

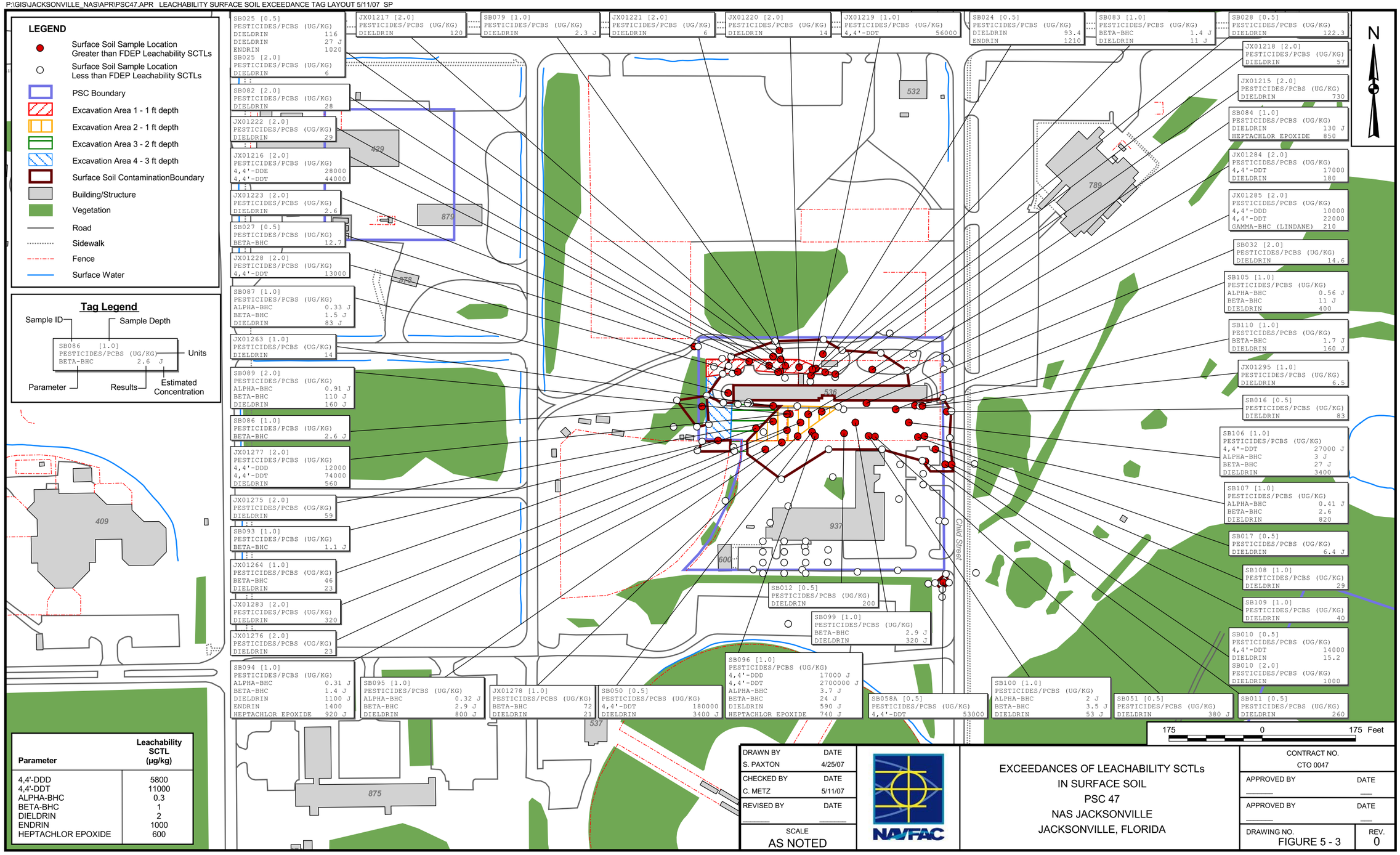
DRAWN BY S. PAXTON	DATE 4/25/07
CHECKED BY C. METZ	DATE 5/11/07
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF INDUSTRIAL SCTLs
IN SURFACE SOIL
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 5 - 2	REV. 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR LEACHABILITY SURFACE SOIL EXCEEDANCE TAG LAYOUT 5/11/07 SP



Parameter	Leachability SCTL (µg/kg)
4,4'-DDD	5800
4,4'-DDT	11000
ALPHA-BHC	0.3
BETA-BHC	1
DIELDRIN	2
ENDRIN	1000
HEPTACHLOR EPOXIDE	600

DRAWN BY S. PAXTON	DATE 4/25/07
CHECKED BY C. METZ	DATE 5/11/07
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF LEACHABILITY SCTLs
IN SURFACE SOIL
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 5 - 3	REV. 0

Highest concentration and locations of the three exceedances for leachabilty only were: alpha-BHC (3.7 µg/kg) in SB96, beta-BHC (110 µg/kg) in SB89, and endrin (1,400 µg/kg) in SB594.

As indicated on Figures 5-1, 5-2, and 5-3, pesticide exceedances in surface soil samples are distributed over a broad area of PSC 47. Elevated pesticide concentrations in surface soils are present to the north and south of the Pesticide Shop, in the drainage ditch along Child Street in the northeastern portion of PSC 47, and in one isolated location (SB01) in the southeastern corner of the study area.

5.3.1.1.2 TCL VOCs and SVOCs

Three surface soil samples, collected during the second stage of the Phase I investigation (December 2001), were shipped to Katahdin for analysis of TCL VOCs and SVOCs. One surface soil sample, collected during the Phase III investigation (March 2007), was hand delivered to ENCO for analysis of TCL VOCs and SVOCs. Constituents reported at concentrations exceeding any criteria (residential, industrial, and leachability) are shown in Table 5-2. Concentrations exceeding residential criteria (no industrial or leachability exceedances were reported) are depicted on Figure 5-1. Validated laboratory reports are included in Appendix J.

The samples analyzed originated from the southeastern corner (SB01) of the PSC, south-central area (SB118), the east-central area (SB017), and the north-central area north of the Pesticide Shop (SB25). One SVOC compound was reported at a concentration exceeding residential criteria in SB001 (benzo(a)pyrene equivalent at 643.58 µg/kg) and SB017 (benzo(a)pyrene equivalent at 191.15 µg/kg). No SVOCs were identified in SB25 or SB118.

No VOCs were identified in excess of criteria.

5.3.1.1.3 OP Pesticides and PCBs

No OP pesticides or PCBs were reported exceeding criteria in the surface soil samples analyzed.

5.3.1.1.4 Arsenic

Arsenic was detected in 27 of 56 surface soil samples analyzed. The concentration and location of the maximum detected arsenic sample was 47.4 mg/kg in SB103. Twelve arsenic samples (SB070, SB074, SB085, SB089, SB092, SB095, SB096, SB099, SB100, SB103, SB105, and SB106) exceeded residential criteria in surface soil. Ten of the 12 arsenic exceedances were located around the Pesticide Shop and the remaining two samples (SB070, and SB074) were located off the southwest corner of Building 937. One (SB103) of the 12 residential exceedances also exceeded industrial criteria. The only industrial

Table 5-2
VOC/SVOC Exceedances in Soil

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
Page 1 of 2

LOCATION	FDEP SCTLs			REGION 9 PRGs		JAX47-SB001	JAX47-SB010	JAX47-SB017
SAMPLE ID						JAX47-SB001-00-121901	JAX47-SB010-02-121901	JAX47-SB017-00-121901
MATRIX						SS	SB	SS
TOP DEPTH	RESIDENTIAL	INDUSTRIAL	LEACHABILITY	RESIDENTIAL	INDUSTRIAL	0	2	0
BOTTOM DEPTH						0.5	3	0.5
SAMPLE DATE						20011219	20011219	20011219
Volatile Organics (ug/kg)								
2-BUTANONE	16000000	110000000	17000	22000000	110000000	77	43	12
ACETONE	11000000	68000000	25000	14000000	54000000	22 U	43	7 U
METHYLENE CHLORIDE	17000	26000	20	9100	21000	20 J	8	6 J
TOLUENE	7500000	60000000	500	520000	520000	22 U	6 J	7 U
Semivolatile Organics (ug/kg)								
BAP EQUIVALENT	100	700	8000	62	210	**643.58 [R]**	**409.97 [R]**	**191.15 [R]**
BENZO(A)ANTHRACENE	NL	NL	800	620	2100	230 J	86 J	120 J
BENZO(A)PYRENE	100	700	8000	62	210	**380 J [R]**	**120 J [R]**	**130 J [R]**
BENZO(B)FLUORANTHENE	NL	NL	2400	620	2100	560 J	180 J	120 J
BENZO(G,H,I)PERYLENE	2500000	52000000	32000000	2300000	29000000	420 J	110 J	67 J
BENZO(K)FLUORANTHENE	NL	NL	24000	6200	21000	410 J	120 J	140 J
BIS(2-ETHYLHEXYL)PHTHALATE	72000	390000	3600000	35000	120000	1400	88 J	130 J
BUTYL BENZYL PHTHALATE	17000000	380000000	310000	12000000	100000000	360 J	500 U	35 J
CHRYSENE	NL	NL	77000	62000	210000	480 J	170 J	150 J
DIBENZO(A,H)ANTHRACENE	NL	NL	700	62	210	140 J	500 U	28 J
DIMETHYL PHTHALATE	690000000	NL	380000	100000000	100000000	340 J	500 U	430 U
FLUORANTHENE	3200000	59000000	1200000	2300000	22000000	530 J	190 J	93 J
INDENO(1,2,3-CD)PYRENE	NL	NL	6600	620	2100	400 J	120 J	76 J
PHENANTHRENE	2200000	36000000	250000	2300000	29000000	160 J	49 J	21 J
PYRENE	2400000	45000000	880000	2300000	29000000	520 J	210 J	120 J

Notes:
Concentrations in bold exceed Florida SCTL
R - Residential
I - Industrial
L - Leachability
SCTL = Soil Cleanup Target Levels (Chapter 62-777 F.A.C.)
U - less than laboratory method detection limit
J - estimated
µg/kg - milligrams per kilogram

Table 5-2
VOC/SVOC Exceedances in Soil

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
Page 2 of 2

LOCATION	FDEP SCTLs			REGION 9 PRGs		JAX47-SB025	JAX47-SB118	JAX47-SB118
SAMPLE ID						JAX47-SB025-00-122001	JAX47-SB118-01-031307	JAX47-SB118-03-031307
MATRIX						SS	SS	SB
TOP DEPTH	RESIDENTIAL	INDUSTRIAL	LEACHABILITY	RESIDENTIAL	INDUSTRIAL	0	0	2
BOTTOM DEPTH						0.5	1	3
SAMPLE DATE						20011220	20070313	20070313
Volatile Organics (ug/kg)								
2-BUTANONE	16000000	110000000	17000	22000000	110000000	14	1.4 UR	1.3 UR
ACETONE	11000000	68000000	25000	14000000	54000000	6 U	23.7 J	43.2 J
METHYLENE CHLORIDE	17000	26000	20	9100	21000	6	5.6 J	5.1 J
TOLUENE	7500000	60000000	500	520000	520000	6 U	0.40 U	0.20 U
Semivolatile Organics (ug/kg)								
BAP EQUIVALENT	100	700	8000	62	210	360 U	127 U	134 U
BENZO(A)ANTHRACENE	NL	NL	800	620	2100	360 U	170 U	180 U
BENZO(A)PYRENE	100	700	8000	62	210	360 U	127 U	134 U
BENZO(B)FLUORANTHENE	NL	NL	2400	620	2100	360 U	120 U	126 U
BENZO(G,H,I)PERYLENE	2500000	52000000	32000000	2300000	29000000	360 U	152 U	160 U
BENZO(K)FLUORANTHENE	NL	NL	24000	6200	21000	360 U	145 U	153 U
BIS(2-ETHYLHEXYL)PHTHALATE	72000	390000	3600000	35000	120000	360 U	221 U	233 U
BUTYL BENZYL PHTHALATE	17000000	380000000	310000	12000000	100000000	360 U	137 U	145 U
CHRYSENE	NL	NL	77000	62000	210000	360 U	148 U	156 U
DIBENZO(A,H)ANTHRACENE	NL	NL	700	62	210	360 U	210 U	221 U
DIMETHYL PHTHALATE	690000000	NL	380000	100000000	100000000	360 U	123 U	130 U
FLUORANTHENE	3200000	59000000	1200000	2300000	22000000	360 U	153 U	161 U
INDENO(1,2,3-CD)PYRENE	NL	NL	6600	620	2100	360 U	206 U	218 U
PHENANTHRENE	2200000	36000000	250000	2300000	29000000	360 U	153 U	161 U
PYRENE	2400000	45000000	880000	2300000	29000000	360 U	159 U	168 U

Notes:
Concentrations in bold exceed Florida SCTL
R - Residential
I - Industrial
L - Leachability
SCTL = Soil Cleanup Target Levels (Chapter 62-777 F.A.C.)
U - less than laboratory method detection limit
J - estimated
µg/kg - milligrams per kilogram

exceedance (SB103) was from a sample collected underneath the existing parking lot on the northeast side of the DVECC building.

5.3.1.2 Subsurface Soil

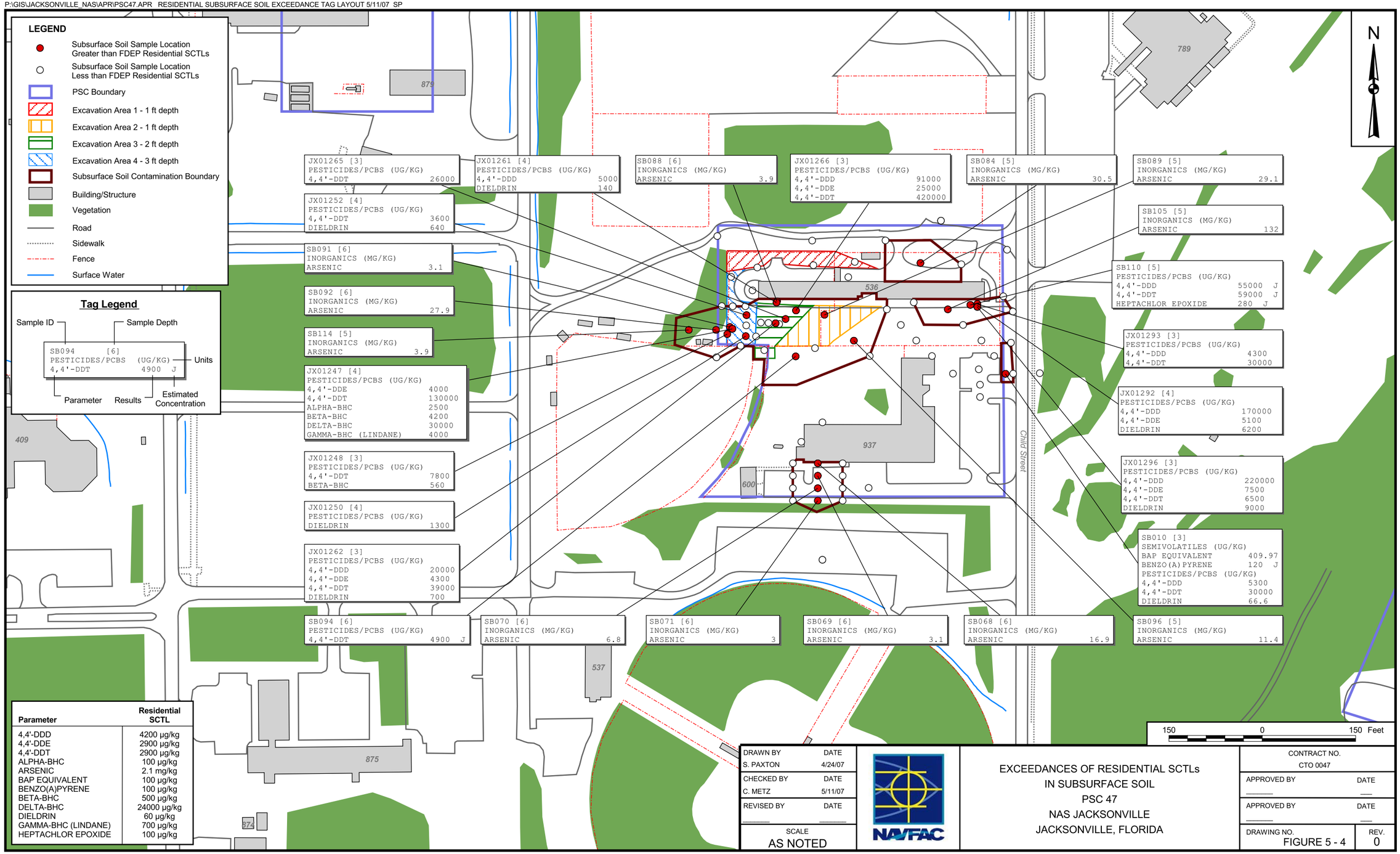
Following the 1999 soil removal action, 19 subsurface soil samples (greater than 2 ft bls), including nine collected from the soakage pit excavations, were analyzed by BEI. During Phase I/II of the RI investigation, three subsurface samples were analyzed as a follow-up to positive hits on the surface soil samples. All Phase I and II subsurface samples were analyzed for TCL pesticides, two were analyzed for OP pesticides (SB10, 2 to 3 ft bls and SB32, 47 to 48 ft bls) and one was analyzed for PCBs, VOCs, and SVOCs (SB10, 2 to 3 ft bls). A saturated soil sample (48 ft bls) was collected to verify if OP pesticides were bound to soil and the reason it was being detected (turbidity issues) in nearby well MW13D. During Phase III RI sampling for TCL pesticides and/or arsenic, 54 subsurface soil samples were analyzed. One subsurface soil sample, SB118, was also analyzed for TCL herbicides, TCL VOCs, and TCL SVOCs. Table D-4 in Appendix D lists the analysis performed on each sample. Laboratory analytical methods were the same as those listed in Section 5.3.1.1.

5.3.1.2.1 TCL Pesticides

TCL pesticide concentrations reported in the subsurface soil samples are listed in Table 5-1. Concentrations exceeding residential, industrial, and leachability criteria are illustrated on Figures 5-4, 5-5, and 5-6, respectively. Mobile laboratory analytical reports on subsurface soil samples are included in Appendix I and validated reports on subsurface soil samples analyzed by a fixed-base laboratory are included in Appendix J Phase I and III data.

Ten TCL pesticide compounds were reported at concentrations exceeding residential criteria (see Figure 5-4) in the subsurface soil samples analyzed by BEI (1999 post excavation samples) and by TtNUS during RI field activities. The most commonly reported pesticide compounds exceeding residential criteria were 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, beta-BHC, delta-BHC, dieldrin, gamma-BHC (lindane), heptachlor, and heptachlor epoxide. Seven (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, beta-BHC gamma-BHC (lindane), and dieldrin) of the ten TCL pesticides exceeding residential criteria also exceeded industrial criteria. Industrial exceedances of pesticides are shown on Figure 5-5. Highest concentrations and locations of the these most-frequently reported pesticide compounds were: 4,4'-DDD (220,000 µg/kg) and dieldrin (9,000 µg/kg) in BEI sample JX01296; 4,4'-DDE (25,000 µg/kg) and 4,4'-DDT (420,000 µg/kg) in BEI sample JX01266; alpha-BHC (2,500 µg/kg), beta-BHC (4,200 µg/kg), delta-BHC (30,000 µg/kg), and gamma-BHC (4,000 µg/kg) in BEI sample JX01247; and heptachlor (190 µg/kg) and heptachlor epoxide (280 µg/kg) in SB110.

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR RESIDENTIAL SUBSURFACE SOIL EXCEEDANCE TAG LAYOUT 5/11/07 SP



Parameter	Residential SCTL
4,4'-DDD	4200 µg/kg
4,4'-DDE	2900 µg/kg
4,4'-DDT	2900 µg/kg
ALPHA-BHC	100 µg/kg
ARSENIC	2.1 mg/kg
BAP EQUIVALENT	100 µg/kg
BENZO(A)PYRENE	100 µg/kg
BETA-BHC	500 µg/kg
DELTA-BHC	24000 µg/kg
DIELDRIN	60 µg/kg
GAMMA-BHC (LINDANE)	700 µg/kg
HEPTACHLOR EPOXIDE	100 µg/kg

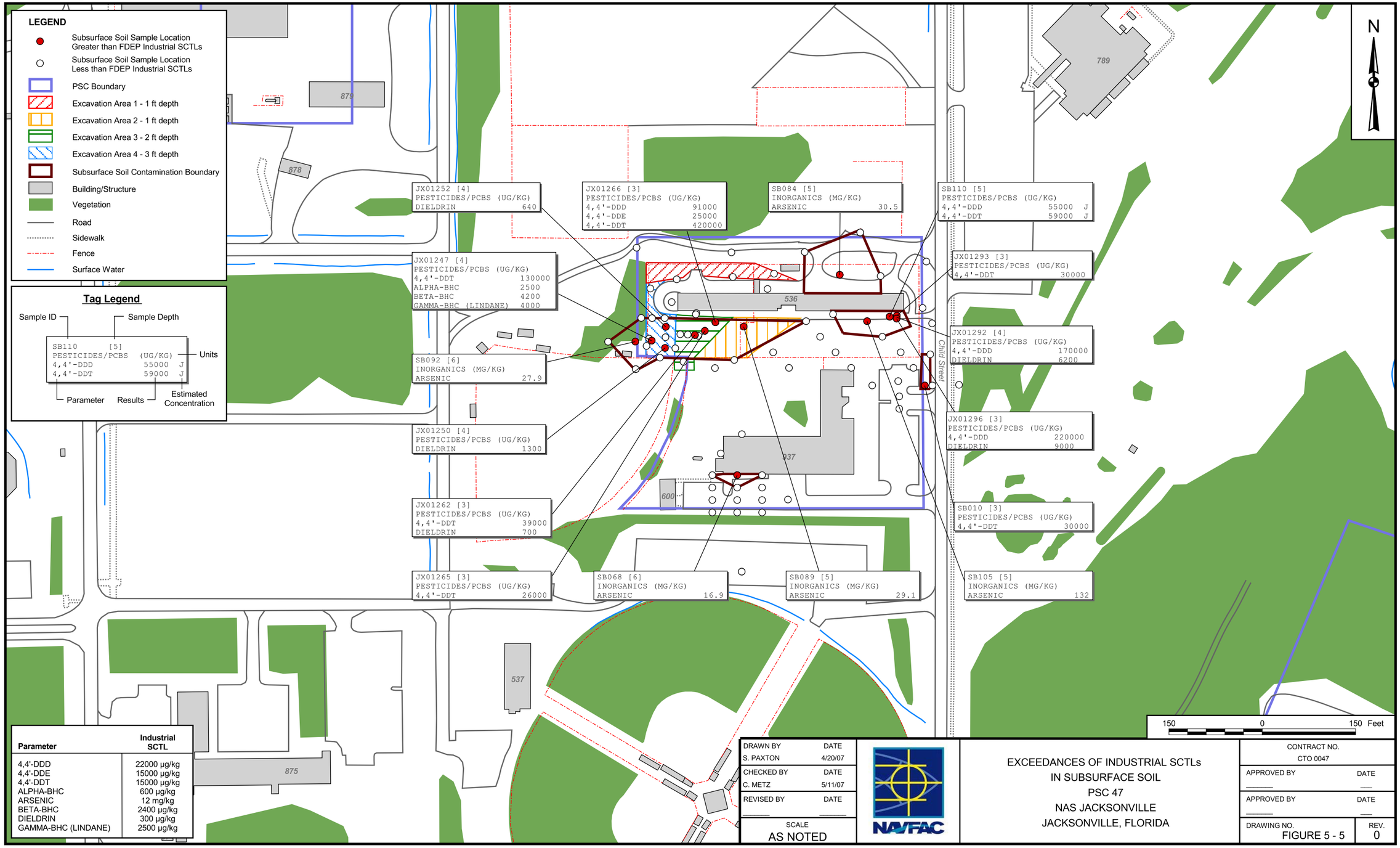
DRAWN BY S. PAXTON	DATE 4/24/07
CHECKED BY C. METZ	DATE 5/11/07
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF RESIDENTIAL SCTLs
IN SUBSURFACE SOIL
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 5 - 4	REV. 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR INDUSTRIAL SUBSURFACE SOIL EXCEEDANCE TAG LAYOUT 5/11/07 SP



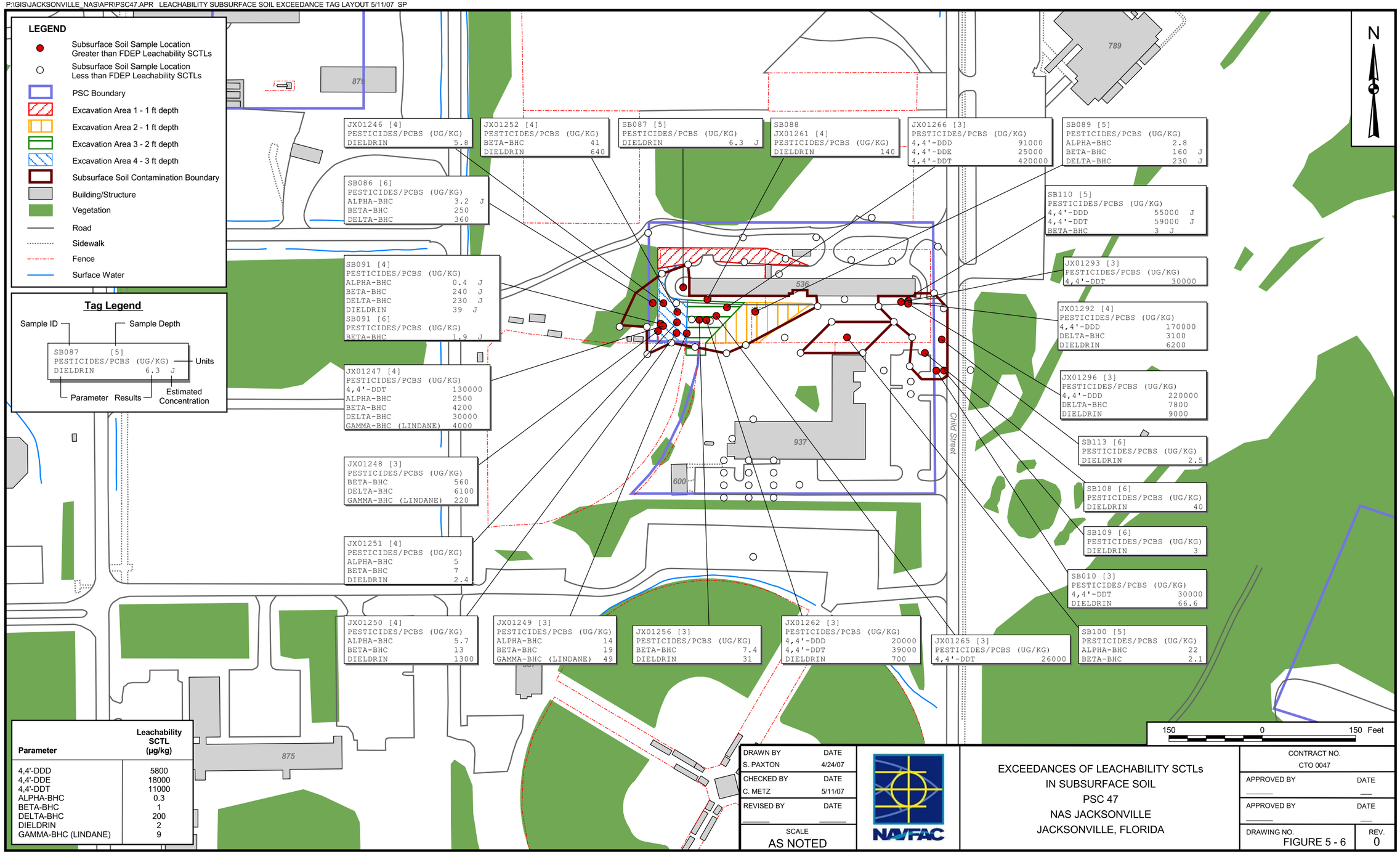
Parameter	Industrial SCTL
4,4'-DDD	22000 µg/kg
4,4'-DDE	15000 µg/kg
4,4'-DDT	15000 µg/kg
ALPHA-BHC	600 µg/kg
ARSENIC	12 mg/kg
BETA-BHC	2400 µg/kg
DIELDRIN	300 µg/kg
GAMMA-BHC (LINDANE)	2500 µg/kg

DRAWN BY S. PAXTON	DATE 4/20/07
CHECKED BY C. METZ	DATE 5/11/07
REVISED BY	DATE
SCALE AS NOTED	

EXCEEDANCES OF INDUSTRIAL SCTLs
IN SUBSURFACE SOIL
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 5 - 5	REV. 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR LEACHABILITY SUBSURFACE SOIL EXCEEDANCE TAG LAYOUT 5/11/07 SP



Parameter	Leachability SCTL (µg/kg)
4,4'-DDD	5800
4,4'-DDE	18000
4,4'-DDT	11000
ALPHA-BHC	0.3
BETA-BHC	1
DELTA-BHC	200
DIELDRIN	2
GAMMA-BHC (LINDANE)	9

DRAWN BY S. PAXTON	DATE 4/24/07
CHECKED BY C. METZ	DATE 5/11/07
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF LEACHABILITY SCTLs
IN SUBSURFACE SOIL
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 5 - 6	REV. 0

Eight TCL pesticides were detected at concentrations exceeding leachability criteria in subsurface soil samples. Pesticide leachability exceedances are shown on Figure 5-6. All seven TCL pesticides that exceeded industrial criteria also exceeded leachability criteria. Delta-BHC (4,200 µg/kg) in JX01247 was the only leachability exceedance that was not also an industrial exceedances. Highest concentration and locations of the remaining seven leachability exceedances (same as industrial exceedances) were listed in the previous paragraph.

As indicated on Figures 5-4, 5-5, and 5-6, pesticide exceedances in subsurface soil samples are primarily located within the fenced area on the west and south side of the Pesticide Shop and in the drainage ditch along Child Street (immediately southwest of the Pesticide Shop). Distribution of individual pesticide contaminants is random within the contaminated subsurface soil.

5.3.1.2.2 COCs Other than TCL Pesticides

Arsenic was detected in 24 of 56 subsurface soil samples analyzed. The concentration and location of the maximum detected arsenic sample was 132 mg/kg in SB105. Thirteen arsenic samples (SB068, SB069, SB070, SB071, SB084, SB088, SB089, SB091, SB092, SB096, SB105, and SB114) exceeded residential criteria in subsurface soil. Eight (SB084, SB088, SB089, SB091, SB092, SB096, SB105, and SB114) of the 13 arsenic exceedances were located around the Pesticide Shop (seven located on southside of Building) and the remaining four samples (SB068, SB069, SB070, and SB071) were located off the southwest corner of Building 937. Five (SB068, SB084, SB089, SB092, and SB105) of the 13 residential exceedances also exceeded industrial criteria. Four of the five industrial exceedances were located within the fenced area around the Pesticide Shop with the fifth sample (SB068) located off the southwest corner of Building 937.

A sample collected 2 to 3 ft bls at SB010 and SB118 were the only subsurface soil samples analyzed for an extended list of COCs other than TCL pesticides or arsenic (i.e., TCL VOCs and SVOCs, PCBs, herbicides, and OP pesticides). The only constituent reported in excess of criteria was benzo(a)pyrene equivalent at 409.97 µg/kg (estimated) in SB010, which exceeds its residential SCTL of 100 µg/kg. No other SVOCs, VOCs, PCBs, herbicides, or OP pesticides were reported in excess of screening criteria.

A deep, saturated soil sample collected 47 to 48 ft bls at SB32 was analyzed for OP pesticides and none were detected.

5.3.1.3 Soil SPLP Data

Eightteen (18) Phase III samples were analyzed for pesticide and arsenic SPLP. The intent was to determine if site specific soil leachability criteria could be derived. Please refer to Appendix D, Table D-4,

for a list of samples analyzed for SPLP. A summary of the SPLP data with corresponding soil data for each sample is provided in Table 5-3. Validated fixed-based laboratory reports listing SPLP analytical results are provided in Appendix J.

5.3.2 Groundwater Quality Assessment

Groundwater analytical reports provided by the mobile laboratory during the initial stage of the DPT investigation are included in Appendix I. Validated fixed-base laboratory reports listing groundwater analytical results obtained during Phase I (i.e., DPT) sampling activities are provided in Appendix J.

5.3.2.1 DPT Groundwater Grab Sampling Results (Phase I)

Phase I RI DPT groundwater grab sampling locations and depths are shown on Figure 4-1. A reference list showing analyses performed during Phase I and type of laboratory (mobile or fixed-base) performing the analysis is provided in Appendix D, Table D-1.

During the period that the mobile laboratory was under contract (June 25 through July 6, 2001), “grab” samples were collected from the six existing monitoring wells around the DVECC tank and the existing microwell located southeast of the Pesticide Shop in addition to the samples collected from the DPT borings. Results of these analyses will be presented herein under the DPT grab sampling results discussion. Please refer to sections 4.2.1.3.2 and 4.2.1.3.3 for a breakdown of laboratory analyses performed on groundwater samples during the two stages of the Phase I RI field investigation.

5.3.2.1.1 TCL Pesticides

TCL pesticide concentrations reported by both laboratories (mobile and fixed laboratories) during the Phase I RI investigation are provided in Table 5-4. Values exceeding 2004 FDEP GCTLs are illustrated in Figures 5-7 (mobile laboratory) and 5-8 (fixed-base laboratory). Fourteen (14) TCL pesticide compounds were identified at concentrations exceeding GCTLs. The most frequently reported compounds were 4,4’-DDD and 4,4’-DDT with 35 and 21 exceedances, respectively. BHC isomers were the next most frequently reported constituents. Alpha- and beta-BHC concentrations exceeded GCTLs in 15 samples, followed by gamma-BHC (12 exceedances) and delta-BHC (9 exceedances). 4,4’-DDD and/or 4,4’-DDT were identified in all areas sampled south of the Pesticide Shop and BHC isomers were detected in most locations sampled except in the drainage ditch along Child Street. Aldrin was reported at concentrations exceeding its GCTL of 0.005 µg/L in eight samples, all in the vicinity of the DVECC tank, and all reported by the mobile laboratory.

Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
Page 1 of 12

LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB081 JAX47-SB081-02-120106 20061201 MG/KG	JAX47-SB081 JAX47-SB081-02-120106-SPLP 20061201 UG/L	JAX47-SB081 JAX47-SB081-05-120106 20061201 MG/KG	JAX47-SB081 JAX47-SB081-05-120106-SPLP 20061201 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.00042 UJ	0.164 [G]	0.00037 UJ	0.105 [G]
4,4'-DDE	2.9	15	18	0.1	0.0023 J	0.008 J	0.00041 UJ	0.005 J
4,4'-DDT	2.9	15	11	0.1	0.0011 U	0.109 [G]	0.00066 U	0.029 J
ALDRIN	0.06	0.3	0.2	0.002	0.00028 UJ	0.002 U	0.00025 UJ	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00019 UJ	0.001 U	0.00016 UJ	0.001 U
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.00056 J	0.029 J	0.00033 UJ	0.022 J
BETA-BHC	0.5	2.4	0.001	0.02	0.00046 UJ	0.01 J	0.00041 UJ	0.242 [G]
DELTA-BHC	24	490	0.2	2.1	0.00023 UJ	0.001 U	0.0002 UJ	0.063
DIELDRIN	0.06	0.3	0.002	0.002	0.00033 UJ	0.01 J [G]	0.00029 UJ	0.017 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00037 UJ	0.002 U	0.00033 UJ	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.00033 UJ	0.002 U	0.00029 UJ	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.00037 UJ	0.002 U	0.00033 UJ	0.002 U
ENDRIN	25	510	1	2	0.00051 UJ	0.002 U	0.00045 UJ	0.002 U
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00023 UJ	0.009 U	0.0002 UJ	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.00042 UJ	0.003 U	0.00037 UJ	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.00023 UJ	0.002 U	0.0002 UJ	0.002 U
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.0007 J	0.015 J	0.00029 UJ	0.01 J
HEPTACHLOR	0.2	1	23	0.4	0.00033 UJ	0.001 U	0.00029 UJ	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.00079 UJ	0.001 U	0.0007 UJ	0.002 J
METHOXYCHLOR	420	8800	160	40	0.00046 UJ	0.003 U	0.00041 UJ	0.003 U
TOXAPHENE	0.9	4.5	31	3	0.0023 UJ	0.05 U	0.002 UJ	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	0.6 U	4 U	0.5 U	6

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

R - Residential
I - Industrial
L - Leachability
G - GCTL
PCB - Polychlorinated biphenyl

mg/kg - milligrams per kilogram
µg/L - micrograms per liter
U - less than laboratory method detection limit
J - estimated
NC - No criteria

Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB082 JAX47-SB082-02-120106 20061201 MG/KG	JAX47-SB082 JAX47-SB082-02-120106-SPLP 20061201 UG/L	JAX47-SB082 JAX47-SB082-05-120106 20061201 MG/KG	JAX47-SB082 JAX47-SB082-05-120106-SPLP 20061201 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.00032 U	0.008 J	0.0004 UJ	0.022 J
4,4'-DDE	2.9	15	18	0.1	0.0081	0.013 J	0.00045 UJ	0.002 U
4,4'-DDT	2.9	15	11	0.1	0.0041 J	0.011 J	0.00018 UJ	0.013 J
ALDRIN	0.06	0.3	0.2	0.002	0.00022 U	0.002 U	0.00027 UJ	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00014 U	0.001 UJ	0.00018 UJ	0.001 U
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.12	0.945 J	0.00036 J	0.013 J
BETA-BHC	0.5	2.4	0.001	0.02	0.00036 U	0.002 UJ	0.00045 UJ	0.023 J [G]
DELTA-BHC	24	490	0.2	2.1	0.00018 U	0.001 UJ	0.00022 UJ	0.007 J
DIELDRIN	0.06	0.3	0.002	0.002	0.028 [L]	0.437 [G]	0.00031 UJ	0.004 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00029 U	0.002 U	0.00036 UJ	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.00025 U	0.006 J	0.00031 UJ	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.00033 J	0.002 UJ	0.00036 UJ	0.002 U
ENDRIN	25	510	1	2	0.0004 U	0.014 J	0.00049 UJ	0.002 U
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00018 U	0.009 UJ	0.00022 UJ	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.00032 UJ	0.003 U	0.0004 UJ	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.00018 U	0.002 UJ	0.00022 UJ	0.002 U
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.14	0.706	0.00032 J	0.008 J
HEPTACHLOR	0.2	1	23	0.4	0.00025 U	0.001 U	0.00031 UJ	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.0033 J	0.021 J	0.00076 UJ	0.005 J
METHOXYCHLOR	420	8800	160	40	0.00036 U	0.003 U	0.00045 UJ	0.003 U
TOXAPHENE	0.9	4.5	31	3	0.0018 U	0.05 U	0.0022 UJ	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	0.4 U	5	1.7	12 [G]

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

R - Residential
I - Industrial
L - Leachability
G - GCTL
PCB - Polychlorinated biphenyl

mg/kg - milligrams per kilogram
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J - estimated
NC - No criteria

Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB083 JAX47-SB083-01-120106 20061201 MG/KG	JAX47-SB083 JAX47-SB083-01-120106-SPLP 20061201 UG/L	JAX47-SB083 JAX47-SB083-05-120106 20061201 MG/KG	JAX47-SB083 JAX47-SB083-05-120106-SPLP 20061201 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.055 J	0.051	0.0039 J	0.036 J
4,4'-DDE	2.9	15	18	0.1	0.13	0.051	0.0077	0.008 J
4,4'-DDT	2.9	15	11	0.1	1.2	0.058	0.025	0.026 J
ALDRIN	0.06	0.3	0.2	0.002	0.00021 U	0.002 U	0.00021 U	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00014 U	0.001 U	0.00014 U	0.001 U
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.21	0.489	0.011	0.166 J
BETA-BHC	0.5	2.4	0.001	0.02	0.0014 J [L]	0.025 J [G]	0.00071 J	0.029 J [G]
DELTA-BHC	24	490	0.2	2.1	0.00018 U	0.001 U	0.00018 U	0.004 J
DIELDRIN	0.06	0.3	0.002	0.002	0.011 J [L]	0.053 J [G]	0.00081 J	0.017 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.0072	0.002 U	0.00032 J	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.00025 U	0.002 U	0.00025 U	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.0005 J	0.002 U	0.00028 U	0.002 U
ENDRIN	25	510	1	2	0.00039 U	0.015 J	0.00039 U	0.002 U
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00018 UJ	0.009 U	0.00057 J	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.00032 U	0.003 U	0.00071 UJ	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.00018 U	0.002 U	0.00018 U	0.002 U
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.3	0.526	0.014	0.089
HEPTACHLOR	0.2	1	23	0.4	0.00096 J	0.002 J	0.00025 U	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.015 J	0.014 J	0.0006 U	0.005 J
METHOXYCHLOR	420	8800	160	40	0.00035 U	0.003 U	0.0011 J	0.003 U
TOXAPHENE	0.9	4.5	31	3	0.0018 U	0.05 U	0.0018 U	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	0.5 U	4 U	0.9 U	4 U

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

R - Residential
I - Industrial
L - Leachability
G - GCTL
PCB - Polychlorinated biphenyl

mg/kg - milligrams per kilogram
µg/L - micrograms per liter
U - less than laboratory method detection limit
J - estimated
NC - No criteria

Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB089 JAX47-SB089-02-113006 20061130 MG/KG	JAX47-SB089 JAX47-SB089-02-113006-SPLP 20061130 UG/L	JAX47-SB089 JAX47-SB089-05-113006 20061130 MG/KG	JAX47-SB089 JAX47-SB089-05-113006-SPLP 20061130 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.26 J	0.066 J	0.00031 UJ	2.88 [G]
4,4'-DDE	2.9	15	18	0.1	0.097 J	0.072	0.001 J	0.012 J
4,4'-DDT	2.9	15	11	0.1	5.5 J [R]	0.701 [G]	0.00084 U	0.009 J
ALDRIN	0.06	0.3	0.2	0.002	0.00021 UJ	0.002 U	0.00021 U	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00091 J [L]	0.003 J	0.0028 [L]	0.436 [G]
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.54 J	0.038 J	0.018 J	0.008 J
BETA-BHC	0.5	2.4	0.001	0.02	0.11 J [L]	1.31 J [G]	0.16 J [L]	0.054 [G]
DELTA-BHC	24	490	0.2	2.1	0.0015 J	0.009 J	0.23 J [L]	0.121
DIELDRIN	0.06	0.3	0.002	0.002	0.16 J [R,L]	0.489 [G]	0.00042 J	0.013 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00028 UJ	0.002 U	0.00028 U	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.014 J	0.002 U	0.00031 J	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.00095 J	0.002 U	0.00028 U	0.002 U
ENDRIN	25	510	1	2	0.00038 UJ	0.002 U	0.00038 U	0.002 U
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00017 UJ	0.009 U	0.00017 U	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.003 J	0.02 J	0.00091 J	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.003 J	0.009 J	0.0072 J	0.005 J
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.71 J	0.186 J	0.0064	0.003 J
HEPTACHLOR	0.2	1	23	0.4	0.015 J	0.021 J	0.00024 U	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.042 J	0.026 J	0.0011 J	0.006 J
METHOXYCHLOR	420	8800	160	40	0.00035 UJ	0.003 U	0.00035 U	0.003 U
TOXAPHENE	0.9	4.5	31	3	0.0017 UJ	0.05 U	0.0017 U	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	3.2 [R]	8	29.1 [R,I]	4 U

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

R - Residential
I - Industrial
L - Leachability
G - GCTL
PCB - Polychlorinated biphenyl

mg/kg - milligrams per kilogram
µg/L - micrograms per liter
U - less than laboratory method detection limit
J - estimated
NC - No criteria

Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB090 JAX47-SB090-03-120106 20061201 MG/KG	JAX47-SB090 JAX47-SB090-03-120106-SPLP 20061201 UG/L	JAX47-SB090 JAX47-SB090-06-120106 20061201 MG/KG	JAX47-SB090 JAX47-SB090-06-120106-SPLP 20061201 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.00032 U	0.037 J	0.0036	0.039 J
4,4'-DDE	2.9	15	18	0.1	0.0023	0.003 J	0.00035 U	0.003 J
4,4'-DDT	2.9	15	11	0.1	0.002 J	0.017 J	0.0006 U	0.017 J
ALDRIN	0.06	0.3	0.2	0.002	0.00021 U	0.002 U	0.00021 U	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00014 U	0.001 U	0.00014 U	0.001 U
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.00028 U	0.01 J	0.00053 J	0.02 J
BETA-BHC	0.5	2.4	0.001	0.02	0.00035 U	0.019 J	0.00085 J	0.029 J [G]
DELTA-BHC	24	490	0.2	2.1	0.00018 U	0.005 J	0.00018 U	0.003 J
DIELDRIN	0.06	0.3	0.002	0.002	0.00025 U	0.004 J [G]	0.00043 J	0.011 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00028 U	0.002 U	0.00028 U	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.00025 U	0.018 J	0.00025 U	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.00028 U	0.002 U	0.00028 U	0.002 U
ENDRIN	25	510	1	2	0.00039 U	0.002 U	0.00039 U	0.002 U
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00018 U	0.009 U	0.00018 U	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.00032 U	0.003 U	0.0006 J	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.00018 U	0.002 U	0.00018 U	0.002 U
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.00043 J	0.005 J	0.00025 U	0.044 J
HEPTACHLOR	0.2	1	23	0.4	0.00025 U	0.001 U	0.00025 UJ	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.0006 U	0.001 U	0.0006 U	0.004 J
METHOXYCHLOR	420	8800	160	40	0.00035 U	0.003 U	0.00035 UJ	0.003 U
TOXAPHENE	0.9	4.5	31	3	0.0018 U	0.05 U	0.0018 U	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	0.4 U	4 U	0.3 U	4 U

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

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Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB091 JAX47-SB091-01-120106 20061201 MG/KG	JAX47-SB091 JAX47-SB091-01-120106-SPLP 20061201 UG/L	JAX47-SB091 JAX47-SB091-04-120106 20061201 MG/KG	JAX47-SB091 JAX47-SB091-04-120106-SPLP 20061201 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.0019	0.023 J	0.014 J	0.057
4,4'-DDE	2.9	15	18	0.1	0.0052	0.007 J	0.083 J	0.023 J
4,4'-DDT	2.9	15	11	0.1	0.008	0.015 J	0.25 J	0.098
ALDRIN	0.06	0.3	0.2	0.002	0.00022 U	0.002 U	0.00026 UJ	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00015 U	0.001 U	0.0004 J [L]	0.013 J [G]
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.00059 J	0.031 J	0.0045 J	0.024 J
BETA-BHC	0.5	2.4	0.001	0.02	0.00037 J	0.002 UJ	0.24 J [L]	7.52 [G]
DELTA-BHC	24	490	0.2	2.1	0.00018 U	0.001 UJ	0.23 J [L]	3.84 [G]
DIELDRIN	0.06	0.3	0.002	0.002	0.00029 J	0.009 J [G]	0.039 J [L]	0.126 [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00029 U	0.002 U	0.00035 UJ	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.00025 U	0.002 U	0.00031 UJ	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.00029 U	0.002 U	0.00067 J	0.002 U
ENDRIN	25	510	1	2	0.0004 U	0.002 U	0.00049 UJ	0.002 U
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00029 J	0.009 U	0.00049 J	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.00033 U	0.003 U	0.0011 J	0.009 J
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.00018 U	0.002 U	0.00049 J	0.011 J
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.00077 J	0.016 J	0.0035 J	0.019 J
HEPTACHLOR	0.2	1	23	0.4	0.00025 U	0.001 U	0.00031 UJ	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.00062 U	0.001 U	0.0023 J	0.008 J
METHOXYCHLOR	420	8800	160	40	0.00036 U	0.003 U	0.00044 UJ	0.01 J
TOXAPHENE	0.9	4.5	31	3	0.0018 U	0.05 U	0.0022 UJ	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	0.6 U	4 U	2	6

Notes:
Concentrations in bold exceed Florida GCTL
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Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB091 JAX47-SB091-06-120106 20061201 MG/KG	JAX47-SB091 JAX47-SB091-06-120106-SPLP 20061201 UG/L	JAX47-SB093 JAX47-SB093-01-112906 20061129 MG/KG	JAX47-SB093 JAX47-SB093-01-112906-SPLP 20061129 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.00035 UJ	0.044 J	0.0096 J	0.061
4,4'-DDE	2.9	15	18	0.1	0.00067 J	0.003 J	0.55 J	0.028 J
4,4'-DDT	2.9	15	11	0.1	0.0013 J	0.021 J	0.36 J	0.033 J
ALDRIN	0.06	0.3	0.2	0.002	0.00024 UJ	0.002 U	0.0002 UJ	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00016 UJ	0.001 U	0.00013 UJ	0.001 U
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.00031 UJ	0.011 J	0.00027 U	0.017 J
BETA-BHC	0.5	2.4	0.001	0.02	0.0019 J [L]	0.089 [G]	0.0011 J [L]	0.002 U
DELTA-BHC	24	490	0.2	2.1	0.0013 J	0.026 J	0.00017 UJ	0.001 U
DIELDRIN	0.06	0.3	0.002	0.002	0.00048 J	0.017 J [G]	0.0011 J	0.009 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00031 UJ	0.002 U	0.00027 U	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.00027 UJ	0.002 U	0.00024 U	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.00031 UJ	0.002 U	0.011 J	0.002 U
ENDRIN	25	510	1	2	0.00043 UJ	0.002 U	0.00037 U	0.002 J
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.0002 UJ	0.009 U	0.00017 U	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.00035 UJ	0.003 U	0.0003 U	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.0002 UJ	0.002 U	0.00037 UJ	0.002 U
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.00027 UJ	0.005 J	0.0011 J	0.005 J
HEPTACHLOR	0.2	1	23	0.4	0.00027 UJ	0.001 U	0.00024 UJ	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.00067 UJ	0.001 U	0.0034 J	0.002 J
METHOXYCHLOR	420	8800	160	40	0.00039 UJ	0.003 U	0.0015 J	0.003 U
TOXAPHENE	0.9	4.5	31	3	0.002 UJ	0.05 U	0.0017 U	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	3.1 [R]	4 U	0.2	4 U

Notes:
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GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

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Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB096 JAX47-SB096-01-113006 20061130 MG/KG	JAX47-SB096 JAX47-SB096-01-113006-SPLP 20061130 UG/L	JAX47-SB099 JAX47-SB099-01-113006 20061130 MG/KG	JAX47-SB099 JAX47-SB099-01-113006-SPLP 20061130 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	17 J [R,L]	0.183 J [G]	0.28 J	0.008 J
4,4'-DDE	2.9	15	18	0.1	6.1 J [R]	0.435 [G]	2.2 J	0.114 [G]
4,4'-DDT	2.9	15	11	0.1	2700 J [R,I,L]	32.6 [G]	5.1 J [R]	0.179 [G]
ALDRIN	0.06	0.3	0.2	0.002	0.0002 UJ	0.002 U	0.00021 UJ	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.0037 J [L]	0.001 U	0.00018 J	0.001 U
ALPHA-CHLORDANE	2.8	14	9.6	NC	4.2 J [R]	1.61 J	0.61 J	0.214 J
BETA-BHC	0.5	2.4	0.001	0.02	0.024 J [L]	0.029 J [G]	0.0029 J [L]	0.002 U
DELTA-BHC	24	490	0.2	2.1	0.0087 J	0.001 U	0.00085 J	0.001 U
DIELDRIN	0.06	0.3	0.002	0.002	0.59 J [R,I,L]	0.211 [G]	0.32 J [R,I,L]	0.1 [G]
ENDOSULFAN I	450	7600	3.8	NC	0.15 J	0.002 U	0.00028 UJ	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.13 J	0.002 U	0.00025 UJ	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.057 J	0.007 J	0.028 J	0.002 U
ENDRIN	25	510	1	2	0.15 J	0.002 U	0.00039 UJ	0.002 U
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.13 J	0.009 U	0.00018 UJ	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.039 J	0.011 J	0.00032 UJ	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.0045 J	0.002 U	0.00053 J	0.002 U
GAMMA-CHLORDANE	2.8	14	9.6	NC	5.9 J [R]	0.779	0.54 J	0.037 J
HEPTACHLOR	0.2	1	23	0.4	3.4 J [R,I]	0.036 J	0.00085 J	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.74 J [R,I,L]	0.02 J	0.13 J [R]	0.033 J
METHOXYCHLOR	420	8800	160	40	0.21 J	0.003 U	0.03 J	0.003 U
TOXAPHENE	0.9	4.5	31	3	0.0017 UJ	0.05 U	0.0018 UJ	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	5.1 [R]	5	2.6 [R]	5

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

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Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB100 JAX47-SB100-01-113006 20061130 MG/KG	JAX47-SB100 JAX47-SB100-01-113006-SPLP 20061130 UG/L	JAX47-SB104 JAX47-SB104-01-112906 20061129 MG/KG	JAX47-SB104 JAX47-SB104-01-112906-SPLP 20061129 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.46 J	0.195 [G]	0.0025	0.092
4,4'-DDE	2.9	15	18	0.1	0.53	0.084	0.013	0.004 J
4,4'-DDT	2.9	15	11	0.1	1.3 J	0.129 J [G]	0.084 J	0.026 J
ALDRIN	0.06	0.3	0.2	0.002	0.00031 J	0.002 U	0.00022 U	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.002 J [L]	0.006 J	0.00015 U	0.001 U
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.00049 J	0.048 J	0.00033 J	0.019 J
BETA-BHC	0.5	2.4	0.001	0.02	0.0035 J [L]	0.014 J	0.00037 U	0.002 U
DELTA-BHC	24	490	0.2	2.1	0.0037 J	0.013 J	0.00018 U	0.001 U
DIELDRIN	0.06	0.3	0.002	0.002	0.053 J [L]	0.058 [G]	0.00026 U	0.013 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00028 UJ	0.002 U	0.00029 U	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.00024 UJ	0.003 J	0.00026 U	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.0022 J	0.002 U	0.00029 U	0.002 U
ENDRIN	25	510	1	2	0.0099 J	0.002 U	0.0004 U	0.002 U
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00017 UJ	0.009 U	0.00018 U	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.00031 UJ	0.003 U	0.00033 U	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.0011 J	0.002 U	0.00018 U	0.002 U
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.12 J	0.043 J	0.00045 J	0.006 J
HEPTACHLOR	0.2	1	23	0.4	0.00024 UJ	0.001 U	0.00026 U	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.024 J	0.006 J	0.00062 U	0.001 U
METHOXYCHLOR	420	8800	160	40	0.038 J	0.043 J	0.00037 U	0.003 U
TOXAPHENE	0.9	4.5	31	3	0.0017 UJ	0.05 U	0.0018 U	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	3.8 [R]	8	1.1 U	4 U

Notes:
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GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

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Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB105 JAX47-SB105-01-113006 20061130 MG/KG	JAX47-SB105 JAX47-SB105-01-113006-SPLP 20061130 UG/L	JAX47-SB106 JAX47-SB106-01-113006 20061130 MG/KG	JAX47-SB106 JAX47-SB106-01-113006-SPLP 20061130 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.3 J	0.057	0.82 J	0.114 J [G]
4,4'-DDE	2.9	15	18	0.1	1.4	0.092	1.6 J	0.188 [G]
4,4'-DDT	2.9	15	11	0.1	4.4 J [R]	0.15 [G]	27 J [R,I,L]	0.503 [G]
ALDRIN	0.06	0.3	0.2	0.002	0.00021 U	0.002 U	0.0017 J	0.002 U
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00056 J [L]	0.001 U	0.003 J [L]	0.001 U
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.52 J	0.112 J	1.7	0.127
BETA-BHC	0.5	2.4	0.001	0.02	0.011 J [L]	0.002 U	0.027 J [L]	0.004 J
DELTA-BHC	24	490	0.2	2.1	0.00094 J	0.001 U	0.0015 J	0.001 U
DIELDRIN	0.06	0.3	0.002	0.002	0.4 [R,I,L]	0.178 [G]	3.4 [R,I,L]	0.417 [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00028 U	0.002 U	0.00027 U	0.002 U
ENDOSULFAN II	450	7600	3.8	NC	0.00024 U	0.003 UJ	0.00024 U	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.027 J	0.002 U	0.0077 J	0.002 U
ENDRIN	25	510	1	2	0.023 J	0.005 J	0.2	0.015 J
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00017 UJ	0.009 U	0.00017 UJ	0.009 U
ENDRIN KETONE	NC	NC	NC	NC	0.0082 J	0.003 U	0.0013 J	0.006 J
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.0008 J	0.002 U	0.0024	0.002 U
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.4	0.087	1.3	0.093
HEPTACHLOR	0.2	1	23	0.4	0.012 J	0.005 J	0.0029 J	0.001 U
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.098 J	0.134	0.17 [R]	0.013 J
METHOXYCHLOR	420	8800	160	40	0.036 J	0.036 J	0.089 J	0.007 J
TOXAPHENE	0.9	4.5	31	3	0.0017 U	0.05 U	0.0017 U	0.05 U
Inorganics								
ARSENIC	2.1	12	NC	10	5.1 [R]	28 [G]	4.9 [R]	4

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

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Table 5-3
Soil SPLP Data

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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB107 JAX47-SB107-01-113006 20061130 MG/KG	JAX47-SB107 JAX47-SB107-01-113006-SPLP 20061130 UG/L	JAX47-SB110 JAX47-SB110-01-113006 20061130 MG/KG	JAX47-SB110 JAX47-SB110-01-113006-SPLP 20061130 UG/L
Pesticides/PCBs								
4,4'-DDD	4.2	22	5.8	0.1	0.06 J	0.051	0.065 J	0.02 J
4,4'-DDE	2.9	15	18	0.1	0.67	0.046 J	1.3 J	0.282 J [G]
4,4'-DDT	2.9	15	11	0.1	1.4 J	0.083	1.4 J	0.005 J
ALDRIN	0.06	0.3	0.2	0.002	0.0002 U	0.002 U	0.0002 UJ	0.002 UJ
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00041 J [L]	0.001 U	0.00027 J	0.001 UJ
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.75 J	0.103	0.23 J	0.074 J
BETA-BHC	0.5	2.4	0.001	0.02	0.0026 [L]	0.002 U	0.0017 J [L]	0.018 J
DELTA-BHC	24	490	0.2	2.1	0.00041 J	0.001 U	0.00058 J	0.001 UJ
DIELDRIN	0.06	0.3	0.002	0.002	0.82 [R,I,L]	0.626 [G]	0.16 J [R,L]	0.139 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00027 U	0.002 U	0.00027 UJ	0.002 UJ
ENDOSULFAN II	450	7600	3.8	NC	0.0033 J	0.002 U	0.00024 UJ	0.002 UJ
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.0036 J	0.002 U	0.01 J	0.002 UJ
ENDRIN	25	510	1	2	0.052	0.016 J	0.046 J	0.018 J
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00017 UJ	0.009 U	0.013 J	0.009 UJ
ENDRIN KETONE	NC	NC	NC	NC	0.0014 J	0.01 J	0.0097 J	0.014 J
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.0013 J	0.002 U	0.00096 J	0.002 UJ
GAMMA-CHLORDANE	2.8	14	9.6	NC	0.5	0.05	0.22 J	0.007 J
HEPTACHLOR	0.2	1	23	0.4	0.0021	0.001 U	0.00041 J	0.001 UJ
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.082 J	0.081	0.034 J	0.023 J
METHOXYCHLOR	420	8800	160	40	0.025 J	0.036 J	0.012 J	0.02 J
TOXAPHENE	0.9	4.5	31	3	0.0017 U	0.05 U	0.0017 UJ	0.05 UJ
Inorganics								
ARSENIC	2.1	12	NC	10	0.9	4 U	0.7 U	7

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

R - Residential
I - Industrial
L - Leachability
G - GCTL
PCB - Polychlorinated biphenyl

mg/kg - milligrams per kilogram
µg/L - micrograms per liter
U - less than laboratory method detection limit
J - estimated
NC - No criteria

Table 5-3
Soil SPLP Data

Remedial Investigation/Feasibility Study
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LOCATION SAMPLE ID SAMPLE DATE UNITS	RESIDENTIAL MG/KG	INDUSTRIAL MG/KG	LEACHABILITY MG/KG	GCTL UG/L	JAX47-SB110 JAX47-SB110-05-113006 20061130 MG/KG	JAX47-SB110 JAX47-SB110-05-113006-SPLP 20061130 UG/L
Pesticides/PCBs						
4,4'-DDD	4.2	22	5.8	0.1	55 J [R,I,L]	36.9 J [G]
4,4'-DDE	2.9	15	18	0.1	2.3 J	1.33 [G]
4,4'-DDT	2.9	15	11	0.1	59 J [R,I,L]	36.7 J [G]
ALDRIN	0.06	0.3	0.2	0.002	0.00022 UJ	0.029 J [G]
ALPHA-BHC	0.1	0.6	0.0003	0.006	0.00015 UJ	0.001 UJ
ALPHA-CHLORDANE	2.8	14	9.6	NC	0.56 J	2 J
BETA-BHC	0.5	2.4	0.001	0.02	0.003 J [L]	0.042 J [G]
DELTA-BHC	24	490	0.2	2.1	0.0023 J	0.001 UJ
DIELDRIN	0.06	0.3	0.002	0.002	0.00026 UJ	0.096 J [G]
ENDOSULFAN I	450	7600	3.8	NC	0.00029 UJ	0.04 J
ENDOSULFAN II	450	7600	3.8	NC	0.01 J	0.002 U
ENDOSULFAN SULFATE	450	7600	3.8	NC	0.0072 J	0.012 J
ENDRIN	25	510	1	2	0.049 J	0.053 J
ENDRIN ALDEHYDE	NC	NC	NC	NC	0.00018 UJ	0.009 UJ
ENDRIN KETONE	NC	NC	NC	NC	0.00033 UJ	0.003 U
GAMMA-BHC (LINDANE)	0.7	2.5	0.009	0.2	0.00018 UJ	0.002 UJ
GAMMA-CHLORDANE	2.8	14	9.6	NC	1 J	1.14
HEPTACHLOR	0.2	1	23	0.4	0.19 J	0.129
HEPTACHLOR EPOXIDE	0.1	0.5	0.6	0.2	0.28 J [R]	0.177 J
METHOXYCHLOR	420	8800	160	40	0.00037 UJ	0.066 J
TOXAPHENE	0.9	4.5	31	3	0.0018 UJ	0.05 U
Inorganics						
ARSENIC	2.1	12	NC	10	0.8 U	11 [G]

Notes:
Concentrations in bold exceed Florida GCTL
GCTL = Groundwater Cleanup Target Levels (Chapter 62-777 F.A.C.)

R - Residential
I - Industrial
L - Leachability
G - GCTL
PCB - Polychlorinated biphenyl

mg/kg - milligrams per kilogram
µg/L - micrograms per liter
U - less than laboratory method detection limit
J - estimated
NC - No criteria

Table 5-4
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB01			SB02			SB03		
Sample ID			G-8	G-26	G-40	G-8	G-22	G-36	G-6	G-8	G-22
Collection Date			6/30/2001	6/30/2001	6/30/2001	6/29/2001	6/29/2001	6/29/2001	6/29/2001	7/5/2001	6/29/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	**1**	1 U	1 U	1 U	1 U	1 U	1 U	0.026 J	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.015 J	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Delta-BHC	2.1	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U
Endrin	2	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.50 U	1 U
Toxaphene	3	0.061								1.0 U	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB03	SB04			SB05				
Sample ID			G-36	G-8	G-22	G-36	G-5	G-5	G-18	G-20	G-28
Collection Date			6/29/2001	6/29/2001	6/29/2001	6/29/2001	7/2/2001	7/6/2001	7/2/2001	12/19/2001	7/2/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	1 U	1 U	1 U	**1.2**	**0.24**	1 U	NA	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U	NA	1 U
4,4'-DDT	0.1	0.2	1 U	**1.2**	1 U	1 U	1 U	0.047 J	1 U	NA	1 U
Aldrin	0.005	0.004	1 U	**16**	**5.9**	1 U	1 U	0.050 U	1 U	NA	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	1 U	1 U	0.027 J	1 U	NA	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U	NA	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U	NA	1 U
Delta-BHC	2.1	0.011	1 U	**2.1**	1 U	1 U	1 U	0.050 U	1 U	NA	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U	NA	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U	NA	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U	NA	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U	NA	1 U
Endrin	2	11	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U	NA	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U	NA	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	0.10 U	1 U	NA	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	**1**	1 U	1 U	1 U	0.022 J	1 U	NA	1 U
Gamma-Chlordane	2	0.19	1 U	1.9	1.4	1 U	1 U	0.050 U	1 U	NA	1 U
Heptachlor	0.4	0.015	1 U	**1**	**2**	1 U	1 U	0.050 U	1 U	NA	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	0.050 U	1 U	NA	1 U
Methoxychlor	40	180	1 U	1.3	1 U	1 U	1 U	0.50 U	1 U	NA	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	1.0 U	NA	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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Jacksonville, Florida
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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB06					SB07			
Sample ID			G-10	G-16	G-20	G-28	G-36	G-8	G-20	G-20	G-36
Collection Date			7/6/2001	12/19/2001	7/2/2001	12/19/2001	7/2/2001	6/30/2001	6/30/2001	7/5/2001	6/30/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1.1 U	NA	1 U	NA	1 U	1 U	**2.6**	0.052 J	**1**
4,4'-DDE	0.1	0.2	1.1 U	NA	1 U	NA	1 U	1 U	1 U	0.017 J	1 U
4,4'-DDT	0.1	0.2	**0.38 J**	NA	1 U	NA	1 U	1 U	1 U	0.017 J	1 U
Aldrin	0.005	0.004	0.54 U	NA	**6.9**	NA	**1.6**	1 U	1 U	0.050 U	1 U
Alpha-BHC	0.006	0.011	0.54 U	NA	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Alpha-Chlordane	2	0.19	0.54 U	NA	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Beta-BHC	0.02	0.037	0.54 U	NA	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Delta-BHC	2.1	0.011	0.54 U	NA	1.1	NA	1 U	1 U	1 U	0.050 U	1 U
Dieldrin	0.005	0.0042	1.1 U	NA	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Endosulfan I	42	220	0.54 U	NA	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Endosulfan II	42	220	1.1 U	NA	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Endosulfan Sulfate	NL	220	1.1 U	NA	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Endrin	2	11	1.1 U	NA	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Endrin Aldehyde	NL	11	1.1 U	NA	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Endrin Ketone	NL	11	1.1 U	NA	1.9	NA	1 U	1 U	1 U	0.10 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	**0.41 J**	NA	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Gamma-Chlordane	2	0.19	0.54 U	NA	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Heptachlor	0.4	0.015	0.54 U	NA	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Heptachlor Epoxide	0.2	0.0074	0.54 U	NA	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Methoxychlor	40	180	5.4 U	NA	1 U	NA	1 U	1 U	1 U	0.50 U	1 U
Toxaphene	3	0.061	11 U	NA	NA	NA	NA	NA	NA	1.0 U	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB08			SB09			SB10		
Sample ID			G-8	G-20	G-36	G-8	G-16	G-28	G-8	G-20	G-36
Collection Date			6/30/2001	6/30/2001	6/30/2001	6/29/2001	6/29/2001	6/29/2001	6/30/2001	6/30/2001	6/30/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Delta-BHC	2.1	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin	2	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	NA	NA	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB11			SB12			SB13		
Sample ID			G-8	G-28	G-36	G-8	G-20	G-30	G-8	G-8	G-20
Collection Date			6/30/2001	6/30/2001	6/30/2001	6/26/2001	6/29/2001	6/29/2001	6/30/2001	7/6/2001	6/30/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	1 U	1 U	1 U	1 U	1 U	**1.1**	**160**	**2.4**
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	11 U	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	**5.3**	11 U	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5.5 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	1 U	1 U	1 U	**13.1**	5.5 U	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5.5 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	1 U	1 U	**1.5**	**1.6**	5.5 U	1 U
Delta-BHC	2.1	0.011	1 U	1 U	1 U	1 U	1 U	1 U	**9.6**	5.5 U	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	1 U	1 U	11 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5.5 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	11 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	11 U	1 U
Endrin	2	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	11 U	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	11 U	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	11 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	1 U	1 U	1 U	**24.4**	5.5 U	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5.5 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5.5 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	1 U	1 U	5.5 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	55 U	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	NA	NA	110 U	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB13	SB14			SB15			SB16	
Sample ID			G-36	G-8	G-18	G-28	G-8	G-16	G-32	G-8	G-20
Collection Date			6/30/2001	6/29/2001	6/29/2001	6/29/2001	6/29/2001	6/29/2001	6/29/2001	6/25/2001	6/25/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	**1.4**	1 U	1 U	1 U	1 U	1 U	1 U	**1.6**	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**1.1**	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Delta-BHC	2.1	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin	2	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	4.9	5.6
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	NA	NA	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB16	SB17			SB18				SB19
Sample ID			G-32	G-8	G-20	G-32[1]	G-8	G-20	G-32	G-32	G-8
Collection Date			6/25/2001	6/25/2001	6/25/2001	6/25/2001	6/25/2001	6/25/2001	6/25/2001	7/6/2001	7/2/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	1 U	1 U	NA	1 U	1 U	1 U	**1.1**	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	NA	1 U	1 U	1 U	**0.10**	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	NA	**1.4**	1 U	1 U	**0.39**	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	NA	**3.2**	1 U	1 U	**0.025 J**	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.026 J	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	NA	**1.6**	1 U	**2.2**	0.080	1 U
Delta-BHC	2.1	0.011	1 U	1 U	1 U	NA	**3.6**	1 U	1 U	0.061 J	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	NA	1 U	1 U	1 U	**0.021 J**	1 U
Endosulfan I	42	220	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Endrin	2	11	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Endrin Aldehyde	NL	11	4.9	4.8	5.3	NA	4.5	6	5.6	0.10 U	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.10 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	NA	**3.6**	1 U	1 U	0.024 J	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.050 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.017 J	1 U
Methoxychlor	40	180	1 U	1 U	1 U	NA	1 U	1 U	1 U	0.50 U	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	NA	NA	1.0 U	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB19		SB20			SB21			SB22
Sample ID			G-20	G-36	G-7	G-17	G-27	G-8	G-32	G-44	G-8
Collection Date			7/2/2001	7/2/2001	6/28/2001	6/28/2001	6/28/2001	6/26/2001	7/1/2001	7/1/2001	6/26/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	1 U	1 U	1 U	**1.1**	1 U	**2.7**
Delta-BHC	2.1	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin	2	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	NA	NA	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB22		SB23			SB24			SB25
Sample ID			G-26	G-44	G-8	G-26	G-44	G-8	G-26	G-44	G-8
Collection Date			6/26/2001	6/26/2001	6/26/2001	6/27/2001	6/27/2001	6/26/2001	6/27/2001	6/27/2001	6/28/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Delta-BHC	2.1	0.011	1 U	1.1	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin	2	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	NA	NA	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB25		SB26			SB27			SB28
Sample ID			G-18	G-28	G-8	G-22	G-35	G-10	G-26	G-44	G-8
Collection Date			6/28/2001	6/28/2001	6/27/2001	6/27/2001	6/27/2001	6/28/2001	6/28/2001	6/28/2001	6/30/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**18**
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**2.5**
Delta-BHC	2.1	0.011	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**17**
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin	2	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	**29**
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	NA	NA	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB28			SB29			SB30		
Sample ID			G-10	G-20	G-32	G-8	G-26	G-44	G-8	G-26	G-44
Collection Date			7/6/2001	6/30/2001	6/30/2001	6/26/2001	6/27/2001	6/27/2001	6/26/2001	6/27/2001	6/27/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	**0.46**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDE	0.1	0.2	0.094 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4,4'-DDT	0.1	0.2	0.057 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Aldrin	0.005	0.004	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-BHC	0.006	0.011	**0.26**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Alpha-Chlordane	2	0.19	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Beta-BHC	0.02	0.037	**0.12**	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Delta-BHC	2.1	0.011	0.43 J	1 U	1.1	1 U	1 U	1 U	1 U	1 U	1 U
Dieldrin	0.005	0.0042	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan I	42	220	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan II	42	220	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endosulfan Sulfate	NL	220	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin	2	11	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Aldehyde	NL	11	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Endrin Ketone	NL	11	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	0.16	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Gamma-Chlordane	2	0.19	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor	0.4	0.015	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	0.021 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Methoxychlor	40	180	0.50 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toxaphene	3	0.061	1.0 U	NA	NA	NA	NA	NA	NA	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB31			SB32				SB33	
Sample ID			G-8	G-20	G-36	G-8	G-20	G-36	G-36	G-8	G-18
Collection Date			6/30/2001	6/30/2001	6/30/2001	7/1/2001	7/1/2001	7/1/2001	7/6/2001	7/2/2001	7/2/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	1 U	1 U	**19.7**	**12**	**12.6**	**31**	1 U	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U	1 U	1 U	1 U	5.0 U	1 U	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U	**3.7**	**2.1**	**1.6**	**8.9**	1 U	1 U
Aldrin	0.005	0.004	1 U	1 U	1 U	1 U	1 U	1 U	2.5 U	1 U	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U	**140**	**20**	**12.8**	**1.0 J**	1 U	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	2.5 U	1 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U	**19.2**	**2.3**	**1.2**	2.5 U	1 U	1 U
Delta-BHC	2.1	0.011	1 U	1 U	1 U	**120**	**10**	**8.2**	1.1 J	1 U	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U	1 U	1 U	1 U	5.0 U	1 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U	1 U	1 U	1 U	2.5 U	1 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U	1 U	1 U	1 U	5.0 U	1 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U	1 U	1 U	1 U	5.0 U	1 U	1 U
Endrin	2	11	1 U	1 U	1 U	**5.2**	1 U	1 U	5.0 U	1 U	1 U
Endrin Aldehyde	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	5.0 U	1 U	1 U
Endrin Ketone	NL	11	1 U	1 U	1 U	1 U	1 U	1 U	5.0 U	1 U	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U	**240**	**23**	**12.2**	**0.79 J**	1 U	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U	1 U	1 U	1 U	2.5 U	1 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U	1 U	1 U	1 U	2.5 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	1 U	1 U	1 U	1 U	1 U	1 U	2.5 U	1 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U	1 U	1 U	1 U	25 U	1 U	1 U
Toxaphene	3	0.061	NA	NA	NA	NA	NA	NA	50 U	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB33		SB34			SB35			SB36
Sample ID			G-28	G-28	G-8	G-20	G-32	G-8	G-20	G-36	G-8
Collection Date			7/2/2001	7/6/2002	7/2/2001	7/2/2001	7/2/2001	7/2/2001	7/2/2001	7/2/2001	12/20/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	1 U	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1.0 U
4,4'-DDE	0.1	0.2	1 U	0.032 J	1 U	1 U	1 U	1 U	1 U	1 U	1.0 U
4,4'-DDT	0.1	0.2	1 U	0.016 J	1 U	1 U	1 U	1 U	1 U	1 U	**0.28 J**
Aldrin	0.005	0.004	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	0.50 U
Alpha-BHC	0.006	0.011	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	**4.0**
Alpha-Chlordane	2	0.19	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	0.50 U
Beta-BHC	0.02	0.037	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	**3.5**
Delta-BHC	2.1	0.011	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	**8.1**
Dieldrin	0.005	0.0042	1 U	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1.0 U
Endosulfan I	42	220	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	0.50 U
Endosulfan II	42	220	1 U	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1.0 U
Endosulfan Sulfate	NL	220	1 U	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1.0 U
Endrin	2	11	1 U	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1.0 U
Endrin Aldehyde	NL	11	1 U	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1.0 U
Endrin Ketone	NL	11	1 U	0.10 U	1 U	1 U	1 U	1 U	1 U	1 U	1.0 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	0.021 J	1 U	1 U	1 U	1 U	1 U	1 U	**5.6**
Gamma-Chlordane	2	0.19	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	0.50 U
Heptachlor	0.4	0.015	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	0.50 U
Heptachlor Epoxide	0.2	0.0074	1 U	0.050 U	1 U	1 U	1 U	1 U	1 U	1 U	0.50 U
Methoxychlor	40	180	1 U	0.50 U	1 U	1 U	1 U	1 U	1 U	1 U	5.0 U
Toxaphene	3	0.061	NA	1.0 U	NA	NA	NA	NA	NA	NA	10 U

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB36		SB37			SB38			SB39
Sample ID			G-20	G-36	G-8	G-22	G-36	G-8	G-22	G-36	G-20
Collection Date			12/20/2001	12/20/2001	12/20/2001	7/5/2001	12/20/2001	7/5/2001	7/5/2001	12/18/2001	7/5/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	**0.61**	**0.16**	**0.30**	0.10 U	**0.11 J**	**47**	**83**	**0.19**	**0.16**
4,4'-DDE	0.1	0.2	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.6 U	**1.6 J**	0.023 J	0.10 U
4,4'-DDT	0.1	0.2	0.041 J	0.10 U	0.095 J	**0.12**	0.025 J	**14**	**44**	**0.10 J**	0.041 J
Aldrin	0.005	0.004	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	4.8 U	4.8 U	0.051 U	0.050 U
Alpha-BHC	0.006	0.011	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	4.8 U	4.8 U	0.051 U	0.050 U
Alpha-Chlordane	2	0.19	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	4.8 U	**4.8 J**	0.051 U	0.054
Beta-BHC	0.02	0.037	0.050 U	0.050 U	**0.19 J**	0.050 U	0.050 U	4.8 U	4.8 U	0.051 U	0.050 U
Delta-BHC	2.1	0.011	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	4.8 U	4.8 U	0.051 U	0.050 U
Dieldrin	0.005	0.0042	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.6 U	9.7 U	0.10 U	0.10 U
Endosulfan I	42	220	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	4.8 U	4.8 U	0.051 U	0.050 U
Endosulfan II	42	220	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.6 U	9.7 U	0.10 U	0.10 U
Endosulfan Sulfate	NL	220	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	7.3 J	42	0.10 U	0.10 U
Endrin	2	11	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.6 U	9.7 U	0.10 U	0.10 U
Endrin Aldehyde	NL	11	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.6 U	9.7 U	0.10 U	0.10 U
Endrin Ketone	NL	11	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	9.6 U	9.7 U	0.10 U	0.10 U
Gamma-BHC (Lindane)	0.2	0.052	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	4.8 U	4.8 U	0.051 U	0.050 U
Gamma-Chlordane	2	0.19	0.019 J	0.023 J	0.050 U	0.050 U	0.016 J	4.8 U	4.7 J	0.051 U	0.050 U
Heptachlor	0.4	0.015	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	4.8 U	4.8 U	0.051 U	0.026 J
Heptachlor Epoxide	0.2	0.0074	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	4.8 U	4.8 U	0.051 U	0.050 U
Methoxychlor	40	180	0.50 U	0.50 U	0.20 J	0.50 U	0.50 U	48 U	48 U	0.51 U	0.50 U
Toxaphene	3	0.061	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	96 U	97 U	1.0 U	1.0 U

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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Boring JAX47-	FDEP GCTLs (µg/L)	REGION 9 PRGs	SB48	SB49	SB55	SB57			SB58		
Sample ID			G-8	G-8	G-15	G-8	G-20	G-36	G-8	G-20	G-37
Collection Date			12/18/2001	12/20/2001	12/20/2001	12/19/2001	12/19/2001	12/19/2001	12/20/2001	12/20/2001	12/20/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	**0.16**	**0.15**	**0.37**	**7.4**	**3.6**	**2.2**	**0.20**	0.037 J	0.10 U
4,4'-DDE	0.1	0.2	0.10 U	0.10 U	0.10 U	0.95 U	0.48 U	0.10 U	0.050 J	0.10 U	0.10 U
4,4'-DDT	0.1	0.2	**0.18**	0.030 J	0.056 J	**0.39 J**	**0.30 J**	**0.10 J**	0.090 J	0.034 J	0.10 U
Aldrin	0.005	0.004	0.050 U	0.050 U	0.050 U	0.48 U	0.24 U	0.050 U	0.050 U	0.050 U	0.050 U
Alpha-BHC	0.006	0.011	0.050 U	0.050 U	0.050 U	0.48 U	**0.12 J**	**0.025 J**	0.050 U	0.050 U	0.050 U
Alpha-Chlordane	2	0.19	0.050 U	0.050 U	0.050 U	0.48 U	0.24 U	0.050 U	0.050 U	0.050 U	0.050 U
Beta-BHC	0.02	0.037	0.050 U	0.050 U	0.050 U	0.48 U	0.24 U	0.050 U	0.050 U	0.050 U	0.050 U
Delta-BHC	2.1	0.011	0.050 U	0.050 U	0.050 U	0.48 U	0.16 J	0.034 J	0.050 U	0.050 U	0.050 U
Dieldrin	0.005	0.0042	0.10 U	0.10 U	0.10 U	0.95 U	0.48 U	0.10 U	0.10 U	0.10 U	0.10 U
Endosulfan I	42	220	0.050 U	0.050 U	0.050 U	0.48 U	0.24 U	0.050 U	0.050 U	0.074	0.044 J
Endosulfan II	42	220	0.10 U	0.10 U	0.10 U	0.95 U	0.48 U	0.10 U	0.10 U	0.10 U	0.10 U
Endosulfan Sulfate	NL	220	0.10 U	0.10 U	0.10 U	0.95 U	0.48 U	0.10 U	0.10 U	0.10 U	0.10 U
Endrin	2	11	0.10 U	0.10 U	0.10 U	0.95 U	0.48 U	0.10 U	0.10 U	0.10 U	0.10 U
Endrin Aldehyde	NL	11	0.10 U	0.10 U	0.10 U	0.95 U	0.48 U	0.10 U	0.10 U	0.10 U	0.10 U
Endrin Ketone	NL	11	0.10 U	0.10 U	0.10 U	0.95 U	0.48 U	0.10 U	0.10 U	0.10 U	0.10 U
Gamma-BHC (Lindane)	0.2	0.052	0.050 U	0.050 U	0.050 U	0.48 U	0.24 U	0.050 U	0.050 U	0.050 U	0.050 U
Gamma-Chlordane	2	0.19	0.050 U	0.050 U	0.026 J	0.48 U	0.24 U	0.050 U	0.050 U	0.050 U	0.050 U
Heptachlor	0.4	0.015	0.050 U	0.050 U	0.050 U	0.48 U	0.24 U	0.050 U	0.046 J	0.050 U	0.050 U
Heptachlor Epoxide	0.2	0.0074	0.050 U	0.050 U	0.050 U	0.48 U	0.24 U	0.050 U	0.050 U	0.050 U	0.050 U
Methoxychlor	40	180	0.50 U	0.50 U	0.50 U	0.16 J	2.4 U	0.50 U	0.50 U	0.50 U	0.50 U
Toxaphene	3	0.061	1.0 U	1.0 U	1.0 U	9.5 U	4.8 U	1.0 U	1.0 U	1.0 U	1.0 U

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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									JAX47-937-		
Boring JAX47-	**FDEP GCTLs (µg/L)**	**REGION 9 PRGs**	**SB59**			**SB60**	**SB61**	**JAX47-536**	**MW01S**	**MW02S**	**MW03S**
Sample ID			G-8	G-20	G-37	G-8	G-15	MW03	MW9371	MW9372	MW9373
Collection Date			12/20/2001	12/20/2001	12/20/2001	12/20/2001	12/20/2001	6/25/2001	6/25/2001	6/25/2001	6/25/2001
Pesticides (µg/L)											
4,4'-DDD	0.1	0.28	0.10 U	0.10 U	0.10 U	**0.12**	**0.16**	**210**	1 U	1 U	**7.1**
4,4'-DDE	0.1	0.2	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1 U	1 U	1 U	1 U
4,4'-DDT	0.1	0.2	0.10 U	0.10 U	0.10 U	0.10 U	0.034 J	**22**	1 U	**1**	**7.8**
Aldrin	0.005	0.004	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	1 U	**7.7**	**8.5**	1 U
Alpha-BHC	0.006	0.011	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	**8.4**	1 U	1 U	**1.3**
Alpha-Chlordane	2	0.19	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	1 U	1 U	1 U	1 U
Beta-BHC	0.02	0.037	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	**2.1**	1 U	1 U	1 U
Delta-BHC	2.1	0.011	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	**9.6**	1 U	1 U	1.2
Dieldrin	0.005	0.0042	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1 U	1 U	1 U	1 U
Endosulfan I	42	220	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	1	1 U	1 U	1 U
Endosulfan II	42	220	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1.8	1 U	1 U	1 U
Endosulfan Sulfate	NL	220	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	1 U	1 U	1 U	1 U
Endrin	2	11	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	**25**	1 U	1 U	1 U
Endrin Aldehyde	NL	11	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	3	4.6	5.8	5.6
Endrin Ketone	NL	11	0.10 U	0.021 J	0.10 U	0.10 U	0.10 U	1 U	6.9	27.8	4
Gamma-BHC (Lindane)	0.2	0.052	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	**2.2**	1 U	1 U	**1.8**
Gamma-Chlordane	2	0.19	0.050 U	0.050 U	0.050 U	0.050 U	0.013 J	1.4	**5.8**	1 U	1 U
Heptachlor	0.4	0.015	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	1 U	1 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	1 U	1 U	1 U	1 U
Methoxychlor	40	180	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	1 U	1 U	1 U	1 U
Toxaphene	3	0.061	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	NA	NA	NA	NA

See notes at end of table.

Table 5-4 (Continued)
Summary of Detected Pesticide Concentrations in Groundwater Samples - Phase I

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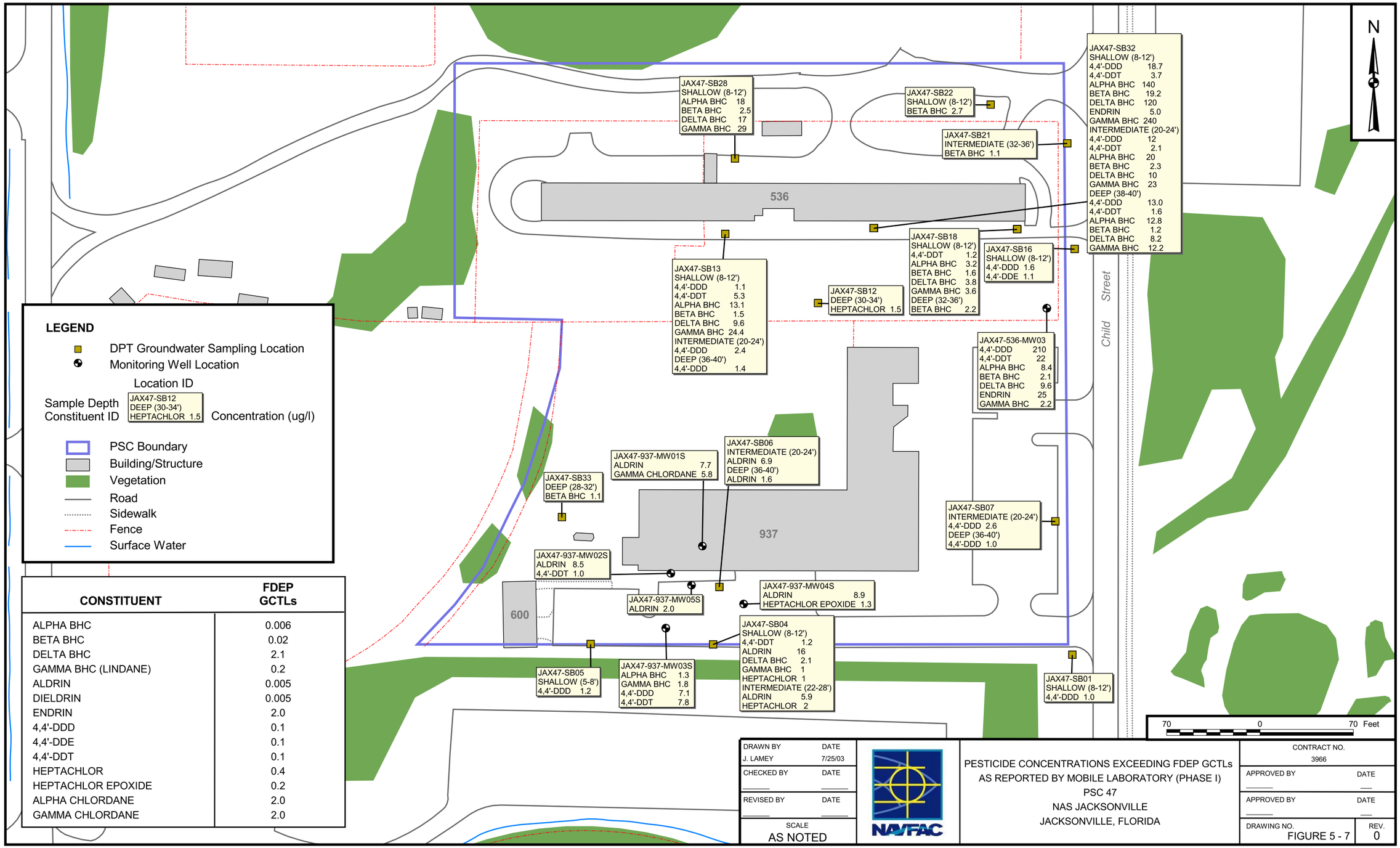
			JAX47-937-		
Boring JAX47-	**FDEP GCTLs (µg/L)**	**REGION 9 PRGs**	**MW04S**	**MW05S**	**MW06D**
Sample ID			MW9374	MW9375	MW9376
Collection Date			6/25/2001	6/25/2001	6/25/2001
Pesticides (µg/L)					
4,4'-DDD	0.1	0.28	1 U	1 U	1 U
4,4'-DDE	0.1	0.2	1 U	1 U	1 U
4,4'-DDT	0.1	0.2	1 U	1 U	1 U
Aldrin	0.005	0.004	**8.9**	**2**	1 U
Alpha-BHC	0.006	0.011	1 U	1 U	1 U
Alpha-Chlordane	2	0.19	1 U	1 U	1 U
Beta-BHC	0.02	0.037	1 U	1 U	1 U
Delta-BHC	2.1	0.011	1 U	1 U	1 U
Dieldrin	0.005	0.0042	1 U	1 U	1 U
Endosulfan I	42	220	1 U	1 U	1 U
Endosulfan II	42	220	1 U	1 U	1 U
Endosulfan Sulfate	NL	220	1 U	1 U	1 U
Endrin	2	11	1 U	1 U	1 U
Endrin Aldehyde	NL	11	5.2	6.4	6
Endrin Ketone	NL	11	1 U	3.3	1 U
Gamma-BHC (Lindane)	0.2	0.052	1 U	1 U	1 U
Gamma-Chlordane	2	0.19	1 U	1 U	1 U
Heptachlor	0.4	0.015	1 U	1 U	1 U
Heptachlor Epoxide	0.2	0.0074	**1.3**	1 U	1 U
Methoxychlor	40	180	1 U	1 U	1 U
Toxaphene	3	0.061	NA	NA	NA

Notes:
[1] Sample not analyzed due to high turbidity
FDEP = Florida Department of Environmental Protection
GCTLs = Groundwater Cleanup Target Levels
PRGs = Preliminary Remedial Goals
NL = not listed

µg/L = micrograms per liter
U = less than laboratory detection limit
J= estimated value
NA= Not analyzed
Bold values exceed FDEP GCTLs

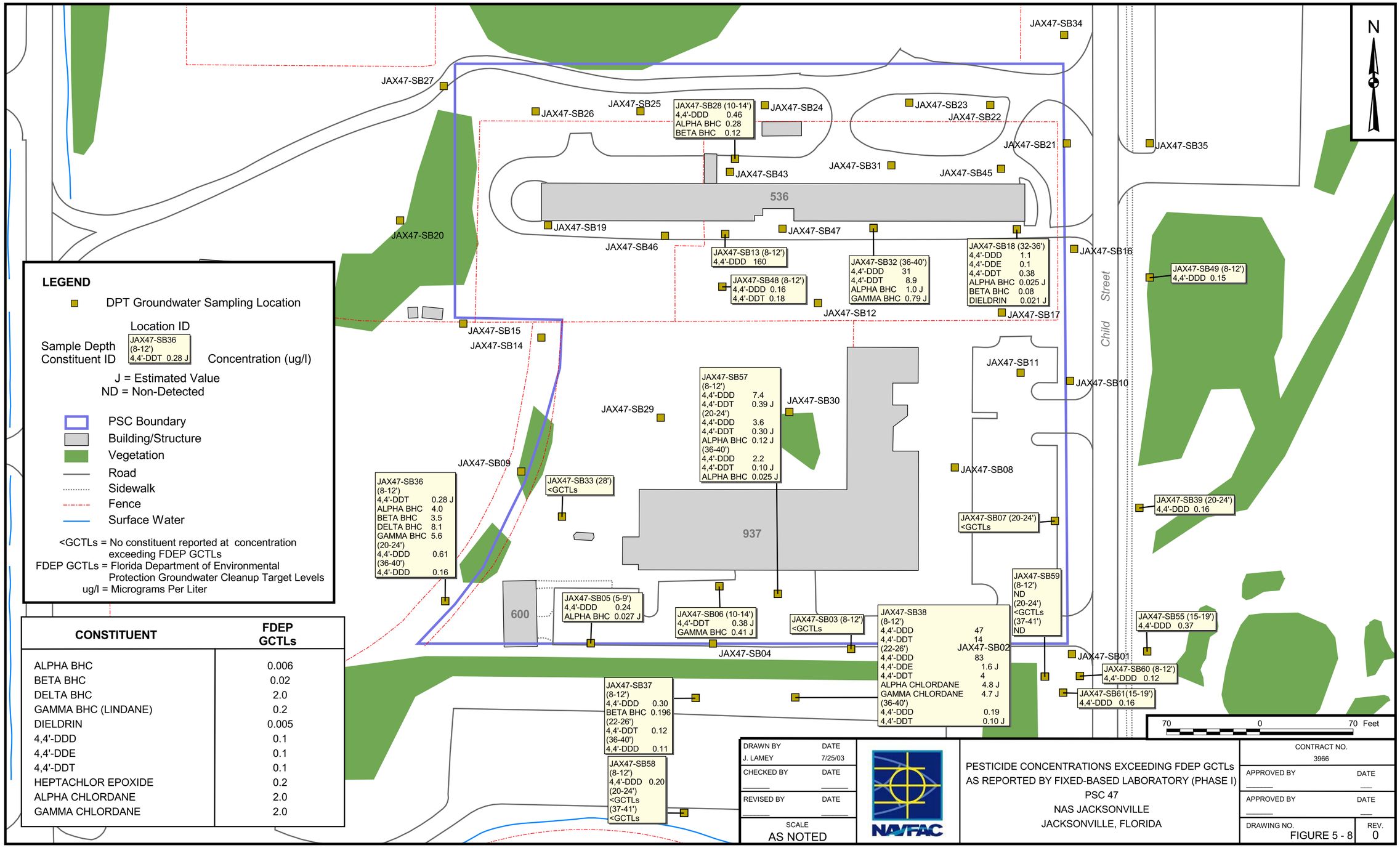
P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR PHASE I GROUNDWATER TCL PESTICIDE EXCEEDANCES-MOBILE LAB 5/11/07 SP



CONSTITUENT	FDEP GCTLs
ALPHA BHC	0.006
BETA BHC	0.02
DELTA BHC	2.1
GAMMA BHC (LINDANE)	0.2
ALDRIN	0.005
DIELDRIN	0.005
ENDRIN	2.0
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
HEPTACHLOR	0.4
HEPTACHLOR EPOXIDE	0.2
ALPHA CHLORDANE	2.0
GAMMA CHLORDANE	2.0

DRAWN BY J. LAMEY	DATE 7/25/03	PESTICIDE CONCENTRATIONS EXCEEDING FDEP GCTLs AS REPORTED BY MOBILE LABORATORY (PHASE I) PSC 47 NAS JACKSONVILLE JACKSONVILLE, FLORIDA	CONTRACT NO. 3966
CHECKED BY	DATE		APPROVED BY / DATE
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED		NAVFAC	DRAWING NO. FIGURE 5 - 7 / REV. 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR PHASE I GROUNDWATER TCL PESTICIDE EXCEEDANCES-FIXED BASED 5/11/07 SP



CONSTITUENT	FDEP GCTLs
ALPHA BHC	0.006
BETA BHC	0.02
DELTA BHC	2.0
GAMMA BHC (LINDANE)	0.2
DIELDRIN	0.005
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
HEPTACHLOR EPOXIDE	0.2
ALPHA CHLORDANE	2.0
GAMMA CHLORDANE	2.0

DRAWN BY J. LAMEY	DATE 7/25/03
CHECKED BY	DATE
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

PESTICIDE CONCENTRATIONS EXCEEDING FDEP GCTLs
AS REPORTED BY FIXED-BASED LABORATORY (PHASE I)
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. 3966	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 5 - 8	REV. 0

Highest concentrations of the most frequently reported compounds occurred in the area south of the Pesticide Shop. Highest concentrations of all BHC isomers were reported in the shallow sample (8-12 ft bls) at SB32 and highest 4,4'-DDD and 4,4'-DDT concentrations were reported in the old HLA microwell (JAX-947-536-MW03) located southeast of the Pesticide Shop. Highest reported concentrations of the frequently-occurring compounds were as follows: 4,4'-DDD (210 µg/L), 4,4'-DDT (22 µg/L), alpha-BHC (140 µg/L), beta-BHC (19.2 µg/L), gamma-BHC (240 µg/L), delta-BHC (120 µg/L), and aldrin (15 µg/L). The GCTLs for these compounds are all less than or equal to 0.1 µg/L, except for delta-BHC, which has a GCTL of 2.1 µg/L.

In most but not all cases, the greatest number of exceedances and highest concentrations occurred in shallow samples and concentrations progressively decreased with depth. Aside from the area south of the Pesticide Shop, the vicinity surrounding the removed DVECC tank had the highest frequency of pesticide exceedances, although concentrations were not as high. Other TCL pesticide constituents reported at concentrations exceeding GCTLs, but at lesser frequencies than those listed above, included 4,4'-DDE and heptachlor (3 exceedances), gamma-chlordane and endrin (2), alpha-chlordane, heptachlor epoxide, and dieldrin (1).

Pesticide compounds were identified at concentrations exceeding GCTLs at two outlying locations, seemingly out of the projected downgradient flowpaths of the two primary suspected source areas (DVECC tank and Pesticide Shop). One of the outlying areas is centered on DPT borings SB37, SB38, and SB58 (see Figure 5-8), located upgradient (south) of the former DVECC tank location. Highest pesticide concentrations in this area were identified in samples collected from SB38, located approximately 100 ft southeast of the former DVECC source area. 4,4'-DDD and 4,4'-DDT were reported at concentrations exceeding the GCTL of 0.1 µg/L at all three sampling depths (8-12 ft bls, 22-26 ft bls, and 36-40 ft bls). In the intermediate depth sample (22-26 ft bls), concentrations slightly exceeding GCTLs were also reported for alpha and gamma-chlordane and 4,4'-DDE. The highest 4,4'-DDD concentration reported at SB38 was 83 µg/L (22-26 ft bls) and the highest 4,4'-DDT concentration was 14 µg/L (8-12 ft bls). Concentrations of either 4,4'-DDD or 4,4'-DDT slightly exceeding GCTLs were also reported from these same three depth intervals at SB37, located approximately 85 ft due south of the former source area. The only exceedance reported at SB58, located approximately 85 ft south of SB37 (170 ft south of source area), was 4,4'-DDD at a concentration of 0.2 µg/L in the shallow sample (8-12 ft bls).

The other outlying hotspot was revealed by analytical results reported on DPT grab samples collected at SB36 (see Figure 5-8), located approximately 200 ft west (cross-gradient) of the former DVECC source area, between the DVECC property boundary fence and the outfield fence of the adjacent baseball field. Exceedances were reported for 4,4'-DDT and for each of the four BHC isomers in samples collected from

the shallow interval (8-12 ft bls) at SB36, and for 4,4'-DDD only, at concentrations slightly exceeding GCTLs in the intermediate (20-24 ft bls) and deep (36-40 ft bls) samples.

5.3.2.1.2 TCL VOCs and SVOCs

VOC and SVOC concentrations exceeding GCTLs, as reported by mobile and fixed-base laboratories on groundwater samples collected during Phase I of the RI assessment, are illustrated on Figure 5-5. Please refer to Appendix D, Table D-1 to view a table showing which samples were analyzed for TCL VOCs and which samples were analyzed for a "hydrocarbon short list" during the Phase I groundwater assessment. VOC concentrations reported during Phase I are listed in Table 5-5 and SVOC concentrations are listed in Table 5-6. Laboratory reports are provided in Appendices I (mobile) and J (fixed base).

As indicated on Figure 5-9, groundwater analytical data suggest the presence of two, possibly three, separate hydrocarbon plumes at PSC 47: one near the removed DVECC tank south of Building 937 (southern plume), another in the vicinity of the former ASTs and UST near the central portion of the Pesticide Shop (Building 536) (northern plume), and a possible third plume upgradient (south) of DVECC in the area around SB37, SB38, and SB58.

Higher concentrations and greater diversity of constituents were identified in the southern plume. Petroleum hydrocarbons, PAHs, and chlorinated hydrocarbons were all reported at concentrations exceeding GCTLs in this area. Groundwater samples collected from MW01S, located inside Building 937 approximately 15 ft north of the former DVECC tank, had 10 reported exceedances, including benzene (7.4 µg/L), toluene (50.2 µg/L), ethylbenzene (110 µg/L), total xylenes (1960 µg/L), cis-DCE (380 µg/L), TCE (3.2 µg/L), PCE (14.0 µg/L), naphthalene (130 µg/L), 1-methylnaphthalene (36.7 µg/L), and 2-methylnaphthalene (65.0 µg/L). Six of these constituents (toluene, ethylbenzene, total xylenes, cis-DCE, PCE, and naphthalene) were reported at concentrations exceeding GCTLs in samples collected from MW04, located approximately 50 ft southeast of the former DVECC tank. Other than the 10 constituents listed above for MW01S, vinyl chloride was also reported at levels slightly exceeding its GCTL of 1 µg/L in three shallow grab samples collected in the vicinity of the former DVECC tank location during the DPT program.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB03 SB03-G-08-121801 12/18/2001	JAX47-SB03 SB03-G08-070501 7/5/2001	JAX47-SB05 SB05-G-20-121901 12/19/2001	JAX47-SB05 SB05-G05-070601 7/6/2001	JAX47-SB06 SB06-G10-070601 7/6/2001
LABORATORY FIXED/MOBILE			**F**	**F**	**F**	**F**	**F**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	7	340	5 U	5 U	5 U	5 U	5 U
1,2,4-TRICHLOROBENZENE	70	190	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROBENZENE	600	370	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROETHANE	3	0.12	5 U	5 U	5 U	5 U	0.4 J
1,3-DICHLOROBENZENE	10	5.5	5 U	5 U	5 U	5 U	5 U
1,4-DICHLOROBENZENE	75	0.5	5 U	5 U	5 U	5 U	5 U
1-METHYLNAPHTHALENE	20	NL	NA	NA	NA	NA	NA
2-BUTANONE	4200	1900	5 U	5 U	5 U	5 U	2 J
2-HEXANONE	280	NL	5 U	5 U	5 U	5 U	5 U
2-METHYLNAPHTHALENE	20	6.2	NA	NA	NA	NA	NA
4-METHYL-2-PENTANONE	560	160	5 U	5 U	5 U	5 U	5 U
ACETONE	700	610	5 U	5 U	5 U	10 U	5 U
BENZENE	1	0.34	5 U	5 U	5 U	5 U	4 J
BROMOMETHANE	9.8	8.7	5 U	5 U	5 U	2 J	5 U
CARBON DISULFIDE	700	1000	5 U	0.8 J	5 U	5 U	0.9 J
CHLOROBENZENE	100	110	5 U	5 U	5 U	5 U	1 J
CHLOROETHANE	12	4.6	5 U	5 U	5 U	5 U	2 J
CHLOROFORM	5.7	6.2	5 U	5 U	5 U	5 U	5 U
CHLOROMETHANE	2.7	1.5	5 U	5 U	5 U	5 U	1 J
CIS-1,2-DICHLOROETHENE	70	61	2 J	4 J	5 U	0.3 J	**600**
CYCLOHEXANE	NL	35000	5 U	5 U	5 U	5 U	5 U
ETHYLBENZENE	30	2.9	5 U	5 U	5 U	5 U	**50**
ISOPROPYLBENZENE	0.8	660	5 U	5 U	5 U	5 U	3 J
M+P-XYLENES	NL[1]	NL	NA	NA	NA	NA	NA
METHYL ACETATE	5000	6100	5 U	5 U	5 U	5 U	5 U
METHYL CYCLOHEXANE	NL	5200	5 U	5 U	5 U	5 U	5 U
METHYL TERT-BUTYL ETHER	50	13	5 U	5 U	5 U	5 U	5 U
NAPHTHALENE	20	6.2	NA	NA	NA	NA	NA
O-XYLENE	NL	210	NA	NA	NA	NA	NA
STYRENE	100	1600	5 U	5 U	5 U	5 U	5 U
TETRACHLOROETHENE	3	0.66	5 U	0.4 J	5 U	5 U	**7**
TOLUENE	40	720	5 U	5 U	5 U	5 U	11
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	5 U	5 U	5 U	5 U	**280**
TRANS-1,2-DICHLOROETHENE	100	120	5 U	5 U	5 U	5 U	1 J
TRICHLOROETHENE	3	0.028	5 U	5 U	5 U	5 U	5 U
VINYL CHLORIDE	1	0.02	5 U	5 U	5 U	5 U	**4 J**

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB06 SB06-G16-121901 12/19/2001	JAX47-SB06 SB06-G28-121901 12/19/2001	JAX47-SB13 SB13-G08-070601 7/6/2001	JAX47-SB13 SB13-G20-121801 12/18/2001	JAX47-SB16 SB16-G08-062501 6/25/2001
LABORATORY FIXED/MOBILE			**F**	**F**	**F**	**F**	**M**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	5 U	5 U	5 U	5 U	NA
1,1-DICHLOROETHENE	7	340	5 U	5 U	5 U	5 U	NA
1,2,4-TRICHLOROBENZENE	70	190	5 U	5 U	5 U	5 U	NA
1,2-DICHLOROBENZENE	600	370	5 U	5 U	1 J	5 U	NA
1,2-DICHLOROETHANE	3	0.12	5 U	2 J	5 U	5 U	NA
1,3-DICHLOROBENZENE	10	5.5	5 U	5 U	5 U	5 U	NA
1,4-DICHLOROBENZENE	75	0.5	5 U	5 U	4 J	5 U	NA
1-METHYLNAPHTHALENE	20	NL	NA	NA	NA	NA	10 U
2-BUTANONE	4200	1900	5 U	9	5 U	1 J	NA
2-HEXANONE	280	NL	5 U	2 J	5 U	5 U	NA
2-METHYLNAPHTHALENE	20	6.2	NA	NA	NA	NA	10 U
4-METHYL-2-PENTANONE	560	160	5 U	3 J	5 U	5 U	NA
ACETONE	700	610	5 U	84 U	28	6 U	NA
BENZENE	1	0.34	0.8 J	29	2 J	5 U	1 U
BROMOMETHANE	9.8	8.7	5 U	5 U	5 U	5 U	NA
CARBON DISULFIDE	700	1000	5 U	1 J	5 U	5 U	NA
CHLOROBENZENE	100	110	0.4 J	5 J	18	5 U	NA
CHLOROETHANE	12	4.6	5 U	5 U	5 U	5 U	NA
CHLOROFORM	5.7	6.2	5 U	5 U	0.6 J	5 U	NA
CHLOROMETHANE	2.7	1.5	5 U	5 U	5 U	5 U	NA
CIS-1,2-DICHLOROETHENE	70	61	6	**340**	5 U	5 U	1 U
CYCLOHEXANE	NL	35000	5 U	5 U	5 U	5 U	NA
ETHYLBENZENE	30	2.9	5 U	**350**	4 J	5 U	1 U
ISOPROPYLBENZENE	0.8	660	5 U	**26**	0.7 J	5 U	NA
M+P-XYLENES	NL[1]	NL	NA	NA	NA	NA	1 U
METHYL ACETATE	5000	6100	5 U	5 U	5 U	5 U	NA
METHYL CYCLOHEXANE	NL	5200	5 U	5 U	5 U	1 J	NA
METHYL TERT-BUTYL ETHER	50	13	5 U	5 U	5 U	5 U	NA
NAPHTHALENE	20	6.2	NA	NA	NA	NA	3 U
O-XYLENE	NL	210	NA	NA	NA	NA	1 U
STYRENE	100	1600	5 U	5 U	5 U	5 U	NA
TETRACHLOROETHENE	3	0.66	5 U	3 J	5 U	5 U	1 U
TOLUENE	40	720	5 U	**110**	0.4 J	5 U	1 U
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	5 U	**4000**	**21**	5 U	NA
TRANS-1,2-DICHLOROETHENE	100	120	5 U	0.5 J	5 U	5 U	1 U
TRICHLOROETHENE	3	0.028	5 U	2 J	**11**	5 U	1 U
VINYL CHLORIDE	1	0.02	5 U	**4 J**	5 U	5 U	1 U

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB16 SB16-G20-062501 6/25/2001	JAX47-SB16 SB16-G32-062501 6/25/2001	JAX47-SB17 SB17-G08-062501 6/25/2001	JAX47-SB17 SB17-G08-062601 6/26/2001	JAX47-SB17 SB17-G20-062501 6/25/2001
LABORATORY FIXED/MOBILE			**M**	**M**	**M**	**M**	**M**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	NA	NA	NA	NA	NA
1,1-DICHLOROETHENE	7	340	NA	NA	NA	NA	NA
1,2,4-TRICHLOROBENZENE	70	190	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	600	370	NA	NA	NA	NA	NA
1,2-DICHLOROETHANE	3	0.12	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	10	5.5	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	75	0.5	NA	NA	NA	NA	NA
1-METHYLNAPHTHALENE	20	NL	10 U	10 U	10 U	10 U	10 U
2-BUTANONE	4200	1900	NA	NA	NA	NA	NA
2-HEXANONE	280	NL	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	20	6.2	10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE	560	160	NA	NA	NA	NA	NA
ACETONE	700	610	NA	NA	NA	NA	NA
BENZENE	1	0.34	1 U	1 U	1 U	1 U	1 U
BROMOMETHANE	9.8	8.7	NA	NA	NA	NA	NA
CARBON DISULFIDE	700	1000	NA	NA	NA	NA	NA
CHLOROBENZENE	100	110	NA	NA	NA	NA	NA
CHLOROETHANE	12	4.6	NA	NA	NA	NA	NA
CHLOROFORM	5.7	6.2	NA	NA	NA	NA	NA
CHLOROMETHANE	2.7	1.5	NA	NA	NA	NA	NA
CIS-1,2-DICHLOROETHENE	70	61	1 U	1 U	1 U	1 U	1 U
CYCLOHEXANE	NL	35000	NA	NA	NA	NA	NA
ETHYLBENZENE	30	2.9	1 U	1 U	1 U	1 U	1 U
ISOPROPYLBENZENE	0.8	660	NA	NA	NA	NA	NA
M+P-XYLENES	NL[1]	NL	1 U	1 U	1 U	1 U	1.3
METHYL ACETATE	5000	6100	NA	NA	NA	NA	NA
METHYL CYCLOHEXANE	NL	5200	NA	NA	NA	NA	NA
METHYL TERT-BUTYL ETHER	50	13	NA	NA	NA	NA	NA
NAPHTHALENE	20	6.2	3 U	3 U	3 U	3 U	3 U
O-XYLENE	NL	210	1 U	1 U	1 U	1 U	2.1
STYRENE	100	1600	NA	NA	NA	NA	NA
TETRACHLOROETHENE	3	0.66	1 U	1 U	1 U	1 U	1 U
TOLUENE	40	720	1 U	1 U	1 U	1 U	1 U
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	NA	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	100	120	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	3	0.028	1 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	1	0.02	1 U	1 U	1 U	1 U	1 U

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB17 SB17-G32-062501 6/25/2001	JAX47-SB18 SB18-G08-062501 6/25/2001	JAX47-SB18 SB18-G20-062501 6/25/2001	JAX47-SB18 SB18-G32-062501 6/25/2001	JAX47-SB18 SB18-G32-070601 7/6/2001
LABORATORY FIXED/MOBILE			**M**	**M**	**M**	**M**	**F**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	NA	NA	NA	NA	5 U
1,1-DICHLOROETHENE	7	340	NA	NA	NA	NA	5 U
1,2,4-TRICHLOROBENZENE	70	190	NA	NA	NA	NA	5 U
1,2-DICHLOROBENZENE	600	370	NA	NA	NA	NA	5 U
1,2-DICHLOROETHANE	3	0.12	NA	NA	NA	NA	0.4 J
1,3-DICHLOROBENZENE	10	5.5	NA	NA	NA	NA	5 U
1,4-DICHLOROBENZENE	75	0.5	NA	NA	NA	NA	5 U
1-METHYLNAPHTHALENE	20	NL	50 U	14	10 U	10 U	NA
2-BUTANONE	4200	1900	NA	NA	NA	NA	5 U
2-HEXANONE	280	NL	NA	NA	NA	NA	5 U
2-METHYLNAPHTHALENE	20	6.2	50 U	10 U	10 U	10 U	NA
4-METHYL-2-PENTANONE	560	160	NA	NA	NA	NA	5 U
ACETONE	700	610	NA	NA	NA	NA	5 U
BENZENE	1	0.34	5 U	2.8	1 U	1 U	5 U
BROMOMETHANE	9.8	8.7	NA	NA	NA	NA	5 U
CARBON DISULFIDE	700	1000	NA	NA	NA	NA	5 U
CHLOROBENZENE	100	110	NA	NA	NA	NA	5 U
CHLOROETHANE	12	4.6	NA	NA	NA	NA	5 U
CHLOROFORM	5.7	6.2	NA	NA	NA	NA	5 U
CHLOROMETHANE	2.7	1.5	NA	NA	NA	NA	5 U
CIS-1,2-DICHLOROETHENE	70	61	5 U	2.3	1 U	2	5 U
CYCLOHEXANE	NL	35000	NA	NA	NA	NA	5 U
ETHYLBENZENE	30	2.9	5 U	2.4	1 U	1 U	5 U
ISOPROPYLBENZENE	0.8	660	NA	NA	NA	NA	5 U
M+P-XYLENES	NL[1]	NL	5 U	1 U	1 U	1 U	NA
METHYL ACETATE	5000	6100	NA	NA	NA	NA	5 U
METHYL CYCLOHEXANE	NL	5200	NA	NA	NA	NA	2 J
METHYL TERT-BUTYL ETHER	50	13	NA	NA	NA	NA	5 U
NAPHTHALENE	20	6.2	15 U	10.8	3 U	3 U	NA
O-XYLENE	NL	210	5 U	1 U	1 U	1 U	NA
STYRENE	100	1600	NA	NA	NA	NA	5 U
TETRACHLOROETHENE	3	0.66	5 U	1 U	1 U	1 U	5 U
TOLUENE	40	720	5 U	37.2	1 U	1 U	5 U
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	NA	NA	NA	NA	5 U
TRANS-1,2-DICHLOROETHENE	100	120	5 U	1 U	1 U	1 U	5 U
TRICHLOROETHENE	3	0.028	5 U	1.3	1 U	1 U	5 U
VINYL CHLORIDE	1	0.02	5 U	1 U	1 U	1 U	5 U

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

Remedial Investigation/Feasibility Study
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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB29 SB29-G08-121901 12/19/2001	JAX47-SB30 SB30-G08-121901 12/19/2001	JAX47-SB33 SB33-G08-070601 7/6/2001	JAX47-SB37 SB37-G08-122001 12/20/2001	JAX47-SB43 SB43-G08-121801 12/18/2001
LABORATORY FIXED/MOBILE			**F**	**F**	**F**	**F**	**F**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	7	340	5 U	5 U	5 U	5 U	2 J
1,2,4-TRICHLOROBENZENE	70	190	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROBENZENE	600	370	5 U	5 U	5 U	5 U	3 J
1,2-DICHLOROETHANE	3	0.12	5 U	5 U	5 U	5 U	5 U
1,3-DICHLOROBENZENE	10	5.5	5 U	5 U	5 U	5 U	5 U
1,4-DICHLOROBENZENE	75	0.5	5 U	5 U	5 U	5 U	9
1-METHYLNAPHTHALENE	20	NL	NA	NA	NA	NA	NA
2-BUTANONE	4200	1900	5 U	5 U	5 U	3 J	5
2-HEXANONE	280	NL	5 U	5 U	5 U	5 U	5 U
2-METHYLNAPHTHALENE	20	6.2	NA	NA	NA	NA	NA
4-METHYL-2-PENTANONE	560	160	5 U	5 U	5 U	5 U	5 U
ACETONE	700	610	5 U	5 U	5 U	12 U	13 U
BENZENE	1	0.34	5 U	5 U	5 U	**3 J**	**7**
BROMOMETHANE	9.8	8.7	5 U	5 U	5 U	5 U	5 U
CARBON DISULFIDE	700	1000	5 U	5 U	5 U	2 J	5 U
CHLOROBENZENE	100	110	5 U	5 U	5 U	0.5 J	42
CHLOROETHANE	12	4.6	5 U	5 U	5 U	5 U	5 U
CHLOROFORM	5.7	6.2	5 U	5 U	5 U	5 U	2 J
CHLOROMETHANE	2.7	1.5	5 U	5 U	5 U	5 U	0.9 J
CIS-1,2-DICHLOROETHENE	70	61	5 U	5 U	5 U	**390**	19
CYCLOHEXANE	NL	35000	5 U	5 U	5 U	5 U	120
ETHYLBENZENE	30	2.9	5 U	5 U	5 U	5 J	**100**
ISOPROPYLBENZENE	0.8	660	5 U	5 U	5 U	**4 J**	**18**
M+P-XYLENES	NL[1]	NL	NA	NA	NA	NA	NA
METHYL ACETATE	5000	6100	5 U	5 U	5 U	5 U	5 U
METHYL CYCLOHEXANE	NL	5200	5 U	5 U	5 U	5 U	46
METHYL TERT-BUTYL ETHER	50	13	5 U	5 U	5 U	5 U	5 U
NAPHTHALENE	20	6.2	NA	NA	NA	NA	NA
O-XYLENE	NL	210	NA	NA	NA	NA	NA
STYRENE	100	1600	5 U	5 U	5 U	5 U	5 U
TETRACHLOROETHENE	3	0.66	5 U	5 U	5 U	**6**	0.4 J
TOLUENE	40	720	5 U	5 U	5 U	5 U	1 J
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	5 U	5 U	5 U	4 J	**63**
TRANS-1,2-DICHLOROETHENE	100	120	5 U	5 U	5 U	2 J	5 U
TRICHLOROETHENE	3	0.028	5 U	5 U	5 U	3 J	**86**
VINYL CHLORIDE	1	0.02	5 U	5 U	5 U	2 J	5 U

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB43 SB43-G20-121801 12/18/2001	JAX47-SB45 SB45-G08-121801 12/18/2001	JAX47-SB46 SB46-G08-122001 12/20/2001	JAX47-SB46 SB46-G20-122001 12/20/2001	JAX47-SB47 SB47-G08-121801 12/18/2001
LABORATORY FIXED/MOBILE			**F**	**F**	**F**	**F**	**F**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	7	340	5 U	5 U	5 U	5 U	5 U
1,2,4-TRICHLOROBENZENE	70	190	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROBENZENE	600	370	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROETHANE	3	0.12	5 U	5 U	5 U	5 U	5 U
1,3-DICHLOROBENZENE	10	5.5	5 U	5 U	5 U	5 U	0.8 J
1,4-DICHLOROBENZENE	75	0.5	5 U	5 U	5 U	5 U	4 J
1-METHYLNAPHTHALENE	20	NL	NA	NA	NA	NA	NA
2-BUTANONE	4200	1900	5 U	5 U	5 U	5 U	10
2-HEXANONE	280	NL	5 U	5 U	5 U	5 U	5 U
2-METHYLNAPHTHALENE	20	6.2	NA	NA	NA	NA	NA
4-METHYL-2-PENTANONE	560	160	5 U	5 U	5 U	5 U	5 U
ACETONE	700	610	5 U	9 U	10 U	14 U	25 U
BENZENE	1	0.34	5 U	5 U	5 U	5 U	3 J
BROMOMETHANE	9.8	8.7	5 U	5 U	5 U	5 U	5 U
CARBON DISULFIDE	700	1000	5 U	5 U	5 U	5 U	0.7 J
CHLOROBENZENE	100	110	5 U	5 U	5 U	5 U	22
CHLOROETHANE	12	4.6	5 U	5 U	5 U	5 U	5 U
CHLOROFORM	5.7	6.2	5 U	5 U	0.4 J	5 U	5 U
CHLOROMETHANE	2.7	1.5	5 U	5 U	5 U	5 U	5 U
CIS-1,2-DICHLOROETHENE	70	61	5 U	5 U	5 U	5 U	0.6 J
CYCLOHEXANE	NL	35000	5 U	5 U	5 U	5 U	110
ETHYLBENZENE	30	2.9	5 U	5 U	5 U	5 U	**110**
ISOPROPYLBENZENE	0.8	660	5 U	5 U	5 U	5 U	**26**
M+P-XYLENES	NL[1]	NL	NA	NA	NA	NA	NA
METHYL ACETATE	5000	6100	5 U	5 U	5 U	5 U	5 U
METHYL CYCLOHEXANE	NL	5200	5 U	5 U	1 J	1 J	72
METHYL TERT-BUTYL ETHER	50	13	5 U	5 U	5 U	0.2 J	5 U
NAPHTHALENE	20	6.2	NA	NA	NA	NA	NA
O-XYLENE	NL	210	NA	NA	NA	NA	NA
STYRENE	100	1600	5 U	5 U	5 U	5 U	5 U
TETRACHLOROETHENE	3	0.66	5 U	5 U	5 U	5 U	5 U
TOLUENE	40	720	5 U	5 U	5 U	5 U	1 J
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	5 U	5 U	5 U	5 U	**65**
TRANS-1,2-DICHLOROETHENE	100	120	5 U	5 U	5 U	5 U	5 U
TRICHLOROETHENE	3	0.028	5 U	5 U	5 U	5 U	5 U
VINYL CHLORIDE	1	0.02	5 U	5 U	5 U	5 U	5 U

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB47 SB47-G20-121801 12/18/2001	JAX47-SB48 SB48-G08-121801 12/18/2001	JAX47-SB48 SB48-G20-121801 12/18/2001	JAX47-SB57 SB57-G08-121901 12/19/2001	JAX47-SB57 SB57-G20-121901 12/19/2001
LABORATORY FIXED/MOBILE			**F**	**F**	**F**	**F**	**F**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	7	340	5 U	5 U	5 U	5 U	5 U
1,2,4-TRICHLOROBENZENE	70	190	5 U	9 U	5 U	5 U	5 U
1,2-DICHLOROBENZENE	600	370	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROETHANE	3	0.12	5 U	5 U	5 U	5 U	5 U
1,3-DICHLOROBENZENE	10	5.5	5 U	0.4 J	5 U	5 U	5 U
1,4-DICHLOROBENZENE	75	0.5	5 U	5 U	5 U	5 U	5 U
1-METHYLNAPHTHALENE	20	NL	NA	NA	NA	NA	NA
2-BUTANONE	4200	1900	5 U	4 J	5 U	5 U	5 U
2-HEXANONE	280	NL	5 U	5 U	5 U	5 U	5 U
2-METHYLNAPHTHALENE	20	6.2	NA	NA	NA	NA	NA
4-METHYL-2-PENTANONE	560	160	5 U	5 U	5 U	5 U	5 U
ACETONE	700	610	6 U	14 U	8 U	5 U	5 U
BENZENE	1	0.34	5 U	0.7 J	5 U	6	5
BROMOMETHANE	9.8	8.7	5 U	5 U	5 U	5 U	5 U
CARBON DISULFIDE	700	1000	5 U	5 U	5 U	5 U	5 U
CHLOROBENZENE	100	110	5 U	11	5 U	5 U	5 U
CHLOROETHANE	12	4.6	5 U	5 U	5 U	5 U	5 U
CHLOROFORM	5.7	6.2	5 U	5 U	5 U	5 U	5 U
CHLOROMETHANE	2.7	1.5	5 U	5 U	0.8 J	5 U	5 U
CIS-1,2-DICHLOROETHENE	70	61	5 U	5 U	5 U	**230**	**73**
CYCLOHEXANE	NL	35000	5 U	5 U	5 U	5 U	5 U
ETHYLBENZENE	30	2.9	5 U	13	5 U	60	5 U
ISOPROPYLBENZENE	0.8	660	5 U	**3 J**	5 U	**4 J**	3 J
M+P-XYLENES	NL[1]	NL	NA	NA	NA	NA	NA
METHYL ACETATE	5000	6100	5 U	5 U	5 U	5	5
METHYL CYCLOHEXANE	NL	5200	5 U	5 U	5 U	5 U	5 U
METHYL TERT-BUTYL ETHER	50	13	5 U	5 U	5 U	5 U	5 U
NAPHTHALENE	20	6.2	NA	NA	NA	NA	NA
O-XYLENE	NL	210	NA	NA	NA	NA	NA
STYRENE	100	1600	5 U	1 J	5 U	5 U	5 U
TETRACHLOROETHENE	3	0.66	5 U	5 U	5 U	1 J	3 J
TOLUENE	40	720	5 U	0.8 J	5 U	2 J	0.4 J
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	5 U	**23**	5 U	9	3 J
TRANS-1,2-DICHLOROETHENE	100	120	5 U	5 U	5 U	4 J	5 U
TRICHLOROETHENE	3	0.028	5 U	5 U	5 U	5 U	**13**
VINYL CHLORIDE	1	0.02	5 U	5 U	5 U	**4 J**	5 U

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB57 SB57-G36-121901 12/19/2001	JAX47-SB60 SB60-G08-122001 12/20/2001	USGS-DSMW46 USGS(D)-040902 4/9/2002	USGS-SSMW45 USGS(S)-040902 4/9/2002	JAX47-536-MW03 MW5363-062501 6/25/2001
LABORATORY FIXED/MOBILE			**F**	**F**	**F**	**F**	**M**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	5 U	5 U	5 U	5 U	NA
1,1-DICHLOROETHENE	7	340	5 U	5 U	5 U	5 U	NA
1,2,4-TRICHLOROBENZENE	70	190	5 U	5 U	5 U	5 U	NA
1,2-DICHLOROBENZENE	600	370	5 U	5 U	5 U	5 U	NA
1,2-DICHLOROETHANE	3	0.12	5 U	5 U	5 U	5 U	NA
1,3-DICHLOROBENZENE	10	5.5	5 U	5 U	5 U	5 U	NA
1,4-DICHLOROBENZENE	75	0.5	5 U	5 U	5 U	5 U	NA
1-METHYLNAPHTHALENE	20	NL	NA	NA	NA	NA	16.2
2-BUTANONE	4200	1900	5 U	5 U	5 U	5 U	NA
2-HEXANONE	280	NL	5 U	5 U	5 U	5 U	NA
2-METHYLNAPHTHALENE	20	6.2	NA	NA	NA	NA	16.5
4-METHYL-2-PENTANONE	560	160	5 U	5 U	5 U	5 U	NA
ACETONE	700	610	5 U	13 U	5 U	5 U	NA
BENZENE	1	0.34	5 U	5 U	5 U	5 U	1 U
BROMOMETHANE	9.8	8.7	5 U	5 U	5 U	5 U	NA
CARBON DISULFIDE	700	1000	5 U	5 U	0.8 J	0.8 J	NA
CHLOROBENZENE	100	110	5 U	5 U	5 U	5 U	NA
CHLOROETHANE	12	4.6	5 U	5 U	5 U	5 U	NA
CHLOROFORM	5.7	6.2	5 U	5 U	5 U	5 U	NA
CHLOROMETHANE	2.7	1.5	5 U	5 U	5 U	5 U	NA
CIS-1,2-DICHLOROETHENE	70	61	5 U	0.3 J	5 U	5 U	1.2
CYCLOHEXANE	NL	35000	5 U	5 U	5 U	5 U	NA
ETHYLBENZENE	30	2.9	5 U	5 U	5 U	5 U	1.6
ISOPROPYLBENZENE	0.8	660	5 U	5 U	5 U	5 U	NA
M+P-XYLENES	NL[1]	NL	NA	NA	NA	NA	3.5
METHYL ACETATE	5000	6100	5 U	5 U	5 U	5 U	NA
METHYL CYCLOHEXANE	NL	5200	5 U	5 U	5 U	5 U	NA
METHYL TERT-BUTYL ETHER	50	13	5 U	5 U	5 U	5 U	NA
NAPHTHALENE	20	6.2	NA	NA	NA	NA	6.5
O-XYLENE	NL	210	NA	NA	NA	NA	2.5
STYRENE	100	1600	5 U	5 U	5 U	5 U	NA
TETRACHLOROETHENE	3	0.66	5 U	5 U	5 U	5 U	1 U
TOLUENE	40	720	5 U	5 U	5 U	5 U	1 U
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	5 U	5 U	5 U	5 U	NA
TRANS-1,2-DICHLOROETHENE	100	120	5 U	5 U	5 U	5 U	1 U
TRICHLOROETHENE	3	0.028	5 U	5 U	5 U	5 U	1.8
VINYL CHLORIDE	1	0.02	5 U	5 U	5 U	5 U	1 U

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-937-MW01S MW9371-062501 6/25/2001	JAX47-937-MW02S MW9372-062501 6/25/2001	JAX47-937-MW03S MW9373-062501 6/25/2001	JAX47-937-MW04S MW9374-062501 6/25/2001	JAX47-937-MW05S MW9375-062501 6/25/2001
LABORATORY FIXED/MOBILE			**M**	**M**	**M**	**M**	**M**
Volatile Organics (ug/L)							
1,1-DICHLOROETHANE	70	810	NA	NA	NA	NA	NA
1,1-DICHLOROETHENE	7	340	NA	NA	NA	NA	NA
1,2,4-TRICHLOROBENZENE	70	190	NA	NA	NA	NA	NA
1,2-DICHLOROBENZENE	600	370	NA	NA	NA	NA	NA
1,2-DICHLOROETHANE	3	0.12	NA	NA	NA	NA	NA
1,3-DICHLOROBENZENE	10	5.5	NA	NA	NA	NA	NA
1,4-DICHLOROBENZENE	75	0.5	NA	NA	NA	NA	NA
1-METHYLNAPHTHALENE	20	NL	36.7	10 U	10 U	100 U	10 U
2-BUTANONE	4200	1900	NA	NA	NA	NA	NA
2-HEXANONE	280	NL	NA	NA	NA	NA	NA
2-METHYLNAPHTHALENE	20	6.2	65	10 U	10 U	100 U	10 U
4-METHYL-2-PENTANONE	560	160	NA	NA	NA	NA	NA
ACETONE	700	610	NA	NA	NA	NA	NA
BENZENE	1	0.34	7.4	1 U	1 U	0	1 U
BROMOMETHANE	9.8	8.7	NA	NA	NA	NA	NA
CARBON DISULFIDE	700	1000	NA	NA	NA	NA	NA
CHLOROBENZENE	100	110	NA	NA	NA	NA	NA
CHLOROETHANE	12	4.6	NA	NA	NA	NA	NA
CHLOROFORM	5.7	6.2	NA	NA	NA	NA	NA
CHLOROMETHANE	2.7	1.5	NA	NA	NA	NA	NA
CIS-1,2-DICHLOROETHENE	70	61	**380**	47.4	**79.3**	**360**	45.2
CYCLOHEXANE	NL	35000	NA	NA	NA	NA	NA
ETHYLBENZENE	30	2.9	110	4.5	1 U	140	1 U
ISOPROPYLBENZENE	0.8	660	NA	NA	NA	NA	NA
M+P-XYLENES	NL[1]	NL	**760**	1 U	3.2	**930**	1 U
METHYL ACETATE	5000	6100	NA	NA	NA	NA	NA
METHYL CYCLOHEXANE	NL	5200	NA	NA	NA	NA	NA
METHYL TERT-BUTYL ETHER	50	13	NA	NA	NA	NA	NA
NAPHTHALENE	20	6.2	**130**	3 U	5.2	**150**	3 U
O-XYLENE	NL	210	**1200**	1 U	3.3	**1400**	1 U
STYRENE	100	1600	NA	NA	NA	NA	NA
TETRACHLOROETHENE	3	0.66	**14**	**21.7**	2.3	**23**	**4.6**
TOLUENE	40	720	**50.2**	1 U	1 U	**67**	1 U
TOTAL 1,2-DICHLOROETHENE	63	61	NA	NA	NA	NA	NA
TOTAL XYLENES	20	210	NA	NA	NA	NA	NA
TRANS-1,2-DICHLOROETHENE	100	120	1 U	1 U	1 U	10 U	1 U
TRICHLOROETHENE	3	0.028	**3.2**	**6.6**	**6.3**	10 U	2.5
VINYL CHLORIDE	1	0.02	1 U	1 U	1 U	10 U	1 U

See notes at end of table.

Table 5-5
Summary of Detected VOCs in Groundwater-Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE NUMBER* SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-937-MW06D MW9376-062501 6/25/2001
LABORATORY FIXED/MOBILE			**M**
Volatile Organics (ug/L)			
1,1-DICHLOROETHANE	70	810	NA
1,1-DICHLOROETHENE	7	340	NA
1,2,4-TRICHLOROBENZENE	70	190	NA
1,2-DICHLOROBENZENE	600	370	NA
1,2-DICHLOROETHANE	3	0.12	NA
1,3-DICHLOROBENZENE	10	5.5	NA
1,4-DICHLOROBENZENE	75	0.5	NA
1-METHYLNAPHTHALENE	20	NL	10 U
2-BUTANONE	4200	1900	NA
2-HEXANONE	280	NL	NA
2-METHYLNAPHTHALENE	20	6.2	10 U
4-METHYL-2-PENTANONE	560	160	NA
ACETONE	700	610	NA
BENZENE	1	0.34	1 U
BROMOMETHANE	9.8	8.7	NA
CARBON DISULFIDE	700	1000	NA
CHLOROBENZENE	100	110	NA
CHLOROETHANE	12	4.6	NA
CHLOROFORM	5.7	6.2	NA
CHLOROMETHANE	2.7	1.5	NA
CIS-1,2-DICHLOROETHENE	70	61	3.9
CYCLOHEXANE	NL	35000	NA
ETHYLBENZENE	30	2.9	1 U
ISOPROPYLBENZENE	0.8	660	NA
M+P-XYLENES	NL[1]	NL	1 U
METHYL ACETATE	5000	6100	NA
METHYL CYCLOHEXANE	NL	5200	NA
METHYL TERT-BUTYL ETHER	50	13	NA
NAPHTHALENE	20	6.2	3 U
O-XYLENE	NL	210	1 U
STYRENE	100	1600	NA
TETRACHLOROETHENE	3	0.66	1 U
TOLUENE	40	720	1 U
TOTAL 1,2-DICHLOROETHENE	63	61	NA
TOTAL XYLENES	20	210	NA
TRANS-1,2-DICHLOROETHENE	100	120	1 U
TRICHLOROETHENE	3	0.028	1 U
VINYL CHLORIDE	1	0.02	1 U

See notes at end of table.

Notes:
[1] GCTL for Total Xylenes = 20 µg/L
GCTL = Groundwater Cleanup Target Level
F = Fixed-Base Laboratory
M = Mobile Laboratory
J = Estimated
NA = not analyzed
NL - GCTL not listed in 62-770 FAC
U = Less than Laboratory Detection Limit
PRGs = Preliminary Remedial Goals
* = PSC47 prefix was dropped from each sample number.

Table 5-6
Summary of Detected SVOCs in Groundwater-Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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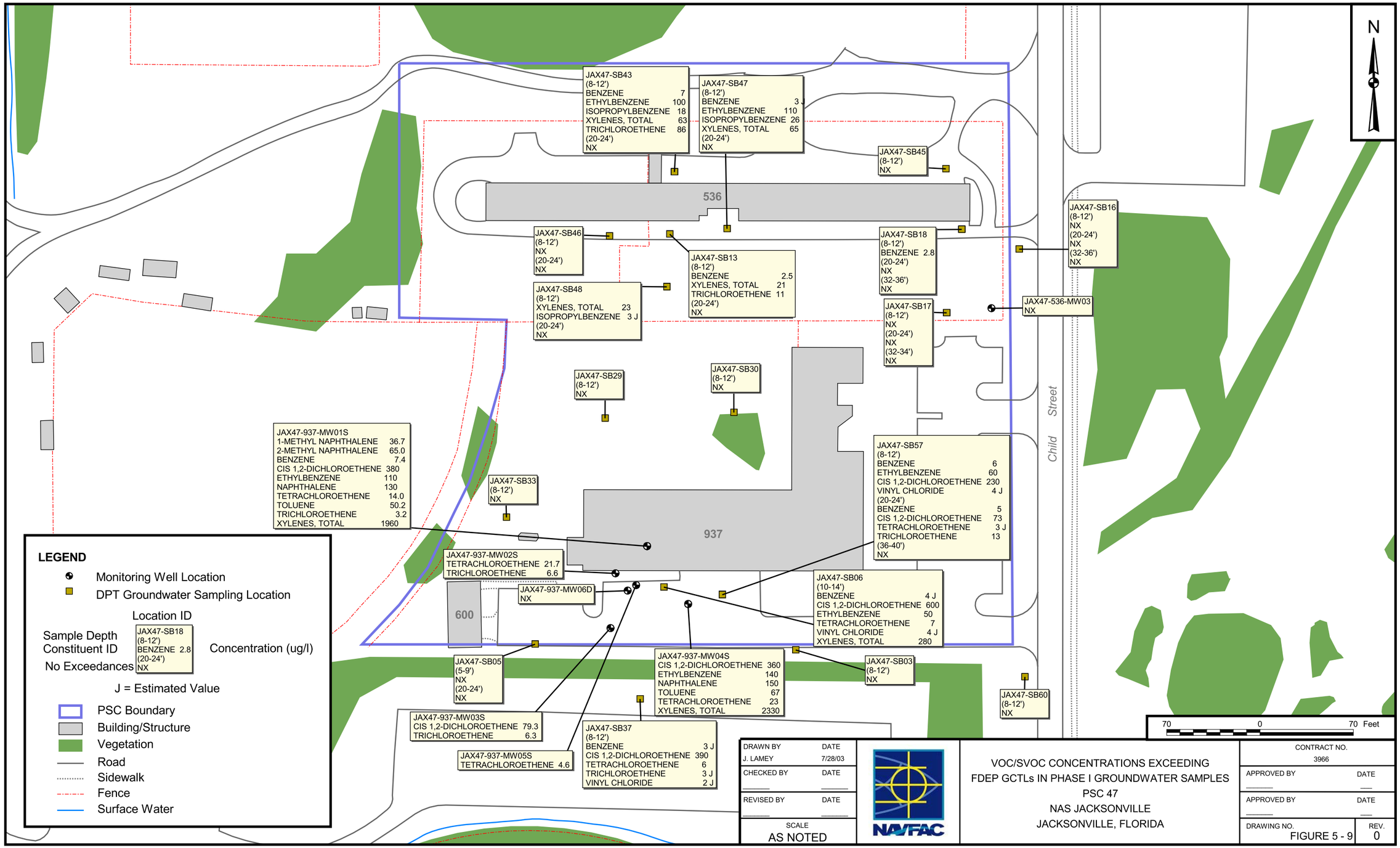
LOCATION SAMPLE NUMBER SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	JAX47-SB03 JAX47-SB03-G08-070501 7/5/2001	JAX47-SB05 JAX47-SB05-G05-070601 7/6/2001	JAX47-SB06 JAX47-SB06-G10-070601 7/6/2001
Semivolatile Organics (ug/L)					
2,4-DICHLOROPHENOL	0.5	110	10 U	**8 J**	10 U
2,4-DIMETHYLPHENOL	140	730	10 U	10 U	4 J
2-METHYLNAPHTHALENE	20	6.2	10 U	10 U	**52**
2-METHYLPHENOL	35	1800	10 U	10 U	2 J
4-METHYLPHENOL	4	180	10 U	3 J	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8	10 U	5 J	5 J
DI-N-BUTYL PHTHALATE	700	3600	10 U	10 U	0.9 J
DIETHYL PHTHALATE	5600	29000	10 U	10 U	2 J
FLUORENE	280	240	10 U	10 U	10 U
NAPHTHALENE	20	6.2	0.8 J	10 U	**60**
PHENANTHRENE	210	180	10 U	10 U	10 U

LOCATION SAMPLE NUMBER SAMPLE DATE	FDEP GCTLs (ug/L)	REGION 9 PRGs (ug/L)	USGS-DSMW46 JAX47-USGS(D)-040902 4/9/2002	USGS-SSMW45 JAX47-USGS(S)-040902 4/9/2002
Semivolatile Organics (ug/L)				
2,4-DICHLOROPHENOL	0.5	110	11 U	10 U
2,4-DIMETHYLPHENOL	140	730	11 U	10 U
2-METHYLNAPHTHALENE	20	6.2	11 U	10 U
2-METHYLPHENOL	35	1800	11 U	10 U
4-METHYLPHENOL	4	180	11 U	10 U
BIS(2-ETHYLHEXYL)PHTHALATE	6	4.8	11 U	10 U
DI-N-BUTYL PHTHALATE	700	3600	11 U	0.9 J
DIETHYL PHTHALATE	5600	29000	11 U	10 U
FLUORENE	280	240	11 U	10 U
NAPHTHALENE	20	6.2	11 U	10 U
PHENANTHRENE	210	180	11 U	10 U

Notes:
Bold values exceed GCTLs
GCTL = Groundwater Cleanup Target Level
PRGs = Preliminary Remedial Goals
U = Less than Laboratory Detection Limit
J = Estimated value
NA = Not analyzed

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR PHASE I VOC/SVOC GROUNDWATER EXCEEDANCES 5/11/07 SP



DRAWN BY	DATE
J. LAMEY	7/28/03
CHECKED BY	DATE
REVISED BY	DATE
SCALE	
AS NOTED	

NAVFAC

VOC/SVOC CONCENTRATIONS EXCEEDING
FDEP GCTLs IN PHASE I GROUNDWATER SAMPLES
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO.	
3966	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 5 - 9	REV. 0

Grab samples were collected from eight DPT borings located in and around the former DVECC tank and analyzed for constituents in the mobile laboratory's "hydrocarbon short list". Generally, targeted constituents were identified in samples collected within and to the south and southeast of the network of permanent wells and were absent in samples to the southwest (SB05), northwest (SB33) and north (SB29 and -30) of the former DVECC tank location (Please refer to Figure 5-9). The identity and location of the highest concentrations of the 11 hydrocarbon compounds identified in the southern plume are as follows:

- Benzene, 1-methylnaphthalene, and 2-methylnaphthalene in MW01S (as detailed above).

- Toluene (67 µg/L), ethylbenzene (140 µg/L), total xylenes (2,330 µg/L), PCE (23 µg/L), and naphthalene (150 µg/L) in MW04S, approximately 50 ft southeast of the former DVECC tank.

- cis-DCE (600 µg/L) in a sample collected 10-14 ft bls from DPT boring SB06 in center of former DVECC tank excavation.

- TCE (13 µg/L) in a sample collected 20-24 ft bls from DPT boring SB57, located approximately 45 ft east-southeast of the former tank location.

- Vinyl chloride (4 µg/L) (estimated) in SB57 (8-12 ft bls) and SB06 (10-14 ft bls).

The absence of constituents in samples collected from borings SB33, SB29, and SB30 provides strong evidence that the southern and northern plumes are separate entities originating from different source areas.

- Four petroleum hydrocarbons (benzene, ethylbenzene, total xylenes, and isopropylbenzene) and one chlorinated hydrocarbon (TCE) were identified at elevated levels in the northern plume area near the central portion of the Pesticide Shop. Two or more GCTL exceedances were reported in four shallow DPT samples (8 to 12 ft bls), three collected south of the Pesticide Shop (SB13, SB47, and SB48) and one north of the Pesticide Shop (SB43). Each of the five constituents listed above was reported at concentrations exceeding GCTLs in the northernmost sample, SB43. Four exceedances were reported in SB47, located approximately 55 ft southeast of SB43. Three GCTL exceedances were reported in SB13 and two in SB48. Highest concentrations of the individual constituents were reported as follows: benzene (7 µg/L) and TCE (86 µg/L) in SB43; and ethylbenzene (110 µg/L), total xylenes (65 µg/L), and isopropylbenzene (26 µg/L) in SB47. Samples from an intermediate interval (20 to 24 ft bls) were also collected and analyzed for the hydrocarbon COCs at these four locations and no exceedances were reported.

Since the location of the former eastern soakage pit near the southeast corner of the Pesticide Shop was considered another potential source area of VOC/SVOC contamination, based upon previous analytical data and site historical operations, DPT grab samples were collected from four borings advanced in this area including one (SB18) which penetrated the former soakage pit itself. Shallow, intermediate, and deep samples from three of the four DPT borings (including SB18) were analyzed for hydrocarbon COCs. A sample collected from HLA's shallow microwell (MW03), located approximately 50 ft southeast of the former soakage pit location, was also analyzed for these constituents. Benzene was identified at a concentration of 2.8 µg/L in the shallow SB18 (soakage pit) sample (8 to 12 ft bls). This was the only VOC or SVOC GCTL exceedance reported in the area.

Evidence also exists that hydrocarbon compounds are present at concentrations exceeding GCTLs in the outlying area south (upgradient) of the DVECC source area where pesticide contamination was discovered, as noted in the previous section. Of the three DPT locations in this area where groundwater grab samples were analyzed for pesticides (SB37, SB38, and SB58), only samples from the shallow interval of SB37 (8-12 ft bls) were analyzed for VOCs. As shown on Figure 5-9, GCTL exceedances reported in this sample were primarily chlorinated solvents, most notably cis-1,2-DCE at a concentration of 390 µg/L and PCE at a concentration of 6 µg/L. Other GCTL exceedances reported in this sample were all "J", or estimated values: benzene and TCE (3 µg/L) and vinyl chloride (2 µg/L).

5.3.2.1.3 TCL Herbicides

It was determined during the DQO process that approximately 10 percent of the groundwater grab samples collected by DPT during Phase I would be sent to a fixed-base laboratory for analysis of TCL herbicides. Several of these compounds had been identified at elevated concentrations in soil and/or groundwater samples in pre-RI investigations (BRE, 1997 and HLA, 1999).

Ten (10) groundwater samples (six shallow, one intermediate, and three deep) were analyzed for TCL herbicides during the Phase I investigation. Half of the analyzed samples were collected in the southern portion of the site near Building 937, and the other half were collected around Building 536. None of the 12 compounds included in the list of TCL herbicides was reported at a concentration exceeding its GCTL, although some were reported at concentrations exceeding laboratory detection limits. A summary of these detections is provided in Table 5-7.

5.3.2.1.4 Dioxins

Four groundwater samples from the DVECC area (three shallow and one deep) were analyzed for dioxins. Dioxins are reported in picograms per liter (pg/L) or parts per trillion. Seventeen (17) complexes of dibenzodioxins and dibenzofurans, with specific numerical molecular structures, are included in

Table 5-7
Summary of Detected Dioxins and Herbicides in Groundwater-Phase I

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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Jacksonville, Florida
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LOCATION SAMPLE NUMBER SAMPLE DATE	FDEP GCTLs	REGION 9 PRGs	JAX47-SB03 JAX47-SB03-G08-070501 7/5/2001	JAX47-SB05 JAX47-SB05-G05-070601 7/6/2001	JAX47-SB06 JAX47-SB06-G10-070601 7/6/2001	JAX47-SB07 JAX47-SB07-G20-070501 7/5/2001	JAX47-SB13 JAX47-SB13-G08-070601 7/6/2001
Herbicides (ug/L)							
2,4-D	70	360	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ
DICAMBA	210	1100	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
DICHLOROPROP	35	NL	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ	0.54 R
DINOSEB	7	36	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
MCPA	3.5	18	100 UR	100 UR	100 UR	100 UJ	100 J
PENTACHLOROPHENOL	1	0.56	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.2 J
Dioxins/Furans (pg/L)							
1,2,3,4,6,7,8,9-OCDD	NL*	NL*	NA	81.44	26.97 U	NA	NA
1,2,3,4,6,7,8-HPCDD	NL*	NL*	NA	8.408	3.514 U	NA	NA
1,2,3,7,8,9-HXCDD	NL*	NL*	NA	1.044 U	0.987 U	NA	NA
TOTAL HPCDD	NL*	NL*	NA	22.33	9.056 U	NA	NA
TOTAL HXCDD	NL*	NL*	NA	14.95	0.968 U	NA	NA
TOTAL PECDD	NL*	NL*	NA	5.152	0.966 U	NA	NA
TOTAL TCDD	NL*	NL*	NA	3.580	13.01	NA	NA

LOCATION SAMPLE NUMBER SAMPLE DATE	FDEP GCTLs	REGION 9 PRGs	JAX47-SB18 JAX47-SB18-G32-070601 7/6/2001	JAX47-SB28 JAX47-SB28-G10-070601 7/6/2001	JAX47-SB32 JAX47-SB32-G36-070601 7/6/2001	JAX47-SB33 JAX47-SB33-G28-070601 7/6/2001	JAX47-SB38 JAX47-SB38-G08-070501 7/5/2001
Herbicides (ug/L)							
2,4-D	70	360	2.5 UJ	2.5 UJ	2.5 UJ	2.2 J	25 J
DICAMBA	210	1100	1 UJ	0.36 J	1 UJ	1 UJ	1 UJ
DICHLOROPROP	35	NL	1.5 UJ	1.5 UJ	1.5 UJ	1.5 UJ	1.6 J
DINOSEB	7	36	1 UJ	1 UJ	1 UJ	1.5 J	6.7 J
MCPA	3.5	18	100 UR	100 UR	100 UR	100 UR	100 UR
PENTACHLOROPHENOL	1	0.56	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
Dioxins/Furans (pg/L)							
1,2,3,4,6,7,8,9-OCDD	NL*	NL*	NA	NA	NA	251.9	422.2
1,2,3,4,6,7,8-HPCDD	NL*	NL*	NA	NA	NA	61.91	17.31 U
1,2,3,7,8,9-HXCDD	NL*	NL*	NA	NA	NA	14.59	1.079 U
TOTAL HPCDD	NL*	NL*	NA	NA	NA	147.5	27.44
TOTAL HXCDD	NL*	NL*	NA	NA	NA	218.7	13.09
TOTAL PECDD	NL*	NL*	NA	NA	NA	107.7	1.200 U
TOTAL TCDD	NL*	NL*	NA	NA	NA	138.0	2.309 U

Notes:
* The EPA and FDEP criteria is for 2,3,7,8-TCDD.
NA - Not analyzed
NL - Not listed
U - Less than laboratory Detection Limit
J - Estimated
R - Rejected

laboratory analyses of "dioxins". At least one compound was identified in each of the four samples at concentrations exceeding reporting limits: one in SB06 (10-14 ft), three in SB38 (8 to 12 ft), six in SB05 (5 to 9 ft), and seven in SB33 (28 to 32 ft). A list showing concentrations of detected dioxin complexes is included in Table 5-7.

5.3.2.1.5 OP Pesticides

Since there was documented historical usage of malathion at the site, the NAS Jacksonville Partnering Team requested that 10 percent of the groundwater grab samples collected by DPT during Phase I be sent to a fixed-base laboratory for analysis of OP pesticides. Consequently, nine groundwater samples (five shallow, one intermediate, and three deep) were analyzed for these constituents. Nineteen (19) compounds are included in this group of analytes and none were detected.

5.3.2.1.6 PCBs

Two shallow groundwater samples, one collected southeast of the former DVECC tank location (SB03) and another collected southwest of the former DVECC tank location (SB05), were analyzed for PCBs. Although PCBs had not been reported at elevated concentrations during previous site investigations, the NAS Jacksonville Partnering Team requested that two samples from locations considered most likely to be impacted by PCBs be analyzed for these compounds. Samples from SB03 and SB05 were selected because of their proximity to the DVECC tank. No PCBs were detected. The reporting limit for each aroclor congener (0.5 µg/L) was equal to the GCTL.

5.3.2.2 Permanent Monitoring Well Groundwater Analytical Results (Phase II and Phase III)

5.3.2.2.1 TCL Pesticides

Detected TCL pesticide concentrations in samples collected from the permanent monitoring well network during Phase II and III groundwater sampling activities are listed in Table 5-8 and validated laboratory reports are provided in Appendix J. Groundwater pesticide concentrations exceeding FDEP GCTLs during Phase II (2002/2003) and Phase III (2006/2007) are shown on Figure 5-10. Phase III groundwater data will be used preferentially over Phase II data as it is most representative of current site conditions. Phase II data is presented for trend comparison purposes.

During Phase III groundwater sampling, 10 TCL pesticide compounds were reported at concentrations exceeding GCTLs. Each of these had also been identified at elevated levels in at least one sample during Phase I sampling. Three compounds reported at elevated levels in Phase I were not identified at

Table 5-8
Summary of Detected Pesticide Concentrations in Groundwater Samples

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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-536-MW03 536-MW03-040902 04/09/02	JAX47-937-MW01S 937-MW01S-041102 04/11/02	JAX47-937-MW01S 937-MW01S-041102-D 04/11/02	JAX47-937-MW01S 937-MW01S-112906 11/29/06	JAX47-937-MW02S 937-MW02S-041002 04/09/02	JAX47-937-MW02S 937-MW02S-113006 11/30/06	JAX47-937-MW03S 937-MW03S-041102 04/11/02	JAX47-937-MW03S 937-MW03S-072505 07/25/05
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	**48 [G]**	0.10 U	0.10 U	0.0004 U	0.10 U	0.071 J	**20 [G]**	**34.5 [G]**
4,4'-DDE	0.1	0.2	**0.92 J [G]**	0.10 U	0.10 U	0.002 U	0.10 U	0.033 J	**0.15 J [G]**	0.97 U
4,4'-DDT	0.1	0.2	2.3 U	0.10 U	0.10 U	0.002 U	0.10 U	0.002 U	**5.7 [G]**	0.97 U
ALDRIN	0.002	0.004	1.2 U	0.05 U	0.05 U	0.002 U	0.05 U	**3.5 J [G]**	0.47 U	0.97 U
ALPHA-BHC	0.006	0.011	**4.2 [G]**	0.05 UJ	**0.11 J [G]**	0.004 J	0.05 U	0.001 U	**2.4 [G]**	**5.3 [G]**
ALPHA-CHLORDANE	2	0.19	1.2 U	0.05 U	0.05 U	0.005 J	0.05 U	0.27 J	0.47 U	0.49 U
BETA-BHC	0.02	0.037	1.2 U	0.05 U	0.05 U	0.002 U	0.05 U	**0.097 J [G]**	**1.2 [G]**	**3.6 [G]**
DELTA-BHC	2.1	0.011	**4.6 [G]**	0.05 U	0.05 U	0.02 J	0.05 U	0.42 J	**3.6 [G]**	**7.1 [G]**
DIELDRIN	0.002	0.0042	2.3 U	0.10 U	0.10 U	**0.003 J [G]**	0.10 U	0.0008 U	**0.83 J [G]**	**1.8 I [G]**
ENDOSULFAN I	NC	220	1.2 U	0.05 U	0.05 U	0.002 U	0.05 U	0.002 U	0.47 U	0.49 U
ENDOSULFAN II	NC	220	2.3 U	0.10 U	0.10 U	0.002 U	0.10 U	0.002 U	0.94 U	0.97 U
ENDOSULFAN SULFATE	NC	220	2.3 U	0.10 U	0.10 U	0.072 J	0.10 U	0.045 J	0.94 U	0.97 U
ENDRIN	2	11	2.3 U	0.10 U	0.10 U	0.002 J	0.10 U	0.002 UJ	0.94 U	1.9 U
ENDRIN ALDEHYDE	NC	11	2.3 U	0.10 U	0.10 U	0.009 U	0.10 U	0.009 U	0.94 U	1.9 U
ENDRIN KETONE	NC	11	2.3 U	0.10 U	0.10 U	0.003 U	0.10 U	4.7 J	0.94 U	0.97 U
GAMMA-BHC (LINDANE)	0.2	0.052	1.2 U	0.05 U	0.05 U	0.002 UJ	0.05 U	0.007 J	**6.1 [G]**	**12.6 [G]**
GAMMA-CHLORDANE	2	0.19	1.2 U	0.05 U	0.05 U	0.001 U	0.05 U	0.001 UJ	0.47 U	0.49 U
HEPTACHLOR	0.4	0.015	1.2 U	0.05 U	0.05 U	0.013 J	0.05 U	0.001 U	0.47 U	0.97 U
HEPTACHLOR EPOXIDE	0.2	0.0074	1.2 U	0.05 U	0.05 U	0.001 U	0.05 U	0.001 U	0.47 U	0.49 U
METHOXYCHLOR	40	180	12 U	0.50 U	0.50 U	0.075 J	0.50 U	0.003 U	4.7 U	1.9 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-937-MW03S 937-MW03S-112906 11/29/06	JAX47-937-MW04S 937-MW04S-041102 04/11/02	JAX47-937-MW04S 937-MW04S-120106 12/01/06	JAX47-937-MW05S 937-MW05S-041002 04/09/02	JAX47-937-MW05S 937-MW05S-112906 11/29/06	JAX47-937-MW06D 937-MW06D-041102 04/11/02	JAX47-937-MW06D 937-MW06D-113006 11/30/06	JAX47-MW10S MW10S-040902 04/09/02
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	**13 J [G]**	1 U	**8.2 [G]**	**0.13 [G]**	0.076 J	0.10 U	0.0004 U	0.10 U
4,4'-DDE	0.1	0.2	0.094 J	1 U	0.056	0.10 U	**0.13 J [G]**	0.10 U	0.002 U	0.10 U
4,4'-DDT	0.1	0.2	0.013 J	1 U	0.002 U	0.10 U	0.002 U	0.10 U	0.002 U	0.10 U
ALDRIN	0.002	0.004	**2.6 J [G]**	0.50 U	**2.6 J [G]**	0.05 U	**3.8 J [G]**	0.05 U	0.002 U	0.05 U
ALPHA-BHC	0.006	0.011	**0.64 J [G]**	0.50 U	**0.45 [G]**	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U
ALPHA-CHLORDANE	2	0.19	0.14 J	0.50 U	0.001 U	0.054	0.58 J	0.05 U	0.001 U	0.05 U
BETA-BHC	0.02	0.037	**1.1 J [G]**	0.50 U	**3.9 J [G]**	0.05 U	0.002 U	0.05 U	0.002 U	0.05 U
DELTA-BHC	2.1	0.011	1.1 J	0.50 U	0.64	0.05 U	**4 J [G]**	0.05 U	0.001 U	0.05 U
DIELDRIN	0.002	0.0042	**0.32 J [G]**	1 U	**0.19 J [G]**	0.10 U	**0.018 J [G]**	0.10 U	0.0008 U	0.10 U
ENDOSULFAN I	NC	220	0.002 U	0.50 U	0.002 U	0.05 U	0.002 U	0.05 U	0.002 U	0.05 U
ENDOSULFAN II	NC	220	0.002 U	1 U	0.002 U	0.10 U	0.002 U	0.10 U	0.002 U	0.10 U
ENDOSULFAN SULFATE	NC	220	0.009 J	1 U	0.009 J	0.10 U	0.21 J	0.10 U	0.002 U	0.10 U
ENDRIN	2	11	0.002 U	1 U	0.008 J	0.10 U	0.044 J	0.10 U	0.002 UJ	0.10 U
ENDRIN ALDEHYDE	NC	11	0.009 U	1 U	0.009 U	0.10 U	0.009 U	0.10 U	0.009 U	0.10 U
ENDRIN KETONE	NC	11	0.23 J	1 U	0.18	0.10 U	1 J	0.10 U	0.004 J	0.10 U
GAMMA-BHC (LINDANE)	0.2	0.052	**1.1 J [G]**	0.50 U	**0.66 [G]**	0.05 U	0.058 J	0.05 U	0.002 U	0.05 U
GAMMA-CHLORDANE	2	0.19	0.001 U	0.50 U	0.001 U	0.05 U	0.039 J	0.05 U	0.001 UJ	0.05 U
HEPTACHLOR	0.4	0.015	0.018 J	0.50 U	0.001 U	0.05 U	0.029 J	0.05 U	0.001 U	0.05 U
HEPTACHLOR EPOXIDE	0.2	0.0074	0.036 J	0.50 U	0.02 J	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U
METHOXYCHLOR	40	180	0.025 J	5 U	0.003 UJ	0.50 U	1.1 J	0.50 U	0.003 U	0.50 U

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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW10S MW10S-113006 11/30/06	JAX47-MW11D MW11D-040402 04/04/02	JAX47-MW11D MW11D-120106 12/01/06	JAX47-MW11S MW11S-040402 04/04/02	JAX47-MW11S MW11S-120106 12/01/06	JAX47-MW12S MW12S-041002 04/10/02	JAX47-MW12S MW12S-120806 12/08/06	JAX47-MW13D MW13D-040402 04/04/02
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	0.0004 U	0.10 U	0.0004 U	0.48 U	0.0004 U	0.10 U	0.0004 U	**1.9 [G]**
4,4'-DDE	0.1	0.2	0.002 U	0.10 U	0.002 U	0.48 U	0.002 U	0.10 U	0.056 J	0.10 U
4,4'-DDT	0.1	0.2	0.002 U	0.10 U	0.003 J	0.48 U	0.007 J	0.10 U	0.002 U	**0.17 [G]**
ALDRIN	0.002	0.004	0.002 U	0.05 U	0.002 U	0.24 U	**0.11 J [G]**	0.05 U	0.002 U	0.05 U
ALPHA-BHC	0.006	0.011	0.001 U	0.05 U	0.001 U	**4.8 [G]**	**9.3 [G]**	0.05 U	**1.1 J [G]**	**0.057 [G]**
ALPHA-CHLORDANE	2	0.19	0.001 U	0.05 U	0.001 U	0.24 U	0.001 U	0.05 U	0.44 J	0.05 U
BETA-BHC	0.02	0.037	0.002 U	0.05 U	0.002 U	**1.7 [G]**	**1.2 [G]**	**1.3 [G]**	**0.7 J [G]**	0.05 U
DELTA-BHC	2.1	0.011	0.001 U	0.05 U	0.001 U	**4.2 [G]**	**8.3 [G]**	0.05 U	0.015 J	0.071
DIELDRIN	0.002	0.0042	0.0008 U	0.10 U	0.0008 U	0.48 U	**0.033 J [G]**	**0.023 J [G]**	**0.15 J [G]**	0.10 U
ENDOSULFAN I	NC	220	0.002 U	0.05 U	0.002 U	0.24 U	0.002 U	0.05 U	0.002 U	0.05 U
ENDOSULFAN II	NC	220	0.002 U	0.10 U	0.002 U	0.48 U	0.023 J	0.10 U	0.032 J	0.10 U
ENDOSULFAN SULFATE	NC	220	0.002 U	0.10 U	0.01 J	0.48 U	0.007 J	0.10 U	0.002 U	0.10 U
ENDRIN	2	11	0.002 UJ	0.10 U	0.002 U	0.48 U	0.021 J	0.10 U	0.002 U	0.10 U
ENDRIN ALDEHYDE	NC	11	0.009 U	0.10 U	0.009 U	0.48 U	0.009 U	0.10 U	0.009 U	0.10 U
ENDRIN KETONE	NC	11	0.003 UJ	0.10 U	0.003 U	0.48 U	0.003 U	0.10 U	0.027 J	0.10 U
GAMMA-BHC (LINDANE)	0.2	0.052	0.002 U	0.05 U	0.002 U	**8.4 [G]**	**15 [G]**	0.05 U	0.11 J	0.05 U
GAMMA-CHLORDANE	2	0.19	0.001 UJ	0.05 U	0.001 U	0.24 U	0.035 J	0.014 J	0.016 J	0.05 U
HEPTACHLOR	0.4	0.015	0.001 U	0.05 U	0.001 U	0.24 U	0.001 U	0.05 U	0.001 U	0.05 U
HEPTACHLOR EPOXIDE	0.2	0.0074	0.001 U	0.05 U	0.001 U	0.24 U	0.001 U	0.05 U	0.081 J	0.05 U
METHOXYCHLOR	40	180	0.003 U	0.50 U	0.003 UJ	2.4 U	1.1 J	0.50 U	0.003 UJ	0.50 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW13D MW13D-120106 12/01/06	JAX47-MW13S MW13S-040402 04/04/02	JAX47-MW13S MW13S-072505 07/25/05	JAX47-MW13S MW13S-120106 12/01/06	JAX47-MW13S MW13S-120106-D 12/01/06	JAX47-MW14D MW14D-041002 04/10/02	JAX47-MW14D MW14D-041002-D 04/10/02	JAX47-MW14D MW14D-120106 12/01/06
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	**0.31 [G]**	**3.1 [G]**	**3.4 [G]**	**0.69 [G]**	**0.54 [G]**	0.10 U	0.10 U	0.0004 U
4,4'-DDE	0.1	0.2	0.003 J	0.96 U	0.20 U	0.004 J	0.002 U	0.10 U	0.10 U	0.003 J
4,4'-DDT	0.1	0.2	0.002 U	**1.5 [G]**	**1.7 [G]**	**0.49 [G]**	**0.38 [G]**	0.10 U	0.10 U	0.003 J
ALDRIN	0.002	0.004	0.002 U	0.48 U	0.20 U	**0.011 J [G]**	**0.01 J [G]**	0.05 U	0.05 U	0.002 U
ALPHA-BHC	0.006	0.011	0.001 U	**14 [G]**	**1.2 [G]**	**2.7 [G]**	**2 [G]**	0.05 U	0.05 U	0.003 J
ALPHA-CHLORDANE	2	0.19	0.001 U	0.48 U	0.78	0.28 J	0.16 J	0.05 U	0.05 U	0.002 J
BETA-BHC	0.02	0.037	0.002 U	**1.2 [G]**	**0.38 I [G]**	**0.32 [G]**	**0.28 [G]**	0.05 U	0.05 U	0.002 U
DELTA-BHC	2.1	0.011	0.001 U	**10 [G]**	0.84	**2.3 [G]**	1.7	0.05 U	0.05 U	0.026 J
DIELDRIN	0.002	0.0042	0.0008 U	0.96 U	**0.32 I [G]**	**0.036 J [G]**	**0.038 J [G]**	0.10 U	0.10 U	0.0008 U
ENDOSULFAN I	NC	220	0.002 U	0.48 U	0.098 U	0.011 J	0.002 U	0.05 U	0.05 U	0.002 U
ENDOSULFAN II	NC	220	0.002 U	0.96 U	0.20 U	0.008 J	0.007 J	0.10 U	0.10 U	0.002 U
ENDOSULFAN SULFATE	NC	220	0.002 U	0.96 U	0.20 U	0.006 J	0.002 U	0.10 U	0.10 U	0.002 U
ENDRIN	2	11	0.002 U	0.96 U	0.39 U	0.025 J	0.021 J	0.10 U	0.10 U	0.002 U
ENDRIN ALDEHYDE	NC	11	0.009 U	0.96 U	0.39 U	0.021 J	0.011 J	0.10 U	0.10 U	0.009 U
ENDRIN KETONE	NC	11	0.003 UJ	0.96 U	0.20 U	0.017 J	0.006 J	0.10 U	0.10 U	0.019 J
GAMMA-BHC (LINDANE)	0.2	0.052	0.002 U	**22 [G]**	**1.1 [G]**	**3.3 [G]**	**2.5 [G]**	0.05 U	0.05 U	0.002 J
GAMMA-CHLORDANE	2	0.19	0.001 U	0.48 U	0.90	0.32	0.25	0.05 U	0.05 U	0.001 U
HEPTACHLOR	0.4	0.015	0.001 U	0.48 U	0.20 U	0.028 J	0.001 U	0.05 U	0.05 U	0.002 J
HEPTACHLOR EPOXIDE	0.2	0.0074	0.001 U	0.48 U	0.12 I	0.082 J	0.073 J	0.05 U	0.05 U	0.001 U
METHOXYCHLOR	40	180	0.003 U	4.8 U	0.39 U	0.011 J	0.003 U	0.50 U	0.50 U	0.003 UJ

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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW14S MW14S-120806 12/08/06	JAX47-MW15D MW15D-040802 04/08/02	JAX47-MW15D MW15D-112906 11/29/06	JAX47-MW15S MW15S-040802 04/08/02	JAX47-MW15S MW15S-040802-D 04/08/02	JAX47-MW15S MW15S-112906 11/29/06	JAX47-MW16D MW16D-040502 04/05/02	JAX47-MW16D MW16D-120506 12/05/06
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	0.0004 U	0.10 U	0.0004 U	0.10 U	0.10 U	0.0004 U	0.10 U	0.0004 U
4,4'-DDE	0.1	0.2	0.002 U	0.10 U	0.002 U	0.10 U	0.10 U	0.002 J	0.10 U	0.002 U
4,4'-DDT	0.1	0.2	0.002 U	0.10 U	0.002 U	0.10 U	0.10 U	0.002 U	0.10 U	0.002 U
ALDRIN	0.002	0.004	0.002 U	0.05 U	0.002 U	0.05 U	0.05 U	0.002 U	0.05 U	0.002 U
ALPHA-BHC	0.006	0.011	0.001 U	0.05 U	0.001 U	0.05 U	0.05 U	0.001 U	0.05 U	0.001 U
ALPHA-CHLORDANE	2	0.19	0.055 J	0.05 U	0.001 U	0.05 U	0.05 U	0.001 U	0.05 U	0.001 U
BETA-BHC	0.02	0.037	0.002 U	0.05 U	0.002 U	0.05 U	0.05 U	0.002 U	0.05 U	0.002 U
DELTA-BHC	2.1	0.011	0.001 U	0.05 U	0.002 J	0.05 U	0.05 U	0.001 U	0.05 U	0.003 J
DIELDRIN	0.002	0.0042	**0.003 J [G]**	0.10 U	0.0008 U	0.10 U	0.10 U	0.0008 U	0.10 U	0.0008 U
ENDOSULFAN I	NC	220	0.002 U	0.05 U	0.002 U	0.05 U	0.05 U	0.002 U	0.05 U	0.002 U
ENDOSULFAN II	NC	220	0.002 U	0.10 U	0.002 U	0.10 U	0.10 U	0.002 U	0.10 U	0.002 U
ENDOSULFAN SULFATE	NC	220	0.002 U	0.10 U	0.002 U	0.10 U	0.10 U	0.002 U	0.10 U	0.002 U
ENDRIN	2	11	0.002 U	0.10 U	0.002 U	0.10 U	0.10 U	0.002 U	0.10 U	0.002 U
ENDRIN ALDEHYDE	NC	11	0.009 U	0.10 U	0.009 U	0.10 U	0.10 U	0.009 U	0.10 U	0.009 U
ENDRIN KETONE	NC	11	0.01 J	0.10 U	0.003 U	0.10 U	0.10 U	0.003 U	0.10 U	0.003 UJ
GAMMA-BHC (LINDANE)	0.2	0.052	0.002 U	0.05 U	0.002 U	0.05 U	0.05 U	0.002 U	0.05 U	0.002 U
GAMMA-CHLORDANE	2	0.19	0.017 J	0.05 U	0.001 U	0.05 U	0.05 U	0.001 U	0.05 U	0.001 U
HEPTACHLOR	0.4	0.015	0.001 U	0.05 U	0.001 U	0.05 U	0.05 U	0.001 U	0.05 U	0.007 J
HEPTACHLOR EPOXIDE	0.2	0.0074	**0.62 J [G]**	0.05 U	0.001 U	0.05 U	0.05 U	0.001 U	0.05 U	0.001 U
METHOXYCHLOR	40	180	0.003 UJ	0.50 U	0.003 U	0.50 U	0.50 U	0.003 U	0.50 U	0.003 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW16S MW16S-040502 04/05/02	JAX47-MW16S MW16S-120506 12/05/06	JAX47-MW17D MW17D-040402 04/04/02	JAX47-MW17D MW17D-120506 12/05/06	JAX47-MW17S MW17S-040402 04/04/02	JAX47-MW17S MW17S-120506 12/05/06	JAX47-MW18D MW18D-040502 04/05/02	JAX47-MW18D MW18D-113006 11/30/06
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	0.10 U	0.0004 U	**0.26 [G]**	0.094	**6.5 [G]**	**25 J [G]**	0.10 U	0.0004 U
4,4'-DDE	0.1	0.2	0.10 U	0.002 U	0.10 U	0.002 U	0.48 U	0.036 J	0.10 U	0.002 U
4,4'-DDT	0.1	0.2	0.10 U	0.002 U	0.052 J	0.002 U	**1.1 [G]**	0.015 J	0.10 U	0.002 U
ALDRIN	0.002	0.004	0.05 U	0.002 U	0.05 U	0.002 U	0.24 U	**0.01 J [G]**	0.05 U	0.002 U
ALPHA-BHC	0.006	0.011	0.05 U	0.001 U	0.05 U	0.001 U	0.24 U	0.002 UJ	0.05 U	0.001 U
ALPHA-CHLORDANE	2	0.19	0.05 U	0.001 U	0.15	0.039 J	**4 [G]**	1.8	0.05 U	0.001 U
BETA-BHC	0.02	0.037	0.05 U	0.002 U	0.05 U	**0.089 [G]**	0.24 U	0.002 U	0.05 U	0.002 U
DELTA-BHC	2.1	0.011	0.05 U	0.001 U	0.05 U	0.031 J	0.24 U	0.032 J	0.05 U	0.001 U
DIELDRIN	0.002	0.0042	0.10 U	0.0008 U	0.10 U	0.0008 U	0.48 U	**0.036 J [G]**	0.10 U	0.0008 U
ENDOSULFAN I	NC	220	0.05 U	0.002 U	0.05 U	0.002 U	0.24 U	0.077	0.05 U	0.002 U
ENDOSULFAN II	NC	220	0.10 U	0.002 U	0.10 U	0.002 U	0.48 U	0.037 J	0.10 U	0.002 U
ENDOSULFAN SULFATE	NC	220	0.10 U	0.002 U	0.10 U	0.005 J	0.48 U	0.017 J	0.10 U	0.002 U
ENDRIN	2	11	0.10 U	0.002 U	0.10 U	0.002 U	0.48 U	0.005 J	0.10 U	0.002 UJ
ENDRIN ALDEHYDE	NC	11	0.10 U	0.009 U	0.10 U	0.009 U	0.48 U	0.009 U	0.10 U	0.009 U
ENDRIN KETONE	NC	11	0.10 U	0.003 UJ	0.10 U	0.003 UJ	0.48 U	0.009 J	0.10 U	0.003 UJ
GAMMA-BHC (LINDANE)	0.2	0.052	0.05 U	0.002 U	0.05 U	0.002 U	0.24 U	0.002 U	0.05 U	0.002 U
GAMMA-CHLORDANE	2	0.19	0.05 U	0.001 U	0.10	0.042 J	0.24 U	1.1	0.05 U	0.001 UJ
HEPTACHLOR	0.4	0.015	0.05 U	0.001 U	0.05 U	0.22	**0.60 [G]**	0.03 J	0.05 U	0.001 U
HEPTACHLOR EPOXIDE	0.2	0.0074	0.05 U	0.001 U	0.05 U	0.001 U	0.24 U	0.001 U	0.05 U	0.001 U
METHOXYCHLOR	40	180	0.50 U	0.003 U	0.50 U	0.003 U	2.4 U	0.003 U	0.50 U	0.003 U

Table 5-8
Summary of Detected Pesticide Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW18S MW18S-040502 04/05/02	JAX47-MW18S MW18S-113006 11/30/06	JAX47-MW19S MW19S-041202 04/12/02	JAX47-MW19S MW19S-120506 12/05/06	JAX47-MW20S MW20S-040902 04/09/02	JAX47-MW20S MW20S-113006 11/30/06	JAX47-MW21S MW21S-110602 11/06/02	JAX47-MW22D MW22D-110602 11/06/02
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	0.10 U	0.0004 U	0.10 U	0.0004 U	0.10 U	0.0004 U	0.10 UJ	0.10 UJ
4,4'-DDE	0.1	0.2	0.10 U	0.002 U	0.10 U	0.002 U	0.10 U	0.002 U	0.10 UJ	0.10 UJ
4,4'-DDT	0.1	0.2	0.10 U	0.002 U	0.10 U	0.002 U	0.10 U	0.002 U	0.10 UJ	0.10 UJ
ALDRIN	0.002	0.004	0.05 U	0.002 U	0.05 U	0.002 U	0.05 U	0.002 U	0.05 U	0.05 U
ALPHA-BHC	0.006	0.011	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U	0.05 U
ALPHA-CHLORDANE	2	0.19	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U	0.05 U
BETA-BHC	0.02	0.037	0.05 U	0.002 U	0.05 U	0.002 U	0.05 U	0.009 J	0.05 U	0.05 U
DELTA-BHC	2.1	0.011	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U	0.001 U	0.05 UJ	0.05 UJ
DIELDRIN	0.002	0.0042	0.10 U	0.0008 U	0.10 U	0.0008 U	0.10 U	**0.047 J [G]**	0.10 U	0.10 U
ENDOSULFAN I	NC	220	0.05 U	0.002 U	0.05 U	0.002 U	0.05 U	0.002 U	0.05 U	0.05 U
ENDOSULFAN II	NC	220	0.10 U	0.002 U	0.10 U	0.002 U	0.10 U	0.003 J	0.10 U	0.10 U
ENDOSULFAN SULFATE	NC	220	0.10 U	0.002 U	0.10 U	0.002 U	0.10 U	0.002 U	0.10 UJ	0.10 UJ
ENDRIN	2	11	0.10 U	0.002 UJ	0.10 U	0.002 U	0.10 U	0.002 U	0.10 U	0.10 U
ENDRIN ALDEHYDE	NC	11	0.10 U	0.009 U	0.10 U	0.009 U	0.10 U	0.009 U	0.10 U	0.10 U
ENDRIN KETONE	NC	11	0.10 U	0.003 UJ	0.10 U	0.003 UJ	0.10 U	0.003 UJ	0.10 U	0.10 U
GAMMA-BHC (LINDANE)	0.2	0.052	0.05 U	0.002 U	0.05 U	0.002 U	0.05 U	0.002 U	0.05 UJ	0.05 UJ
GAMMA-CHLORDANE	2	0.19	0.05 U	0.001 UJ	0.05 U	0.001 U	0.05 U	0.016 J	0.05 U	0.05 U
HEPTACHLOR	0.4	0.015	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE	0.2	0.0074	0.05 U	0.001 U	0.05 U	0.001 U	0.05 U	0.004 J	0.05 U	0.05 U
METHOXYCHLOR	40	180	0.50 U	0.003 U	0.50 U	0.003 U	0.50 U	0.003 U	0.50 U	0.50 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW23S MW23S-110602 11/07/02	JAX47-MW23S MW23S-120506 12/05/06	JAX47-MW24D MW24D-111202 11/12/02	JAX47-MW24D MW24D-120506 12/05/06	JAX47-MW25S MW25S-110602 11/07/02	JAX47-MW25S MW25S-120806 12/08/06	JAX47-MW26S MW26S-012003 01/20/03	JAX47-MW26S MW26S-120806 12/08/06
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	0.10 UJ	0.0004 U	0.10 U	0.0004 U	1 U	0.0004 U	0.10 U	0.0004 U
4,4'-DDE	0.1	0.2	0.10 UJ	0.002 U	0.10 U	0.002 U	1 U	0.002 U	0.10 U	0.002 U
4,4'-DDT	0.1	0.2	0.10 UJ	0.002 U	0.10 U	0.002 U	1 U	0.003 U	0.10 U	0.01 J
ALDRIN	0.002	0.004	0.053 U	0.002 U	0.05 U	0.002 U	0.50 U	0.002 U	0.05 U	0.002 U
ALPHA-BHC	0.006	0.011	0.053 U	0.001 U	0.05 U	0.001 U	**5.9 [G]**	**3.4 [G]**	0.05 U	0.001 U
ALPHA-CHLORDANE	2	0.19	0.053 U	0.001 U	0.05 U	0.001 U	0.50 U	0.032 J	0.05 U	0.001 U
BETA-BHC	0.02	0.037	0.053 U	0.002 U	0.05 U	0.002 U	**2.8 [G]**	**1.8 J [G]**	0.05 U	0.002 U
DELTA-BHC	2.1	0.011	0.053 UJ	0.001 U	0.05 U	0.001 U	**5.6 [G]**	**3.6 [G]**	0.05 U	0.001 U
DIELDRIN	0.002	0.0042	0.10 U	0.0008 U	0.10 U	0.0008 U	1 U	0.0008 U	0.10 U	0.0008 U
ENDOSULFAN I	NC	220	0.053 U	0.002 U	0.05 U	0.002 U	0.50 U	0.012 J	0.05 U	0.002 U
ENDOSULFAN II	NC	220	0.10 U	0.002 U	0.10 U	0.002 U	1 U	0.002 U	0.10 U	0.002 U
ENDOSULFAN SULFATE	NC	220	0.10 UJ	0.002 U	0.10 U	0.002 U	1 U	0.002 U	0.10 U	0.002 U
ENDRIN	2	11	0.10 U	0.002 U	0.10 U	0.002 U	1 U	0.003 UJ	0.10 U	0.002 U
ENDRIN ALDEHYDE	NC	11	0.10 U	0.009 U	0.10 U	0.009 U	1 U	0.009 U	0.10 U	0.009 U
ENDRIN KETONE	NC	11	0.10 U	0.003 UJ	0.10 U	0.003 UJ	1 U	0.003 UJ	0.10 U	0.003 UJ
GAMMA-BHC (LINDANE)	0.2	0.052	0.053 UJ	0.002 U	0.05 U	0.002 U	**10 [G]**	**4.4 [G]**	0.05 U	0.002 U
GAMMA-CHLORDANE	2	0.19	0.053 U	0.001 U	0.05 U	0.001 U	0.50 U	0.036 J	0.05 U	0.001 U
HEPTACHLOR	0.4	0.015	0.053 U	0.001 U	0.05 U	0.011 J	0.50 U	0.001 U	0.05 U	0.001 U
HEPTACHLOR EPOXIDE	0.2	0.0074	0.053 U	0.001 U	0.05 U	0.001 U	0.50 U	0.023 J	0.05 U	0.001 U
METHOXYCHLOR	40	180	0.53 U	0.003 U	0.50 U	0.003 UJ	0.50 U	0.014 J	0.50 U	0.003 UJ

Table 5-8
Summary of Detected Pesticide Concentrations in Groundwater Samples

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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW27S MW27S-012003 01/20/03	JAX47-MW27S MW27S-030303 03/03/03	JAX47-MW27S MW27S-030303-F 03/03/03	JAX47-MW27S MW27S-113006 11/30/06	JAX47-MW28S MW28S-120806 12/08/06	JAX47-MW29S MW29S-030907 03/09/07	JAX47-MW30S MW30S-030907 03/09/07	JAX47-MW31D MW31D-030907 03/09/07
Total Pesticides/PCBs (ug/L)										
4,4'-DDD	0.1	0.28	0.10 U	0.10 U	0.10 U	0.001 J	0.0004 U	0.0004 U	0.004 J	0.0004 U
4,4'-DDE	0.1	0.2	0.10 U	0.10 U	0.10 U	0.002 U	0.002 U	0.002 U	0.004 J	0.002 U
4,4'-DDT	0.1	0.2	0.10 U	0.10 U	0.10 U	0.002 U	0.002 U	0.002 J	0.002 U	0.002 U
ALDRIN	0.002	0.004	0.05 U	0.05 U	0.05 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
ALPHA-BHC	0.006	0.011	0.05 U	0.05 U	0.05 U	**0.21 [G]**	0.001 U	0.001 U	0.001 U	0.001 U
ALPHA-CHLORDANE	2	0.19	0.05 U	0.05 U	0.05 U	0.012 J	0.001 U	0.001 U	0.001 U	0.001 U
BETA-BHC	0.02	0.037	**0.064 [G]**	0.05 U	0.05 U	**0.16 [G]**	0.002 U	0.003 J	0.004 J	0.002 U
DELTA-BHC	2.1	0.011	0.11	0.05 U	0.05 U	0.41 J	0.001 U	0.062 U	0.061 U	0.001 U
DIELDRIN	0.002	0.0042	0.10 U	0.10 U	0.10 U	**0.004 J [G]**	**0.003 J [G]**	**0.004 J [G]**	**0.009 J [G]**	0.0008 U
ENDOSULFAN I	NC	220	0.05 U	0.05 U	0.05 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
ENDOSULFAN II	NC	220	0.10 U	0.10 U	0.10 U	0.013 J	0.002 U	0.003 J	0.039 J	0.002 U
ENDOSULFAN SULFATE	NC	220	0.10 U	0.10 U	0.10 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
ENDRIN	2	11	0.10 U	0.10 U	0.10 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
ENDRIN ALDEHYDE	NC	11	0.10 U	0.10 U	0.10 U	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U
ENDRIN KETONE	NC	11	0.10 U	0.10 U	0.10 U	0.006 J	0.003 UJ	0.003 U	0.003 U	0.003 U
GAMMA-BHC (LINDANE)	0.2	0.052	0.039	0.05 U	0.05 U	**0.33 [G]**	0.002 U	0.002 U	0.002 U	0.002 U
GAMMA-CHLORDANE	2	0.19	0.05 U	0.05 U	0.05 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
HEPTACHLOR	0.4	0.015	0.05 U	0.05 U	0.05 U	0.001 U	0.001 U	0.001 J	0.002 J	0.001 U
HEPTACHLOR EPOXIDE	0.2	0.0074	0.05 U	0.05 U	0.05 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
METHOXYCHLOR	40	180	0.50 U	0.50 U	0.50 U	0.003 U	0.003 UJ	0.003 U	0.003 U	0.003 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	USGS-DSMW46 USGS(D)-040902 04/09/02	USGS-SSMW45 USGS(S)-040902 04/09/02	USGS-SSMW45 USGS(S)-113006 11/30/06
Total Pesticides/PCBs (ug/L)					
4,4'-DDD	0.1	0.28	0.10 U	0.10 U	0.0004 U
4,4'-DDE	0.1	0.2	0.10 U	0.10 U	0.002 U
4,4'-DDT	0.1	0.2	0.10 U	0.10 U	0.002 U
ALDRIN	0.002	0.004	0.05 U	0.05 U	0.002 U
ALPHA-BHC	0.006	0.011	0.05 U	0.05 U	0.001 U
ALPHA-CHLORDANE	2	0.19	0.05 U	0.05 U	0.001 U
BETA-BHC	0.02	0.037	0.05 U	0.05 U	0.002 U
DELTA-BHC	2.1	0.011	0.05 U	0.05 U	0.001 U
DIELDRIN	0.002	0.0042	0.10 U	0.10 U	0.0008 U
ENDOSULFAN I	NC	220	0.05 U	0.05 U	0.002 U
ENDOSULFAN II	NC	220	0.10 U	0.10 U	0.002 U
ENDOSULFAN SULFATE	NC	220	0.10 U	0.10 U	0.002 U
ENDRIN	2	11	0.10 U	0.10 U	0.002 U
ENDRIN ALDEHYDE	NC	11	0.10 U	0.10 U	0.009 U
ENDRIN KETONE	NC	11	0.10 U	0.10 U	0.003 UJ
GAMMA-BHC (LINDANE)	0.2	0.052	0.05 U	0.05 U	0.002 U
GAMMA-CHLORDANE	2	0.19	0.05 U	0.05 U	0.001 U
HEPTACHLOR	0.4	0.015	0.05 U	0.05 U	0.001 U
HEPTACHLOR EPOXIDE	0.2	0.0074	0.05 U	0.05 U	0.001 U
METHOXYCHLOR	40	180	0.50 U	0.50 U	0.003 U

Notes:

GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
BHC - benzene hexachloride
PCB - polychlorinated biphenyl

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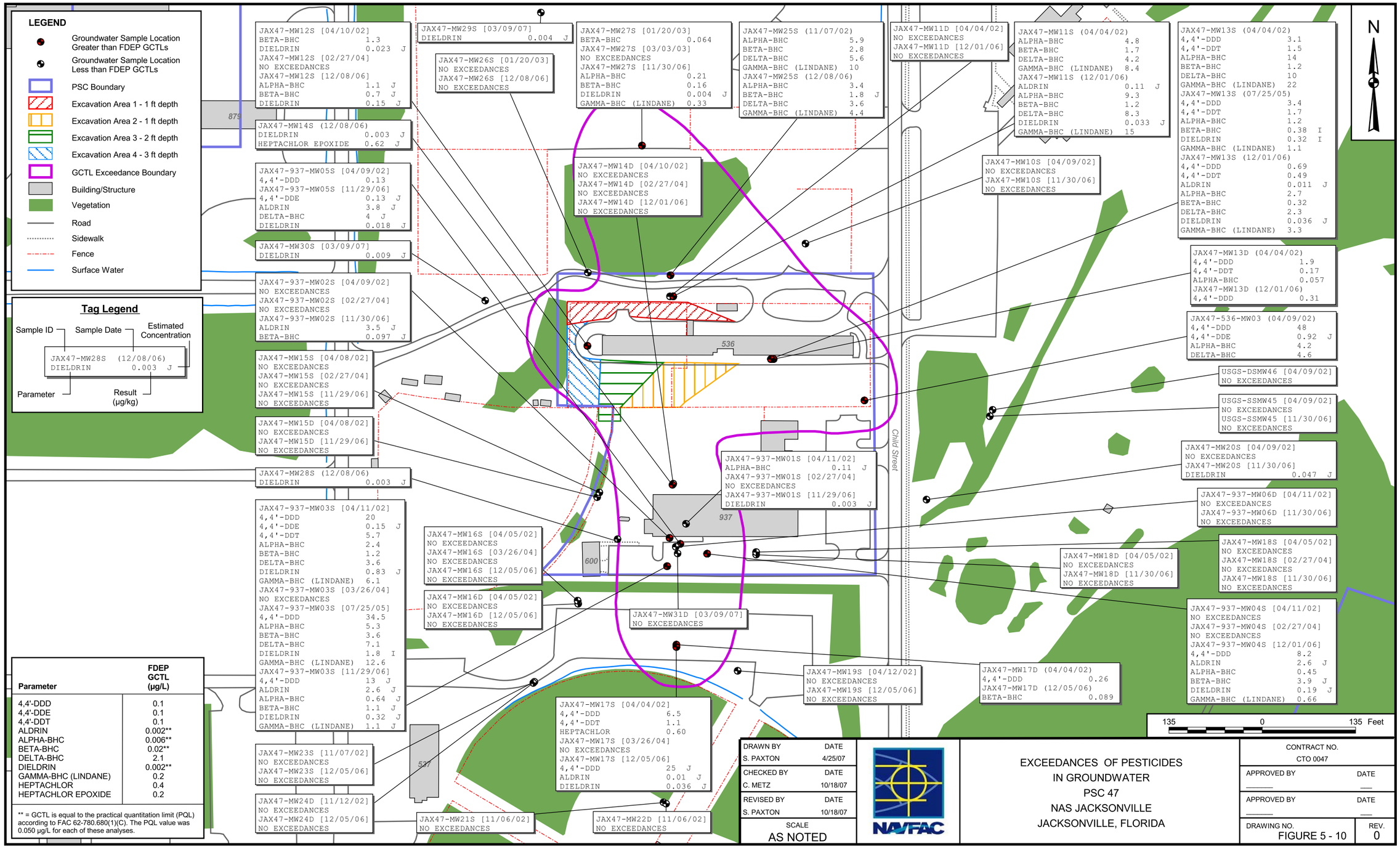

Parameter	FDEP GCTL (µg/L)
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
ALDRIN	0.002**
ALPHA-BHC	0.006**
BETA-BHC	0.02**
DELTA-BHC	2.1
DIELDRIN	0.002**
GAMMA-BHC (LINDANE)	0.2
HEPTACHLOR	0.4
HEPTACHLOR EPOXIDE	0.2

** = GCTL is equal to the practical quantitation limit (PQL) according to FAC 62-780.680(1)(C). The PQL value was 0.050 µg/L for each of these analyses.

DRAWN BY S. PAXTON	DATE 4/25/07
CHECKED BY C. METZ	DATE 10/18/07
REVISED BY S. PAXTON	DATE 10/18/07
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF PESTICIDES
IN GROUNDWATER
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047
APPROVED BY ____ DATE ____
APPROVED BY ____ DATE ____
DRAWING NO. FIGURE 5 - 10
REV. 0

concentrations exceeding GCTLs in Phase III: endrin, alpha-chlordane, and gamma-chlordane. The compounds reported most frequently at concentrations exceeding GCTLs in order of exceedances along with location of maximum detection are as follows:

- Dieldrin was detected exceeding GCTLs in 12 monitoring wells at a maximum concentration of 0.32 µg/L in JAX47-937-MW03S (south of Building 937). It was detected in 14 of 34 wells sampled during Phase III.
- Beta-BHC was detected exceeding GCTLs in nine monitoring wells at a maximum concentration of 3.9 µg/L in JAX47-937-MW04S (south of Building 937). It was detected in 12 of 34 wells sampled during Phase III.
- Alpha-BHC was detected exceeding GCTLs in seven monitoring wells at a maximum concentration of 9.3 µg/L in JAX47-MW11S (north of Building 536). It was detected in 9 of 34 wells sampled during Phase III.
- Aldrin was detected exceeding GCTLs in seven monitoring wells at a maximum concentration of 3.8 µg/L in JAX47-937-MW05S (south of Building 937). It was detected in 7 of 34 wells sampled during Phase III.
- Gamma-BHC was detected exceeding GCTLs in six monitoring wells at a maximum concentration of 15 µg/L in JAX47-MW11S (north of Building 536). It was detected in 10 of 34 wells sampled during Phase III.
- 4,4'-DDD was detected exceeding GCTLs in five monitoring wells at a maximum concentration of 25 µg/L in JAX47-MW17S (south central area of PSC 47). It was detected in 10 of 34 wells sampled during Phase III.
- Delta-BHC was detected exceeding GCTLs in four monitoring wells at a maximum concentration of 8.3 µg/L in JAX47-MW11S (north of Building 536). It was detected in 15 of 34 wells sampled during Phase III.
- 4,4'-DDE was detected exceeding GCTLs in one monitoring well at a maximum concentration of 0.13 µg/L in JAX47-937-MW05S (south of Building 937). It was detected in 11 of 34 wells sampled during Phase III.
- 4,4'-DDT was detected exceeding GCTLs in one monitoring well at a maximum concentration of 0.49 µg/L in JAX47-13S (south of Building 937). It was detected in 8 of 34 wells sampled during Phase III.
- Heptachlor epoxide was detected exceeding GCTLs in one monitoring well at a maximum concentration of 0.62 µg/L in JAX47-MW14S (north corner of Building 937). It was detected in 7 of 34 wells sampled during Phase III.

The distribution of pesticide compounds observed in Phase I was similar to that observed in Phases II and III. BHC isomers, aldrin, and dieldrin were identified in the vicinity of the removed DVECC tank and in a broad area north and south of the Pesticide Shop. Pesticide exceedances were reported at three

sampling points north of the Pesticide Shop (MW11S, MW25S, and MW27S), and at each location, the identified compounds were BHC isomers, except MW11S, which also contained aldrin and dieldrin. Beta-BHC was the only pesticide identified in the farthest downgradient well (MW27S) sampled during Phase II. Phase III sampling results for MW27S reported concentrations of three BHC isomers (alpha, beta, and gamma) and dieldrin exceeding GCTLs. This resulted in monitoring well MW29S (downgradient of MW27S) and MW30S (downgradient/cross-gradient of western end of Pesticide Shop) to verify the downgradient extent of contamination. No pesticide concentrations were reported in excess of criteria for MW29S or MW30S.

Monitoring well pair MW17S/-MW17D was placed upgradient (south) of DVECC, approximately equidistant between DPT borings SB37 and SB58, where pesticide compounds and VOCs were detected at elevated levels during Phase I, as discussed in Sections 5.3.2.1.1 and 5.3.2.1.2. Locations of several other monitoring wells installed during Phase II, including MW16S/MW16D and MW19S, were chosen to delineate the contamination discovered in this area. Of the wells installed in this area for delineation purposes, exceedances were only reported in samples collected from the MW17 pair. Pesticide compounds 4,4'-DDD, 4,4'-DDT, alpha-chlordane and heptachlor were reported in MW17S samples at concentrations exceeding their respective GCTLs. 4,4'-DDD (0.26 µg/L) was the only GCTL exceedance reported in samples collected from MW17D. Wells MW21S, MW22D, MW23S, and MW24D (see Figure 5-10) were added to the monitoring network for further delineation after analytical results on samples collected from the MW17 pair were known. No pesticide compounds were identified at concentrations exceeding GCTLs in any of the samples collected from these four additional wells.

5.3.2.2.2 TCL VOCs and SVOCs

VOC and SVOC concentrations reported in samples collected from permanent monitoring wells during Phases II and III RI activities are listed in Tables 5-9 and 5-10, respectively. Validated laboratory reports showing these results are included in Appendices J.2 and J.3, respectively. Concentrations exceeding GCTLs for these constituents are illustrated on Figure 5-11. Please refer to Appendix D, Tables D-3 and D-5 that detail which samples were analyzed for TCL VOCs and SVOCs during the Phase II and III (respectively) groundwater assessment. All Phase III samples were analyzed for VOCs and SVOCs except monitoring well MW31D. Monitoring well MW31D was installed for the purpose of delineating arsenic vertically and was, therefore, not sampled for VOCs and SVOCs.

Table 5-9
Summary of Detected VOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-536-MW03 536-MW03-040902 04/09/02	JAX47-937-MW01S 937-MW01S-041102 04/11/02	JAX47-937-MW01S 937-MW01S-041102-D 04/11/02	JAX47-937-MW01S 937-MW01S-112906 11/29/06	JAX47-937-MW02S 937-MW02S-041002 04/09/02	JAX47-937-MW02S 937-MW02S-113006 11/30/06	JAX47-937-MW03S 937-MW03S-041102 04/11/02	JAX47-937-MW03S 937-MW03S-112906 11/29/06
Volatile Organics (ug/L)										
1,1-DICHLOROETHANE	70	810	5 U	0.90 J	0.90 J	0.2 U	5 U	0.2 U	5 U	0.2 U
1,1-DICHLOROETHENE	7	340	5 U	5 U	5 U	0.2 U	5 U	0.2 U	0.70 J	0.7 J
1,2,4-TRICHLOROBENZENE	70	7.2	5 U	5 U	5 U	0.1 U	5 U	0.3 U	5 U	2.5
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048	5 U	5 U	5 U	0.3 U	5 U	**2.7 [G]**	5 U	0.3 U
1,2-DICHLOROBENZENE	600	370	5 U	5 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,2-DICHLOROETHANE	3	0.12	5 U	5 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
1,3-DICHLOROBENZENE	210	180	5 U	5 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,4-DICHLOROBENZENE	75	0.5	2 J	5 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
2-BUTANONE	4200	7000	26	5 UJ	5 UJ	2 U	5 U	2 U	5 UJ	2 U
2-HEXANONE	280	NC	2 J	5 U	5 U	0.6 U	5 UJ	0.6 U	5 U	0.6 U
ACETONE	6300	5500	85	5 UJ	5 UJ	2 U	5 U	2 U	5 UJ	13.3 U
BENZENE	1	0.35	**2 J [G]**	1 J	1 J	0.2 U	0.60 J	**4.4 [G]**	0.40 J	**3.3 [G]**
BROMOFORM	4.4	8.5	5 U	5 U	5 U	0.2 UJ	5 U	1.5 J	5 U	0.2 UJ
CARBON DISULFIDE	700	1000	2 J	0.70 J	5 U	0.9 U	5 U	0.9 U	5 U	0.9 U
CHLOROBENZENE	100	110	4 J	0.50 J	0.40 J	0.2 U	5 U	0.8 J	5 U	0.6 J
CHLOROETHANE	12	4.6	5 U	5 U	5 U	0.3 U	5 U	1	5 U	0.3 U
CHLOROFORM	70	0.17	5 U	5 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
CHLOROMETHANE	2.7	160	5 U	0.80 J	2 J	0.3 U	**3 J [G]**	0.3 U	2 J	0.3 U
CIS-1,2-DICHLOROETHENE	70	61	1 J	62	61	17	21	**228 J [G]**	58	**564 [G]**
CYCLOHEXANE	NC	35000	5 U	5 U	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U
DIETHYL ETHER	750	1200				0.5 U		0.5 U		0.5 U
ETHYLBENZENE	30	1300	3 J	19	18	0.3 U	2 J	26.8	5 U	9.9
ISOPROPYLBENZENE	0.8	660	5 U	**2 J [G]**	**2 J [G]**	0.1 U	5 U	**1.6 [G]**	5 U	**1 J [G]**
M+P-XYLENES	20	NC								
METHANE	NC	NC	1800	4000			410		63	
METHYL ACETATE	3000	6100	4 J	5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U
METHYL CYCLOHEXANE	NC	5200	5 U	5 U	5 U	0.6 UJ	5 U	0.6 UJ	5 U	0.6 UJ
METHYL TERT-BUTYL ETHER	20	11	5 U	5 U	5 U	0.2 J	5 U	0.2 U	5 U	0.2 U
O-XYLENE	20	210								
STYRENE	100	1600	5 U	5 U	5 U	0.1 U	5 U	1.7	5 U	0.1 U
TETRACHLOROETHENE	3	0.1	5 U	**7 [G]**	**6 [G]**	1.5 J	**11 [G]**	**3.8 [G]**	2 J	**3.9 J [G]**
TOLUENE	40	720	0.90 J	4 J	4 J	0.2 U	5 U	3.5	5 U	1 J
TOTAL 1,2-DICHLOROETHENE	63	61								
TOTAL XYLENES	20	210	9	**220 [G]**	**210 [G]**	0.3 U	5 U	**89.5 [G]**	5 U	**22.7 [G]**
TRANS-1,2-DICHLOROETHENE	100	120	5 U	5 U	5 U	0.5 J	5 U	1.7	0.80 J	4.2
TRICHLOROETHENE	3	0.028	2 J	2 J	2 J	1 J	**4 J [G]**	**3.1 [G]**	**6 [G]**	**7.4 [G]**
VINYL CHLORIDE	1	0.02	5 U	0.80 J	0.70 J	0.4 U	5 U	**5.1 [G]**	0.40 J	**1.9 [G]**

Notes:

GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
Blank cells denote not analyzed
PRG - preliminary remediation goal

Table 5-9
Summary of Detected VOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-937-MW04S 937-MW04S-041102 04/11/02	JAX47-937-MW04S 937-MW04S-120106 12/01/06	JAX47-937-MW05S 937-MW05S-041002 04/09/02	JAX47-937-MW05S 937-MW05S-112906 11/29/06	JAX47-937-MW06D 937-MW06D-041102 04/11/02	JAX47-937-MW06D 937-MW06D-113006 11/30/06	JAX47-MW10S MW10S-040902 04/09/02	JAX47-MW10S MW10S-113006 11/30/06
Volatile Organics (ug/L)										
1,1-DICHLOROETHANE	70	810	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,1-DICHLOROETHENE	7	340	5 U	0.7 J	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,2,4-TRICHLOROBENZENE	70	7.2	5 U	3.4	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
1,2-DICHLOROBENZENE	600	370	5 U	0.2 U	5 U	0.3 J	5 U	0.2 U	5 U	0.2 U
1,2-DICHLOROETHANE	3	0.12	0.40 J	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
1,3-DICHLOROBENZENE	210	180	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,4-DICHLOROBENZENE	75	0.5	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
2-BUTANONE	4200	7000	11 J	2 U	5 U	2 U	5 UJ	2 U	5 U	2 U
2-HEXANONE	280	NC	5 U	0.6 U	5 UJ	0.6 U	5 U	0.6 U	5 U	0.6 U
ACETONE	6300	5500	110 J	5.6 U	5 U	2.4 U	5 UJ	2 U	5 U	2 U
BENZENE	1	0.35	**9 [G]**	**3.2 [G]**	5 U	**14.6 [G]**	0.50 J	0.2 U	5 U	0.2 U
BROMOFORM	4.4	8.5	5 U	0.2 U	5 U	0.2 UJ	5 U	0.2 UJ	5 U	0.2 UJ
CARBON DISULFIDE	700	1000	5 U	0.9 U	5 U	0.9 U	5 U	0.9 U	0.70 J	0.9 U
CHLOROBENZENE	100	110	2 J	0.5 J	5 U	2.7 J	5 U	0.2 U	5 U	0.2 U
CHLOROETHANE	12	4.6	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
CHLOROFORM	70	0.17	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
CHLOROMETHANE	2.7	160	**3 J [G]**	0.3 U	1 J	0.3 U	**3 J [G]**	0.3 U	5 U	0.3 U
CIS-1,2-DICHLOROETHENE	70	61	**150 [G]**	**586 [G]**	30	**936 [G]**	3 J	0.9 J	5 U	0.2 U
CYCLOHEXANE	NC	35000	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U
DIETHYL ETHER	750	1200		0.5 U		0.9 J		0.5 U		0.5 U
ETHYLBENZENE	30	1300	**200 J [G]**	9.9	5 U	**135 [G]**	5 U	0.3 U	5 U	0.3 U
ISOPROPYLBENZENE	0.8	660	**6 [G]**	**1.1 [G]**	5 U	**3.6 J [G]**	5 U	0.1 U	5 U	0.1 U
M+P-XYLENES	20	NC								
METHANE	NC	NC	3000		76		260		10 U	
METHYL ACETATE	3000	6100	18	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U
METHYL CYCLOHEXANE	NC	5200	5 U	0.6 UJ	5 U	0.6 UJ	5 U	0.6 UJ	5 U	0.6 UJ
METHYL TERT-BUTYL ETHER	20	11	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
O-XYLENE	20	210								
STYRENE	100	1600	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
TETRACHLOROETHENE	3	0.1	**24 [G]**	**4 J [G]**	0.90 J	0.9 J	5 U	0.3 U	5 U	0.3 U
TOLUENE	40	720	**180 [G]**	0.6 J	5 U	21.9 J	5 U	0.2 U	5 U	0.2 U
TOTAL 1,2-DICHLOROETHENE	63	61								
TOTAL XYLENES	20	210	**6200 [G]**	**25.4 [G]**	5 U	**914 [G]**	5 U	0.3 U	5 U	0.3 U
TRANS-1,2-DICHLOROETHENE	100	120	0.60 J	4.5	0.50 J	2.5	5 U	0.2 U	5 U	0.2 U
TRICHLOROETHENE	3	0.028	**4 J [G]**	**7.7 [G]**	1 J	2	0.60 J	0.3 U	5 U	0.3 U
VINYL CHLORIDE	1	0.02	1 J	**1.6 [G]**	5 U	**5.5 [G]**	5 U	0.4 U	5 U	0.4 U

Notes:

GCTL = Groundwater Cleanup Target Level
J = estimated value
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µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
Blank cells denote not analyzed
PRG - preliminary remediation goal

Table 5-9
Summary of Detected VOC Concentrations in Groundwater Samples

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Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW11D MW11D-040402 04/04/02	JAX47-MW11D MW11D-120106 12/01/06	JAX47-MW11S MW11S-040402 04/04/02	JAX47-MW11S MW11S-120106 12/01/06	JAX47-MW12S MW12S-041002 04/10/02	JAX47-MW12S MW12S-120806 12/08/06	JAX47-MW13D MW13D-040402 04/04/02	JAX47-MW13D MW13D-120106 12/01/06	JAX47-MW13S MW13S-040402 04/04/02	JAX47-MW13S MW13S-120106 12/01/06
Volatile Organics (ug/L)												
1,1-DICHLOROETHANE	70	810	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,1-DICHLOROETHENE	7	340	5 U	0.2 U	0.60 J	0.6 J	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,2,4-TRICHLOROBENZENE	70	7.2	5 U	0.1 U	5 U	1.8	5 U	0.4 U	5 U	0.4 U	24	6.6
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
1,2-DICHLOROBENZENE	600	370	5 U	0.2 U	5 U	1.8	5 U	0.2 U	5 U	0.2 U	10	2.3 J
1,2-DICHLOROETHANE	3	0.12	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
1,3-DICHLOROBENZENE	210	180	5 U	0.2 U	5 U	0.6 J	5 U	0.2 U	5 U	0.2 U	2 J	1.3 J
1,4-DICHLOROBENZENE	75	0.5	5 U	0.1 U	2 J	5.6	5 U	0.1 U	5 U	0.1 U	9	3.9 J
2-BUTANONE	4200	7000	5 U	2 U	5 U	2 U	5 U	2 U	5 U	2 U	5 U	2 U
2-HEXANONE	280	NC	5 U	0.6 U	5 U	0.6 U	5 UJ	0.6 U	5 U	0.6 U	5 U	0.6 U
ACETONE	6300	5500	5 U	2.3 U	5 U	15.4 U	5 U	2 UJ	5 U	2 U	5 U	2 U
BENZENE	1	0.35	5 U	0.2 U	**4 J [G]**	**2.5 [G]**	5 U	0.2 U	5 U	0.2 U	1 J	0.6 J
BROMOFORM	4.4	8.5	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 UJ	5 U	0.2 UJ
CARBON DISULFIDE	700	1000	5 U	0.9 U	5 U	0.9 U	0.70 J	0.9 UJ	0.60 J	0.9 U	0.60 J	0.9 U
CHLOROBENZENE	100	110	5 U	0.2 U	18	12.7	5 U	0.2 U	5 U	0.2 U	8	2.6 J
CHLOROETHANE	12	4.6	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
CHLOROFORM	70	0.17	1 J	0.2 U	0.40 J	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
CHLOROMETHANE	2.7	160	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
CIS-1,2-DICHLOROETHENE	70	61	0.50 J	0.5 J	18	1.2	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
CYCLOHEXANE	NC	35000	5 U	0.4 U	43	38.3	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U
DIETHYL ETHER	750	1200		0.5 U		0.5 U		0.5 U		0.5 U		0.5 U
ETHYLBENZENE	30	1300	5 U	0.3 U	5	17.4	5 U	0.3 U	5 U	0.3 U	2 J	0.3 U
ISOPROPYLBENZENE	0.8	660	5 U	0.1 U	**5 [G]**	**9 [G]**	5 U	0.1 U	5 U	0.1 U	0.60 J	0.1 U
M+P-XYLENES	20	NC										
METHANE	NC	NC	10 U		480		10 U		10 U		13	
METHYL ACETATE	3000	6100	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U
METHYL CYCLOHEXANE	NC	5200	5 U	0.6 UJ	12	22.7 J	5 U	0.6 UJ	5 U	0.6 UJ	5 U	0.6 UJ
METHYL TERT-BUTYL ETHER	20	11	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
O-XYLENE	20	210										
STYRENE	100	1600	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
TETRACHLOROETHENE	3	0.1	5 U	0.3 UJ	5 U	0.3 UJ	5 U	0.3 UJ	5 U	0.3 U	5 U	0.3 U
TOLUENE	40	720	5 U	0.2 U	0.50 J	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
TOTAL 1,2-DICHLOROETHENE	63	61										
TOTAL XYLENES	20	210	5 U	0.3 U	20	17.4	5 U	0.3 U	5 U	0.3 U	6	0.3 U
TRANS-1,2-DICHLOROETHENE	100	120	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
TRICHLOROETHENE	3	0.028	5 U	0.3 U	**23 [G]**	**4.5 [G]**	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
VINYL CHLORIDE	1	0.02	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U

Notes:
GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
Blank cells denote not analyzed
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Table 5-9
Summary of Detected VOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW13S MW13S-120106-D 12/01/06	JAX47-MW14D MW14D-041002 04/10/02	JAX47-MW14D MW14D-041002-D 04/10/02	JAX47-MW14D MW14D-120106 12/01/06	JAX47-MW14S MW14S-120806 12/08/06	JAX47-MW15D MW15D-040802 04/08/02	JAX47-MW15D MW15D-112906 11/29/06	JAX47-MW15S MW15S-040802 04/08/02	JAX47-MW15S MW15S-040802-D 04/08/02	JAX47-MW15S MW15S-112906 11/29/06
Volatile Organics (ug/L)												
1,1-DICHLOROETHANE	70	810	0.2 U	5 U	5 U	0.2 U	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
1,1-DICHLOROETHENE	7	340	0.2 U	5 U	5 U	0.2 U	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
1,2,4-TRICHLOROBENZENE	70	7.2	8.6	5 U	5 U	0.1 U	0.1 U	5 U	0.1 U	5 U	5 U	0.1 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048	0.3 U	5 U	5 U	0.3 U	0.3 U	5 U	0.3 U	5 U	5 U	0.3 U
1,2-DICHLOROBENZENE	600	370	4.4 J	5 U	5 U	0.2 U	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
1,2-DICHLOROETHANE	3	0.12	0.1 U	5 U	5 U	0.1 U	0.1 U	5 U	0.1 U	5 U	5 U	0.1 U
1,3-DICHLOROBENZENE	210	180	2 J	5 U	5 U	0.2 U	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
1,4-DICHLOROBENZENE	75	0.5	6.3 J	5 U	5 U	0.1 U	0.1 U	5 U	0.1 U	5 U	5 U	0.1 U
2-BUTANONE	4200	7000	2 U	5 U	5 U	2 U	2 U	5 U	2 U	5 U	5 U	2 U
2-HEXANONE	280	NC	0.6 U	5 UJ	5 UJ	0.6 U	0.6 U	5 U	0.6 U	5 U	5 U	0.6 U
ACETONE	6300	5500	2 U	5 U	5 U	2 U	2 UJ	5 U	2 U	5 U	5 U	2 U
BENZENE	1	0.35	0.9 J	5 U	5 U	0.9 J	0.2 U	5 U	0.6 J	5 U	5 U	0.2 U
BROMOFORM	4.4	8.5	0.2 UJ	5 U	5 U	0.2 U	0.2 U	5 U	0.2 UJ	5 U	5 U	0.2 UJ
CARBON DISULFIDE	700	1000	0.9 U	5 U	0.60 J	0.9 U	0.9 UJ	5 U	0.9 U	5 U	5 U	0.9 U
CHLOROBENZENE	100	110	4.2 J	5 U	5 U	0.3 J	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
CHLOROETHANE	12	4.6	0.3 U	5 U	5 U	0.3 U	0.3 U	5 U	0.3 U	5 U	5 U	0.3 U
CHLOROFORM	70	0.17	0.2 U	0.90 J	1 J	0.2 U	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
CHLOROMETHANE	2.7	160	0.3 U	5 U	2 J	0.3 U	0.3 U	5 U	0.3 U	5 U	5 U	0.3 U
CIS-1,2-DICHLOROETHENE	70	61	0.2 U	0.40 J	0.40 J	12.4	0.2 U	0.50 J	4.8	5 U	5 U	0.2 U
CYCLOHEXANE	NC	35000	0.4 U	5 U	5 U	0.4 U	0.4 U	4 J	1.5	5 U	5 U	0.4 U
DIETHYL ETHER	750	1200	0.5 U			0.5 U	0.5 U		0.5 U			0.5 U
ETHYLBENZENE	30	1300	0.5 J	5 U	5 U	0.3 U	0.3 U	5 U	0.3 U	5 U	5 U	0.3 U
ISOPROPYLBENZENE	0.8	660	0.3 J	5 U	5 U	0.4 J	0.1 U	5 U	0.1 U	5 U	5 U	0.1 U
M+P-XYLENES	20	NC										
METHANE	NC	NC		44				110		20		
METHYL ACETATE	3000	6100	0.5 U	5 U	5 U	0.5 U	0.5 U	5 U	0.5 U	5 U	5 U	0.5 U
METHYL CYCLOHEXANE	NC	5200	0.6 UJ	5 U	5 U	0.6 UJ	0.6 UJ	4 J	1.7 J	5 U	5 U	0.6 UJ
METHYL TERT-BUTYL ETHER	20	11	0.2 U	5 U	5 U	0.2 U	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
O-XYLENE	20	210										
STYRENE	100	1600	0.1 U	5 U	5 U	0.1 U	0.1 U	5 U	0.1 U	5 U	5 U	0.1 U
TETRACHLOROETHENE	3	0.1	0.3 U	0.50 J	0.40 J	1.3 J	0.3 UJ	5 U	0.3 UJ	5 U	5 U	0.3 UJ
TOLUENE	40	720	0.2 U	5 U	5 U	0.2 U	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
TOTAL 1,2-DICHLOROETHENE	63	61										
TOTAL XYLENES	20	210	0.8 J	5 U	5 U	0.3 U	0.3 U	5 U	0.3 U	5 U	5 U	0.3 U
TRANS-1,2-DICHLOROETHENE	100	120	0.2 U	5 U	5 U	0.2 U	0.2 U	5 U	0.2 U	5 U	5 U	0.2 U
TRICHLOROETHENE	3	0.028	0.3 U	5 U	5 U	0.6 J	0.3 U	5 U	0.7 J	5 U	5 U	0.3 U
VINYL CHLORIDE	1	0.02	0.4 U	5 U	5 U	0.4 J	0.4 U	5 U	0.4 U	5 U	5 U	0.4 U

Notes:
GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
Blank cells denote not analyzed
PRG - preliminary remediation goal

Table 5-9
Summary of Detected VOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW16D MW16D-040502 04/05/02	JAX47-MW16D MW16D-120506 12/05/06	JAX47-MW16S MW16S-040502 04/05/02	JAX47-MW16S MW16S-120506 12/05/06	JAX47-MW17D MW17D-040402 04/04/02	JAX47-MW17D MW17D-120506 12/05/06	JAX47-MW17S MW17S-040402 04/04/02	JAX47-MW17S MW17S-120506 12/05/06	JAX47-MW18D MW18D-040502 04/05/02	JAX47-MW18D MW18D-113006 11/30/06
Volatile Organics (ug/L)												
1,1-DICHLOROETHANE	70	810	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,1-DICHLOROETHENE	7	340	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,2,4-TRICHLOROBENZENE	70	7.2	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
1,2-DICHLOROBENZENE	600	370	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,2-DICHLOROETHANE	3	0.12	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
1,3-DICHLOROBENZENE	210	180	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
1,4-DICHLOROBENZENE	75	0.5	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
2-BUTANONE	4200	7000	5 U	2 U	5 U	2 U	5 U	2 U	5 U	2 U	5 U	2 U
2-HEXANONE	280	NC	5 U	0.6 U	5 U	0.6 U	5 U	0.6 U	5 U	0.6 U	5 U	0.6 U
ACETONE	6300	5500	5 U	2 U	5 U	2 U	5 U	2 U	5 U	2 U	5 U	2 U
BENZENE	1	0.35	5 U	0.3 J	5 U	0.2 U	**11 [G]**	**8.4 [G]**	5 U	0.2 U	5 U	0.2 U
BROMOFORM	4.4	8.5	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 UJ
CARBON DISULFIDE	700	1000	5 U	0.9 U	0.80 J	0.9 U	1 J	0.9 U	0.70 J	0.9 U	0.80 J	0.9 U
CHLOROBENZENE	100	110	5 U	0.2 U	5 U	0.2 U	0.40 J	0.4 J	5 U	0.2 U	5 U	0.2 U
CHLOROETHANE	12	4.6	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
CHLOROFORM	70	0.17	1 J	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	1 J	0.2 U
CHLOROMETHANE	2.7	160	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U
CIS-1,2-DICHLOROETHENE	70	61	3 J	4.7	0.60 J	0.2 U	**400 [G]**	**328 [G]**	23	1.8	5 U	0.2 U
CYCLOHEXANE	NC	35000	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U
DIETHYL ETHER	750	1200		0.5 U		0.5 U		0.8 J		0.5 U		0.5 U
ETHYLBENZENE	30	1300	5 U	0.3 U	5 U	0.3 U	5	4	**44 [G]**	3.6	5 U	0.3 U
ISOPROPYLBENZENE	0.8	660	5 U	0.1 U	5 U	0.1 U	**3 J [G]**	**4.6 [G]**	**10 [G]**	**3.8 [G]**	5 U	0.1 U
M+P-XYLENES	20	NC										
METHANE	NC	NC	190		62		5000		24		19	
METHYL ACETATE	3000	6100	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U
METHYL CYCLOHEXANE	NC	5200	5 U	0.6 UJ	5 U	0.6 UJ	5 U	0.6 UJ	2 J	0.6 UJ	5 U	0.6 UJ
METHYL TERT-BUTYL ETHER	20	11	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U
O-XYLENE	20	210										
STYRENE	100	1600	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U
TETRACHLOROETHENE	3	0.1	5 U	0.3 UJ	5 U	0.3 UJ	5 U	0.3 UJ	**21 [G]**	2.8	5 U	0.3 U
TOLUENE	40	720	5 U	0.2 U	5 U	0.2 U	2 J	1.4	0.40 J	0.2 U	5 U	0.2 U
TOTAL 1,2-DICHLOROETHENE	63	61										
TOTAL XYLENES	20	210	5 U	0.3 U	5 U	0.3 U	**54 [G]**	**41.5 [G]**	**750 [G]**	0.3 U	5 U	0.3 U
TRANS-1,2-DICHLOROETHENE	100	120	5 U	0.2 U	5 U	0.2 U	10	0.6 J	5 U	0.2 U	5 U	0.2 U
TRICHLOROETHENE	3	0.028	0.60 J	1.3	5 U	0.3 U	5 U	0.3 U	2 J	0.3 U	5 U	0.3 U
VINYL CHLORIDE	1	0.02	5 U	0.4 U	5 U	0.4 U	**2 J [G]**	1	5 U	0.4 U	5 U	0.4 U

Notes:

GCTL = Groundwater Cleanup Target Level
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µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
Blank cells denote not analyzed
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Table 5-9
Summary of Detected VOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION	FDEP	REGION 9	JAX47-MW18S	JAX47-MW18S	JAX47-MW19S	JAX47-MW19S	JAX47-MW20S	JAX47-MW20S	JAX47-MW21S	JAX47-MW22D	JAX47-MW23S	JAX47-MW23S
SAMPLE ID	GCTL	PRGs	MW18S-040502	MW18S-113006	MW19S-041202	MW19S-120506	MW20S-040902	MW20S-113006	MW21S-110602	MW22D-110602	MW23S-110602	MW23S-120506
SAMPLE DATE			04/05/02	11/30/06	04/12/02	12/05/06	04/09/02	11/30/06	11/06/02	11/06/02	11/07/02	12/05/06
Volatile Organics (ug/L)												
1,1-DICHLOROETHANE	70	810	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	5 U	5 U	0.2 U
1,1-DICHLOROETHENE	7	340	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	5 U	5 U	0.2 U
1,2,4-TRICHLOROBENZENE	70	7.2	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	5 U	5 U	0.1 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	5 U	5 U	0.3 U
1,2-DICHLOROBENZENE	600	370	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	5 U	5 U	0.2 U
1,2-DICHLOROETHANE	3	0.12	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	5 U	5 U	0.1 U
1,3-DICHLOROBENZENE	210	180	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	5 U	5 U	0.2 U
1,4-DICHLOROBENZENE	75	0.5	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	5 U	5 U	0.1 U
2-BUTANONE	4200	7000	5 U	2 U	5 UJ	2 U	5 U	2 U	5 UR	5 UR	5 UR	2 U
2-HEXANONE	280	NC	5 U	0.6 U	5 U	0.6 U	5 U	0.6 U	5 UJ	5 UJ	5 UJ	0.6 U
ACETONE	6300	5500	5 U	2 U	5 UJ	2 U	5 U	2 U	5 UR	5 UR	27 R	2 U
BENZENE	1	0.35	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.20 J	5 U	0.2 U
BROMOFORM	4.4	8.5	5 U	0.2 UJ	5 U	0.2 U	5 U	0.2 UJ	5 U	5 U	5 U	0.2 U
CARBON DISULFIDE	700	1000	2 J	0.9 U	5 U	0.9 U	5 U	0.9 U	5 U	5 U	5 U	0.9 U
CHLOROBENZENE	100	110	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	5 U	5 U	0.2 U
CHLOROETHANE	12	4.6	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	5 U	5 U	0.3 U
CHLOROFORM	70	0.17	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.20 J	5 U	0.2 U
CHLOROMETHANE	2.7	160	5 U	0.3 U	0.80 J	0.3 U	5 U	0.3 U	5 U	5 U	5 U	0.3 U
CIS-1,2-DICHLOROETHENE	70	61	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.70 J	5 U	0.2 U
CYCLOHEXANE	NC	35000	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	5 U	5 U	0.4 U
DIETHYL ETHER	750	1200		0.5 U		0.5 U		0.5 U				0.5 U
ETHYLBENZENE	30	1300	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	5 U	5 U	0.3 U
ISOPROPYLBENZENE	0.8	660	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	5 U	5 U	0.1 U
M+P-XYLENES	20	NC							5 U	5 U	5 U	
METHANE	NC	NC	80		27		10 U					
METHYL ACETATE	3000	6100	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	5 U	5 U	0.5 U
METHYL CYCLOHEXANE	NC	5200	5 U	0.6 UJ	5 U	0.6 UJ	5 U	0.6 UJ	5 U	5 U	5 U	0.6 UJ
METHYL TERT-BUTYL ETHER	20	11	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	5 U	5 U	0.2 U
O-XYLENE	20	210							5 U	5 U	5 U	
STYRENE	100	1600	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	5 U	5 U	0.1 U
TETRACHLOROETHENE	3	0.1	5 U	0.3 U	5 U	0.3 UJ	5 U	0.3 U	5 U	5 U	5 U	0.3 UJ
TOLUENE	40	720	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	5 U	5 U	0.2 U
TOTAL 1,2-DICHLOROETHENE	63	61							5 U	5 U	5 U	
TOTAL XYLENES	20	210	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	5 U	5 U	0.3 U
TRANS-1,2-DICHLOROETHENE	100	120	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	5 U	5 U	0.2 U
TRICHLOROETHENE	3	0.028	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	5 U	5 U	0.3 U
VINYL CHLORIDE	1	0.02	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	5 U	5 U	0.4 U

Notes:
GCTL = Groundwater Cleanup Target Level
J = estimated value
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µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
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Blank cells denote not analyzed
PRG - preliminary remediation goal

Table 5-9
Summary of Detected VOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW24D MW24D-111202 11/12/02	JAX47-MW24D MW24D-120506 12/05/06	JAX47-MW25S MW25S-110602 11/07/02	JAX47-MW25S MW25S-120806 12/08/06	JAX47-MW26S MW26S-012003 01/20/03	JAX47-MW26S MW26S-120806 12/08/06	JAX47-MW27S MW27S-012003 01/20/03	JAX47-MW27S MW27S-113006 11/30/06	JAX47-MW28S MW28S-120806 12/08/06	JAX47-MW29S MW29S-030907 03/09/07	JAX47-MW30S MW30S-030907 03/09/07
Volatile Organics (ug/L)													
1,1-DICHLOROETHANE	70	810	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.20 U
1,1-DICHLOROETHENE	7	340	5 U	0.2 U	0.40 J	0.4 J	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.20 U
1,2,4-TRICHLOROBENZENE	70	7.2	5 U	0.1 U	1 U	0.9 U	5 U	0.1 U	5 U	0.8 U	0.1 U	0.10 U	0.10 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	0.3 U	0.30 U	0.30 U
1,2-DICHLOROBENZENE	600	370	5 U	0.2 U	1 J	0.6 J	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.20 U
1,2-DICHLOROETHANE	3	0.12	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	0.1 U	0.10 U	0.10 U
1,3-DICHLOROBENZENE	210	180	5 U	0.2 U	0.30 J	0.2 U	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.20 U
1,4-DICHLOROBENZENE	75	0.5	5 U	0.1 U	4 J	3.2	5 U	0.1 U	5 U	0.4 J	0.1 U	0.10 U	0.10 U
2-BUTANONE	4200	7000	5 U	2 U	5 UR	2 U	5 U	2 U	5 U	2 U	2 U	2 U	4.06 J
2-HEXANONE	280	NC	5 U	0.6 U	5 UJ	0.6 U	5 U	0.6 U	5 U	0.6 U	0.6 U	0.60 U	0.60 U
ACETONE	6300	5500	5 U	2 U	5 UR	5.5 U	5 U	2 UJ	5 U	2 U	5.4 U	2 U	2 U
BENZENE	1	0.35	1 J	1	**2 J [G]**	0.5 J	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.22 J
BROMOFORM	4.4	8.5	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 UJ	0.2 U	0.20 U	0.20 U
CARBON DISULFIDE	700	1000	5 U	0.9 U	5 U	0.9 UJ	5 U	0.9 UJ	5 U	0.9 U	0.9 UJ	0.90 U	0.90 U
CHLOROBENZENE	100	110	5 U	0.2 U	8	2.7	5 U	0.2 U	5 U	0.2 J	0.2 U	0.20 U	0.20 U
CHLOROETHANE	12	4.6	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	0.3 U	0.30 U	0.30 U
CHLOROFORM	70	0.17	5 U	0.2 U	1 J	0.2 U	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.37 J
CHLOROMETHANE	2.7	160	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	5 U	0.3 U	0.3 U	0.30 U	0.30 U
CIS-1,2-DICHLOROETHENE	70	61	19	23.1	0.50 J	0.2 U	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.20 U
CYCLOHEXANE	NC	35000	5 U	0.4 U	40	0.4 U	5 U	0.4 U	5 U	0.4 U	0.4 U	0.45 U	0.45 U
DIETHYL ETHER	750	1200		0.5 U		0.5 U		0.5 U		0.5 U	0.5 U	0.54 U	0.54 U
ETHYLBENZENE	30	1300	5 U	0.3 U	0.80 J	0.3 U	5 U	0.3 U	5 U	0.3 U	0.3 U	0.30 U	0.30 U
ISOPROPYLBENZENE	0.8	660	5 U	0.1 U	**7 [G]**	**2.5 [G]**	5 U	0.1 U	5 U	0.1 U	0.1 U	0.10 U	0.10 U
M+P-XYLENES	20	NC	0.40 J		6		5 U		5 U				
METHANE	NC	NC											
METHYL ACETATE	3000	6100	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	5 U	0.5 U	0.5 U	0.51 U	0.51 U
METHYL CYCLOHEXANE	NC	5200	5 U	0.6 UJ	22	0.7 J	5 U	0.6 UJ	5 U	0.6 UJ	0.6 UJ	0.55 U	0.55 U
METHYL TERT-BUTYL ETHER	20	11	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	0.70 J	0.2 U	0.2 U	0.20 U	0.20 U
O-XYLENE	20	210	5 U		10		5 U		5 U				
STYRENE	100	1600	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	5 U	0.1 U	0.1 U	0.10 U	0.10 U
TETRACHLOROETHENE	3	0.1	5 U	0.3 UJ	5 U	0.3 UJ	5 U	0.3 UJ	5 U	0.3 U	0.3 UJ	0.30 U	0.30 U
TOLUENE	40	720	5 U	0.2 U	0.30 J	0.2 U	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.51 U
TOTAL 1,2-DICHLOROETHENE	63	61	19		5 U		5 U		5 U				
TOTAL XYLENES	20	210	0.40 J	0.3 U	16	0.6 J	5 U	0.3 U	5 U	0.3 U	0.3 U	0.40 U	0.43 U
TRANS-1,2-DICHLOROETHENE	100	120	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	0.2 U	0.2 U	0.20 U	0.20 U
TRICHLOROETHENE	3	0.028	2 J	1.7	**4 J [G]**	0.3 J	5 U	0.3 U	5 U	0.3 U	0.3 U	0.30 U	0.30 U
VINYL CHLORIDE	1	0.02	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	0.4 U	0.4 U	0.40 U	0.40 U

Notes:
GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
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Table 5-9
Summary of Detected VOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW31D MW31D-030907 03/09/07	USGS-DSMW46 USGS(D)-040902 04/09/02	USGS-SSMW45 USGS(S)-040902 04/09/02	USGS-SSMW45 USGS(S)-113006 11/30/06
Volatile Organics (ug/L)						
1,1-DICHLOROETHANE	70	810	0.20 U	5 U	5 U	0.2 U
1,1-DICHLOROETHENE	7	340	0.20 U	5 U	5 U	0.2 U
1,2,4-TRICHLOROBENZENE	70	7.2	0.10 U	5 U	5 U	0.1 U
1,2-DIBROMO-3-CHLOROPROPANE	0.2	0.048	0.30 U	5 U	5 U	0.3 U
1,2-DICHLOROBENZENE	600	370	0.20 U	5 U	5 U	0.2 U
1,2-DICHLOROETHANE	3	0.12	0.10 U	5 U	5 U	0.1 U
1,3-DICHLOROBENZENE	210	180	0.20 U	5 U	5 U	0.2 U
1,4-DICHLOROBENZENE	75	0.5	0.10 U	5 U	5 U	0.1 U
2-BUTANONE	4200	7000	2 U	5 U	5 U	2 U
2-HEXANONE	280	NC	0.60 U	5 U	5 U	0.6 U
ACETONE	6300	5500	2 U	5 U	5 U	2 U
BENZENE	1	0.35	0.66 J	5 U	5 U	0.2 U
BROMOFORM	4.4	8.5	0.20 U	5 U	5 U	0.2 UJ
CARBON DISULFIDE	700	1000	0.90 U	0.80 J	0.80 J	0.9 U
CHLOROBENZENE	100	110	0.20 U	5 U	5 U	0.2 U
CHLOROETHANE	12	4.6	0.30 U	5 U	5 U	0.3 U
CHLOROFORM	70	0.17	0.20 U	5 U	5 U	0.2 U
CHLOROMETHANE	2.7	160	0.30 U	5 U	5 U	0.3 U
CIS-1,2-DICHLOROETHENE	70	61	2.18	5 U	5 U	0.2 U
CYCLOHEXANE	NC	35000	0.45 U	5 U	5 U	0.4 U
DIETHYL ETHER	750	1200	0.54 U			0.5 U
ETHYLBENZENE	30	1300	0.30 U	5 U	5 U	0.3 U
ISOPROPYLBENZENE	0.8	660	0.10 U	5 U	5 U	0.1 U
M+P-XYLENES	20	NC				
METHANE	NC	NC		10 U	11	
METHYL ACETATE	3000	6100	0.51 U	5 U	5 U	0.5 U
METHYL CYCLOHEXANE	NC	5200	0.55 U	5 U	5 U	0.6 UJ
METHYL TERT-BUTYL ETHER	20	11	0.20 U	5 U	5 U	0.2 U
O-XYLENE	20	210				
STYRENE	100	1600	0.75 J	5 U	5 U	0.1 U
TETRACHLOROETHENE	3	0.1	0.30 U	5 U	5 U	0.3 U
TOLUENE	40	720	0.24 U	5 U	5 U	0.2 U
TOTAL 1,2-DICHLOROETHENE	63	61				
TOTAL XYLENES	20	210	0.40 U	5 U	5 U	0.3 U
TRANS-1,2-DICHLOROETHENE	100	120	0.20 U	5 U	5 U	0.2 U
TRICHLOROETHENE	3	0.028	0.30 U	5 U	5 U	0.3 U
VINYL CHLORIDE	1	0.02	0.40 U	5 U	5 U	0.4 U

Notes:
GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
Blank cells denote not analyzed
PRG - preliminary remediation goal

TABLE 5-10
Summary of Detected SVOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-937-MW01S 937-MW01S-041102 04/11/02	JAX47-937-MW01S 937-MW01S-041102-D 04/11/02	JAX47-937-MW01S 937-MW01S-112906 11/29/06	JAX47-937-MW02S 937-MW02S-113006 11/30/06	JAX47-937-MW03S 937-MW03S-112906 11/29/06	JAX47-937-MW04S 937-MW04S-120106 12/01/06	JAX47-937-MW05S 937-MW05S-112906 11/29/06	JAX47-937-MW06D 937-MW06D-041102 04/11/02
Semivolatile Organics (ug/L)										
1,1-BIPHENYL	0.5	300	10 U	10 U	3 U	3 U	3 U	3 U	3 U	10 U
2,4,5-TRICHLOROPHENOL	1	3600	25 U	25 U	2 U	**104 [G]**	**2720 [G]**	2 U	2 U	25 U
2,4-DICHLOROPHENOL	0.3	110	10 U	10 U	2 U	**6 J [G]**	**529 [G]**	**87 [G]**	2 U	10 U
2,4-DIMETHYLPHENOL	140	730	10 U	10 U	2 U	2 U	2 U	2 U	16	10 U
2-METHYLNAPHTHALENE	28	6.2	22	21	2 U	10 J	2 U	2 U	2 U	10 U
2-METHYLPHENOL	35	1800	10 U	1 J	2 U	2 U	2 U	2 U	6 J	10 U
3&4-METHYLPHENOL	3.5	180	10 U	0.80 J	2 U	2 U	2 U	2 U	2 U	10 U
DI-N-BUTYL PHTHALATE	700	3600	1 J	0.80 J	1 U	1 U	1 U	1 U	1 U	10 U
DIETHYL PHTHALATE	5600	29000	2 J	2 J	2 U	2 U	2 U	2 U	2 U	10 U
FLUORENE	280	240	10 U	10 U	1 U	1 U	1 U	1 U	1 U	10 U
NAPHTHALENE	14	6.2	**25 [G]**	**22 [G]**	3 U	14	3 U	3 U	**21 [G]**	10 U
PENTACHLOROPHENOL	1	0.56	25 U	25 U	1 U	1 UJ	**11 [G]**	**12 J [G]**	1 U	25 U
PHENANTHRENE	210	180	10 U	10 U	1 U	1 U	1 U	1 U	1 U	10 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-937-MW06D 937-MW06D-113006 11/30/06	JAX47-MW10S MW10S-113006 11/30/06	JAX47-MW11D MW11D-120106 12/01/06	JAX47-MW11S MW11S-120106 12/01/06	JAX47-MW12S MW12S-120806 12/08/06	JAX47-MW13D MW13D-040402 04/04/02	JAX47-MW13D MW13D-120106 12/01/06	JAX47-MW13S MW13S-040402 04/04/02
Semivolatile Organics (ug/L)										
1,1-BIPHENYL	0.5	300	3 U	3 U	3 U	**8 J [G]**	3 U	10 U	3 U	10 U
2,4,5-TRICHLOROPHENOL	1	3600	2 U	2 U	2 U	2 U	2 U	25 U	2 U	25 U
2,4-DICHLOROPHENOL	0.3	110	2 U	2 U	2 U	2 U	2 U	10 U	2 U	10 U
2,4-DIMETHYLPHENOL	140	730	2 U	2 U	2 U	2 U	2 U	10 U	2 U	10 U
2-METHYLNAPHTHALENE	28	6.2	2 U	2 U	2 U	**103 [G]**	2 U	10 U	2 U	**31 [G]**
2-METHYLPHENOL	35	1800	2 U	2 U	2 U	2 U	2 U	10 U	2 U	10 U
3&4-METHYLPHENOL	3.5	180	2 U	2 U	2 U	2 U	2 U	10 U	2 U	10 U
DI-N-BUTYL PHTHALATE	700	3600	1 U	1 U	1 U	1 U	1 U	10 U	1 U	10 U
DIETHYL PHTHALATE	5600	29000	2 U	2 U	2 U	2 U	2 U	10 U	2 U	10 U
FLUORENE	280	240	1 U	1 U	1 U	1 U	1 U	10 U	1 U	2 J
NAPHTHALENE	14	6.2	3 U	3 U	3 U	**194 [G]**	3 U	10 U	3 U	11
PENTACHLOROPHENOL	1	0.56	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	25 U	1 UJ	25 U
PHENANTHRENE	210	180	1 U	1 U	1 U	1 U	1 U	10 U	1 U	1 J

TABLE 5-10
Summary of Detected SVOC Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW13S MW13S-120106 12/01/06	JAX47-MW13S MW13S-120106-AVG 12/01/06	JAX47-MW13S MW13S-120106-D 12/01/06	JAX47-MW14D MW14D-120106 12/01/06	JAX47-MW14S MW14S-120806 12/08/06	JAX47-MW15D MW15D-112906 11/29/06	JAX47-MW15S MW15S-112906 11/29/06	JAX47-MW16D MW16D-120506 12/05/06
Semivolatile Organics (ug/L)										
1,1-BIPHENYL	0.5	300	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
2,4,5-TRICHLOROPHENOL	1	3600	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DICHLOROPHENOL	0.3	110	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DIMETHYLPHENOL	140	730	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-METHYLNAPHTHALENE	28	6.2	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-METHYLPHENOL	35	1800	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
3&4-METHYLPHENOL	3.5	180	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
DI-N-BUTYL PHTHALATE	700	3600	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIETHYL PHTHALATE	5600	29000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
FLUORENE	280	240	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
NAPHTHALENE	14	6.2	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
PENTACHLOROPHENOL	1	0.56	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 U	1 U	1 UJ
PHENANTHRENE	210	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW16S MW16S-120506 12/05/06	JAX47-MW17D MW17D-120506 12/05/06	JAX47-MW17S MW17S-120506 12/05/06	JAX47-MW18D MW18D-113006 11/30/06	JAX47-MW18S MW18S-113006 11/30/06	JAX47-MW19S MW19S-120506 12/05/06	JAX47-MW20S MW20S-113006 11/30/06	JAX47-MW23S MW23S-120506 12/05/06
Semivolatile Organics (ug/L)										
1,1-BIPHENYL	0.5	300	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
2,4,5-TRICHLOROPHENOL	1	3600	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DICHLOROPHENOL	0.3	110	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DIMETHYLPHENOL	140	730	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-METHYLNAPHTHALENE	28	6.2	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-METHYLPHENOL	35	1800	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
3&4-METHYLPHENOL	3.5	180	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
DI-N-BUTYL PHTHALATE	700	3600	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIETHYL PHTHALATE	5600	29000	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
FLUORENE	280	240	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
NAPHTHALENE	14	6.2	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
PENTACHLOROPHENOL	1	0.56	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
PHENANTHRENE	210	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

TABLE 5-10
Summary of Detected SVOC Concentrations in Groundwater Samples

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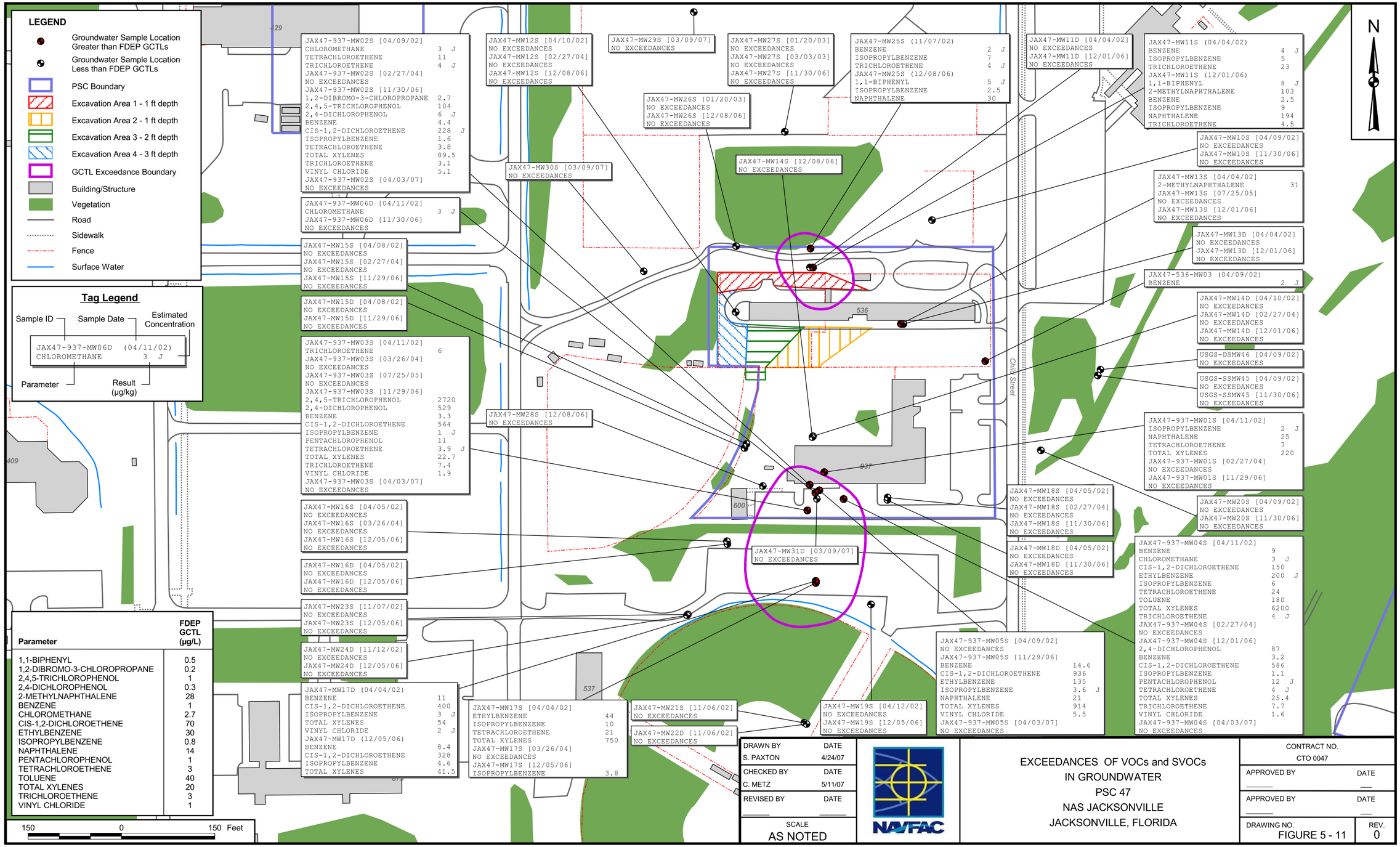
LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW24D MW24D-120506 12/05/06	JAX47-MW25S MW25S-120806 12/08/06	JAX47-MW26S MW26S-120806 12/08/06	JAX47-MW27S MW27S-113006 11/30/06	JAX47-MW28S MW28S-120806 12/08/06	JAX47-MW29S MW29S-030907 03/09/07	JAX47-MW30S MW30S-030907 03/09/07	JAX47-MW31D MW31D-030907 03/09/07
Semivolatile Organics (ug/L)										
1,1-BIPHENYL	0.5	300	3 U	**5 J [G]**	3 U	3 U	3 U	3 U	3 U	3 U
2,4,5-TRICHLOROPHENOL	1	3600	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DICHLOROPHENOL	0.3	110	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DIMETHYLPHENOL	140	730	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2-METHYLNAPHTHALENE	28	6.2	2 U	25	2 U	2 U	2 U	2 U	2 U	2 U
2-METHYLPHENOL	35	1800	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
3&4-METHYLPHENOL	3.5	180	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
DI-N-BUTYL PHTHALATE	700	3600	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIETHYL PHTHALATE	5600	29000	2 U	2 U	2 U	2 U	2 U	9 J	2 U	2 U
FLUORENE	280	240	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
NAPHTHALENE	14	6.2	3 U	**30 [G]**	3 U	3 U	3 U	3 U	3 U	3 U
PENTACHLOROPHENOL	1	0.56	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 U	1 U	1 U
PHENANTHRENE	210	180	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	USGS-DSMW46 USGS(D)-040902 04/09/02	USGS-SSMW45 USGS(S)-040902 04/09/02	USGS-SSMW45 USGS(S)-113006 11/30/06
Semivolatile Organics (ug/L)					
1,1-BIPHENYL	0.5	300	11 U	10 U	3 U
2,4,5-TRICHLOROPHENOL	1	3600	28 U	25 U	2 U
2,4-DICHLOROPHENOL	0.3	110	11 U	10 U	2 U
2,4-DIMETHYLPHENOL	140	730	11 U	10 U	2 U
2-METHYLNAPHTHALENE	28	6.2	11 U	10 U	2 U
2-METHYLPHENOL	35	1800	11 U	10 U	2 U
3&4-METHYLPHENOL	3.5	180	11 U	10 U	2 U
DI-N-BUTYL PHTHALATE	700	3600	11 U	0.90 J	1 U
DIETHYL PHTHALATE	5600	29000	11 U	10 U	2 U
FLUORENE	280	240	11 U	10 U	1 U
NAPHTHALENE	14	6.2	11 U	10 U	3 U
PENTACHLOROPHENOL	1	0.56	28 U	25 U	1 UJ
PHENANTHRENE	210	180	11 U	10 U	1 U

Notes:
GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
Blank cells denote not analyzed
PRG - preliminary remediation goal

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR VOC/SVOC EXCEEDANCE IN GROUNDWATER TAG LAYOUT 5/11/07 SP



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S. PAXTON	4/24/07
CHECKED BY	DATE
C. METZ	5/11/07
REVISED BY	DATE
SCALE	
AS NOTED	

NAVFAC

EXCEEDANCES OF VOCs and SVOCs
IN GROUNDWATER
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO.
CTO 0047

APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 5 - 11	REV. 0

Groundwater analytical results reported on samples collected from permanent monitoring wells were similar to results obtained during Phase I of the groundwater assessment program. Two separate zones of elevated hydrocarbon concentrations were verified within the PSC boundary (southern plume in former DVECC tank vicinity and northern plume near central portion of Pesticide Shop). An additional area south of the PSC boundary near the MW17 well pair was confirmed as an area of concern for VOCs and SVOCs as well as pesticides. This additional area will be considered part of the southern plume associated with DVECC.

In the DVECC area, the largest number of exceedances and the highest concentrations were reported in samples collected from MW03S (10 GCTL exceedances) during Phase III. Monitoring well MW03S is located southwest of the former UST enclosures. In this sample, three petroleum hydrocarbon compounds (benzene, total xylenes, and isopropylbenzene) and seven chlorinated solvents (2,4,5-trichlorophenol, 2,4-dichlorophenol, cis-1,2-DCE, pentachlorophenol, PCE, TCE, and vinyl chloride) were reported at concentrations exceeding GCTLs. Highest of these concentrations were benzene (3.3 µg/L), total xylenes (22.7 µg/L), 2,4,5-trichlorophenol (2,720 µg/L), 2,4-dichlorophenol (529 µg/L), cis-1,2-DCE (564 µg/L), pentachlorophenol (11 µg/L), PCE (3.9 µg/L, estimated), TCE (7.4 µg/L) and vinyl chloride 1.9(9 µg/L). Nine targeted compounds exceeding GCTLs were reported in MW04S at concentrations similar to those reported in MW03S. MW03S is located southwest of the former UST enclosure.

Concentrations of petroleum hydrocarbon compounds and chlorinated solvents were also detected above GCTLs in DVECC wells MW01S (4 exceedances), MW02S (10 exceedances), and MW05S (7 exceedances). No GCTL exceedances were reported in samples from the deep well (MW06D) or perimeter wells MW14S, MW18S, and MW28S around the DVECC area.

Petroleum hydrocarbons and chlorinated solvents were identified in samples collected from MW17S (screened 2.5 to 12. 5 ft bls) and from MW17D (screened 37 to 42 ft bls), located in the hotspot identified outside the PSC boundary to the south of DVECC. The only compound reported at concentrations exceeding its GCTL in both wells was isopropylbenzene (3.8 µg/L in MW17S and 4.6 µg/L in MW17D). No other GCTL exceedances were reported in MW17S. Other exceedances reported in MW17D were benzene (8.4 µg/L), cis-1-2-DCE (328 µg/L), and total xylenes (41.5 µg/L). No VOC GCTL exceedances were reported in samples collected from MW19S, MW21S (Phase II only), MW 22D (Phase II only), or MW23S. Monitoring wells MW 21S and MW22D were abandoned following Phase II sampling because of their location (middle of a baseball field) and the fact no GCTL exceedances were reported in either well.

In the northern plume area (around the Pesticide Shop), GCTL exceedances were reported in samples from MW11S and MW25S only, both located north of the Pesticide Shop. The main analytes detected in this area were low levels of petroleum hydrocarbons, specifically benzene, isopropylbenzene, naphthalene, 2-methylnaphthalene, and 1,1-biphenyl. The only chlorinated solvent reported in this area was TCE. All six of the constituents listed above were detected in excess of GCTLs in MW11S. Concentrations for the six exceedances in MW11S ranged from 2.5 µg/L (estimated) for benzene to 194 µg/L for naphthalene. Three GCTL exceedances (isopropylbenzene, naphthalene, and 1,1-biphenyl) were reported in MW25S, all at concentrations slightly exceeding GCTLs.

The number of detections and constituent concentrations were lower in the two permanent monitoring wells sampled in this area during Phase II/III as compared to DPT grab sample results from Phase I. Based upon Phase I analyses, the highest concentrations of the most-frequently reported constituents in this area are present in close proximity to Building 536, on both the north and south side of the structure as indicated by analytical results for SB43 and SB47 (Figure 5-9).

5.3.2.2.3 TCL Herbicides

Although not considered COCs, due to lack of detections in pre-RI sampling efforts, groundwater samples collected from permanent monitoring wells during the April 2002 sampling event were analyzed for TCL herbicides to provide a reassurance that herbicides were not present in groundwater beneath the site. Monitoring wells added to the network after this date (i.e., those with designations of MW21 or higher) were not sampled for herbicides based upon current analytical data at the time. A summary of detected herbicide constituents is provided in Table 5-11 and validated laboratory analytical results are included in Appendix J. In each case where an herbicide compound was reported at a concentration equal to or exceeding its laboratory detection limit, the value was presented as a “J”, or estimated value.

A high concentration of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) necessitated a 2500X dilution factor for analysis of the sample collected from DVECC well JAX47-937-MW03S, located southwest of the former UST. The reported “J” value for this sample was 10,000 µg/L, exceeding the GCTL of 50 µg/L for 2,4,5-T. 2,4-D was also reported at a “J” value of 1,000 µg/L, exceeding its GCTL of 70 µg/L. No other herbicides were detected in the MW03 samples at the elevated reporting limits.

Several herbicides were identified in other samples analyzed, but the reported J values were two to three magnitudes less than GCTLs in most cases. Samples in which the largest number of herbicide compounds were identified at these low concentrations were DVECC wells MW02S and MW04S (four identified compounds), the HLA well, JAX47-536-MW03, (six compounds), and MW11S, north of western half of the Pesticide Shop, (five compounds). The most frequently reported compounds were 2,4,5-T, 2,4-D, silvex (2,4,5-TP), and pentachlorophenol.

Table 5-11
Summary of Detected Herbicide Concentrations in Groundwater Samples

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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	FEDERAL MCLs	JAX47-536-MW03 536-MW03-040902 04/09/02	JAX47-937-MW01S 937-MW01S-041102 04/11/02	JAX47-937-MW01S 937-MW01S-041102-D 04/11/02	JAX47-937-MW02S 937-MW02S-041002 04/09/02	JAX47-937-MW03S 937-MW03S-041102 04/11/02	JAX47-937-MW04S 937-MW04S-041102 04/11/02
Herbicides (ug/L)								
2,4,5-T	70	NC	1.1	1.8 J	1 U	0.46 J	**10000 J [G]**	1.1 R
2,4,5-TP (SILVEX)	50	50	1 U	1 U	1 U	0.22 J	260 R	0.25 J
2,4-D	70	70	0.55 J	4 U	4 U	0.70 J	**1000 J [G]**	1.6 J
2,4-DB	56	NC	0.51 R	4 U	4 U	0.42 R	10000 U	1.9 R
DICAMBA	210	NC	0.78 R	2 U	2 U	2 U	5000 U	0.20 J
DICHLOROPROP	35	NC	0.64 R	4 U	4 U	4 U	10000 U	2.2 R
PENTACHLOROPHENOL	1	1	0.083 J	0.50 U	0.50 U	0.061 J	1200 U	0.26 J

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	FEDERAL MCLs	JAX47-937-MW05S 937-MW05S-041002 04/09/02	JAX47-937-MW06D 937-MW06D-041102 04/11/02	JAX47-MW10S MW10S-040902 04/09/02	JAX47-MW11D MW11D-040402 04/04/02	JAX47-MW11S MW11S-040402 04/04/02	JAX47-MW12S MW12S-041002 04/10/02
Herbicides (ug/L)								
2,4,5-T	70	NC	1 U	0.14 J	1 U	1 U	0.57 J	1 U
2,4,5-TP (SILVEX)	50	50	1 U	1 U	1 U	0.35 J	0.31 J	1 U
2,4-D	70	70	4 U	4 U	4 U	4 U	4 U	4 U
2,4-DB	56	NC	4 U	4 U	4 U	4 U	0.51 J	4 U
DICAMBA	210	NC	2 U	2 U	2 U	2 U	2 U	2 U
DICHLOROPROP	35	NC	4 U	4 U	4 U	4 U	0.34 J	4 U
PENTACHLOROPHENOL	1	1	0.50 U	0.50 U	0.50 U	0.50 U	0.11 J	0.50 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	FEDERAL MCLs	JAX47-MW13D MW13D-040402 04/04/02	JAX47-MW13S MW13S-040402 04/04/02	JAX47-MW14D MW14D-041002 04/10/02	JAX47-MW14D MW14D-041002-D 04/10/02	JAX47-MW15D MW15D-040802 04/08/02
Herbicides (ug/L)							
2,4,5-T	70	NC	1 U	1 U	1 U	1 U	1 U
2,4,5-TP (SILVEX)	50	50	1 U	1 U	1 U	1 U	1 U
2,4-D	70	70	4 U	4 U	4 U	4 U	4 U
2,4-DB	56	NC	4 U	4 U	4 U	4 U	4 U
DICAMBA	210	NC	2 U	2 U	2 U	2 U	2 U
DICHLOROPROP	35	NC	4 U	4 U	4 U	4 U	4 U
PENTACHLOROPHENOL	1	1	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U

Table 5-11
Summary of Detected Herbicide Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	FEDERAL MCLs	JAX47-MW15S MW15S-040802 04/08/02	JAX47-MW15S MW15S-040802-D 04/08/02	JAX47-MW16D MW16D-040502 04/05/02	JAX47-MW16S MW16S-040502 04/05/02	JAX47-MW17D MW17D-040402 04/04/02	JAX47-MW17S MW17S-040402 04/04/02
Herbicides (ug/L)								
2,4,5-T	70	NC	1 U	1 U	1 U	1 U	1 U	1 U
2,4,5-TP (SILVEX)	50	50	1 U	1 U	1 U	1 U	1 U	1 U
2,4-D	70	70	4 U	4 U	4 U	4 U	4 U	4 U
2,4-DB	56	NC	4 U	4 U	4 U	4 U	4 U	0.61 R
DICAMBA	210	NC	2 U	2 U	2 U	2 U	2 U	2 U
DICHLOROPROP	35	NC	4 U	4 U	4 U	4 U	4 U	4 U
PENTACHLOROPHENOL	1	1	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	FEDERAL MCLs	JAX47-MW18D MW18D-040502 04/05/02	JAX47-MW18S MW18S-040502 04/05/02	JAX47-MW19S MW19S-041202 04/12/02	JAX47-MW20S MW20S-040902 04/09/02	USGS-DSMW46 USGS(D)-040902 04/09/02	USGS-SSMW45 USGS(S)-040902 04/09/02
Herbicides (ug/L)								
2,4,5-T	70	NC	1 U	1 U	1 U	1 U	1 U	1 U
2,4,5-TP (SILVEX)	50	50	1 U	1 U	1 U	1 U	1 U	1 U
2,4-D	70	70	4 U	4 U	4 U	4 U	4 U	4 U
2,4-DB	56	NC	4 U	4 U	4 U	4 U	4 U	4 U
DICAMBA	210	NC	2 U	2 U	2 U	2 U	2 U	2 U
DICHLOROPROP	35	NC	4 U	4 U	4 U	4 U	4 U	4 U
PENTACHLOROPHENOL	1	1	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U

Notes:

GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
MCL - Maximum Contaminant Level

R - Rejected due to percent difference between analytical columns exceeds 100 percent (D).

5.3.2.2.4 OP Pesticides and PCBs

The same wells that were sampled for TCL herbicides (preceding section) were also sampled for OP pesticides for the same reason. The rationale for PCB analyses was the same as that for SVOC analyses discussed above in Section 5.3.2.2.2 (i.e., maximum information from limited number of samples regarding constituents not previously identified at elevated levels). Consequently, samples collected from well pairs MW13S/D, JAX47-937-MW01S/MW06D, and USGS-SSMW45/DSMW46 were analyzed for PCBs in addition to SVOCs. Validated laboratory reports are provided in Appendix J. Thirty-one (31) OP pesticide compounds and seven aroclor congeners (PCBs) were included in the analyses. None of the targeted analytes were identified at concentrations equal to or exceeding laboratory reporting limits.

5.3.2.2.5 TAL Metals

During Phase II, samples collected from wells MW13S/MW13D, DVECC wells MW01S and MW06D, and the two USGS wells (DSMW46 and SSMW45) were analyzed for the 23 TAL Metals (i.e, inorganic constituents) according to the same rationale as discussed above for SVOCs and PCBs. Reported concentrations of TAL metals are listed in Table 5-12 and validated laboratory reports are included in Appendix J. In addition to FDEP GCTLs, reported metals concentrations were compared to NAS Jacksonville background concentrations.

Samples collected from all 26 monitoring wells during the April 2002 sampling event were analyzed for iron and manganese as part of the laboratory natural attenuation parameters list. The significance of iron and manganese analytical results, as they pertain to natural attenuation processes, is discussed in Section 6.3.

Arsenic was reported at concentrations of 746 µg/L and 810 µg/L (duplicate sample) in the sample collected from well MW01S during the initial Phase II groundwater sampling. This concentration for arsenic exceeded its NAS Jacksonville background concentration of 13.2 µg/L and the 2004 FDEP GCTL of 50 µg/L. This was the only metal value reported to exceed background concentrations in the six samples analyzed. Iron and aluminum were reported at concentrations exceeding their respective GCTLs of 300 and 200 µg/L in several samples, but these values and the other values reported for iron and aluminum are below NAS Jacksonville background concentrations.

5.3.2.3 Additional Arsenic Investigation

Due to the arsenic results for MW01S, additional arsenic sampling was performed in 2004 to further delineate the arsenic exceedance detected in MW01S at DVECC. The highest reported concentration during the additional arsenic investigation (2004) was in MW02S (8960 µg/L). Table 5-13 provides the

Table 5-12
Summary of Detected Total Inorganic Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-536-MW03 536-MW03-040902 04/09/02	JAX47-937-MW01S 937-MW01S-041102 04/11/02	JAX47-937-MW01S 937-MW01S-041102-D 04/11/02	JAX47-937-MW01S 937-MW01S-022704 02/27/04	JAX47-937-MW01S 937-MW01S-022704-D 02/27/04	JAX47-937-MW01S 937-MW01S-112906 11/29/06	JAX47-937-MW02S 937-MW02S-041002 04/09/02	JAX47-937-MW02S 937-MW02S-022704 02/27/04
Total Inorganics (ug/L)										
ALUMINUM	200	36000		124 U	171 U					
ARSENIC	10	0.045		**746 [G]**	**810 [G]**	**387 [G]**	**301 [G]**	**41 [G]**		**8960 [G]**
BARIUM	2000	2600		137	148					
CALCIUM	NC	NC		27800	29000					
CHROMIUM	100	110		0.84 U	0.84 U					
IRON	300	11000	**33000 [G]**	**31000 [G]**	**31400 [G]**				**10500 [G]**	
LEAD	15	15		1.37 U	1.37 U					
MAGNESIUM	NC	NC		8860	9000					
MANGANESE	50	880	32.4	37.8	39.9				**196 [G]**	
MERCURY	2	11		0.01 U	0.02					
NICKEL	100	730		0.93 U	0.93 U					
POTASSIUM	NC	NC		6720	6850					
SELENIUM	50	180		3.42 U	3.42 U					
VANADIUM	49	36		6	7					
ZINC	5000	11000		1.8 U	6.8 U					

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-937-MW02S 937-MW02S-113006 11/30/06	JAX47-937-MW02S 937-MW02S-040307 04/03/07	JAX47-937-MW03S 937-MW03S-041102 04/11/02	JAX47-937-MW03S 937-MW03S-032604 03/26/04	JAX47-937-MW03S 937-MW03S-112906 11/29/06	JAX47-937-MW03S 937-MW03S-040307 04/03/07	JAX47-937-MW04S 937-MW04S-041102 04/11/02	JAX47-937-MW04S 937-MW04S-022704 02/27/04
Total Inorganics (ug/L)										
ALUMINUM	200	36000								
ARSENIC	10	0.045	**8400 [G]**	**6640 [G]**		**7930 [G]**	**23000 [G]**	**6240 [G]**		3.8
BARIUM	2000	2600								
CALCIUM	NC	NC								
CHROMIUM	100	110								
IRON	300	11000			**6790 [G]**				**38400 [G]**	
LEAD	15	15								
MAGNESIUM	NC	NC								
MANGANESE	50	880			**96.5 [G]**				**465 [G]**	
MERCURY	2	11								
NICKEL	100	730								
POTASSIUM	NC	NC								
SELENIUM	50	180								
VANADIUM	49	36								
ZINC	5000	11000								

Table 5-12
Summary of Detected Total Inorganic Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-937-MW04S 937-MW04S-120106 12/01/06	JAX47-937-MW04S 937-MW04S-040307 04/03/07	JAX47-937-MW05S 937-MW05S-041002 04/09/02	JAX47-937-MW05S 937-MW05S-112906 11/29/06	JAX47-937-MW05S 937-MW05S-040307 04/03/07	JAX47-937-MW06D 937-MW06D-041102 04/11/02	JAX47-937-MW06D 937-MW06D-113006 11/30/06	JAX47-MW10S MW10S-040902 04/09/02
Total Inorganics (ug/L)										
ALUMINUM	200	36000						38.7 U		
ARSENIC	10	0.045	**5880 [G]**	18.3 U		**2310 [G]**	**2100 [G]**	**16.4 [G]**	**40.3 [G]**	
BARIUM	2000	2600						56.3		
CALCIUM	NC	NC						5570		
CHROMIUM	100	110						0.84 U		
IRON	300	11000			**11000 [G]**			**15500 [G]**		84.7 U
LEAD	15	15						1.37 U		
MAGNESIUM	NC	NC						2910		
MANGANESE	50	880			**214 [G]**			21		7.6
MERCURY	2	11						0.01 U		
NICKEL	100	730						1.2 U		
POTASSIUM	NC	NC						826		
SELENIUM	50	180						3.42 U		
VANADIUM	49	36						0.87 U		
ZINC	5000	11000						8.2 U		

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW10S MW10S-113006 11/30/06	JAX47-MW11D MW11D-040402 04/04/02	JAX47-MW11D MW11D-120106 12/01/06	JAX47-MW11S MW11S-040402 04/04/02	JAX47-MW11S MW11S-120106 12/01/06	JAX47-MW12S MW12S-041002 04/10/02	JAX47-MW12S MW12S-022704 02/27/04
Total Inorganics (ug/L)									
ALUMINUM	200	36000							
ARSENIC	10	0.045	4 U		4 U		5		2.13 U
BARIUM	2000	2600							
CALCIUM	NC	NC							
CHROMIUM	100	110							
IRON	300	11000		**325 [G]**		**679 [G]**		7.3 U	
LEAD	15	15							
MAGNESIUM	NC	NC							
MANGANESE	50	880		**128 [G]**		14.8		**53.7 [G]**	
MERCURY	2	11							
NICKEL	100	730							
POTASSIUM	NC	NC							
SELENIUM	50	180							
VANADIUM	49	36							
ZINC	5000	11000							

Table 5-12
Summary of Detected Total Inorganic Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW12S MW12S-120806 12/08/06	JAX47-MW13D MW13D-040402 04/04/02	JAX47-MW13D MW13D-120106 12/01/06	JAX47-MW13S MW13S-040402 04/04/02	JAX47-MW13S MW13S-120106 12/01/06	JAX47-MW13S MW13S-120106-D 12/01/06	JAX47-MW14D MW14D-041002 04/10/02	JAX47-MW14D MW14D-022704 02/27/04
Total Inorganics (ug/L)										
ALUMINUM	200	36000		**15600 [G]**		**929 [G]**				
ARSENIC	10	0.045	4 U	2.15 U	4 U	2.15 U	4 U	4 U		4.4
BARIUM	2000	2600		60.7		162				
CALCIUM	NC	NC		13300		6880				
CHROMIUM	100	110		15		1				
IRON	300	11000		**3910 [G]**		**1400 [G]**			**840 [G]**	
LEAD	15	15		7.3		1.37 U				
MAGNESIUM	NC	NC		6220		8360				
MANGANESE	50	880		29.4		10.9			**277 [G]**	
MERCURY	2	11		0.13 U		0.10 U				
NICKEL	100	730		6.1		2.1				
POTASSIUM	NC	NC		1450		3340				
SELENIUM	50	180		3.8		3.42 U				
VANADIUM	49	36		13.1		0.70 U				
ZINC	5000	11000		11.6		4.4				

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW14D MW14D-120106 12/01/06	JAX47-MW14S MW14S-120806 12/08/06	JAX47-MW15D MW15D-040802 04/08/02	JAX47-MW15D MW15D-112906 11/29/06	JAX47-MW15S MW15S-040802 04/08/02	JAX47-MW15S MW15S-022704 02/27/04	JAX47-MW15S MW15S-112906 11/29/06	JAX47-MW16D MW16D-040502 04/05/02
Total Inorganics (ug/L)										
ALUMINUM	200	36000								
ARSENIC	10	0.045	4 U	4 U		4 U		2.13 U	5.2	
BARIUM	2000	2600								
CALCIUM	NC	NC								
CHROMIUM	100	110								
IRON	300	11000			**569 [G]**		**469 [G]**			**6700 [G]**
LEAD	15	15								
MAGNESIUM	NC	NC								
MANGANESE	50	880			**65.3 [G]**		9.4			**256 [G]**
MERCURY	2	11								
NICKEL	100	730								
POTASSIUM	NC	NC								
SELENIUM	50	180								
VANADIUM	49	36								
ZINC	5000	11000								

Table 5-12
Summary of Detected Total Inorganic Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW16D MW16D-120506 12/05/06	JAX47-MW16S MW16S-040502 04/05/02	JAX47-MW16S MW16S-032604 03/26/04	JAX47-MW16S MW16S-120506 12/05/06	JAX47-MW17D MW17D-040402 04/04/02	JAX47-MW17D MW17D-120506 12/05/06	JAX47-MW17S MW17S-040402 04/04/02	JAX47-MW17S MW17S-032604 03/26/04
Total Inorganics (ug/L)										
ALUMINUM	200	36000								
ARSENIC	10	0.045	9.7		2.8	5.5		5.6		2.13 U
BARIUM	2000	2600								
CALCIUM	NC	NC								
CHROMIUM	100	110								
IRON	300	11000		**1360 [G]**			**6000 [G]**		**25800 [G]**	
LEAD	15	15								
MAGNESIUM	NC	NC								
MANGANESE	50	880		14.5			**168 [G]**		19.5	
MERCURY	2	11								
NICKEL	100	730								
POTASSIUM	NC	NC								
SELENIUM	50	180								
VANADIUM	49	36								
ZINC	5000	11000								

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW17S MW17S-120506 12/05/06	JAX47-MW18D MW18D-040502 04/05/02	JAX47-MW18D MW18D-113006 11/30/06	JAX47-MW18S MW18S-040502 04/05/02	JAX47-MW18S MW18S-022704 02/27/04	JAX47-MW18S MW18S-113006 11/30/06	JAX47-MW19S MW19S-041202 04/12/02	JAX47-MW19S MW19S-120506 12/05/06
Total Inorganics (ug/L)										
ALUMINUM	200	36000								
ARSENIC	10	0.045	4 U		**10.2 [G]**		2.13 U	4 U		4 U
BARIUM	2000	2600								
CALCIUM	NC	NC								
CHROMIUM	100	110								
IRON	300	11000		**8210 [G]**		**7080 [G]**			**395 [G]**	
LEAD	15	15								
MAGNESIUM	NC	NC								
MANGANESE	50	880		**307 [G]**		11.9			4.8	
MERCURY	2	11								
NICKEL	100	730								
POTASSIUM	NC	NC								
SELENIUM	50	180								
VANADIUM	49	36								
ZINC	5000	11000								

Table 5-12
Summary of Detected Total Inorganic Concentrations in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW20S MW20S-040902 04/09/02	JAX47-MW20S MW20S-113006 11/30/06	JAX47-MW23S MW23S-120506 12/05/06	JAX47-MW24D MW24D-120506 12/05/06	JAX47-MW25S MW25S-120806 12/08/06	JAX47-MW26S MW26S-120806 12/08/06	JAX47-MW27S MW27S-113006 11/30/06	JAX47-MW28S MW28S-120806 12/08/06
Total Inorganics (ug/L)										
ALUMINUM	200	36000								
ARSENIC	10	0.045		4 U	4 U	4 U	4.1	4 U	4 U	4 U
BARIUM	2000	2600								
CALCIUM	NC	NC								
CHROMIUM	100	110								
IRON	300	11000	**4460 [G]**							
LEAD	15	15								
MAGNESIUM	NC	NC								
MANGANESE	50	880	**82.1 [G]**							
MERCURY	2	11								
NICKEL	100	730								
POTASSIUM	NC	NC								
SELENIUM	50	180								
VANADIUM	49	36								
ZINC	5000	11000								

LOCATION SAMPLE ID SAMPLE DATE	FDEP GCTL	REGION 9 PRGs	JAX47-MW29S MW29S-030907 03/09/07	JAX47-MW30S MW30S-030907 03/09/07	JAX47-MW31D MW31D-030907 03/09/07	USGS-DSMW46 USGS(D)-040902 04/09/02	USGS-SSMW45 USGS(S)-040902 04/09/02	USGS-SSMW45 USGS(S)-113006 11/30/06
Total Inorganics (ug/L)								
ALUMINUM	200	36000				127	**2530 [G]**	
ARSENIC	10	0.045	4 U	4 U	4 U	2.15 U	2.15 U	4 U
BARIUM	2000	2600				149	52.8	
CALCIUM	NC	NC				5130	5840	
CHROMIUM	100	110				0.84 U	2.9	
IRON	300	11000				**1980 [G]**	**31200 [G]**	
LEAD	15	15				1.37 U	1.37 U	
MAGNESIUM	NC	NC				7680	12900	
MANGANESE	50	880				25.7	14.1	
MERCURY	2	11				0.11 U	0.03 U	
NICKEL	100	730				2.9	3.6	
POTASSIUM	NC	NC				1970	2680	
SELENIUM	50	180				3.42 U	3.42 U	
VANADIUM	49	36				1 U	2.9 U	
ZINC	5000	11000				16.9	6.8	

Notes:
GCTL = Groundwater Cleanup Target Level
J = estimated value
U = less than laboratory detection limit
µg/L = micrograms per liter
Concentrations in bold exceed Florida GCTL
NC: no criteria established in 62-777 F.A.C.
Blank cells denote not analyzed
PRG - preliminary remediation goal

Table 5-13
Summary of Arsenic in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Location	Sample ID	Sample Date	Arsenic Result (ug/L)	FDEP GCTL	REGION 9 PRG
JAX47-937-MW01S	937-MW01S-041102	04/11/02	**746 [G]**	10	0.045
JAX47-937-MW01S	937-MW01S-041102-D	04/11/02	**810 [G]**	10	0.045
JAX47-937-MW01S	937-MW01S-022704	02/27/04	**387 [G]**	10	0.045
JAX47-937-MW01S	937-MW01S-022704-D	02/27/04	**301 [G]**	10	0.045
JAX47-937-MW01S	937-MW01S-112906	11/29/06	**41 [G]**	10	0.045
JAX47-937-MW02S	937-MW02S-022704	02/27/04	**8960 [G]**	10	0.045
JAX47-937-MW02S	937-MW02S-113006	11/30/06	**8400 [G]**	10	0.045
JAX47-937-MW02S	937-MW02S-040307	04/03/07	**6640 [G]**	10	0.045
JAX47-937-MW03S	937-MW03S-032604	03/26/04	**7930 [G]**	10	0.045
JAX47-937-MW03S	937-MW03S-112906	11/29/06	**23000 [G]**	10	0.045
JAX47-937-MW03S	937-MW03S-040307	04/03/07	**6240 [G]**	10	0.045
JAX47-937-MW04S	937-MW04S-022704	02/27/04	3.8	10	0.045
JAX47-937-MW04S	937-MW04S-120106	12/01/06	**5880 [G]**	10	0.045
JAX47-937-MW04S	937-MW04S-040307	04/03/07	18.3 U	10	0.045
JAX47-937-MW05S	937-MW05S-112906	11/29/06	**2310 [G]**	10	0.045
JAX47-937-MW05S	937-MW05S-040307	04/03/07	**2100 [G]**	10	0.045
JAX47-937-MW06D	937-MW06D-041102	04/11/02	**16.4 [G]**	10	0.045
JAX47-937-MW06D	937-MW06D-113006	11/30/06	**40.3 [G]**	10	0.045
JAX47-MW10S	MW10S-113006	11/30/06	4 U	10	0.045
JAX47-MW11D	MW11D-120106	12/01/06	4 U	10	0.045
JAX47-MW11S	MW11S-120106	12/01/06	5	10	0.045
JAX47-MW12S	MW12S-022704	02/27/04	2.13 U	10	0.045
JAX47-MW12S	MW12S-120806	12/08/06	4 U	10	0.045
JAX47-MW13D	MW13D-040402	04/04/02	2.15 U	10	0.045
JAX47-MW13D	MW13D-120106	12/01/06	4 U	10	0.045
JAX47-MW13S	MW13S-040402	04/04/02	2.15 U	10	0.045
JAX47-MW13S	MW13S-120106	12/01/06	4 U	10	0.045
JAX47-MW13S	MW13S-120106-D	12/01/06	4 U	10	0.045
JAX47-MW14D	MW14D-022704	02/27/04	4.4	10	0.045
JAX47-MW14D	MW14D-120106	12/01/06	4 U	10	0.045
JAX47-MW14S	MW14S-120806	12/08/06	4 U	10	0.045
JAX47-MW15D	MW15D-112906	11/29/06	4 U	10	0.045
JAX47-MW15S	MW15S-022704	02/27/04	2.13 U	10	0.045
JAX47-MW15S	MW15S-112906	11/29/06	5.2	10	0.045
JAX47-MW16D	MW16D-120506	12/05/06	9.7	10	0.045
JAX47-MW16S	MW16S-032604	03/26/04	2.8	10	0.045
JAX47-MW16S	MW16S-120506	12/05/06	5.5	10	0.045
JAX47-MW17D	MW17D-120506	12/05/06	5.6	10	0.045
JAX47-MW17S	MW17S-032604	03/26/04	2.13 U	10	0.045
JAX47-MW17S	MW17S-120506	12/05/06	4 U	10	0.045
JAX47-MW18D	MW18D-113006	11/30/06	**10.2 [G]**	10	0.045
JAX47-MW18S	MW18S-022704	02/27/04	2.13 U	10	0.045

Table 5-13
Summary of Arsenic in Groundwater Samples

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Location	Sample ID	Sample Date	Arsenic Result (ug/L)	FDEP GCTL	REGION 9 PRG
JAX47-MW18S	MW18S-113006	11/30/06	4 U	10	0.045
JAX47-MW19S	MW19S-120506	12/05/06	4 U	10	0.045
JAX47-MW20S	MW20S-113006	11/30/06	4 U	10	0.045
JAX47-MW23S	MW23S-120506	12/05/06	4 U	10	0.045
JAX47-MW24D	MW24D-120506	12/05/06	4 U	10	0.045
JAX47-MW25S	MW25S-120806	12/08/06	4.1	10	0.045
JAX47-MW26S	MW26S-120806	12/08/06	4 U	10	0.045
JAX47-MW27S	MW27S-113006	11/30/06	4 U	10	0.045
JAX47-MW28S	MW28S-120806	12/08/06	4 U	10	0.045
JAX47-MW29S	MW29S-030907	03/09/07	4 U	10	0.045
JAX47-MW30S	MW30S-030907	03/09/07	4 U	10	0.045
JAX47-MW31D	MW31D-030907	03/09/07	4 U	10	0.045
USGS-DSMW46	USGS(D)-040902	04/09/02	2.15 U	10	0.045
USGS-SSMW45	USGS(S)-040902	04/09/02	2.15 U	10	0.045
USGS-SSMW45	USGS(S)-113006	11/30/06	4 U	10	0.045

Notes:

GCTL = Groundwater Cleanup Target Level

J = estimated value

U = less than laboratory detection limit

µg/L = micrograms per liter

Concentrations in bold exceed Florida GCTL

PRG - preliminary remediation goal

results from the arsenic sampling events. Concentrations exceeding GCTLs for arsenic is illustrated on Figure 5-12. The validated laboratory packages are included in Appendix J. Monitoring well MW14S (downgradient), MW28S (cross-gradient) and MW31D (deep vertical well in center of "hot spot") were installed to further delineate the arsenic "hot spot" during Phase III. All site wells sampled in 2006/2007 during Phase III were analyzed for arsenic. Three wells (MW02S, MW03S, and MW05S), all located immediately southwest of of DVECC, were found to have significant concentrations of arsenic exceeding GCTLs (see Figure 5-12). This arsenic "hot spot" is located in the general vicinity of the UST mixing tanks that were removed from DVECC. Concentrations ranged from 6240 µg/L in MW03S and 6640 µg/L in MW02S to 2100 µg/L in MW05S during the most recent sampling event conducted in April 2007. No arsenic exceedances were detected in down-gradient wells (MW14S, MW14D, MW15S, MW15D, and MW28S) or deep well MW31D (screened 48 to 53 ft bls). The arsenic "hot spot" is confined to the shallow portion of the aquifer and has not migrated with groundwater flow (generally northwest). Groundwater contour maps were provided in Section 2 as Figures 2-7 through 2-12.

The location and concentration of the arsenic "hot spot" has not changed since being first detected in 2004. There were two spikes in arsenic concentration in monitoring wells MW03S (2006 – 23,000 µg/L) and MW04S (2006 -5,880 µg/L) but resampling (4 months later in 2007) of these two wells showed reported concentrations of 6,240 µg/L and 18.3 µg/L, respectively. Down-gradient wells have not had any reported GCTL exceedances which indicates that migration of the arsenic plume does not appear to be occurring with groundwater flow. Overall, there appears to be a very small highly concentrated arsenic plume located in the shallow aquifer in the general vicinity of the former DVECC mixing tanks.

5.3.2.4 Natural Attenuation Sampling

Field natural attenuation parameters (carbon dioxide, alkalinity, ferrous iron, hydrogen sulfide, sulfide, and manganese were collected from the site wells present before MW21S through MW31D were installed. See Table 5-14 for field natural attenuation data. Twenty-six wells were sampled for laboratory natural attenuation parameters during Phase II groundwater sampling. A list of wells sampled along with natural attenuation parameters is provided in Appendix D, Table D-3. Results of the Phase II laboratory natural attenuation sampling are provided in Table 5-15.

5.4 DISCUSSION OF RI RESULTS

The most common COCs at PSC 47 that exceed screening criteria are organochlorine pesticides and VOCs. VOC contamination is mainly a groundwater concern, whereas significant concentrations of pesticide constituents are present in both soil and groundwater. The types of TCL pesticides present reflect both the nature of the materials handled at PSC 47 and its historical use for pesticide mixing, application training, and equipment cleaning and maintenance. The presence of petroleum

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR ARSENIC EXCEEDANCE IN GROUNDWATER TAG LAYOUT 5/11/07 SP

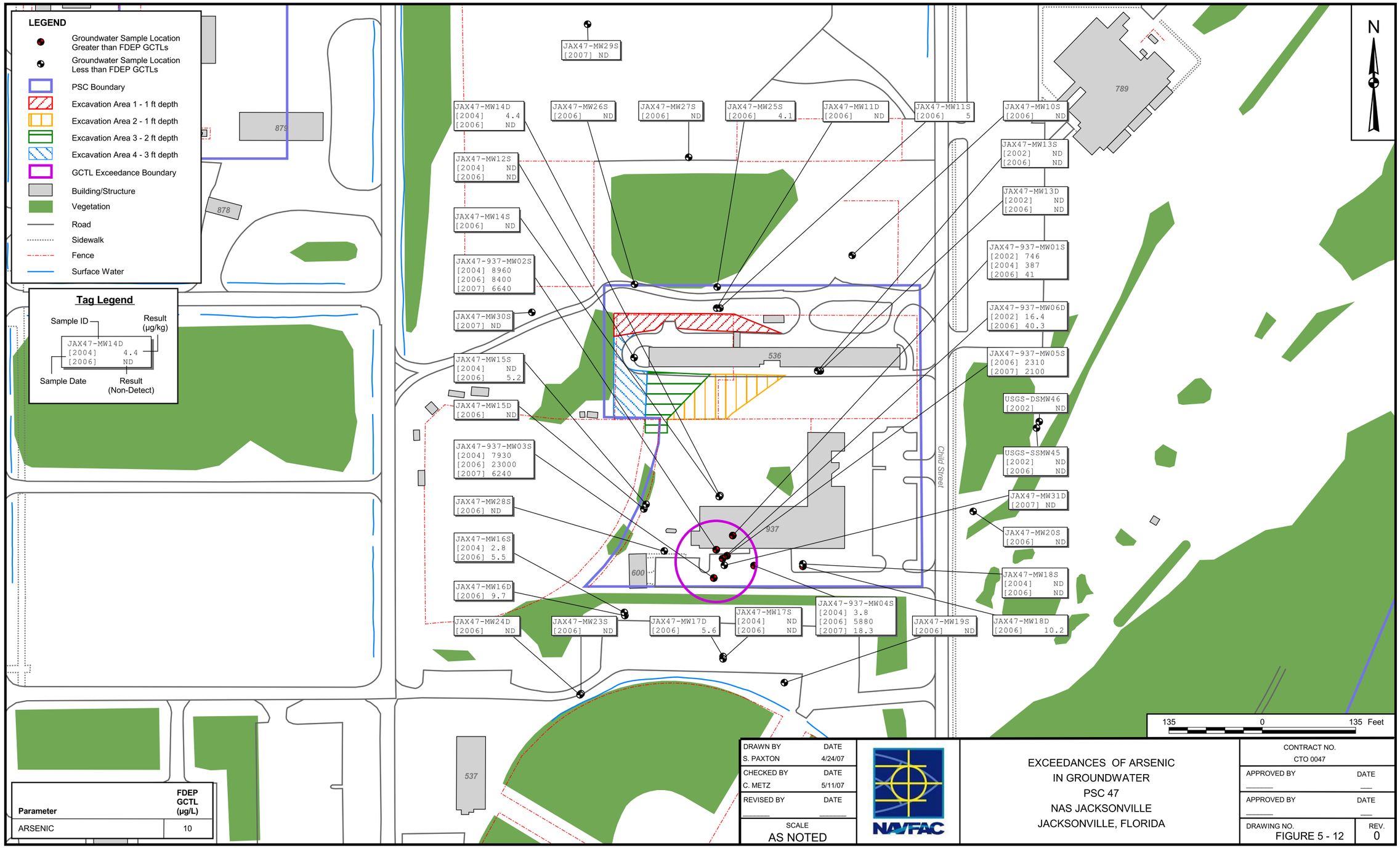

Table 5-14
Field Results for Natural Attenuation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Monitoring Well ID		JAX-47-						
		937-MW1S	**937-MW02S**	**937-MW3S**	**937-MW4S**	**937-MW5S**	**937-MW6D**	**536-MW03**
Sample Date		11-Apr-02	10-Apr-02	11-Apr-02	11-Apr-02	10-Apr-02	11-Apr-02	9-Apr-02
Parameter	**Units**							
Dissolved Oxygen[1]	mg/L	0.3	1	0.8	No data	1	0.6	2
Alkalinity[2]	mg/L	18	50	25	<10	250	11	60
Carbon Dioxide[2]	mg/L	150	170	70	No data	30	40	110
Ferrous Iron[3]	mg/L	>3.3	3.25	3.25	>3.30	3.16	3.16	3.18
Manganese[3]	mg/L	0	0.4	0	0.9	0.5	0	0
Dissolved Sufide[3]	mg/L	0.25	0.04	0.06	>0.8	0.02	0.03	0.38
Hydrogen Sulfide[4]	mg/L	No data	0.1	0.3	>5	0.3	0	5
pH[5]	--	5.48	5.61	5.52	4.75	6.52	5.28	5.98
Specific Conductivity[5]	mS/cm	37.31	104.5	15.62	124.3	216.2	34.63	29.79
Temperature[5]	Celsius	21.9°	22.3°	21.06°	23.56°	23.15°	23.2°	23.0°
ORP[5]	mV	13.8	83	38.9	-95.5	-46.7	128.3	-42

See notes at end of table.

Table 5-14 (Continued)
Field Results for Natural Attenuation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Monitoring Well ID		JAX-47-						
		MW10S	**MW11D**	**MW11S**	**MW12S**	**MW13D**	**MW13S**	**MW14D**
	Sample Date	9-Apr-02	4-Apr-02	4-Apr-02	10-Apr-02	4-Apr-02	4-Apr-02	10-Apr-02
Parameter	**Units**							
Dissolved Oxygen[1]	mg/L	1	0.5	0.4	2	0.4	0.3	2
Alkalinity[2]	mg/L	35	No data	No data	0	No data	No data	70
Carbon Dioxide[2]	mg/L	100	No data	No data	35	No data	No data	16
Ferrous Iron[3]	mg/L	0.25	0.23	0.56	0.04	1.77	0.09	0.18
Manganese[3]	mg/L	0	0.2	0.2	0.1	0	0.3	0
Dissolved Sufide[3]	mg/L	0.13	0.03	0.01	0.00	0.72	0.00	0.03
Hydrogen Sulfide[4]	mg/L	0	0	0	0	0	0	0
pH[5]	--	5.57	7.41	4.53	4.45	6.18	4.66	6.57
Specific Conductivity[5]	mS/cm	42.21	39.46	34.13	27.09	11.92	37.94	23.56
Temperature[5]	Celsius	22.35°	22.87°	21.68°	22.26°	24.30°	23.6	22.2°
ORP[5]	mV	230.9	-55	209.3	315	47.8	272	39.2

See notes at end of table.

Table 5-14 (Continued)
Field Results for Natural Attenuation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Monitoring Well ID		JAX-47-						
		MW15D	**MW15S**	**MW16D**	**MW16S**	**MW17D**	**MW17S**	**MW18D**
Sample Date		8-Apr-02	8-Apr-02	5-Apr-02	5-Apr-02	4-Apr-02	4-Apr-02	4-Apr-02
Parameter	**Units**							
Dissolved Oxygen[1]	mg/L	1.0	2.0	0.3	4.0	1.0	0	0.4
Alkalinity[2]	mg/L	70	0	45	<10	No data	No data	35
Carbon Dioxide[2]	mg/L	18	30	40	50	No data	No data	35
Ferrous Iron[3]	mg/L	0.28	0	>3.30	1.36	>3.30	>3.30	>3.30
Manganese[3]	mg/L	0	0.4	0.2	0.5	0.1	0.003	0.3
Dissolved Sufide[3]	mg/L	0.02	0.04	0.02	>0.8	0.27	0.78	0.05
Hydrogen Sulfide[4]	mg/L	0	0	0	5.0	0	5.0	0
pH[5]	--	6.45	5.00	6.04	5.43	6.08	5.35	5.87
Specific Conductivity[5]	mS/cm	24.04	17.01	67.33	31.25	62.24	59.1	63.72
Temperature[5]	Celsius	22.91°	22.10°	23.55°	21.92°	25.52°	24.89°	22.16°
ORP[5]	mV	49.3	93	60.4	-28.6	37.1	-77.8	83.9

See notes at end of table.

Table 5-14 (Continued)
Field Results for Natural Attenuation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Monitoring Well ID		JAX-47-				
		MW18S	**MW19S**	**MW20S**	**USGS (D)**	**USGS(S)**
	Sample Date	5-Apr-02	12-Apr-02	9-Apr-02	9-Apr-02	9-Apr-02
Parameter	**Units**					
Dissolved Oxygen[1]	mg/L	1	1	2	1	2
Alkalinity[2]	mg/L	<10	75	0	0	0
Carbon Dioxide[2]	mg/L	70	40	130	0	40
Ferrous Iron[3]	mg/L	>3.3	0.34	3.09	0.21	3.01
Manganese[3]	mg/L	0.2	0.1	0.2	0	1
Dissolved Sufide[3]	mg/L	0.04	0.1	0.12	0.07	0.04
Hydrogen Sulfide[4]	mg/L	5	0	0	0	0
pH[5]	--	5.24	6.21	4.36	4.62	4.63
Specific Conductivity[5]	mS/cm	37.00	41.00	56.51	31.21	63.22
Temperature[5]	Celsius	20.66°	22.0°	22.6°	21.6°	20.22°
ORP[5]	mV	-14.5	-17.8	288	295	116.2

[1] - Analyzed using CHEMetrics
[2] - Analyzed using CHEMetrics titrets
[3] - Analyzed using HACH DR-890 Colorimeter
[4] - Analyzed using HS-C Test Kit
[5] -Analyzed usingYSI water quality instrument
mg/L - milligrams per liter
mS/cm - microsiemens per centimeter
mV - millivolts

Table 5-15
Laboratory Analytical Results for Natural Attenuation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Monitoring Well ID		JAX-47-													
		937-MW1S		**937-MW02S**		**937-MW3S**		**937-MW4S**		**937-MW5S**		**937-MW6D**		**536-MW03**	
Sample Date		11-Apr-02		10-Apr-02		11-Apr-02		11-Apr-02		10-Apr-02		11-Apr-02		9-Apr-02	
Parameter	**Units**														
Nitrate	mg/L	0.57		0.050	U	0.06		5		0.050	U	0.050	U	0.050	U
Nitrite	mg/L	0.050	U	0.050	U	0.050	U	0.06		0.050	U	0.050	U	0.050	U
Ammonia	mg/L	0.1	U	0.4		0.4		0.1		0.77		0.1	U	1.8	
TKN	mg/L	0.56		1.1		1.1		2		1.4		0.10	U	5.4	
Chloride	mg/L	57		170		23		94		53		28		33	
Dissolved Sulfide	mg/L	8		4	U	3		10		4.0	U	4.0	U	4.0	U
Sulfate	mg/L	130		370		19		120		240		33		4.0	U
Dissolved Iron	mg/L	30.2		10.6		6.02		42.3		9.24		14.9		12.6	
Dissolved Manganese	mg/L	0.0383		0.202		0.0798		0.482		0.212		0.0207		0.0193	
Ethane	µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Ethene	µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Methane	µg/L	4000		410		63		3000		76		260		1800	
Biological Oxygen Demand	mg/L	6.0	UJ	6.0	UJ	6.0	UJ	90.0	J	6.0	UJ	6.0	UJ	24	
Chemical Oxygen Demand	mg/L	30		70		99		340		50		15	U	490	
Total Organic Carbon	mg/L	50		82		79		130		79		19		10	

See notes at end of table.

Table 5-15 (Continued)
Laboratory Analytical Results for Natural Attenuation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Monitoring Well ID		JAX-47-													
		MW10S		MW11D		MW11S		MW12S		MW13D		MW13S		MW14D	
Sample Date		9-Apr-02		4-Apr-02		4-Apr-02		10-Apr-02		4-Apr-02		4-Apr-02		10-Apr-02	
Parameter	**Units**														
Nitrate	mg/L	3.4		0.050	U	3.4		1.3		0.050		0.43		0.050	U
Nitrite	mg/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Ammonia	mg/L	0.10	U	0.10	U	0.10		0.10	U	0.10	U	0.10	U	0.10	U
TKN	mg/L	0.3	U	0.10	U	0.57	U	0.10	U	0.2	U	0.1	U	0.1	
Chloride	mg/L	3		10		18		14		12		12		6	
Dissolved Sulfide	mg/L	4.0	U	2.0	UJ	1.0	UJ	10		2.0	UJ	2.0	UJ	4.0	U
Sulfate	mg/L	38		59		39		37		4.0	U	99		85	
Dissolved Iron	mg/L	0.0411	U	0.172		0.328		0.0069	u	1.49		2.9		0.579	
Dissolved Manganese	mg/L	0.0083		0.114		0.0152		0.0506		0.0279		0.0661		0.29	
Ethane	µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Ethene	µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Methane	µg/L	10	U	10	U	480		10	U	10	U	13		44	
Biological Oxygen Demand	mg/L	6.0	U	6.0	U	6.0	U	6.0	UJ	6.0	U	6.0	U	6.0	UJ
Chemical Oxygen Demand	mg/L	15	U	15.0	U	20		15.0	U	20		20		15	U
Total Organic Carbon	mg/L	4		4.0		12		34.0		6		8.2		21	

See notes at end of table.

Table 5-15 (Continued)
Laboratory Analytical Results for Natural Attenuation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Monitoring Well ID		JAX-47-													
		MW15D		MW15S		MW16D		MW16S		MW17D		MW17S		MW18D	
Sample Date		8-Apr-02		8-Apr-02		5-Apr-02		5-Apr-02		4-Apr-02		4-Apr-02		4-Apr-02	
Parameter	**Units**														
Nitrate	mg/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Nitrite	mg/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Ammonia	mg/L	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U	0.10	U
TKN	mg/L	0.10	U	0.2	U	0.10	U	1.1		0.1	U	0.1	U	0.1	U
Chloride	mg/L	8		7		18		53		16		15		25	
Dissolved Sulfide	mg/L	2.0	U	1	U	2.0	U	1.0	U	2.0	UJ	2.0	UJ	2.0	U
Sulfate	mg/L	5		8		73		69		26		66		62	
Dissolved Iron	mg/L	0.526		0.402		6.45		1.4		5.07		17.3		7.81	
Dissolved Manganese	mg/L	0.0628		0.0099		0.264		0.0195		0.258		0.03		0.31	
Ethane	µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Ethene	µg/L	10	U	10	U	10	U	10	U	10	U	10	U	10	U
Methane	µg/L	110		20		190		62		5000		24		19	
Biological Oxygen Demand	mg/L	6.0	U	6.0	U	6.0	U	6.0	U	6.0	U	6.0	U	6.0	U
Chemical Oxygen Demand	mg/L	15	U	20		15	U	83		15	U	20		15	U
Total Organic Carbon	mg/L	3		6		4		20		5.2		5.8		3	

See notes at end of table

Table 5-15(Continued)
Laboratory Analytical Results for Natural Attenuation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Monitoring Well ID		JAX-47-									
		MW18S		MW19S		MW20S		USGS (D)		USGS(S)	
	Sample Date	5-Apr-02		12-Apr-02		9-Apr-02		9-Apr-02		9-Apr-02	
Parameter	**Units**										
Nitrate	mg/L	0.050	U	0.050	U	35		0.050	U	0.64	
Nitrite	mg/L	0.050	U	0.050	U	0.050	U	0.050	U	0.050	U
Ammonia	mg/L	0.10	U	0.10	U	0.10	U	0.10	U	0.3	
TKN	mg/L	0.54	U	0.3		0.10	U	0.10	U	0.73	
Chloride	mg/L	83		5		16		17		27	
Dissolved Sulfide	mg/L	2.0	U	1		4.0	U	4.0	U	9.0	
Sulfate	mg/L	66		20		150		56		94	
Dissolved Iron	mg/L	6.61		0.32		4.92		2.29		25.8	
Dissolved Manganese	mg/L	0.0113		0.0045		0.081		0.0292		0.0146	
Ethane	µg/L	10	U	10	U	10	U	10	U	10	U
Ethene	µg/L	10	U	10	U	10	U	10	U	10	U
Methane	µg/L	80		27		10	U	10	U	11	
Biological Oxygen Demand	mg/L	6.0	U	6.0	UJ	6.0	U	6.0	U	6.0	U
Chemical Oxygen Demand	mg/L	40		20		15	U	15	U	20	
Total Organic Carbon	mg/L	20		13		6.6		2		7.5	

Notes:
U = less than laboratory detection limit.
J = estimated value.

hydrocarbons, PAHs, and chlorinated solvents, is also consistent with the fact that substances containing these compounds were formerly stored on site in ASTs and USTs.

Aside from the location of the former pesticide mixing tank south of Building 937 and the former location of an AST south of the Pesticide Shop, allegedly used for storage of a diesel-malathion mixture ("hot fogger"), current or former source areas of pesticide contamination cannot be traced to bulk storage or to a suspected sole point source(s). Instead, only isolated spill events, training exercises involving pesticide usage conducted over limited time periods, and temporary storage of pesticide compounds in 55-gallon drums, have been documented as possible sources of elevated pesticide concentrations in soil and groundwater at PSC 47. Consequently, the task of defining three-dimensional plume boundaries where pesticide compounds exceed regulatory criteria is essentially a "hit-and-miss" proposition in which the objective is to identify isolated areas where relatively small quantities of pesticides released or applied, either intentionally or by accident.

Results of the RI and previous sampling events show that soil and groundwater at PSC 47 have been impacted with COCs in excess of regulatory thresholds. Surface water and sediment are not present at the site. Review of this data allows for a conceptual understanding of data trends that are important to consider in the evaluation of fate and transport aspects, potential risks to human health, potential risks to ecological receptors, and potential remedies.

5.4.1 Soil

Pesticide concentrations exceeding residential screening criteria, including numerous values exceeding industrial and leachability SCTLs, are present in soils surrounding Building 536 despite removal of approximately 1,300 cubic yards of soil in 1999. Surface soil contamination (0-2 ft bls) is mainly present in the non-excavated areas surrounding Building 536. Impacted subsurface soils are primarily concentrated to the southern half of fenced area confining Building 536, beyond either the lateral or vertical boundary of the 1999 soil removal area. Limited surface and subsurface soil contamination is present in the drainage swale located immediately southeast of Building 536 and adjacent to Child Street.

The most frequently identified pesticide compounds remaining in soils at PSC 47, as determined by the current study and post-excavation soil sampling by BEI (1999), are essentially the same as those reported by HLA in 1997 before the soil removal action (i.e., 4,4'-DDD, 4,4'-DDT, DDE, dieldrin, and BHC isomers). Pesticide compounds whose breadth of occurrence was most significantly reduced by the removal action, based upon comparison of detection frequencies in before-and-after soil samples, were chlordane, endrin, and aldrin.

As shown on Figure 5-1, three general areas of surface soil contamination exceeding residential SCTLs were identified. The largest area of surface soil contamination is located around Building 536. Two smaller areas (area off southwest corner of Building 937 under existing parking lot and area in drainage swell located where SB058A was collected) of surface soil contamination are located on the southern portion of the PSC. Surface soil contains pesticide COCs in excess of residential, industrial, and leachability SCTLs over a large portion of the Building 536 site. Surface soil industrial and leachability exceedances were shown on Figures 5-2 and 5-3, respectively. SB001, SB010, and SB016 sampling results indicate that the drainage swale adjacent to Building 536 is also impacted with pesticide COCs. There is a small area of arsenic contaminated surface soil that is located of the southwest corner of Building 937. This small area of arsenic contamination only exceeds residential SCTLs and is present underneath an existing asphalt parking lot utilized by the tenants of Building 937. The surface soil around SB58A contains concentrations of 4,4'-DDT at concentrations exceeding residential, industrial, and leachability SCTLs.

Subsurface soil sampling results indicate that arsenic and various pesticide COCs are present at PSC 47. Pesticide COCs were found predominantly in the subsurface soil samples collected from within the fenced area on the south side of Building 536 and in the drainage swell located immediately southeast of this building. Exceedances of residential, industrial, and leachability SCTLs are shown on Figures 5-4, 5-5, and 5-6, respectively, for the fenced area on the south side of Building 536 and associated drainage swell. Arsenic exceedances were located predominantly on the south side of Building 536 (except for SB084 located on north side), but were isolated to a small area off the southwest corner of Building 937. Both residential and industrial exceedances of the arsenic SCTL were reported for both areas. One subsurface soil sample location (SB0010) collected in the drainage swell southeast of Building 536 had a reported benzo(a)pyrene equivalent concentration that exceeded its respective residential SCTL. This sample was collected from the drainage swale and may represent sedimentary deposits and runoff from the adjacent road (Child Street) and/or parking lot associated with Building 937.

5.4.2 Groundwater

Significant differences exist between the composition of pesticide contamination in soil as opposed to that in groundwater. For example, no surface soil samples and only one subsurface soil sample (3 to 4 ft bls) had reported concentrations of BHC isomers exceeding residential SCTLs in the vicinity of the Pesticide Shop, whereas concentrations of these compounds exceeding GCTLs were common in groundwater samples collected in this area. Accountability for this difference is assumed to lie primarily in the varying solubility of the pesticide compounds or, as in the case of the BHC isomers, in their extremely low GCTL values compared to their residential and industrial SCTLs.

The estimated pesticide groundwater contamination plume from the shallow portion of the aquifer underlying PSC 47 is depicted on Figure 5-10. This figure should be considered a general depiction of impacted groundwater and does not depict GCTL exceedances for any one pesticide compound. Two main areas (northern and southern plume) of shallow groundwater contamination are shown on this figure: one large area around Building 536 (northern plume extending slightly to the northwest) and one smaller area at the southwest end of Building 937 (southern plume extending from the west end of Building 937 to the south, near the MW17 well pair). An isolated pesticide detection (dieldrin) was reported in monitoring well MW20S (located east of PSC 47 boundary on the NAS JAX golf course) and is believed to be related to the golf course and not PSC 47. Two monitoring wells [MW13D (northern plume), and MW17D (southern plume)] screened in the deeper portions of the shallow aquifer had compounds that exceeded GCTLs. Each of these wells had only one GCTL exceedance reported during the most recent (2006) sampling event. The downward migration is believed to have been predominantly caused by the downward vertical gradient in these areas. A confining unit begins below our deepest samples and is believed to contain any downward migration of contaminants; therefore, contaminant migration horizontally follows groundwater flow.

The estimated VOC/SVOC plume boundaries in the shallow portion of the surficial aquifer are illustrated on Figure 5-11. This figure should be considered a general depiction of impacted groundwater and does not depict GCTL exceedances for any one VOC/SVOC compound. The VOC and SVOC concentrations exceeding GCTLs are relatively coincidental with areas of pesticide contamination except the northern plume is significantly smaller. As with the pesticide figure, two areas were identified: one in the vicinity of the removed DVECC tank and one centered on the north central side of the Pesticide Shop. The suspected source(s) of VOC contamination reported in the area of the Pesticide Shop are the single UST and/or one or both of the ASTs formerly in service at this building (see discussion, Section 1.2.1). The source of VOC/SVOC contamination south of Building 937 is presumably a former used oil UST. Site plans provided by RUST (1995) and BRE (1997) indicate the presence of such a tank approximately 10 ft east of the DVECC pesticide tank, yet none of the available documents describing site historical operations (see Section 3.0) provide a narrative regarding origin, installation date, usage, closure, or disposition of this UST. The source of contamination slightly upgradient to DVECC in monitoring wells MW17S and MW17D, is unknown.

Herbicide compounds were only detected in one sample (JAX47-937-MW03S). The herbicide compounds 2,4,5-T and 2,4-D were detected at estimated concentrations exceeding GCTLs. Herbicide compounds were either not detected or were at concentrations less than GCTLs in other monitoring wells in close proximity to JAX47-937-MW03S.

Arsenic was the only inorganic detected at concentrations exceeding GCTLs during the sampling events. The distribution of arsenic has been limited to a “hot spot” located off the immediate southwest corner of DVECC where the former mixing tanks had been located. Figure 5-12 shows the estimated extent of groundwater contamination due to arsenic. The area of groundwater contamination is commingled with the pesticide plume. Two wells (MW02S and MW03S) re-sampled in April 2007 had reported concentrations in excess of 6000 µg/L, which is several orders of magnitude greater than the arsenic GCTL of 10 µg/L. Arsenic concentrations have remained in the 6,000 to 9,000 µg/L range in these two wells since 2004 when they were first sampled for arsenic. Monitoring well MW03S had a reported concentration of 23,000 µg/L in 2006, but this concentration decreased to 6,240 µg/L when resampled in 2007 (4 months later). Deviations in the arsenic concentrations have been documented but no migration of the arsenic “hot spot” has occurred since its detection in 2004 and there have been no reported detections of arsenic in the downgradient shallow or deep monitoring wells. Since the DVECC tank was removed in 1995 (likely source and location of current arsenic “hot spot”), it is possible the arsenic “hot spot” has not migrated since then, but there is no data to support this assumption.

Inferred direction of groundwater flow, depicted on Figures 2-7 through 2-12 (i.e., northwesterly), is in agreement with flow models generated by the USGS (Davis *et al*, 1996). There has been little downgradient movement of COCs in groundwater from the southern plume (DVECC). Only limited migration (BHC isomers and dieldrin in MW27S) has been noticed in the northern plume since the time of release, judging from groundwater analytical data and from inferred plume geometries as described in the previous paragraph. Lack of significant COC concentrations at downgradient locations is likely due to the site’s flat topography and resultant flat hydraulic gradient and relatively slow groundwater velocity and/or to dispersion, adsorption, and/or natural attenuation of released compounds.

Overall, soils contaminated with pesticides are present in a large area around the Pesticide Shop but are mostly confined within the site fence boundary, except for the drainage swell to the southeast of this building. Groundwater contamination can be separated into two plumes, a northern and southern plume. The northern plume consists primarily of low concentrations of pesticides that are centered around the Pesticide Shop. The southern plume is a mixture of pesticides, arsenic, and VOCs that is centered between monitoring well pair MW17 and the west end of DVECC where the former UST mixing tanks were located. A small arsenic “hot spot” is located within the southern plume in the area of the former mixing tanks.

6.0 CHEMICAL FATE AND TRANSPORT ANALYSIS

Knowledge of a contaminant's potential to migrate and persist in an environmental medium is critical when evaluating the potential for a chemical to produce an adverse human health or ecological effect. This section contains information on various aspects of contaminant fate and transport and the chemical properties affecting contaminant migration at PSC 47. Section 6.1 contains a general discussion of the various chemical and physical properties of significant contaminants detected in all media. The various contaminant transport pathways are reviewed in Section 6.2. A brief discussion of contaminant fate (persistence) and migration is presented in Section 6.3. A discussion and evaluation of biodegradation and natural attenuation for each plume (i.e., North Plume and South Plume) is presented in Section 6.4. A conceptual model is presented for each of the two plumes in Section 6.5.

6.1 CHEMICAL AND PHYSICAL PROPERTIES IMPACTING FATE AND TRANSPORT

The physical and chemical properties of the organic compounds detected in soil and groundwater at PSC 47 are presented in Table 6-1. Environmental fate and transport characteristics of inorganics detected at the site are provided in Table 6-2. These properties can be used to determine the environmental mobility and fate of site contaminants. The properties of interest include the following:

- Specific gravity
- Vapor pressure
- Water solubility
- Octanol/water partition coefficient
- Organic carbon partition coefficient
- Henry's Law constant
- Bioconcentration factor
- Distribution Coefficient
- Mobility index

Empirically determined literature values of the water solubility, octanol/water partition coefficient, organic carbon partition coefficient, vapor pressure, Henry's Law constant, bioconcentration factor, and specific gravity are presented, when available. Calculated values, which were obtained using approximation methods, are presented when literature values are not available. A discussion of the environmental significance of each of these parameters follows.

Table 6-1
Environmental Fate and Transport Parameters for Organic Chemicals

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	Specific Gravity (@ 20/4°C)[2]	Vapor Pressure (mm Hg @ 20°C)[2]	Solubility (mg/L @ 20°C)[2]	Octanol/Water Partition Coefficient[2]	Organic Carbon Partition Coefficient[4]	Henry's Law Constant (atm-m3/mole)[2]	Bioconcentration Factor (mg/L/mg/kg)[4]	Mobility Index log((solubility*VP)/K_{oc})
KETONES								
2-Butanone	0.8054	1.0E+2 (25°C)	2.75E+05	1.82E+00	4.44E+0(6)	4.66E-5 (25°C)	9.3E-1(5)	6.79E+00
2-Hexanone	0.8113	2.00E+00	1.64E+04	2.40E+01	1.35E+02	1.75E-03	7.00E+00	2.39E+00
4-Methyl-2-pentanone	0.7978 (20°C)	1.0E+1 (30°C)	1.91E+04	1.23E+01	5.30E+0(6)	1.49E-5 (25°C)	3.9E+0(5)	4.56E+00
Acetone	0.7899	2.66E+2 (25°C)	Miscible	5.75E-01	5.75E-01	3.88E-05	3.81E-1(5)	NA
MONOCYCLIC AROMATICS								
1,2,4-Trichlorobenzene	1.459	4.60E-01	3.00E+02	9.55E+03	1.78E+03	1.42E-03	6.50E+02	-1.11E+00
1,2-Dichlorobenzene	1.3059	1.36E+00	1.56E+02	2.40E+03	6.17E+02	1.50E-03	2.30E+02	-4.64E-01
1,3-Dichlorobenzene	1.2884	2.15E+00	1.33E+02	3.24E+03	7.21E+02	3.10E-03	3.20E+02	-4.02E-01
1,4-Dichlorobenzene	1.29	1.20E+00	7.38E+01(3)	2.63E+03(3)	6.16E+02(3)	2.43E-03	2.3E+02(5)	-8.42E-01
2-Methylphenol	1.047	2.99E-01	2.60E+04	9.55E+01	9.12E+01	1.20E-06	1.60E+01	1.93E+00
4-Methylphenol	1.0178	1.1E-1 (25°C)	2.4E+4 (25°C)	8.32E+01	1.15E+02	3.92E-07	1.7E+1(5)	1.36E+00
Benzene	0.8765	9.50E+01	1.75E+03	1.35E+02	5.89E+01	5.56E-03	3.70E+01	3.45E+00
Chlorobenzene	1.11	1.18E+01	4.72E+02(3)	7.24E+02(3)	2.24E+02(3)	3.71E-03	7.9E+01(5)	1.40E+00
Ethylbenzene	0.867	9.6 (25°C)	1.52E+02	1.41E+03	2.04E+02(7)	7.88E-03	4.70E+02	8.54E-01
Toluene	0.8669	2.8E+1 (25°C)	5.15E+02	4.90E+02	1.4E+02 (7)	6.63E-03	1.48E+02	2.01E+00
Xylenes (Total)	0.86104-0.8801	7.99 (25°C)	1.6E+2-1.75E+2(5)	5.89E+2-1.58E+3	1.96E+02-3.11E+02(7)	5.25E-03	7.5E+1-1.59E+2(5)	7.53E-01
HALOGENATED ALIPHATICS								
1,1-Dichloroethane	1.1757	2.34E+2 (25°C)	5.50E+03	1.67E+01	5.34E+01 (7)	5.871E-3 (25°C)	1.90E+01	4.38E+00
1,1-Dichloroethene	1.218	5.91E+2 (25°C)	2.1E+2 (25°C)	3.02E+01	6.5E+01 (7)	2.286E-2 (25°C)	5.30E+01	3.28E+00
1,2-Dichloroethane	1.2351	7.90E+01	8.52E+02	2.95E+01	3.8E+01 (7)	9.78E-04	8.10E+00	3.25E+00
Chloroform	1.4832	1.60E+02	9.3E+3 (25°C)	9.33E+01	5.25E+01 (7)	3.66E-03	2.60E+01	4.45E+00
Chloromethane	0.9159	3.80E+03	6.36E+03	8.13E+00	4.30E+00	8.82E-03	3.20E+00	6.75E+00
cis-1,2-Dichloroethene	1.2837	2.02E+2 (25°C)	8.00E+02	1.58E+02	3.55E+01 (7)	4.07E-03	1.4E+1(3)	3.66E+00
Tetrachloroethene	1.6227	1.85E+1 (25°C)	1.5E+2 (25°C)	3.39E+02	2.65E+02 (7)	1.84E-02	26 - 77	2.00E-02
Trichloroethene	1.4624	7.10E+01	1.10E+03	5.13E+02	9.43E+01 (7)	1.03E-02	4 - 39	2.92E+00
Vinyl chloride	0.9106	2.58E+03	1.1E+3 (25°C)	3.98E+00	1.86E+01 (7)	2.71E-02	5.70E+00	5.18E+00
MISCELLANEOUS VOLATILE ORGANICS								
Methyl Acetate	0.934	2.16E+2 (25°C)	2.44E+05	6.61E-01	3.00E+01	1.15E-04	8.00E-01	6.24E+00
Carbon disulfide	1.2632	2.98E+02	2.90E+03	1.45E+04	4.57E+01 (7)	1.921E-2 (25°C)	2.6E+1 (5)	4.28E+00
Methyl Cyclohexane	0.76	4.30E+01	1.40E+01	9.12E+02	2.21E+03	4.3E-1 (25°C)	NA	-5.65E-01
Isopropylbenzene	0.862	4.50E+00	6.13E+01	3.16E+03	2.29E+03	1.31E-02	2.70E+02	-9.19E-01
Methyl tert butyl ether	0.7405	2.50E+02	5.10E+04	8.71E+00	1.12E+01	5.87E-04	3.10E+00	6.06E+00

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Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	Specific Gravity (@ 20/4°C)[2]	Vapor Pressure (mm Hg @ 20°C)[2]	Solubility (mg/L @ 20°C)[2]	Octanol/Water Partition Coefficient[2]	Organic Carbon Partition Coefficient[4]	Henry's Law Constant (atm-m3/mole)[2]	Bioconcentration Factor (mg/L/mg/kg)[4]	Mobility Index log((solubility*VP)/K_{oc})
POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)								
2-Methylnaphthalene	1.0058	6.81E-2 (25°C)	2.6E+1 (25°C)	7.24E+03	7.27E+2 (6)	5.80E-05	5.1E+2 (5)	-2.61E+00
Benzo(a)anthracene	1.274	5.00E-09	1E-2 (24°C)	4.07E+05	3.58E+05 (7)	6.60E-07	5.30E+04	-1.59E+01
Benzo(a)pyrene	1.351	5.00E-09	3.8E-3 (25°C)	9.55E+05	9.69E+05 (7)	4.9E-7 (25°C)	1.40E+05	-1.67E+01
Benzo(b)fluoranthene	NA	5.00E-07	1.2E-3 (25°C)	3.72E+06	1.23E+06 (7)	1.20E-05	1.40E+05	-1.53E+01
Benzo(g,h,i)perylene	1.35	1.00E-10	2.6E-4 (25°C)	1.70E+07	1.60E+06	1.4E-7 (25°C)	3.50E+05	-1.98E+01
Benzo(k)fluoranthene	NA	9.59E-11	5.5E-4 (25°C)	6.92E+06	1.23E+06 (7)	1.04E-03	1.40E+05	-1.94E+01
Chrysene	1.274 (20°C)	6.3E-9 (25°C)	6E-3 (25°C)	4.07E+05	3.98E+05 (7)	1.05E-6 (25°C)	5.30E+04	-1.60E+01
Dibenzo(a,h)anthracene	1.282	1.00E-10	5E-4 (25°C)	9.33E+05	1.79E+06 (7)	7.3E-8 (25°C)	6.90E+05	-1.99E+01
Fluoranthene	1.252	5.0E-6 (25°C)	2.65E-1 (25°C)	2.14E+05	4.91E+04 (7)	6.5E-6 (25°C)	1.20E+04	-1.06E+01
Fluorene	1.202	6.0E-4 (25°C)	1.98E+00	1.62E+04	1.38E+04	6.36E-05	3.80E+03	-7.07E+00
Indeno(1,2,3-cd)pyrene	NA	1E-10 (25°C)	6.20E-02	4.57E+07	3.47E+06 (7)	6.95E-8 (25°C)	3.50E+05	-1.77E+01
Naphthalene	1.162	8.2E-2 (25°C)	3E+1 (25°C)	2.34E+03	1.19E+03 (7)	4.83E-4 (25°C)	4.20E+02	-2.68E+00
Phenanthrene	0.980 (4°C)	5.0E-4 (25°C)	8.5E-1 (25°C)	2.88E+04	1.40E+04	3.93E-5 (25°C)	4.70E+03	-8.52E+00
Pyrene	1.271 (23/4°C)	2.5E+0 (200°C)	1.6E-1 (26°C)	1.51E+05	6.8E+04 (7)	5.1E-6 (25°C)	1.20E+04	-5.21E+00
PHTHALATE ESTERS								
Bis(2-ethylhexyl)phthalate	0.99 (20/20°C)	7.23E-08	4E-1 (25°C)	2.00E+05	1.10E-05	3.00E-07	115 - 851	-2.57E+00
Butylbenzylphthalate	1.113	8.60E-06	7.10E-01	6.92E+04	5.75E+04	1.26E-06	7.72E+02	-9.97E+00
Diethylphthalate	1.1175	2.1E-3 (25°C)	1.08E+3 (25°C)	9.12E+02	8.22E+01 (7)	8.46E-07	1.07E+02	-1.56E+00
Dimethylphthalate	1.19 (25/25°C)	1.00E-02	5.00E+03	3.98E+01	8.0E+01-3.6E+02	2.00E-07	4.7E+00-5.7E+01	- 2.04E-01 to -8.57E-01
Di-n-butylphthalate	1.047 (20/20°C)	2.01E-5 (25°C)	1.3E+1 (25°C)	1.58E+05	1.57E+03 (7)	2.8E-7 (25°C)	4.70E+04	-6.78E+00
PESTICIDES								
4,4'-DDD	1.476	1.35E-06 (25°C)	1.6E-1 (24°C)	9.77E+05	4.58E+04 (7)	2.16E-05	1.80E+05	-1.13E+01
4,4'-DDE	NA	6.50E-06	4.00E-02	4.90E+05	8.64E+04 (7)	2.34E-05	8.90E+05	-1.15E+01
4,4'-DDT	1.5 (15/4°C)	1.50E-07	3.1E-3 (25°C)	1.55E+06	6.78E+05 (7)	3.89E-5 (25°C)	6.0E+02 - 8.5E+04	-1.52E+01
Aldrin	1.18	2.31E-05	1.80E-01	3.16E+06	2.45E+06	6.97E-03	1.10E+02	-1.18E+01
alpha-BHC	1.87	4.50E-05	2.00E+00	6.31E+03	1.23E+03	1.05E-05	2E+02 - 2E+03	-7.14E+00
alpha-Chlordane (11)	1.61 (25°C)	1E-5 (25°C)	5.60E-02	6.03E+02	1.20E+05	4.79E-05 (25°C)	4.00E+04	-1.13E+01
beta-BHC	1.89	2.80E-07	7.00E-01	6.03E+03	1.06E+03	6.90E-07	6.31E+02	-9.73E+00
delta-BHC	1.87	1.75E-05	1.7E+01 (24°C)	1.38E+04	7.1E+02 - 2.7E+03	3.84E-07	8.00E+02	- 6.37E-01 to -6.96E-01
Dieldrin	1.75	1.8E-7 (25°C)	1.86E-01	1.23E+04	2.55E+04 (7)	5.84E-5 (25°C)	3.3E+03-1.4E+04	-1.19E+01
Endrin	1.65 (25°C)	2.0E-7 (25°C)	2.5E-01(3)	1.15E+05(3)	1.08E+04(7)	7.52E-06(3)	1.8E+03(5)	-1.13E+01
Endrin aldehyde	1.65 (25°C)	2.0E-7 (25°C)	2.5E-01(3)	1.15E+05(3)	1.08E+04(7)	7.52E-06(3)	1.8E+03(5)	-1.13E+01
Endrin ketone	NA	NA	NA	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	1.61 (25°C)	1E-5 (25°C)	6.80E+00	5.37E+03	1.07E+03	1.40E-05	4.00E+04	-1.13E+01
gamma-Chlordane (11)	1.61 (25°C)	1E-5 (25°C)	5.60E-02	6.03E+02	1.20E+05	4.79E-05 (25°C)	4.00E+04	-1.13E+01
Heptachlor	1.57 (9°C)	4E-4 (25°C)	5.6E-2 (25°C)	2.51E+04	1.33E+04 - 6.61E+05	2.30E-03	4.40E+03	-9.03E+00
Heptachlor epoxide	NA	3.00E-04	3.5E-1(15°C)	5.00E+00	8.32E+04	3.90E-04	7.50E+03	-8.90E+00
Methoxychlor	1.41 (25°C)	NA	4.0E-02 (24°C)	4.91E+00	1.07E+05	1.60E-05	8.10E+03	NA

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HERBICIDES								
2,4'-D	1.42 (25°C)	8.25E-08	5.40E+02	6.46E+02	2.0E+01 - 1.36E+02	8.60E-06	1.00E+00	-6.25E+00
2,4,5-T	1.8	7.50E-08	2.68E+02 (25°C)	1.00E+04	86(sand) - 280(silt)	9.4E-11 (25°C)	2.3E+01 - 4.3E+01	-6.97E+00
Pentachlorophenol	1.978 (8)	1.10E-04	1.40E+01	1.32E+05	1.2E+03 - 2.5E+04	2.45E-08	1.0E+02 - 1.0E+03	-5.91E+00

1 NA - Not Available
2 USEPA, September 1992, Handbook of RCRA Groundwater Monitoring Constituents: Chemical and Physical Properties.
3 Lyman et al., 1990; Equation 5-3, Handbook of Chemical Property Estimation Methods.
4 USEPA, December 1982, Aquatic Fate Process Data for Organic Priority Pollutants.
5 Lyman et al., 1990, Eq. 5-2
6 Lyman et al., 1990; Equation 4-5
7 USEPA, July 1996, Soil Screening Guidance.
8 TOXNET (http://toxnet.nlm.nih.gov/) September, 2003
mm = Millimeters
Hg = Mercury

Table 6-2
Relative Mobilities of Inorganics as a Function of Environmental Conditions (Eh, pH)

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
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Jacksonville, Florida

Relative Mobility	Environmental Conditions			
	Oxidizing	Acidic	Neutral/Alkaline	Reducing
Very High			Se	
High	Se, Zn	Se, Zn, Cu, Ni, Hg,Ag		
Medium	Cu, Ni, Hg, Ag, As, Cd	As, Cd	As, Cd	
Low	Pb, Ba, Se	Pb, Ba, Be	Pb, Ba, Be	
Very Low	Fe, Cr	Cr	Cr, Zn, Cu, Ni, Hg, Ag	Cr, Se, Zn, Cu, Ni, Hg, Pb, Ba, Be, Ag

Notes:

As = Arsenic	Fe = Iron
Ag = Silver	Hg = Mercury
Ba = Barium	Ni = Nickel
Be = Beryllium	Pb = Lead
Cd = Cadmium	Se = Selenium
Cr = Chromium	Zn = Zinc
Cu = Copper	Eh = Standard Redox Potential

6.1.1 Specific Gravity

Specific gravity is the ratio of the weight of a given volume of pure chemical at a specified temperature to the weight of the same volume of water at that temperature. Its primary use is to determine whether a chemical will have a tendency to float or sink in water if it is present as a pure chemical or at very high concentrations. Chemicals with a specific gravity greater than 1 will tend to sink, and chemicals with a specific gravity less than 1 will tend to float.

Of the chemicals detected at PSC 47, some of the VOCs (ketones and some monocyclic aromatics, such as benzene) have specific gravities less than 1. Other VOCs (halogenated aliphatics), PAHs, phthalate esters, pesticides, and herbicides have specific gravities greater than 1.

6.1.2 Vapor Pressure

Vapor pressure provides an indication of the rate at which a chemical volatilizes from both soil and water. It is of primary importance at environmental interfaces, particularly at atmospheric interfaces with soil or surface water. Volatilization is not as important when evaluating contaminated groundwater and subsurface soils that are not exposed to the atmosphere. Vapor pressures for ketones, monocyclic aromatics, and halogenated aliphatics are generally many times higher than vapor pressures for pesticides and PAHs. Chemicals with higher vapor pressures are expected to enter the atmosphere much more readily than chemicals with lower vapor pressures. Volatilization can be a significant loss process for VOCs from surface soil. Surface soils at PSC 47 do not contain VOCs. Therefore, volatilization from surface soil should not be an important loss mechanism at the site. Volatilization is not significant for inorganics and pesticides.

6.1.3 Water Solubility

The rate at which a chemical is leached from a waste deposit by infiltrating precipitation is proportional to its water solubility. More soluble chemicals are more readily leached than less soluble chemicals. The water solubility for organic compounds presented in Table 6-1 indicate that the VOCs are usually several orders of magnitude more water soluble than the PAHs and pesticides.

The solubility of inorganics is strongly influenced by their valence state(s) and forms (hydroxides, oxides, carbonates, etc.). The solubility is also dependent on pH, Eh (redox potential), temperature, and other ionic species in solution (the Debye-Huckel theory). The solubility products reported in the literature vary with the type of complex formed, but generally it can be noted that some complexes (e.g., cadmium and copper) are more soluble than others (e.g., lead and nickel).

6.1.4 Octanol/Water Partition Coefficient

The octanol/water partition coefficient (K_{ow}) is a measure of the equilibrium partitioning of organic chemicals between octanol and water. A linear relationship between the K_{ow} and the uptake of chemicals by fatty tissues of animal and human receptors (the bioconcentration factor) has been established (Lyman et al., 1990). It is also useful in characterizing the sorption of compounds by organic soils where experimental values are not available. The K_{ow} of pesticides, herbicides, and PAHs are typically several orders of magnitude greater than the more soluble VOCs and are, therefore, more likely to partition to fatty tissues. The K_{ow} can also be used to estimate bioconcentration factors in aquatic organisms.

6.1.5 Organic Carbon Partition Coefficient

The organic carbon partition coefficient (K_{oc}) indicates the tendency of a chemical to adhere to soil particles containing organic carbon. Chemicals with high K_{oc} generally have low water solubility and vice versa. This parameter may be used to infer the relative rates at which the more mobile chemicals (ketones, monocyclic aromatics, and halogenated aliphatics) are transported in the groundwater. Chemicals such as most pesticides and PAHs are relatively immobile in the soil and are preferentially bound to the soil. These compounds are not subject to groundwater transport to the extent that compounds with higher water solubility are. However, these immobile chemicals can be transported by erosional processes when they are present in surface soil.

6.1.6 Henry's Law Constant

Both the vapor pressure and the water solubility are of use in determining volatilization rates from surface water bodies and from groundwater. The ratio of these two parameters (the Henry's Law constant) is used to calculate the equilibrium chemical concentrations in the vapor (air) phase versus the liquid (water) phase for the dilute solutions commonly encountered in environmental settings. In general, chemicals having a Henry's Law constant of less than 1×10^{-5} atm-m^3/mole, such as pesticides and PAHs, should volatilize very little and be present only in minute amounts in the atmosphere or soil gas. For chemicals with a Henry's Law constant greater than 5×10^{-3} atm-m^3/mole, such as many of the VOCs (halogenated aliphatics), volatilization and diffusion in soil gas could be significant.

6.1.7 Bioconcentration Factor

The bioconcentration factor (BCF) represents the ratio of aquatic-animal-tissue concentration to water concentration. The ratio is both contaminant and species specific. When site-specific values are not measured, literature values are used or the BCF is derived from the octanol/water coefficient. Many of the pesticides and PAHs will bioconcentrate at levels three to five orders of magnitude greater than those concentrations found in the water, whereas VOCs are not as readily bioconcentrated.

6.1.8 Distribution Coefficient

The soil-water distribution coefficient (K_d) is a measure of the equilibrium distribution of a chemical or ion in soil/water systems. The distribution of organic chemicals is a function of both the K_{oc} and the amount of organic carbon (f_{oc}) in the soil ($K_d = K_{oc}.* f_{oc}$). For inorganic ions (e.g., metals), K_d is the ratio of the concentration adsorbed on soil surfaces to the concentration in water. Distribution coefficients for metals vary over several orders of magnitude because the K_d is dependent on the size and charge of the ion and the soil properties governing exchange sites on soil surfaces. Coulomb's Law predicts that the ion with the smallest hydrated radius and the largest charge will be preferentially accumulated over ions with larger radii and smaller charges.

6.1.9 Mobility Index

The mobility index (MI) is a quantitative assessment of mobility that uses water solubility (S), vapor pressure (VP), and the organic carbon partition coefficient (K_{oc}) (Laskowski, 1983). It is defined as

$$MI = \log ((S*VP)/K_{oc})$$

A scale to evaluate MI as presented by Ford and Gurba (1994) is

Relative MI	Mobility Description
> 5	extremely mobile
0 to 5	very mobile
-5 to 0	slightly mobile
-10 to –5	immobile
< -10	very immobile

Of the organic chemicals detected at PSC 47, chlorinated solvents and ketones generally have MIs greater than 5 and are considered extremely mobile. The MIs of monocyclic aromatics, such as chlorobenzene, toluene, and xylenes, range from 0 to 5 and these chemicals are classified as very mobile. Lighter molecular weight PAHs, such as naphthalene, have MIs ranging from -5 to 0 and are considered slightly mobile, and the heavier molecular weight PAHs (e.g., benzo(a)pyrene) are classified as very immobile, having MIs less than -10. The MIs of phthalate esters detected at PSC 47 range from -0.7 (diethyl phthalate) to -10 (butylbenzylphthalate) and are, therefore, classified as slightly mobile to immobile. The MIs of pesticides detected at PSC 47 range from -6.37 (delta-BHC) to -15.8 (DDT); most of the pesticides have MIs less than -10. Therefore, pesticides are generally considered to be very immobile in soil. The MIs of herbicides are less than -5, and these chemicals are classified as immobile. The MIs for organic chemicals detected at PSC 47 are presented in Table 6-1.

The relative mobilities of inorganic ions are presented in Table 6-2. Arsenic is the only inorganic chemical present at PSC 47 that is considered to be a COC. As shown on Table 6-2, the mobility of inorganic arsenic relative to other metals and metalloids is considered to be medium. The USEPA lists the K_d of inorganic arsenic as 27 liters per kilogram (L/kg) at a pH value of 6.0 (USEPA, 2001). Assuming the average bulk density ($þ_d$) of the aquifer materials is approximately 1.6 kg/L, the USEPA given K_d value is 27 L/kg, and the total porosity (n) of the aquifer material is 0.30, then the arsenic retardation factor (R_f) in groundwater flow can be approximated as:

$$R_f = 1 + (K_d * þ_d) / n = 1 + (27 * 1.6) / 0.30 = 145$$

However, laboratory analyses of saturated soil collected from OU 3 during bench-scale treatability studies (TtNUS, 2001) showed that site-specific R_f values were much lower than the value calculated above. The laboratory results showed total arsenic has a R_f value 0f 21 $\pm$ 9 L/kg, As^{5+} has a R_f value of 21 $\pm$ 8 L/kg, and trivalent arsenic (As^{3+}) has a R_f value of 14 $\pm$ 3 L/kg. Based on the OU 3 treatability study, the mobility of arsenic is much higher in shallow groundwater at NAS Jacksonville than predicted using estimated values from scientific literature. Arsenic species have been identified in four groundwater samples collected from four shallow wells in November 2006 (Table 5-13). The laboratory analyses identified the majority of arsenic is present as trivalent arsenic (As^{3+}). Pentavalent arsenic (As^{5+}) was the second most prevalent form of arsenic. In addition, 5 to 8 µg/L of monomethylarsenate (MMA, arsenic complexed to a methyl radical) was present in two of the wells. The trivalent arsenic is more mobile than the pentavalent form of arsenic, as determined by the OU 3 treatability study. Approximate values for K_{oc}, K_d, and R_f for MMA could not be found in scientific literature.

6.2 CONTAMINANT TRANSPORT PATHWAYS

A brief overview of contaminant fate and transport issues at PSC 47 is presented in this section. Based on the evaluation of existing conditions at the site, the following potential contaminant transport pathways have been identified:

- Leaching of soil contaminants to groundwater.
- Migration of groundwater contaminants.
- Volatilization from soil.
- Volatilization from groundwater.
- Erosion and runoff of contaminated particles from soil and deposition in surface water bodies.

6.2.1 Leaching of Soil Contaminants to Groundwater

Contaminants that adhere to soil particles or have accumulated in soil pore spaces can leach and migrate vertically to the groundwater as a result of infiltration or precipitation. The rate and extent of this leaching are influenced by the depth of the water table, amount of precipitation, rate of infiltration, the physical and chemical properties of the soil, and the physical and chemical properties of the contaminant.

High concentrations of pesticides were detected in surface and subsurface soil samples and VOCs, pesticides, and herbicides were detected in the groundwater samples at the site. As indicated in Section 5.0, groundwater analytical data suggest the presence of two, possibly three, separate contaminant plumes at PSC 47: one near the removed DVECC tank south of Building 937 (southern plume), another in the vicinity of the former ASTs near the central portion of the Pesticide Shop (Building 536) (northern plume), and a possible third at JAX47-MW03. Previous remedial actions associated with the DVECC tank and the surface soil contamination at the Pesticide Shop have eliminated some of the contamination in the surface and subsurface soil at PSC 47 (Section 3.7.3). Only a few VOCs, including several which are common laboratory contaminants, were detected in soil samples collected at the site, whereas many were detected in groundwater. These data indicate that the groundwater contamination is probably not only the result of leaching of contaminants from surface soil to groundwater but also is the result of underground releases from storage tanks, floor drains, and/or subsurface piping at the Pesticide Shop and Building 937.

6.2.2 Migration of Groundwater Contaminants

Contaminants can migrate in either a dissolved phase or as an immiscible liquid. A contaminant that is present in water above its solubility concentration will form an immiscible liquid. Based on the specific gravity of the contaminant, it will either float or sink in the water. In the case of chlorinated solvents (e.g., TCE), the contaminant will sink in the water because it has a higher specific gravity than water. Subsurface transport of the immiscible contaminants is governed by a set of factors different from those of dissolved contaminants. Contaminants from the immiscible liquids may also dissolve into groundwater, volatilize from the groundwater to ground air, evaporate directly into ground air, or sorb from groundwater to solid surfaces.

Contaminant concentrations may be affected by one or more mechanisms during transport. Volatilization or precipitation may physically transform contaminants. Contaminants may be chemically transformed through photolysis, hydrolysis, or oxidation-reduction. Contaminants may also be biologically transformed by biodegradation. Additionally, contaminants may accumulate in one or more media.

Organics leaching from the soil into the groundwater can migrate as dissolved constituents in groundwater. Three general processes govern the migration of dissolved constituents in groundwater: advection, dispersion, and retardation. Advection is a process by which solutes are carried by groundwater movement. Dispersion is a mixing of contaminated and uncontaminated water during advection. Retardation is a slowing of contaminant migration caused by the reaction of the solute with the aquifer soil.

The concentrations of chemicals detected in groundwater at PSC 47 are less than published solubility levels (see Table 6-1) indicating that they are likely present in the dissolved phase. Therefore, the migration of groundwater contaminants at the site is most likely determined by the factors that govern the movement of dissolved contaminants.

6.2.3 Volatilization from Soil

Pesticides, herbicides, and arsenic were the COCs detected in soil at PSC 47. As shown in Table 6-1, these chemicals have very low vapor pressures and Henry's Law Constants, and would not be expected to volatilize from soil to a great extent. Based on the available soil data, volatilization from the soil to ambient air is not expected to be a major transport pathway at PSC 47.

6.2.4 Volatilization from Groundwater

Several types of VOCs (halogenated aliphatics, monocyclic aromatics, ketones, naphthalene, miscellaneous VOCs, and MMA) were detected in groundwater at the site. Since VOCs are typically very mobile, they may leach to groundwater (as discussed above) or volatilize into ambient air. VOC vapors in groundwater may migrate through the overlying soil layers and into ambient air. Studies have shown that the vapors can move either horizontally or vertically in the subsurface. The vapors may also enter buildings through cracks in building foundations or walls. Upon entering ambient air, the vapors are not expected to persist for long periods of time because they have half-lives in the atmosphere typically measured in hours or a few days. Vapors may also be released directly to ambient air from soil or groundwater during excavation activities.

Because a number of VOCs were detected in groundwater at concentrations above risk-based screening levels, potential exposure via volatilization from groundwater into ambient air is evaluated in this report.

6.2.5 Erosion and Runoff of Contaminated Particles from Soil

Chemicals adhering to particulate matter in soil (or sediment) may migrate to drainage ditches or streams (if nearby) by erosional processes such as stormwater runoff. This is a potentially important migration

mechanism for environmentally immobile chemicals (i.e., PAHs, pesticides, and herbicides) that tend to bind to soil. The contaminated soil particles may be moved by runoff or by intermittent flow in drainage ditches.

PSC 47 is relatively flat with a south-flowing drainage ditch (swale) present along its eastern boundary. This ditch is usually dry except during rain events. Because the site is flat and no significant surface water bodies exist near the site, erosion and runoff of contaminated particles are not considered to be important transport pathways at the site.

6.3 CHEMICAL FATE (PERSISTENCE) AND MIGRATION

An overview of contaminant fate and transport issues for the major chemical classes detected at PSC 47 is presented in this section. The following general classes of compounds are discussed:

- Monocyclic aromatics (e.g., chlorobenzenes and BTEX)
- Halogenated aliphatics (chloroform, PCE, and degradation products)
- PAHs (e.g., naphthalene, benzo(a)pyrene, pyrene)
- Phthalate esters (bis(2-ethylhexyl)phthalate)
- Pesticides (e.g., dieldrin, DDT and metabolites, chlordanes) and herbicides (2,4-D, 2,4,5-T)
- Metals (i.e., arsenic)

The information for specific chemicals discussed in the following sections was obtained from TOXNET at http://toxnet.nlm.nih.gov/.

6.3.1 Monocyclic Aromatics

Monocyclic aromatic compounds such as benzene and toluene are not considered to be persistent in the environment, particularly compared to chemicals such as PAHs and pesticides. Monocyclic aromatics are subject to degradation via the action of both soil and aquatic microorganisms.

The fate and transport characteristics of two monocyclic aromatics detected at PSC 47 are discussed below. The characteristics of these compounds are generally comparable to other similar compounds.

- **Benzene's** production, existence in gasoline, and use in the production of ethylbenzene and styrene as well as many other chemicals can result in its release to the environment. Benzene is found in volcanoes, as a constituent of crude oil, from forest fires, and as a plant volatile. If released to soil, benzene is expected to have high mobility based on its K_{oc}. Based on its Henry's Law Constant,

volatilization from moist soil surfaces is expected to be an important fate process. Benzene may volatilize from dry soil surfaces based upon its vapor pressure. Benzene is expected to biodegrade in soils based on biodegradation studies. If released to air, benzene will exist solely as a vapor in the ambient atmosphere. Vapor-phase benzene will be degraded in the atmosphere with a half-life estimated to be 13 days. Since benzene is very water soluble, it may be removed from the atmosphere by rain. If released into water, benzene is not expected to adsorb to sediment and suspended solids in water based upon the K_{oc}. Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant. Based on experimental evidence, biodegradation of benzene in water is expected. In aqueous solution, benzene will react with hydroxyl radical which results in an estimated half-life of 103 days. BCFs ranging from 1.1 to 20 suggest bioconcentration in aquatic organisms is low. Hydrolysis is not expected to occur due to the lack of hydrolyzable functional groups.

- **1,4-Dichlorobenzene** is used as an insecticide, space deodorant and a chemical intermediate. Dichlorobenzene is expected to have moderate to low mobility in soils based upon log K_{oc} values in the range of 300 to 63,000 measured in soils and sediment. Volatilization of 1,4-dichlorobenzene from dry soil surfaces is expected to be an important fate process based upon the vapor pressure of this compound. Volatilization from moist soil surfaces is expected based on the Henry's Law constant of 2.4×10^{-3} atm-cu m/mole at 20°C. 1,4-Dichlorobenzene is not expected to biodegrade in soils or water with reported biodegradation half-lives of about a year or longer. Based on a vapor pressure of 1.2 millimeters mercury (mm Hg) at 20°C, 1,4-dichlorobenzene is expected to exist solely as a vapor in the ambient atmosphere. Vapor-phase 1,4-dichlorobenzene is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals with an estimated atmospheric half-life of 50 days. In water, 1,4-dichlorobenzene is expected to adsorb to sediment or particulate matter based on its measured K_{oc} values. This compound is expected to volatilize from water surfaces given its Henry's Law constant. Bioconcentration in aquatic organisms is considered moderate to high based on BCF values in the range of 60 to 720 measured in fish.

6.3.2 Halogenated Aliphatics

In general, halogenated aliphatic hydrocarbons are subject to abiotic dehydrohalogenation. This process is an elimination reaction that results in the formation of an ethene from a saturated halogenated compound. Research indicates that microbial degradation of highly chlorinated ethanes is a relatively slow process. Hydrolysis, photolysis, and oxidation are generally not considered to be significant fate processes for the chlorinated ethanes.

Volatilization is usually a significant fate process for these compounds. Volatilization is only significant at the air-soil or air-water interface. Compounds such as chloroform and methylene chloride volatilize rapidly

to the atmosphere from soil or surface water due to low soil adsorption. Adsorption should not be considered an important fate for these types of compounds when compared to more hydrophobic compounds. BCF factors indicate that these compounds should not bioaccumulate.

Photolysis is not considered to be a relevant degradation mechanism for this class of compounds. Limited hydrolysis of saturated aliphatics (i.e., alkanes) may occur, but it does not appear to be a significant degradation mechanism for unsaturated species (i.e., alkenes).

The fate and transport characteristics of some of the more common halogenated aliphatic compounds detected at PSC 47 are discussed below.

- **PCE** production and use as a dry cleaning agent, degreasing agent, and as a chemical intermediate in the production of fluorocarbons has resulted in its release to the environment through various waste streams. If released to soil, PCE is expected to have moderate mobility based upon K_{oc} values in the range of 150 to 237 and PCE is often detected in groundwater. Volatilization from moist soil surfaces is expected to be an important fate process based on its Henry's Law constant. PCE may volatilize from dry soil surfaces based upon its vapor pressure. Volatilization half-lives in the range of 1.2 to 5.4 hours were measured for PCE from a sandy loam soil surface and volatilization half-lives of 1.9 to 5.2 hours were measured from organic topsoil. Biodegradation is expected to occur slowly in soils under both aerobic and anaerobic conditions. If released to air, a vapor pressure of 18.5 mm Hg at 25°C indicates PCE will exist solely as a vapor in the ambient atmosphere. Vapor-phase PCE will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 96 days. Direct photolysis is not expected to be an important environmental fate process since this compound only absorbs light weakly in the environmental UV spectrum. If released into water, PCE is not expected to adsorb to suspended solids and sediment in water based upon the K_{oc} data. The biodegradation half-lives of PCE in aerobic and anaerobic waters were reported as 180 and 98 days, respectively. Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant. Measured BCF values of 26 to 77 in fish suggest bioconcentration in aquatic organisms is low to moderate. Hydrolysis is not expected to be an important environmental fate process based on a hydrolysis half-life of nine months.

- **TCE** use in degreasing operations as well as in plastics, appliances, jewelry, automobiles, plumbing fixtures, textiles, paper, glass, and printing industries has resulted in its release to the environment through various waste streams. If released to soil, TCE is expected to have high mobility based upon an average K_{oc} of 101 measured in various soil types. Volatilization from moist soil surfaces is expected to be an important fate process based upon a Henry's Law constant of $9.85X10^{-3}$ atm-cu

m/mole. TCE is expected to volatilize from dry soil surfaces based upon its vapor pressure. Biodegradation of TCE has been reported under aerobic conditions where additional nutrients have been added. Under anaerobic conditions, as might be seen in flooded soils, sediments, or aquifer environments, TCE is slowly biodegraded via reductive dechlorination; the extent and rate of degradation is dependent upon the strength of the reducing environment. TCE half-lives in aquifer studies ranged from 35 days to over 6 years. If released to air, a vapor pressure of 69 mm Hg at 25°C indicates TCE will exist solely as a vapor in the ambient atmosphere. Vapor-phase TCE will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 7 hours. If released into water, TCE is not expected to adsorb to suspended solids and sediment based on an average K_{oc} value of 101. Volatilization from water surfaces will be an important fate process based upon this compound's Henry's Law constant. BCF values in fish ranging from 4 to 39 suggest bioconcentration in aquatic organisms is moderate to low. TCE is widely detected in groundwater in the U.S.

- **1,2-DCE's** use as a solvent has resulted in past release to the environment. Under anaerobic conditions that may exist in landfills or sediment. cis-1,2-DCE may be formed from the reductive dehalogenation of TCE facilitated by microorganisms. If released to soil, cis-1,2-DCE is expected to have moderate mobility based upon a K_{oc} of 250. Volatilization from moist soil surfaces is expected to be an important fate process based upon a Henry's Law constant of $4.1X10^{-3}$ atm-cu m/mole. Cis-1,2-DCE may volatilize from dry soil surfaces based upon its vapor pressure of 200 mm Hg. If released to air, a vapor pressure of 200 mm Hg at 25°C indicates cis-1,2-DCE will exist solely as a vapor in the ambient atmosphere. Vapor-phase cis-1,2-DCE will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 6.1 days. If released into water, cis-1,2-DCE is expected to adsorb to suspended solids and sediment based upon the estimated K_{oc}. cis-1,2-DCE biodegrades in soil under anaerobic conditions. Under anaerobic conditions, field-scale biodegradation half-lives range from 0.14 to 9.9 years. The fact that ethyl chloride is produced as well as vinyl chloride indicates that there are different pathways in the sequential dechlorination of cis-1,2-DCE than for the trans isomer where only vinyl chloride is produced. Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant. An estimated BCF of 5 suggests the potential for bioconcentration in aquatic organisms is low. Hydrolysis is not expected since chlorinated ethylenes hydrolyze very slowly at environmental conditions. cis-1,2-DCE has been widely detected in groundwater at concentrations up to a maximum of 1,200 µg/L.

6.3.3 PAHs

PAHs have very low solubility, vapor pressures, and Henry's Law Constants and high K_{oc} and K_{ow} values. The lower molecular weight PAHs (e.g., acenaphthene, anthracene, fluorene, phenanthrene) are more

environmentally mobile than the higher molecular weight PAHs and are more likely to leach to groundwater. The high molecular weight PAHs (e.g., benzo(a)pyrene, benzo(a)anthracene, chrysene, etc.) are less mobile and tend to adhere to soil particles. Therefore, PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than to go into solution. PAHs are subject to degradation via aerobic bacteria, but may be relatively persistent in the absence of microbial population or macronutrients such as phosphorus and nitrogen.

Bioconcentration of PAHs in aquatic organisms is greater for the higher molecular weight compounds than the lower molecular weight compounds. PAHs can be bioaccumulated from water, sediments, or lower organisms in the food chain.

Landspreading applications have indicated that PAHs are highly amenable to microbial degradation in soil. The rate of degradation is influenced by temperature, pH, oxygen concentrations, initial chemical concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not important fate processes for the degradation of PAHs in soil.

The most important fates of PAHs in water are photo-oxidation, chemical oxidation, and biodegradation. PAHs do not contain functional groups that are susceptible to hydrolytic action, and hydrolysis is considered to be an insignificant degradation mechanism. The rate of photodegradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene and chrysene are reported to be resistant to photodegradation. PAHs may also be oxidized by chlorination and ozonation and may be metabolized by microbes under oxygenated conditions.

The fate and transport characteristics of some of the more common PAHs detected at PSC 47 are discussed below.

- **Benzo(a)pyrene** occurs in fossil fuels and is released to the environment as a product of incomplete combustion. If released to soil, the measured soil K_{oc} values of benzo(a)pyrene (ranging from 930 to 6,300) indicate benzo(a)pyrene is expected to have low to no mobility. Volatilization of benzo(a)pyrene from wet and dry soil surfaces is not expected to be an important fate process based on its measured Henry's Law constant of $4.57X10^{-7}$ atm-cu m/mole and its extrapolated vapor pressure, respectively. Biodegradation in soil is expected to be a slow fate process based upon half-lives in soil ranging from 120 to 309 days. Adsorption to soil is expected to inhibit biodegradation. If released to air, benzo(a)pyrene's extrapolated vapor pressure of $5.5X10^{-9}$ mm Hg at 25°C indicates this compound is expected to exist solely in the particulate phase in the ambient atmosphere. Particulate-phase benzo(a)pyrene will be physically removed from the atmosphere by wet and dry deposition. If released into water, benzo(a)pyrene is expected to adsorb to suspended solids and

sediment in the water column based upon K_{oc} values ranging from $2.7X10^5$ to $1.9X10^6$. Volatilization from water surfaces is not expected to occur given this compound's measured Henry's Law constant. Adsorption to dissolved humic material in the water column is expected to attenuate bioconcentration in aquatic organisms. BCFs for benzo(a)pyrene have been measured ranging from 8.7 to $1X10^5$ indicating that bioconcentration in aquatic organisms is low to very high. Marine organisms which lack a metabolic detoxification enzyme system tend to accumulate PAHs. Hydrolysis is not expected to be an important process due to the lack of hydrolyzable functional groups. Biodegradation of benzo(a)pyrene is expected to occur in aquatic systems. Since benzo(a)pyrene is a product of incomplete combustion, occupational situations involving heating organic material may potentially result in exposure to this compound through inhalation of air particulate matter and dermal contact with combustion products. The general population can also be exposed to benzo(a)pyrene primarily through the smoking of tobacco, inhalation of polluted air, by ingestion of water contaminated by combustion effluents and charcoal-broiled food.

- **Phenanthrene** is a lower molecular weight PAH which was detected in soil and groundwater at PSC 47. Release of phenanthrene most likely results from the incomplete combustion of a variety of organic compounds including wood and fossil fuels. Release to the soil will likely result in biodegradation. Volatilization is not expected to be significant. Phenanthrene is expected to bind strongly to soil and not leach extensively to groundwater. When released to water, adsorption to suspended sediments is expected to remove most of the compound from solution. Photolysis is expected to occur near the water surface and biodegradation of phenanthrene in the water column is expected. Oxidation, volatilization and bioconcentration are not expected to be significant. Phenanthrene released to the atmosphere is expected to rapidly adsorb to particulate matter. Phenanthrene adsorbed on fly ash has been shown to photolyze rapidly (half-life 49 hours) and phenanthrene adsorbed on particulate matter will be subject to wet and dry deposition. Vapor phase phenanthrene will react with photochemically generated, atmospheric hydroxyl radicals with an estimated half-life of 1.67 days.

6.3.4 Phthalate Esters

Phthalate esters are considered to be relatively persistent chemicals in the environment. Although numerous studies have demonstrated that phthalate esters undergo biodegradation, it appears that this is a slow process in both soils and surface waters. Certain microorganisms have been shown to excrete products that increase the solubility of phthalate esters and enhance their biodegradation.

Biodegradation of bis(2-ethylhexyl) phthalate (BEHP) and di-n-butyl phthalate in water is an important fate mechanism. However, hydrolysis of BEHP is very slow, with a calculated half-life of 2,000 years. In soil, microorganisms appear to be capable of degrading di-n-butyl phthalate rapidly. Bioaccumulation is also a

significant fate process. Photolysis and volatilization are considered to be insignificant degradation mechanisms.

The fate and transport characteristics of BEHP are discussed below.

- **BEHP** has been reported to be a possible natural product in animals and plants. BEHP has been found in floor tiles, various types of furnishings for households and transportation vehicles, food packaging systems, industrial tubing and conduits, medical tubing, catheters and blood containers, certain types of dental material, coatings for drugs, and numerous other products. BEHP's production and use as a plasticizer and as an insulating fluid in electrical transformers may result in its release to the environment through various waste streams. If released to soil, measured K_{oc} values ranging from 87,420 to 510,000 indicate BEHP will be immobile. Volatilization is not expected to be an important process from wet or dry soil surfaces based upon an estimated Henry's Law constant of $1.3X10^{-7}$ atm-cu m/mole and this compound's measured vapor pressure, respectively. Biodegradation is expected to be an important process in both water and soil under aerobic conditions. If released to air, a vapor pressure of $7.23X10^{-8}$ mm Hg suggests this compound will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase BEHP will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 18 hours. Particulate-phase BEHP will be physically removed from the atmosphere by wet and dry deposition. If released into water, measured soil/sediment K_{oc} values ranging from 87,420 to 510,000 and suspended solid K_{oc} values ranging from 22,000 to $1X10^{6}$ indicate BEHP will adsorb to suspended solids and sediment in the water column. Volatilization from water surfaces is not expected to occur based upon the estimated Henry's Law constant. Hydrolysis is not expected to be an important process based upon a half-life of 2,000 years at pH 7. Measured BCFs of 115 and 851 in bluegill sunfish and fathead minnows indicate bioconcentration in aquatic organisms will be high. However, experiments with rainbow trout showed that the majority of BEHP did not reach the systemic circulation of the fish, but was present in the exposure water as metabolites as a result of presystemic branchial metabolism of this compound.

6.3.5 Pesticides and Herbicides

Whether pesticides and herbicides are sprayed, dusted, or applied directly to the soil, the soil is the ultimate sink for these chemicals. Surface soil runoff may carry pesticides to adjacent surface water bodies where they are likely to settle in the sediment (although this is not an important pathway at PSC 47). Bioconcentration of pesticides in the food chain is another important fate mechanism. Hydrolysis, oxidation, and photolysis are not generally important fate mechanisms for pesticides in soil or water. Hydrolysis half-lives for several pesticides are reported in periods of months to years. The fate

and transport characteristics of some of the more common pesticides and herbicides used at the site in the past are discussed below.

- **DDT's** former production and use as a broad spectrum pesticide has resulted in its widespread environmental release. If released to soil, DDT is expected to have very little mobility based upon K_{oc} values in the range of $1.13X10^5$ to $3.5X10^5$. Volatilization from moist soil surfaces could occur based on DDT's Henry's Law constant; however, adsorption may attenuate this process. DDT is generally considered recalcitrant under aerobic conditions in soil surfaces, but may undergo biodegradation under anaerobic conditions. It was reported that the mean lifetime of DDT in temperate United States soils is about 5.3 years. If released to air, a vapor pressure of $1.6X1^{-7}$ mm Hg at 25°C indicates DDT will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase DDT will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 5 days. Particulate-phase DDT will be removed from the atmosphere by wet and dry deposition. If released into water, DDT is expected to adsorb to suspended solids and sediment in water based upon the K_{oc} data. Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant but the K_{oc} values would suggest that volatilization will be seriously attenuated. DDT undergoes base catalyzed hydrolysis with a half-life of 81 days at pH 9 and the product formed in the hydrolysis reaction is DDE. The hydrolysis rate of DDT under acidic conditions is very slow, with a reported half-life of 12 years at 27°C and pH 3-5. BCF values of 600 to 84,500 measured in fish, suggest that bioconcentration in aquatic organisms is very high. Although DDT is no longer used in the United States, the general population continues to be exposed to this compound due to its long persistence time.

- **Dieldrin's** former production and use as an insecticide resulted in its direct release to the environment. Dieldrin is also a degradation product of the insecticide aldrin, and the former use of aldrin has contributed to the occurrence of dieldrin in the environment. If released to soil, dieldrin is expected to have low mobility based upon K_{oc} values measured in soil and sediment. Volatilization from moist soil surfaces may be significant based upon a Henry's Law constant of $1X10^{-5}$ atm-cu m/mole; however, adsorption may attenuate this process. Dieldrin was volatilized 90 percent in 30 days when applied to vegetation and 20 percent in 50 days when applied to a moist soil surface. Approximately 3.6 percent dieldrin was volatilized in 167 days when incorporated in a soil at a depth of 7.5 centimeters (cm). Dieldrin degrades slowly in soil surfaces with a reported half-life of about 7 years in field studies. If released to air, its vapor pressure indicates dieldrin will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase dieldrin will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals. The half-life for the reaction with hydroxyl radicals in air is estimated to be 42 hours. Dieldrin also undergoes direct photolysis in

the environment yielding photodieldrin as the primary degradation product. Particulate-phase dieldrin will be removed from the atmosphere by wet and dry deposition. If released into water, dieldrin is expected to adsorb to suspended solids and sediment in water based upon the K_{oc} data. Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant. However, volatilization from water surfaces is expected to be attenuated by adsorption to suspended solids and sediment in the water column. The estimated volatilization half-life from a model pond is 7 years when adsorption is considered. The hydrolysis half-life of dieldrin has been reported as greater than 4 years. BCF values of 3,300 to 14,500, measured in fish, suggest bioconcentration in aquatic organisms is very high.

- **Chlordane** is extremely persistent in the environment and in some soils may persist for long periods of time. One review of chlordane soil persistence literature has reported that the mean degradation rate of chlordane in soil under field conditions has been observed to range from 4.05 to 28.33 percent per year; another literature review has reported the mean half-life of chlordane under field conditions to be 3.3 years. Based on field tests, soil column leaching tests and K_{oc} estimation, chlordane is expected to be generally immobile or only slightly mobile in soil; however, the detection of chlordane in a number of groundwater samples indicates that leaching has occurred at PSC 47. Soil volatility studies have found that chlordane can volatilize significantly from soil surfaces on which it has been sprayed, particularly moist soil surfaces; however, shallow incorporation into soil was found to greatly restrict volatilization losses. Sufficient data are not available to predict the biodegradation rate of chlordane in soil. However, it has been suggested that chlordane is very slowly biotransformed in the environment (similar in nature to dieldrin), which is consistent with the long persistence periods observed under field conditions.

- **Heptachlor** was used extensively as an insecticide on many agricultural crops until its use was banned by the USEPA in 1974. Its production and former use in termite control, seed/seed furrow treatment, and wood treatment did result in its direct release to the environment. If released to soil, heptachlor is expected to have no mobility based upon a range of K_{oc}s of 13,330 to 661,000. Volatilization from moist soil surfaces may be an important fate process based upon a Henry's Law constant of $2.3X10^{-3}$ atm-cu m/mole. Complete degradation of heptachlor in flooded sandy loam and Louisiana clay occurred after 1 and 2 months, respectively. However, field dissipation half-lives for heptachlor can range from 40 days to 5.5 yrs. If released to air, a vapor pressure of $4.00X10^{-4}$ mm Hg at 25°C indicates heptachlor will exist in both the vapor and particulate phases in the ambient atmosphere. Vapor-phase heptachlor will be degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals and ozone; the half-life for these reactions in air are estimated to be 6.3 and 1.4 hours, respectively. Particulate-phase heptachlor will be removed from the atmosphere by wet and dry deposition. Direct and photosensitized photolysis of unabsorbed

heptachlor may occur in the environment. If released to water, heptachlor is expected to adsorb to suspended solids and sediment based upon the range of K_{oc}. In water, 95.3 percent of heptachlor was removed by an acclimated aerobic mixed microbial culture in 4 weeks. Anaerobic incubation of heptachlor with thick sewage sludge inoculum at 53°C resulted in complete degradation in about 1 day. Volatilization from water surfaces is expected to be an important fate process based upon this compound's Henry's Law constant. However, volatilization from water surfaces is expected to be attenuated by adsorption to suspended solids and sediment in the water column. A range of BCF values of 200 to 37,000 suggest bioconcentration in aquatic organisms is high to very high. In water and moist soil, heptachlor readily undergoes hydrolysis to 1-hydrochlorodene, which is then readily converted by microorganisms into heptachlor epoxide. The chemical hydrolysis half-life for heptachlor is reported to be 4.5 days at pH 7.

- **2,4-D.** K_{oc} values for 2,4-D range from 20 to 136 indicating that 2,4-D is expected to have some mobility in soil. The pKa of 2,4-D is 2.73, indicating that this compound will primarily exist in the anion form in the environment and anions generally do not adsorb to soil more strongly than their neutral counterparts. Volatilization from moist soil surfaces is not expected to be an important fate process based upon this compound's pKa, which indicates 2,4-D will exist almost entirely as an anion. 2,4-D is not expected to volatilize from dry soil surfaces based upon its vapor pressure of $8.3X10^{-8}$ mm Hg at 20°C. Half-lives for 2,4-D volatilization from soil of 660 days (from 1 cm) and 7.1 year (from 10 cm) were calculated by assuming a zero degradation rate. Biodegradation is by far the most important loss process for 2,4-D in most soils, leading to various hydroxylic aromatic products. The rate of degradation is affected by the conditions, especially the concentrations of 2,4-D and water content temperature and the organic content of soil and the status of preexposure of the soil to 2,4-D or its salts or its esters. Typical half-lives are short, ranging from less than 1 day to several weeks. Longer half-lives in dry or sandy soils with low organic content are possible. Adsorption to soil will probably not be important, but will depend on type of soil and organic content. In other soils, rapid biodegradation is expected to prevent consequential leaching. Evaporation and hydrolysis will be negligible.

- Release of **2,4,5-T** to the environment occurred during its past use as a herbicide and it can form in the environment as a hydrolysis product of its herbicide esters. Other sources of release may include losses during formulation, packaging or disposal of 2,4,5-T or its esters. If released to soil, 2,4,5-T is likely to biodegrade and its mobility is expected to vary from highly mobile in sandy soil and moderately mobile in clay and silt loams to slightly mobile in muck (due to adsorption to humic acids and other organic matter). Removal by biodegradation apparently limits the extent of leaching, of 2,4,5-trichlorophenol and 2,4,5-trichloroanisole, the primary degradation product of 2,4,5-T in soil. The anisole is apparently formed by microbial methylation of the phenol. Chemical hydrolysis in moist

soils should not be significant. The persistence of 2,4,5-T in soil is reported to vary from 14 to 300 days depending upon climatic conditions and population of soil microorganisms, but usually does not exceed one full growing season regardless of the application rate. Degradation under anaerobic conditions is much slower than under aerobic conditions, thus 2,4,5-T persists longer in flooded soils (half-life of less than or equal to 48 weeks) than in field moist soils. Data regarding the biodegradation of 2,4,5-T in soil suggest that biodegradation may contribute significantly to the degradation of 2,4,5-T in aquatic systems.

6.3.6 Metals

Arsenic is the only metal considered to be a COC at PSC 47. It is present in both soils and groundwater. Arsenic does not biodegrade, but it does change valence states (As^{5+} and As^{3+} are the most common states). The valence state of arsenic is dependent primarily on the redox conditions in the soil or groundwater where it is located. Oxidizing conditions favor the pentavalent form of arsenic; whereas, mildly reducing to reducing conditions favor trivalent arsenic. Bacterial metabolism and other biotic activities can affect the redox conditions and the valence state of arsenic. The greater portion of the arsenic mass is adsorbed to subsurface soil. In particular, arsenate and arsenite anions sorb relatively strongly to iron oxyhydroxide coatings on soil mineral surfaces. Since the arsenic does not degrade and there is little uptake of arsenic by plants at the site (arsenic is found primarily in the deeper soil and groundwater), the primary fate of arsenic at PSC 47 is sorption to the soil.

6.4 BIODEGRADATION AND NATURAL ATTENUATION AT PSC 47

6.4.1 Northern Plume

The highest groundwater concentrations of most pesticides in the Northern Plume have been detected historically in two wells on the north side of Building 536 (JAX47-MW11S and JAX47-MW25S) and two wells on the southeastern side of Building 536 (JAX47-536-MW03 and JAX47-MW13S) (Table 6-3). The concentrations of nearly all of the pesticide compounds detected in these four wells have decreased by about 50 percent or more between 2001 and 2006. Pesticide concentrations in one other nearby well (JAX47-MW13D) also showed decreasing concentrations between 2002 and 2006. Two wells (JAX47-MW12S and JAX47-MW27S), however, have shown a slight increase in four pesticides [alpha-BHC, delta-BHC, gamma-BHC (Lindane), and alpha-chlordane] between 2002 and 2006. The data from five of the seven wells that have the highest pesticide concentrations suggest that biodegradation or other natural attenuation processes (e.g., dilution and dispersion) are causing the pesticide concentrations to decrease over time in the Northern Plume. The two wells showing very minor increases in concentration are located at the far northern and western sides of the plume.

Table 6-3
Summary of Contaminant Concentrations in Groundwater Over Time

Remedial Investigation/Feasibility Study
Potential Source of Contamibnation 47
Naval Air Station Jacksonville
Jacksonville, Florida

Northern Plume

	JAX47-536-MW03		JAX47-MW11S		JAX47-MW12S			JAX47-MW13S			JAX47-MW13D		JAX47-MW25S		JAX47-MW27S		
Collection Date	**6/25/2001**	**4/9/2002**	**4/4/2002**	**12/1/2006**	**4/10/2002**	**2/27/2004**	**12/8/2006**	**4/4/2002**	**7/25/2005**	**12/1/2006**	**4/4/2002**	**12/1/2006**	**11/7/2002**	**12/8/2006**	**1/20/2003**	**3/3/2003**	**11/30/2006**
Pesticides (µg/L)																	
4,4'-DDD	**210**	**48**	0.48 U	0.0004 U	0.10 U	NA	0.0004 U	**3.1**	3.4	0.54	**1.9**	0.31	1.0 U	0.0004 U	0.10 U	0.10 U	0.001 J
4,4'-DDE	1 U	0.92 J	0.48 U	0.002 U	0.10 U	NA	0.056 J	0.96 U	0.2 U	0.002 U	0.10 U	0.003 J	1.0 U	0.002 U	0.10 U	0.10 U	0.002 U
4,4'-DDT	**22**	2.3 U	0.48 U	0.002 U	0.10 U	NA	0.002 U	**1.5**	1.7	0.38	**0.17**	0.002 U	1.0 U	0.003 U	0.10 U	0.10 U	0.002 U
ALDRIN	1 U	1.2 U	0.24 U	0.002 U	0.050 U	NA	0.002 U	0.48 U	0.2 U	0.01 J	0.050 U	0.002 U	0.5 U	0.002 U	0.050 U	0.050 U	0.002 U
ALPHA-BHC	**8.4**	**4.2**	**4.8**	0.001 U	0.050 U	NA	1.1 J	**14**	1.2	2	**0.057**	0.001 U	**5.9**	3.4	0.050 U	0.050 U	0.21
ALPHA-CHLORDANE	1 U	1.2 U	0.24 U	0.001 U	0.050 U	NA	0.44 J	0.48 U	0.78	0.16 J	0.050 U	0.001 U	0.5 U	0.032 J	0.050 U	0.050 U	0.012 J
BETA-BHC	**2.1**	1.2 U	**1.7**	0.002 U	**1.3**	NA	0.7 J	**1.2**	0.38 I	0.28	0.050 U	0.002 U	**2.8**	1.8 J	**0.064**	0.050 U	0.16
DELTA-BHC	**9.6**	**4.6**	**4.2**	0.001 U	0.050 U	NA	0.015 J	**10**	0.84	1.7	0.071	0.001 U	**5.6**	3.6	0.11	0.050 U	0.41 J
DIELDRIN	1 U	2.3 U	0.48 U	0.0008 U	**0.023 J**	NA	0.15 J	0.96 U	0.32 I	0.038 J	0.10 U	0.0008 U	1.0 U	0.0008 U	0.10 U	0.10 U	0.004 J
ENDRIN	**25**	2.3 U	0.48 U	0.002 UJ	0.10 U	NA	0.002 U	0.96 U	0.39 U	0.021 J	0.10 U	0.002 U	1.0 U	0.003 UJ	0.10 U	0.10 U	0.002 U
ENRIN ALDEHYDE	3	2.3 U	0.48 U	0.009 U	0.10 U	NA	0.009 U	0.96 U	0.39 U	0.011 J	0.10 U	0.009 U	1.0 U	0.009 U	0.10 U	0.10 U	0.009 U
ENDRIN KETONE	1 U	2.3 U	0.48 U	0.003 UJ	0.10 U	NA	0.027 J	0.96 U	0.2 U	0.006 J	0.10 U	0.003 UJ	1.0 U	0.003 UJ	0.10 U	0.10 U	0.006 J
GAMMA-BHC (LINDANE)	**2.2**	1.2 U	**8.4**	0.002 U	0.050 U	NA	0.11 J	**22**	1.1	2.5	0.050 U	0.002 U	**10**	4.4	0.039	0.050 U	0.33
GAMMA-CHLORDANE	1.4	1.2 U	0.24 U	0.001 UJ	0.014 J	NA	0.016 J	0.48 U	0.9	0.25	0.050 U	0.001 U	0.5 U	0.036 J	0.050 U	0.050 U	0.001 U
Volatile Organics (ug/L)																	
TETRACHLOROETHENE	1 U	5 U	5 U	0.3 U	5 U	NA	0.3 UJ	5 U	NA	0.3 U	5 U	0.3 U	5 U	0.3 UJ	5 U	NA	0.3 U
TRICHLOROETHENE	1.8	2 J	**23**	0.3 U	5 U	NA	0.3 U	5 U	NA	0.3 U	5 U	0.3 U	**4 J**	0.3 J	5 U	NA	0.3 U
CIS-1,2-DICHLOROETHENE	1.2	1 J	18	0.2 U	5 U	NA	0.2 U	5 U	NA	0.2 U	5 U	0.2 U	0.5 J	0.2 U	5 U	NA	0.2 U
TRANS-1,2-DICHLOROETHENE	1 U	5 U	5 U	0.2 U	5 U	NA	0.2 U	5 U	NA	0.2 U	5 U	0.2 U	5 U	0.2 U	5 U	NA	0.2 U
VINYL CHLORIDE	1 U	5 U	5 U	0.4 U	5 U	NA	0.4 U	5 U	NA	0.4 U	5 U	0.4 U	5 U	0.4 U	5 U	NA	0.4 U
BENZENE	1 U	**2 J**	**4 J**	0.2 U	5 U	NA	0.2 U	**1 J**	NA	**0.6 J**	5 U	0.2 U	**2 J**	**0.5 J**	5 U	NA	0.2 U
TOLUENE	1 U	0.9 J	0.5 J	0.2 U	5 U	NA	0.2 U	5 U	NA	0.2 U	5 U	0.2 U	0.3 J	0.2 U	5 U	NA	0.2 U
ETHYLBENZENE	1.6	3 J	5	0.3 U	5 U	NA	0.3 U	2 J	NA	0.5 J	5 U	0.3 U	0.8 J	0.3 U	5 U	NA	0.3 U
TOTAL XYLENES	6	9	20	0.3 U	5 U	NA	0.3 U	6	NA	0.8 J	5 U	0.3 U	16	0.6 J	5 U	NA	0.3 U
1,2,4-TRICHLOROBENZENE	NA	5 U	5 U	0.1 U	5 U	NA	0.4 U	24	NA	6.6	5 U	0.4 U	1 U	0.9 U	5 U	NA	0.8 U
1,2-DICHLOROBENZENE	NA	5 U	5 U	0.2 U	5 U	NA	0.2 U	10	NA	2.3 J	5 U	0.2 U	1 J	0.6 U	5 U	NA	0.2 U
1,4-DICHLOROBENZENE	NA	2 J	2 J	0.1 U	5 U	NA	0.1 U	9	NA	3.9 J	5 U	0.1 U	4 J	3.2	5 U	NA	0.4 J
CHLOROBENZENE	NA	4 J	18	0.2 U	5 U	NA	0.2 U	8	NA	2.6 J	5 U	0.2 U	8	2.7	5 U	NA	0.2 J
CYCLOHEXANE	NA	5 U	43	0.4 U	5 U	NA	0.4 U	5 U	NA	0.4 U	5 U	0.4 U	40	0.4 U	5 U	NA	0.4 U
ISOPROPYLBENZENE	NA	5 U	**5**	0.1 U	5 U	NA	0.1 U	0.6 J	NA	0.1 U	5 U	0.1 U	**7**	**2.5**	5 U	NA	0.1 U
METHYL CYCLOHEXANE	NA	5 U	12	0.6 UJ	5 U	NA	0.6 UJ	5 U	NA	0.6 UJ	5 U	0.6 UJ	22	0.7 J	5 U	NA	0.6 UJ
Semi-Volatile Organics (ug/L)																	
2-METHYLNAPHTHALENE	16.5	NA	NA	2 U	NA	NA	2 U	31	NA	2 U	10 U	2 U	NA	25	NA	NA	2 U
NAPHTHALENE	6.5	NA	NA	3 U	NA	NA	3 U	11	NA	3 U	10 U	3 U	NA	30	NA	NA	3 U
Metals (ug/L)																	
ARSENIC	NA	NA	NA	4 U	NA	2.13 U	4 U	2.15 U	NA	4 U	2.15 U	4 U	NA	4.1	NA	NA	4 U

Table 6-3
Summary of Contaminant Concentrations in Groundwater Over Time

Remedial Investigation/Feasibility Study
Potential Source of Contamibnation 47
Naval Air Station Jacksonville
Jacksonville, Florida

Southern Plume

	JAX47-MW01S				JAX47-MW02S					JAX47-MW03S						JAX47-MW04S				
Collection Date	**6/25/2001**	**4/11/2002**	**2/27/2004**	**11/29/2006**	**6/25/2001**	**4/9/2002**	**2/27/2004**	**11/30/2006**	**4/3/2007**	**6/25/2001**	**4/11/2002**	**3/26/2004**	**7/25/2005**	**11/29/2006**	**4/3/2007**	**6/25/2001**	**4/11/2002**	**2/27/2004**	**12/1/2006**	**4/3/2007**
Pesticides (µg/L)																				
4,4'-DDD	1 U	0.10 U	NA	0.0004 U	1 U	0.10 U	NA	0.071 J	NA	**7.1**	**20**	NA	34.5	13 J	NA	1 U	1.0 U	NA	8.2	NA
4,4'-DDE	1 U	0.10 U	NA	0.002 U	1 U	0.10 U	NA	0.033 J	NA	1 U	**0.15 J**	NA	0.97 U	0.094 J	NA	1 U	1.0 U	NA	0.056	NA
4,4'-DDT	1 U	0.10 U	NA	0.002 U	**1**	0.10 U	NA	0.002 U	NA	**7.8**	**5.7**	NA	0.97 U	0.013 J	NA	1 U	1.0 U	NA	0.002 U	NA
ALDRIN	**7.7**	0.050 U	NA	0.002 U	**8.5**	0.050 U	NA	3.5 J	NA	1 U	0.47 U	NA	0.97 U	2.6 J	NA	**8.9**	0.50 U	NA	2.6 J	NA
ALPHA-BHC	1 U	0.08 J	NA	0.004 J	1 U	0.050 U	NA	0.001 U	NA	**1.3**	**2.4**	NA	5.3	0.64 J	NA	1 U	0.50 U	NA	0.45	NA
ALPHA-CHLORDANE	1 U	0.050 U	NA	0.005 J	1 U	0.050 U	NA	0.27 J	NA	1 U	0.47 U	NA	0.49 U	0.14 J	NA	1 U	0.50 U	NA	0.001 U	NA
BETA-BHC	1 U	0.050 U	NA	0.002 U	1 U	0.050 U	NA	0.097 J	NA	1 U	**1.2**	NA	3.6	1.1 J	NA	1 U	0.50 U	NA	3.9 J	NA
DELTA-BHC	1 U	0.050 U	NA	0.02 J	1 U	0.050 U	NA	0.42 J	NA	1.2	**3.6**	NA	7.1	1.1 J	NA	1 U	0.50 U	NA	0.64	NA
DIELDRIN	1 U	0.10 U	NA	0.003 J	1 U	0.10 U	NA	0.0008 U	NA	1 U	**0.83 J**	NA	1.8 I	0.32 J	NA	1 U	1.0 U	NA	0.19 J	NA
ENDRIN	1 U	0.10 U	NA	0.002 J	1 U	0.10 U	NA	0.002 UJ	NA	1 U	0.94 U	NA	1.9 U	0.002 U	NA	1 U	1.0 U	NA	0.008 J	NA
ENRIN ALDEHYDE	4.6	0.10 U	NA	0.009 U	5.8	0.10 U	NA	0.009 U	NA	5.6	0.94 U	NA	1.9 U	0.009 U	NA	5.2	1.0 U	NA	0.009 U	NA
ENDRIN KETONE	6.9	0.10 U	NA	0.003 U	27.8	0.10 U	NA	4.7 J	NA	4	0.94 U	NA	0.97 U	0.23 J	NA	1 U	1.0 U	NA	0.18	NA
GAMMA-BHC (LINDANE)	1 U	0.050 U	NA	0.002 UJ	1 U	0.050 U	NA	0.007 J	NA	**1.8**	**6.1**	NA	12.6	1.1 J	NA	1 U	0.50 U	NA	0.66	NA
GAMMA-CHLORDANE	**5.8**	0.050 U	NA	0.001 U	1 U	0.050 U	NA	0.001 UJ	NA	1 U	0.47 U	NA	0.49 U	0.001 U	NA	1 U	0.50 U	NA	0.001 U	NA
Volatile Organics (ug/L)																				
TETRACHLOROETHENE	**14**	**6.5**	NA	**1.5 J**	**21.7**	**11**	NA	**3.8**	NA	2.3	2 J	NA	NA	3.9 J	NA	**23**	**24**	NA	**4 J**	NA
TRICHLOROETHENE	**3.2**	2 J	NA	1 J	**6.6**	**4 J**	NA	**3.1**	NA	**6.3**	**6**	NA	NA	**7.4**	NA	10 U	**4 J**	NA	**7.7**	NA
CIS-1,2-DICHLOROETHENE	**380**	61.5	NA	17	47.4	21	NA	228 J	NA	**79.3**	58	NA	NA	564	NA	**360**	**150**	NA	**586**	NA
TRANS-1,2-DICHLOROETHENE	1 U	5 U	NA	0.5 J	1 U	5 U	NA	1.7	NA	1 U	0.8 J	NA	NA	4.2	NA	10 U	0.6 J	NA	4.5	NA
VINYL CHLORIDE	1 U	0.75 J	NA	0.4 U	1 U	5 U	NA	5.1	NA	1 U	0.4 J	NA	NA	1.9	NA	10 U	**1 J**	NA	**1.6**	NA
BENZENE	7.4	1 J	NA	0.2 U	1 U	0.6 J	NA	4.4	NA	1 U	0.4 J	NA	NA	3.3	NA	0	**9**	NA	**3.2**	NA
TOLUENE	**50.2**	4 J	NA	0.2 U	1 U	5 U	NA	3.5	NA	1 U	5 U	NA	NA	1 J	NA	**67**	**180**	NA	**0.6 J**	NA
ETHYLBENZENE	110	18.5	NA	0.3 U	4.5	2 J	NA	26.8	NA	1 U	5 U	NA	NA	9.9	NA	140	**200 J**	NA	**9.9**	NA
TOTAL XYLENES	**1960**	**215**	NA	0.3 U	1 U	5 U	NA	89.5	NA	6.5	5 U	NA	NA	22.7	NA	**2330**	**6200**	NA	**25.4**	NA
1,2,4-TRICHLOROBENZENE	NA	5 U	NA	0.1 U	NA	5 U	NA	0.3 U	NA	NA	5 U	NA	NA	2.5	NA	NA	5 U	NA	3.4	NA
1,2-DICHLOROBENZENE	NA	5 U	NA	0.2 U	NA	5 U	NA	0.2 U	NA	NA	5 U	NA	NA	0.2 U	NA	NA	5 U	NA	0.2 U	NA
1,4-DICHLOROBENZENE	NA	5 U	NA	0.1 U	NA	5 U	NA	0.1 U	NA	NA	5 U	NA	NA	0.1 U	NA	NA	5 U	NA	0.1 U	NA
CHLOROBENZENE	NA	0.45 J	NA	0.2 U	NA	5 U	NA	0.8 J	NA	NA	5 U	NA	NA	0.6 J	NA	NA	2 J	NA	0.5 J	NA
CYCLOHEXANE	NA	5 U	NA	0.4 U	NA	5 U	NA	0.4 U	NA	NA	5 U	NA	NA	0.4 U	NA	NA	5 U	NA	0.4 U	NA
ISOPROPYLBENZENE	NA	**2 J**	NA	0.1 U	NA	5 U	NA	1.6	NA	NA	5 U	NA	NA	1 J	NA	NA	**6**	NA	**1.1**	NA
METHYL CYCLOHEXANE	NA	5 U	NA	0.6 UJ	NA	5 U	NA	0.6 UJ	NA	NA	5 U	NA	NA	0.6 UJ	NA	NA	5 U	NA	0.6 UJ	NA
Semi-Volatile Organics (ug/L)																				
2-METHYLNAPHTHALENE	65	22	NA	2 U	10 U	NA	NA	10 J	NA	10 U	NA	NA	NA	2 U	NA	100 U	NA	NA	2 U	NA
NAPHTHALENE	**130**	22	NA	3 U	3 U	NA	NA	14	NA	5.2	NA	NA	NA	3 U	NA	**150**	NA	NA	3 U	NA
Metals (ug/L)																				
ARSENIC	NA	810	344	41	NA	NA	8960	8400 R	6640	NA	NA	7930	NA	23000 R	6240	NA	NA	3.8	5880 R	18.3

Table 6-3
Summary of Contaminant Concentrations in Groundwater Over Time

Remedial Investigation/Feasibility Study
Potential Source of Contamibnation 47
Naval Air Station Jacksonville
Jacksonville, Florida

Southern Plume (continued)

	JAX47-MW05S				JAX47-937-MW06D			JAX47-MW14D			JAX47-MW17S			JAX47-MW17D	
Collection Date	**6/25/2001**	**4/9/2002**	**11/29/2006**	**4/3/2007**	**6/25/2001**	**4/11/2002**	**11/30/2006**	**4/10/2002**	**2/27/2004**	**12/1/2006**	**4/4/2002**	**3/26/2004**	**12/5/2006**	**4/4/2002**	**12/5/2006**
Pesticides (µg/L)															
4,4'-DDD	1 U	**0.13**	0.076 J	NA	1 U	0.10 U	0.0004 U	0.10 U	NA	0.0004 U	**6.5**	NA	25 J	**0.26**	0.094
4,4'-DDE	1 U	0.10 U	0.13 J	NA	1 U	0.10 U	0.002 U	0.10 U	NA	0.003 J	0.48 U	NA	0.036 J	0.10 U	0.002 U
4,4'-DDT	1 U	0.10 U	0.002 U	NA	1 U	0.10 U	0.002 U	0.10 U	NA	0.003 J	**1.1**	NA	0.015 J	0.052 J	0.002 U
ALDRIN	**2**	0.050 U	3.8 J	NA	1 U	0.050 U	0.002 U	0.050 U	NA	0.002 U	0.24 U	NA	0.01 J	0.050 U	0.002 U
ALPHA-BHC	1 U	0.050 U	0.001 U	NA	1 U	0.050 U	0.001 U	0.050 U	NA	0.003 J	0.24 U	NA	0.002 UJ	0.050 U	0.001 U
ALPHA-CHLORDANE	1 U	0.054	0.58 J	NA	1 U	0.050 U	0.001 U	0.050 U	NA	0.002 J	**4.0**	NA	1.8	0.15	0.039 J
BETA-BHC	1 U	0.050 U	0.002 U	NA	1 U	0.050 U	0.002 U	0.050 U	NA	0.002 U	0.24 U	NA	0.002 U	0.050 U	0.089
DELTA-BHC	1 U	0.050 U	4 J	NA	1 U	0.050 U	0.001 U	0.050 U	NA	0.026 J	0.24 U	NA	0.032 J	0.050 U	0.031 J
DIELDRIN	1 U	0.10 U	0.018 J	NA	1 U	0.10 U	0.0008 U	0.10 U	NA	0.0008 U	0.48 U	NA	0.036 J	0.10 U	0.0008 U
ENDRIN	1 U	0.10 U	0.004 J	NA	1 U	0.10 U	0.002 UJ	0.10 U	NA	0.002 U	0.48 U	NA	0.005 J	0.10 U	0.002 U
ENRIN ALDEHYDE	6.4	0.10 U	0.009 U	NA	6	0.10 U	0.009 U	0.10 U	NA	0.009 U	0.48 U	NA	0.009 U	0.10 U	0.009 U
ENDRIN KETONE	3.3	0.10 U	1 J	NA	1 U	0.10 U	0.004 J	0.10 U	NA	0.019 J	0.48 U	NA	0.009 J	0.10 U	0.003 UJ
GAMMA-BHC (LINDANE)	1 U	0.050 U	0.058 J	NA	1 U	0.050 U	0.002 U	0.050 U	NA	0.002 J	0.24 U	NA	0.002 U	0.050 U	0.002 U
GAMMA-CHLORDANE	1 U	0.050 U	0.039 J	NA	1 U	0.050 U	0.001 UJ	0.050 U	NA	0.001 U	0.24 U	NA	1.1	0.10	0.042 J
Volatile Organics (ug/L)															
TETRACHLOROETHENE	**4.6**	0.9 J	0.9 J	NA	1 U	5 U	0.3 U	0.45 J	NA	1.3 J	**21**	NA	**2.8**	5 U	0.3 J
TRICHLOROETHENE	2.5	1 J	2	NA	1 U	0.6 J	0.3 U	5 U	NA	0.6 J	2 J	NA	0.3 U	5 U	0.3 U
CIS-1,2-DICHLOROETHENE	45.2	30	936	NA	3.9	3 J	0.9 J	0.4 J	NA	12.4	23	NA	1.8	**400**	328
TRANS-1,2-DICHLOROETHENE	1 U	0.5 J	2.5	NA	1 U	5 U	0.2 U	5 U	NA	0.2 U	5 U	NA	0.2 U	10	0.6 J
VINYL CHLORIDE	1 U	5 U	5.5	NA	1 U	5 U	0.4 U	5 U	NA	0.4 J	5 U	NA	0.4 U	**2 J**	1
BENZENE	1 U	5 U	14.6	NA	1 U	0.5 J	0.2 U	5 U	NA	0.9 J	5 U	NA	0.2 U	**11**	8.4
TOLUENE	1 U	5 U	21.9 J	NA	1 U	5 U	0.2 U	5 U	NA	0.2 U	0.4 J	NA	0.2 U	2 J	1.4
ETHYLBENZENE	1 U	5 U	135	NA	1 U	5 U	0.3 U	5 U	NA	0.3 U	**44**	NA	3.6	5	4
TOTAL XYLENES	1 U	5 U	914	NA	1 U	5 U	0.3 U	5 U	NA	0.3 U	**750**	NA	0.3 U	**54**	41.5
1,2,4-TRICHLOROBENZENE	NA	5 U	0.1 U	NA	NA	5 U	0.1 U	5 U	NA	0.1 U	5 U	NA	0.1 U	5 U	0.1 U
1,2-DICHLOROBENZENE	NA	5 U	0.3 J	NA	NA	5 U	0.2 U	5 U	NA	0.2 U	5 U	NA	0.2 U	5 U	0.2 U
1,4-DICHLOROBENZENE	NA	5 U	0.1 U	NA	NA	5 U	0.1 U	5 U	NA	0.1 U	5 U	NA	0.1 U	5 U	0.1 U
CHLOROBENZENE	NA	5 U	2.7 J	NA	NA	5 U	0.2 U	5 U	NA	0.3 J	5 U	NA	0.2 U	0.4 J	0.4 J
CYCLOHEXANE	NA	5 U	0.4 U	NA	NA	5 U	0.4 U	5 U	NA	0.4 U	5 U	NA	0.4 U	5 U	0.4 U
ISOPROPYLBENZENE	NA	5 U	3.6 J	NA	NA	5 U	0.1 U	5 U	NA	0.4 J	**10**	NA	3.8	**3 J**	4.6
METHYL CYCLOHEXANE	NA	5 U	0.6 UJ	NA	NA	5 U	0.6 UJ	5 U	NA	0.6 UJ	2 J	NA	0.6 UJ	5 U	0.6 UJ
Semi-Volatile Organics (ug/L)															
2-METHYLNAPHTHALENE	10 U	NA	2 U	NA	10 U	10 U	2 U	NA	NA	2 U	NA	NA	2 U	NA	2 U
NAPHTHALENE	3 U	NA	21	NA	3 U	10 U	3 U	NA	NA	3 U	NA	NA	3 U	NA	3 U
Metals (ug/L)															
ARSENIC	NA	NA	2310 R	2100	NA	16.4	40.3	NA	4.4	4 U	NA	2.13 U	4 U	NA	5.6

Groundwater concentrations of chlorinated and non-chlorinated VOCs are relatively low in the Northern Plume (Table 6-3). Low to moderate concentrations of VOCs have been detected in four wells (JAX47-536-MW03, JAX47-MW11S, JAX47-MW13S, and JAX47-MW25S). These are the same four wells in the Northern Plume that had the highest pesticide concentrations, which suggests these contaminants (i.e., pesticides and VOCs) may have migrated from the same source area(s). The highest concentration of TCE in the Northern Plume (23 µg/L) was detected in JAX47-MW11S (Table 6-3). Cis-1,2-DCE was also detected in this sample at 18 µg/L. Cis-1,2-DCE has also been detected in low concentrations in three other wells in the Northern Plume. Thus, it appears that a significant portion of the TCE in this plume has already degraded to cis-1,2-DCE. The fact that the chlorinated VOC concentrations are decreasing over time in most wells and biodegradation daughter products are present in the plume strongly suggest that biodegradation of the VOCs is an ongoing process and effectively causing the contaminant mass to decrease over time.

6.4.2 Southern Plume

In the Southern Plume, the highest concentrations of pesticides have been detected in six monitoring wells (JAX47-MW01S, JAX47-MW02S, JAX47-MW03S, JAX47-MW04S, JAX47-MW05S, and JAX47-MW17S), which are located beneath and south of Building 937 (Figure 5-10). These wells have each been sampled twice to four times. Data from two wells (JAX47-MW01S and JAX47-MW02S) show decreasing pesticide concentrations between 2002 and 2006 (Table 6-3). However, data from the four other shallow wells (JAX47-MW03S, -MW04S, -MW05S, and –MW17S) all display variable concentrations of pesticides between 2001 and 2006; some compound concentrations are increasing, some are decreasing, and some are fluctuating. Therefore, evidence for natural attenuation of pesticides in the Southern Plume is not conclusive.

Chlorinated VOCs have been detected in seven different permanent monitoring wells in the Southern Plume (Table 6-3, Figure 5-11). Six of these wells are the same ones that were identified above as having pesticide contamination. The seventh well (JAX47-MW17D) is a deep well and has had significant concentrations of cis-1,2-DCE and vinyl chloride, but not PCE or TCE. The highest concentrations of PCE and TCE have been detected in wells JAX47-MW02S, -MW04S, and -MW17S. These two compounds were also detected in numerous temporary wells during Phase I of the RI (Figure 5-9). Of the six permanent monitoring wells that had PCE and TCE detections and were sampled two or more times, the PCE and TCE concentrations decreased in five of the wells (JAX47-MW01S, -MW02S, -MW04S, -MW05S, and -17S) and remained stable in only one well (JAX47-MW03S). PCE and TCE did not increase in any well. Cis-1,2-DCE is a biodegradation product of PCE and TCE. This compound has been detected in every well where PCE and TCE have been detected, and often at concentrations 10 to 100 times greater than the PCE and TCE concentrations. For example, the concentration of cis-1,2-DCE in well JAX47-MW04S in December 2006 was 586 µg/L; whereas, the concentrations of PCE and TCE

were only 4 and 7.7 µg/L, respectively (Table 6-3). The concentration of cis-1,2-DCE exceeded the combined concentrations of PCE and TCE in almost every groundwater sample collected from every permanent well. This is also true for groundwater samples from the temporary wells collected during Phase I (Figure 5-9). Vinyl chloride have been detected in relatively low concentrations in a few wells in the Southern Plume (≤ 2 µg/L), which indicates that some cis-1,2-DCE is degrading anaerobically (i.e., reductive dechlorination). However, it is very likely that cis-1,2-DCE is also degrading aerobically to carbon dioxide. Overall, the data indicate that the chlorinated VOCs are degrading and their concentrations are significantly decreasing over time due largely to biodegradation, and partially to dilution and dispersion.

Elevated arsenic concentrations have been detected in the Southern Plume, but not the Northern Plume. The highest arsenic concentrations have been detected in five wells (JAX47-MW01S through JAX47-MW05S). A slightly elevated arsenic concentration (40.3 µg/L) was detected in deep well JAX47-937-MW06D in November 2006. In the five shallow wells with significant arsenic concentrations, the arsenic appears to be decreasing in three of the wells (JAX47-MW01S, JAX47-MW02S, and JAX47-MW03S) and remaining steady or oscillating in the other two wells (JAX47-MW04S and JAX47-MW05S). Thus, there is some evidence that the arsenic concentrations are decreasing over time due to dilution and dispersion. There is no evidence to suggest that arsenic is expanding beyond the area that is identified as “Arsenic Hot Spot” in Figure 5-12. If the organics (particularly the BTEX compounds) degrade as fast as they appear to be (Table 6-3), then the shallow aquifer should become more oxidizing as time progresses. Presumably, higher redox conditions (i.e., higher ORP readings) would enable the arsenic species to convert from trivalent to pentavalent arsenic. This would cause the K_d of arsenic to increase substantially, thereby reducing its mobility. Based on the data collected from 2002 to 2007, arsenic has not migrated. The discussion above suggests that migration rates in the future will be even less than currently exists.

Aside from the former location of the pesticide mixing tank south of Building 937 and the former location of an AST south of the Pesticide Shop allegedly used for storage of a diesel-malathion mixture (“hot fogger”), current or former source areas of pesticide contamination cannot be traced to bulk storage or to a suspected sole point source(s). Instead, only isolated spill events, training exercises involving pesticide usage conducted over limited time periods, and temporary storage of pesticide compounds in 55-gallon drums, have been documented as possible sources of elevated pesticide concentrations in soil and groundwater at PSC 47. Consequently, the task of defining three-dimensional plume boundaries where pesticide compounds exceed regulatory criteria is essentially a “hit-and-miss” proposition in which the objective is to identify isolated areas where relatively small quantities of pesticides were disposed of or applied, either intentionally or by accident.

6.5 CONCEPTUAL MODEL OF CONTAMINANT MIGRATION

6.5.1 Northern Plume

The Northern Plume encompasses most of Building 536 and extends a short distance to the southeast (see Figure 9-5). The primary contaminants in this plume are pesticides, herbicides, and VOCs (chlorinated VOCs and BTEX). The plume originates near Building 536, which is suspected as being the source of the contaminants in shallow groundwater. Very low concentrations of some pesticides were detected in a single deep well (JAX47-MW13D) and these concentrations decreased between 2002 and 2006, so it appears that contamination is limited almost exclusively to the shallow zone. Pesticide concentrations of four of the six shallow wells in the plume area decreased over time. Concentrations in the two other wells increased slightly between 2002 and 2006. The concentrations of VOCs and SVOCs in this plume are relatively low.

6.5.2 Southern Plume

The Southern Plume is located beneath the western part of Building 937 and extends southward about 200 ft (see Figure 9-5). The overall plume encompasses groundwater contaminated with pesticides, herbicides, and VOCs. The smaller interior area labeled “Arsenic Hot Spot” on Figure 9-5 covers the smaller area of groundwater that is contaminated with arsenic. Concentrations of pesticides and VOCs are declining relatively rapidly over time, as a result of biodegradation, dilution, and dispersion. Significant concentrations of cis-1,2-DCE in the shallow zone is clear evidence that PCE and TCE are degrading in the shallow aquifer. The presence of BTEX and other fuel-related compounds in the plume is a strong booster for PCE and TCE biodegradation.

Elevated arsenic concentrations are found in a very limited portion of the shallow aquifer (circular area about 120 ft in diameter). In the five shallow wells with significant arsenic concentrations, the arsenic appears to be decreasing in three of the wells (JAX47-MW01S, JAX47-MW02S, and JAX47-MW03S) and remaining steady or oscillating in the other two wells (JAX47-MW04S and JAX47-MW05S). Thus, there is some evidence that the arsenic concentrations are decreasing over time due to dilution and dispersion. There is no evidence that arsenic is migrating to date.

Low redox conditions (currently present) are likely affecting the sorption and precipitation of arsenic via iron(III) oxides which are unstable under reducing conditions. In addition, redox transformations of arsenic, iron, and sulfur (all present at elevated levels) can be microbially mediated, thus, microbial activity can control reaction rates. Zones of microbial activity and reducing condition develop in aquifers over time and with distance from a source of reduced carbon (Resinger et al, 2005). This is important because arsenic is mobilized in iron and manganese reduction zones and sequestered in oxidation

zones. Site natural attenuation data collected in 2003 generally supports these arguments as low redox (-100 to 100 mV), slightly acidic pH (5.0 to 6.0 pH), low dissolved oxygen (less than 1.0 mg/L), elevated ferrous iron [Fe(II) (greater than 3.0 mg/L)], and proximity to former carbon source (former mixing tank) are present. This likely explains why the arsenic "hot spot" is isolated to such a small area. Any migration of arsenic from the "hot spot" would either be sorbed or precipitated as it migrated with groundwater flow into zones of higher oxidation. However, more current natural attenuation data is needed to confirm any such argument.

In the future, as organic compounds are depleted in the plume, the redox conditions of the shallow aquifer are expected to become more oxidizing. Under these conditions, the mobility of arsenic would be expected to be even less than it is currently, in which case arsenic-contaminated groundwater is not expected to migrate in any appreciable manner.

7.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

The baseline HHRA contained in this section was performed to characterize and quantify potential health risks at PSC 47 at the NAS Jacksonville in the absence of further remedial action. The results of the baseline HHRA are also used to focus the evaluation of remedial action alternatives, if action is required. The baseline HHRA consists of six major components:

- Data evaluation
- Exposure assessment
- Toxicity assessment
- Risk characterization
- Uncertainty analysis
- Remedial Goal Options (RGOs)

Methods for selection of COPCs to be evaluated quantitatively in the baseline HHRA, as well as those chemicals identified as COPCs for PSC 47, are described in Section 7.1, Data Evaluation. The data evaluation section is primarily concerned with the selection of COPCs that are representative of the type and magnitude of potential human health effects. The COPC screening process involves the comparison of maximum site concentrations to risk-based screening levels and other health-based standards. A brief discussion of data usability is also provided.

Potential receptor populations and exposure pathways by which receptors may come in contact with contaminants at the site are identified in Section 7.2, Exposure Assessment. Potential exposure routes under current and future land uses are developed from information on source area, chemical concentrations, chemical release mechanisms, patterns of human activity, and other pertinent information. A concise conceptual site model (CSM) illustrates the potential receptors and exposure pathways evaluated in the baseline risk assessment. The exposure assessment also includes the calculation of quantitative estimates of chemical intake for each identified receptor, pathway, and route of exposure under the reasonable maximum exposure (RME) scenario. Equations and relevant exposure input parameters used in estimating chemical intakes are provided.

The chemical-specific toxicity criteria for the identified COPCs, which are used in the quantification of potential human health risks, are presented in Section 7.3, Toxicity Assessment. These toxicity criteria, when integrated with the estimated chemical intakes developed in the exposure assessment, provide the basis for quantifying potential human health risks.

Methods used for characterizing risks associated with non-carcinogenic and carcinogenic effects for exposure to COPCs are provided in Section 7.4, Risk Characterization. Actual numerical results of the baseline HHRA for PSC 47 are summarized.

Because the quantitative risk estimates developed in the risk characterization are based on a number of assumptions (concerning exposure, land use, toxicity, etc.), various uncertainties are associated with the risk assessment process. A brief discussion of the uncertainties associated with the risk evaluation for PSC 47 is contained in Section 7.5, Uncertainty Analysis.

Site-specific risk-based PRGs for those chemicals with cancer risks and/or hazard indices (HIs) that exceed USEPA target levels are presented in Section 7.6, Remedial Goal Options.

To assess potential public health risks, four major aspects of chemical contamination and exposure must be considered: (1) contaminants with toxic characteristics must be found in environmental media; (2) the contaminants must be released by either natural processes or by human action; (3) potential exposure points must exist; and (4) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure; without one of the factors listed above, there is no risk.

An illustration of the baseline HHRA process is provided in Figure 7-1.

The baseline HHRA for PSC 47 was conducted using the most recent guidance from the USEPA (USEPA, 1989, 1991, 1997b, and 2004a), including Regional Supplemental Guidance (USEPA Region IV, 2000a) and also considers FDEP guidance.

7.1 DATA EVALUATION

Data evaluation is a site-specific task that uses a variety of information to determine which of the detected chemicals at a site are most likely to present a risk to potential human receptors. The end result of this qualitative selection process is a list of COPCs for each environmental medium under consideration. Subsection 7.1.1 provides a brief summary of data usability, as it pertains to the baseline HHRA. The selection of COPCs for the site is contained in Subsection 7.1.2.

7.1.1 Data Usability

All sample data collected for PSC 47 were used to assess potential human health risks. The qualification of data during the formal data validation process is not expected to compromise the results of the baseline HHRA. Analytical data qualified as estimated were utilized, even though the reported positive concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated

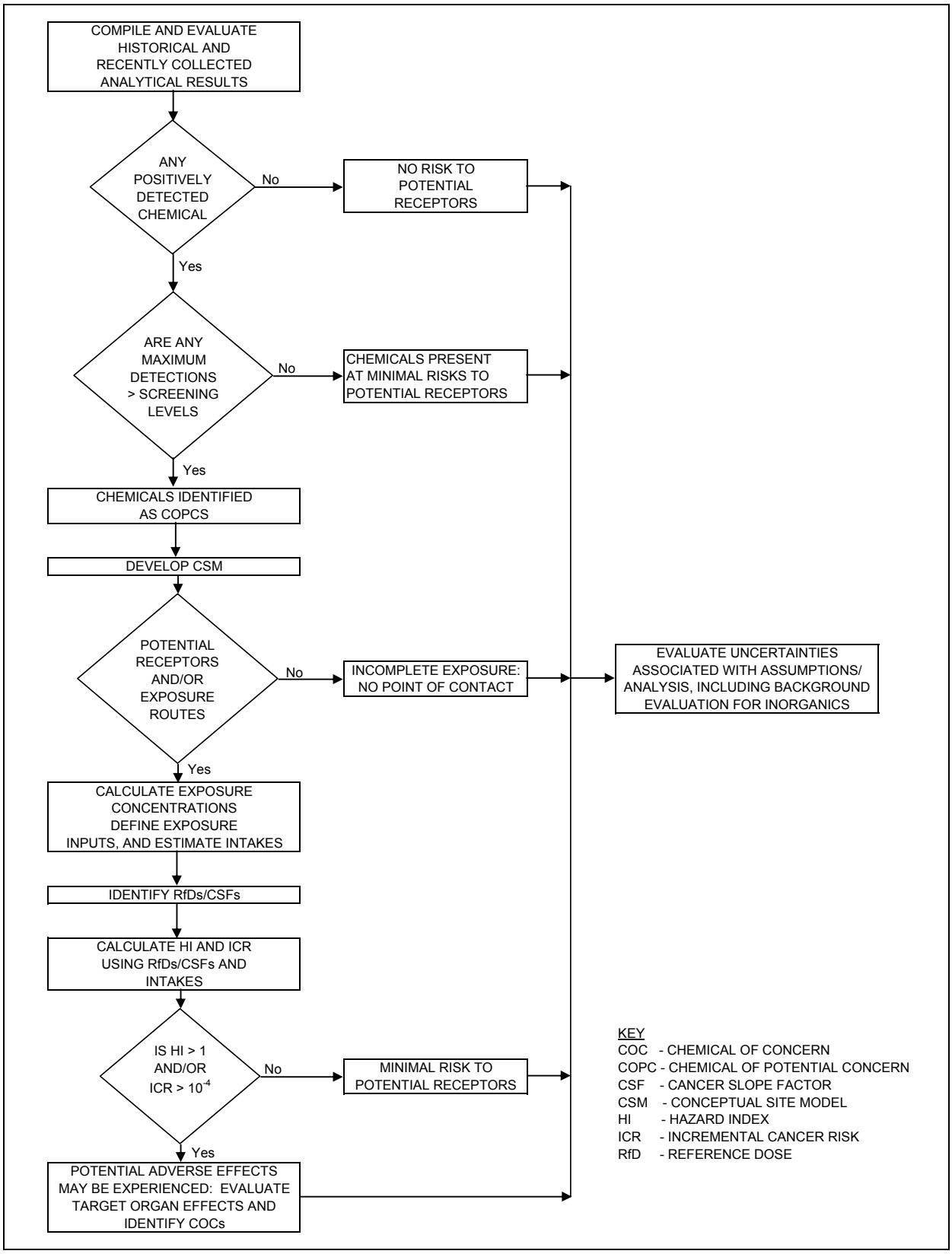

FIGURE 7-1

SUMMARY OF HUMAN HEALTH RISK ASSESSMENT PROCESS
POTENTIAL SOURCE OF CONTAMINATION 47
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

data adds to the uncertainty associated with the risk assessment; however, the associated uncertainty is expected to be negligible compared to the other uncertainties inherent in the risk evaluation process (i.e., uncertainties with land uses, exposure scenarios, toxicological criteria, etc.).

7.1.2 Selection of COPCs

The overall goal of the baseline HHRA is to quantify risks associated with those chemicals that represent a potentially significant human health hazard on the basis of toxicity, environmental concentration, and mobility. USEPA guidance (USEPA, 1989 and USEPA, 2000a) recommends focusing the baseline risk assessment by quantifying risk only for a select list of COPCs at a site. These chemicals, which are a subset of all detected chemicals in a given medium, are defined as those chemicals likely to dominate the overall potential risks for a site.

Several types of screening levels were used to identify COPCs for PSC 47. Screening concentrations based on USEPA Region 9 PRGs (USEPA, 2004b) were used, as well as other FDEP and USEPA criteria. The risk-based screening concentrations correspond to a systemic Hazard Quotient (HQ) of 0.1 (for non-carcinogens) or a lifetime cancer risk of 1×10^{-6} (for carcinogens). Note that the Region 9 PRGs are based on a HQ of 1.0 and the screening concentrations are based on a HQ of 0.1. Conservatively, PRGs used as screening levels for non-carcinogenic chemicals have been divided by a factor of 10 to further account for the potential cumulative effects of several chemicals affecting the same target organ or producing the same adverse non-carcinogenic health effect. The screening levels used for each medium in the risk assessment are briefly discussed below.

Soil

The following criteria were used to select COPCs for soil (surface and subsurface soil):

- USEPA Region 9 PRGs for Residential Soil (USEPA, 2004b)
- USEPA generic soil screening levels (SSLs) for migration to groundwater (USEPA, 2007a)
- USEPA generic SSLs for transfers from soil to air (USEPA, 2007a)
- FDEP SCTLs for residential exposures to soil (FDEP, 2005)
- FDEP SCTLs for migration to groundwater (FDEP, 2005)

USEPA SSLs and FDEP SCTLs for transfers from soil to groundwater were not used for COPC selection, but were presented to allow a qualitative evaluation of the potential for chemical migration from soil to groundwater. Chemicals with concentrations exceeding these SSLs and FDEP SCTLs may potentially migrate from the soil to groundwater in sufficient quantities to pose concerns about groundwater quality.

Site soil data are compared to USEPA generic SSLs for transfers from soil to air to identify whether a quantitative analysis of this exposure pathway is warranted. If the maximum soil concentration of a chemical exceeds the SSL, a quantitative evaluation of potential risks from inhalation is performed. Otherwise, the risks associated with the inhalation pathway are considered insignificant, and the exposure pathway is eliminated from further evaluation.

Because of the different exposure scenarios for potential human receptors, COPCs are identified separately for surface and subsurface soil. Surface soil is defined as soil collected from 0 to 1 ft bls and subsurface soil is defined as soil collected from depths greater than 1 ft bls.

Groundwater

The following criteria were used to select COPCs for groundwater:

- USEPA Region 9 PRGs for tap water (USEPA, 2004b)
- FDEP GCTLs, (FDEP, 2005)
- USEPA MCLs (USEPA, 2006)
- USEPA Generic Screening Levels for Evaluating the Vapor Intrusion to Indoor Air (USEPA, 2002a)

If the maximum concentration of a constituent exceeds any of these criteria, the chemical was selected as a COPC and carried through to the quantitative risk assessment.

The essential nutrients, calcium, magnesium, potassium, and sodium, were not identified as COPCs. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses. In addition, because of the lack of toxicity criteria, risk-based COPC screening levels are not available for some compounds (e.g., benzo(g,h,i)perylene, phenanthrene, alpha and gamma-chlordane, delta-BHC, endosulfan, endrin aldehyde, and endrin ketone). Surrogates were selected for these chemicals based on similar chemical structures. In the COPC screening, pyrene was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene, chlordane was selected as a surrogate for alpha- and gamma-chlordane, endosulfan was selected as a surrogate for endosulfan sulfate, and endrin was selected as a surrogate for endrin aldehyde and endrin ketone.

Individual chemicals were eliminated as COPCs if they were detected at a frequency less than 5 percent in any given medium, but only if there were no other indications that the chemical would pose an unacceptable risk to receptors (i.e., there is no evidence of a contaminant “hot spot”).

Maximum detected concentrations (in a single sample) in each sample medium for PSC 47 were compared to the risk-based and health-based screening criteria. If the maximum concentration exceeded

any of the screening criteria, that chemical was retained as a COPC for all significant exposures involving that medium. For example, if arsenic was retained for soil, this chemical was evaluated as a COPC for both ingestion and dermal exposure routes. If none of the chemicals detected in a medium exceeded screening criteria, that medium was dropped from further consideration and the potential risks associated with exposure to that medium are regarded as relatively insignificant.

Tables 7-1 and 7-2 summarize the screening criteria used in the selection of COPCs. The results for the selection process are provided in the remainder of this section.

7.1.2.1 Surface Soil

Chemicals detected in surface soil samples from PSC 47 included: 3 VOCs, 14 SVOCs, 20 pesticides/PCBs, and arsenic. A comparison of the maximum detected concentrations to the risk-based screening levels for direct contact exposures is presented in Table 7-3. The following chemicals were detected at maximum concentrations in surface soil that exceeded the direct contact risk-based COPC screening levels and were retained as COPCs for surface soil at PSC 47.

- SVOCs [benzo(a)pyrene and dibenzo(a,h)anthracene]
- Pesticides/PCBs (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, dieldrin, gamma-chlordane, heptachlor, and heptachlor epoxide)
- Arsenic

A comparison of the maximum detected surface soil concentrations to USEPA SSLs for chemical migration from soil to air (when available) is also presented in Table 7-3. Concentrations reported for all chemicals were less than the screening criteria for migration from soil to air with the exception of 4,4'-DDT and dieldrin. Therefore, 4,4'-DDT and dieldrin were retained as COPCs for migration from surface soil to air at PSC 47.

A comparison of the maximum detected surface soil concentrations to USEPA SSLs for chemical migration from soil to groundwater is presented in Table 7-4. The following chemicals were detected in surface soil at maximum concentrations exceeding the COPC screening levels for migration from soil to groundwater and were retained as COPCs for surface soil at the PSC 47.

- Pesticides/PCBs (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, alpha-chlordane, beta-BHC, dieldrin, endrin, gamma-BHC, gamma-chlordane, and heptachlor epoxide)
- Arsenic

Table 7-1
Screening Criteria Used in Selection of COPCs - Soil

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical	USEPA Region IX PRG [1] Residential (ug/kg)	USEPA SSL [2] Soil to Air (ug/kg)	USEPA SSL [2] Soil to Groundwater (ug/kg)	FDEP [3] Soil Residential (ug/kg)	FDEP [3] Soil Leachability (ug/kg)
Volatile Organic Compounds (ug/kg)					
2-Butanone	22,000,000 N	24,000,000 sat	89,000 N	16,000,000	17,000
Acetone	14,000,000 N	NA	130,000 N	11,000,000	25,000
Methylene Chloride	9,100 C	13,000 C	23 C	17,000	20
Toluene	520,000 sat	650,000 sat	12,000 MCL	7,500,000	500
Semivolatile Organic Compounds (ug/kg)					
Benzo(a)anthracene	620 C	NA	3,200 C	[9]	800
Benzo(a)pyrene	62 C	NA	8,200 MCL	100	8,000
Benzo(b)fluoranthene	620 C	NA	9,800 C	[9]	2,400
Benzo(g,h,i)perylene	2,300,000 N[4]	NA	NA	2,500,000	32,000,000
Benzo(k)fluoranthene	6,200 C	NA	9,800 C	[9]	24,000
Bis(2-ethylhexyl)phthalate	35,000 C	NA	3,600,000 MCL	72,000	3,600,000
Butyl benzyl phthalate	12,000,000 N	NA	17,000,000 N	17,000,000	310,000
Chrysene	62,000 C	NA	3,200 C	[9]	77,000
Dibenzo(a,h)anthracene	62 C	NA	30,000 C	[9]	700
Dimethyl phthalate	100,000,000 max	NA	NA	690,000,000	380,000
Fluoranthene	2,300,000 N	NA	6,300,000 N	3,200,000	1,200,000
Indeno(1,2,3-cd)pyrene	620 C	NA	28,000 C	[9]	6,600
Phenanthrene	2,300,000 N[4]	NA	NA	22,000	250,000
Pyrene	2,300,000 N	NA	4,600,000 N	2,400,000	880,000
Pesticides/PCBs (ug/kg)					
4,4'-DDD	2,400 C	NA	14,000 C	4,200	5,800
4,4'-DDE	1,700 C	NA	45,000 C	2,900	18,000
4,4'-DDT	1,700 C	750,000 C	26,000 C	2,900	11,000
Aldrin	29 C	3,400 C	500 C	60	200
Alpha-BHC	90 C	750 C	0.72 C	100	0.3
Alpha-Chlordane	1,600 C[5]	72,000 C	9,600 MCL	2,800[5]	9,600[5]
Beta-BHC	320 C	6,000 C	2.6 C	500	1
Delta-BHC	90 C[6]	NA	NA	24,000	200
Dieldrin	30 C	1,100 C	5 C	60	2
Endosulfan I	370,000 N[7]	NA	NA	450,000[7]	3,800[7]
Endosulfan II	370,000 N[7]	NA	NA	450,000[7]	3,800[7]
Endosulfan Sulfate	370,000 N[7]	NA	NA	450,000[7]	3,800[7]
Endrin	18,000 N	NA	990 MCL	25,000	1,000
Endrin Aldehyde	18,000 N[8]	NA	NA	NA	NA
Endrin Ketone	18,000 N[8]	NA	NA	NA	NA
Gamma-BHC	440 C	NA	9.4 MCL	700	9
Gamma-Chlordane	1,600 C[5]	72,000 C	9,600 MCL	2,800[5]	9,600[5]
Heptachlor	110 C	4,100 C	23,000 MCL	200	23,000
Heptachlor Epoxide	53 C	4,700 C	670 MCL	100	600
Methoxychlor	310,000 N	NA	160,000 MCL	420,000	160,000
Inorganics (mg/kg)					
Arsenic	0.39 C	769 C	5.8 MCL	2.1	[10]

Table 7-1
Screening Criteria Used in Selection of COPCs - Soil

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Notes:
1 - USEPA Region 9 Preliminary Remedial Goal Table, October 1, 2004. (Cancer benchmark value = 1E-06, HI = 1.0)
2 - EPA Soil Screening Levels. EPA Internet Site at http://rais.ornl.gov/epa/ssl1.shtml.
The soil-to-groundwater SSLs value represents a DAF of 20.
3 - Soil Cleanup Target Levels (SCTLs) for Chapter 62-777, F.A.C., Florida Department of Environmental Protection (FDEP), April 2005.
4 - Value is for pyrene.
5 - Value is for chlordane.
6 - Value is for alpha-BHC.
7 - Value is for endosulfan.
8 - Value is for endrin.
9 - Chemical concentration must be converted to benzo(a)pyrene equivalents before comparison to SCTL for benzo(a)pyrene.
10 - Leachability values may be derived using the SPLP Test to calculate site-specific SCTLs.

Definitions:	MCL = Maximum Contaminant Level
NA = Not Available	PRG = Preliminary Remedial Goal
C = Carcinogenic	SSL = Soil Screening Level
N = Non-Carcinogenic	FDEP = Florida Department of Environmental Protection
sat = saturation concentration	FAC = Florida Administrative Code

Table 7-2
Screening Criteria Used in Selection of COPCs - Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical	USEPA Region IX PRG [1] Tap Water (ug/L)	FDEP [2] Groundwater (ug/L)	USEPA MCL [3] (ug/L)	USEPA Groundwater to Indoor Air[4] (ug/L)
Volatile Organic Compounds				
1,1-Dichloroethane	810 N	70	NA	2,200 N
1,1-Dichloroethene	340 N	7	7	190 N
1,2,4-Trichlorobenzene	7.2 N	70	70	3,400 N
1,2-Dibromo-3-Chloropropane	0.35 N[5]	200	NA	33 N
1,2-Dichlorobenzene	370 N	600	600	2,600 N
1,3-Dichlorobenzene	180 N	0.2	NA	830 N
1,4-Dichlorobenzene	0.5 C	75	75	8,200 N
2-Butanone	7,000 N	4,200	NA	440,000 N
Benzene	0.35 C	1	5	5 MCL
Bromoform	8.5 C	4.4	80	0.0083 C
Chlorobenzene	110 N	100	100	390 N
Chloroethane	4.6 C	12	NA	2 C
Chloroform	0.17 N	70	80	80 MCL
cis-1,2-Dichloroethene	61 N	70	70	210 N
Cyclohexane	10,000 N	NA	NA	NA
Diethyl Ether	1,200 N	750	NA	520 N
Ethylbenzene	1,300 N	30	700	700 MCL
Isopropylbenzene	660 N	0.8	NA	8 N
Methyl Cyclohexane	5,200 N	NA	NA	710 N
Methyl Tert-Butyl Ether	11 C	20	NA	120,000 C
Styrene	1,600 N	100	100	8,900 N
Tetrachloroethene	0.1 C	3	5	5 MCL
Toluene	720 N	40	1,000	1,500 N
Total Xylenes	210 N	20	10,000	22,000 N
Trans-1,2-Dichloroethene	120 N	1	100	180 N
Trichloroethene	0.028 C	3	5	5 MCL
Vinyl Chloride	0.02 C	1	2	2 MCL
Semivolatile Organic Compounds				
1,1-Biphenyl	300 N	0.5	NA	NA
2,4,5-Trichlorophenol	3600 N	1	NA	NA
2,4-Dichlorophenol	110 N	0.3	NA	NA
2,4-Dimethylphenol	730 N	140	NA	NA
2-Methylnaphthalene	6.2 N[6]	28	NA	3,300 N
2-Methylphenol	1,800 N	35	NA	NA
Diethyl Phthalate	29,000 N	5,600	NA	NA
Naphthalene	6.2 N	14	NA	150 N
Pentachlorophenol	0.56 C	1	1	NA
Pesticides/PCBs				
4,4'-DDD	0.28 C	0.1	NA	NA
4,4'-DDE	0.2 C	0.1	NA	29 C
4,4'-DDT	0.2 C	0.1	NA	NA
Aldrin	0.004 C	0.002	NA	0.071 C
Alpha-BHC	0.011 C	0.006	NA	3.1 C
Alpha-Chlordane	0.19 C[7]	2[7]	2[7]	12 C[7]
Beta-BHC	0.037 C	0.02	NA	NA
Delta-BHC	0.011 C[8]	2.1	NA	NA
Dieldrin	0.0042 C	0.002	NA	0.86 C
Endosulfan I	220 N[9]	42[9]	NA	NA
Endosulfan II	220 N[9]	42[9]	NA	NA
Endosulfan Sulfate	220 N[9]	42[9]	NA	NA
Endrin	11 N	2	2	NA
Endrin Aldehyde	11 N[10]	2[10]	NA	NA
Endrin Ketone	11 N[10]	2[10]	NA	NA

Table 7-2
Screening Criteria Used in Selection of COPCs - Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical	USEPA Region IX PRG [1] Tap Water (ug/L)	FDEP [2] Groundwater (ug/L)	USEPA MCL [3] (ug/L)	USEPA Groundwater to Indoor Air[4] (ug/L)
gamma-BHC (Lindane)	0.052 C	0.2	0.2	11 C
gamma-Chlordane	0.19 C[7]	2[7]	2[7]	12 C[7]
Heptachlor	0.015 C	0.4	0.4	0.4 MCL
Heptachlor Epoxide	0.0074 C	0.2	0.2	NA
Methoxychlor	180 N	40	40	NA
Inorganics				
Arsenic	0.045 C	10	10	NA

Notes:
1 - USEPA Region IX Preliminary Remedial Goal Table, October 2004.
(Cancer benchmark value = 1E-06, HI = 1.0)
2 - FAC 62-777
3 - 2006 Edition of the Drinking Water Standards and Health Advisories, USEPA (EPA 822-R-06-013).
4 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052. Values are from Table 2c. (Cancer benchmark = 1E-6 or HI =1.0).
5 - One tenth of the noncarcinogenic PRG is less than the carcinogenic PRG, therefore the noncarcinogenic PRG is presented.
6 - Value is for naphthalene.
7 - Value is for chlordane.
8 - Value is for alpha-BHC.
9 - Value is for endosulfan
10 - Value is for endrin

Definitions:
NA = Not Available
C = Carcinogenic
N = Non-Carcinogenic
PRG = Risk-Based Concentration
FDEP = Florida Department of Environmental Protection
MCL = Maximum Contaminant Level

Table 7-3
Occurrence, Distribution, and Selection of COPCs
Surface Soil - Direct Contact Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Location of Maximum Concentration	Detection Frequency[2]	Range of Nondetects[3]	Concentration Used for Screening[4]	Background Value[5]	Risk-Based COPC Screening Level[6]	Potential ARAR/TBC Value	Potential ARAR/TBC Source[7]	USEPA SSL Soil to Air[8]	COPC Flag[9]	Rationale for Contaminant Deletion or Selection
Volatile Organics Compounds															
78-93-3	2-Butanone	12	77	µg/kg	JAX47-SB001	3/4	1.4 - 1.4	77	NA	2,200,000 N	16,000,000	FDEP	24,000,000 sat	No	BSL
67-64-1	Acetone	23.7 J	23.7 J	µg/kg	JAX47-SB118	1/4	6 - 22	23.7	NA	1,400,000 N	11,000,000	FDEP	NA	No	BSL
75-09-2	Methylene Chloride	5.6 J	20 J	µg/kg	JAX47-SB001	4/4	-	20	NA	9,100 C	17,000	FDEP	13,000 C	No	BSL
SemivolatileOrganicsCompounds															
	BaP Equivalent	190	640	µg/kg	JAX47-SB001	2/4	127 - 360	640	NA	**62 C**	**100**	FDEP	NA	**Yes**	ASL
56-55-3	Benzo(a)anthracene	120 J	230 J	µg/kg	JAX47-SB001	2/4	170 - 360	230	NA	620 C	1,000	FDEP	NA	No	BSL
50-32-8	**Benzo(a)pyrene**	130 J	380 J	µg/kg	JAX47-SB001	2/4	127 - 360	380	NA	**62 C**	**100**	FDEP	NA	**Yes**	ASL
205-99-2	Benzo(b)fluoranthene	120 J	560 J	µg/kg	JAX47-SB001	2/4	120 - 360	560	NA	620 C	1,000	FDEP	NA	No	BSL
191-24-2	Benzo(g,h,i)perylene	67 J	420 J	µg/kg	JAX47-SB001	2/4	152 - 360	420	NA	230,000 N[10]	2,500,000	FDEP	NA	No	BSL
207-08-9	Benzo(k)fluoranthene	140 J	410 J	µg/kg	JAX47-SB001	2/4	145 - 360	410	NA	6,200 C	10,000	FDEP	NA	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	130 J	1400	µg/kg	JAX47-SB001	2/4	221 - 360	1400	NA	35,000 C	72,000	FDEP	NA	No	BSL
85-68-7	Butyl Benzyl Phthalate	35 J	360 J	µg/kg	JAX47-SB001	2/4	137 - 360	360	NA	1,200,000 N	17,000,000	FDEP	NA	No	BSL
218-01-9	Chrysene	150 J	480 J	µg/kg	JAX47-SB001	2/4	148 - 360	480	NA	62,000 C	100,000	FDEP	NA	No	BSL
53-70-3	**Dibenzo(a,h)anthracene**	28 J	140 J	µg/kg	JAX47-SB001	2/4	210 - 360	140	NA	**62 C**	**100**	FDEP	NA	**Yes**	ASL
131-11-3	Dimethyl Phthalate	340 J	340 J	µg/kg	JAX47-SB001	1/4	123 - 430	340	NA	61,000 N	690,000,000	FDEP	NA	No	BSL
206-44-0	Fluoranthene	93 J	530 J	µg/kg	JAX47-SB001	2/4	153 - 360	530	NA	230,000 N	3,200,000	FDEP	NA	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	76 J	400 J	µg/kg	JAX47-SB001	2/4	206 - 360	400	NA	620 C	1,000	FDEP	NA	No	BSL
85-01-8	Phenanthrene	21 J	160 J	µg/kg	JAX47-SB001	2/4	153 - 360	160	NA	230,000 N[10]	22,000	FDEP	NA	No	BSL
129-00-0	Pyrene	120 J	520 J	µg/kg	JAX47-SB001	2/4	159 - 360	520	NA	230,000 N	2,400,000	FDEP	NA	No	BSL
Pesticides/PCBs															
72-54-8	**4,4'-DDD**	0.63 J	17000 J	µg/kg	JAX47-SB096	76/130	0 - 10000	17000	NA	**2,400 C**	**4,200**	FDEP	NA	**Yes**	ASL
72-55-9	**4,4'-DDE**	0.37 J	28000	µg/kg	JX01216	115/130	0.34 - 12.5	28000	NA	**1,700 C**	**2,900**	FDEP	NA	**Yes**	ASL
50-29-3	**4,4'-DDT**	0.33 J	2700000 J	µg/kg	JAX47-SB096	110/130	0.18 - 12.5	2700000	NA	**1,700 C**	**2,900**	FDEP	**750,000** C	**Yes**	ASL
309-00-2	Aldrin	0.31 J	13.9	µg/kg	JAX47-SB029	3/130	0.2 - 5300	13.9	NA	29 C	60	FDEP	3,400 C	No	BSL
319-84-6	alpha-BHC	0.18 J	3.7 J	µg/kg	JAX47-SB096	12/130	0.13 - 5300	3.7	NA	90 C	100	FDEP	750 C	No	BSL
5103-71-9	**alpha-Chlordane**	0.33 J	50000 J	µg/kg	JAX47-SB094	47/130	0.27 - 2300	50000	NA	**1,600 C[11]**	**2,800[11]**	FDEP	72,000 C	**Yes**	ASL
319-85-7	beta-BHC	0.37 J	110 J	µg/kg	JAX47-SB089	23/130	0.34 - 5300	110	NA	320 C	500	FDEP	6,000 C	No	BSL
319-86-8	delta-BHC	0.34 J	82.5	µg/kg	JAX47-SB025	16/130	0.17 - 5300	82.5	NA	90 C[12]	24,000	FDEP	NA	No	BSL
60-57-1	**Dieldrin**	0.29 J	3400	µg/kg	JAX47-SB050, JAX47-SB106	59/130	0.24 - 4400	3400	NA	**30 C**	**60**	FDEP	**1,100** C	**Yes**	ASL
959-98-8	Endosulfan I	7.2	400 J	µg/kg	JAX47-SB094	3/130	0.27 - 5300	400	NA	37,000 N[13]	450,000[13]	FDEP	NA	No	BSL
33213-65-9	Endosulfan II	1.3 J	220 J	µg/kg	JAX47-SB087	7/130	0.23 - 10000	220	NA	37,000 N[13]	450,000[13]	FDEP	NA	No	BSL
1031-07-8	Endosulfan Sulfate	0.33 J	200	µg/kg	JAX47-SB011	23/130	0.27 - 10000	200	NA	37,000 N[13]	450,000[13]	FDEP	NA	No	BSL
72-20-8	Endrin	0.61 J	1400	µg/kg	JAX47-SB094	28/130	0.37 - 10000	1400	NA	1,800 N	25,000	FDEP	NA	No	BSL
7421-93-4	Endrin Aldehyde	0.24 J	130 J	µg/kg	JAX47-SB096	18/130	0.17 - 10000	130	NA	1,800 N[14]	NA	FDEP	NA	No	BSL
53494-70-5	Endrin Ketone	0.31 J	127.9	µg/kg	JAX47-SB024	17/130	0.3 - 10000	127.9	NA	1,800 N[14]	NA	FDEP	NA	No	BSL
58-89-9	gamma-BHC (Lindane)	0.28 J	210	µg/kg	JX01285	13/130	0.17 - 5300	210	NA	440 C	NA	FDEP	NA	No	BSL
5103-74-2	**gamma-Chlordane**	0.34 J	37000	µg/kg	JAX47-SB094	59/130	0.23 - 2300	37000	NA	**1,600 C[11]**	**2,800[11]**	FDEP	72,000 C	**Yes**	ASL

Table 7-3
Occurrence, Distribution, and Selection of COPCs
Surface Soil - Direct Contact Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Location of Maximum Concentration	Detection Frequency(2)	Range of Nondetects(3)	Concentration Used for Screening(4)	Background Value(5)	Risk-Based COPC Screening Level(6)		Potential ARAR/TBC Value	Potential ARAR/TBC Source(7)	USEPA SSL Soil to Air(8)	COPC Flag(9)	Rationale for Contaminant Deletion or Selection
76-44-8	**Heptachlor**	0.24 J	3400 J	µg/kg	JAX47-SB096	23/130	0.23 - 5300	3400	NA	**110**	**C**	**200**	FDEP	4,100 C	**Yes**	ASL
1024-57-3	**Heptachlor Epoxide**	0.82 J	920 J	µg/kg	JAX47-SB094	30/130	0.57 - 5300	920	NA	**53**	**C**	**100**	FDEP	4,700 C	**Yes**	ASL
72-43-5	Methoxychlor	0.45 J	210 J	µg/kg	JAX47-SB096	24/130	0.34 - 53000	210	NA	31,000	N	420,000	FDEP	NA	No	BSL
Inorganics																
7440-38-2	**Arsenic**	0.2	47.4	mg/kg	JAX47-SB103	27/54	0.2 - 2.2	47.4	NA	**0.39**	**C**	**2.1**	FDEP	769 C	**Yes**	ASL

Footnotes
1- Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Sample and duplicate are counted as one sample when determining frequency of detection.
3 - Values presented are sample-specific quantitation limits.
4 - The maximum detected concentration is used for screening purposes.
5 - Value presented is twice the mean concentration.
6 - The risk-based COPC screening level for residential exposures to soil is presented. The value is based on a target Hazard Quotient of 0.1 for non-carcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (USEPA, Region 9, October 2004). The RBCs for non-carcinogenic compounds are divided by 10.
7 - Soil Cleanup Target Levels taken from Table II, FAC 62-777 (FDEP, February 2005).
8 - USEPA Soil Screening Levels. USEPA Internet Site at http://risk.lsd.ornl.gov/calc_start.htm (SSLs for non-carcinogens are divided by 10).
9 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or ARAR/TBC(s) and background levels.
10 - Value is for pyrene.
11 - Value is for chlordane.
12 - Value is for alpha-BHC.
13 - Value is for endosulfan.
14 - Value is for endrin.

Shading indicates that the maximum detected concentration exceeded the screening criteria; therefore, the chemical was retained as a COPC.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value with undetermined bias
N = Non-carcinogen
NA = Not Applicable/Not Available
max = ceiling limit
sat = soil saturation limit
SSL = Soil Screening Level

Rationale Codes:
For selection as a COPC
ASL = Above COPC Screening Level/ARAR/TBC

For elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC

Table 7-4
Occurrence, Distribution, and Selection of COPCs
Surface Soil - Migration to Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Location of Maximum Concentration	Detection Frequency[2]	Range of Nondetects[3]	Concentration Used for Screening[4]	Background Value[5]	USEPA SSL Soil to Groundwater[6]	Potential ARAR/TBC Value	Potential ARAR/TBC Source[7]	COPC Flag[8]	Rationale for Contaminant Deletion or Selection
Volatile Organic Compounds														
78-93-3	2-Butanone	12	77	µg/kg	JAX47-SB001	3/4	1.4 - 1.4	77	NA	89000 N	17000	FDEP	No	BSL
67-64-1	Acetone	23.7 J	23.7 J	µg/kg	JAX47-SB118	1/4	6 - 22	23.7	NA	130000 N	25000	FDEP	No	BSL
75-09-2	Methylene Chloride	5.6 J	20 J	µg/kg	JAX47-SB001	4/4	-	20	NA	23 C	20	FDEP	No	BSL
SemivolatileOrganicsCompounds														
	BaP Equivalent	190	640	µg/kg	JAX47-SB001	2/4	127 - 360	640	NA	8200 MCL	8000	FDEP	No	BSL
56-55-3	Benzo(a)anthracene	120 J	230 J	µg/kg	JAX47-SB001	2/4	170 - 360	230	NA	3200 C	800	FDEP	No	BSL
50-32-8	Benzo(a)pyrene	130 J	380 J	µg/kg	JAX47-SB001	2/4	127 - 360	380	NA	8200 MCL	8000	FDEP	No	BSL
205-99-2	Benzo(b)fluoranthene	120 J	560 J	µg/kg	JAX47-SB001	2/4	120 - 360	560	NA	9800 C	2400	FDEP	No	BSL
191-24-2	Benzo(g,h,i)perylene	67 J	420 J	µg/kg	JAX47-SB001	2/4	152 - 360	420	NA	NA	32000000	FDEP	No	BSL
207-08-9	Benzo(k)fluoranthene	140 J	410 J	µg/kg	JAX47-SB001	2/4	145 - 360	410	NA	9800 C	24000	FDEP	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	130 J	1400	µg/kg	JAX47-SB001	2/4	221 - 360	1400	NA	3600000 MCL	3600000	FDEP	No	BSL
85-68-7	Butyl Benzyl Phthalate	35 J	360 J	µg/kg	JAX47-SB001	2/4	137 - 360	360	NA	17000000 N	310000	FDEP	No	BSL
218-01-9	Chrysene	150 J	480 J	µg/kg	JAX47-SB001	2/4	148 - 360	480	NA	3200 C	77000	FDEP	No	BSL
53-70-3	Dibenzo(a,h)anthracene	28 J	140 J	µg/kg	JAX47-SB001	2/4	210 - 360	140	NA	30000 C	700	FDEP	No	BSL
131-11-3	Dimethyl Phthalate	340 J	340 J	µg/kg	JAX47-SB001	1/4	123 - 430	340	NA	NA	380000	FDEP	No	BSL
206-44-0	Fluoranthene	93 J	530 J	µg/kg	JAX47-SB001	2/4	153 - 360	530	NA	6300000 N	1200000	FDEP	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	76 J	400 J	µg/kg	JAX47-SB001	2/4	206 - 360	400	NA	28000 C	6600	FDEP	No	BSL
85-01-8	Phenanthrene	21 J	160 J	µg/kg	JAX47-SB001	2/4	153 - 360	160	NA	NA	250000	FDEP	No	BSL
129-00-0	Pyrene	120 J	520 J	µg/kg	JAX47-SB001	2/4	159 - 360	520	NA	4600000 N	880000	FDEP	No	BSL
Pesticides/PCBs														
72-54-8	**4,4'-DDD**	0.63 J	17000 J	µg/kg	JAX47-SB096	76/130	0 - 10000	17000	NA	**14000 C**	**5800**	FDEP	**Yes**	ASL
72-55-9	**4,4'-DDE**	0.37 J	28000	µg/kg	JX01216	115/130	0.34 - 12.5	28000	NA	45000 C	**18000**	FDEP	**Yes**	ASL
50-29-3	**4,4'-DDT**	0.33 J	2700000 J	µg/kg	JAX47-SB096	110/130	0.18 - 12.5	2700000	NA	**26000 C**	**11000**	FDEP	**Yes**	ASL
309-00-2	Aldrin	0.31 J	13.9	µg/kg	JAX47-SB029	3/130	0.2 - 5300	13.9	NA	500 C	200	FDEP	No	BSL
319-84-6	**alpha-BHC**	0.18 J	3.7 J	µg/kg	JAX47-SB096	12/130	0.13 - 5300	3.7	NA	**0.72 C**	**0.3**	FDEP	**Yes**	ASL
5103-71-9	**alpha-Chlordane**	0.33 J	50000 J	µg/kg	JAX47-SB094	47/130	0.27 - 2300	50000	NA	**9600[9] MCL**	**9600[9]**	FDEP	**Yes**	ASL
319-85-7	**beta-BHC**	0.37 J	110 J	µg/kg	JAX47-SB089	23/130	0.34 - 5300	110	NA	**2.6 C**	**1**	FDEP	**Yes**	ASL
319-86-8	delta-BHC	0.34 J	82.5	µg/kg	JAX47-SB025	16/130	0.17 - 5300	82.5	NA	NA	200	FDEP	No	BSL
60-57-1	**Dieldrin**	0.29 J	3400	µg/kg	7-SB050, JAX47-S	59/130	0.24 - 4400	3400	NA	**4.6 C**	**2**	FDEP	**Yes**	ASL
959-98-8	Endosulfan I	7.2	400 J	µg/kg	JAX47-SB094	3/130	0.27 - 5300	400	NA	NA	3,800	FDEP	No	BSL
33213-65-9	Endosulfan II	1.3 J	220 J	µg/kg	JAX47-SB087	7/130	0.23 - 10000	220	NA	NA	3,800	FDEP	No	BSL
1031-07-8	Endosulfan Sulfate	0.33 J	200	µg/kg	JAX47-SB011	23/130	0.27 - 10000	200	NA	NA	3,800	FDEP	No	BSL
72-20-8	**Endrin**	0.61 J	1400	µg/kg	JAX47-SB094	28/130	0.37 - 10000	1400	NA	**990 MCL**	**1000**	FDEP	**Yes**	ASL
7421-93-4	Endrin Aldehyde	0.24 J	130 J	µg/kg	JAX47-SB096	18/130	0.17 - 10000	130	NA	NA	NA	FDEP	No	NTX
53494-70-5	Endrin Ketone	0.31 J	127.9	µg/kg	JAX47-SB024	17/130	0.3 - 10000	127.9	NA	NA	NA	FDEP	No	NTX
58-89-9	**gamma-BHC (Lindane)**	0.28 J	210	µg/kg	JX01285	13/130	0.17 - 5300	210	NA	**9.4 MCL**	**9**	FDEP	**Yes**	ASL
5103-74-2	**gamma-Chlordane**	0.34 J	37000	µg/kg	JAX47-SB094	59/130	0.23 - 2300	37000	NA	**9600[9] MCL**	**9600[9]**	FDEP	**Yes**	ASL
76-44-8	Heptachlor	0.24 J	3400 J	µg/kg	JAX47-SB096	23/130	0.23 - 5300	3400	NA	23000 MCL	23000	FDEP	No	BSL
1024-57-3	**Heptachlor Epoxide**	0.82 J	920 J	µg/kg	JAX47-SB094	30/130	0.57 - 5300	920	NA	**670 MCL**	**600**	FDEP	**Yes**	ASL
72-43-5	Methoxychlor	0.45 J	210 J	µg/kg	JAX47-SB096	24/130	0.34 - 53000	210	NA	160000 MCL	160000	FDEP	No	BSL
Inorganics														
7440-38-2	**Arsenic**	0.2	47.4	mg/kg	JAX47-SB103	27/54	0.2 - 2.2	47.4	1.48	**5.8 MCL**	NA	FDEP	**Yes**	ASL

Table 7-4
Occurrence, Distribution, and Selection of COPCs
Surface Soil - Migration to Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Footnotes
1- Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Sample and duplicate are counted as one sample when determining frequency of detection.
3 - Values presented are sample-specific quantitation limits.
4 - The maximum detected concentration is used for screening purposes.
5 - Value presented is twice the mean concentration.
6 - USEPA Soil Screening Levels. USEPA Internet Site at http://risk.lsd.ornl.gov/calc_start.htm (SSLs for non-carcinogens are divided by 10).
7 - Soil Cleanup Target Levels taken from Table II, FAC 62-777.
8 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or ARAR/TBC(s) and background levels.
9 - Value is for chlordane.

Shading indicates that the maximum detected concentration exceeded the screening criteria; therefore, the chemical was retained as a COPC.

Rationale Codes:
For selection as a COPC
ASL = Above COPC Screening Level/ARAR/TBC

For elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC
NTX = No toxicity criteria

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value with undetermined bias

Definitions Continued:
MCL = Maximum Contaminant Level
N = Non-carcinogen
NA = Not Applicable/Not Available
SSL = Soil Screening Level

7.1.2.2 Subsurface Soil

Chemicals detected in subsurface soil samples from PSC 47 included: 4 VOCs, 11 SVOCs, 20 pesticides/PCBs, and arsenic. A comparison of the maximum detected concentrations to the risk-based screening levels for direct contact exposures is presented in Table 7-5. The following chemicals were detected at maximum concentrations in subsurface soil that exceeded the direct contact risk-based COPC screening levels and were retained as COPCs for subsurface soil at PSC 47.

- SVOCs [benzo(a)pyrene]
- Pesticides/PCBs (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, alpha-chlordane, beta-BHC, delta-BHC, dieldrin, gamma-BHC, gamma-chlordane, heptachlor, and heptachlor epoxide)
- Arsenic

Concentrations of all chemicals detected in subsurface soil were less than the USEPA SSLs for migration from soil to air (Table 7-5) with the exception of alpha-BHC and dieldrin. Therefore, alpha-BHC and dieldrin were retained as COPCs for migration from subsurface soil to air at PSC 47.

A comparison of the maximum detected subsurface soil concentrations to USEPA SSLs for chemical migration from soil to groundwater is presented in Table 7-6. The following chemicals were detected in subsurface soil at maximum concentrations exceeding the COPC screening levels for migration from soil to groundwater and were retained as COPCs for subsurface soil at the PSC 47.

- Pesticides/PCBs (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, alpha-chlordane, beta-BHC, dieldrin, delta-BHC, gamma-BHC, and gamma-chlordane)
- Arsenic

7.1.2.3 Groundwater

Chemicals detected in groundwater samples from PSC 47 included: 26 VOCs, 9 SVOCs, 20 pesticides/PCBs, and arsenic. A comparison of the maximum detected concentrations to the risk-based screening levels is presented in Table 7-7. The following chemicals were detected at maximum concentrations in groundwater that exceeded the risk-based COPC screening levels and were retained as COPCs for groundwater at PSC 47.

- VOCs (1,2,4-trichlorobenzene, 1,2-dibromo-3-chloropropane, 1,4-dichlorobenzene, benzene, chlorobenzene, chloroform, cis-1,2-DCE, ethylbenzene, isopropylbenzene, PCE, total xylenes, trans-1,2-DCE, TCE, and vinyl chloride)

Table 7-5
Occurrence, Distribution, and Selection of COPCs
Subsurface Soil - Direct Contact Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Location of Maximum Concentration	Detection Frequency[2]	Range of Nondetects[3]	Concentration Used for Screening[4]	Background Value[5]	Risk-Based COPC Screening Level[6]	Potential ARAR/TBC Value	Potential ARAR/TBC Source[7]	USEPA SSL Soil to Air[8]	COPC Flag[9]	Rationale for Contaminant Deletion or Selection
Volatile Organics Compounds															
78-93-3	2-Butanone	43	43	µg/kg	JAX47-SB010	1/2	1.3 - 1.3	43	NA	2,200,000 N	16,000,000	FDEP	24,000,000 sat	No	BSL
67-64-1	Acetone	43	43.2 J	µg/kg	JAX47-SB118	2/2	-	43.2	NA	1,400,000 N	11,000,000	FDEP	NA	No	BSL
75-09-2	Methylene Chloride	5.1 J	8	µg/kg	JAX47-SB010	2/2	-	8	NA	9,100 C	17,000	FDEP	13,000 C	No	BSL
108-88-3	Toluene	6 J	6 J	µg/kg	JAX47-SB010	1/2	0.2 - 0.2	6	NA	520,000 sat	7,500,000	FDEP	650,000 sat	No	BSL
Semivolatile Organics Compounds															
CALC013	**BaP Equivalent**	410	410	µg/kg	JAX47-SB010	1/2	134 - 134	410	NA	**62 C**	**100**	FDEP	NA	**Yes**	ASL
56-55-3	Benzo(a)anthracene	86 J	86 J	µg/kg	JAX47-SB010	1/2	180 - 180	86	NA	620 C	1,000	FDEP	NA	No	BSL
50-32-8	**Benzo(a)pyrene**	120 J	120 J	µg/kg	JAX47-SB010	1/2	134 - 134	120	NA	**62 C**	**100**	FDEP	NA	**Yes**	ASL
205-99-2	Benzo(b)fluoranthene	180 J	180 J	µg/kg	JAX47-SB010	1/2	126 - 126	180	NA	620 C	1,000	FDEP	NA	No	BSL
191-24-2	Benzo(g,h,i)perylene	110 J	110 J	µg/kg	JAX47-SB010	1/2	160 - 160	110	NA	230,000 N[10]	2,500,000	FDEP	NA	No	BSL
207-08-9	Benzo(k)fluoranthene	120 J	120 J	µg/kg	JAX47-SB010	1/2	153 - 153	120	NA	6,200 C	10,000	FDEP	NA	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	88 J	88 J	µg/kg	JAX47-SB010	1/2	233 - 233	88	NA	35,000 C	72,000	FDEP	NA	No	BSL
218-01-9	Chrysene	170 J	170 J	µg/kg	JAX47-SB010	1/2	156 - 156	170	NA	62,000 C	100,000	FDEP	NA	No	BSL
206-44-0	Fluoranthene	190 J	190 J	µg/kg	JAX47-SB010	1/2	161 - 161	190	NA	230,000 N	3,200,000	FDEP	NA	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	120 J	120 J	µg/kg	JAX47-SB010	1/2	218 - 218	120	NA	620 C	1,000	FDEP	NA	No	BSL
85-01-8	Phenanthrene	49 J	49 J	µg/kg	JAX47-SB010	1/2	161 - 161	49	NA	230,000 N[10]	22,000	FDEP	NA	No	BSL
129-00-0	Pyrene	210 J	210 J	µg/kg	JAX47-SB010	1/2	168 - 168	210	NA	230,000 N	2,400,000	FDEP	NA	No	BSL
Pesticides/PCBs															
72-54-8	**4,4'-DDD**	0.67 J	220000	µg/kg	JX01296	30/62	0.31 - 5	220000	NA	**2,400 C**	**4,200**	FDEP	NA	**Yes**	ASL
72-55-9	**4,4'-DDE**	0.54 J	25000	µg/kg	JX01266	44/62	0.34 - 5	25000	NA	**1,700 C**	**2,900**	FDEP	NA	**Yes**	ASL
50-29-3	**4,4'-DDT**	0.38 J	420000	µg/kg	JX01266	46/62	0.15 - 5	420000	NA	**1,700 C**	**2,900**	FDEP	750,000 C	**Yes**	ASL
309-00-2	Aldrin	0.24 J	0.24 J	µg/kg	JAX47-SB094	1/62	0.2 - 260	0.24	NA	29 C	60	FDEP	3,400 C	No	BSL
319-84-6	**alpha-BHC**	0.4 J	2500	µg/kg	JX01247	8/62	0.14 - 260	2500	NA	**90 C**	**100**	FDEP	**750** C	**Yes**	ASL
5103-71-9	**alpha-Chlordane**	0.32 J	37000	µg/kg	JX01296	27/62	0.27 - 5	37000	NA	**1,600 C[11]**	**2,800[11]**	FDEP	72,000 C	**Yes**	ASL
319-85-7	**beta-BHC**	0.44 J	4200	µg/kg	JX01247	17/62	0.34 - 260	4200	NA	**320 C**	**500**	FDEP	6,000 C	**Yes**	ASL
319-86-8	**delta-BHC**	0.22 J	30000	µg/kg	JX01247	16/62	0.17 - 260	30000	NA	**90 C[12]**	**24,000**	FDEP	NA	**Yes**	ASL
60-57-1	**Dieldrin**	0.26 J	9000	µg/kg	JX01296	27/62	0.24 - 500	9000	NA	**30 C**	**60**	FDEP	**1,100** C	**Yes**	ASL
959-98-8	Endosulfan I	0.32 J	0.4 J	µg/kg	JAX47-SB080	3/62	0.27 - 260	0.4	NA	37,000 N[13]	450,000[13]	FDEP	NA	No	BSL
33213-65-9	Endosulfan II	0.31 J	39 J	µg/kg	JAX47-SB087	6/62	0.24 - 500	39	NA	37,000 N[13]	450,000[13]	FDEP	NA	No	BSL
1031-07-8	Endosulfan Sulfate	0.42 J	7.2 J	µg/kg	JAX47-SB110	2/62	0.27 - 500	7.2	NA	37,000 N[13]	450,000[13]	FDEP	NA	No	BSL
72-20-8	Endrin	0.64 J	49 J	µg/kg	JAX47-SB110	6/62	0.37 - 500	49	NA	1,800 N	25,000	FDEP	NA	No	BSL
7421-93-4	Endrin Aldehyde	0.17 J	0.76 J	µg/kg	JAX47-SB079	5/62	0.17 - 500	0.76	NA	1,800 N[14]	NA	FDEP	NA	No	BSL
53494-70-5	Endrin Ketone	0.42 J	20.5	µg/kg	JAX47-SB010	6/62	0.31 - 500	20.5	NA	1,800 N[14]	NA	FDEP	NA	No	BSL
58-89-9	**gamma-BHC (Lindane)**	0.32 J	4000	µg/kg	JX01247	9/62	0.17 - 260	4000	NA	**440 C**		FDEP	NA	**Yes**	ASL
5103-74-2	**gamma-Chlordane**	0.26 J	47000	µg/kg	JX01296	30/62	0.24 - 260	47000	NA	**1,600 C[11]**	**2,800[11]**	FDEP	72,000 C	**Yes**	ASL
76-44-8	**Heptachlor**	0.29 J	190 J	µg/kg	JAX47-SB110	5/62	0.24 - 260	190	NA	**110 C**	200	FDEP	4,100 C	**Yes**	ASL
1024-57-3	**Heptachlor Epoxide**	0.98 J	280 J	µg/kg	JAX47-SB110	10/62	0.58 - 260	280	NA	**53 C**	**100**	FDEP	4,700 C	**Yes**	ASL
72-43-5	Methoxychlor	0.49 J	13.5	µg/kg	JAX47-SB010	4/62	0.34 - 2600	13.5	NA	31,000 N	420,000	FDEP	NA	No	BSL
Inorganics															
7440-38-2	**Arsenic**	0.2	132	mg/kg	JAX47-SB105	24/56	0.2 - 1.1	132	NA	**0.39 C**	**2.1**	FDEP	769 C	**Yes**	ASL

Table 7-5
Occurrence, Distribution, and Selection of COPCs
Subsurface Soil - Direct Contact Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Footnotes
1- Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Sample and duplicate are counted as one sample when determining frequency of detection.
3 - Values presented are sample-specific quantitation limits.
4 - The maximum detected concentration is used for screening purposes.
5 - Value presented is twice the mean concentration.
6 - The risk-based COPC screening level for residential exposures to soil is presented. The value is based on a target Hazard Quotient of 0.1 for non-carcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (USEPA, Region 9, October 2004). The RBCs for non-carcinogenic compounds are divided by 10.
7 - Soil Cleanup Target Levels taken from Table II, FAC 62-777 (FDEP, February 2005).
8 - USEPA Soil Screening Levels. USEPA Internet Site at http://risk.lsd.ornl.gov/calc_start.htm (SSLs for non-carcinogens are divided by 10).
9 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or ARAR/TBC(s) and background levels.
10 - Value is for pyrene.
11 - Value is for chlordane.
12 - Value is for alpha-BHC.
13 - Value is for endosulfan.
14 - Value is for endrin.

Shading indicates that the maximum detected concentration exceeded the screening criteria; therefore, the chemical was retained as a COPC.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value with undetermined bias
N = Non-carcinogen
NA = Not Applicable/Not Available
max = ceiling limit
sat = soil saturation limit
SSL = Soil Screening Level

Rationale Codes:
For selection as a COPC
ASL = Above COPC Screening Level/ARAR/TBC

For elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC

Table 7-6
Occurrence, Distribution, and Selection of COPCs
Subsurface Soil - Migration to Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Location of Maximum Concentration	Detection Frequency[2]	Range of Nondetects[3]	Concentration Used for Screening[4]	Background Value[5]	USEPA SSL Soil to Groundwater[6]	Potential ARAR/TBC Value	Potential ARAR/TBC Source[7]	COPC Flag[8]	Rationale for Contaminant Deletion or Selection
Volatile Organic Compounds														
78-93-3	2-Butanone	43	43	µg/kg	JAX47-SB010	1/2	1.3 - 1.3	43	NA	89000 N	17000	FDEP	No	BSL
67-64-1	Acetone	43	43.2 J	µg/kg	JAX47-SB118	2/2	-	43.2	NA	130000 N	25000	FDEP	No	BSL
75-09-2	Methylene Chloride	5.1 J	8	µg/kg	JAX47-SB010	2/2	-	8	NA	23 C	20	FDEP	No	BSL
108-88-3	Toluene	6 J	6 J	µg/kg	JAX47-SB010	1/2	0.2 - 0.2	6	NA	12000 MCL	500	FDEP	No	BSL
Semivolatile Organics Compounds														
	BaP Equivalent	410	410	µg/kg	JAX47-SB010	1/2	134 - 134	410	NA	8200 MCL	8000	FDEP	No	BSL
56-55-3	Benzo(a)anthracene	86 J	86 J	µg/kg	JAX47-SB010	1/2	180 - 180	86	NA	3200 C	800	FDEP	No	BSL
50-32-8	Benzo(a)pyrene	120 J	120 J	µg/kg	JAX47-SB010	1/2	134 - 134	120	NA	8200 MCL	8000	FDEP	No	BSL
205-99-2	Benzo(b)fluoranthene	180 J	180 J	µg/kg	JAX47-SB010	1/2	126 - 126	180	NA	9800 C	2400	FDEP	No	BSL
191-24-2	Benzo(g,h,i)perylene	110 J	110 J	µg/kg	JAX47-SB010	1/2	160 - 160	110	NA	NA	32000000	FDEP	No	BSL
207-08-9	Benzo(k)fluoranthene	120 J	120 J	µg/kg	JAX47-SB010	1/2	153 - 153	120	NA	9800 C	24000	FDEP	No	BSL
117-81-7	Bis(2-ethylhexyl)phthalate	88 J	88 J	µg/kg	JAX47-SB010	1/2	233 - 233	88	NA	3600000 MCL	3600000	FDEP	No	BSL
218-01-9	Chrysene	170 J	170 J	µg/kg	JAX47-SB010	1/2	156 - 156	170	NA	3200 C	77000	FDEP	No	BSL
206-44-0	Fluoranthene	190 J	190 J	µg/kg	JAX47-SB010	1/2	161 - 161	190	NA	6300000 N	1200000	FDEP	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	120 J	120 J	µg/kg	JAX47-SB010	1/2	218 - 218	120	NA	28000 C	6600	FDEP	No	BSL
85-01-8	Phenanthrene	49 J	49 J	µg/kg	JAX47-SB010	1/2	161 - 161	49	NA	NA	250000	FDEP	No	BSL
129-00-0	Pyrene	210 J	210 J	µg/kg	JAX47-SB010	1/2	168 - 168	210	NA	4600000 N	880000	FDEP	No	BSL
Pesticides/PCBs														
72-54-8	**4,4'-DDD**	0.67 J	220000	µg/kg	JX01296	30/62	0.31 - 5	220000	NA	**14000 C**	**5800**	FDEP	**Yes**	ASL
72-55-9	**4,4'-DDE**	0.54 J	25000	µg/kg	JX01266	44/62	0.34 - 5	25000	NA	45000 C	**18000**	FDEP	**Yes**	ASL
50-29-3	**4,4'-DDT**	0.38 J	420000	µg/kg	JX01266	46/62	0.15 - 5	420000	NA	**26000 C**	**11000**	FDEP	**Yes**	ASL
309-00-2	Aldrin	0.24 J	0.24 J	µg/kg	JAX47-SB094	1/62	0.2 - 260	0.24	NA	500 C	200	FDEP	No	BSL
319-84-6	**alpha-BHC**	0.4 J	2500	µg/kg	JX01247	8/62	0.14 - 260	2500	NA	**0.72 C**	**0.3**	FDEP	**Yes**	ASL
5103-71-9	**alpha-Chlordane**	0.32 J	37000	µg/kg	JX01296	27/62	0.27 - 5	37000	NA	**9600[9] MCL**	**9600[9]**	FDEP	**Yes**	ASL
319-85-7	**beta-BHC**	0.44 J	4200	µg/kg	JX01247	17/62	0.34 - 260	4200	NA	**2.6 C**	**1**	FDEP	**Yes**	ASL
319-86-8	**delta-BHC**	0.22 J	30000	µg/kg	JX01247	16/62	0.17 - 260	30000	NA	NA	**200**	FDEP	**Yes**	ASL
60-57-1	**Dieldrin**	0.26 J	9000	µg/kg	JX01296	27/62	0.24 - 500	9000	NA	**4.6 C**	**2**	FDEP	**Yes**	ASL
959-98-8	Endosulfan I	0.32 J	0.4 J	µg/kg	JAX47-SB080	3/62	0.27 - 260	0.4	NA	NA	3,800	FDEP	No	BSL
33213-65-9	Endosulfan II	0.31 J	39 J	µg/kg	JAX47-SB087	6/62	0.24 - 500	39	NA	NA	3,800	FDEP	No	BSL
1031-07-8	Endosulfan Sulfate	0.42 J	7.2 J	µg/kg	JAX47-SB110	2/62	0.27 - 500	7.2	NA	NA	3,800	FDEP	No	BSL
72-20-8	Endrin	0.64 J	49 J	µg/kg	JAX47-SB110	6/62	0.37 - 500	49	NA	990 MCL	1000	FDEP	No	BSL
7421-93-4	Endrin Aldehyde	0.17 J	0.76 J	µg/kg	JAX47-SB079	5/62	0.17 - 500	0.76	NA	NA	NA	FDEP	No	NTX
53494-70-5	Endrin Ketone	0.42 J	20.5	µg/kg	JAX47-SB010	6/62	0.31 - 500	20.5	NA	NA	NA	FDEP	No	NTX
58-89-9	**gamma-BHC (Lindane)**	0.32 J	4000	µg/kg	JX01247	9/62	0.17 - 260	4000	NA	**9.4 MCL**	**9**	FDEP	**Yes**	ASL
5103-74-2	**gamma-Chlordane**	0.26 J	47000	µg/kg	JX01296	30/62	0.24 - 260	47000	NA	**9600[9] MCL**	**9600[9]**	FDEP	**Yes**	ASL
76-44-8	Heptachlor	0.29 J	190 J	µg/kg	JAX47-SB110	5/62	0.24 - 260	190	NA	23000 MCL	23000	FDEP	No	BSL
1024-57-3	Heptachlor Epoxide	0.98 J	280 J	µg/kg	JAX47-SB110	10/62	0.58 - 260	280	NA	670 MCL	600	FDEP	No	BSL
72-43-5	Methoxychlor	0.49 J	13.5	µg/kg	JAX47-SB010	4/62	0.34 - 2600	13.5	NA	160000 MCL	160000	FDEP	No	BSL
Inorganics														
7440-38-2	**Arsenic**	0.2	132	mg/kg	JAX47-SB105	24/56	0.2 - 1.1	132	NA	**5.8 MCL**	NA	FDEP	**Yes**	ASL

Table 7-6
Occurrence, Distribution, and Selection of COPCs
Subsurface Soil - Migration to Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Footnotes
1- Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Sample and duplicate are counted as one sample when determining frequency of detection.
3 - Values presented are sample-specific quantitation limits.
4 - The maximum detected concentration is used for screening purposes.
5 - Value presented is twice the mean concentration.
6 - USEPA Soil Screening Levels. USEPA Internet Site at http://risk.lsd.ornl.gov/calc_start.htm (SSLs for non-carcinogens are divided by 10).
7 - Soil Cleanup Target Levels taken from Table II, FAC 62-777.
8 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or ARAR/TBC(s) and background levels.
Shading indicates that the maximum detected concentration exceeded the screening criteria; therefore, the chemical was retained as a COPC.
9 - Value is for chlordane.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value with undetermined bias
Definitions Continued:
MCL = Maximum Contaminant Level
N = Non-carcinogen
NA = Not Applicable/Not Available
SSL = Soil Screening Level

Rationale Codes:
For selection as a COPC
ASL = Above COPC Screening Level/ARAR/TBC

For elimination as a COPC:
BKG = Within background levels
BSL = Below COPC Screening Level/ARAR/TBC
NTX = No toxicity criteria

Table 7-7
Occurrence, Distribution, and Selection of COPCs
Groundwater-Direct Contact Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Location of Maximum Concentration	Detection Frequency(2)	Range of Nondetects(3)	Concentration Used for Screening(4)	Background Value(5)	Risk-Based COPC Screening Level(6)	Potential ARAR/TBC Value	Potential ARAR/TBC Source(7)	Potential ARAR/TBC Value	Potential ARAR/TBC Source(8)	COPC Flag(9)	Rationale for Contaminant Deletion or Selection
Volatile Organic Compounds																
75-35-4	1,1-Dichloroethene	0.4 J	0.7 J	µg/L	JAX47-937-MW03S, JAX47-937-MW04S	4/34	0.2 - 0.2	0.7	NA	34 N	7	FDEP	7	NA	No	BSL
120-82-1	**1,2,4-Trichlorobenzene**	1.8	8.6	µg/L	JAX47-MW13S	4/34	0.1 - 0.9	8.6	NA	**0.72 N**	70	FDEP	70	MCL	**Yes**	ASL
96-12-8	**1,2-Dibromo-3-Chloropropane**	2.7	2.7	µg/L	JAX47-937-MW02S	1/34	0.3 - 0.3	2.7	NA	**0.0035 N**	200	FDEP	NA	MCL	**Yes**	ASL
95-50-1	1,2-Dichlorobenzene	0.3 J	4.4 J	µg/L	JAX47-MW13S	4/34	0.2 - 0.2	4.4	NA	37 N	600	FDEP	600	MCL	No	BSL
541-73-1	1,3-Dichlorobenzene	0.6 J	2 J	µg/L	JAX47-MW13S	2/34	0.2 - 0.2	2	NA	18 N	210	FDEP	NA	NA	No	BSL
106-46-7	**1,4-Dichlorobenzene**	0.4 J	6.3 J	µg/L	JAX47-MW13S	4/34	0.1 - 0.1	6.3	NA	**0.5 C**	75	FDEP	75	MCL	**Yes**	ASL
78-93-3	2-Butanone	4.06 J	4.06 J	µg/L	JAX47-MW30S	1/34	2 - 2	4.06	NA	700 N	4200	FDEP	NA	NA	No	BSL
71-43-2	**Benzene**	0.22 J	14.6	µg/L	JAX47-937-MW05S	14/34	0.2 - 0.2	14.6	NA	**0.35 C**	**1**	FDEP	**5**	MCL	**Yes**	ASL
75-25-2	Bromoform	1.5 J	1.5 J	µg/L	JAX47-937-MW02S	1/34	0.2 - 0.2	1.5	NA	8.5 C	4.4	FDEP	80	NA	No	BSL
108-90-7	**Chlorobenzene**	0.2 J	12.7	µg/L	JAX47-MW11S	10/34	0.2 - 0.2	12.7	NA	**11 N**	100	FDEP	100	NA	**Yes**	ASL
75-00-3	Chloroethane	1	1	µg/L	JAX47-937-MW02S	1/34	0.3 - 0.3	1	NA	4.6 C	12	FDEP	NA	NA	No	BSL
67-66-3	**Chloroform**	0.37 J	0.37 J	µg/L	JAX47-MW30S	1/34	0.2 - 0.2	0.37	NA	**0.017 N**	70	FDEP	80	MCL	**Yes**	ASL
156-59-2	**cis-1,2-Dichloroethene**	0.5 J	936	µg/L	JAX47-937-MW05S	15/34	0.2 - 0.2	936	NA	**6.1 N**	**70**	FDEP	**70**	MCL	**Yes**	ASL
110-82-7	Cyclohexane	1.5	38.3	µg/L	JAX47-MW11S	2/34	0.4 - 0.45	38.3	NA	1000 N	NA	FDEP	NA	NA	No	BSL
60-29-7	Diethyl Ether	0.8 J	0.9 J	µg/L	JAX47-937-MW05S	2/34	0.5 - 0.54	0.9	NA	120 N	750	FDEP	NA	NA	No	BSL
100-41-4	**Ethylbenzene**	0.5 J	135	µg/L	JAX47-937-MW05S	8/34	0.3 - 0.3	135	NA	**130 N**	**30**	FDEP	700	MCL	**Yes**	ASL
98-82-8	**Isopropylbenzene**	0.3 J	9	µg/L	JAX47-MW11S	10/34	0.1 - 0.1	9	NA	66 N	**0.8**	FDEP	NA	NA	**Yes**	ASL
108-87-2	Methyl Cyclohexane	0.7 J	22.7 J	µg/L	JAX47-MW11S	3/34	0.55 - 0.6	22.7	NA	520 N	NA	FDEP	NA	NA	No	BSL
1634-04-4	Methyl Tert-Butyl Ether	0.2 J	0.2 J	µg/L	JAX47-937-MW01S	1/34	0.2 - 0.2	0.2	NA	11 C	20	FDEP	NA	NA	No	BSL
100-42-5	Styrene	0.75 J	1.7	µg/L	JAX47-937-MW02S	2/34	0.1 - 0.1	1.7	NA	160 N	100	FDEP	100	MCL	No	BSL
127-18-4	**Tetrachloroethene**	0.9 J	4 J	µg/L	JAX47-937-MW04S	7/34	0.3 - 0.3	4	NA	**0.1 C**	**3**	FDEP	5	MCL	**Yes**	ASL
108-88-3	Toluene	0.6 J	21.9 J	µg/L	JAX47-937-MW05S	5/34	0.2 - 0.51	21.9	NA	72 N	40	FDEP	1000	MCL	No	BSL
1330-20-7	**Total Xylenes**	0.6 J	914	µg/L	JAX47-937-MW05S	8/34	0.3 - 0.43	914	NA	**21 N**	**20**	FDEP	10000	MCL	**Yes**	ASL
156-60-5	**trans-1,2-Dichloroethene**	0.5 J	4.5	µg/L	JAX47-937-MW04S	6/34	0.2 - 0.2	4.5	NA	12 N	**1**	FDEP	100	MCL	**Yes**	ASL
79-01-6	**Trichloroethene**	0.3 J	7.7	µg/L	JAX47-937-MW04S	11/34	0.3 - 0.3	7.7	NA	**0.028 C**	**3**	FDEP	**5**	MCL	**Yes**	ASL
75-01-4	**Vinyl Chloride**	0.4 J	5.5	µg/L	JAX47-937-MW05S	6/34	0.4 - 0.4	5.5	NA	**0.02 C**	**1**	FDEP	**2**	MCL	**Yes**	ASL
Semivolatile Organic Compounds																
92-52-4	**1,1-Biphenyl**	5 J	8 J	µg/L	JAX47-MW11S	2/34	3 - 3	8	NA	30 N	**0.5**	FDEP	NA	NA	**Yes**	ASL
95-95-4	**2,4,5-Trichlorophenol**	104	2720	µg/L	JAX47-937-MW03S	2/34	2 - 2	2720	NA	**360 N**	**1**	FDEP	NA	NA	**Yes**	ASL
120-83-2	**2,4-Dichlorophenol**	6 J	529	µg/L	JAX47-937-MW03S	3/34	2 - 2	529	NA	**11 N**	**0.3**	FDEP	NA	NA	**Yes**	ASL
105-67-9	2,4-Dimethylphenol	16	16	µg/L	JAX47-937-MW05S	1/34	2 - 2	16	NA	73 N	28	FDEP	NA	NA	No	BSL
91-57-6	**2-Methylnaphthalene**	10 J	103	µg/L	JAX47-MW11S	3/34	2 - 2	103	NA	**0.62 N**	**28**	FDEP	NA	NA	**Yes**	ASL
95-48-7	2-Methylphenol	6 J	6 J	µg/L	JAX47-937-MW05S	1/34	2 - 2	6	NA	180 N	35	FDEP	NA	NA	No	BSL
84-66-2	Diethyl Phthalate	9 J	9 J	µg/L	JAX47-MW29S	1/34	2 - 2	9	NA	2900 N	5600	FDEP	NA	NA	No	BSL
91-20-3	**Naphthalene**	14	194	µg/L	JAX47-MW11S	4/34	3 - 3	194	NA	**0.62 N**	**14**	FDEP	NA	NA	**Yes**	ASL
87-86-5	**Pentachlorophenol**	11	12 J	µg/L	JAX47-937-MW04S	2/34	1 - 1	12	NA	**0.56 C**	**1**	FDEP	**1**	NA	**Yes**	ASL

Table 7-7
Occurrence, Distribution, and Selection of COPCs
Groundwater-Direct Contact Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Location of Maximum Concentration	Detection Frequency[2]	Range of Nondetects[3]	Concentration Used for Screening[4]	Background Value[5]	Risk-Based COPC Screening Level[6]	Potential ARAR/TBC Value	Potential ARAR/TBC Source[7]	Potential ARAR/TBC Value	Potential ARAR/TBC Source[8]	COPC Flag[9]	Rationale for Contaminant Deletion or Selection
Pesticides/PCBs																
72-54-8	**4,4'-DDD**	0.001 J	25 J	µg/L	JAX47-MW17S	10/34	0.0004 - 0.0004	25	NA	**0.28 C**	**0.1**	FDEP	NA	NA	**Yes**	ASL
72-55-9	**4,4'-DDE**	0.002 J	0.13 J	µg/L	JAX47-937-MW05S	11/34	0.002 - 0.002	0.13	NA	0.2 C	**0.1**	FDEP	NA	NA	**Yes**	ASL
50-29-3	**4,4'-DDT**	0.002 J	0.49	µg/L	JAX47-MW13S	8/34	0.002 - 0.003	0.49	NA	**0.2 C**	**0.1**	FDEP	NA	NA	**Yes**	ASL
309-00-2	**Aldrin**	0.01 J	3.8 J	µg/L	JAX47-937-MW05S	7/34	0.002 - 0.002	3.8	NA	**0.004 C**	**0.002**	FDEP	NA	NA	**Yes**	ASL
319-84-6	**alpha-BHC**	0.003 J	9.3	µg/L	JAX47-MW11S	9/34	0.001 - 0.002	9.3	NA	**0.011 C**	**0.006**	FDEP	NA	MCL	**Yes**	ASL
5103-71-9	**alpha-Chlordane**	0.002 J	1.8	µg/L	JAX47-MW17S	12/34	0.001 - 0.001	1.8	NA	**0.19 C[10]**	2	FDEP	2	NA	**Yes**	ASL
319-85-7	**beta-BHC**	0.003 J	3.9 J	µg/L	JAX47-937-MW04S	12/34	0.002 - 0.002	3.9	NA	**0.037 C**	**0.02**	FDEP	NA	NA	**Yes**	ASL
319-86-8	**delta-BHC**	0.002 J	8.3	µg/L	JAX47-MW11S	15/34	0.001 - 0.062	8.3	NA	**0.011 C[11]**	**2.1**	FDEP	NA	NA	**Yes**	ASL
60-57-1	**Dieldrin**	0.003 J	0.32 J	µg/L	JAX47-937-MW03S	14/34	0.0008 - 0.0008	0.32	NA	**0.0042 C**	**0.002**	FDEP	NA	MCL	**Yes**	ASL
959-98-8	Endosulfan I	0.011 J	0.077	µg/L	JAX47-MW17S	3/34	0.002 - 0.002	0.077	NA	22 N[12]	42[12]	FDEP	NA	NA	No	BSL
33213-65-9	Endosulfan II	0.003 J	0.039 J	µg/L	JAX47-MW30S	8/34	0.002 - 0.002	0.039	NA	22 N[12]	42[12]	FDEP	NA	NA	No	BSL
1031-07-8	Endosulfan Sulfate	0.005 J	0.21 J	µg/L	JAX47-937-MW05S	10/34	0.002 - 0.002	0.21	NA	22 N[12]	42[12]	FDEP	NA	NA	No	BSL
72-20-8	Endrin	0.002 J	0.044 J	µg/L	JAX47-937-MW05S	6/34	0.002 - 0.003	0.044	NA	1.1 N	2	FDEP	2	MCL	No	BSL
7421-93-4	Endrin Aldehyde	0.011 J	0.021 J	µg/L	JAX47-MW13S	1/34	0.009 - 0.009	0.021	NA	1.1 N[13]	2[13]	FDEP	NA	MCL	No	BSL
53494-70-5	**Endrin Ketone**	0.004 J	4.7 J	µg/L	JAX47-937-MW02S	11/34	0.003 - 0.003	4.7	NA	**1.1 N[13]**	**2[13]**	FDEP	NA	NA	**Yes**	ASL
58-89-9	**gamma-BHC (Lindane)**	0.002 J	15	µg/L	JAX47-MW11S	10/34	0.002 - 0.002	15	NA	**0.052 C**	**0.2**	FDEP	**0.2**	NA	**Yes**	ASL
5103-74-2	**gamma-Chlordane**	0.016 J	1.1	µg/L	JAX47-MW17S	9/34	0.001 - 0.001	1.1	NA	**0.19 C[10]**	2	FDEP	2	NA	**Yes**	ASL
76-44-8	**Heptachlor**	0.001 J	0.22	µg/L	JAX47-MW17D	11/34	0.001 - 0.001	0.22	NA	**0.015 C**	0.4	FDEP	0.4	MCL	**Yes**	ASL
1024-57-3	**Heptachlor Epoxide**	0.004 J	0.62 J	µg/L	JAX47-MW14S	7/34	0.001 - 0.001	0.62	NA	**0.0074 C**	**0.2**	FDEP	**0.2**	NA	**Yes**	ASL
72-43-5	Methoxychlor	0.011 J	1.1 J	µg/L	JAX47-MW11S, JAX47-937-MW05S	6/34	0.003 - 0.003	1.1	NA	18 N	40	FDEP	40	MCL	No	BSL
Total Inorganics																
7440-38-2	**Arsenic**	4.1	6640	µg/L	JAX47-937-MW02S	12/34	4 - 18.3	6640	**13.2**	**0.045 C**	**10**	FDEP	**10**	MCL	**Yes**	ASL
Filtered Inorganics																
7440-38-2	**Arsenic**	10	26	µg/L	JAX47-937-MW01S	2/4	4 - 4	26	**13.2**	**0.045 C**	**10**	FDEP	**10**	MCL	**Yes**	ASL

Footnotes
1- Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Sample and duplicate are counted as one sample when determining frequency of detection.
3 - Values presented are sample-specific quantitation limits.
4 - The maximum detected concentration is used for screening purposes.
5 - Value presented is twice the mean concentration.
Footnotes Continued
6 - The risk-based COPC screening level for tap water use is presented. The value is based on a target Hazard Quotient of 0.1 for non-carcinogens (denoted with a "N" flag) or an incremental cancer risk of 1E-6 for carcinogens (denoted with a "C" flag) (USEPA, Region 9, October 2004).
The PRG for non-carcinogenic compounds are divided by 10.
7 - Groundwater Cleanup Target Levels taken from Table I, FAC 62-777 (FDEP, February 2005).
8 - 2006 Edition of the Drinking Water Standards and Health Advisories, USEPA (EPA 822-R-06-013) Summer 2006.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C = Carcinogen
COPC = Chemical Of Potential Concern
FDEP = Florida Department of Environmental Protection
J = Estimated value with undetermined bias

Definitions
MCL = Maximum contaminant level
N = Non-carcinogen
NA = Not Applicable/Not Available

Rationale Codes:

Table 7-7
Occurrence, Distribution, and Selection of COPCs
Groundwater-Direct Contact Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration(1)	Maximum Concentration(1)	Units	Location of Maximum Concentration	Detection Frequency(2)	Range of Nondetects(3)	Concentration Used for Screening(4)	Background Value(5)	Risk-Based COPC Screening Level(6)	Potential ARAR/TBC Value	Potential ARAR/TBC Source(7)	Potential ARAR/TBC Value	Potential ARAR/TBC Source(8)	COPC Flag(9)	Rationale for Contaminant Deletion or Selection

9 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and/or ARAR/TBC(s) and background levels.
10 - Value is for chlordane.
11 - Value is for alpha-BHC.
12 - Value is for endosulfan
13 - Value is for endrin

For selection as a COPC
ASL = Above COPC Screening Level/ARAR/TBC

For elimination as a COPC:
BKG = Within background levels
BSL = Below COPC Screening Level/ARAR/TBC

Shading indicates that the maximum detected concentration exceeded the screening criteria; therefore, the chemical was retained as a COPC.

- SVOCs (1,1-biphenyl, 2,4,5-trichlorophenol, 2,4-dichlorophenol, 2-methylnaphthalene, naphthalene, and pentachlorophenol)
- Pesticides/PCBs (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, alpha-chlordane, beta-BHC, delta-BHC, dieldrin, endrin ketone, gamma-BHC, gamma-chlordane, heptachlor, and heptachlor epoxide)
- Arsenic

Maximum detected concentrations in groundwater were also compared to screening criteria for the migration of chemicals from groundwater through building foundations and into indoor air (Table 7-8). The following chemicals were detected at maximum concentrations that exceeded the screening criteria and were retained as COPCs for the migration from groundwater to indoor air exposure pathway.

- VOCs (benzene, bromoform, cis-1,2-DCE, isopropylbenzene, TCE, and vinyl chloride)
- SVOCs (naphthalene)
- Pesticides/PCBs (aldrin, alpha-BHC, and gamma-BHC)

A summary of the chemicals retained as COPCs in surface soil, subsurface soil, and groundwater at PSC 47 is presented in Table 7-9.

7.2 EXPOSURE ASSESSMENT

The exposure assessment defines and evaluates the exposures experienced by likely receptor populations at a site. In order to have an exposure, several factors must be present: (1) a source and mechanism of release; (2) a route of contaminant transport through an environmental medium; (3) a contact point for a human receptor; and (4) an exposure route at the point of contact. All four components must be present for the exposures to occur.

The exposure assessment presented in this section of the report consists of several subsections in which the physical site setting and the potential receptors of concern are characterized, the potential contaminant migration and exposure pathways are identified, the contaminant concentrations at the point of exposure are defined, and the equations used to quantify exposure in terms of contaminant intake (dose) are presented.

Appendix K of this report contains sample calculations for the quantification of contaminant intakes, as well as the chemical-specific intakes for PSC 47.

Table 7-8
Occurrence, Distribution, and Selection of COPCs
Groundwater-Vapor Intrusion

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Location of Maximum Concentration	Detection Frequency[2]	Range of Nondetects[3]	Concentration Used for Screening[4]	Background Value[5]	Risk-Based COPC Screening Level[6]	COPC Flag[7]	Rationale for Contaminant Deletion or Selection
Volatile Organic Compounds												
75-35-4	1,1-Dichloroethene	0.4 J	0.7 J	µg/L	JAX47-937-MW03S, JAX47-937-MW04S	4/34	0.2 - 0.2	0.7	NA	190 N	No	BSL
120-82-1	1,2,4-Trichlorobenzene	1.8	8.6	µg/L	JAX47-MW13S	4/34	0.1 - 0.9	8.6	NA	3400 N	No	BSL
96-12-8	1,2-Dibromo-3-Chloropropane	2.7	2.7	µg/L	JAX47-937-MW02S	1/34	0.3 - 0.3	2.7	NA	33 N	No	BSL
95-50-1	1,2-Dichlorobenzene	0.3 J	4.4 J	µg/L	JAX47-MW13S	4/34	0.2 - 0.2	4.4	NA	2600 N	No	BSL
541-73-1	1,3-Dichlorobenzene	0.6 J	2 J	µg/L	JAX47-MW13S	2/34	0.2 - 0.2	2	NA	830 N	No	BSL
106-46-7	1,4-Dichlorobenzene	0.4 J	6.3 J	µg/L	JAX47-MW13S	4/34	0.1 - 0.1	6.3	NA	8200 N	No	BSL
78-93-3	2-Butanone	4.06 J	4.06 J	µg/L	JAX47-MW30S	1/34	2 - 2	4.06	NA	440000 N	No	BSL
71-43-2	**Benzene**	0.22 J	14.6	µg/L	JAX47-937-MW05S	14/34	0.2 - 0.2	14.6	NA	**5 MCL**	**Yes**	ASL
75-25-2	**Bromoform**	1.5 J	1.5 J	µg/L	JAX47-937-MW02S	1/34	0.2 - 0.2	1.5	NA	**0.0083 C**	**Yes**	ASL
108-90-7	Chlorobenzene	0.2 J	12.7	µg/L	JAX47-MW11S	10/34	0.2 - 0.2	12.7	NA	390 N	No	BSL
75-00-3	Chloroethane	1	1	µg/L	JAX47-937-MW02S	1/34	0.3 - 0.3	1	NA	28000 C	No	BSL
67-66-3	Chloroform	0.37 J	0.37 J	µg/L	JAX47-MW30S	1/34	0.2 - 0.2	0.37	NA	80 MCL	No	BSL
156-59-2	**cis-1,2-Dichloroethene**	0.5 J	936	µg/L	JAX47-937-MW05S	15/34	0.2 - 0.2	936	NA	**210 N**	**Yes**	ASL
110-82-7	Cyclohexane	1.5	38.3	µg/L	JAX47-MW11S	2/34	0.4 - 0.45	38.3	NA	NA	No	NTX
60-29-7	Diethyl Ether	0.8 J	0.9 J	µg/L	JAX47-937-MW05S	2/34	0.5 - 0.54	0.9	NA	520 N	No	BSL
100-41-4	Ethylbenzene	0.5 J	135	µg/L	JAX47-937-MW05S	8/34	0.3 - 0.3	135	NA	700 MCL	No	BSL
98-82-8	**Isopropylbenzene**	0.3 J	9	µg/L	JAX47-MW11S	10/34	0.1 - 0.1	9	NA	**8.4 N**	**Yes**	ASL
108-87-2	Methyl Cyclohexane	0.7 J	22.7 J	µg/L	JAX47-MW11S	3/34	0.55 - 0.6	22.7	NA	710 N	No	BSL
1634-04-4	Methyl Tert-Butyl Ether	0.2 J	0.2 J	µg/L	JAX47-937-MW01S	1/34	0.2 - 0.2	0.2	NA	120000 C	No	BSL
100-42-5	Styrene	0.75 J	1.7	µg/L	JAX47-937-MW02S	2/34	0.1 - 0.1	1.7	NA	8900 N	No	BSL
127-18-4	Tetrachloroethene	0.9 J	4 J	µg/L	JAX47-937-MW04S	7/34	0.3 - 0.3	4	NA	5 MCL	No	BSL
108-88-3	Toluene	0.6 J	21.9 J	µg/L	JAX47-937-MW05S	5/34	0.2 - 0.51	21.9	NA	1500 N	No	BSL
1330-20-7	Total Xylenes	0.6 J	914	µg/L	JAX47-937-MW05S	8/34	0.3 - 0.43	914	NA	22000 N	No	BSL
156-60-5	trans-1,2-Dichloroethene	0.5 J	4.5	µg/L	JAX47-937-MW04S	6/34	0.2 - 0.2	4.5	NA	180 N	No	BSL
79-01-6	**Trichloroethene**	0.3 J	7.7	µg/L	JAX47-937-MW04S	11/34	0.3 - 0.3	7.7	NA	**5 MCL**	**Yes**	ASL
75-01-4	**Vinyl Chloride**	0.4 J	5.5	µg/L	JAX47-937-MW05S	6/34	0.4 - 0.4	5.5	NA	**2 MCL**	**Yes**	ASL
Semivolatile Organic Compounds												
92-52-4	1,1-Biphenyl	5 J	8 J	µg/L	JAX47-MW11S	2/34	3 - 3	8	NA	NA	No	NTX
95-95-4	2,4,5-Trichlorophenol	104	2720	µg/L	JAX47-937-MW03S	2/34	2 - 2	2720	NA	NA	No	NTX
120-83-2	2,4-Dichlorophenol	6 J	529	µg/L	JAX47-937-MW03S	3/34	2 - 2	529	NA	NA	No	NTX
105-67-9	2,4-Dimethylphenol	16	16	µg/L	JAX47-937-MW05S	1/34	2 - 2	16	NA	NA	No	NTX
91-57-6	2-Methylnaphthalene	10 J	103	µg/L	JAX47-MW11S	3/34	2 - 2	103	NA	3300 N	No	BSL
95-48-7	2-Methylphenol	6 J	6 J	µg/L	JAX47-937-MW05S	1/34	2 - 2	6	NA	NA	No	NTX
84-66-2	Diethyl Phthalate	9 J	9 J	µg/L	JAX47-MW29S	1/34	2 - 2	9	NA	NA	No	NTX
91-20-3	**Naphthalene**	14	194	µg/L	JAX47-MW11S	4/34	3 - 3	194	NA	**150 N**	**Yes**	ASL
87-86-5	Pentachlorophenol	11	12 J	µg/L	JAX47-937-MW04S	2/34	1 - 1	12	NA	NA	No	NTX

Table 7-8
Occurrence, Distribution, and Selection of COPCs
Groundwater-Vapor Intrusion

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Units	Location of Maximum Concentration	Detection Frequency[2]	Range of Nondetects[3]	Concentration Used for Screening[4]	Background Value[5]	Risk-Based COPC Screening Level[6]	COPC Flag[7]	Rationale for Contaminant Deletion or Selection
Pesticides/PCBs												
72-54-8	4,4'-DDD	0.001 J	25 J	µg/L	JAX47-MW17S	10/34	0.0004 - 0.0004	25	NA	NA	No	NTX
72-55-9	4,4'-DDE	0.002 J	0.13 J	µg/L	JAX47-937-MW05S	11/34	0.002 - 0.002	0.13	NA	29 C	No	BSL
50-29-3	4,4'-DDT	0.002 J	0.49	µg/L	JAX47-MW13S	8/34	0.002 - 0.003	0.49	NA	NA	No	NTX
309-00-2	**Aldrin**	0.01 J	3.8 J	µg/L	JAX47-937-MW05S	7/34	0.002 - 0.002	3.8	NA	**0.071**	**Yes**	ASL
319-84-6	**alpha-BHC**	0.003 J	9.3	µg/L	JAX47-MW11S	9/34	0.001 - 0.002	9.3	NA	**3.1 C**	**Yes**	ASL
5103-71-9	alpha-Chlordane	0.002 J	1.8	µg/L	JAX47-MW17S	12/34	0.001 - 0.001	1.8	NA	12 C[8]	No	BSL
319-85-7	beta-BHC	0.003 J	3.9 J	µg/L	JAX47-937-MW04S	12/34	0.002 - 0.002	3.9	NA	NA	No	NTX
319-86-8	delta-BHC	0.002 J	8.3	µg/L	JAX47-MW11S	15/34	0.001 - 0.062	8.3	NA	NA	No	NTX
60-57-1	Dieldrin	0.003 J	0.32 J	µg/L	JAX47-937-MW03S	14/34	0.0008 - 0.0008	0.32	NA	0.86 C	No	BSL
959-98-8	Endosulfan I	0.011 J	0.077	µg/L	JAX47-MW17S	3/34	0.002 - 0.002	0.077	NA	NA	No	NTX
33213-65-9	Endosulfan II	0.003 J	0.039 J	µg/L	JAX47-MW30S	8/34	0.002 - 0.002	0.039	NA	NA	No	NTX
1031-07-8	Endosulfan Sulfate	0.005 J	0.21 J	µg/L	JAX47-937-MW05S	10/34	0.002 - 0.002	0.21	NA	NA	No	NTX
72-20-8	Endrin	0.002 J	0.044 J	µg/L	JAX47-937-MW05S	6/34	0.002 - 0.003	0.044	NA	NA	No	NTX
7421-93-4	Endrin Aldehyde	0.011 J	0.021 J	µg/L	JAX47-MW13S	1/34	0.009 - 0.009	0.021	NA	NA	No	NTX
53494-70-5	Endrin Ketone	0.004 J	4.7 J	µg/L	JAX47-937-MW02S	11/34	0.003 - 0.003	4.7	NA	NA	No	NTX
58-89-9	**gamma-BHC (Lindane)**	0.002 J	15	µg/L	JAX47-MW11S	10/34	0.002 - 0.002	15	NA	**11 C**	**Yes**	ASL
5103-74-2	gamma-Chlordane	0.016 J	1.1	µg/L	JAX47-MW17S	9/34	0.001 - 0.001	1.1	NA	12 C[8]	No	BSL
76-44-8	Heptachlor	0.001 J	0.22	µg/L	JAX47-MW17D	11/34	0.001 - 0.001	0.22	NA	0.4 MCL	No	BSL
1024-57-3	Heptachlor Epoxide	0.004 J	0.62 J	µg/L	JAX47-MW14S	7/34	0.001 - 0.001	0.62	NA	NA	No	NTX
72-43-5	Methoxychlor	0.011 J	1.1 J	µg/L	JAX47-MW11S, JAX47-937-MW05S	6/34	0.003 - 0.003	1.1	NA	NA	No	NTX

Footnotes
1- Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.
2 - Sample and duplicate are counted as one sample when determining frequency of detection.
3 - Values presented are sample-specific quantitation limits.
4 - The maximum detected concentration is used for screening purposes.
5 - Value presented is twice the mean concentration.
6 - Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. November 2002. EPA530-F-02-052. Values are from Table 2c and correspond to a target cancer risk level of 1E-6 or HI =1.
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Value is for chlordane.

Shading indicates that the maximum detected concentration exceeded the screening criteria; therefore, the chemical was retained as a COPC.

Definitions:
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Consid
C = Carcinogen
COPC = Chemical Of Potential Concern
J = Estimated value with undetermined bias
N = Non-carcinogen
NA = Not Applicable/Not Available

Rationale Codes:
For selection as a COPC
ASL = Above COPC Screening Level/ARAR/TBC

For elimination as a COPC:
BSL = Below COPC Screening Level/ARAR/TBC
NTX = No toxicity criteria available

Table 7-9
Chemicals Retained as COPCs

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	Surface Soil			Subsurface Soil			Groundwater	
	Direct Contact	Soil to Air	Soil to Groundwater	Direct Contact	Soil to Air	Soil to Groundwater	Direct Contact	Vapor Intrusion
Volatile Organic Compounds								
1,2,4-Trichlorobenzene							X	
1,2-Dibromo-3-Chloropropane							X	
1,4-Dichlorobenzene							X	
Benzene							X	X
Bromoform								X
Chlorobenzene							X	
Chloroform							X	
cis-1,2-Dichloroethene							X	X
Ethylbenzene							X	
Isopropylbenzene							X	X
Tetrachloroethene							X	
Total Xylenes							X	
trans-1,2-Dichloroethene							X	
Trichloroethene							X	X
Vinyl Chloride							X	X
Semivolatile Organic Compounds								
1,1-Biphenyl							X	
2,4,5-Trichlorophenol							X	
2,4-Dichlorophenol							X	
2-Methylnaphthalene							X	
Benzo(a)pyrene	X			X				
Dibenzo(a,h)anthracene	X							
Naphthalene							X	X
Pentachlorophenol							X	
Pesticides/PCBs								
4,4'-DDD	X		X	X		X	X	
4,4'-DDE	X		X	X		X	X	
4,4'-DDT	X	X	X	X		X	X	
Aldrin							X	X
Alpha-BHC			X	X	X	X	X	X
Alpha-Chlordane	X		X	X		X	X	
Beta-BHC			X	X		X	X	
Delta-BHC				X		X	X	
Dieldrin	X	X	X	X	X	X	X	
Endrin			X					
Endrin Ketone							X	
Gamma-BHC			X	X		X	X	X
Gamma-Chlordane	X		X	X		X	X	
Heptachlor	X			X			X	
Heptachlor Epoxide	X		X	X			X	
Inorganics								
Arsenic	X		X	X		X	X	

Notes
X - Indicates chemical was retained as a COPC.

7.2.1 Conceptual Site Model

The CSM for PSC 47 is presented in this section. A CSM facilitates consistent and comprehensive evaluation of the potential risks to human health by creating a framework for identifying the pathways by which human receptors may come in contact with contaminated media originating from the source area. A CSM depicts the relationships between the following elements, which are necessary for defining complete exposure pathways:

- Site sources of contamination
- COPCs in environmental media
- Contaminant release mechanisms
- Contaminant transport pathways
- Exposure mechanisms and exposure routes
- Potential receptors

Physical site characteristics, results of previous site investigations, hazard identification (detected chemicals of interest based on the previous investigations), and current and future land use scenarios also were considered during the development of the site-specific CSM. Details on previous investigations and hazard identification were presented in Section 2.1. Details on the site background and physical setting were also presented in Section 2.0. The CSM for PSC 47 is provided in Figure 7-2. The potential sources of contamination at PSC 47 were releases to surface soil and groundwater from past operations. Contaminants may be released from the site by mechanisms such as storm water runoff and subsequent erosion of surface soil, leaching of COPCs from soil via infiltrating water to subsurface soil and subsequent migration through the subsurface soil to the water table, wind erosion of surface soil (fugitive dust), and the volatilization of chemicals from soil (volatile emissions).

Storms generate runoff, which is directed toward the surrounding surface water. Initially, this water may move across the site as sheet flow, which can entrain loose soil material. This soil is moved from the site as a sediment, and will be deposited where the flow velocity diminishes below that needed to carry a particular grain size.

Soluble chemicals may also migrate downward through the soil column via infiltrating precipitation. The migration of these chemicals may be somewhat impeded by the chemical's tendency to bind to soil organic material. However, these soluble chemicals may eventually reach the water table. Once in the groundwater, these chemicals continue to migrate via dispersion and advection.

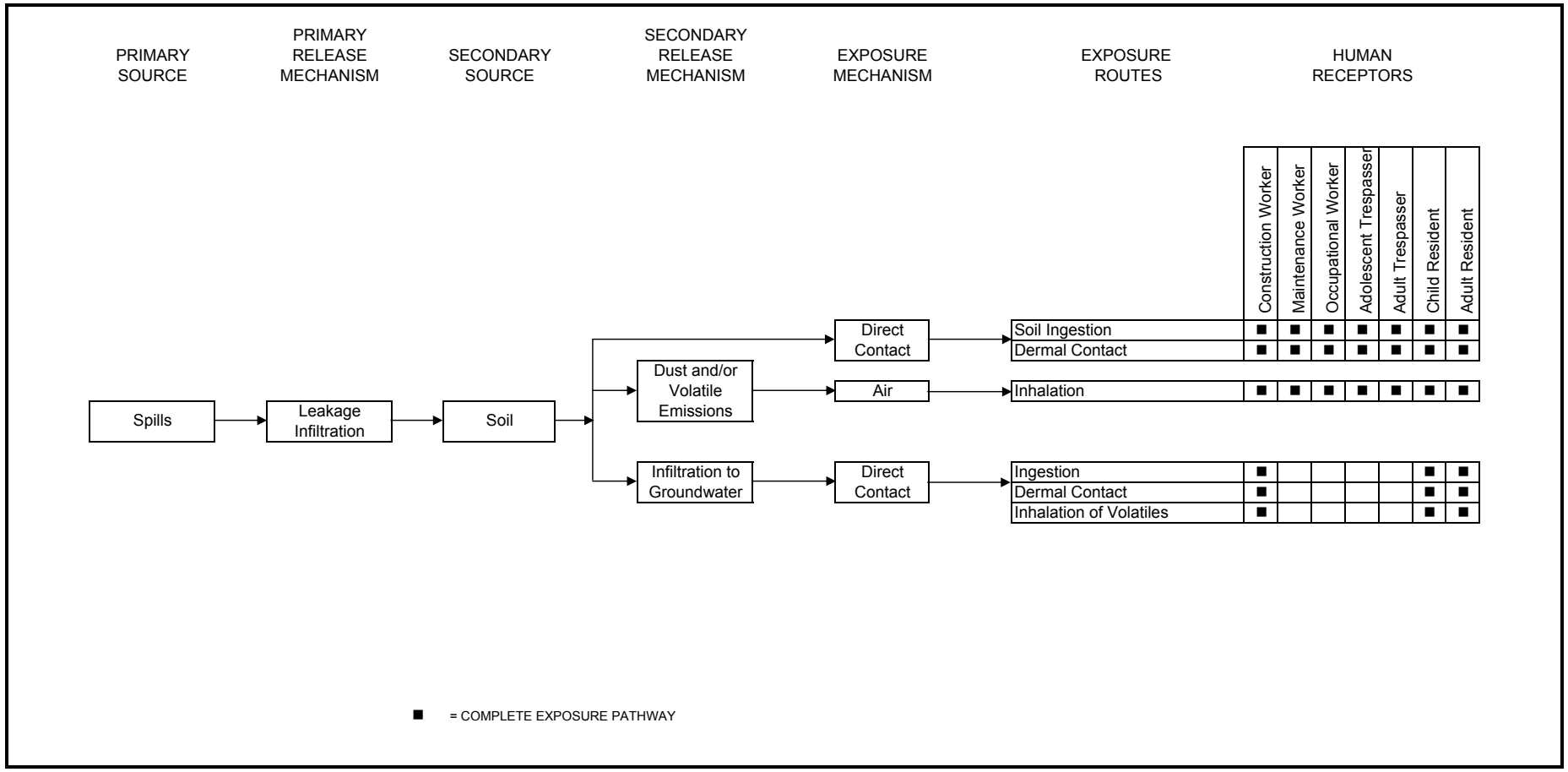

FIGURE 7-2

CONCEPTUAL SITE MODEL
POTENTIAL SOURCE OF CONTAMINATION 47
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Chemicals adsorbed to surface soil may also be released from a site via wind erosion of loose soil material. These particulates are carried downwind and potentially off site if the grain size is small enough and the wind velocity is great enough. Additionally, chemicals may also be released from soil via volatilization.

Once released from the source, contaminants are transported in media such as soil, groundwater, surface water, sediment, or air. Potential receptors may be exposed either directly or indirectly to contaminants in these media by a variety of exposure mechanisms, such as direct contact and immersion. Typically, several exposure routes (ingestion, dermal contact, inhalation, etc.) are associated with a particular exposure mechanism.

The CSM presented in Figure 7-2 also indicates those exposure routes that are carried through the quantitative risk assessment for each potential receptor. An objective of the development of the CSM, as well as the baseline HHRA, is to focus attention on those pathways that contribute the most to the potential impacts on human health and the environment and to provide the rationale for eliminating other exposure pathways that are considered to be minor components of the overall risk.

7.2.2 Potential Current and Future Receptors of Concern and Exposure Pathways

Potential receptors were identified for both current and future land use conditions. The receptors were identified by analyzing the interaction of current land use practices and the identified sources of contamination. Future site use is expected to remain the same as current. The identified receptors are as follows:

- **Future construction workers** who may contact contaminated media while excavating or performing construction activities. Construction workers could be exposed to surface and subsurface soils (incidental ingestion, dermal contact), shallow groundwater pooling at the bottom of an excavation pit (dermal contact), and air (inhalation).

- **Current/future maintenance workers (groundskeepers)** who may contact contaminated surface soil while performing assigned duties. The maintenance worker could be exposed to surface soil (incidental ingestion, dermal contact) and air (inhalation) during grounds keeping or maintenance activities.

- **Current/future occupational (commercial/industrial) workers** who may contact contaminated surface soil media while performing work tasks. This receptor could be exposed to surface soil (incidental ingestion, dermal contact) and air (inhalation). It is anticipated that this receptor would not

be routinely exposed to groundwater. Office workers may be minimally exposed to site-related contamination when compared to outdoor workers.

- **Current/future adult and adolescent trespassers** who may contact contaminated surface soil. Trespassers are not a likely receptor under current conditions since a fence surrounds PSC 47 and access to NAS Jacksonville is restricted. Trespassers may be exposed to potentially contaminated surface soil (incidental ingestion, dermal contact) and air (inhalation). Direct contact with groundwater or subsurface soils is not anticipated for this receptor.

- **Hypothetical future on-site residents** are evaluated as potential receptors. Future child and adult residents are not receptors under current or expected future land use and are included only to provide an indication of potential risks if the area was developed for residential use. Hypothetical future on-site residents may be exposed to contaminated surface soil and groundwater. In addition, future hypothetical residents could be exposed to subsurface soil that has been brought to the surface during construction activities. It is assumed that the hypothetical resident may be exposed to surface soils (incidental ingestion, dermal contact), groundwater (ingestion, dermal contact), and air (inhalation).

A summary of the rationale used for the selection or elimination of a potential receptor group is provided in Table 7-10. Recreational users are not considered to be a potential receptor group because the site is not currently used for recreational activities nor is it expected to be used for recreational activities in the future. If an individual did use the site for recreational activities, their exposures would be similar to those of the adolescent and adult trespassers.

7.2.3 Exposure Point Concentrations

According to USEPA guidance (1989, 2002b), risk assessments are conducted using a representative exposure point concentration (EPC) for each COPC. The EPC is typically defined as the 95 percent upper confidence limit (UCL), which is based on the distribution of a data set. However, when small data sets (i.e., less than 11 samples) are available for a site and/or medium, the UCL is not considered to be a good estimate of the sample mean and in those cases the maximum detected concentration is used as the EPC.

The EPCs for soil were calculated following USEPA's Calculating UCLs for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002b using TtNUS software based on the USEPA's ProUCL software and guidance (Singh et al., 2004). In general, the concentration selected for the EPC was the value recommended by the ProUCL guidance, subject to final review by the risk assessor or a

Table 7-10
Selection of Exposure Pathways

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil	Surface Soil	Surface Soil	Maintenance Workers	Adult	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Site maintenance workers, such as groundskeepers, may periodically enter the site and contact contaminated soil in the course of their job duties.
		Air	Surface Soil	Maintenance Workers	Adult	Inhalation	On-Site	Quantative	No COPCs were identified in soil for the inhalation pathway, therefore this pathway is not evaluated.
		Surface Soil	Surface Soil	Trespassers	Adolescents and Adults	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Persons may trespass on the site and contact contaminated soil.
		Air	Surface Soil	Trespassers	Adolescents and Adults	Inhalation	On-Site	Quantative	Trespassers may be exposed to fugitive dust and volatile emissions.
Future	Surface Soil	Surface Soil	Surface Soil	Construction Workers	Adult	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Construction workers may have contact with surface soil during excavation activities.
		Air	Surface Soil	Construction Workers	Adult	Inhalation	On-Site	Quantative	Construction workers may be exposed to fugitive dust and volatile emissions during construction activities.
		Surface Soil	Surface Soil	Occupational Workers	Adult	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Occupational (commercial/industrial) workers, may contact contaminated soil in the course of their job duties.
		Air	Surface Soil	Occupational Workers	Adult	Inhalation	On-Site	Quantative	Occupational workers may be exposed to fugitive dust and volatile emissions.
	Surface Soil	Surface Soil	Surface Soil	Residents	Child	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Hypothetical on-site residents may be exposed to contaminated soil during typical residential activities, such as gardening or playing.
					Adult	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Hypothetical on-site residents may be exposed to contaminated soil during typical residential activities, such as gardening or playing.
		Air	Surface Soil	Residents	Child	Inhalation	On-Site	Quantative	Hypothetical on-site residents may be exposed to fugitive dust and volatile emissions.
					Adult	Inhalation	On-Site	Quantative	Hypothetical on-site residents may be exposed to fugitive dust and volatile emissions.
	SubSurface Soil	SubSurface Soil	SubSurface Soil	Construction Workers	Adult	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Construction workers may have contact with subsurface soil during excavation activities.
			SubSurface Soil	Residents	Child	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Hypothetical on-site residents may be exposed to contaminated subsurface soil that was brought to the surface.
					Adult	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Hypothetical on-site residents may be exposed to contaminated subsurface soil that was brought to the surface.
		Air	SubSurface Soil	Construction Workers	Adult	Inhalation	On-Site	Quantative	Construction workers may be exposed to fugitive dust and volatile emissions during construction activities.
			SubSurface Soil	Residents	Child	Inhalation	On-Site	Quantative	Hypothetical on-site residents may be exposed to fugitive dust and volatile emissions.
					Adult	Inhalation	On-Site	Quantative	Hypothetical on-site residents may be exposed to fugitive dust and volatile emissions.
	Groundwater	Groundwater	Groundwater	Construction Workers	Adult	Ingestion Dermal	On-Site On-Site	None Quantative	Groundwater is not used as a potable water supply at the site. Construction workers may contact groundwater during excavation activities.
			Tap Water	Residents	Child	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Hypothetical on-site residents may be exposed to COPCs in groundwater if groundwater was used as a potable water source.
					Adult	Ingestion Dermal	On-Site On-Site	Quantative Quantative	Hypothetical on-site residents may be exposed to COPCs in groundwater if groundwater was used as a potable water source.

Table 7-10
Selection of Exposure Pathways

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Air	Groundwater	Construction Workers	Adult	Inhalation	On-Site	Quantative	Construction workers may contact groundwater during excavation activities.
			Tap Water	Residents	Child	Inhalation	On-Site	Quantative	Hypothetical on-site residents may be exposed to COPCs in groundwater if groundwater was used as a potable water source.
					Adult	Inhalation	On-Site	Quantative	Hypothetical on-site residents may be exposed to COPCs in groundwater if groundwater was used as a potable water source.
			Indoor Air	Residents	Child	Inhalation	On-Site	Quantative	Hypothetical on-site residents may be exposed to COPCs that have volatilized from groundwater and migrated through building foundations into indoor air.
					Adult	Inhalation	On-Site	Quantative	Hypothetical on-site residents may be exposed to COPCs that have volatilized from groundwater and migrated through building foundations into indoor air.

statistician. The distribution-based UCL and the rationale for selecting the EPC are described on the RAGS Part D Table 3 presented in Appendix K.

The maximum detected concentration in groundwater was used as the EPC for evaluating direct exposures to groundwater.

USEPA Region IV has adopted a Toxicity Equivalence Factor (TEF) approach to evaluate potentially carcinogenic PAHs. These TEFs are based on the relative potency of each compound relative to that of benzo(a)pyrene. TEFs for the individual carcinogenic PAHs are as follows:

Compound	**TEF**
Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenzo(a,h)anthracene	1.0
Indeno(1,2,3-cd)pyrene	0.1

The TEFs are used to convert each individual carcinogenic PAH concentration into an equivalent concentration of benzo(a)pyrene. Using individual benzo(a)pyrene equivalent concentrations, an EPC for carcinogenic PAHs is derived. If all the carcinogenic PAHs were not detected in a sample then one half the sample quantitation limit for benzo(a)pyrene was used as the equivalent concentration for that sample.

EPCs for COPCs for exposed surface soil, all surface soil, surface/subsurface soil, and groundwater are summarized in Table 7-11. The EPCs are also presented in the Risk Assessment Guidance for Superfund (RAGS) Part D tables included in Appendix K.

7.2.4 Quantification of Exposure

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this section and have been obtained from a variety of USEPA guidance documents, which are cited in the specific intake estimation sections that follow.

Exposure model parameters for all receptors are presented in Table 7-12. The parameters are used in the equations presented in this section, along with the EPCs previously defined to estimate contaminant

Table 7-11
Exposure Point Concentrations

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	All Surface Soil (ug/kg)	Surface/ Subsurface Soil (ug/kg)	Groundwater (6) (ug/L)
Volatile Organic Compounds			
1,2,4-Trichlorobenzene	NA	NA	8.6
1,2-Dibromo-3-Chloropropane	NA	NA	2.7
1,4-Dichlorobenzene	NA	NA	6.3
Benzene	NA	NA	14.6
Chlorobenzene	NA	NA	12.7
Chloroform	NA	NA	0.37
cis-1,2-Dichloroethene	NA	NA	936
Ethylbenzene	NA	NA	135
Isopropylbenzene	NA	NA	9
Tetrachloroethene	NA	NA	4
Total Xylenes	NA	NA	914
trans-1,2-Dichloroethene	NA	NA	4.5
Trichloroethene	NA	NA	7.7
Vinyl Chloride	NA	NA	5.5
Semivolatile Organic Compounds			
1,1'- Biphenyl	NA	NA	8
2,4,5-Trichlorophenol	NA	NA	2720
2,4-Dichlorophenol	NA	NA	529
2-Methylnaphthalene	NA	NA	103
Benzo(a)pyrene Equivalents	0.644 (1)	0.644 (1)	NA
Pentachlorphenol	NA	NA	12
Naphthalene	NA	NA	194
Pesticides/PCBs			
4,4'-DDD	2.49 (2)	18.9 (2)	25
4,4'-DDE	4.12 (3)	8.48 (3)	0.13
4,4'-DDT	116 (4)	163 (2)	0.49
Aldrin	NA	NA	3.8
Alpha-BHC	NA	0.241 (2)	9.3
Alpha-Chlordane	4.73 (3)	4.0 (2)	1.8
Beta-BHC	NA	0.226 (5)	3.9
Delta-BHC	NA	1.92 (2)	8.3
Dieldrin	0.592 (2)	0.838 (2)	0.32
Endrin Ketone	NA	NA	4.7
Gamma-BHC	NA	0.308 (2)	15
Gamma-Chlordane	3.57 (2)	3.83 (2)	1.1
Heptachlor	0.433 (2)	0.204 (2)	0.22
Heptachlor Epoxide	0.223 (5)	0.154 (5)	0.62
Inorganics			
Arsenic	7.77 (5)	12.1(5)	6640

Notes
RAGS Part D Tables for the exposure point concentrations are included in Appendix L.
NA - Not applicable - Chemical is not a COPC for this media.
1 - There were less than 10 samples therefore the maximum detected concentration was used for the exposure point concentration.
2 - 99% Chebyshev(Mean, Std) UCL
3 - H-UCL
4 - 95% Chebyshev(Mean, Std) UCL
5 - 97.5% Chebyshev(Mean, Std) UCL
6 - Maximum concentration is used as the exposure point concentration for groundwater in accordance with FDEP guidance.

Table 7-12
Summary of Exposure Input Parameters

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Exposure Input Parameter	Construction Worker	Site Maintenance Worker	Occupational Worker	Adolescent Trespasser	Adult Trespasser	Child Resident	Adult Resident
All Exposures							
Exposure Concentration - C_{soil}(mg/kg) C_{gw} (ug/L)	Maximum or 95% UCL	Maximum or 95% UCL	Maximum or 95% UCL	Maximum or 95% UCL	Maximum or 95% UCL	Maximum or 95% UCL	Maximum or 95% UCL
Exposure Duration (ED) (years)	1[1]	25[2]	25[2]	10[1]	20[1]	6[2]	24[2]
Body Weight (BW) (kg)	70[3]	70[3]	70[3]	45[4]	70[3]	15[3]	70[3]
Non-carcinogenic Averaging Time (AT_n) (days)	365[3]	9,125[3]	9,125[3]	3,650[3]	7,300[3]	2,190[3]	8,760[3]
Carcinogenic Averaging Time (AT_c) (days)	25,550[3]	25,550[3]	25,550[3]	25,550[3]	25,550[3]	25,550[3]	25,550[3]
Incidental Ingestion/Dermal Contact with Soil							
Ingestion Rate (IR) (mg/day)	330[5]	50[2]	50[2]	100[2]	100[2]	200[2]	100[2]
EF (days/year)	90[1]	30[1]	250[2]	100[1]	45[1]	350[2]	350[2]
Fraction Ingested from Contaminated Source (Fi) (unitless)	1.0[2]	1.0[2]	1.0[2]	1.0[2]	1.0[2]	1.0[2]	1.0[2]
Skin Surface Area (SA) (cm^2/day)	3,300[5,6]	3,300[6]	3,300[6]	3,280[4]	5,700[6]	2,800[6]	5,700[6]
Soil-to-Skin Adherence Factor (AF) (mg/cm^2)	0.3[5,6]	0.2[6]	0.2[6]	0.2[6]	0.07[6]	0.2[6]	0.07[6]
Absorption Factor (ABS) (unitless)	chemical-specific[6]	chemical-specific[6]	chemical-specific[6]	chemical-specific[6]	chemical-specific[6]	chemical-specific[6]	chemical-specific[6]
Conversion Factor (CF) (kg/mg)	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06	1.0E-06
Inhalation Fugitive Dust/Volatile Emissions from Surface Soil							
C_{air} (mg/m^3)	calculated[7]	calculated[7]	calculated[7]	calculated[7]	calculated[7]	calculated[7]	calculated[7]
InhR (m^3/hour)	2.5[8]	2.5[8]	2.5[8]	1.2[4]	1.6[4]	0.34[8]	0.55[8]
ET (hours/day)	8[2]	8[2]	8[2]	4[1]	4[1]	24[2]	24[2]
PEF (m^3/kg)	1.49E+06[5]	1.24E+09[8]	1.24E+09[8]	1.24E+09[8]	1.24E+09[8]	1.24E+09[8]	1.24E+09[8]
Ingestion/Dermal Contact with Groundwater							
Ingestion Rate (IR_{gw})(L/day)	NA	NA	NA	NA	NA	1.5[4]	2[2]
EF (days/year)	30[1]	NA	NA	NA	NA	350[2]	350[2]
Exposure Time (ET) (hours/day) and t_{event} (hours/event)	1.0[1]	NA	NA	NA	NA	0.33[6]	0.25[6]
Skin Surface Area (SA) (cm^2/day)	3,300[5,6]	NA	NA	NA	NA	6,600[6]	18,000[6]
Event Frequency (EV) (events/day)	1[1]	NA	NA	NA	NA	1[6]	1[6]
Permeability Coefficient from Water through Skin (K_p)(cm/hour)	chemical-specific[6]	NA	NA	NA	NA	chemical-specific[6]	chemical-specific[6]
Bunge Dermal Model variables - t* (hour/event), T (hour), and B (unitless)	chemical-specific[6]	NA	NA	NA	NA	chemical-specific[6]	chemical-specific[6]

Table 7-12
Summary of Exposure Input Parameters

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Exposure Input Parameter	Construction Worker	Site Maintenance Worker	Occupational Worker	Adolescent Trespasser	Adult Trespasser	Child Resident	Adult Resident
Conversion Factor (CF) (L/cm^3)	1.0E-03	NA	NA	NA	NA	1.0E-03	1.0E-03

Notes:

A = Skin surface area available for contact
ABS = Absorption factor
AF = Soil-to-skin adherence factor
AT_c = Averaging time for carcinogenic effects
AT_n = Averaging time for noncarcinogenic effects
B = Bunge Model partitioning coefficient
BW = Body weight
CF = Conversion factor
CR = Contact rate
C_{air} = Exposure concentration for air
C_{soil} = Exposure concentration for soil/sediment
C_{gw} = Exposure concentration for groundwater
ED = Exposure duration
EF = Exposure frequency
ET = Exposure time
EV = Event frequency
FI = Fraction ingested from contaminated source
InhR = Inhalation rate
IR = Ingestion rate (soil or groundwater)
K_p = Permeability coefficient from water through skin
L/cm^3 = Liters per cubic centimeters
L/day = Liters per day
mg/cm^2 = Milligrams per centimeter squared
PEF = Particulate Emission Factor
SA = Skin surface area available for contact
τ = Lag time
t* = Time it takes to reach steady-state conditions
t_{event} = Duration of event

1 - Assumption, based on professional judgement
2 - USEPA 1991. *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Parameters*
3 - USEPA 1989. *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Interim Final)* EPA/540/1-89/002
4 - USEPA 1997. *Exposure Factors Handbook* EPA/600/p-95/002 Fa
5 - USEPA, 2002: *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. OSWER 9355.4-24.
6 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment Final Guidance) EPA/540/R/99/005.
7 - USEPA, 1996: Soil Screening Guidance: Technical Background Document.
8 - FDEP, 2005: Technical Report: Development of Cleanup Target Levels (CTLs) for Chapter 62-777, F.A.C.

intakes, which will be used to determine potential risks. Individual chemical intakes for each receptor/exposure route combination are presented in Appendix K.

7.2.4.1 Incidental Ingestion of Soil

The incidental ingestion of a small amount of soil is assumed to occur when a receptor comes into direct contact with contaminated soil. Exposure associated with the oral route of exposure is estimated in the following manner (USEPA, 1989):

$$Intake_{si} = \frac{(C_{si})(IR_s)(FI)(EF)(ED)(CF)}{(BW)(AT)}$$

where:

$Intake_i$	=	intake of contaminant "i" from soil (mg/kg/day)
C_{si}	=	concentration of contaminant "i" in soil (mg/kg)
IR_s	=	incidental ingestion rate for soil (mg/day)
FI	=	fraction ingested from contaminated source (decimal fraction)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
CF	=	conversion factor (10^{-6} kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for non-carcinogens, AT = ED x 365 days/year;
		for carcinogens, AT = 70 years x 365 days/year

Since PSC 47 is relatively small in size, it was assumed that a construction worker would be engaged in construction related activities 90 days/year (EF_{Soil}) over a 1 year period (ED). Maintenance workers are assumed to be exposed 30 days a year over 25 years. Adolescent trespassers are assumed to be exposed 100 days a year over 10 years. Adult trespassers are assumed to be exposed 45 days a year over 20 years. All other exposure parameters for incidental ingestion of soil are standard USEPA default values.

7.2.4.2 Dermal Contact with Soil

During direct contact, contaminated soil may adhere to the skin of potential receptors. Dermal absorption of COPCs from potentially contaminated soil and sediment is calculated using the following equation:

$$Intake_{si} = \frac{(C_{si})(SA)(AF)(ABS)(CF)(EF)(ED)}{(BW)(AT)}$$

where: $Intake_{si}$ = amount of chemical "i" absorbed during contact with soil or sediment (mg/kg/day)

C_{si} = concentration of chemical "i" in soil or sediment (mg/kg)

SA = skin surface area available for contact (cm^2/day)

AF = skin adherence factor (mg/cm^2)

ABS = absorption factor (decimal fraction)

CF = conversion factor (10^{-6} kg/mg)

EF = exposure frequency (days/year)

ED = exposure duration (years)

BW = body weight (kg)

AT = averaging time (days);
for non-carcinogens, AT = ED x 365 days/year;
for carcinogens, AT = 70 years x 365 days/year

The same exposure frequencies and durations used in the estimation of incidental ingestion intakes of soil/sediment are used to estimate exposure via dermal contact. Current guidance (USEPA, 2004a) is used to develop the following default assumptions concerning the amount of skin surface area available for contact for a receptor:

- For the construction worker, maintenance worker, and occupational worker, the surface area assumed to be available for soil contact [3,300 centimeters squared (cm^2)] is the average of the 50th percentile skin surface area value for the head, hands, and forearms (USEPA, 2004a).

- For the adolescent trespasser, the surface area assumed to be available for soil contact (3,820 cm^2) which assumes that 25 percent of the total body surface is available for exposure.

- For hypothetical future on-site child resident, the surface area assumed to be available for soil contact (2,800 cm^2) is the average of the 50th percentile skin surface area value for the head, hands, forearms, lower legs, and feet (USEPA, 2004a).

- For the adult trespasser and hypothetical future on-site adult resident, the surface area assumed to be available for soil contact (5,700 cm^2) is the average of the 50th percentile skin surface area value for the head, hands, forearms, and lower legs (USEPA, 2004a).

Current USEPA Guidance (USEPA, 2004a) was used to determine soil adherence factors and chemical-specific absorption factors. The soil adherence factors were 0.3 mg/cm^2 for construction

workers; 0.2 mg/cm^2 for maintenance workers, occupational workers, adolescent trespassers, and child residents; and 0.07 mg/cm^2 for adult trespassers and adult residents.

For the constituents identified as COPCs in soil, the following absorption factors were used (USEPA, 2004a, unless otherwise noted):

- DDD, DDE, and DDT – 0.03
- Chlordane – 0.04
- Arsenic – 0.03
- Semivolatile Organics – 0.1
- Other Inorganics and Volatile Organics – not evaluated for dermal contact with soil (USEPA, 2004a)

7.2.4.3 Inhalation of Air and Fugitive Dust/Volatile Emissions from Soil

The amount of a chemical that a receptor takes in as a result of respiration was determined using the concentration of the contaminant in air. Intakes of both particulates and vapors and gases from soil were calculated using the same equation, as follows (USEPA, 1989):

$$\text{Intake}_{ai} = \frac{(C_{ai})(IR_a)(ET)(EF)(ED)}{(BW)(AT)}$$

where:	Intake_{ai}	=	intake of chemical "i" from air via inhalation (mg/kg/day)
	C_{ai}	=	concentration of chemical "i" in air (mg/m^3)
	IR_a	=	inhalation rate (m^3/hour)
	ET	=	exposure time (hours/day)
	EF	=	exposure frequency (days/year)
	ED	=	exposure duration (year)
	BW	=	body weight (kg)
	AT	=	averaging time (days);
			for noncarcinogens, AT = ED x 365 days/year;
			for carcinogens, AT = 70 years x 365 days/year

The concentrations of chemicals in air resulting from emissions from soil were developed following procedures presented in USEPA Soil Screening Guidance (USEPA, 1996). No volatiles were retained as COPCs in soil therefore the chemical concentration in air was calculated as follows:

$$C_a = C_s \times \left[\frac{1}{PEF}\right]$$

where: C_a = chemical concentration in air, mg/m^3
C_s = chemical concentration in soil, mg/kg
PEF = particulate emission factor, m^3/kg

The PEF relates the concentration of the chemical in soil with the concentration of dust particles in air. A PEF value of 1.24 x 10^{+9} was used for PSC 47 (FDEP, 2005). Because air emissions resulting from fugitive dust emissions settings will be different than dust emissions generated during construction activities, a separate PEF was used for construction activities. The PEF for construction workers (1.49 x 10^{+6} m^3/kg) was calculated using the equations presented in the supplemental SSL guidance document (USEPA, 2002c).

7.2.4.4 Ingestion of Groundwater

Ingestion of groundwater was evaluated for the hypothetical future resident only. Intakes associated with ingestion of groundwater were evaluated using the following equations (USEPA, 1989):

$$\text{Intake}_{wi} = \frac{(C_{wi})(IR_w)(EF)(ED)}{(BW)(AT)}$$

where: Intake_{wi} = intake of chemical "i" from water (mg/kg/day)
C_{wi} = concentration of chemical "i" in water (mg/L)
IR_w = ingestion rate for groundwater (L/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)
for non-carcinogens, AT = ED x 365 days/year
for carcinogens, AT = 70 years x 365 days/year

USEPA default exposure assumptions are used to evaluate exposure to groundwater by hypothetical future child and adult residents.

7.2.4.5 Dermal Contact with Groundwater

The following equation is used to assess exposures resulting from dermal contact with water (USEPA, 2004a):

$$DAD_{wi} = \frac{(DA_{event})(EV)(ED)(EF)(A)}{(BW)(AT)}$$

where:

DAD_{wi}	=	dermally absorbed dose of chemical "i" from water (mg/kg/day)
DA_{event}	=	absorbed dose per event (mg/cm^2-event)
EV	=	event frequency (events/day)
ED	=	exposure duration (years)
EF	=	exposure frequency (days/year)
A	=	skin surface area available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
		for non-carcinogens, AT = ED x 365 days/year
		for carcinogens, AT = 70 years x 365 days/year

Total body exposure (e.g. showering) is assumed for residents dermally exposed to COPCs in groundwater. For dermal exposure to groundwater by construction workers, the surface area assumed to be available for contact is 3,300 cm^2, which is average of the 50th percentile skin surface area value for the head, hands, and forearms (USEPA, 2004a). It was assumed that a construction worker was exposed to groundwater one hour a day. USEPA default values were used for child and adult residents. The total body surface area was assumed to be available for contact to groundwater by a child (6,600 cm^2) and adult resident (18,000 cm^2). Exposure frequencies and durations for dermal contact with groundwater are assumed to be the same as those for ingestion of groundwater.

The absorbed dose per event (DA_{event}) is estimated using a nonsteady-state approach for organic compounds and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^*, \text{ then : } DA_{event} = (2K_p)(FA)(C_{wi})(CF)\left(\sqrt{\frac{6\,\tau\, t_{event}}{\pi}}\right)$$

$$\text{If } t_{event} > t^*, \text{ then : } DA_{event} = (K_p)(FA)(C_{w_i})(CF)\left(\frac{t_{event}}{1+B} + 2\,\tau\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right)$$

where:

DA_{event}	=	absorbed dose per event
FA	=	fraction absorbed (dimensionless) – chemical specific
t_{event}	=	duration of event (hour/event)
t^*	=	time it takes to reach steady-state conditions (hours)
K_p	=	permeability coefficient from water through skin (cm/hour)
C_{wi}	=	concentration of chemical "i" in water (mg/L)
τ	=	lag time (hours)

π	=	constant (dimensionless; equal to 3.1416)
CF	=	conversion factor (0.001 L/cm^3)
B	=	partitioning constant derived by Bunge Model (dimensionless)

Values for the chemical-specific parameters (t_{event}, t^*, K_p, τ, and B) are obtained from the current dermal guidance (USEPA, 2004a) and are presented in Table 7-13. If no published values were available for a particular compound, they were calculated using equations provided in the USEPA dermal guidance.

The following steady-state equation is used to estimate DA_{event} for inorganics:

$$DA_{event} = (K_p)(C_{wi})(t_{event})$$

The dermal permeability (K_p) values recommended in the USEPA dermal guidance (USEPA, 2004a) were used to calculate DA_{event} for inorganic COPCs.

7.2.4.6 Inhalation of Volatiles in Groundwater by Hypothetical Residents

Groundwater exposure may also result in inhalation of volatiles, typically for adult residential receptors who may be exposed while showering, bathing, washing dishes, etc. Future adult residents exposed through inhalation while showering will be evaluated following USEPA Region IV guidance (USEPA, 2000a). USEPA Region IV Human Health Risk Assessment Guidance stipulates that the risk associated with inhalation of volatile COPCs while showering is equivalent to risk from exposure via ingestion of two liters of contaminated water per day. In order to calculate total risk from groundwater in accordance with USEPA Region IV guidance, the estimated risk calculated for ingestion of volatile organic COPCs in groundwater is doubled to factor in the risk from inhalation of volatile organic COPCs in groundwater.

7.2.4.7 Inhalation of Volatiles in Groundwater by Construction Workers

Construction workers may be exposed to COPCs that have volatilized from groundwater when excavation exposes the shallow water table. Exposures for construction workers associated with the inhalation route are estimated in the following manner (USEPA, 1989):

$$Intake_{ai} = \frac{(C_{ai})(IR_a)(ET)(EF)(ED)}{(BW)(AT)}$$

Table 7-13
Parameters for Evaluation of Dermal Contact with Soil/Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical of Potential Concern	Media	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Volatile Organic Compounds												
1,2,4-Trichlorobenzene	Groundwater	NA	1	6.6E-02	cm/hr	(1)	hr	1.1E+00	hr	2.7E+00	hr	3.4E-01
1,2-Dibromo-3-Chloropropane	Groundwater	NA	1	6.8E-03	cm/hr	(1)	hr	2.2E+00	hr	5.3E+00	hr	4.0E-02
1,4-Dichlorobenzene	Groundwater	NA	1	4.2E-02	cm/hr	(1)	hr	7.1E-01	hr	1.7E+00	hr	2.0E-01
Benzene	Groundwater	NA	1	1.5E-02	cm/hr	(1)	hr	2.9E-01	hr	7.0E-01	hr	5.1E-02
Chlorobenzene	Groundwater	NA	1	2.8E-02	cm/hr	(1)	hr	4.6E-01	hr	1.1E+00	hr	1.2E-01
Chloroform	Groundwater	NA	1	6.8E-03	cm/hr	(1)	hr	5.0E-01	hr	1.2E+00	hr	2.9E-02
cis-1,2-Dichloroethene	Groundwater	NA	1	1.1E-02	cm/hr	(1)	hr	3.7E-01	hr	8.8E-01	hr	4.1E-02
Ethylbenzene	Groundwater	NA	1	4.9E-02	cm/hr	(1)	hr	4.2E-01	hr	1.0E+00	hr	2.0E-01
Isopropylbenzene	Groundwater	NA	1	8.8E-02	cm/hr	(1)	hr	4.9E-01	hr	1.2E+00	hr	3.7E-01
Tetrachloroethene	Groundwater	NA	1	3.3E-02	cm/hr	(1)	hr	9.1E-01	hr	2.2E+00	hr	1.7E-01
Total Xylenes	Groundwater	NA	1	4.6E-02	cm/hr	(1)	hr	4.1E-01	hr	9.9E-01	hr	1.8E-01
trans-1,2-Dichloroethene	Groundwater	NA	1	7.7E-03	cm/hr	(1)	hr	3.7E-01	hr	8.9E-01	hr	2.9E-02
Trichloroethene	Groundwater	NA	1	1.2E-02	cm/hr	(1)	hr	5.8E-01	hr	1.4E+00	hr	5.1E-02
Vinyl Chloride	Groundwater	NA	1	5.6E-03	cm/hr	(1)	hr	2.4E-01	hr	5.7E-01	hr	1.7E-02
Semivolatile Organic Compounds												
1,1'- Biphenyl	Groundwater	NA	1	9.2E-02	cm/hr	(1)	hr	7.7E-01	hr	1.8E+00	hr	4.4E-01
2,4,5-Trichlorophenol	Groundwater	NA	1	3.5E-02	cm/hr	(1)	hr	1.3E+00	hr	3.2E+00	hr	1.9E-01
2,4-Dichlorophenol	Groundwater	NA	1	2.1E-02	cm/hr	(1)	hr	8.7E-01	hr	2.1E+00	hr	1.0E-01
2-Methylnaphthalene	Groundwater	NA	1	8.9E-02	cm/hr	(1)	hr	6.6E-01	hr	1.6E+00	hr	4.1E-01
Benzo(a)pyrene Equivalents	Soil	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Groundwater	NA	1	4.7E-02	cm/hr	(1)	hr	5.6E-01	hr	1.3E+00	hr	2.0E-01
Pentachlorophenol	Groundwater	NA	0.9	3.9E-01	cm/hr	(1)	hr	3.3E+00	hr	1.4E+01	hr	2.5E+00
Pesticides/PCBs												
4,4'-DDD	Groundwater/Soil	0.03	0.8	1.8E-01	cm/hr	(1)	hr	6.6E+00	hr	2.6E+01	hr	1.2E+00
4,4'-DDE	Groundwater/Soil	0.03	0.8	1.6E-01	cm/hr	(1)	hr	6.5E+00	hr	2.5E+01	hr	1.1E+00
4,4'-DDT	Groundwater/Soil	0.03	0.7	2.7E-01	cm/hr	(1)	hr	1.0E+01	hr	4.3E+01	hr	1.9E+00
Aldrin	Groundwater	NA	1	1.4E-03	cm/hr	(1)	hr	1.2E+01	hr	2.9E+01	hr	1.0E-02
alpha-BHC	Groundwater/Soil	0.1	1	2.0E-02	cm/hr	(1)	hr	4.5E+00	hr	1.1E+01	hr	1.3E-01
alpha-Chlordane	Groundwater/Soil	0.04	0.7	3.8E-02	cm/hr	(1)	hr	2.1E+01	hr	5.1E+01	hr	2.9E-01
beta-BHC	Groundwater/Soil	0.1	1	2.0E-02	cm/hr	(1)	hr	4.5E+00	hr	1.1E+01	hr	1.3E-01
delta-BHC	Groundwater/Soil	0.1	1	2.0E-02	cm/hr	(1)	hr	4.5E+00	hr	1.1E+01	hr	1.3E-01
Dieldrin	Groundwater/Soil	0.1	0.8	1.2E-02	cm/hr	(1)	hr	1.5E+01	hr	3.5E+01	hr	9.2E-02
Endrin Ketone	Groundwater	NA	0.8	2.3E-02	cm/hr	(1)	hr	1.4E+01	hr	3.4E+01	hr	1.7E-01
gamma-BHC (Lindane)	Groundwater/Soil	0.1	0.9	1.1E-02	cm/hr	(1)	hr	4.6E+00	hr	1.1E+01	hr	7.1E-02
gamma-Chlordane	Groundwater/Soil	0.04	0.7	3.8E-02	cm/hr	(1)	hr	2.1E+01	hr	5.1E+01	hr	2.9E-01
Heptachlor	Groundwater/Soil	0.1	0.8	8.6E-03	cm/hr	(1)	hr	1.3E+01	hr	3.2E+01	hr	6.4E-02
Heptachlor Epoxide	Groundwater/Soil	0.1	0.8	8.6E-03	cm/hr	(1)	hr	1.3E+01	hr	3.2E+01	hr	6.4E-02
Inorganics												
Arsenic	Groundwater/Soil	NA	NA	1.0E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA

Table 7-13
Parameters for Evaluation of Dermal Contact with Soil/Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Notes:
All values from USEPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim, Septemb
1 - T(event) is 1 hr for the construction worker, 0.33 hr for the child resident, and 0.25 hr for the adult resident.

FA = Fraction Absorbed Water
Kp = Dermal Permeability Coefficient of Compound in Water
T(event) = Event Duration
Tau = Lag Time
T* = Time to Reach Steady-State
B = Dimensionless Ratio of the Permeability Coefficient of a Compound Through the Stratum Corneum Relative to its Permeability Coefficient Across the Viable Epidermis
NA = Not applicable.

where:

$Intake_{ai}$	=	intake of chemical "i" from air via inhalation (mg/kg/day)
C_{ai}	=	concentration of chemical "i" in air (mg/m^3)
IR_a	=	inhalation rate (m^3/hour)
ET	=	exposure time (hours/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for non-carcinogens, AT = ED x 365 days/year;
		for carcinogens, AT = 70 years x 365 days/year

There are no well-established models available for estimating migration of volatiles from groundwater into a construction/utility trench. This risk assessment used an approach suggested by the Virginia Department of Environmental Quality (VDEQ, 2002) that is based on a combination of a vadose zone model to estimate volatilization of gases from contaminated groundwater into a trench and a box model to estimate dispersion of the contaminants from the air inside the trench into the aboveground atmosphere to estimate the EPC for air in a construction trench. The VDEQ methodology is described in the following sections.

Airborne concentrations of a contaminant in a trench were estimated using the following equation:

$$C_{ai} = C_{GW} \times VF \times CF$$

where:

C_{ai}	=	air concentration of contaminant in the trench (mg/m^3)
C_{GW}	=	concentration of contaminant in groundwater (µg/L)
VF	=	volatilization factor (L/m^3)
CF	=	conversion factor [0.001 milligrams per micrograms (mg/ug)]

The model used in this risk assessment assumed that a construction project could result in an excavation 15 ft bls or less. If the depth to groundwater at a site was less than 15 ft, the VDEQ model assumed that a worker would encounter groundwater when digging an excavation or a trench. The worker would then have direct exposure to the groundwater. The worker would also be exposed to contaminants in the air inside the trench that would result from volatilization from the groundwater pooling at the bottom of the trench.

The following equation was used to calculate volatilization factor for a trench less than 15 ft deep.

$$VF = (Ki \times A \times F \times 10^{-3} \times 10^{4} \times 3{,}600) / (ACH \times V)$$

where:

	K_i	= overall mass transfer coefficient of contaminant [centimeters per second (cm/s)]
	A	= area of the trench (m^2)
	F	= fraction of floor through which contaminant can enter (unitless)
	ACH	= air changes per hour (h^{-1})(360 h^{-1})
	V	= volume of trench (m^3)
	10^{-3}	= conversion factor (L/cm^3)
	10^4	= conversion factor (cm^2/m^2)
	3,600	= conversion factor (seconds/hour)

Studies of urban canyons suggest that if the ratio of trench width relative to wind direction to trench depth is less than or equal to 1, a circulation cell or cells will be set up within the trench that limits the degree of gas exchange with the atmosphere. If the ratio of trench width to trench depth is greater than 1, air exchange between the trench and aboveground atmosphere is not restricted, thus ACHs are assumed to be 360 based on the ratio of trench depth to the average wind speed. This risk assessment assumed that the width to trench depth ratio was greater than 1. Therefore, ACH were assumed to be 360.

$$K_i = 1 / \{(1/k_iL) + [(RT) / (H_i\ k_iG)]\}$$

where:

	k_iL	= liquid-phase mass transfer coefficient of i (cm/s)
	R	= ideal gas constant (atm-m^3/mole-°K = 8.2×10^{-5})
	T	= average system absolute temperature °K (Default = 298°K)
	H_i	= Henry's Law constant of i (atm-m^3/mol)
	k_iG	= gas-phase mass transfer coefficient of i (cm/s)

$$k_iL = (MWO_2/MWi)^{0.5} \times (T/298) \times kL,O_2$$

where:

	k_iL	= liquid-phase mass transfer coefficient of component i (cm/s)
	MWO_2	= molecular weight of O_2 [grams per mole (g/mol)]
	MW_i	= molecular weight of component i (g/mol)

kL,O_2 = liquid-phase mass transfer coefficient of oxygen at 25°C (cm/s)
= 0.002 cm/s

$k_iG = (MWH_2O/MW_i)^{0.335} \times (T/298)^{1.005} \times kG, H_2O$

where: k_iG = gas-phase mass transfer coefficient of component i (cm/s)
MWH_2O = molecular weight of water (g/mol)
kG,H_2O = gas-phase mass transfer coefficient of water vapor at 25°C (cm/s)
= 0.833 (cm/s)

The same exposure frequency and exposure time used to estimate intake from dermal contact with groundwater is used to evaluate intake from inhalation of VOCs from groundwater during construction activities. Chemical properties were obtained from the USEPA's Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, 2002c) and are presented in Table 7-14.

7.2.4.8 Vapor Intrusion Into Buildings

Future full-time employees and hypothetical future residents may be exposed to COPCs that have volatilized from groundwater and migrated through building foundations into indoor air. Indoor air concentrations resulting from vapor intrusion from groundwater are estimated using the Johnson and Ettinger volatilization model (USEPA, 2003). The model assumes that vapors of volatile chemicals are emitted from groundwater, migrate through surface and subsurface soil, through cracks in the building foundation, and accumulate in air inside a building. Input values for the vapor intrusion model are presented in Table 7-15. Results of the vapor intrusion model are included in Appendix K.

7.3 TOXICITY ASSESSMENT

The objective of a toxicity assessment is to identify the potential for human health hazards and adverse effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified COPCs. Quantitative toxicity values [cancer slope factors (CSFs) and reference doses (RfDs)] determined during this component of the risk assessment are integrated with outputs of the exposure assessment to characterize the potential for adverse health effects for each receptor group (Section 7.4). A CSF is an indicator of the potency of a chemical carcinogen (i.e., the greater the CSF, the more potent the carcinogen). More formally, a CSF is an upper bound estimate, approximating a 95-percent confidence limit, on the increased cancer risk from a lifetime exposure to a carcinogen. This estimate is usually expressed in units of proportion (of a population) affected per mg/kg/day of a carcinogen. The RfD is the dose at which and below which adverse non-carcinogenic effects are not anticipated.

Table 7-14
Chemical Properties for
Volatilization from Groundwater to Outdoor Air Model

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	Molecular Weight (g/mole)	Henry's Law Constant (atm-m^3/mol)
Volatile Organic Compounds		
1,2,4-Trichlorobenzene	181.5	1.42E-03
1,4-Dichlorobenzene	147	2.43E-03
Benzene	78.1	5.56E-03
Chlorobenzene	112.6	3.71E-03
Chloroform	119.4	3.66E-03
cis-1,2-Dichloroethene	96.95	4.07E-03
Ethylbenzene	106.2	7.88E-03
Isopropylbenzene	120.19	1.31E-02
Tetrachloroethene	165.83	1.84E-02
Total Xylenes	106.2	5.25E-03
trans-1,2-Dichloroethene	97	9.39E-03
Trichloroethene	131.4	1.03E-02
Vinyl Chloride	62.5	2.71E-02
Semivolatile Organic Compounds		
1,1'- Biphenyl	154.2	4.08E-04
2-Methylnaphthalene	1.42E+02	5.80E-05
Naphthalene	1.28E+02	4.83E-04

Source: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, USEPA, December 2002.

Table 7-15
Input Parameters for Vapor Intrusion Model

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Value	Definition
L_F	15 (Default)	Depth below grade to bottom of enclosed space floor, (cm)
L_{WT}	61 (Site-specific)	Depth below grade to water table, (cm)
Soil Type	SC (Site-specific)	SCS soil type directly above water table
T_S	22 (Site-specific)	Average soil/groundwater temperature, (^oC)
ρ_b^V	1.63 (Default)	Vadose zone soil dry bulk density, (g/cm^3)
n^V	0.385 (Default)	Vadose zone soil total porosity, (unitless)
θ_w^V	0.197 (Site-specific)	Vadose zone soil water-filled porosity, (cm^3/cm^3)
TR	1.0E-06 (Default)	Target risk for carcinogens, (unitless)
THQ	1 (Default)	Target hazard quotient for noncarcinogens, (unitless)
AT_C	70 (Default)	Averaging time for carcinogens, (years)
AT_{NC}	30 (Default)	Averaging time for noncarcinogens, (years)
ED	30 (Default)	Exposure duration, (years)
EF	350 (Default)	Exposure frequency, (days/years)

Notes:
Default values are representative of site conditions.

7.3.1 Sources of Toxicity Criteria

Oral and inhalation RfDs and CSFs to be used in the site-specific risk assessments were obtained from the following primary USEPA sources (USEPA, 2003):

- Integrated Risk Information System (IRIS) (Online) (USEPA, 2007b).
- USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops PPRTVs on a chemical specific basis when requested by USEPA's Superfund program.
- Other Toxicity Values – These sources include but are not limited to California Environmental Protection Agency (CA EPA) toxicity values, the Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs), and the Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997c).

Although RfDs and CSFs can be found in several toxicological sources, USEPA's IRIS on-line database is the preferred source of toxicity values. This database is continuously updated and values presented have been verified by USEPA. The USEPA Region III Risk-Based Concentration (RBC) tables were also used as a source of toxicity criteria when these criteria were not available from the aforementioned references. Oral and inhalation RfDs and CSFs for the constituents identified as COPCs are presented in Tables 7-16 through 7-19.

7.3.2 Toxicity Criteria for Dermal Exposures

RfDs and CSFs found in the literature are frequently expressed as administered doses; therefore, these values are considered to be inappropriate for estimating the risks associated with dermal routes of exposure. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before the comparison to estimated dermal exposure intakes is made.

The adjustment from administered to absorbed dose was made using chemical-specific gastrointestinal absorption efficiencies published in available guidance [i.e., USEPA 2004a (the primary reference); IRIS; ATSDR toxicological profiles, etc.] and the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) \ / \ (ABS_{GI})$$

where: ABS_{GI} = absorption efficiency in the gastrointestinal tract.

Table 7-16
Non-Cancer Toxicity Data - Oral/Dermal

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds										
1,2,4-Trichlorobenzene	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Kidney	1000/1	IRIS	04/18/2007
1,2-Dibromo-3-Chloropropane	Chronic	2.0E-04	mg/kg/day	1	2.0E-04	mg/kg/day	Reproductive	NA	NCEA	4/6/2006
1,4-Dichlorobenzene	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Liver	NA	NCEA	4/6/2006
Benzene	Chronic	4.0E-03	mg/kg/day	1	4.0E-03	mg/kg/day	Blood	300/1	IRIS	04/18/2007
Chlorobenzene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Liver	1000/1	IRIS	04/18/2007
Chloroform	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000/1	IRIS	04/18/2007
cis-1,2-Dichloroethene	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Blood	NA	NCEA	4/6/2006
trans-1,2-Dichloroethene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Blood	1000/1	IRIS	04/18/2007
Ethylbenzene	Chronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Liver, Kidney	1000/1	IRIS	04/18/2007
Isopropylbenzene	Chronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Kidney	1000/1	IRIS	04/18/2007
Tetrachloroethene	Chronic	1.0E-02	mg/kg/day	1	1.0E-02	mg/kg/day	Liver	1000/1	IRIS	04/18/2007
Total Xylenes	Chronic	2.0E-01	mg/kg/day	1	2.0E-01	mg/kg/day	Body Weight	1000/1	IRIS	04/18/2007
Trichloroethene	Chronic	5.0E-01	mg/kg/day	1	5.0E-01	mg/kg/day	Liver	NA	CA EPA	12/2002
Vinyl Chloride	Chronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Liver	30/1	IRIS	04/18/2007
Semivolatile Organic Compounds										
1,1-Biphenyl	Chronic	5.0E-02	mg/kg/day	1	5.0E-02	mg/kg/day	Kidney	100/10	IRIS	04/18/2007
2,4,5-Trichlorophenol	Chronic	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	Liver, Kidney	1000/1	IRIS	04/18/2007
2,4-Dichlorophenol	Chronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Immunological	100/1	IRIS	04/18/2007
2-Methylnaphthalene	Chronic	4.0E-03	mg/kg/day	1	4.0E-03	mg/kg/day	Lungs	1000/1	IRIS	04/18/2007
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight, Nasal	3000/1	IRIS	04/18/2007
Pentachlorophenol	Chronic	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	Liver, Kidney	100/1	IRIS	04/18/2007
Pesticides/PCBs										
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	Chronic	5.0E-04	mg/kg/day	1	5.0E-04	mg/kg/day	Liver	100/1	IRIS	04/18/2007
Alpha-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alpha-Chlordane	Chronic	5.0E-04	mg/kg/day	1	5.0E-04	mg/kg/day	Liver	300/1	IRIS	04/18/2007
Beta-BHC	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Delta-BHC	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	Chronic	5.0E-05	mg/kg/day	1	5.0E-05	mg/kg/day	Liver	100/1	IRIS	04/18/2007
Endrin Ketone(3)	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Liver	100/1	IRIS	04/18/2007
Gamma-BHC (Lindane)	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Liver, Kidney	1000/1	IRIS	04/18/2007
Gamma-Chlordane	Chronic	5.0E-04	mg/kg/day	1	5.0E-04	mg/kg/day	Liver	300/1	IRIS	04/18/2007
Heptachor	Chronic	5.0E-04	mg/kg/day	1	5.0E-04	mg/kg/day	Liver	300/1	IRIS	04/18/2007
Heptachor Epoxide	Chronic	1.3E-05	mg/kg/day	1	1.3E-05	mg/kg/day	Liver	1000/1	IRIS	04/18/2007
Metals										
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	09/15/2003

Notes:
1 - USEPA, 2001a: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 - Endrin is used as a surrogate for endrin ketone.

Definitions:
NA = Not Applicable
CVS = Cardiovascular system
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
NCEA = USEPA Region 3 Risk-Based Concentration Table, April 25, 2003.

Table 7-17
Non-Cancer Toxicity Data - Inhalation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds									
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromo-3-Chloropropane	Chronic	2.0E-04	mg/m3	5.7E-05	mg/kg/day	Reproductive	1000/1	IRIS	04/18/2007
1,4-Dichlorobenzene	Chronic	8.0E-01	mg/m3	2.3E-01	mg/kg/day	Liver	100/1	IRIS	04/18/2007
Benzene	Chronic	3.0E-02	mg/m3	8.6E-03	mg/kg/day	Blood	300/1	IRIS	04/18/2007
Chlorobenzene	Chronic	4.9E-02	mg/m3	1.4E-02	mg/kg/day	Liver	NA	NCEA	04/6/2007
Chloroform	Chronic	4.9E-02	mg/m3	1.4E-02	mg/kg/day	Liver	NA	NCEA	04/6/2007
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA
trans-1,2-Dichloroethene	Chronic	6.0E-02	mg/m3	1.7E-02	mg/kg/day	Blood	NA	NCEA	04/6/2007
Ethylbenzene	Chronic	1.0E+00	mg/m3	2.9E-01	mg/kg/day	Liver, Kidney	300/1	IRIS	04/18/2007
Isopropylbenzene	Chronic	4.0E-01	mg/m3	1.1E-01	mg/kg/day	Kidney	1000/1	IRIS	04/18/2007
Tetrachloroethene	Chronic	2.8E-01	mg/m3	8.0E-02	mg/kg/day	Liver	NA	NCEA	04/6/2007
Total Xylenes	Chronic	1.1E-01	mg/m3	3.0E-02	mg/kg/day	Body Weight	300/1	IRIS	04/18/2007
Trichloroethene	Chronic	6.0E-01	mg/m^3	1.7E-01	(mg/kg/day)	Liver	NA	CA EPA	12/2002
Vinyl Chloride	Chronic	9.8E-02	mg/m3	2.8E-02	mg/kg/day	Liver	30/1	IRIS	04/18/2007
Semivolatile Organic Compounds									
1,1-Biphenyl	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	3.0E-03	mg/m3	8.6E-04	mg/kg/day	Body Weight, Nasal	3000/1	IRIS	04/18/2007
Pentachlorophenol	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pesticides/PCBs									
4,4'-DDD	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	NA	NA	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alpha-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alpha-Chlordane	Chronic	7.0E-04	mg/m3	2.0E-04	(mg/kg/day)	Liver	1000/1	IRIS	04/18/2007
Beta-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA
Delta-BHC	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	NA	NA	NA	NA	NA	NA	NA	NA	NA
Endrin Ketone	NA	NA	NA	NA	NA	NA	NA	NA	NA
Gamma-BHC (Lindane)	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 7-17
Non-Cancer Toxicity Data - Inhalation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Gamma-Chlordane	Chronic	7.0E-04	mg/m3	2.0E-04	(mg/kg/day)	Liver	1000/1	IRIS	09/15/2003
Heptachor	NA	NA	NA	NA	NA	NA	NA	NA	NA
Heptachor Epoxide	NA	NA	NA	NA	NA	NA	NA	NA	NA
Metals									
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
(1) - Extrapolated RfD = RfC *20m^3/day / 70 kg

Definitions:
NA = Not Applicable
CNS = Central Nervous System
IRIS = Integrated Risk Information System
HEAST= Health Effects Assessment Summary Tables
NCEA = USEPA Region 3 RBC Table, April 25, 2003.

Table 7-18
Cancer Toxicity Data - Oral/Dermal

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds								
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	D	IRIS	04/18/2007
1,2-Dibromo-3-Chloropropane	8.0E-01	(mg/kg/day)-1	1	8.0E-01	(mg/kg/day)-1	NA	NCEA	04/6/2007
1,4-Dichlorobenzene	2.4E-02	(mg/kg/day)-1	1	2.4E-02	(mg/kg/day)-1	C	HEAST	07/97
Benzene	5.5E-02	(mg/kg/day)-1	1	5.5E-02	(mg/kg/day)-1	A	IRIS	04/18/2007
Chlorobenzene	NA	NA	NA	NA	NA	D	IRIS	04/18/2007
Chloroform	NA	NA	NA	NA	NA	B2	IRIS	04/18/2007
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	D	IRIS	04/18/2007
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	D	IRIS	04/18/2007
Isopropylbenzene	NA	NA	NA	NA	NA	D	IRIS	04/18/2007
Tetrachloroethene	5.4E-01	(mg/kg/day)-1	1	5.4E-01	(mg/kg/day)-1	NA	NCEA	04/6/2007
Total Xylenes	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	1.3E-02	$(mg/kg/day)^{-1}$	1	1.3E-02	$(mg/kg/day)^{-1}$	C	CA EPA	12/2002
Vinyl Chloride	1.5E+00	(mg/kg/day)-1	1	1.5E+00	(mg/kg/day)-1	A	IRIS	09/15/2003
Semivolatile Organic Compounds								
1,1-Biphenyl	NA	NA	NA	NA	NA	D	IRIS	04/18/2007
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	7.3E+00	(mg/kg/day)-1	1	7.3E+00	(mg/kg/day)-1	B2	IRIS	04/18/2007
Naphthalene	NA	NA	NA	NA	NA	C	IRIS	04/18/2007
Pentachlorophenol	1.2E-01	(mg/kg/day)-1	1	1.2E-01	(mg/kg/day)-1	B2	IRIS	04/18/2007
Pesticides/PCBs								
4,4'-DDD	2.4E-01	(mg/kg/day)-1	1	2.4E-01	(mg/kg/day)-1	B2	IRIS	04/18/2007
4,4'-DDE	3.4E-01	(mg/kg/day)-1	1	3.4E-01	(mg/kg/day)-1	B2	IRIS	04/18/2007
4,4'-DDT	3.4E-01	(mg/kg/day)-1	1	3.4E-01	(mg/kg/day)-1	B2	IRIS	04/18/2007
Alpha-BHC	6.3E+00	(mg/kg/day)-1	1	6.3E+00	(mg/kg/day)-1	B2	IRIS	04/18/2007
Alpha-Chlordane	3.5E-01	(mg/kg/day)-1	1	3.5E-01	(mg/kg/day)-1	B2	IRIS	04/18/2007
Beta-BHC	1.8E+00	(mg/kg/day)-1	1	1.8E+00	(mg/kg/day)-1	C	IRIS	04/18/2007
Delta-BHC	NA	NA	NA	NA	NA	D	IRIS	04/18/2007
Dieldrin	1.6E+01	(mg/kg/day)-1	1	1.6E+01	(mg/kg/day)-1	B2	IRIS	04/18/2007
Endrin Ketone	NA	NA	NA	NA	NA	NA	NA	NA
Gamma-BHC (Lindane)	1.3E+00	(mg/kg/day)-1	1	1.3E+00	(mg/kg/day)-1	B2	HEAST	07/97

Table 7-18
Cancer Toxicity Data - Oral/Dermal

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Gamma-Chlordane	3.5E-01	(mg/kg/day)-1	1	3.5E-01	(mg/kg/day)-1	B2	IRIS	04/18/2007
Heptachor	4.5E+00	(mg/kg/day)-1	1	4.5E+00	(mg/kg/day)-1	B2	IRIS	04/18/2007
Heptachor Epoxide	9.1E+00	(mg/kg/day)-1	1	9.1E+00	(mg/kg/day)-1	B2	IRIS	04/18/2007
Metals								
Arsenic	1.5E+00	(mg/kg/day)-1	1	1.5E+00	(mg/kg/day)-1	A	IRIS	09/15/2003

Notes:
(1) - USEPA, 2001a: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
(2) - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.

USEPA Group:
A - Human carcinogen.
B1 - Probable human carcinogen - indicates that limited human data are available.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.
C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
E - Evidence of non-carcinogenicity.

IRIS = Integrated Risk Information System.
HEAST= Health Effects Assessment Summary Tables.
NA = Not Available.
NCEA = USEPA National Center for Environmental Assessment (USEPA Region III RBC Table, April 25, 2003).
USEPA(1) = USEPA, Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons, July 1993, EPA/600/R-93/089.
USEPA(2) = USEPA, PCBs: Cancer Dose-Response Assessment and Applications to Environmental Mixtures, September 1996, EPA/600/P-96/001F.

Table 7-19
Cancer Toxicity Data - Inhalation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Volatile Organic Compounds							
1,2,4-Trichlorobenzene	NA	NA	NA	NA	D	IRIS	04/18/2007
1,2-Dibromo-3-Chloropropane	6.0E+00	$(mg/m^3)^{-1}$	2.1E+01	$(mg/kg/day)^{-1}$	NA	NCEA	04/6/2007
1,4-Dichlorobenzene	6.3E-03	$(mg/m^3)^{-1}$	2.2E-02	$(mg/kg/day)^{-1}$	NA	NCEA	04/6/2007
Benzene	7.8E-03	$(mg/m^3)^{-1}$	2.7E-02	$(mg/kg/day)^{-1}$	A	IRIS	04/18/2007
Chlorobenzene	NA	NA	NA	NA	D	IRIS	04/18/2007
Chloroform	2.3E-02	$(mg/m^3)^{-1}$	8.1E-02	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
cis-1,2-Dichloroethene	NA	NA	NA	NA	D	IRIS	04/18/2007
trans-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	D	IRIS	04/18/2007
Isopropylbenzene	NA	NA	NA	NA	D	IRIS	04/18/2007
Tetrachloroethene	5.7E-03	$(mg/m^3)^{-1}$	2.0E-02	$(mg/kg/day)^{-1}$	NA	NCEA	04/6/2007
Total Xylenes	NA	NA	NA	NA	NA	NA	NA
Trichloroethene	2.0E-03	$(mg/m^3)^{-1}$	7.0E-03	$(mg/kg/day)^{-1}$	C	CA EPA	12/2002
Vinyl Chloride	8.8E-03	$(mg/m^3)^{-1}$	3.1E-02	$(mg/kg/day)^{-1}$	A	IRIS	04/18/2007
Semivolatile Organic Compounds							
1,1-Biphenyl	NA	NA	NA	NA	D	IRIS	04/18/2007
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	NA
Benzo(a)pyrene	NA	NA	3.1E+00	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
Naphthalene	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	NA	NA	NA	NA	B2	IRIS	04/18/2007
Pesticides/PCBs							
4,4'-DDD	NA	NA	NA	NA	B2	IRIS	04/18/2007
4,4'-DDE	NA	NA	NA	NA	B2	IRIS	04/18/2007
4,4'-DDT	9.7E-02	$(mg/m^3)^{-1}$	3.4E-01	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
Alpha-BHC	1.8E+00	$(mg/m^3)^{-1}$	6.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
Alpha-Chlordane	1.0E-01	$(mg/m^3)^{-1}$	3.5E-01	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
Beta-BHC	5.3E-01	$(mg/m^3)^{-1}$	1.9E+00	$(mg/kg/day)^{-1}$	C	IRIS	04/18/2007
Delta-BHC	NA	NA	NA	NA	D	IRIS	04/18/2007
Dieldrin	4.6E+00	$(mg/m^3)^{-1}$	1.6E+01	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
Endrin Ketone	NA	NA	NA	NA	NA	NA	NA
Gamma-BHC (Lindane)	NA	NA	NA	NA	NA	NA	NA

Table 7-19
Cancer Toxicity Data - Inhalation

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Gamma-Chlordane	1.0E-01	$(mg/m^3)^{-1}$	3.5E-01	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
Heptachor	1.3E-01	$(mg/m^3)^{-1}$	4.6E-01	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
Heptachor Epoxide	2.6E+00	$(mg/m^3)^{-1}$	9.1E+00	$(mg/kg/day)^{-1}$	B2	IRIS	04/18/2007
Metals							
Arsenic	4.3E+00	$(mg/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A	IRIS	04/18/2007

Notes:
1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

Definitions:
IRIS = Integrated Risk Information System.
HEAST= Health Effects Assessment Summary Tables.
NA = Not Available.
NCEA = USEPA National Center for Environmental Assessment
(USEPA Region 3 RBC Table, April 25, 2003).

USEPA Group:
A - Human carcinogen.
B1 - Probable human carcinogen - indicates that limited human data are available.
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.
C - Possible human carcinogen.
D - Not classifiable as a human carcinogen.
E - Evidence of non-carcinogenicity.

7.3.3 Toxicity Criteria for TCE

Toxicity criteria (i.e., RfDs, CSFs) for TCE are not currently published on the USEPA's IRIS database or in HEAST. The toxicity criteria developed by the CA EPA (2002) were used for TCE in this risk assessment. The uncertainty associated with the use of the CA EPA toxicity values is discussed in the Uncertainty Analysis.

7.4 RISK CHARACTERIZATION

Potential risks (non-carcinogenic and carcinogenic) for human receptors resulting from the exposures to contaminated media are quantitatively determined during the risk characterization component of the HHRA.

A summary and interpretive discussion of the quantitative risk estimates will be provided in the text of the risk assessment. COPCs which contribute significantly to elevated risks will be identified as "risk drivers" during the interpretive risk discussion. The chemical-specific numeric estimates of risk will be contained in the risk assessment spreadsheets provided in the appendices to the risk assessment.

7.4.1 Risk Estimation Methods

Quantitative estimates of risk are calculated using intake and toxicity values according to risk assessment methods outlined in current USEPA guidance (USEPA, 1989). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as incremental cancer risks (ICRs), which are derived using published CSFs. Non-carcinogenic risk estimates are presented in the form of HQs that are derived using published RfDs.

ICR estimates are generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$ICR = (\text{Estimated Exposure Intake})\ (CSF)$$

If the above equation results in an ICR greater than 0.01, the following equation is used:

$$ICR = 1-[\exp(-\text{Estimated Exposure Intake})(CSF)]$$

The ICRs for all COPCs in an exposure scenario are summed to give a cumulative ICR. An ICR of 10^{-6} indicates that the exposed receptor has a 1-in-1 million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of 1 million persons.

Non-carcinogenic risks are assessed using the concept of HQs and HIs. The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

$$HQ = (\text{Estimated Exposure Intake})/(RfD)$$

An HI is generated by summing the individual HQs for all of the COPCs. It should be noted that HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of non-carcinogenic (threshold) effects.

7.4.2 Comparison of Quantitative Risk Estimates to Benchmarks

In order to interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site, quantitative risk estimates will be compared to typical benchmarks. The USEPA has defined the range of 10^{-4} to 10^{-6} as the ICR "target range" for most hazardous waste facilities addressed under CERCLA. Cumulative ICRs greater than 10^{-4} generally will indicate that some degree of remediation is required, while ICRs below 10^{-6} normally will not result in remedial efforts. Whenever ICRs fall between 10^{-4} and 10^{-6}, decisions for remediation will be made on a case-specific basis. Individual chemicals contributing significantly to risks above the target range are considered to be COCs. FDEP has indicated that 1×10^{-6} is its cancer risk level of concern.

An HI exceeding unity (1.0) indicates that there may be potential non-carcinogenic health risks associated with exposure. If an HI exceeds unity, target organ effects from individual COPCs contributing to the risk are considered. Only those chemicals which impact the same target organ(s) or exhibit similar critical effect(s) will be regarded as truly additive. Thus, COPCs contributing to an HI greater than 1.0 on the basis of a single target organ/effect are considered to be COCs.

7.4.3 Results of the Risk Characterization

This section contains a summary of the results of the risk characterization for PSC 47. Potential cancer risks and HIs were calculated for construction workers, site maintenance workers, occupational workers, adolescent and adult trespassers, and child and adult residents, and are summarized in Table 7-20. Chemicals with ICRs and HIs exceeding USEPA and FDEP target levels are summarized in Table 7-21. Results of the risk assessment in RAGS Part D format are included in Appendix K. Sample calculations are also presented in Appendix K.

Table 7-20
Summary of Cancer Risks and Hazard Indices
Reasonable Maximum Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Construction Worker	Surface/Subsurface Soil	Incidental Ingestion	2E-06	- -	- -	- -	0.5	- -
		Dermal Contact	2E-07	- -	- -	- -	0.05	- -
		Inhalation	2E-07	- -	- -	- -	0.002	
		Total	2E-06	- -	- -	- -	0.5	- -
	Groundwater	Dermal Contact	4E-06	- -	- -	Arsenic	0.7	- -
		Inhalation	6E-09	- -	- -	- -	0.09	- -
		Total	4E-06	- -	- -	Arsenic	0.8	- -
		Total All Media	7E-06				1	
Maintenance Workers	Surface Soil	Incidental Ingestion	2E-06	- -	- -	- -	0.02	- -
		Dermal Contact	8E-07	- -	- -	- -	0.007	- -
		Inhalation	1E-09	- -	- -	- -	0.0000008	- -
		Total	2E-06	- -	- -	- -	0.02	- -
Occupational Workers	Surface Soil	Incidental Ingestion	3E-05	- -	- -	Benzo(a)pyrene Equivalents, 4,4'-DDT, Dieldrin, Arsenic	0.3	- -
		Dermal Contact	8E-06	- -	- -	4,4'-DDT, Dieldrin	0.07	- -
		Inhalation	1E-08	- -	- -	- -	0.000007	- -
		Total	3E-05	- -	4,4'-DDT	Benzo(a)pyrene Equivalents, Dieldrin, Arsenic	0.4	- -
Adolescent Trespassers	Surface Soil	Incidental Ingestion	6E-06	- -	- -	4,4'-DDT	0.2	- -
		Dermal Contact	2E-06	- -	- -	- -	0.05	- -
		Inhalation	6E-10				0.0000010	- -
		Total	9E-06	- -	- -	4,4'-DDT	0.2	- -
Adult Trespassers	Surface Soil	Incidental Ingestion	4E-06	- -	- -	4,4'-DDT	0.05	- -
		Dermal Contact	7E-07	- -	- -	- -	0.008	- -
		Inhalation	1E-09	- -	- -	- -	0.0000008	- -
		Total	4E-06	- -	- -	4,4'-DDT	0.06	- -

Table 7-20
Summary of Cancer Risks and Hazard Indices
Reasonable Maximum Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Child Residents	Surface/Subsurface Soil	Incidental Ingestion	1E-04	- -	4,4'-DDT, Arsenic	Benzo(a)pyrene Equivalents, 4,4'-DDD, 4,4'-DDE, alpha-BHC, alpha-Chlordane, Dieldrin, Heptachlor Epoxide	5	4,4'-DDT
		Dermal Contact	2E-05	- -	- -	Benzo(a)pyrene Equivalents, 4,4'-DDT, Dieldrin, Arsenic	0.5	- -
		Inhalation	9E-09	- -	- -	- -	0.00002	- -
		Total	1E-04	- -	4,4'-DDT, Dieldrin, Arsenic	Benzo(a)pyrene Equivalents, 4,4'-DDD, 4,4'-DDE, alpha-BHC, alpha-Chlordane, gamma-Chlordane, Heptachlor Epoxide	6	4,4'-DDT
	Groundwater	Ingestion	8E-02	Aldrin, alpha-BHC, Arsenic, gamma-BHC	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Vinyl Chloride, 4,4'-DDD, beta-BHC, Dieldrin, Heptachlor Epoxide	Benzene, Pentachlorophenol, alpha-Chlordane, gamma-Chlordane, Heptachlor	2184	cis-1,2-Dichloroethene, 2,4,5-Trichlorophenol, 2,4-Dichlorophenol, 2-Methylnaphthalene, Aldrin, delta-BHC, Endrin Ketone, gamma-BHC, Heptachlor Epoxide, Arsenic
		Dermal Contact	5E-04	- -	Pentachlorophenol, 4,4'-DDD, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, Arsenic	Tetrachloroethene, 4,4'-DDT, alpha-Chlordane, Dieldrin, gamma-Chlordane, Heptachlor Epoxide	13	2,4-Dichlorophenol, 2,4,5-Trichlorophenol, delta-BHC, 4,4'-DDT, Endrin Ketone, alpha-Chlordane, delta-BHC, gamma-BHC, Aldrin, Heptachlor Epoxide, Arsenic
		Inhalation	1E-04	- -	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Vinyl Chloride	Benzene	15	cis-1,2-Dichloroethene, 2-Methylnaphthalene
		Total	8E-02	4,4'-DDD, Aldrin, alpha-BHC, gamma-BHC, Arsenic	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Pentachlorophenol, beta-BHC, Dieldrin, Heptachlor Epoxide	1,4-Dichlorobenzene, Benzene Trichloroethene, 4,4'-DDT, gamma-Chlordane	2212	1,2-Dibromo-3-Chloropropane, cis-1,2-Dichloroethene, 2,4,5-Trichlorophenol. 2,4-Dichlorophenol, 2-Methylnaphthalene, Naphthalene, Vinyl Chloride, 4,4'-DDT, Aldrin, alpha-Chlordane, gamma-Chlordane, Dieldrin, delta-BHC, Endrin Ketone, gamma-BHC, Heptachlor Epoxide, Arsenic
		Total All Media	8E-02				2218	
Adult Residents	Surface/Subsurface Soil	Incidental Ingestion	5E-05	- -	4,4'-DDT	Benzo(a)pyrene Equivalents, 4,4'-DDD, Dieldrin, Arsenic	0.6	- -
		Dermal Contact	9E-06	- -	- -	4,4'-DDT, Arsenic	0.08	- -
		Inhalation	2E-08				0.000009	- -

Table 7-20
Summary of Cancer Risks and Hazard Indices
Reasonable Maximum Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida
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Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
		Total	6E-05	- -	4,4'-DDT	Benzo(a)pyrene Equivalents, 4,4'-DDD, 4,4'-DDE, Dieldrin, Arsenic	0.7	- -
	Groundwater	Ingestion	9E-02	Aldrin, alpha-BHC, gamma-BHC, Arsenic	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Vinyl Chloride, 4,4'-DDD, beta-BHC, Dieldrin, Heptachlor Epoxide	Benzene, Pentachlorophenol, 4,4'-DDT, alpha-Chlordane, gamma-Chlordane, Heptachlor	624	cis,1,2-Dichloroethene, 2,4-Dichlorophenol, 2,4,5-Trichlorophenol, Aldrin, delta-BHC, gamma-BHC, Arsenic, Heptachlor Epoxide
		Dermal Contact	1E-03	4,4'-DDD, alpha-BHC, Arsenic	Pentachlorophenol, Aldin, beta-BHC, Dieldrin, gamma-BHC, Heptachlor Epoxide	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Vinyl Chloride, 4,4'-DDE, 4,4'-DDT, alpha-Chlordane, gamma-Chlordane, Heptachlor	6	2,4,5-Trichlorophenol, delta-BHC, Endrin Ketone, gamma-BHC
		Inhalation	1E-04	- -	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Vinyl Chloride	Benzene	4	cis-1,2-Dichloroethene
		Total	9E-02	Vinyl Chloride, 4,4'-DDD, Aldrin, alpha-BHC, gamma-BHC, Arsenic	1,2-Dibromo-3-Chloropropane, Benzene, Tetrachloroethene, Pentachlorophenol, Dieldrin, Heptachlor Epoxide	1,4-Dichlorobenzene, Trichloroethene, 4,4'-DDE, gamma-Chlordane	635	cis,1,2-Dichloroethene, 2,4-Dichlorophenol, 2,4,5-Trichlorophenol, 2-Methylnaphthalene, Aldrin, delta BHC, gamma-BHC, Endrin Ketone, Heptachlor Epoxide, Arsenic
		Total All Media	9E-02				635	

Table 7-20
Summary of Cancer Risks and Hazard Indices
Reasonable Maximum Exposures

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals with HI > 1
Lifelong Residents (Child and Adult)	Surface/Subsurface Soil	Incidental Ingestion	2E-04	- -	4,4'-DDT, Dieldrin, Arsenic	Benzo(a)pyrene Equivalents, 4,4'-DDE, 4,4'-DDD, Alpha-BHC, Alpha-Chlordane, Gamma-Chlordane, Heptachlor Epoxide	NA	- -
		Dermal Contact	2E-05	- -	- -	Benzo(a)pyrene Equivalents, 4,4'-DDT, Dieldrin, Arsenic	NA	- -
		Inhalation	3E-08	- -	- -	- -	NA	- -
		Total	2E-04	- -	4,4'-DDT, Dieldrin, Arsenic	Benzo(a)pyrene Equivalents, 4,4'-DDE, 4,4'-DDD, Alpha-BHC, Alpha-Chlordane, Gamma-Chlordane, Heptachlor Epoxide	NA	- -
	Groundwater	Ingestion	2E-01	Aldrin, alpha-BHC, beta-BHC, gamma-BHC, Arsenic	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Vinyl Chloride, Pentachlorophenol, 4,4'-DDD, Dieldrin, Heptachlor, Heptachlor Epoxide	1,4-Dichlorobenzene, Benzene Trichloroethene, 4,4'-DDT, alpha-Chlordane, gamma-Chlordane	NA	- -
		Dermal Contact	2E-03	Pentachlorophenol, 4,4'-DDD, alpha-BHC, Arsenic	4,4'-DDT, Aldin, beta-BHC, Dieldrin, gamma-BHC, Heptachlor Epoxide	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Vinyl Chloride, 4,4'-DDE, alpha-Chlordane, gamma-Chlordane, Heptachlor	NA	- -
		Inhalation	2E-04	- -	1,2-Dibromo-3-Chloropropane, Tetrachloroethene, Vinyl Chloride	1,4-Dichlorobenzene, Benzene Trichloroethene	NA	- -
		Total	2E-01	Vinyl Chloride, Pentachlorophenol, 4,4'-DDD, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, Arsenic	1,2-Dibromo-3-Chloropropane, Benzene, Tetrachloroethene, 4,4'-DDT, alpha-Chlordane, Dieldrin, Heptachlor, Heptachlor Epoxide	1,4-Dichlorobenzene, Trichloroethene, 4,4'-DDE, gamma-Chlordane	NA	- -
		Total All Media	2E-01				NA	

Table 7-21
Chemicals Retained as Chemicals of Concern

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical of Concern[1]	Impact on Human Receptors
Surface/Subsurface Soil	
Benzo(a)pyrene Equivalents	Occupation Workers ILCR = 3E-6
	Child Residents ILCR = 7E-6
	Adult Residents ILCR = 3E-6
	Lifelong Residents ILCR = 1E-5
4,4'-DDD	Child Residents ILCR = 5E-6
	Adult Residents ILCR = 2E-6
	Lifelong Residents ILCR = 8E-6
4,4'-DDE	Child Residents ILCR = 3E-6
	Adult Residents ILCR = 2E-6
	Lifelong Residents ILCR = 5E-6
4,4'-DDT	Occupation Workers ILCR = 2E-5
	Adolescent Trespassers ILCR = 4E-6
	Adult Trespassers ILCR = 2E-6
	Child Residents ILCR = 7E-5
	Adult Residents ILCR = 3E-5
	Lifelong Residents ILCR = 9E-5
alpha-BHC	Child Residents ILCR = 2E-6
	Lifelong Residents ILCR = 3E-6
alpha-Chlordane	Child Residents ILCR = 2E-6
	Lifelong Residents ILCR = 2E-6
Dieldrin	Occupation Workers ILCR = 5E-6
	Child Residents ILCR = 2E-5
	Adult Residents ILCR = 9E-6
	Lifelong Residents ILCR = 3E-5
gamma-Chlordane	Child Residents ILCR = 2E-6
	Lifelong Residents ILCR = 2E-6
Heptachlor	Lifelong Residents ILCR = 2E-6
Heptachlor Epoxide	Child Residents ILCR = 2E-6
	Lifelong Residents ILCR = 3E-6
Arsenic	Occupation Workers ILCR = 5E-6
	Child Residents ILCR = 2E-5
	Adult Residents ILCR = 1E-5
	Lifelong Residents ILCR = 3E-5
Groundwater - Direct Contact	
1,2-Dibromo-3-Chloropropane	Child Resident ILCR = 3E-6
	Adult Resident ILCR = 4E-6
	Lifelong Resident ILCR = 7E-6
1,4-Dichlorobenzne	Child Resident ILCR = 3E-6
	Adult Resident ILCR = 3E-6
	Lifelong Resident ILCR = 6E-6
Benzene	Lifelong Resident ILCR = 3E-6
cis-1,2-Dichloroethene	Child Resident HI = 18
	Adult Resident HI = 6
Tetrachloroethene	Child Resident ILCR = 4E-5
	Adult Resident ILCR = 2E-5
	Lifelong Resident ILCR = 6E-5
Trichloroethene	Child Resident ILCR = 2E-6
	Adult Resident ILCR = 2E-6
	Lifelong Resident ILCR = 4E-6
Vinyl Chloride	Child Resident ILCR = 2E-4
	Adult Resident ILCR = 2E-4
	Lifelong Resident ILCR = 3E-4

Table 7-21
Chemicals Retained as Chemicals of Concern

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical of Concern[1]	Impact on Human Receptors
	Child Resident HI = 0.4
	Adult Resident HI = 0.1
2,4,5-Trichlorophenol	Child Resident HI = 3
	Adult Resident HI = 1
2,4-Dichlorophenol	Child Resident HI = 19
	Adult Resident HI = 6
2-Methylnaphthalene	Child Resident HI = 5
	Adult Resident HI = 2
Naphthalene	Child Resident HI = 3
Pentachlorophenol	Child Resident ILCR = 7E-5
	Adult Resident ILCR = 1E-4
	Lifelong Resident ILCR = 2E-4
	Child Resident HI = 0.2
	Adult Resident HI = 0.1
4,4'-DDD	Child Resident ILCR = 2E-4
	Adult Resident ILCR = 1E-4
	Lifelong Resident ILCR = 3E-4
4,4'-DDE	Child Resident ILCR = 1E-6
	Adult Resident ILCR = 2E-6
	Lifelong Resident ILCR = 3E-6
4,4'-DDT	Child Resident ILCR = 7E-6
	Adult Resident ILCR = 1E-5
	Lifelong Resident ILCR = 2E-5
	Child Resident HI = 0.5
	Adult Resident HI = 0.2
Aldrin	Child Resident ILCR = 5E-4
	Adult Resident ILCR = 6E-4
	Lifelong Resident ILCR = 1E-3
	Child Resident HI = 13
	Adult Resident HI = 4
alpha-BHC	Child Resident ILCR = 6E-4
	Adult Resident ILCR = 8E-4
	Lifelong Resident ILCR = 1E-3
alpha-Chlordane	Child Resident ILCR = 1E-5
	Adult Resident ILCR = 1E-5
	Lifelong Resident ILCR = 2E-5
	Child Resident HI = 0.6
	Adult Resident HI = 0.2
beta-BHC	Child Resident ILCR = 7E-5
	Adult Resident ILCR = 1E-4
	Lifelong Resident ILCR = 2E-4
delta-BHC	Child Resident HI = 3
	Adult Resident HI = 1
Dieldrin	Child Resident ILCR = 5E-5
	Adult Resident ILCR = 7E-5
	Lifelong Resident ILCR = 1E-4
	Child Resident HI = 0.8
	Adult Resident HI = 0.3
Endrin Ketone	Child Resident HI = 2
	Adult Resident HI = 0.8
gamma-BHC	Child Resident ILCR = 2E-4
	Adult Resident ILCR = 2E-4
	Lifelong Resident ILCR = 4E-4

Table 7-21
Chemicals Retained as Chemicals of Concern

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical of Concern[1]	Impact on Human Receptors
	Child Resident HI = 0.4
	Adult Resident HI = 0.2
gamma-Chlordane	Child Resident ILCR = 6E-6
	Adult Resident ILCR = 9E-6
	Lifelong Resident ILCR = 1E-5
	Child Resident HI = 0.4
	Adult Resident HI = 0.2
Heptachlor	Child Resident ILCR = 1E-5
	Adult Resident ILCR = 1E-5
	Lifelong Resident ILCR = 2E-5
Heptachlor Epoxide	Child Resident ILCR = 5E-5
	Adult Resident ILCR = 7E-5
	Lifelong Resident ILCR = 1E-4
	Child Resident HI = 5
	Adult Resident HI = 2
Arsenic	Child Resident ILCR = 8E-2
	Adult Resident ILCR = 9E-2
	Lifelong Resident ILCR = 2E-1
	Child Resident HI = 2197
	Adult Resident HI = 608

HQ = Hazard Quotient
ILCR = Incremental Lifetime Cancer Risk
(1) - Any carcinogenic chemical contributing to an ICR greater than 1.0E-6 or any non-carcinogenic chemical contributing to target organ hazard indices (HI) greater than 0.1

7.4.3.1 Non-carcinogenic Risks

HIs for exposures to soil by all of the evaluated receptor groups with the exception of child residents were less than unity indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions.

The HI for child residents (HI = 6) exposed to surface/subsurface soil exceeded the acceptable level of 1. 4,4'-DDT (HI = 5) was the major contributor to the HI for the child resident exposed to surface/subsurface soil.

HIs for domestic use of groundwater by child residents (HI = 2212) and adult residents (HI = 635) exceeded the acceptable level of 1. Arsenic was the major contributor to the HI for the child (HQ = 2197) and adult residents (HQ = 609). The HI for use of groundwater by the construction worker is approximately equal to the acceptable level of 1.

The Johnson and Ettinger volatilization model was used to estimate risks from exposures from vapor intrusion. The HI for residents exposed to COPCs that may volatilize from groundwater and migrate into indoor air was less than unity indicating that adverse non-carcinogenic effects are not anticipated for residents under the defined exposure conditions.

7.4.3.2 Carcinogenic Risks

Incremental lifetime cancer risks (ILCRs) for exposures to soil by construction workers, maintenance workers, adolescent trespassers, adult trespassers, and adult residents were within than USEPA's target risk range of 10^{-4} to 10^{-6}, but exceeded FDEP's level of concern of 1×10^{-6}. The ILCR for child residents (ILCR = 1×10^{-4}) exposed to surface/subsurface soil was equal to the upper bound of USEPA's target risk, but exceeded the FDEP level of concern. The ILCR for lifetime residents (ILCR = 2×10^{-4}) exposed to surface/subsurface soil exceeded the USEPA target risk range and the FDEP level of concern. 4,4'-DDT, dieldrin, and arsenic were the major contributors the ILCRs.

ILCRs for domestic use of groundwater by child residents (ILCR = 8×10^{-2}), adult residents (9×10^{-2}), and lifelong residents (2×10^{-1}) exceeded USEPA's target risk range and FDEP's level of concern. Arsenic was the major contributors to the ILCRs.

The Johnson and Ettinger volatilization model was used to estimate risks from exposures from vapor intrusion. The ILCRs for residents (ILCR = 3×10^{-7}) exposed to COPCs that may volatilize from groundwater and migrate into indoor air were less USEPA's target risk range and FDEP's level of concern.

7.5 UNCERTAINTY ANALYSIS

There is uncertainty associated with all aspects of the baseline HHRA presented in this section. A summary of the uncertainties, including a discussion of how they may affect the final risk numbers, is provided in this section.

Uncertainty in the selection of COPCs is related to the current status of the predictive databases, the grouping of samples, and the procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route/scenario, the assumptions made to determine EPCs, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose-response relationships and the weight-of-evidence used for determining the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

While there are various sources of uncertainty, as described above, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose-response relationships. Throughout the entire risk assessment, assumptions which consider safety factors are made so that the final calculated risks are overestimated.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions,

thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward over-predicting both carcinogenic and non-carcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point-of-departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are below an "acceptable" risk level (i.e., 1×10^{-6}), the interpretation of no significant risk is typically straightforward. However, when risks calculated using a high degree of uncertainty are above an "acceptable" risk level (i.e., 1×10^{-6}), a conclusion can be difficult unless uncertainty is considered.

7.5.1 Uncertainty in Selection of COPCs

There is a minor amount of uncertainty associated with the selection of COPCs that may impact the numerical risk estimates presented in Section 7.4, Risk Characterization. The most significant issues related to uncertainty in COPC selection for PSC 47 are the screening levels used and the absence of screening levels for a few chemicals detected in the site media. A brief discussion of each of these issues is provided in the remainder of this section.

COPC Screening Levels

The use of predetermined screening values, based on conservative land use scenarios (i.e., residential land use for soil and ingestion/inhalation for groundwater) in combination with the use of risk-based screening values corresponding to a 1×10^{-6} ICR and a 0.1 HI, should ensure that the significant contributors to risk from a site are evaluated. The elimination of chemicals that are present at concentrations that correspond to a less than 1×10^{-6} ICR and less than 0.1 HI should not affect the final conclusions of the risk assessment since these chemicals are not expected to cause a potential health concern.

7.5.1.1 Chemicals Without Established Screening Levels

Direct Contact Criteria

Risk-based screening levels are currently not available for some constituents (e.g., benzo(g,h,i)perylene, phenanthrene, alpha and gamma-chlordane, delta-BHC, endosulfan sulfate, endrin aldehyde, and endrin ketone). Therefore, surrogates were selected for these chemicals based on similar chemical structures. In the COPC screening, pyrene was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene, chlordane was selected as a surrogate for alpha and gamma-chlordane, endosulfan was selected as a surrogate for endosulfan sulfate, and endrin was selected as a surrogate for endrin aldehyde and endrin

ketone. Applying toxicity values of one compound to another adds to the uncertainty in the risk assessment both in regard to the selection of COPCs and the subsequently calculated risks.

Migration Criteria

A number of constituents do not have USEPA SSLs for the migration from soil to air pathway. This uncertainty is expected to be small because potential risks associated with exposures via inhalation are typically orders of magnitude lower than those associated with exposures via incidental ingestion and dermal contact with soil. A comparison of the screening criteria for direct contact exposures with the screening criteria for migration from soil to air shows that the direct contact screening criteria are at least an order of magnitude lower than the migration screening criteria for the same compound. If there are unacceptable risks resulting from inhalation exposures, then usually there are unacceptable risks from exposures via incidental ingestion and dermal contact.

There were no USEPA SSLs for migration of chemicals from soil to groundwater for several chemicals. The uncertainty associated with the absence of these criteria is small. An exceedance of the SSLs does not mean that a chemical will definitely migrate from soil to groundwater, only that the potential for migration from soil to groundwater exists. Groundwater samples were collected at the site, and therefore real data is available to indicate whether chemicals have migrated from soil to groundwater at the site.

7.5.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment includes the determination of land use conditions, the selection of receptors and scenarios, and the selection of exposure parameters. Uncertainties associated with the exposure assessment are presented in this section.

Land Use

The current land use patterns at the site are well established, thereby reducing the uncertainty associated with land use assumptions. The site is currently used for grounds maintenance contractor, pesticide storage, and for pesticide training.

Exposure Point Concentration

The estimation of the EPC is dependent on the representativeness of the sampling, including number of samples, collection and location, and the variance associated with scientific measurements. For soils, the upper confidence limit of the mean is used to account for the referenced uncertainty. This results in a potentially higher estimate of the EPC. For groundwater, the maximum detected groundwater concentration is used, which most likely overestimates the actual concentration at any randomly selected point within a groundwater plume.

Exposure Routes and Receptor Identification

An attempt was made to simplify the various receptor groups and exposure routes of potential concern in this report. The uncertainty associated with this approach is minimal since exposure routes and potential receptors are considered to be well-defined, based on the limited land use observed at the site. In addition, exposure routes eliminated from further evaluation were excluded only after a qualitative evaluation of potential exposure.

Exposure Parameters

Each exposure factor selected for use in the risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, the USEPA exposure assessment guidelines for the RME receptor were used to calculate COPC intake. These guidelines generally suggest the 95th percentile value for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Generally, the uncertainty can be assessed quantitatively for a number of assumptions made in determining factors for calculating exposures and intakes. Many of these parameters were determined from statistical analyses on human population characteristics. Often the database used to summarize a particular exposure parameter (i.e., body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (i.e., dermal absorption of organic chemicals from soil), there is greater uncertainty. However, there are often sufficient data to estimate these parameters with low uncertainty.

Many of the quantities used to calculate exposures and risks in this report are selected from a distribution of possible values. For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. This risk number is used in risk management decisions, but does not indicate what a more average or typical exposure might be, or what risk range might be expected for individuals in the exposed population.

7.5.3 Uncertainty in the Toxicological Evaluation

Uncertainties associated with the toxicity assessment (determination of RfDs and CSFs and use of available criteria) are presented in this section.

Derivation of Toxicity Criteria

Uncertainty associated with the toxicity assessment is associated with hazard assessment and dose-response evaluations for the COPCs. The hazard assessment deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination, using the USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may also manifest a carcinogenic response. However, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of non-cancer effects, however, positive animal data suggest the nature of the effects (i.e., the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced:

- When similar effects are observed across species, strain, sex, and exposure route.
- When the magnitude of the response is clearly dose-related.
- When pharmacokinetic data indicate a similar fate in humans and animals.
- When postulated mechanisms of toxicity are similar for humans and animals.
- When the COC is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes the determination of a CSF for the carcinogenic assessment and derivation of an RfD for the non-carcinogenic assessment. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so that intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias, because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a nonthreshold assumption of carcinogenesis. There is evidence to suggest, however, that epigenetic carcinogens, as well as many

genotoxic carcinogens, have a threshold below which they are non-carcinogenic (Williams and Weisburger, 1991); therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

For non-cancer effects, additional uncertainty factors may be applied in the derivation of the RfD to mitigate poor quality of the key study or gaps in the data base. Additional uncertainty for non-cancer effects arises from the use of an effect level in the estimation of an RfD, because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimation of an RfD for chronic exposure from less-than-chronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the less-than-chronic study. Uncertainty in the derivation of RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

Uncertainty Associated with Toxicity Criteria for Trichloroethene

As noted in Section 7.3.3 toxicity criteria (i.e., RfDs, CSFs) for TCE are not currently published on the USEPA's IRIS database or in HEAST. The toxicity criteria developed by the CA EPA (2002) were used for TCE in this risk assessment. USEPA has published draft toxicity values for TCE in a recent technical document (USEPA, 2001b). The draft toxicity criteria are currently undergoing peer review. A range of CSFs [0.02 – 0.4 $(mg/kg/day)^{-1}$], as opposed to a single recommended value, is presented in the recent guidance. The draft CSFs are 2 to 30 times higher than the CA EPA CSF [0.013 $(mg/kg/day^{-1}$]. The draft oral RfD is 0.0004 mg/kg/day as compared to the CA EPA RfD of 0.5 mg/kg/day. TCE was identified as a COPC in groundwater. Risks for exposures to TCE in groundwater were within acceptable levels using the CA EPA toxicity values. Risks would still be within the USEPA acceptable levels if the draft USEPA toxicity criteria had been used in the calculations, but risks would exceed the FDEP level of concern.

7.5.4 Uncertainty in the Risk Characterization

Uncertainty in risk characterization results primarily from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing cancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and differ in their fate in the body, so additivity may not be an appropriate assumption; however, the assumption of additivity is made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs.

Therefore, this uncertainty cannot be discussed for its impact on the risk assessment, since it may either underestimate or overestimate potential human health risk.

7.6 REMEDIAL GOAL OPTIONS

In accordance with USEPA Region IV guidance, RGOs were developed for those media with estimated lifetime cancer risks greater than 1×10^{-4} and total HI greater than 1.0. In addition, RGOs were also developed for media with cancer risks above the FDEP target risk level of 1×10^{-6}. The chemicals with ICRs and HIs exceeding USEPA and FDEP target levels for which RGOs were developed are summarized in Table 7-21.

RGOs for direct contact with soil and groundwater were developed according to guidance provided in the USEPA Region IV Human Health Risk Assessment Bulletins. The RGOs were calculated using the following equation:

RGO[chemical i] = EPC[chemical i] x Target Risk/Calculated Risk[chemical i]

Where:

RGO(chemical i) = the chemical-specific remediation goal option.

EPC(chemical i) = the exposure point concentration for the chemical used in risk assessment calculations.

Target Risk = target risk for carcinogens or the Target HQs for non-carcinogens.

Calculated Risk(chemical i) = the total risk calculated for a specific chemical in the risk assessment.

RGOs for the migration of chemicals that may volatilize from groundwater and migrate into indoor air were calculated using Johnson and Ettinger volatilization model (USEPA, 2003). In accordance to the USEPA Region IV guidance, RGOs are based on target cancer risks of 1×10^{-6}, 1×10^{-5}, and 1×10^{-4} and the target HQs of 0.1, 1, and 3. The chemical-specific RGOs for occupational workers, child, adult, and lifelong residents are presented in Tables 7-22 and 7-23.

Table 7-22
Remedial Goal Options for Soil

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

OCCUPATIONAL WORKER								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA IX
Chemical	10^{-6} (mg/kg)	10^{-5} (mg/kg)	10^{-4} (mg/kg)	0.1 (mg/kg)	1 (mg/kg)	3 (mg/kg)	SCTL[1] (mg/kg)	PRG (mg/kg)
Benzo(a)pyrene Equivalents	0.2	2.1	21	NA	NA	NA	0.7	0.21
4,4'-DDT	7.0	70	702	43	427	1280	15	7
Dieldrin	0.1	1.1	11	3.1	31	92	0.3	0.11

ADOLESCENT TRESPASSERS								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA IX
Chemical	10^{-6} (mg/kg)	10^{-5} (mg/kg)	10^{-4} (mg/kg)	0.1 (mg/kg)	1 (mg/kg)	3 (mg/kg)	SCTL[2] (mg/kg)	PRG (mg/kg)
4,4'-DDT	28.3	282.5	2825	69	686	2059	NA	NA

ADULT TRESPASSERS								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA IX
Chemical	10^{-6} (mg/kg)	10^{-5} (mg/kg)	10^{-4} (mg/kg)	0.1 (mg/kg)	1 (mg/kg)	3 (mg/kg)	SCTL[2] (mg/kg)	PRG (mg/kg)
4,4'-DDT	52.2	521.9	5219	254	2535	7606	NA	NA

CHILD RESIDENT								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA IX
Chemical	10^{-6} (mg/kg)	10^{-5} (mg/kg)	10^{-4} (mg/kg)	0.1 (mg/kg)	1 (mg/kg)	3 (mg/kg)	SCTL[2] (mg/kg)	PRG (mg/kg)
Benzo(a)pyrene Equivalents	0.092	0.9	9.2	NA	NA	NA	0.1	0.062
4,4'-DDD	3.51	35.1	350.7	NA	NA	NA	4.2	2.4
4,4'-DDE	2.48	24.8	247.6	NA	NA	NA	2.9	1.7
4,4'-DDT	2.48	24.8	247.6	3.61	36.1	108	2.9	1.7
alpha-BHC	0.113	1.1	11.3	NA	NA	NA	0.1	0.09
alpha-Chlordane	2.34	23.4	234.4	3.52	35.2	105	2.8	1.6
Dieldrin	0.045	0.4	4.5	0.306	3.06	9.17	0.06	0.03
gamma-Chlordane	2.34	23.4	234.4	3.52	35.2	105	2.8	1.6
Heptachlor Epoxide	0.078	0.8	7.8	0.079	0.794	2.38	0.1	0.053
Arsenic	0.561	5.6	56.1	2.16	21.6	64.9	2.1	0.39

ADULT RESIDENT								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA IX
Chemical	10^{-6} (mg/kg)	10^{-5} (mg/kg)	10^{-4} (mg/kg)	0.1 (mg/kg)	1 (mg/kg)	3 (mg/kg)	SCTL[2] (mg/kg)	PRG (mg/kg)
Benzo(a)pyrene Equivalents	0.192	1.92	19.2	NA	NA	NA	0.1	0.062
4,4'-DDD	7.92	79.2	792	NA	NA	NA	4.2	2.4
4,4'-DDE	5.59	55.9	559	NA	NA	NA	2.9	1.7
4,4'-DDT	5.59	55.9	559	32.6	326	978	2.9	1.7
Dieldrin	0.095	0.951	9.51	2.61	26.1	78.3	0.06	0.03
Arsenic	1.27	12.7	127	19.6	196	587	2.1	0.39

Table 7-22
Remedial Goal Options for Soil

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

LIFELONG RESIDENT								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA IX
Chemical	10^{-6} (mg/kg)	10^{-5} (mg/kg)	10^{-4} (mg/kg)	0.1 (mg/kg)	1 (mg/kg)	3 (mg/kg)	SCTL[2] (mg/kg)	PRG (mg/kg)
Benzo(a)pyrene Equivalents	0.062	0.620	6.20	NA	NA	NA	0.1	0.062
4,4'-DDD	2.43	24.3	243	NA	NA	NA	4.2	2.4
4,4'-DDE	1.72	17.2	172	NA	NA	NA	2.9	1.7
4,4'-DDT	1.72	17.2	172	NA	NA	NA	2.9	1.7
alpha-BHC	0.077	0.771	7.71	NA	NA	NA	0.1	0.09
alpha-Chlordane	1.62	16.2	162	NA	NA	NA	2.8	1.6
Dieldrin	0.030	0.303	3.03	NA	NA	NA	0.06	0.03
gamma-Chlordane	1.62	16.2	162	NA	NA	NA	2.8	1.6
Heptachlor	0.108	1.08	10.8	NA	NA	NA	0.2	0.11
Heptachlor Epoxide	0.053	0.533	5.33	NA	NA	NA	0.1	0.053
Arsenic	0.389	3.89	38.9	NA	NA	NA	2.1	0.39

Notes:
NA = Not Applicable no toxicity criteria available.
SCTL = Soil Cleanup Target Level
PRG = Preliminary Remediation Goal
SCTL[1] = SCTL for Industrial exposure
SCTL[2] = SCTL for Residential exposure

Table 7-23
Remedial Goal Options for Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

CHILD RESIDENT - DIRECT CONTACT								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA
Chemical	10^{-6} (ug/L)	10^{-5} (ug/L)	10^{-4} (ug/L)	0.1 (ug/L)	1 (ug/L)	3 (ug/L)	GCTL (ug/L)	MCL (ug/L)
1,2-Dibromo-3-Chloropropane	0.07	0.73	7.3	0.10	1.0	3.0	200	NA
1,4-Dichlorobenzene	2.3	23	226	14	139	418	75	75
Benzene	1.1	11	108	2.0	20	61	1	5
Tetrachloroethene	0.10	1.0	10	4.7	47	141	3	5
cis-1,2-Dichloroethene	NA	NA	NA	5.1	51	153	70	70
Trichoroethene	4.5	45	454	253	2529	7586	3	5
Vinyl Chloride	0.04	0.40	4.0	1.5	15	46	1	2
2,4,5-Trichlorophenol	NA	NA	NA	81	811	2432	1	NA
2,4-Dichlorophenol	NA	NA	NA	2.8	28	83	0.3	NA
2-Methylnaphthalene	NA	NA	NA	1.7	17	50	28	NA
Naphthalene	NA	NA	NA	9.3	93	279	14	NA
Pentachlorophenol	0.18	1.8	18	5.7	57	170	1	1
4,4'-DDD	0.14	1.4	14	NA	NA	NA	0.1	NA
4,4'-DDE	0.11	1.1	11	NA	NA	NA	0.1	NA
4,4'-DDT	0.07	0.68	6.8	0.10	0.99	3.0	0.1	NA
Aldrin	0.007	0.07	0.69	0.03	0.30	0.91	0.002	NA
alpha-BHC	0.01	0.15	1.5	NA	NA	NA	0.006	NA
alpha-Chlordane	0.19	1.9	19	0.28	2.8	8.5	2	2
beta-BHC	0.05	0.52	5.2	NA	NA	NA	0.02	NA
delta-BHC	NA	NA	NA	0.24	2.4	7.2	2.1	NA
Dieldrin	0.006	0.06	0.60	0.04	0.41	1.2	0.002	NA
gamma-BHC	0.08	0.82	8.2	0.27	2.7	8.2	0.2	0.2
gamma-Chlordane	0.19	1.9	19	0.28	2.8	8.5	2	2
Heptachlor	0.02	0.23	2.3	0.44	4.4	13	0.4	0.4
Heptachlor Epoxide	0.01	0.11	1.1	0.01	0.12	0.35	0.2	0.2
Arsenic	0.08	0.8	8.2	0.31	3.1	9.4	10	10

Table 7-23
Remedial Goal Options for Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

ADULT RESIDENT - DIRECT CONTACT								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA
Chemical	10^{-6} (ug/L)	10^{-5} (ug/L)	10^{-4} (ug/L)	0.1 (ug/L)	1 (ug/L)	3 (ug/L)	GCTL (ug/L)	MCL (ug/L)
1,2-Dibromo-3-Chloropropane	0.06	0.63	6.3	0.34	3.4	10	200	NA
1,4-Dichlorobenzene	1.82	18	182	45	449	1346	75	75
Benzene	0.92	9.2	92	7.0	70	209	1	5
Tetrachloroethene	0.08	0.82	8.2	15	152	457	3	5
cis-1,2-Dichloroethene	NA	NA	NA	NA	175	526	70	70
Trichoroethene	3.9	39	388	865	8648	25944	3	5
Vinyl Chloride	0.03	0.35	3.5	5.4	54	162	1	2
2,4,5-Trichlorophenol	NA	NA	NA	NA	2417	7251	1	NA
2,4-Dichlorophenol	NA	NA	NA	NA	88	265	0.3	NA
2-Methylnaphthalene	NA	NA	NA	NA	50	151	28	NA
Naphthalene	NA	NA	NA	NA	300	900	14	NA
Pentachlorophenol	0.10	0.98	9.8	12	121	364	1	1
4,4'-DDD	0.08	0.79	7.9	NA	NA	NA	0.1	NA
4,4'-DDE	0.06	0.63	6.3	NA	NA	NA	0.1	NA
4,4'-DDT	0.04	0.37	3.7	0.21	2.1	6	0.1	NA
Aldrin	0.006	0.06	0.59	0.10	1.0	3.1	0.002	NA
alpha-BHC	0.01	0.11	1.1	NA	NA	NA	0.006	NA
alpha-Chlordane	0.12	1.2	12	0.73	7.3	22	2	2
beta-BHC	0.04	0.39	3.9	NA	NA	NA	0.02	NA
delta-BHC	NA	NA	NA	NA	7.2	21	2.1	NA
Dieldrin	0.005	0.05	0.45	0.12	1.2	3.7	0.002	NA
gamma-BHC	0.07	0.65	6.5	0.87	8.7	26	0.2	0.2
gamma-Chlordane	0.12	1.2	12	0.73	7.3	22	2	2
Heptachlor	0.02	0.18	1.8	1.4	14	42	0.4	0.4
Heptachlor Epoxide	0.009	0.09	0.89	0.04	0.36	1.1	0.2	0.2
Arsenic	0.07	0.71	7.1	1.1	11	33	10	10

Table 7-23
Remedial Goal Options for Groundwater

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

LIFELONG RESIDENT - DIRECT CONTACT								
	Target Cancer Risk Level			Target Hazard Index			FDEP	USEPA
Chemical	10^{-6} (ug/L)	10^{-5} (ug/L)	10^{-4} (ug/L)	0.1 (ug/L)	1 (ug/L)	3 (ug/L)	GCTL (ug/L)	MCL (ug/L)
1,2-Dibromo-3-Chloropropane	0.03	0.34	3.4	NA	NA	NA	200	NA
1,4-Dichlorobenzene	1.01	10	101	NA	NA	NA	75	75
Benzene	0.50	5.0	50	NA	NA	NA	1	5
Tetrachloroethene	0.05	0.45	4.5	NA	NA	NA	3	5
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	70	70
Trichoroethene	2.09	21	209	NA	NA	NA	3	5
Vinyl Chloride	0.02	0.19	1.9	NA	NA	NA	1	2
2,4,5-Trichlorophenol	NA	NA	NA	NA	NA	NA	1	NA
2,4-Dichlorophenol	NA	NA	NA	NA	NA	NA	0.3	NA
2-Methylnaphthalene	NA	NA	NA	NA	NA	NA	28	NA
Naphthalene	NA	NA	NA	NA	NA	NA	14	NA
Pentachlorophenol	0.06	0.64	6.4	NA	NA	NA	1	1
4,4'-DDD	0.05	0.51	5.1	NA	NA	NA	0.1	NA
4,4'-DDE	0.04	0.40	4.0	NA	NA	NA	0.1	NA
4,4'-DDT	0.02	0.24	2.4	NA	NA	NA	0.1	NA
Aldrin	0.003	0.03	0.32	NA	NA	NA	0.002	NA
alpha-BHC	0.006	0.06	0.63	NA	NA	NA	0.006	NA
alpha-Chlordane	0.074	0.74	7.4	NA	NA	NA	2	2
beta-BHC	0.02	0.22	2.2	NA	NA	NA	0.02	NA
delta-BHC	NA	NA	NA	NA	NA	NA	2.1	NA
Dieldrin	0.003	0.03	0.26	NA	NA	NA	0.002	NA
gamma-BHC	0.04	0.36	3.6	NA	NA	NA	0.2	0.2
gamma-Chlordane	0.07	0.74	7.4	NA	NA	NA	2	2
Heptachlor	0.01	0.10	1.0	NA	NA	NA	0.4	0.4
Heptachlor Epoxide	0.005	0.05	0.50	NA	NA	NA	0.2	0.2
Arsenic	0.04	0.38	3.8	NA	NA	NA	10	10

Notes:
NA = Not Applicable no toxicity criteria available.
MCL = Maximum Contaminant Level
GCTL = Groundwater Cleanup Target Level

7.7 SUMMARY OF HHRA

The baseline HHRA for PSC 47 at the NAS Jacksonville was performed to characterize the potential risks to likely human receptors under current and potential future land use. Potential receptors under current land use are maintenance workers and adolescent and adult trespassers. Potential receptors under future land use are construction workers, occupational workers and child and adult residents. Although future land use is likely to be the same as current land use, potential future residents were evaluated in the baseline HHRA, primarily for decision-making purposes. The COCs for PSC 47 at the NAS Jacksonville are summarized in Table 7-21.

The list of COPCs for direct contact exposures at PSC 47 includes the following:

- Surface Soil - benzo(a)pyrene, dibenzo(a,h)anthracene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, dieldrin, gamma-chlordane, heptachlor, heptachlor epoxide, and arsenic.
- Subsurface Soil - 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, alpha-chlordane, beta-BHC, delta-BHC, dieldrin, gamma-BHC, gamma-chlordane, heptachlor, heptachlor epoxide, and arsenic.
- Groundwater - 1,2,4-trichlorobenzene, 1,2-dibromo-3-chloropropane, 1,4-dichlorobenzene, benzene, chlorobenzene, chloroform, cis-1,2-DCE, ethylbenzene, isopropylbenzene, PCE, total xylenes, trans-1,2-DCE, TCE, vinyl chloride, 1,1-biphenyl, 2,4,5-trichlorophenol, 2,4-dichlorophenol, 2-methylnaphthalene, naphthalene, pentachlorophenol, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-BHC, alpha-chlordane, beta-BHC, delta-BHC, dieldrin, endrin ketone, gamma-BHC, gamma-chlordane, heptachlor, heptachlor epoxide, and arsenic.

The list of COPCs for migration from soil to groundwater includes the following:

- Surface Soil – 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, alpha-chlordane, beta-BHC, dieldrin, endrin, gamma-BHC, gamma-chlordane, heptachlor epoxide, and arsenic.
- Subsurface Soil - 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-BHC, alpha-chlordane, beta-BHC, dieldrin, gamma-BHC, gamma-chlordane, and arsenic

In addition, benzene, bromoform, cis-1,2-DCE, isopropylbenzene, TCE, vinyl chloride, naphthalene, aldrin, alpha-BHC, and gamma-BHC were identified as COPCs for the migration from groundwater to indoor air pathway.

HIs for exposures to soil by all of the evaluated receptor groups with the exception of child residents and residents exposed to COPCs that may volatilize from groundwater and migrate into indoor air were less

than unity indicating that adverse non-carcinogenic effects are not anticipated for these receptors under the defined exposure conditions. The HI for child residents exposed to surface/subsurface soil exceeded the acceptable level of 1. 4,4'-DDT was the major contributor to the HI for the child resident exposed to surface/subsurface soil.

HIs for domestic use of groundwater by child residents and adult residents exceeded the acceptable level of 1. Arsenic was the major contributor to the HI for the child and adult residents.

ILCRs for exposures to soil by construction workers, maintenance workers, and adult trespassers were compared with USEPA's and FDEP's target risk levels. ILCRs for construction workers, maintenance workers, adolescent trespassers, adult trespassers, and adult residents were within USEPA's target risk range but exceeded FDEP's level of concern. The ILCR for child residents exposed to surface/subsurface soil was equal to the upper bound of USEPA's target risk but exceeded the FDEP level of concern. The ILCR for lifetime residents exposed to surface/subsurface soil exceeded the USEPA target risk range and the FDEP level of concern. 4,4'-DDT, dieldrin, and arsenic were the major contributors the ILCRs.

ILCRs for domestic use of groundwater by child residents, adult residents, and lifelong residents exceeded USEPA's target risk range and FDEP's level of concern. Arsenic was the major contributor to the ILCRs.

The Johnson and Ettinger volatilization model was used to estimate risks from exposures from vapor intrusion. The HIs and ILCRs for residents exposed to COPCs that may volatilize from groundwater and migrate into indoor air were less USEPA's target risk range and FDEP's level of concern.

8.0 ECOLOGICAL RISK ASSESSMENT

This screening-level ERA was conducted in accordance with USEPA ERA Guidance for Superfund (USEPA, 1997a), USEPA Amended Guidance on ERA at Military Bases (USEPA, 2000b), and the Navy Policy for Conducting ERAs (DON, 1999). The risk assessment for PSC 47 consists of Steps 1 through 3A of USEPA's 8-step ERA process. Steps 1 through 3A consist of the following:

Step 1	Screening-Level Problem Formulation and Ecological Effects Evaluation
Step 2	Screening-Level Exposure Estimate and Risk Calculation
Step 3A	Refinement of Preliminary COPCs

Section 8.1.1 provides the environmental setting for PSC 47. The fate and transport characteristics of the chemicals detected in soil are provided in Section 8.1.2. The ecotoxicity of site contaminants and potential ecological receptors are described in Section 8.1.3. Section 8.1.4 describes complete exposure pathways, while Section 8.1.5 provides assessment and measurement endpoints. Sections 8.2, 8.3, and 8.4 describe the ecological effects evaluation, exposure estimates, and risk characterization, respectively. Section 8.5 describes the refinement of preliminary COPCs. Uncertainties inherent with the ERA are discussed in Section 8.6. The summary and conclusions of this ERA are provided in Section 8.7.

8.1 SCREENING-LEVEL PROBLEM FORMULATION

8.1.1 Environmental Setting

PSC 47 comprises approximately 4.2 acres. Approximately one-half of the site consists of Building 536 (the Pesticide Shop), Building 937 (DVECC), other structures, and areas covered by concrete, asphalt, or gravel. The remainder of the site is covered by turf grass and maintained as lawn, with a narrow strip of oak and pine trees along the southern and western boundaries of the site. Recreational ball fields are located to the west and south of PSC 47. Child Street forms the east boundary of the site, and a golf course (Casa Linda Oaks) is located east of Child Street. Turf grass and a grove of oak trees are located immediately north of the site.

The site is relatively flat with a gentle slope to the east and southeast. Natural surface elevations range from slightly below 23 ft msl in the southeastern corner of the PSC to slightly above 24 ft msl in the southwestern, central, and north-central areas. Soil at PSC 47 consists of fine to medium sands.

There are no aquatic habitats in the vicinity of the site. A drainage ditch, dry except during and shortly after rain events, is present along the eastern boundary of the site parallel with Child Street. Because the ditch

is shallow and typically dry, it is vegetated with grasses that are mowed during lawn maintenance activities at the site. During rain events, a barely perceptible storm water flow southward in the ditch has been noted. There is a 30 ft by 40 ft shallow storm water retention pond approximately 400 ft north of the Pesticide Shop. The nearest other surface water bodies are Casa Linda Lake, located on the golf course approximately 1,700 ft east of the site, and an extensive marsh system along the Ortega River, approximately 3800 ft northwest of the site.

Ecological habitat at PSC 47 consists of a mowed grass, landscaped shrubbery, and a few scattered trees. Because of this, and since PSC 47 is located in a highly developed portion of NAS Jacksonville, the site provides habitat for few terrestrial species. Ecological receptors at PSC 47 are limited to species typically found in urban areas, such as various invertebrates (e.g., earthworms, insect larvae), birds, moles, mice, lizards, and presumably exotic rodents such as the black rat and house mouse. The narrow strip of trees along the south and west boundaries of the site, as well as the grove of trees north of the site, contain a dense understory of vines and shrubby vegetation. These areas provide more cover and food sources than the mowed grass at the site, and are utilized by more species. Cottontail rabbits, gray squirrels, shrews, opossums, raccoons, and snakes, for example, undoubtedly forage in these more densely vegetated areas, and would occasionally forage along the edges of PSC 47 near the tree line.

8.1.2 Contaminant Fate and Transport

Past activities at the Pesticide Shop and the DVECC included pesticide application training, storage and disposal of pesticides, and calibration and testing of pesticide application equipment. These activities have resulted in the contamination of soils with chlorinated pesticides, and to a lesser extent, VOCs and SVOCs. A detailed discussion of contaminant fate and transport was presented in Section 6. The discussion below is limited to a brief review of the fate and transport of contaminants at PSC 47 as related to contaminant migration pathways and ecological exposure.

Contaminant migration pathways applicable at this site include volatilization, erosion, and infiltration. Contaminants in soil could volatilize from surficial material. Since the site is essentially covered with structures, pavement, or turf grass, wind erosion is not a significant migration pathway. However, if surface soil is disturbed through activities such as excavation, soils could serve as a source for airborne transport of contaminants and soil contaminants could then be transported to downwind locations. Soil erosion due to storm water runoff is probably minimal at PSC 47 due to the essentially flat terrain and turf grass cover.

Infiltrating precipitation has resulted in the contamination of subsurface soil and groundwater at PSC 47. As explained in Section 8.1.4, however, PSC 47 groundwater does not seep into surface water. Therefore, the fate of contaminants in surface water is not discussed further in this section.

Chlorinated pesticides are highly persistent in the environment, and tend to tightly sorb to organic matter and be immobile in most soils. Nevertheless, chlorinated pesticides can eventually leach into groundwater, especially in soils with low organic carbon. Although organic carbon was not analyzed in soil samples from PSC 47, the sandy soils of northwest Florida are typically low in organic carbon content, which is presumably a major contributing factor in the migration of pesticides from soil into groundwater at the site. Degradation of chlorinated pesticides in PSC 47 soil would eventually occur through volatilization, photolysis, and aerobic and anaerobic degradation. Due to the lipophilicity of organochlorine pesticides, they can bioaccumulate in animals. These compounds generally bioconcentrate in lower trophic level organisms and can be transferred and magnified in higher trophic level organisms.

VOCs generally volatilize to the atmosphere from surface soil. VOCs in soil will dissolve in rain water to varying degrees and can be transported overland with runoff or into groundwater. As indicated earlier, however, the essentially flat terrain and turf grass cover at PSC 47 largely precludes the overland runoff migration pathway. Photolysis and hydrolysis are not significant mechanisms for VOC degradation. Aerobic biodegradation in soil and groundwater is significant, however, and anaerobic degradation can also occur in these media. VOCs do not bioaccumulate in ecological receptors.

SVOCs detected in PSC 47 surface soil consists of PAHs and phthalates. The fate and transport characteristics of PAHs are dependent on their molecular weights. Low molecular weight PAHs are more soluble and volatile, and therefore more mobile. They may volatilize and photolyze from soil and surface water, and they also may be biodegraded. High molecular weight PAHs tend to be immobile and insoluble, binding strongly to organic matter (reducing the potential for leaching to groundwater), and they are resistant to volatilization, photolysis, and biodegradation (Eisler, 2000). Upper tropic level organisms are primarily exposed to PAHs through diet, but most wildlife can metabolize and excrete PAHs. Food-chain transfer and biomagnification of PAHs is expected to be minimal. PAHs may be absorbed by plants but are expected to be translocated, metabolized, and potentially photodegraded. Accumulation within plants is likely to occur only in heavily polluted locations where uptake exceeds metabolism and degradation (Edwards, 1983).

Phthalates are relatively persistent in the environment. Although numerous studies have demonstrated that phthalates undergo biodegradation, this is a slow process in soil. Some microorganisms have been shown to excrete products that increase the solubility of phthalates and enhance their biodegradation (Gibbons and Alexander, 1989). Bis(2-ethylhexyl)phthalate and butyl benzyl phthalate are not expected to significantly volatilize and neither of these phthalates appreciably leach from soil into groundwater (Spectrum, 2003). Dimethyl phthalate is more likely to leach into groundwater (Spectrum, 2003), but was not detected in PSC 47 groundwater samples. Biomagnification of phthalates does not occur.

8.1.3 Ecotoxicity and Potential Receptors

Pesticides, VOCs, and SVOCs were detected in surface soil. As stated earlier, VOCs readily volatilize from soil. Therefore, their toxicity to ecological receptors is relatively low.

Organochlorine pesticides are reproductive and nervous system toxins. Although these compounds were used as insecticides, they are toxic to other animals as well. The target organ for acute exposures is the nervous system, while chronic exposures can affect the liver and endocrine systems of higher animals. Organochlorine pesticides are lipophilic and can be stored in the fat tissue of organisms such as birds and mammals. In birds of prey they can cause reproductive failure through eggshell thinning and disruption of egg-laying and nesting cycles (Amdur et al., 1991). These pesticides were developed to control insects on crops, and as a result, they are not very toxic to plants.

Few generalizations can be made about the ecotoxicity of PAHs because of the extreme variability in toxicity and physiochemical properties of PAHs. Adverse impacts to plants from PAHs, however, are rare (Eisler, 2000). In most animal species, PAHs are metabolized by a mixed-function oxidase enzyme system into intermediates that may be toxic, mutagenic, or carcinogenic to the host. Some invertebrate species cannot efficiently metabolize PAHs (Eisler, 2000), and PAHs can be chronically toxic to invertebrates, but overall, very little is known about the toxicological mechanisms of PAHs in invertebrates (Erstfield and Snow-Ashbrook, 1999). PAHs can bind to cellular macromolecules and thereby disrupt their function in higher level organisms such as mammals and birds. Biological macromolecules include polymers of carbohydrates (e.g., starch), amino acids (proteins), and nucleotides (e.g., DNA). The cellular functions of these polymers include structure, energy storage, energy transfer, material transport, and the storage and transmittal of genetic information. PAHs show little tendency to biomagnify in the food web (Eisler, 2000). USEPA Region IV considers the potential toxicity of PAHs via the terrestrial food web to be generally negligible unless PAHs are present at extremely high concentrations (i.e., percent levels: 10,000 mg/kg) in soil. Microbial metabolism is the major process for degradation of PAHs in soil (ATSDR, 1997).

In general, phthalates have a low acute toxicity to animals (Amdur et al., 1991). Chronic oral exposures, however, have been shown to result in liver toxicity in mammals. Ingested phthalates metabolize to monoesters in the gut and are subsequently absorbed. Following absorption, phthalates distribute primarily to the liver and kidneys and may, in some species, concentrate in the testes (Rhodes et al., 1986). Liver carcinogenesis has been observed (ATSDR, 1997). Many receptors are able to metabolize and excrete phthalate esters, so their ability to bioaccumulate varies among species. Detailed ecotoxicity data for birds, plants, and invertebrates plants could not be located.

8.1.4 Complete Exposure Pathways

Soil invertebrates are exposed to soil contaminants at PSC 47 through ingestion and dermal contact. Higher trophic level animals such as birds and small mammals will be exposed to site-related contamination through ingestion of contaminated food items. These animals can also incidentally ingest contaminants in soil while grooming fur, preening feathers, digging, grazing close to the soil, or feeding on items to which soil has adhered. Absorption of contaminants from the gastrointestinal tract is the primary pathway of intake for terrestrial receptors. Exposure to contaminants in the soil through dermal contact could occur but is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons minimize transfer of contaminants across dermal tissue. Higher trophic level animals at the site are limited to species typically found in urban areas, such as invertebrates, song birds, moles, mice, lizards, and exotic rodents such as the black rat and house mouse (see Section 8.1.1). Additional species such as rabbits, gray squirrels, shrews, opossums, raccoons, and snakes undoubtedly forage in areas of more dense vegetation near the site, and would occasionally be expected to forage along the periphery of the site.

The airborne transport of dust is a negligible pathway for terrestrial animals because the area is covered by impermeable surfaces or vegetation. Similarly, the inhalation pathway is not significant.

Terrestrial vegetation could be exposed to contaminants via contact with soil and subsequent root translocation. Aerial deposition is a negligible pathway for plants and animals at PSC 47 because the site is largely covered by vegetation or impermeable surfaces, reducing the amount of bare soil and fugitive dust.

With the exception of the drainage ditch (swale) along Child Street, there are no surface water bodies at the site. The ditch is dry except during and shortly after rain events. The infrequent existence of water in the ditch, and its location along a major public thoroughfare, results in an essentially incomplete surface water exposure pathway.

Extensive groundwater sampling has been conducted at PSC 47 during the past several years. As discussed in Section 5, data indicate that the groundwater flow at the site is toward the northwest. This conclusion is substantiated by flow models generated by the USGS (Davis *et al*, 1996). The nearest surface water body in the direction of groundwater flow is an extensive marsh system along the Ortega River, approximately 3,800 ft from the site, although a drainage ditch located over 1,000 ft northeast of the site may receive groundwater. The ditch ultimately feeds the Ortega River. The Ortega River itself is 5,000 ft from the site. Groundwater beneath PSC 47 does not have an outlet into surface water in any ditches; groundwater seepage into ditches would be evident by the presence of surface water in the ditches, which is not the case. Furthermore, PSC 47 groundwater data indicate that there has been very

little downgradient movement of chemicals in groundwater from contaminated areas at the site. Given the 3800-ft distance to the marshes, and the essentially absent downgradient movement of the plume of contaminated groundwater at the site (even without considering the inevitable attenuation and dilution that would occur in traveling that distance), the groundwater-to-surface water pathway is incomplete at PSC 47.

A complete exposure pathway has three components: a source of contaminants that can be released to the environment; a route of contaminant transport through an environmental medium; and an exposure or contact point for an ecological receptor. As explained in Step 1 of USEPA's ERA guidance (USEPA, 1997), if an exposure pathway is not complete, that exposure pathway does not need to be evaluated. This is the case for groundwater at PSC 47, and groundwater contaminants will not be evaluated in this ERA.

In summary, complete exposure pathways and routes of entry into biota at PSC 47 consist of

- Direct contact with soil
- Ingestion of soil
- Ingestion of contaminated food items

8.1.5 Preliminary Assessment and Measurement Endpoints

USEPA Region IV has specified that assessment endpoints for the screening-level assessment should be broad and generic. For the screening level assessment, the preliminary assessment endpoint is the protection of terrestrial biota from adverse effects of chemicals on their growth, survival, and reproduction. Measurement endpoints represent the assessment endpoints chosen for a site, and are measures of biological effects (USEPA, 1997a). The preliminary measurement endpoints were chemical concentrations in surface soil that are associated with no adverse effects on growth, survival, and reproduction of terrestrial organisms. The measurement endpoints are represented by USEPA Region IV ecological screening values (ESVs) for surface soil.

The USEPA Region IV ESVs for surface soil are based on conservative endpoints and sensitive ecological effects data, and thus, the screening values represent chemical concentrations associated with a low probability of unacceptable risks to ecological receptors. For this reason, USEPA Region IV considers their soil ESVs to be protective of terrestrial invertebrates and plants as well as upper level receptors such as birds and mammals. In the screening level ERA, therefore, a distinction is not made between measurement endpoints associated with direct toxicity to invertebrates and plants versus measurement endpoints associated with food chain effects.

8.2 SCREENING-LEVEL ECOLOGICAL EFFECTS EVALUATION

For the screening level ERA, maximum concentrations of chemicals detected in surface soil collected during Phases I and II were compared to USEPA Region IV ESVs (USEPA, 2001b). If the maximum concentration was less than the ESV, the chemical was eliminated from further consideration. If the maximum concentration equaled or exceeded the ESV, or if an ESV was not available, the chemical was then considered to be an ecological COPC and was retained for further study in the ERA.

8.3 SCREENING-LEVEL EXPOSURE ESTIMATE

Exposure point chemical concentrations were obtained from surface soil samples collected in Phases I and II (2001, 2002, and 2003) and thus, the data set does not include samples collected from areas that were later excavated. Phase III data was not included in the risk assessment. An evaluation of Phase III data was completed by the ecological risk assessor to determine if incorporation of this data would impact the findings of the prior assessment. It was determined that inclusion of this data would likely reduce the calculation of ESVs values, since much of the Phase III data was collected as step out samples from areas of higher impact, and thus contained lower levels or non-detect levels of contamination. The data set (surface and subsurface samples) is presented in Tables 5-1 and 5-2. The term “surface soil” is used in this risk assessment to refer to soil collected form 0 to 1-ft depth, since USEPA Region IV considers this depth to be representative of surface soil.

The surface soil data base consisted of four samples collected beneath pavement plus 37 samples that were not beneath pavement. Since ecological receptors are essentially not exposed to soils beneath pavement, the 37 samples not beneath pavement were the primary data set evaluated in this risk assessment. Nevertheless, the other four samples were evaluated separately as a conservative measure, since moles and tree roots could be exposed to soils under pavement, or in case the pavement is removed in the future.

All analytes (except calcium, magnesium, potassium, and sodium) detected in surface soil samples were assessed in this investigation. Calcium, magnesium, potassium, and sodium were excluded because they are essential nutrients that are toxic only at extremely high concentrations. Due to the scarcity of data for these essential nutrients, it was not possible to develop ranges of toxicity for them even at high concentrations.

8.4 SCREENING-LEVEL RISK CALCULATION

The preliminary risk calculation step compared maximum concentrations of chemicals in surface soil to USEPA Region IV ESVs. The ratio of the maximum concentration to the ESV is called the screening HQ. Analytes whose maximum concentrations did not exceed ESVs (i.e., HQ < 1.0) were dropped from further

consideration, and those that equaled or exceeded ESVs (i.e., HQ $\geq$ 1.0), or did not have ESVs, were retained as ecological COPCs.

Twelve (12) pesticides were retained as COPCs because their maximum concentrations exceeded screening values (Table 8-1). Two VOCs (acetone and 2-butanone) were retained as COPCs because ESVs were not available. Four PAHs (benzo(a)pyrene, fluoranthene, phenanthrene, and pyrene) as well as total PAHs were retained as COPCs because their maximum concentrations exceeded ESVs, while seven other PAHs were retained as COPCs because ESVs were not available. Two phthalates (bis[2-ethylhexyl]phthalate and butyl benzyl phthalate) were retained as COPCs because ESVs were not available.

8.5 REFINEMENT OF PRELIMINARY COPCS

At this point, the first two steps of the ERA have been completed. The ERA process includes a series of scientific/management decision points (SMDPs) (USEPA, 1997a). The first SMDP occurs at the end of Step 2, and requires the risk managers to evaluate and approve or redirect the work up to that point and determine whether the risk assessment will continue into Step 3. However, USEPA Region IV recognizes that most ERAs will proceed into Step 3, and facilities are encouraged to submit the results of Steps 1 through 3 as a single deliverable document (USEPA, 2000b). With this in mind, and since the screening level ERA indicates a potential for adverse effects, a more thorough assessment is warranted. Therefore, the risk assessment process for PSC 47 will proceed into Step 3 (Baseline Risk Assessment Problem Formulation).

The baseline ERA begins with a more balanced evaluation of the conservativeness inherent in the first two steps of the risk assessment process. The initial phase of Step 3 is typically known as Step 3A, and consists of a refinement of the conservative exposure assumptions in order to more realistically estimate potential risks to ecological receptors (i.e., plants, invertebrates, and wildlife receptors). Examples of factors considered during Step 3A include toxicological evaluation of COPCs, spatial distribution of contaminants, food-chain modeling, and habitat quality (USEPA, 1997a; DON, 1999).

Food-chain modeling was conducted to investigate potential risks to representative receptors from ingested doses of surface soil COPCs that are known to bioaccumulate or biomagnify (USEPA, 2000b). The methods used to model the doses that representative receptors could receive, as well as the selection of toxicity reference values (TRVs), are presented in Appendix L. The assessment endpoints associated with the food-chain modeling were the protection of insectivorous birds and mammals from adverse effects of COPCs on growth, survival, and reproduction. The term “insectivorous” is used here in a broad sense to describe birds and mammals that prey not only upon insects, but on a variety of invertebrates (i.e., adult and larval insects, centipedes, millipedes, other arthropods, and worms). The

Table 8-1
Selection of Ecological COPCs for Surface Soil
Ecological Risk Assessment

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	Frequency of Detection	Minimum Detection	Maximum Detection[1]	Location of Maximum	Average of Positive Detections	Average of All Samples	Ecological Screening Value[2]	Hazard Quotient	COPC? (Yes/No)
Pesticides (µg/kg)									
4,4'-DDD	18/37	0.89	2500	SB10	528	395	2.5[3]	**1000**	Yes
4,4'-DDE	31/37	1.1	13000	SB42	1,401	1,174	2.5[3]	**5200**	Yes
4,4'-DDT	31/37	1.8	180000	SB50	8,579	7,188	2.5[3]	**72000**	Yes
Aldrin	1/37	13.9	13.9	SB29	13.9	137	2.5	**5.6**	Yes
Alpha-Chlordane	13/37	2.1	14000	SB50	1,607	598	100[4]	**140**	Yes
Beta-BHC	1/37	12.7	12.7	SB27	12.7	136	1.0	**12.7**	Yes
Delta-BHC	1/37	16.8	16.8	SB24	16.8	137	100[4]	0.2	No
Dieldrin	9/37	1.9	3400	SB50	467	229	0.5	**6800**	Yes
Endrin	6/37	14.5	1210	SB24	265	300	1.0	**1210**	Yes
Endrin Aldehyde	6/37	1.8	60.4	SB22	41.0	264	1.0[5]	**60.4**	Yes
Endrin Ketone	4/37	17.2	127.9	SB24	48.6	262	1.0[5]	**127.9**	Yes
Gamma-Chlordane	15/37	2.8	9700	SB50	1,171	508	100[4]	**97**	Yes
Heptachlor	1/37	430	430	SB42	430	134	100[4]	**4.3**	Yes
Heptachlor Epoxide	4/37	0.82	96	SB51	34.0	136	100[4]	0.96	No
Methoxychlor	2/37	21	25.4	SB08	23.2	1,334	100[4]	0.3	No
VOCs (µg/kg)									
2-Butanone	3/3	12	77	SB01	34.3	34	NA	NA	Yes
Acetone	2/3	3	3.5	SB17	3.3	5.8	NA	NA	Yes
Methylene Chloride	3/3	6	20	SB01	10.7	11	2000	0.01	No
Toluene	2/3	3	3.5	SB17	3.3	5.8	50	0.07	No

Table 8-1
Selection of Ecological COPCs for Surface Soil
Ecological Risk Assessment

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Chemical	Frequency of Detection	Minimum Detection	Maximum Detection(1)	Location of Maximum	Average of Positive Detections	Average of All Samples	Ecological Screening Value(2)	Hazard Quotient	COPC? (Yes/No)
SVOCs (µg/kg)									
Benzo(a)anthracene	2/3	120	230	SB01	175	177	NA	NA	Yes
Benzo(a)pyrene	2/3	130	380	SB01	255	230	100	**3.8**	Yes
Benzo(b)fluoranthene	2/3	120	560	SB01	340	287	NA	NA	Yes
Benzo(g,h,i)perylene	2/3	67	420	SB01	244	222	NA	NA	Yes
Benzo(k)fluoranthene	2/3	140	410	SB01	275	243	NA	NA	Yes
Chrysene	2/3	150	480	SB01	315	270	NA	NA	Yes
Dibenzo(a,h)anthracene	2/3	28	140	SB01	84.0	116	NA	NA	Yes
Fluoranthene	2/3	93	530	SB01	312	268	100	**5.3**	Yes
Indeno(1,2,3-cd)pyrene	2/3	76	400	SB01	238	219	NA	NA	Yes
Phenanthrene	2/3	21	160	SB01	90.5	120	100	**1.6**	Yes
Pyrene	2/3	120	520	SB01	320	273	100	**5.2**	Yes
Total PAHs	2/3	1065	4230	SB01	2,648	2,425	1000	**4.2**	Yes
Bis(2-ethylhexyl)phthalate	2/3	130	1400	SB01	765	570	NA	NA	Yes
Butyl benzyl phthalate	2/3	35	360	SB01	198	192	NA	NA	Yes
Dimethyl phthalate	1/3	340	340	SB01	340	245	200000	0.002	No

Notes:

1 The maximum detected concentration was used for screening purposes.
2 USEPA Region IV Screening Values (USEPA, 2000).
3 Screening value for total of DDT, DDE, and DDD.
4 Screening value for organochlorinated pesticides.
5 Screening value for endrin
NA - Ecological screening value not available.
Bold indicates HQ is greater than 1.0

short-tailed shrew was selected to represent insectivorous mammals and the American robin was selected to represent insectivorous birds. The associated measurement endpoints were doses of COPCs associated with adverse effects on growth, survival, and reproduction of these receptor groups.

Large terrestrial carnivorous birds and mammals (e.g., red fox, red-tailed hawk) were not selected as assessment endpoints because of the developed nature of the sites and their small size compared to the typical foraging areas of carnivorous animals. Omnivores and herbivores were not selected as assessment endpoints because exposure to organochlorine pesticides is greater for insectivores than for omnivores and herbivores.

8.5.1 Results of Food-Chain Modeling

Based on maximum concentrations obtained from Phases I and II data and conservative assumptions, food chain HQs exceeded 1.0 for 10 pesticides: 4,4'-DDT, 4,4'-DDD, 4,4'-DDE (hereafter referred to as DDT, DDD, and DDE, respectively), alpha-chlordane, gamma-chlordane, dieldrin, endrin, endrin aldehyde, endrin ketone, and heptachlor (Table 8-2). Based on the average concentration scenario, food chain HQs exceeded 1.0 for nine pesticides: DDT, DDD, DDE, dieldrin, endrin, endrin aldehyde, endrin ketone, heptachlor, and delta-BHC (Table 8-3). Food chain HQs for DDD, DDE, and DDT were especially elevated for insectivorous birds represented by the robin.

As shown in Tables 8-2 and 8-3, food chain HQs for delta-BHC, endrin aldehyde, and endrin ketone were greater using average concentrations than those using maximum concentrations. This incongruity occurs when the detection limits in "non-detected" samples exceed the maximum detected concentrations, especially when the analyte is infrequently detected. For example, delta-BHC was detected in only one of 37 samples, at a concentration of 16.8 µg/kg, but the detection limit for this analyte in five "non-detect" samples were elevated, and was 5300 µg/kg in one sample. The average concentration calculated by assuming a value of one-half the detection limit for non-detected samples resulted in a concentration that was greater than the maximum detected concentration.

8.5.2 Step 3a Discussion

The results of the screening level assessment and Step 3a considerations are discussed on a COPC-specific basis.

8.5.2.1 Volatile Organic Compounds

Two VOCs (acetone and 2-butanone) were retained as COPCs because ESVs were not available. No pertinent toxicity information was found for 2-butanone. The toxicity of acetone to animals is in the parts-per-thousand range (Opresko, 1995). Neither of these chemicals is expected to be toxic via the

Table 8-2
Terrestrial Wildlife Model - Maximum HQs

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Short-tailed Shrew HQ_{NOAEL}	Short-tailed Shrew HQ_{LOAEL}	American Robin HQ_{NOAEL}	American Robin HQ_{LOAEL}
Pesticides				
4,4'-DDD	**4.3**	0.9	**1876.8**	**187.7**
4,4'-DDE	**22.6**	**4.5**	**9759.3**	**975.9**
4,4'-DDT	**312.7**	**62.5**	**135128.2**	**13512.8**
ALDRIN	0.02	0.005		
ALPHA-CHLORDANE	**1.6**	0.8	**5.3**	**1.1**
BETA-BHC	0.002	0.0003	0.02	0.005
DELTA-BHC	0.64	0.064	0.02	0.01
DIELDRIN	**120.9**	**12.1**	**47.5**	**4.8**
ENDRIN	**5.1**	0.5	**70.9**	**7.1**
ENDRIN ALDEHYDE	0.3	0.03	**3.5**	0.4
ENDRIN KETONE	0.5	0.1	**7.5**	0.7
GAMMA-CHLORDANE	**1.1**	0.6	**3.7**	0.7
HEPTACHLOR	**4.4**	0.4		
HEPTACHLOR EPOXIDE	0.3	0.03		

Notes
- Blank spaces indicates that an HQ could not be calculated because a NOAEL or LOAEL was not available
- Bold indicates HQ is greater than 1.0

HQ - Hazard Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration

Table 8-3
Terrestrial Wildlife Model - Average HQs

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Parameter	Short-tailed Shrew HQ_{NOAEL}	Short-tailed Shrew HQ_{LOAEL}	American Robin HQ_{NOAEL}	American Robin HQ_{LOAEL}
Pesticides				
4,4'-DDD	0.6	0.1	**271.3**	**27.1**
4,4'-DDE	**1.7**	0.3	**807.5**	**80.8**
4,4'-DDT	**10.4**	**2.1**	**4942.9**	**494.3**
ALDRIN	0.2	0.04		
ALPHA-CHLORDANE	0.1	0.03	0.2	0.04
BETA-BHC	0.02	0.003	0.2	0.05
DELTA-BHC	**4.35**	0.44	0.2	0.05
DIELDRIN	**6.8**	0.7	**2.9**	0.3
ENDRIN	**1.1**	0.1	**16.1**	**1.6**
ENDRIN ALDEHYDE	0.9	0.1	**14.2**	**1.4**
ENDRIN KETONE	0.9	0.1	**14.0**	**1.4**
GAMMA-CHLORDANE	0.05	0.02	0.2	0.04
HEPTACHLOR	**1.2**	0.1		
HEPTACHLOR EPOXIDE	0.4	0.04		

Notes:
- Blank spaces indicates that an HQ could not be calculated because a NOAEL or LOAEL was not available
- Bold indicates HQ is greater than 1.0

HQ - Hazard Quotient
NOAEL - No Observed Adverse Effects Concentration
LOAEL - Lowest Observed Adverse Effects Concentration

food chain. Although toxicity data are sparse regarding their effects to invertebrates, the presence of these two chemicals at relatively low concentrations in PSC 47 soil probably poses negligible or minor risk.

8.5.2.2 SVOCs

Maximum screening HQs of four PAHs (benzo(a)pyrene, fluoranthene, phenanthrene, and pyrene) as well as total PAHs exceeded 1.0, but were relatively low (1.6 to 5.3). The USEPA Region IV ESVs for these four PAHs and for total PAHs are based on concentrations that represent background concentrations in soil or detection limits (Friday, 1998). The maximum concentration of total PAHs (4230 µg/kg, Table 8-1) was well below 20,000 µg/kg, which has been described as moderate soil contamination that requires additional study (Friday, 1998). Because of this, and since the toxicity of PAHs via the terrestrial food web is negligible at the concentrations measured in PSC 47 soil, PAHs pose negligible risk at the site.

ESVs were not available for bis(2-ethylhexyl)phthalate or butyl benzyl phthalate. Phthalates are common environmental contaminants due to their use in plastics. Phthalates can also be an artifact of the sampling and/or analytical methods. Ecotoxicity data for plants and invertebrates plants could not be located, but phthalates have a low acute toxicity to animals and would pose negligible risk to animals via the food chain at the concentrations measured in PSC 47 soil.

8.5.2.3 Pesticides

As mentioned in Section 8.3, the surface soil data set used to generate Tables 8-1, 8-2, and 8-3 consisted of samples that were not beneath pavement. Four surface soil samples (SB07, SB11, SB28, and SB57) were collected beneath pavement. Concentrations of pesticides in these four samples were within the range of concentrations in the other 37 samples (Table 5-1).

All pesticide COPCs at PSC 47 are organochlorine insecticides that are no longer used but are known to be extremely persistent in soil. Maximum screening HQs were especially elevated for DDD, DDE, DDT, dieldrin, and endrin (Table 8-1). The HI, which is an estimate of cumulative toxicity and is calculated as the sum of individual HQs, would be particularly elevated, even if only the average concentrations were considered. There is no doubt that concentrations of pesticides in some PSC 47 soil samples pose risk to soil invertebrates; after all, these pesticides were developed to control soil insects.

The elevated food chain HQs indicate risk to birds and mammals that consume soil invertebrates at the site. Food chain HQs for DDD, DDE, and DDT were especially elevated for insectivorous birds represented by the robin. The primary issue in determining risk to insectivorous birds and mammals at

PSC 47 is the extent to which birds and mammals actually forage at the site. Approximately one-half of the 4.2-acre site consists of buildings and areas covered by concrete, asphalt, or gravel. The remainder of the site consists of turf grass, landscaped shrubbery, and a few scattered trees. The site, therefore, provides poor habitat for terrestrial species. Wildlife receptors at the site are those typically found in urban areas, such as moles, mice, lizards, birds, and exotic rodents such as the black rat and house mouse. An examination of Figure 8-1 shows that the samples with elevated concentrations of pesticides had a tendency to be located in areas where exposure to terrestrial receptors would be negligible; specifically, adjacent to Buildings 937 and 536, near parking lots, and along Child Street.

The highest food chain HQs were for DDD, DDE, DDT, dieldrin, and endrin (Table 8-2). Food chain HQs for other pesticides were either less than 1.0, or did not greatly exceed 1.0 (except endrin aldehyde and endrin ketone). As explained in Section 8.5.1, food chain HQs for endrin aldehyde and endrin ketone under the average concentration scenario (14.2 and 14.0, respectively, Table 8-3) were greater than the maximum concentration HQs due to high detection limits in some non-detect samples.

Concentrations of pesticides had a tendency to be much lower in samples along the northern, western, and southern boundaries of the site (Figure 8-1). DDD, DDE, and DDT, which had the highest food chain HQs over the site as a whole, were present at much lower concentrations along the site periphery, and other pesticides were rarely detected along the site periphery. Foraging by birds and mammals would be more likely to occur along the northern, western, and southern boundaries of the site than in areas nearer the buildings and parking lots. Concentrations of DDD, DDE, and DDT were approximately 20 µg/kg, 40 µg/kg, and 40 µg/kg, respectively, in samples along the northern, western, and southern boundaries of the site (Figure 8-1). Based on these concentrations, food chain HQs would be less than 1.0 for the shrew, while food chain no-observed adverse effects level (NOAEL)-based HQs for the robin would be 14 for DDD and 28 for DDE and DDT. Based on the same concentrations, the lowest-observed adverse effects level (LOAEL)-based HQs would be 1.4 for DDD and 2.8 for DDE and DDT.

The food chain HQs are also mitigated by considering the area in which insectivorous birds such as the robin actually forage. The home range of the robin during breeding season is approximately 0.5 to 2.0 acres, while robins often forage over distances of a mile or more during non-breeding seasons (USEPA, 1993; Sallabanks and James, 1999). Therefore, a robin could possibly forage exclusively in the vicinity of PSC47 only during nesting, which is approximately April through July in Florida (Kale and Maehr, 1990).

8.6 UNCERTAINTY

Uncertainty is associated with all aspects of the ecological assessment methodology presented in the preceding sections. This section provides a summary of the uncertainties.

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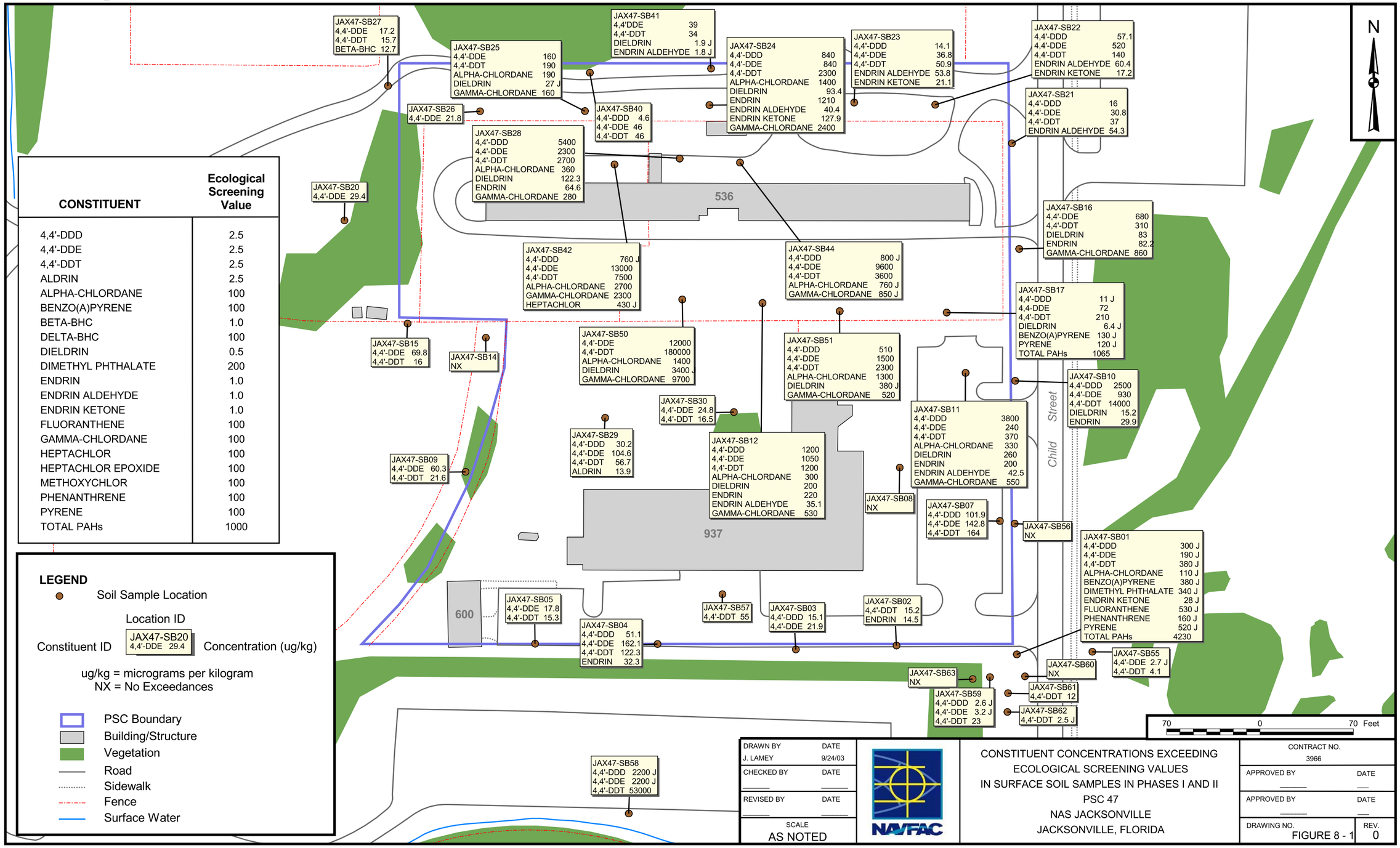


CONSTITUENT	Ecological Screening Value
4,4'-DDD	2.5
4,4'-DDE	2.5
4,4'-DDT	2.5
ALDRIN	2.5
ALPHA-CHLORDANE	100
BENZO(A)PYRENE	100
BETA-BHC	1.0
DELTA-BHC	100
DIELDRIN	0.5
DIMETHYL PHTHALATE	200
ENDRIN	1.0
ENDRIN ALDEHYDE	1.0
ENDRIN KETONE	1.0
FLUORANTHENE	100
GAMMA-CHLORDANE	100
HEPTACHLOR	100
HEPTACHLOR EPOXIDE	100
METHOXYCHLOR	100
PHENANTHRENE	100
PYRENE	100
TOTAL PAHs	1000

8.6.1 Uncertainty in the Problem Formulation

Probably the primary uncertainty in this risk assessment is the extent that wildlife receptors forage at PSC 47. The site provides poor habitat, and as a result, significant foraging probably does not occur at the site. Risk to insectivorous receptors was evaluated as a conservative measure, but under current habitat conditions, the food chain HQs are believed to grossly overestimate risk at the site. The precise extent of overestimation is uncertain.

Another uncertainty associated with PSC 47 is the choice of representative receptors. The short-tailed shrew was selected to represent small mammals that consume insects, but the site provides very little cover in which these timid animals can hide. Under current habitat conditions, the food chain HQs for mammals represented by the shrew are believed to grossly overestimate risk to insectivorous mammals.

Larger animals such as foxes, bobcats, and hawks were not selected as representative receptors due to conditions at the site. Bobcats are not found in developed areas such as the vicinity of PSC 47. Foxes sometimes become habituated to developed areas, but would be inhibited from foraging at the site by the chain link fence along the northern and western boundary of the site. Similarly, the site would not be expected to provide foraging habitat to large predatory birds such as hawks. The uncertainty associated with not including large predatory mammals and birds is negligible.

Evidence indicates that the groundwater-to-surface water pathway is not complete at the site, and therefore, groundwater contaminants are presumed to pose no risk to ecological receptors. Extensive groundwater data, the absence of surface water bodies at the site, and the distance to downgradient surface water bodies supports this presumption. Thus, the uncertainty associated with this presumption appears to be negligible.

8.6.2 Uncertainty in the Ecological Effects Characterization

Laboratory-derived NOAELs and LOAELs might not adequately represent toxicity thresholds for receptors under field conditions. In addition, NOAELs and LOAELs derived for species used in toxicity tests might not adequately represent toxicity thresholds for other species. These uncertainties may overestimate or underestimate potential risks.

Data for investigating toxicity to reptiles and amphibians from oral ingestion of contaminants are sparse. Thus, potential risks via the food chain were not evaluated for reptiles and amphibians. With the exception of toads, however, few reptiles and amphibians probably utilize the site.

8.6.3 Uncertainty in the Exposure Assessment

Detection limits for some non-detected pesticides exceeded ESVs in five samples (SB42, SB44, SB50, SB51, and SB58A (See Table 5-1 for detection limits and Table 8-1 for ESVs). Elevated concentrations of DDT and/or DDE in these five samples required dilutions during the laboratory analytical process, which resulted in elevated reporting limits for non-detected pesticides. While the high detection limits prevents a complete evaluation of the presence of pesticides in these five samples, the overall impact of this uncertainty in not significant.

The dermal exposure for upper-level receptors was not evaluated, potentially underestimating risks. However, this exposure route is usually miniscule.

Literature-based bioaccumulation factors used in food-chain modeling often vary between species and sites. This can overestimate or underestimate potential risks.

Soil samples evaluated in this risk assessment consisted of samples no deeper than 1 ft below the soil surface. However, tree roots extend deeper than 1 ft below the surface, and mammals such as moles could burrow deeper than 1 ft. With the exception of moles and trees, terrestrial species at the site would rarely (if ever) be exposed to soils deeper than 1 ft below the surface. The uncertainty resulting in evaluating only surface soils is negligible.

8.6.4 Uncertainty in the Risk Characterization

This uncertainty results from the combination of the above uncertainties. For example, the assessment of risks to upper-level receptors via the food chain is hindered by uncertainties such as the derivation of the toxicity reference values, the process used to derive bioaccumulation factors, and the choice of the best species to represent mammal and bird receptors. A weight-of-evidence approach to assess risks was used to reduce the overall uncertainty in these situations.

Uncertainty in risk characterization also results from the lack of data regarding the toxicity of multiple chemicals. For example, soil concentrations of pesticides were elevated at numerous locations. The extent to which these concentrations might contribute to cumulative toxicity is uncertain.

An uncertainty in the evaluation of ecological risk at PSC 47 is the future land use of the property that comprises the site. For example, foraging by insectivorous birds and mammal species is essentially non-existent under current conditions. If the site is eventually converted to more natural habitat conditions, pesticide concentrations in soil at current concentrations would pose significant potential risk to many receptors.

8.7 SUMMARY AND CONCLUSIONS

VOCs and SVOCs pose negligible risk at PSC 47.

Organochlorine pesticides, especially DDT, DDD, DDE, dieldrin, and endrin, are present in some surface soil samples at extremely high concentrations. These pesticides are no longer used but are known to be extremely persistent in soil. Pesticide concentrations in several samples pose risk to soil invertebrates, especially from the cumulative toxicity of multiple pesticides.

Organochlorine pesticides can bioaccumulate and biomagnify in the food chain and the risk assessment suggests elevated risk to mammals and birds that consume soil invertebrates at the site. However, the site provides only about one acre of poor-quality habitat in a developed portion of NAS Jacksonville. Pesticide concentrations were greatest near Buildings 937 and 536, parking lots, and along Child Street, where foraging by birds and mammals is essentially negligible. Pesticide concentrations were considerably lower in samples along the northern, western, and southern boundaries of the site.

Earthworm toxicity tests or the collection of soil invertebrates for tissue analyses would provide little benefit in characterizing risk, since the major factor here is habitat quality, rather than actual tissue concentrations or earthworm survival.

The poor habitat, the urban nature of the area, and the small size of PSC 47 results in an exposure pathway that is essentially negligible for wildlife species. Therefore, with the exception of receptors such as soil invertebrates, the potential for ecological impacts from site-related contaminants is minor under current habitat conditions.

9.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section develops RAOs and derives PRGs for the contaminated media. The regulatory requirements and guidance [e.g., Applicable or Relevant and Appropriate Requirement (ARARs)] that may potentially govern remedial activities are presented in this section. In addition, this section presents the COCs identified during the RI, HHRA, and ERA and the conceptual pathways through which these chemicals may affect human health, and thus derives the environmental media of concern. The PRGs for the contaminated media are developed in this section and general response actions (GRAs) that may be suitable to achieve the PRGs are presented. Finally, this section presents an estimate of the volumes of contaminated media.

9.1 REMEDIAL ACTION OBJECTIVES

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 an acceptable range of COC concentrations (i.e., PRGs) for the site.

The development of PRGs takes into consideration ARARs and to be considered (TBC) criteria. Section 9.1.2 identifies the ARARs and TBC criteria, Section 9.1.3 identifies the media of concern, and Section 9.1.4 identifies the COCs for remediation.

9.1.1 Statement of RAOs

Site-specific RAOs specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. RAOs may be developed to permit consideration of a range of treatment and containment alternatives. This FS addresses soil and groundwater contamination at PSC 47. To protect the public from potential current and future health risks, as well as protect the environment, the following RAOs have been developed:

Soil RAO No. 1:

Prevent unacceptable risk from exposure to surface and subsurface soil with concentrations of benzo(a)pyrene equivalent, pesticides, and arsenic greater than the FDEP SCTLs for direct residential exposure.

Soil RAO No. 2:

Prevent migration of pesticides to groundwater from surface and subsurface soil with concentrations of these chemicals greater than the FDEP SCTLs or site specific criteria for leachability to groundwater.

Groundwater RAO No. 1:

Prevent unacceptable risk from exposure to groundwater with concentrations of VOCs, SVOCs, pesticides, and arsenic greater than the FDEP GCTLs and the USEPA MCLs.

Groundwater RAO No. 2:

Prevent migration of groundwater COCs to surface water.

9.1.2 ARARs and TBC Criteria

CERCLA §121 requires selection of a remedial action that is protective of human health and the environment. The USEPA's approach to determining protectiveness involves risk assessment, considering both ARARs and TBCs. The risk assessment includes consideration of site-specific factors such as types of hazardous substances present, potential for exposure, and presence of sensitive populations. Acceptable exposure levels are generally determined by applicable or relevant and appropriate federal and state environmental requirements, if applicable, and the following factors: (1) for systematic toxicants, concentration levels to which the human population (including sensitive subgroups) could be exposed on a daily basis without appreciable risk of significant adverse effects during a lifetime; (2) for known or suspected carcinogens, concentration levels that represent an excess upperbound lifetime cancer risk to an individual of between 10^{-4} and 10^{-7}; and (3) other factors related to exposure (such as multiple contaminants at a site or multiple exposure pathways) or to technical limitations (such as detection/quantification limits for contaminants).

ARARs consist of the following:

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

A requirement under other environmental laws may be either "applicable" or "relevant and appropriate," but not both. Identification of ARARs must be done on a site-specific basis and involves a two-part

analysis: first, a determination whether a given requirement is applicable; then, if it is not applicable, a determination whether it is both relevant and appropriate.

The definition of ARARs is given below:

- 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 circumstances 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 not "applicable" to a hazardous substance, pollutant, contaminant, or remedial action, location, or other circumstances at a CERCLA site, addresses problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

The National Oil and Hazardous Substances Contingency Plan (NCP) has identified 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 USEPA MCLs and Clean Water Act (CWA) Ambient Water Quality Criteria (AWQC).

- 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.

TBCs are a category created by USEPA that includes non-promulgated criteria, advisories, and guidance issued by federal and state government that are not legally binding and do not have the status of potential ARARs. Examples of TBCs include USEPA's Drinking Water Health Advisories, RfDs, CSFs, and FDEP SCTLs. However, pertinent TBCs will be considered along with ARARs in determining the necessary level of cleanup or technology requirements.

The following section discusses contaminant- and location-specific ARARs and TBCs. Action-specific ARARs and TBCs are presented in Section 9.3 with the discussion of the GRAs.

9.1.2.1 Chemical-Specific ARARs and TBCs

This section presents a summary of federal and state chemical-specific ARARs and TBCs. All of the ARARs and TBCs provide medium-specific guidance on "acceptable" or "permissible" concentrations of contaminants. Tables 9-1 and 9-2 present a list of federal and state of Florida chemical-specific ARARs and TBCs for this FS.

9.1.2.2 Location-Specific ARARs and TBCs

This section provides a summary of federal and state location-specific ARARs and TBCs. These ARARs and TBCs place restrictions on concentrations of contaminants or the conduct of activities based upon the site's particular characteristics or location. Tables 9-3 and 9-4 present a list of federal and state of Florida's location-specific ARARs and TBCs for this FS.

9.1.3 Media of Concern

Based upon the results of the RI, HHRA, and ERA involving toxicity and risk assessment for both human and ecological receptors, as well as the agreements made by the NAS Jacksonville Partnering Team, the primary media of concern at PSC 47 were determined to be soil and groundwater.

9.1.4 Chemicals of Concern for Remediation

COCs for PSC 47 were determined based on the HHRA and ERA and based on screening of maximum concentrations with state and federal criteria. The list of COCs was developed by comparing maximum detected chemical concentrations in the soil and groundwater to appropriate criteria as discussed below.

9.1.4.1 Soil COCs

Site-specific soil data were compared to the FDEP direct exposure SCTLs and the FDEP soil leachability criteria and the chemicals listed below are retained as soil COCs based on exceedance of the FDEP residential and/or leachability SCTLs:

Arsenic	delta-BHC	Endrin
BaPEq	4,4'-DDD	Heptachlor
alpha-BHC	4,4'-DDT	Heptachlor Epoxide
beta-BHC	Dieldrin	

Table 9-1
Federal Chemical-Specific ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Safe Drinking Water Act (SWDA) Regulations, Maximum Contaminant Levels (MCLs)	40 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 or surface waters that are current or potential drinking water sources.
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 used as protective levels for groundwater or surface waters that are current or potential drinking water sources.
USEPA Office of Drinking Water, Health Advisories		Potential TBC	Health advisories are estimates of non-carcinogenic risk due to consumption of contaminated drinking water.	These advisories would be considered for contaminants in surface water and groundwater that is or could be used as a potable water source.
Cancer Slope Factors (CSFs)		TBC	CSFs are guidance value used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	CSFs would be considered for development of human health protection PRGs for soil and groundwater at this site.
Reference Doses (RFDs)		TBC	RFDs are guidance values used to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	RFDs would be considered for development of human health protection PRGs for soil and groundwater at this site.

Table 9-2
State Chemical-Specific ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Drinking Water Standards	FAC Chapter 62-550	Applicable	Rule adopts federal primary and secondary drinking water standards and also creates additional rules to fulfill state and federal requirements for community water distribution systems.	These regulations would be used to determine cleanup levels for groundwater that is a potential source of drinking water.
Florida Surface Water Quality Standards	FAC Chapter 62-302	Applicable	Rule distinguishes surface water into five classes based on designated uses and establishes ambient water quality standards (called Florida Water Quality Standards) for listed pollutants.	Because these standards are specifically tailored to Florida waters, they should be used to establish cleanup levels rather than the Federal AWQC.
Florida Groundwater classes, Standards and Exemptions	FAC Chapter 62-520	Applicable	This rule designates the groundwater of the state into five classes and establishes minimum “free from” criteria. This rule also specifies that Classes I & II must meet the primary and secondary drinking water standards listed in Chapter 62-550.	These regulations would be used to determine cleanup levels for groundwater that is a potential source of drinking water.
Contaminant Cleanup Target Levels Rule	FAC Chapter 62-777	Applicable	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 Hazardous Waste Rules	FAC Chapter 62-730,	Relevant and Appropriate	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 when determining whether waste on site is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations.
Contaminated Site Cleanup Criteria	FAC Chapter 62-780	Relevant and Appropriate	This rule is intended to prevent adverse effects on human health, public safety, and the environment that may be caused by contaminants, and implements the risk-based corrective action provisions of Section 376.30701(2), F.S. to accomplish this.	These regulations would be used in determining cleanup goals and alternative exit strategies for the site.
Pollutant Discharge Prevention and Removal	Section 376.30701, Florida Statutes	TBC	This section describes a risk-based corrective action process to be applied at sites where legal responsibility for site rehabilitation exists.	This Florida statute gives the authority to implement FAC Chapter 62-780 and would be used in implementing a risk-based corrective action for this site.

Table 9-2
State Chemical-Specific ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Guidance for the Selection of Analytical Methods and for the Evaluation of Practical Quantitation Limits	Reference document FAC Chapter 62-777	TBC	The document is intended to assist with the selection of appropriate analytical methodology during the development of Data Quality Objectives (DQOs) for assessing contamination in cases where cleanup target levels are below the sensitivity of published methods and also as an aid in the data review process.	Ensure analytical data achieves minimum PQLs for comparison against regulatory criteria thresholds.

Table 9-3
Federal Location-Specific ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
There are no Federal Location-Specific ARARs				

Table 9-4
State Location-Specific ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Hazardous Waste Rules	FAC Chapter 62-730,	Relevant and Appropriate	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 when determining whether waste on site is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations.
Contaminated Site Cleanup Criteria	FAC Chapter 62-780	Relevant and Appropriate	This rule is intended to prevent adverse effects on human health, public safety, and the environment that may be caused by contaminants and implements the risk-based corrective action provisions of Section 376.30701(2), F.S., to accomplish this.	These regulations would be used in determining cleanup goals and alternative exit strategies for the site.
Pollutant Discharge Prevention and Removal	Section 376.30701, Florida Statutes	TBC	This section describes a risk-based corrective action process to be applied at sites where legal responsibility for site rehabilitation exists.	This Florida statute gives the authority to implement FAC Chapter 62-780 and would be used in implementing a risk-based corrective action for this site.
Guidance for the Selection of Analytical Methods and for the Evaluation of Practical Quantitation Limits	Reference document to FAC Chapter 62-777	TBC	The document is intended to assist with the selection of appropriate analytical methodology during the development of Data Quality Objectives (DQOs) for assessing contamination in cases where cleanup target levels are below the sensitivity of published methods and also as an aid in the data review process.	Ensure analytical data achieves minimum PQLs for comparison against regulatory criteria thresholds.

9.1.4.2 Groundwater COCs

The HHRA identified chemicals in the groundwater as a concern to human receptors. Analytical groundwater data for the site were compared to the USEPA's current drinking water Standards (USEPA, 1998a), FDEP GCTLs (FDEP, 1999) as provided in Florida Administrative Code (FAC) 62-777 (April 2005), and NAS Jacksonville background concentrations (ABB-ES, 1996). The following chemicals were detected in the groundwater above their respective site-specific criteria and were retained as groundwater COCs:

Aldrin	4,4'-DDE	Isopropylbenzene
Arsenic	4,4'-DDT	2-Methylnaphthalene
Benzene	Dieldrin	Naphthalene
alpha-BHC	1,2-Dibromo-3-Chloropropane	Pentachlorophenol
beta-BHC	cis-1,2-DCE	PCE
delta-BHC	2,4-Dichlorophenol	TCE
gamma-BHC	Endrin Ketone	2,4,5-Trichlorophenol
1,1-Biphenyl	Ethylbenzene	Vinyl Chloride
4,4'-DDD	Heptachlor Epoxide	Xylenes (total)

9.2 PRELIMINARY REMEDIATION GOALS

PRGs are concentrations of contaminants in the environmental media that, when attained, should achieve RAOs. PRGs are developed to ensure that contaminant concentration levels remaining on site are protective of human health and ecological receptors. In general, PRGs are established with consideration given 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.

9.2.1 PRGs for Soil

Soil PRGs were determined for the COCs identified in Section 9.1.4.1. These soil PRGs were based on the following criteria:

- Protection of human health from direct exposure to COCs in soil at levels exceeding PRGs.
- Protection of potential ecological receptors from direct exposure to COCs in soil at levels exceeding PRGs.
- Protection of groundwater and surface water against the migration of COCs from the soil.

PRGs for soil at PSC 47 are:

Site-Specific COCs	PRG[(1)(3)] (mg/kg)
Arsenic	2.1
BaPEq	0.1
Alpha-BHC	0.0003[(2)(3)]
Beta-BHC	0.001[(2)(3)]
Delta-BHC	0.2[(2)]
4,4;-DDD	4.2
4,4'-DDT	2.9
Dieldrin	0.002[(2)]
Endrin	1.0[(2)]
Heptachlor	0.2
Heptachlor Epoxide	0.1

(1) Based upon FDEP residential SCTLs, except as otherwise noted.
(2) Based upon FDEP leachability SCTL
(3) The laboratory practical quantitation limit (PQL) value should be used if it is less stringent than the PRG according to FAC Rule 62-780.680(1)(C).

9.2.2 PRGs for Groundwater

Groundwater PRGs were determined for the COCs identified in Section 9.1.4.2. These groundwater PRGs were based on the protection of human health from exposure to contaminants in groundwater.

- Protection of human health from exposure to contaminants in groundwater
- Comply with ARARs

PRGs for groundwater at PSC 47 are:

Site-Specific COC	PRG[(1)(2)] (µg/L)
Aldrin	0.002
Arsenic	10
Benzene	1
alpha-BHC	0.006
beta-BHC	0.02
delta-BHC	2.1
gamma-BHC	0.2
1,1-Biphenyl	0.1
4,4'-DDD	0.1
4,4'-DDE	0.1
4,4'-DDT	0.1
Dieldrin	0.002
1,2-Dibromo-3-Chloropropane	0.2
cis-1,2-Dichloroethene	70

Site-Specific COC	PRG[(1)(2)] (µg/L)
2,4-Dichlorophenol	0.3
Endrin Ketone	2.0
Ethylbenzene	30
Heptachlor Epoxide	0.2
Isopropylbenzene	0.8
2-Methylnaphthalene	28
Naphthalene	14
Pentachlorophenol	1.0
Tetrachloroethene	3.0
Trichloroethene	3.0
2,4,5-Trichlorophenol	1.0
Vinyl Chloride	1.0
Xylenes (total)	20

(1) Based on FDEP GCTLs.

(2) The laboratory practical quantitation limit (PQL) value should be used if it is less stringent than the PRG according to FAC Rule 62-780.680(1)(C).

9.3 GRAs 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 are those regulations, criteria, and guidance that must be complied with. In addition, TBCs must be taken into consideration during remedial activities on site.

9.3.1 GRAs

The following GRAs are considered for soil:

- No Action
- Limited Action (LUCs, Monitoring)
- Removal
- Disposal

The following GRAs are considered for groundwater:

- No Action.
- Limited Action (Natural Attenuation, LUCs, Monitoring)
- Removal
- In-Situ Treatment
- Ex-Situ Treatment
- Disposal

9.3.2 Action-Specific ARARs

Tables 9-5 and 9-6 present a list of federal and state action-specific ARARs and TBCs for this FS.

9.4 ESTIMATED VOLUMES OF CONTAMINATED MEDIA

For remedial action purposes, preliminary volumes of contaminated media were estimated from samples that contained concentrations of COCs that exceeded PRGs for the current industrial site use and the hypothetical future residential site use.

9.4.1 Estimated Volumes of Contaminated Soil

The area and volume of surface soil (0 to 2 ft bls) with concentrations of COCs greater than the FDEP residential and/or leachability SCTLs (i.e., PRGs) were estimated to be approximately 91,400 square ft (ft^2) (2.12 acres) and 6,770 cubic yards (yd^3), respectively. The area and volume of subsurface soil with concentrations of COCs greater than the PRGs were estimated to be approximately 66,400 ft^2 (1.52 acres) and 7,400 yd^3, respectively. Depth of subsurface soil contamination was conservatively estimated to uniformly reach to the groundwater table at 5 ft bls. Accordingly, the total volume of soil with concentrations of COCs greater than PRGs is estimated at approximately 14,100 yd^3.

For this FS, the industrial SCTLs are also used as the direct exposure criteria instead of the residential SCTLs and together with the leachability SCTLs for the development of active remedial actions that address existing unacceptable human health risks under the current industrial site use. The area and volume of surface soil with concentrations of COCs greater than the FDEP industrial and/or leachability SCTLs were estimated to be approximately 68,100 ft^2 (1.56 acre) and 5,000 yd^3, respectively. The area and volume of subsurface soil with concentrations of COCs greater than the FDEP industrial and/or leachability SCTLs were estimated to be approximately 52,000 ft^2 (1.19 acres) and 5,800 yd^3, respectively. Accordingly, the total volume of soil with concentrations of COCs greater than the industrial and/or leachability SCTLs is estimated at approximately 10,900 yd^3.

In addition, the industrial SCTLs are used by themselves as disposal criteria to determine which portion of any excavated soil would be identified as RCRA-hazardous. The area and volume of surface soil with concentrations of COCs greater than the FDEP industrial SCTLs were estimated to be approximately 45,500 ft^2 (1.04 acre) and 3,400 yd^3, respectively. The area and volume of subsurface soil with concentrations of COCs greater than the FDEP industrial SCTLs were estimated to be approximately 31,600 ft^2 (0.72 acres) and 3,500 yd^3, respectively. Accordingly, the total volume of soil with concentrations of COCs greater than the industrial SCTLs is estimated at approximately 6,900 yd^3.

Table 9-5
Synopsis of Federal Action-Specific ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Resource Conservation and Recovery Act (RCRA) Regulations, Identification and Listing of Hazardous Wastes	40 CFR Part 261	Relevant and Appropriate	Defines the listed and characteristic hazardous wastes subject to RCRA. Appendix II contains the Toxicity Characteristic Leaching Procedure (TCLP).	These regulations would apply when determining whether waste on site is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations.
RCRA Regulations, Land Disposal Restrictions (LDRs)	40 CFR Part 268	Relevant and Appropriate	This regulation prohibits the land disposal of untreated hazardous wastes and provides criteria for the treatment of hazardous waste prior to land disposal.	Remedial actions that involve excavating, treating, and redepositing hazardous soil would comply with LDRs.
CAA National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Potentially Applicable	NESHAPs are a set of emissions standards for specific chemicals from specific production activities.	Emissions of hazardous air pollutants would be minimized by fugitive dust control and off gas treatment if some soil was treated at a facility such as a thermal desorption facility.

Table 9-5
Synopsis of Federal Action-Specific ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
CWA Regulations, National Pretreatment Standards	40 CFR Part 403	Relevant and Appropriate	Sets pretreatment standards through the National Categorical Standards of the General Pretreatment Regulations for the introduction of pollutants from non-domestic sources into publicly owned treatment works (POTWs) in order to control pollutants that pass through, cause interference, or are otherwise incompatible with treatment processes at a POTW.	If groundwater is discharged to a POTW or federally owned treatment work (FOTW), the discharge must meet local limits imposed by the POTW. A discharge from a CERCLA site must meet the POTW's pretreatment standards in the effluent of the POTW. Discharge to a POTW is considered an offsite activity and is, therefore subject to both the substantive requirements of this rule.
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 air release at a Superfund site.	These guidance documents would be considered when risks due to air releases from fugitive dust are being evaluated.

Table 9-6
Synopsis of State ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Florida Hazardous Waste Rules – October 1993	FAC Chapter 62-730	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 were deemed hazardous and needs to be stored, transported, or disposed of properly.
Ground Water Classes, Standards, and Classes	FAC Chapter 62-520	?	This rule defines what classification aquifers and provides reference to the water quality that must be maintained.	This regulation would classify the aquifer beneath the site and reference the water quality standards that would need to be achieved during remediation.
Florida Drinking Water Standards	FAC Chapter 62-550	Applicable	This rule adopts federal primary and secondary drinking water standards.	These regulations would apply to remedial activities that involve discharges to potential sources of drinking water.
Florida Air Pollution Rules – October 1992	FAC Chapter 62-2	Relevant and Appropriate	Establishes permitting requirements for owners of operators of any source that emits any air pollutant.	These requirements are appropriate for remedial action that could result in a release of regulated contaminants to the atmosphere, such as may occur during excavation.
Florida Ambient Air Quality Standards – December 1994	FAC Chapter 62-272	Applicable	Establishes ambient air quality standards to protect human health and public welfare.	These ambient air quality standards would be met for remedial actions involving the possible release exposure of contaminants to the atmosphere.
Contaminant Cleanup Target Levels	FAC Chapter 62-777	Applicable	This chapter provides criteria that apply to the site rehabilitation for specific chemicals of conern.	This regulation would be used to establish the site PRGs.
Contaminated Site Cleanup Criteria	FAC Chapter 62-780	Relevant and Appropriate	This rule is intended to prevent adverse effects on human health, public safety, and the environment that may be caused by contaminants and implements the risk-based corrective action	These regulations would be used in determining cleanup goals and alternative exit strategies for the site.

Table 9-6
Synopsis of State ARARs and TBCs

Remedial Investigation/Feasibility Study for PSC 47
Naval Air Station Jacksonville
Jacksonville, Florida

			provisions of S. 376.30701(2), F.S., to accomplish this.	
Florida Rules on Permits – November 1994	FAC Chapter 62-4	Applicable	Establishes procedures for obtaining permits for sources of pollution.	These substantive requirements would be met during remediation.

The areas of surface and subsurface soil with concentrations of COCs exceeding the PRGs and the industrial and/or leachability SCTLs are illustrated on Figures 9-1 to 9-4. Calculations to determine the volume of contaminated soil are included in Appendix M.

9.4.2 Estimated Volume of Contaminated Groundwater

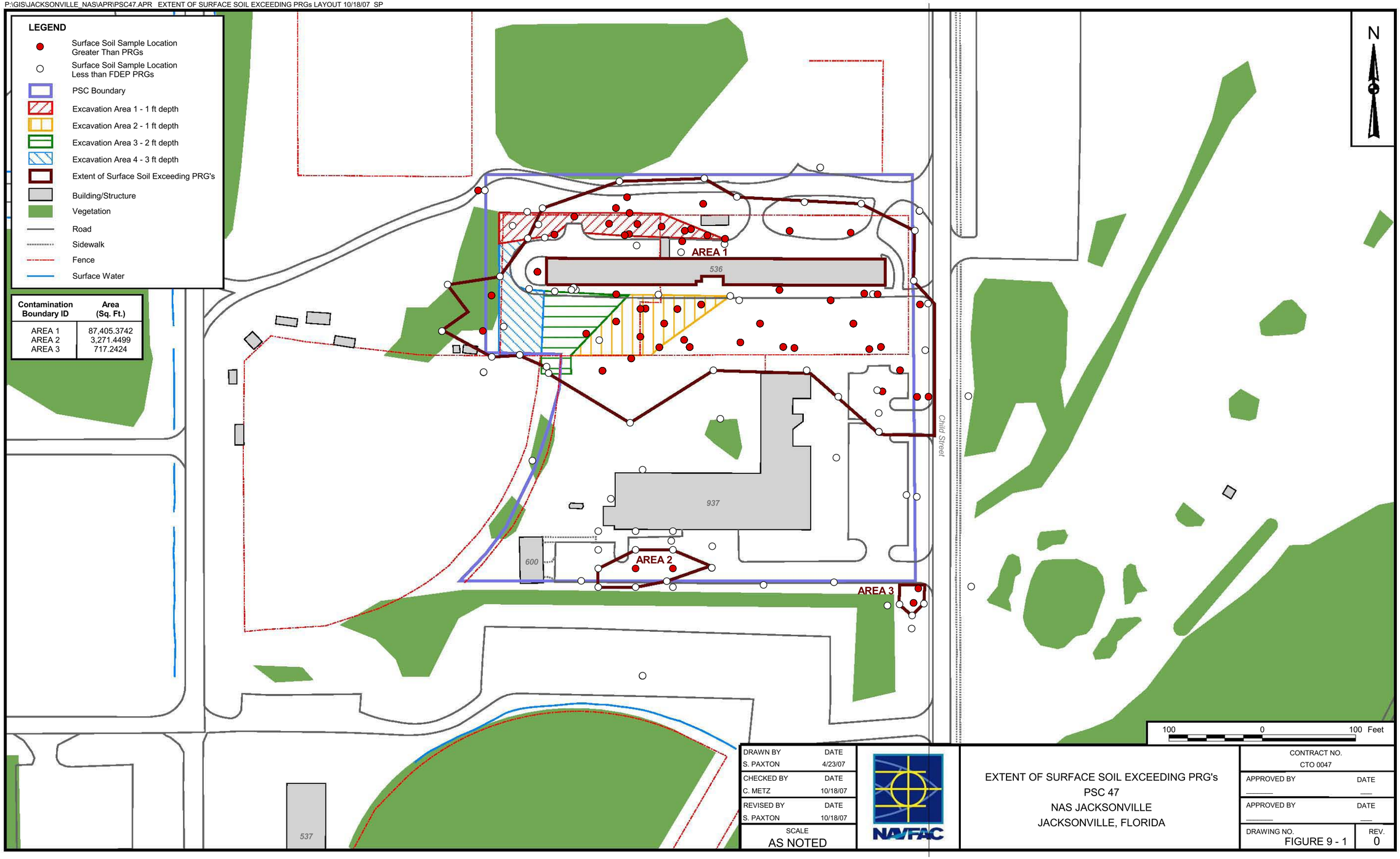
Two areas of contaminated groundwater have been identified with concentrations of COCs greater than the FDEP GCTLs and USEPA MCLs. The first area is located in the vicinity of Building 536 and is identified as the Northern Plume and the second area is located in the vicinity of Building 937 and is identified as the Southern Plume.

The Northern Plume includes monitoring wells JAX47-536-MW03, MW11S, MW12S, MW13S, MW13D, and MW25S. This plume is approximately 500 ft long by 100 to 200 ft wide extending on a west-northwest to east-southeast axis that overlaps most of Building 536. Based on an estimated average thickness of approximately 20 ft and a typical porosity of approximately 0.3, the pore volume of the Northern Plume is estimated at approximately 387,600 cubic ft (ft^3) or 2,899,000 gallons.

The Southern Plume includes monitoring wells MW01S, MW02S, MW03S, MW04S, MW05S, MW06D, MW14S, MW17S, and MW17D. This plume is approximately 300 ft long by 230 ft wide bisecting Building 937 along a north-south axis. Based on an estimated average thickness of approximately 20 ft and a typical porosity of approximately 0.3, the pore volume of the Southern Plume is estimated at approximately 414,600 ft^3 or 3,101,000 gallons. Within the Southern Plume an area located within and immediately south of Building 937 has been identified as containing the highest detections of arsenic (up to 23 mg/L) and has been designated as the Arsenic Hot Spot. The Arsenic Hot Spot includes wells MW01S, MW02S, MW03S, MW04S, MW05S, and MW06D and is approximately 10,800 ft^2 in size (0.25 acres and 117 ft in diameter). The pore volume of the Arsenic Hot Spot is estimated at approximately 64,800 ft^3 or 485,000 gallons.

The Northern and Southern Plumes and the Southern Plume Arsenic Hot Spot are illustrated on Figure 9-5. The calculations for determining the volume of contaminated groundwater are included in Appendix M.

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR EXTENT OF SURFACE SOIL EXCEEDING PRGs LAYOUT 10/18/07 SP



Contamination Boundary ID	Area (Sq. Ft.)
AREA 1	87,405.3742
AREA 2	3,271.4499
AREA 3	717.2424

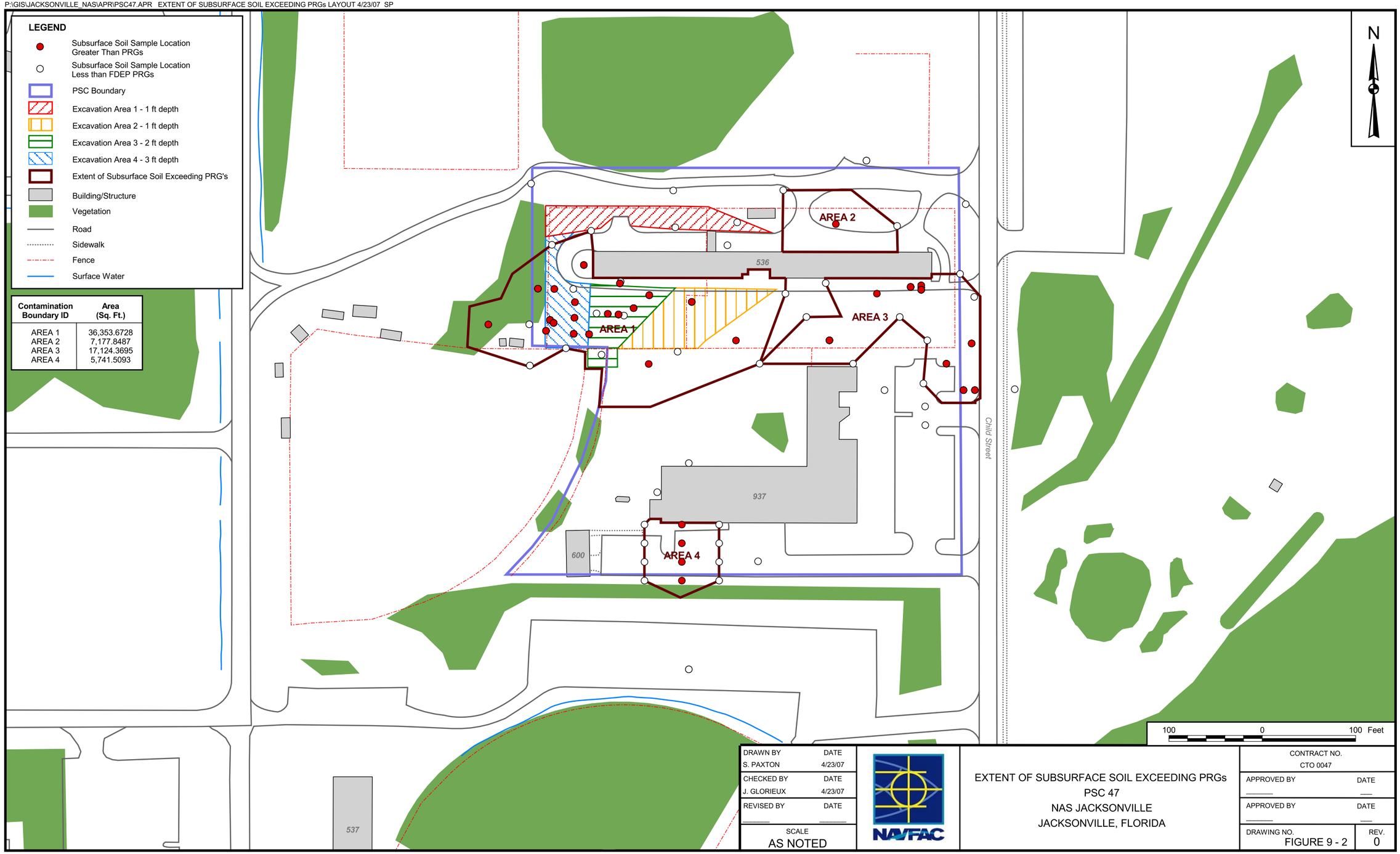
DRAWN BY S. PAXTON	DATE 4/23/07
CHECKED BY C. METZ	DATE 10/18/07
REVISED BY S. PAXTON	DATE 10/18/07
SCALE AS NOTED	

NAVFAC

EXTENT OF SURFACE SOIL EXCEEDING PRG's
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 9 - 1	REV. 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR EXTENT OF SUBSURFACE SOIL EXCEEDING PRGs LAYOUT 4/23/07 SP



Contamination Boundary ID	Area (Sq. Ft.)
AREA 1	36,353.6728
AREA 2	7,177.8487
AREA 3	17,124.3695
AREA 4	5,741.5093

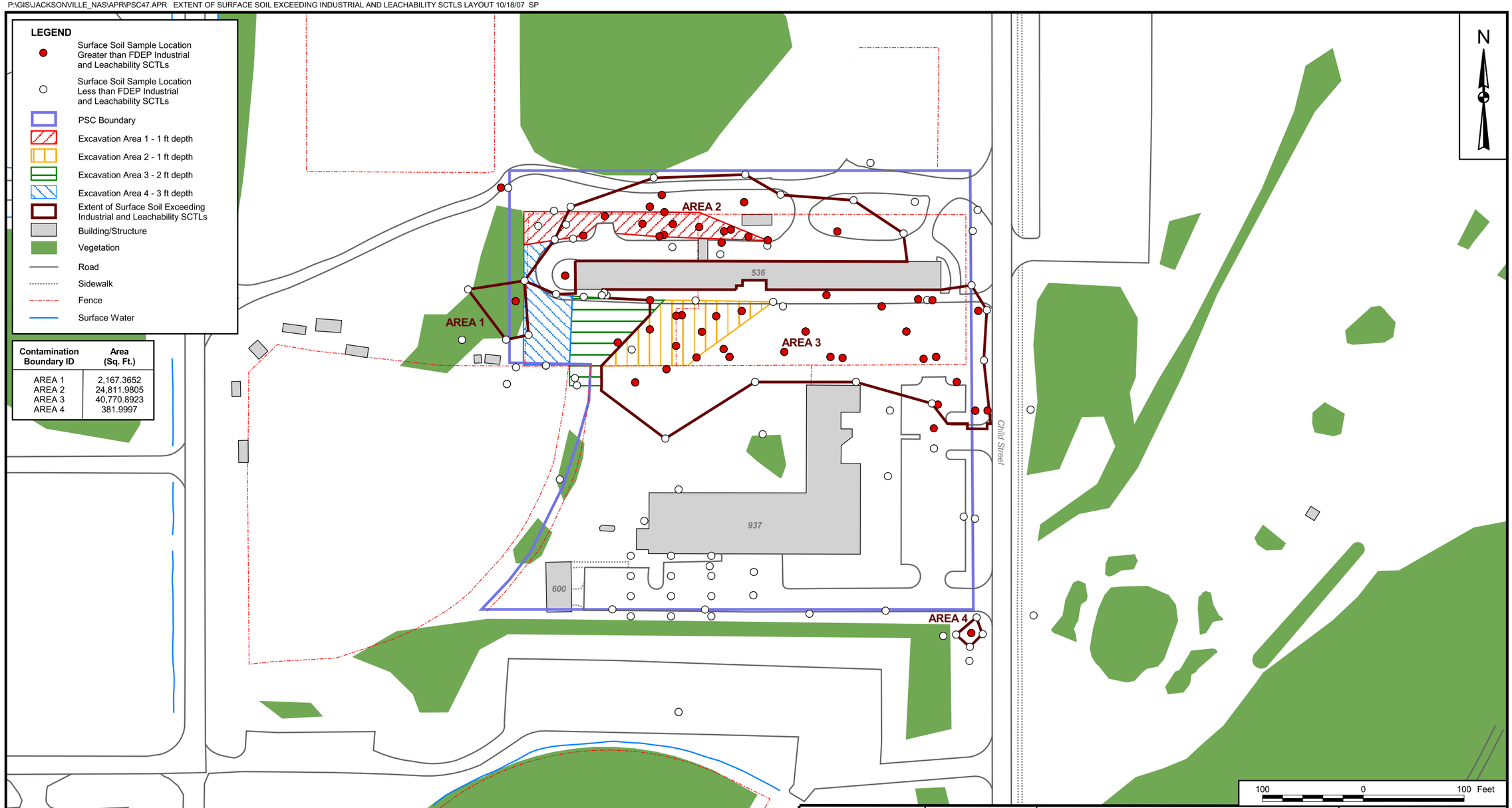
DRAWN BY S. PAXTON	DATE 4/23/07
CHECKED BY J. GLORIEUX	DATE 4/23/07
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

EXTENT OF SUBSURFACE SOIL EXCEEDING PRGs
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 9 - 2	REV. 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR EXTENT OF SURFACE SOIL EXCEEDING INDUSTRIAL AND LEACHABILITY SCTLS LAYOUT 10/18/07 SP



Contamination Boundary ID	Area (Sq. Ft.)
AREA 1	2,167.3652
AREA 2	24,811.9805
AREA 3	40,770.8923
AREA 4	381.9997

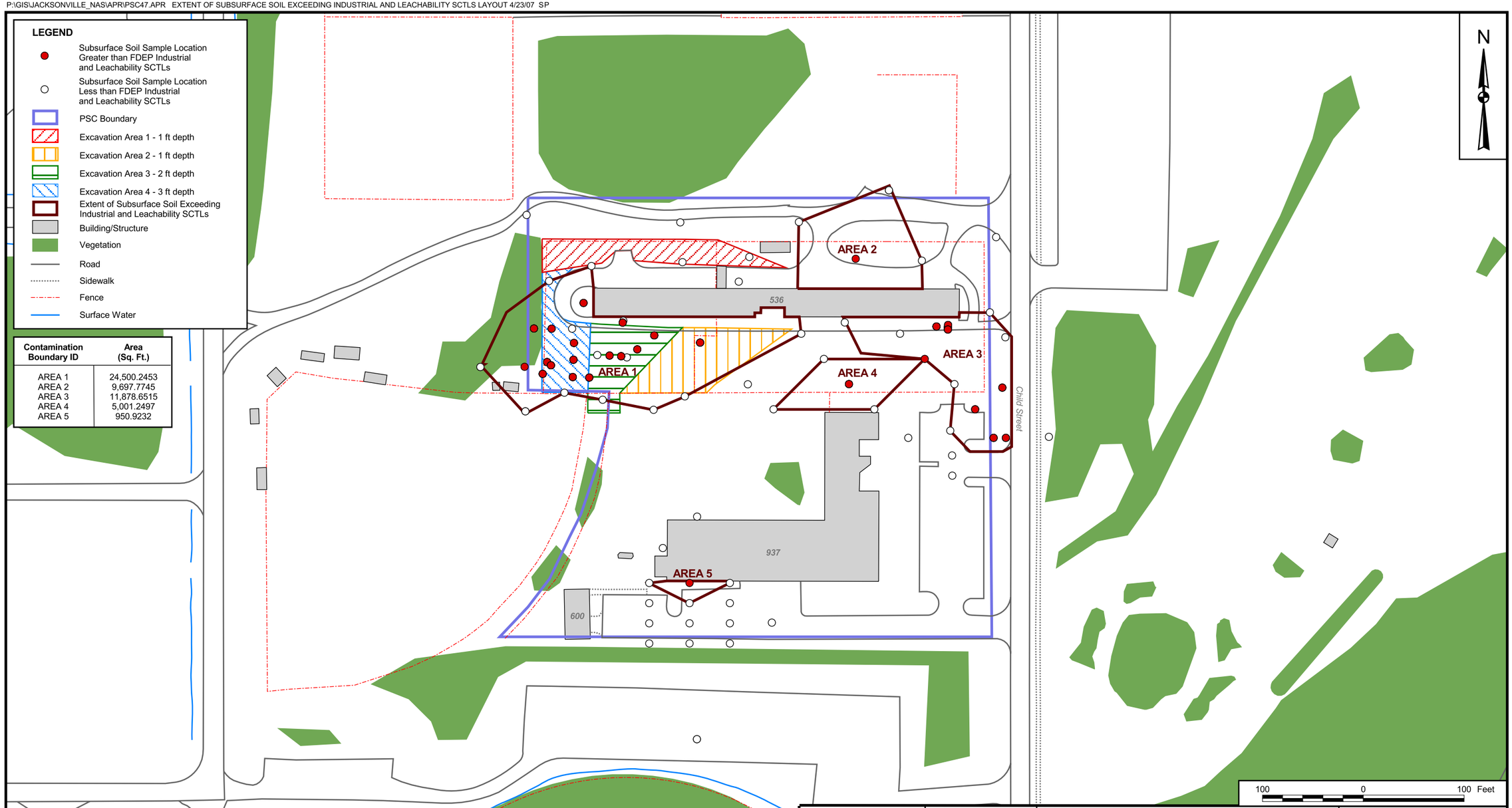
DRAWN BY S. PAXTON	DATE 4/23/07
CHECKED BY C. METZ	DATE 10/18/07
REVISED BY S. PAXTON	DATE 10/18/07
SCALE AS NOTED	

NAVFAC

EXTENT OF SURFACE SOIL EXCEEDING
INDUSTRIAL AND LEACHABILITY SCTLs
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 9 - 3	REV. 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR EXTENT OF SUBSURFACE SOIL EXCEEDING INDUSTRIAL AND LEACHABILITY SCTLS LAYOUT 4/23/07 SP



Contamination Boundary ID	Area (Sq. Ft.)
AREA 1	24,500.2453
AREA 2	9,697.7745
AREA 3	11,878.6515
AREA 4	5,001.2497
AREA 5	950.9232

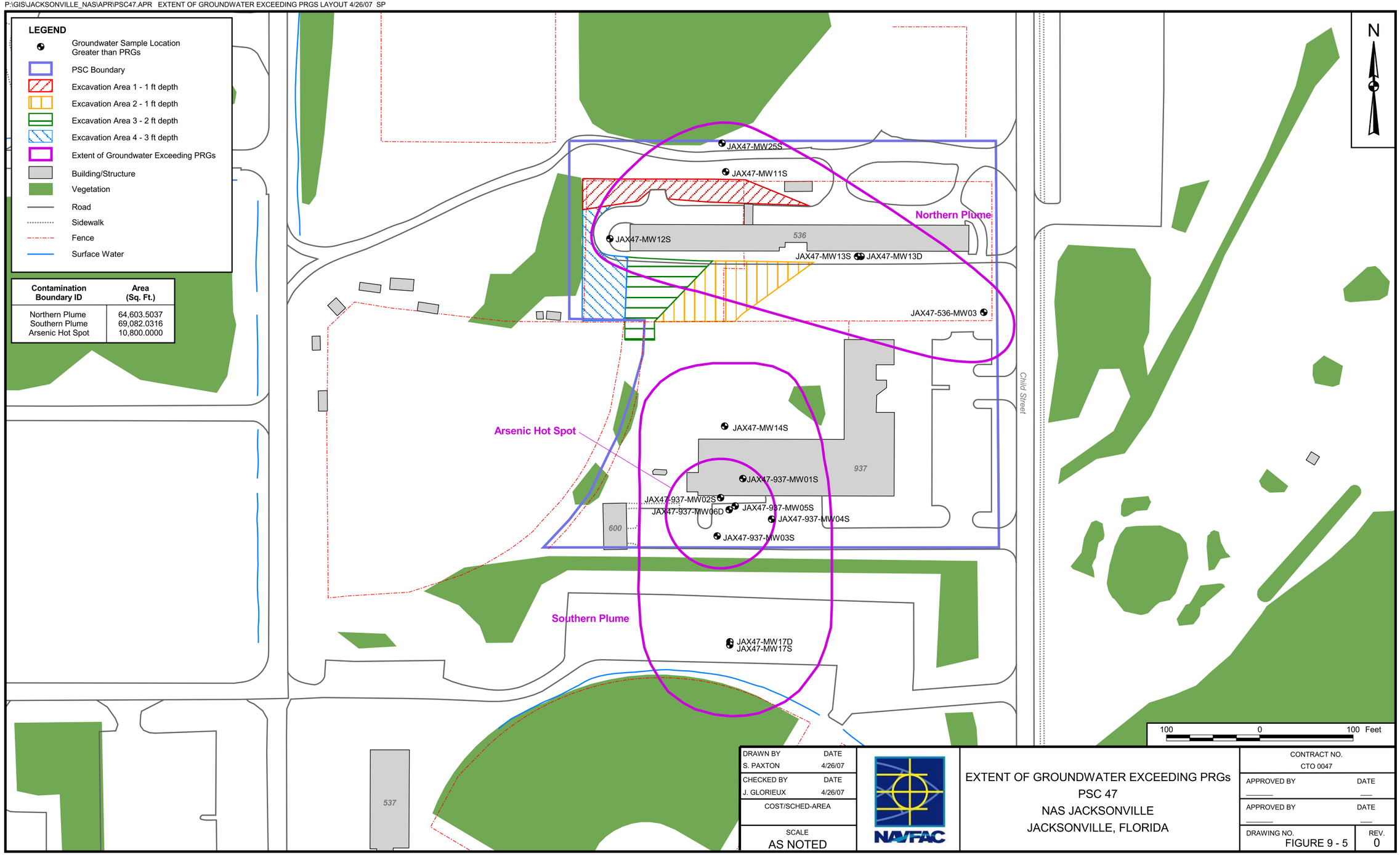
DRAWN BY S. PAXTON	DATE 4/23/07
CHECKED BY C. METZ	DATE 4/23/07
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

EXTENT OF SUBSURFACE SOIL EXCEEDING INDUSTRIAL AND LEACHABILITY SCTLs
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 9 - 4	REV. 0

P:\GIS\JACKSONVILLE_NAS\APR\PSC47.APR EXTENT OF GROUNDWATER EXCEEDING PRGS LAYOUT 4/26/07 SP



Contamination Boundary ID	Area (Sq. Ft.)
Northern Plume	64,603.5037
Southern Plume	69,082.0316
Arsenic Hot Spot	10,800.0000

DRAWN BY S. PAXTON	DATE 4/26/07	EXTENT OF GROUNDWATER EXCEEDING PRGs PSC 47 NAS JACKSONVILLE JACKSONVILLE, FLORIDA	CONTRACT NO. CTO 0047
CHECKED BY J. GLORIEUX	DATE 4/26/07		APPROVED BY ____ DATE ____
COST/SCHED-AREA			APPROVED BY ____ DATE ____
SCALE AS NOTED			DRAWING NO. FIGURE 9 - 5 / REV. 0

10.0 SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential remediation technologies and process options that may be applicable to assemble soil and groundwater remedial alternatives for PSC 47 at NAS Jacksonville. 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 remedial alternatives.

The basis for remediation technology identification and screening began in Section 9.0 with a series of discussions that included the following:

- Identification of ARARs
- Development of RAOs
- Identification of GRAs
- Identification of areas and volumes of media of concern

Remediation technology screening is performed in this section with the completion of the following analytical steps:

- Identification and screening of remediation technologies and process options
- Evaluation and selection of representative process options

In this section a variety of remediation technologies and process options is first identified for each of the GRAs listed in Section 9.3.1 and then screened. The selection of remediation technologies and process options for initial screening is based on the "Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA" (USEPA, 1988). The screening is first conducted at a preliminary level to focus on relevant remediation 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 remediation technologies that have passed the detailed evaluation and screening.

The evaluation criteria for detailed screening of remediation 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 solution.
  - Ability of the technology to address the estimated areas or volumes of contaminated medium.
  - Ability of the technology to attain the PRGs required to meet the RAOs.
  - Technical reliability (innovative versus well-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 considerations (e.g., maintenance and operation requirements).

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

10.1 PRELIMINARY SCREENING OF SOIL REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and screens remediation technologies and process options for soil at a preliminary stage based on implementation with respect to site conditions and COCs. Table 10-1 summarizes the preliminary screening of technologies and process options applicable to soil. It presents the general response actions, identifies the technologies and process options, and provides a brief description of each process option followed by the screening comments.

Table 10-1
Preliminary Screening of Soil Remediation Technologies and Process Options

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, 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	Land Use Controls (LUCs)	Institutional Controls: Land Use Restrictions	Administrative action using land use prohibitions to restrict future site activities.	Retain. Would minimize risk from exposure to contaminated soil.
		Engineering Controls: Physical Barriers/ Security Guards	Fencing, markers, warning signs, and monitoring to restrict site access.	Retain. Would minimize risk from exposure to contaminated soil. Site access is already controlled.
	Monitoring	Sampling and Analysis	Sampling and analysis of soil and groundwater for chemicals of concern (COCs).	Retain. Would allow tracking of potential migration of soil COCs and evaluation of the progress of remedial actions.
Containment	Capping	Soil/Multimedia Cover	Installation of a semi-permeable or impermeable barrier over contaminated soil.	Retain. Would be effective to minimize direct exposure and potential migration of soil COCs to other media.
Removal	Bulk excavation	Excavation	Use of construction equipment such as backhoe, front-end loader, gradall, etc. to remove contaminated soil.	Retain. Would be effective to remove contaminated soil.
In-situ Treatment	Biological	Anaerobic/Aerobic Treatment	Inoculation of microorganisms and nutrients to enhance naturally-occurring biodegradation of COCs.	Eliminate. Pesticides are very persistent and can only be biodegraded under carefully controlled that are not practical to implement in-situ. Arsenic is not biodegradable.

Table 10-1
Preliminary Screening of Soil Remediation Technologies and Process Options

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
In-situ Treatment (continued)	Physical/ Chemical	Soil Flushing	Use of water or other solvents to remove COCs by flushing and collecting and treating/disposing of the wash fluids.	Eliminate. Would be impractical because of the shallowness of the groundwater table. Would not remove pesticides.
		Dynamic Underground Stripping	Injection of steam at the periphery of the contaminated area to volatilize COCs and removal of these COCs through a centrally located extraction well.	Eliminate. Pesticides and arsenic are not volatile and this technology mostly applies to highly-contaminated soil.
		Soil Vapor Extraction	Use of vacuum and possibly air sparging to volatilize COCs.	Eliminate. Pesticides and arsenic are not volatile.
		Chemical Stabilization/ Solidification	Mixing of chemical agents in the vadose zone to chemically stabilize the COCs and/or solidify the surrounding soil matrix.	Eliminate. Would probably immobilize arsenic, but not pesticides.
	Thermal	Vitrification/ Radiofrequency Heating	Use of moderate to high temperature to either volatilize COCs or to fuse them into a glass matrix.	Eliminate. Would be impractical because of the shallowness of the groundwater table.
Ex-situ Treatment	Physical/ Chemical	Soil Washing/Solvent Extraction	Use of water or other solvents to remove COCs by flushing and collecting and treating/disposing of the waste fluids.	Eliminate. Could remove arsenic, but not pesticides.
		Chemical Stabilization/ Solidification	Mixing of chemical agents to chemically stabilize the COCs and/or solidify the surrounding soil matrix.	Retain. Could immobilize arsenic and pesticides.
		On-site Landfarming	Spreading and tilling of contaminated soil into layers of clean surface soil to aerate and biodegrade organic COCs.	Eliminate. Would not remove arsenic. Pesticides are more likely to biodegrade under anaerobic conditions. No on base area is available for this purpose.

Table 10-1
Preliminary Screening of Soil Remediation Technologies and Process Options

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

General Response Action	Remedial Technology	Process Option	Description	Screening Comment
Ex-Situ Treatment (continued)	Biological (continued)	Bioslurry Reactor/Biopile	Treatment of soil in a bioslurry reactor or biopile under controlled conditions using natural or cultured microorganisms to biodegrade organic COCs.	Eliminate. Could be effective for the removal of pesticides but would not remove arsenic.
	Thermal	Incineration	Use of high temperatures to destroy COCs.	Retain. Would destroy pesticides and evaporate arsenic.
		Low-Temperature Thermal Desorption (LTTD)	Use of low to moderate temperatures to evaporate COCs and remove them from soil.	Retain. Would evaporate pesticides and might sublimate arsenic.
	Solids Processing	Crushing/Grinding	Size reduction of wastes as a preliminary process to aid in downstream treatment.	Eliminate. The soil to be excavated is not anticipated to contain significant large debris that would require this kind of pre-treatment.
		Screening	Removal/segregation of material based on size as a preliminary process to aid in downstream treatment.	Eliminate. The soil to be excavated is not anticipated to contain significant large debris that would require this kind of pre-treatment.
Disposal	Landfill	On-Site Landfilling	Disposal of excavated soil in an on-base landfill.	Eliminate. No suitable on-base area is available for this purpose.
		Off-Site Landfilling	Disposal of excavated soil and treatment residues in an off-base permitted treatment, storage, and disposal facility (TSDF).	Retain. Would provide an environmentally-safe disposal for contaminated soil.

The following are the soil remediation technologies and process options retained for detailed screening:

General Response Action	Remediation Technology	Process Option
No Action	None	Not Applicable
Limited Action	Land Use Controls (LUCs)	Institutional Controls (ICs) Engineered Controls
	Monitoring	Sampling and Analysis
Containment	Capping	Multimedia Cover
Removal	Bulk Excavation	Excavation
Ex-situ Treatment	Physical/Chemical	Off-Site Chemical Stabilization/Solidification
	Thermal	Off-Site Incineration
		Off-Site Low-Temperature Thermal Desorption (LTTD)
Disposal	Landfill	Off-Site Landfilling

10.2 DETAILED SCREENING OF SOIL REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

10.2.1 No Action

No Action consists of maintaining 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 alternative and their effectiveness in mitigating risks posed by site contaminants. Since no remedial actions are taken under this alternative, there are no costs associated with “walking away from” the site. There is also no reduction in risk through exposure control or treatment. No action would not be effective in evaluating contaminant mobility and potential migration off-site since no monitoring would be performed.

Effectiveness

No Action would not be effective in meeting the RAOs. No Action would not be effective in evaluating either potential contaminant reduction through natural attenuation or potential contaminant migration off-site since no monitoring would be performed.

Implementability

There would be no implementability concerns since no 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.

10.2.2 Limited Action

The technologies considered under this GRA include LUCs and monitoring.

10.2.2.1 Land Use Controls

LUCs are designed to protect public health and the environment from residual contamination at environmental sites. LUCs consist of administrative or legal mechanisms (e.g., zoning restrictions, permits, etc.) designated as institutional controls (ICs) and/or engineered or physical controls (e.g., fencing, security guards, etc.) designated as engineering controls. Site-specific LUCs are typically implemented, maintained, and enforced through a LUC Remedial Design (RD) that is prepared following the Record of Decision (ROD).

Effectiveness

LUCs consisting of site use and site access restrictions would effectively minimize unacceptable risks from direct exposure of human receptors with contaminated soil. LUCs would not be effective to protect ecological receptors from potential exposure to contaminated soil but, since PSC 47 constitutes a relatively unlikely ecological habitat, unacceptable risks to ecological receptors would be minimal.

Implementability

LUCs would be easy to implement on a military facility where access is already restricted. A LUC RD could be readily prepared.

Cost

Capital and O&M costs for LUCs would be low.

Conclusion

LUCs are retained for the development of soil remedial alternatives.

10.2.2.2 Monitoring

Monitoring would consist of sampling and analyzing soil and groundwater throughout the area of potential contamination to evaluate potential for migration of soil COCs either off-site or to other media, particularly groundwater.

Effectiveness

Monitoring alone would not reduce the toxicity, mobility, or volume of contaminants in the soil. However, monitoring would allow for a determination to be made of the potential off-site migration of contaminants or of the potential reduction in contaminant concentrations through natural attenuation.

Implementability

Monitoring would be easy to implement. Such monitoring has already been performed on several occasions at PSC 47. The resources and material required for monitoring are readily available.

Cost

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

Conclusion

Monitoring is retained for the development of soil remedial alternatives.

10.2.3 Containment

The only technology considered under this GRA is capping. Capping would consist of installing an impervious cover system over the contaminated soil that posed human health or environmental risks.

Effectiveness

Capping is a well-established and proven technology that would be effective to prevent direct exposure to the contaminated soil. An impermeable cap would be effective to minimize the potential for migration of soil COCs either through leaching to groundwater or off-site erosion. Long-term maintenance of the cap and long-term monitoring would ensure that the continued effectiveness of the cap.

Implementability

Installation of a cap at PSC 47 would require careful planning and execution. Materials and services required to implement this technology are readily available. Because of the site topography and the need to maintain normal access to existing buildings, cap installation would require the excavation and off-site disposal of a certain amount of contaminated soil. The construction of a cap would also restrict the future use of the site, but this would not be a problem as long as PSC 47 remains part of a military facility as currently foreseen. Risk of workers exposure to contaminated soil during the cap construction would be adequately mitigated by the wearing of appropriate personal protective equipment (PPE) and by compliance with the Occupational Safety and Health Administration (OSHA) regulations and with site-specific health and safety procedures. Adverse impact on the surrounding community and the environment as a result of the installation of a cap could also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring.

Cost

Capital and O&M costs for capping would be moderate.

Conclusion

Capping is retained for the development of soil remedial alternatives.

10.2.4 Removal

The only technology considered under this GRA is excavation. Excavation can be performed by a variety of equipment, such as tractor shovels (front-end loaders), backhoes, grade-alls, etc. The type of equipment selected must 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, to depth of up to 30 ft and from well-defined areas of ground with significant load bearing capacity (i.e., greater than 1,500 pounds per ft^2).

The logistics of excavation must take into account the available space for operating the equipment, loading/unloading to transport the removed material, location of the site, etc. Once excavation is completed, the location is filled and graded with clean fill material or treated soils. Because of the proximity to occupied buildings, dust and debris produced as a result of the remedial action would have to be strictly controlled.

Effectiveness

Excavation is a very well-established and proven technology that would be extremely effective for the removal of contaminated soil at PSC 47. Properly planned and implemented excavation would remove soil with concentrations of COCs greater than PRGs and remaining soil would not pose an unacceptable risk to human health or the environment. Sampling either via pre-characterization or post excavation is typically required to verify the effectiveness of excavation. These samples would be analyzed for COCs to ensure that the remaining soil is not contaminated at unacceptable levels.

Implementability

Excavation of contaminated soil at PSC 47 would be easy to implement. Excavation equipment and/or services are readily available from multiple vendors or contractors. This technology is well proven and established in the construction/remediation industry. Since the depth of excavation would be limited to that of the groundwater table, which typically occurs at approximately 5 ft bls, the need for shoring and dewatering would be minimal. Care would have to be taken not to undermine the foundations of existing buildings. Risk of workers exposure to contaminated soil during excavation would be adequately mitigated by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures. Adverse impact on the surrounding community and the environment would be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring.

Cost

Capital cost of excavation at PSC 47 would be moderate. There would be no O&M costs associated with this technology.

Conclusion

Excavation is retained for the development of soil remedial alternatives.

10.2.5 Ex-Situ Treatment

The technologies considered under this GRA include technologies that might be required as part of disposal at an off-site treatment, storage, and disposal facility (TSDF) including chemical stabilization/solidification, incineration, and low-temperature thermal desorption (LTTD).

10.2.5.1 Off-Site Chemical Stabilization/Solidification

Chemical stabilization consists of mixing contaminated soil with chemical reagents that modify the COCs to render them less soluble and hence less mobile. Chemical solidification consists of mixing contaminated soil with chemical reagents that bind the COCs within the matrix of the material being treated. The most common stabilization reagents are phosphates, carbonates, hydroxides, and sulfates. The most common solidification reagents are pozzolanic-based materials such as Portland cement, cement kiln dust (CKD), and fly ash. Other reagents such as thermoplastic binders (i.e., asphalt); sorbents such as granular activated carbon (GAC), clays, zeolites, anhydrous sodium silicate; and MAECTITE® have also been successfully used for chemical stabilization/solidification.

The mixing of the material to be treated with the chemical reagents is normally accomplished in the presence of a controlled amount of water and with specialized mechanical blending equipment such as a pug mill. After the material is mixed with the chemical reagents, it is typically allowed to cure for the stabilization or solidification process to take full effect. In the case of chemical solidification, the treated material may either be allowed to cure as a monolithic block, or it can be made into a granular material with the consistency of a soil-cement.

Chemical stabilization/solidification may require pre-treatment for the removal of oversized materials that would not be adequately blended with the chemical reagents and would interfere with the treatment process.

<u>Effectiveness</u>

Chemical stabilization/solidification is a well-established and proven technology, but its effectiveness is highly dependent on the type of material being treated and the type of COCs being immobilized. A thorough physical and chemical characterization of the material to be treated and COCs to be immobilized is needed and treatability testing is typically required to determine the most suitable stabilization/solidification reagents, the mixing ratios, and any special pretreatment or material handling methods that may be required.

At PSC 47, pozzolanic fixation/solidification would very likely be effective for the treatment of soil contaminated with arsenic, SVOCs, and low concentrations of pesticides. Soil contaminated with high concentration of pesticides would most likely require the use of a specialized agent. Because chemical stabilization/solidification would not eliminate contaminant toxicity, the treated soil would still require proper disposal to minimize the unacceptable human health risk that could result from direct exposure. Chemical stabilization/solidification would effectively minimize the potential for migration of COCs from the soil to other environmental media, such as groundwater. Long-term stability and leachability of the

treated soil would remain as potential concerns because COCs would remain within the treated soil. Most chemical stabilization/solidification processes, including in particular the use of pozzolanic reagents result in an increase in the volume of the treated material typically ranging from 5 to 15 percent.

Implementability

Off-site chemical stabilization/solidification would be easy to implement. The necessary equipment and resources are available at most permitted TSDFs to perform this work. Treatability tests would be required to determine the appropriate mix ratios prior to implementation.

Cost

O&M costs of off-site stabilization/solidification would be moderate. Because application of this technology would be contracted as a service there would be no capital costs.

Conclusion

Off-site chemical stabilization/solidification is retained for the development of soil remedial alternatives.

10.2.5.2 Off-Site Incineration

Incineration is a thermal oxidation process that converts organic solids, liquids, and gases to inorganic substances at high temperatures in the presence of oxygen. The technology uses controlled flame combustion in an enclosed reactor to decompose organics. Carbon and hydrogen waste components are converted to carbon dioxide (CO_2) and water, respectively. Other combustion products are also present in smaller quantities. These may include carbon monoxide, nitrogen oxides, chlorine, fluorine, and trace metals. If a wet scrubber air pollution control system is used, a liquid waste stream could also be generated. Screening of the contaminated material would be required to remove the noncombustible waste/debris from the soils. The noncombustible waste/debris must be treated or disposed of by other means, depending upon the level of contamination associated.

Rotary kilns are one of the most widely used incinerators for wastes in the form of solids, sludges, liquids, and gases. An integrated system for incineration by rotary kiln includes a solid feed system, a rotary kiln and secondary combustion chamber, air pollution control units for particulate and acid gas removal, and an exhaust stack. Such a system employs a refractory-lined rotary kiln operating at high temperatures (1,470 to 2,910°F or 800 to 1,600°C) to combust wastes in the presence of oxygen. A typical throughput for a transportable rotary kiln is 75 to 200 tons per day. For wastes that have high heat content, the throughput may be limited by the capacity of the unit to control the heat generation rate. Fixed-based units, such as cement kilns that may be permitted to accept contaminated soils, are also available.

Effectiveness

Incineration is a well-established and proven technology that would be very effective for destroying the organic COCs in the soil such as pesticides, VOCs, and SVOCs. Incineration would typically achieve in excess of 99.99 percent destruction of these types of COCs with the resulting formation of inert carbon dioxide and water. However, incineration would not destroy or remove arsenic, although a certain portion of it might sublimate at high temperature.

Implementability

Off-site incineration would be relatively easy to implement. Qualified TSDFs are available to provide this service. Pre-treatment of the excavated material for size separation and/or reduction would most likely be required and could be accomplished on site. Off-gases from the thermal desorption unit would have to be treated. Pre-approval of the material to be incinerated by the TSDF would be required and trial burn might be necessary as well.

Cost

O&M cost of off-site incineration would be high to very high. Because application of this technology would be contracted as a service there would be no capital costs.

Conclusion

Off-site incineration is eliminated from further consideration because, although it would very effectively destroy pesticides and SVOCs, it would not sufficiently remove arsenic and this degree of treatment is not required to successfully deal with the relatively moderate concentrations of organic COCs in the PSC 47 soil.

10.2.5.3 Off-Site Low Temperature Thermal Desorption

LTTD uses direct or indirect heating to desorb or volatilize organic COCs. The temperatures used are contaminant- and matrix-specific, with a range of approximately 200 to 1,200°F (95 to 650°C). Typically, wastes are processed through an externally fired pug mill or rotary drum system equipped with heat transfer surfaces that are heated by circulating hot oil. An induced airflow conveys the desorbed organic chemicals through a secondary treatment system, such as a GAC adsorption unit, a catalytic oxidation unit, a condenser unit, or even an afterburner. It should be noted, however, use of an afterburner for secondary treatment has typically resulted in the LTTD unit being considered as an incinerator by regulatory agencies. The off-gas is then discharged through a stack.

Effectiveness

LTTD is a well-established and proven technology, but its effectiveness is highly contaminant- and matrix-specific. Therefore, a full characterization of the soil to be treated would be required and treatability testing would have to be performed to verify the level of effectiveness and determine the optimum operating temperature and detention time. LTTD effectiveness is very sensitive to particle size, therefore, pre-treatment would likely be required with size separation and crushing-grinding-shredding.

LTTD would likely be effective for the removal of the organic COCs from contaminated soil at PSC 47 and, because these COCs include low-volatility pesticides and SVOCs, the operating temperature would be expected to be towards the higher end of the range (probably 800 to 900º F). However, LTTD would not remove arsenic from contaminated soil.

To be fully effective, LTTD would require additional treatment of the volatilized contaminants which would be accomplished through treatment of off-gases by such processes as condensation, vapor-phase GAC adsorption, or catalytic oxidation.

Implementability

Off-site treatment of contaminated soil with LTTD would be implementable. Qualified TSDFs would be readily available to provide the necessary services. Pre-treatment of the excavated material for size separation and/or reduction might be required and could also be accomplished off-site. Off-gases from the thermal desorption unit would have to be treated. Treatability testing may have to be performed.

Cost

O&M costs of off-site LTTD would be moderate. Because application of this technology would be contracted as a service there would be no capital costs.

Conclusion

Off-site LTTD is retained for the development of soil remedial alternatives.

10.2.6 Disposal

The only technology considered under this GRA is off-site landfilling. Off-site landfilling consists of transporting the excavated soil for burial in a permitted off-site TSDF. RCRA non-hazardous waste may be disposed at a RCRA Subtitle D, or solid waste, landfill. RCRA-hazardous waste must be disposed at a RCRA Subtitle C, or hazardous waste, landfill.

Various analytical tests are used to determine the appropriate type of landfill to be used, the most common of which is the USEPA TCLP. However, based on the procedure followed for removal actions at Florida sites similar to PSC 47, excavated soil would also be analyzed for site COCs and the results of this analysis compared to the FDEP industrial SCTLs. If any of the detected concentrations of soil COCs exceeded the industrial SCTLs, the excavated soil would be identified as RCRA-hazardous and would be disposed at a RCRA Subtitle C hazardous waste landfill. If no concentrations of COCs exceed the industrial SCTLs, the excavated soil would be identified as RCRA-non hazardous and disposed at a RCRA Subtitle D solid waste landfill.

Effectiveness

Landfilling does not permanently or irreversibly reduce contaminant concentrations. However, although CERCLA preference for treatment relegates landfilling to a less preferable option, this technology can be an effective disposal option for contaminated soil. Landfills are only permitted to operate if they meet certain requirements of design and operation governing 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 Subtitle C hazardous waste landfill are typically more stringent than those of a RCRA Subtitle D solid waste landfill.

Implementability

Off-site landfilling would be easy to implement. Permitted RCRA Subtitle C hazardous waste landfills and RCRA Subtitle Subtitle D solid waste landfills are available for this purpose. Disposal at either type of landfill may require certain pre-treatment, mainly the removal of free liquids. However, based on the results of previous removal actions at PSC 47, it is assumed that no pre-treatment would be required. A waste profile would have to be prepared, including indication of contaminant concentrations and their leachability. Adverse impact on the surrounding community and the environment as a result of the off-site transportation of contaminated soil would be adequately mitigated by adherence to spill prevention procedures and by compliance with DOT regulations.

Cost

O&M cost of off-site disposal would be low to moderate for a RCRA Subtitle D solid waste landfill and moderate to high for a RCRA Subtitle C hazardous waste landfill. Because application of this technology would be contracted as a service there would be no capital costs.

Conclusion

Disposal at an off-site permitted RCRA Subtitle C or D landfill is retained for the development of soil remedial alternatives.

10.3 SELECTION OF SOIL REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

The following remediation technologies and process options are retained to develop soil remedial alternatives:

- No Action
- Limited Action: LUCs and Monitoring
- Containment: Capping
- Removal: Excavation
- Ex-Situ Treatment (if required as part of disposal): Off-Site Chemical Stabilization/Solidification and Off-Site LTTD
- Disposal: Off-Site RCRA Subtitle C or D Landfill

10.4 PRELIMINARY SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

This Section identifies and screens remediation technologies and process options for groundwater at a preliminary stage based on implementation with respect to site conditions and contaminants of concern. Table 10-2 summarizes the preliminary screening of remediation technologies and process options applicable to groundwater. This table presents the GRAs, identifies the remediation technologies and process options, and provides a brief description of each process option followed by a screening comment.

Table 10-2
Preliminary Screening of Groundwater Remediation Technologies and Process Options

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

General Response Action	Technology	Process Options	Description	Screening Comment
No Action	None	Not Applicable	No activities conducted at site to address contamination.	Required by law. Retain for baseline comparison to other technologies.
Limited Action	Land Use Controls (LUCs)	Institutional Controls and/or Engineering Controls.	Administrative action to restrict current and future use of groundwater. Could be used as No Further Action (NFA) With Controls under Chapter 62-780, Florida Administrative Code (FAC), Risk-Based Corrective Action (RBCA) Risk Management Option (RMO) Level III.	Retain. Would effectively minimize human exposure to contaminated groundwater. The Northern and Southern Plumes might qualify for RBCA RMO Level III.
	Monitoring	Sampling and Analysis	Periodic sampling and analysis of groundwater and other media.	Retain. Would be required to evaluate potential migration of chemicals of concern (COCs) and/or progress of remediation.
	Natural Attenuation	Naturally-Occurring Processes.	Decrease in COCs concentrations as a result of naturally-occurring processes (dilution, dispersion, biodegradation).	Retain. Chlorinated volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) naturally attenuate and arsenic and pesticides might.
Containment	Vertical Barriers	Slurry Wall or Sheet Piling	Low-permeability wall formed in a perimeter trench to restrict horizontal migration of groundwater.	Eliminate. Would not remove COCs which have shown little tendency to migrate. Existing structures would severely restrict constructability and the depth of the nearest impervious layer makes this technology impractical.
		Hydraulic Barrier	Use of extraction wells and/or collection trenches to restrict horizontal migration of groundwater.	Eliminate. Would not remove COCs which have shown little tendency to migrate. No suitable area exists reasonably close to site for reinjection.

Table 10-2
Preliminary Screening of Groundwater Remediation Technologies and Process Options

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

General Response Action	Technology	Process Options	Description	Screening Comment
Removal	Groundwater Extraction	Extraction Wells or Collection Trenches	Array of conventional pumping wells or permeable trenches used to remove contaminated groundwater.	Retain. Could be effective to remove contaminated groundwater, particularly from the arsenic hot spot in the Southern Plume.
In-situ Treatment	Biological	Enhanced Bioremediation	Enhancement of natural biodegradation processes by addition of oxygen or hydrogen releasing compounds (ORC or HRC) and/or bacterial cultures.	Retain. Would be effective for the removal of organic COCs. Optional metal removal compound (MRC) technology might also remove arsenic.
		Gas infusion	Enhancement of biodegradation by injection of oxygen and/or alkane gases (iSOC process).	Eliminate. Would be effective for the removal of organic COCs. Would not be effective for arsenic.
	Physical/ Chemical	Permeable Reactive Barrier (PRB)	Use of a permeable barrier that allows the passage of groundwater and reacts with the COCs.	Eliminate. Contaminant plumes are not very mobile. Also this technology would probably not be effective for all COCs.
		Oxidation and Precipitation	Injection of specialized chemical reagents into the contaminant plumes to oxidize and de-solubilize COCs.	Retain. Would immobilize arsenic. Could also remove some organic COCs such as VOCs and SVOCs.
		Air Sparging / Vapor Extraction (AS/VE)	Volatilization and biodegradation enhancement through injection of air and extraction of vapors.	Eliminate. Most COCs are not volatile (SVOCs, pesticides, arsenic) and iSOC process would be more effective for biodegradation enhancement.
Ex-situ Treatment[(1)]	Biological	Aerobic/Anaerobic	Use of fixed- or suspended-growth medium biological reactor under oxygen-rich or oxygen-deficient conditions to degrade COCs.	Eliminate. Would not be effective for arsenic.

Table 10-2
Preliminary Screening of Groundwater Remediation Technologies and Process Options

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

General Response Action	Technology	Process Options	Description	Screening Comment
Ex-situ Treatment[1] (continued)	Physical/ Chemical	Sedimentation	Separation of solids from water via gravity settling.	Eliminate. Based on available data, this level of treatment would not be necessary to remove suspended solids from extracted groundwater.
		Coagulation/ Flocculation	Use of chemicals to neutralize surface charges and promote attraction of colloidal particles to facilitate settling.	Eliminate. Based on available data, this level of treatment would not be necessary to remove suspended solids from extracted groundwater.
		Neutralization/pH Adjustment	Use of acids or bases to counteract excess pHs.	Retain. Could be required as pretreatment step or final step prior to discharge.
		Filtration	Separation of suspended solids from water via entrapment in a bed of granular medium or membrane. Filter medium can also be used to react with COCs to oxidize and/or precipitate them (greensand).	Retain. Oxidative filtration would be effective for the removal of arsenic. Straight filtration might also be required as a pretreatment step prior to potential treatment processes.
		Air Stripping	Contact of water with air to remove volatile compounds.	Eliminate. Would not be effective for arsenic removal.
		Adsorption	Removal of dissolved COCs via adsorption onto bed of reactive material such as granular activated carbon (GAC) or activated alumina.	Retain. Activated alumina would remove arsenic. GAC could remove arsenic and other COCs.
		Ion Exchange (IX)	Percolation on bed of resin that holds ions in active sites and exchanges these for the COCs.	Retain. Would be effective for the removal of arsenic. Efficiency is affected by high concentrations of competing ions.

Table 10-2
Preliminary Screening of Groundwater Remediation Technologies and Process Options

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

General Response Action	Technology	Process Options	Description	Screening Comment
Ex-situ Treatment[1] (continued)	Physical/ Chemical (continued)	Solvent Extraction	Separation of contaminants from a solution by contact with an non-miscible liquid with a higher affinity for the COCs.	Eliminate. Would not be effective for removal of arsenic.
		Enhanced Oxidation	Contact with strong oxidation reagents such as ozone, and hydrogen peroxide, in combination with ultra violet (UV) radiation..	Retain. Would effectively transform arsenic from soluble trivalent oxidation state to insoluble less mobile pentavalent oxidation state.
		Chemical Precipitation	Use of chemical reagents to convert soluble constituents into insoluble constituents.	Retain. Would effectively remove arsenic. Meeting of very low Preliminary Remedial Goal (PRG) would require very efficient separation of precipitated material.
Disposal[1]	Surface Discharge	Direct Discharge to surface water	Discharge of treated water to a local water body (ditch, culvert, pond).	Eliminate. No local water body or ditch is available for this purpose.
		Indirect Discharge to off-site facility	Discharge of collected/treated water to a local treatment facility.	Retain. A local treatment facility would be available to receive treated groundwater.
	Subsurface Discharge	Reinjection	Use of injection wells, spray irrigation, or infiltration to discharge collected/treated groundwater underground.	Eliminate. Groundwater is too shallow for effective injection. No suitable reinjection area is located reasonably close to site.

NOTE:

(1) Because groundwater extraction would be specifically targeted to the remediation of the Southern Plume and more specifically toward the capture of the Arsenic Hot Spot within that plume, the ex-situ treatment and disposal technologies only apply to the Southern Plume groundwater and the ex-situ treatment technologies are focused on arsenic removal.

The following are the groundwater remediation technologies and process options remaining for detailed screening:

General Response Action	Remediation Technology	Process Options
No Action	None	Not Applicable
Limited Action	Land Use Controls (LUCs)	Institutional Controls
	Monitoring	Sampling and Analysis
	Natural Attenuation	Naturally-Occurring Processes
Removal (Southern Plume)	Groundwater Extraction	Extraction Wells or Trenches
In-situ Treatment	Biological	Enhanced Bioremediation
	Physical/Chemical	Chemical Oxidation and Precipitation
Ex-Situ Treatment (Southern Plume)	Biological	Aerobic/Anaerobic Biodegradation
	Physical/Chemical	Neutralization/pH Adjustment
		Oxidative Filtration
		Adsorption
		Ion Exchange
		Enhanced Oxidation
		Chemical Precipitation
Disposal (Southern Plume)	Surface Discharge	Indirect Discharge to Treatment Facility

10.5 DETAILED SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

10.5.1 No Action

No action consists of maintaining 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 alternative and their effectiveness in mitigating risks posed by site contaminants. Since no remedial actions are conducted under this alternative, there are no costs associated with maintaining status quo at the site. Neither is there a reduction in risk through exposure control or treatment.

Effectiveness

No Action would not be effective in meeting the RAOs for the site. No Action would not be effective in evaluating either potential contaminant reduction through natural attenuation or potential contaminant migration off-site since no monitoring would be performed.

Implementability

There would be no implementability concerns since no actions would be implemented.

Cost

There would be no costs associated with No Action.

Conclusion

No Action is retained for comparison to other options.

10.5.2 Limited Action

The technologies considered under this GRA include LUCs, monitoring, and natural attenuation.

10.5.2.1 Land Use Controls

PSC 47 site characteristics are such that contaminated groundwater may be managed as NFA with controls according to Chapter 62-780, FAC, RBCA RMO Level III because Option IIIA would be satisfied by these site characteristics, if the following conditions can be met: (1) historical data and modeling demonstrate that current on-site groundwater COCs concentrations have not resulted in off-site exceedances of the GCTL, and a minimum of one year of monitoring could verify this, and (2) groundwater contamination has not impacted on-site fresh or marine surface water. In addition, previous and planned future excavation of soil with the highest concentrations of COCs would remove the source of groundwater contamination.

LUCs would consist of institutional controls that would limit access to groundwater and restricting future land use. A LUC RD would be prepared and implemented to prevent residential development and to prohibit the use of the surficial aquifer groundwater for human consumption, dewatering, irrigation, heating/cooling, and industrial purposes unless approval from USEPA and FDEP is granted.

Effectiveness

LUCs would not of themselves remove groundwater COCs and restore groundwater quality. However, LUCs would effectively minimize potential human health and ecological risks associated with exposure to contaminated groundwater.

Implementability

LUCs would be easy to implement on a military facility where restrictions on access to and use of groundwater could easily be enforced. A LUC RD could be readily prepared. Resources are readily available for the implementation of such administrative controls.

Cost

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

Conclusion

LUCs are retained for the development of groundwater remedial alternatives.

10.5.2.2 Monitoring

Monitoring would consist of using sampling and analysis of groundwater throughout the area of groundwater contamination to evaluate trends in concentrations of COCs and potential migration of contaminants. Monitoring could also be used to evaluate possible natural attenuation of contaminants and/or the progress of active groundwater remediation.

Effectiveness

Monitoring would not of itself remove groundwater COCs and restore groundwater quality. However, monitoring would allow evaluation of the potential migration of groundwater COCs either off-site or to other media and the potential reduction the concentrations of these COCs either through natural attenuation or as a result of active remediation. As a result, monitoring is an effective and indispensable remedial technology.

Implementability

A groundwater monitoring program would be easy to implement at PSC 47. Such monitoring has already been performed in a number of occasions. The resources and materials required for monitoring are readily available.

Cost

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

Conclusion

Monitoring is retained for the development of groundwater remedial alternatives.

10.5.2.3 Natural Attenuation

Natural attenuation would consist of letting naturally-occurring processes within the surficial aquifer such as biodegradation (for organics), species alteration (for some inorganics), dilution, dispersion, or adsorption reduce the concentrations of groundwater COCs until they meet the PRGs as verified through monitoring.

Biodegradation is a process which causes an organic COC to degrade to a different compound. With biodegradation, the daughter products (i.e., degradation byproducts) can be toxic as well, so biodegradation does not always result in improved conditions.

Species alteration occurs when the valence state or ionic form of a COC is changed. An example of this occurs when groundwater bacteria aerobically degrade organic compounds and utilize electron acceptors (particularly dissolved oxygen) in the process. As the ORP decreases, the valence state of iron, manganese, chromium, and arsenic can decrease, thereby affecting their solubility, ionic forms, toxicities, and sorption characteristics.

The processes of dilution and dispersion do nothing to reduce the total mass of the contaminants or the toxicities of the contaminants; these processes simply cause the spreading and dilution of the contaminants over time, thereby decreasing concentrations over time. Adsorption can reduce the concentrations and total mass of dissolved contaminant over time (i.e., it can immobilize a contaminant); however, consideration should be given the possibility of whether the contaminant could be remobilized at a later time (e.g., if the pH, ORP, or other physico-chemical conditions changed with time which could potentially lower the sorption coefficient of the COC).

Effectiveness

Theoretically, monitored natural attenuation should be an effective remedial technology for all of the COCs present in the PSC 47 groundwater. However, only limited groundwater monitoring analytical data (only 2 to 3 rounds) are currently available. These data sets are insufficient to determine:

- Clear trends of COC concentrations in individual groundwater monitoring wells over time.
- Whether the maximum COC concentrations are increasing or decreasing over time.
- Whether the north and south plumes are increasing in size, decreasing in size, or remaining stable over time.

The vast majority of the concentrations of COCs detected in the Northern and Southern Plumes are below the FDEP's natural attenuation default source concentrations (NADSC). In addition, based upon experience with this class of chemicals, it is likely the VOCs and SVOCs that constitute the secondary COCs of the Northern and Southern Plumes would undergo natural attenuation through biodegradation. The VOCs and the chlorinated VOCs present include two classes of COCs that are particularly amenable to biodegradation and other forms of natural attenuation. As an example, the two chlorinated solvents PCE and TCE are commonly used as degreasers. PCE can biodegrade to TCE via reductive dechlorination, and then sequentially degrade to cis-1,2-DCE and vinyl chloride. At PSC 47 the maximum concentration of cis-1,2-DCE observed in groundwater (400 µg/L) is much greater than its parent compounds (maximum concentrations of PCE and TCE are 24 and 23 µg/L, respectively). Thus, it is readily apparent that the majority of PCE and TCE mass that used to be present at the site has been degraded to cis-1,2-DCE). At least some of the cis-1,2-DCE has also degraded to vinyl chloride.

Pesticides are primary COCs that are found in both the Northern and Southern Plumes. Arsenic is another primary COC, but only in the Southern Plume. The pesticides and arsenic are far more persistent than the SVOCs and chlorinated VOCs, and are likely to require considerable time to naturally attenuate. Most of the chlorinated pesticides biodegrade at slow degradation rates. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT are perhaps the most recalcitrant organic COCs found at the site. The primary attenuation processes of arsenic include sorption and precipitation. Arsenic does not biodegrade to nontoxic compounds, but the valence state and ionic form of this metalloid can change depending on biotic or abiotic reactions that might affect local groundwater pH and/or redox conditions.

Most chlorinated pesticides sorb relatively strongly to the soil matrix and could eventually biodegrade. Arsenic, especially if present in its pentavalent state (As[V]), also sorbs relatively strongly to soil matrices. When oxidizing conditions (e.g., ORP values above 0 mV) are present in groundwater, arsenic is usually found in the form of the arsenate anion. The divalent arsenate anion ($H_2AsO_4^-$) is stable between pH values of 3 and 7; whereas, monovalent arsenate anion ($HAsO_4^=$) is the stable form above a pH of 7 (i.e., neutral to alkaline groundwater) (Hem, 1992). The arsenate anions sorb relatively well to iron oxyhydroxides. Although ferric arsenate and some other metal arsenates have relatively low solubility, the importance of solubility controls on arsenic in groundwater is not clearly understood.

Mildly reducing conditions favor the As (III) form of arsenic as the uncharged or monovalent arsenite anion species ($HAsO_2$ or AsO_2^-). In general, the overall solubility and mobility of all arsenic species (i.e., total arsenic) increases as pH and redox potential decrease. The shallow groundwater conditions in the vicinity of the former mixing tank on the south side of Building 937 are acidic (pH range: 4.93 – 6.41) and mildly reducing to mildly oxidizing (-45 to +211 mV). Under these conditions, the arsenic should theoretically be in both valence states. However, speciation of arsenic in groundwater samples from four

wells has shown the majority of arsenic is in the reduced ionic form (i.e., arsenite). The locations where arsenic concentrations are most elevated in shallow groundwater coincide with locations where VOCs, chlorinated VOCs, and pesticides are elevated. The presence of the VOCs (BTEX) has been at relatively high concentrations in this area (see Figures 5-9 and 5-11). Degradation of the BTEX compounds could be consuming oxygen and thereby reducing the ORP and enhancing the mobility of arsenic as arsenite anions.

The Southern Plume Arsenic Hot Spot includes five shallow wells (MW01S to MW05S) and one deep well (MW06D) that are located beneath and south of Building 937. This area is approximately 117 ft in diameter. None of the three shallow (MW14S, MW15S, and MW28S) and two deep (MW14D and MW15D) monitoring wells located north and east of the hot spot (north and east of Building 937) showed arsenic concentrations above 5.2 µg/L in 2004 through 2006 (Figure 5-12). Thus, the monitoring data suggest that arsenic has not migrated far from the source area since it was released. Based on this information, the mobility of arsenic is probably lower than that of any of the VOCs and most of SVOCs. Studies conducted in Orlando Florida suggest that the retardation factor for arsenic is 21 ± 9 for As (V) and 14 ± 3 for AS (III) (TtNUS, 2001). This suggests that arsenic is strongly sorbed or retarded 21 and 14 times respective to the rate of conservative groundwater flow. Therefore, the relative immobility of the arsenic at PSC 47 is supported by data from other sites.

Implementability

Natural attenuation would be very easy to implement because it requires no action except monitoring. As noted earlier, the resources and materials required for monitoring are readily available. The only negative aspect of implementing this alternative is the time and the cost for monitoring.

Cost

Capital and O&M costs for natural attenuation would be moderate, especially if monitoring extends for 30 years or more.

Conclusion

Although there are some concerns about its effectiveness, primarily for the removal of pesticides and arsenic, natural attenuation is retained for the development of groundwater remedial alternatives.

10.5.3 Removal

The only technology considered under this GRA is groundwater extraction. Groundwater extraction can be performed with the use of extraction wells or collection trenches.

Extraction wells are drilled into the aquifer and screened below the water table to access the groundwater. Pumping is used to extract the water that collects in the wells and bring it to the surface. The process of extraction creates a hydraulic gradient that induces further flow of groundwater into the well. Extraction wells that are placed in the path of migration of a contaminant plume can be used to intercept and contain the plume. Extraction wells that are placed within a contaminated plume can be used to clean the aquifer by removing the contaminated groundwater and flushing the saturated zone. The flushing action occurs when the fresh water from upgradient (clean) areas replaces the extracted contaminated groundwater and causes more contaminants to desorb from the saturated zone soils. Thus, theoretically, the saturated zone soils progressively lose contaminants until the concentrations in the groundwater are at acceptable levels.

A collection trench is formed by excavating a ditch a few feet wide to a depth where an impermeable base is encountered. A backhoe or clamshell is common equipment used for the excavation. This excavated trench is then backfilled with permeable material, such as gravel or crushed rock. Collection pipes and pumps are then placed in the trench for water removal. Collection trenches essentially function like a line of extraction wells by creating a continuous zone of influence. Groundwater within this zone flows toward the collection points.

Extraction pumps are typically submersible, electrically operated centrifugal pumps or pneumatically operated ejector pumps. For shallow groundwater extraction (depths up to 10 ft), surface pumps may be used. Centrifugal pumps are not practical for use at low extraction rates less than 1 gallon per minute (gpm), and, in such cases, pneumatic ejector pumps are preferred.

Extracted groundwater would be temporarily stored in an AST and then discharged through piping into the base industrial sewer lines that run past the site. Ex-situ treatment of the contaminated groundwater would ultimately occur at the base industrial wastewater treatment plant via biological, physical, and/or chemical processes.

The time required to flush contaminants out of a contaminated aquifer can range from a year to more than a century. The factors that affect flushing time and cleanup time are:

- The initial concentrations of contaminant in the groundwater and adsorbed to soil.
- The total mass of contaminant in the groundwater and adsorbed to soil.
- The volume and geometry of the contaminant plume.
- The rainfall recharge rate and the velocity of groundwater moving through the contaminated zone.

- The porosity and hydraulic conductivity of the aquifer material(s).
- The partition coefficient between the soil and groundwater (i.e., K_d), which is unique to the COC, and is different for the form of the contaminant (i.e., the chemical species), the geochemical characteristics and mineralogy of the aquifer material(s), and the geochemistry of the groundwater (e.g., pH, ORP, and ionic strength).
- The rate of contaminant desorption from the aquifer material.
- The number, location, and pumping rates of extraction wells which are removing contaminated groundwater and inducing clean water to enter the contaminated zone.

Effectiveness

Groundwater extraction is a well-established and proven technology for the capture and/or containment of groundwater contaminant plumes where the following conditions exist:

- The source of contaminants in the vadose zone is limited, and the rate of release is moderately rapid.
- Contaminants are mainly in the aqueous phase (i.e., dissolved) and easily desorb from the aquifer materials.
- The aquifer material(s) are sufficiently permeable so that extraction wells or trenches can effectively capture the migrating plume.

While the initial effectiveness of this technology for contaminant capture is high, it has often been shown to decrease over time. This decrease is generally due to one or more of several factors, including the presence of preferential flow pathways due to aquifer heterogeneity, contaminant adsorption onto aquifer materials, diffusion of contaminants into the pore spaces of low-permeability materials, and creation of stagnation zones due to pumping operations. It should be noted, however, that no such decrease over time is observed in the effectiveness of this technology for containment of contaminant plumes.

The potential effectiveness of pump-and-treat technologies is very limited for sites where the zone of contamination possesses low values of hydraulic conductivity (e.g., silts and clays), the mass of contaminant source is large and nonrecoverable, the contaminant is strongly sorbed to the aquifer or adjacent strata, or the plume is very diffuse and complex (e.g., specific migration paths are difficult to identify). The strong adsorption of the contaminants present [e.g., organochlorine pesticides, VOCs, SVOCs, and some of the inorganic contaminants (e.g., arsenic)] in the shallow aquifer near Building 937 is a critical factor when evaluating the potential effectiveness of a pump-and-treat alternative for this site. Many of these contaminants are strongly sorbed to the aquifer (high partition coefficient), thus are very

difficult to extract. Therefore cleanup of the aquifer within a reasonable time frame (e.g., 30 years) is unlikely. The factors that are largely responsible for this anticipated poor performance are discussed in greater detail in Section 10.5.2.3.

Implementability

Groundwater extraction is normally easy to implement. Numerous contractors can drill wells and excavate trenches and pumps are widely available for a variety of flow rates and aquifer conditions. However, this technology requires long-term O&M and extracted groundwater typically requires treatment and disposal. Extraction wells are typically easier to install than collection trenches, particularly in developed areas and in close proximity to existing structures such as at PSC 47. Local and/or State permit might be required for the installation of extraction wells.

Cost

Capital and O&M costs of groundwater extraction would be low to moderate.

Conclusion

Groundwater extraction is eliminated from further consideration because it would likely not be effective for contaminant mass removal as the contaminants are bound to aquifer soils. In addition, groundwater extraction is also not warranted as a containment technology because there is no evidence of off-site migration of COCs.

10.5.4 In-Situ Treatment

The technologies considered under this GRA are enhanced bioremediation and chemical oxidation and precipitation.

10.5.4.1 Enhanced Bioremediation

Enhanced bioremediation consists of using microorganisms, primarily bacteria, actinomycetes, and fungi, to breakdown hazardous organic compounds into nontoxic or less toxic forms. In-situ enhanced bioremediation includes biostimulation and bioaugmentation. Biostimulation is the most common type of in-situ enhanced bioremediation and consists of using an electron acceptor or electron donor compound to enhance the growth of indigenous aerobic or anoxic/anaerobic microorganisms, respectively. Bioaugmentation is typically used in addition to biostimulation. Bioaugmentation consists of using a bacterial culture to increase the naturally occurring microorganism population and to provide organisms specifically targeted to the degradation of COCs.

The electron acceptor, electron donor compound, and/or bacterial culture are fed into contaminated groundwater using either multiple DPT injection well points or one or more focused groundwater recirculation systems with groundwater extraction and reinjection. Focused recirculation provides better control over the subsurface distribution of reagents, but it also requires a more complex system, especially for large plumes. DPT injection is simpler to implement and can be used over large or small areas.

Effectiveness

Enhanced bioremediation is a well-established and proven technology for the in-situ treatment of a wide range of organic contaminants in groundwater. The use of a slow-release electron donor such as food-grade vegetable oil would be effective for the removal of the pesticides, VOCs, and SVOCs that are the groundwater COCs in the Northern Plume. The basic effectiveness of this technology for the removal of pesticides has been demonstrated through bench-scale treatability testing (TtNUS, 2007), but its site-specific effectiveness for PSC 47 would have to be verified and design parameters developed through pilot-scale testing. Enhanced bioremediation would not be effective for the removal of arsenic that is the primary groundwater COC in the Southern Plume.

Implementability

Enhanced bioremediation would be relatively easy to implement. A number of qualified contractors are available to provide this service. Installation of multiple DPT injection points would not unduly interfere with current site activities. As previously mentioned, pilot-scale treatability would be required to verify the site-specific effectiveness of this technology and to develop design parameters. A permit might be required for the subsurface injection of chemicals.

Cost

Capital and O&M costs of enhanced bioremediation would be moderate.

Conclusion

Enhanced bioremediation with electron donor injection is retained for development of groundwater remedial alternatives for the Northern Plume.

10.5.4.2 Chemical Oxidation and Precipitation

In-situ chemical oxidation and precipitation consists of injecting chemical agents into a contaminant plume to chemically transform the COCs and render them either less soluble or insoluble and thus less mobile.

Chemical oxidation agents include powerful oxidants such as iron-catalyzed hydrogen peroxide (known as Fenton's Reagent), sodium persulfate, or potassium permanganate. Milder oxidants such as ORC, typically magnesium peroxide, or catalytically complexed sodium percarbonate (marketed as RegenOx™) have also been successfully used. Chemical precipitation agents include iron salts, phosphates, and zero-valent iron (ZVI).

In-situ chemical oxidation and precipitation reagents are generally fed into contaminated groundwater using either multiple DPT injection well points or one or more focused groundwater recirculation systems. As mentioned in the description of in-situ bioremediation, focused recirculation provides better control over the subsurface distribution of reagents, but it also requires a more complex system, especially for large plumes. DPT injection is simpler to implement and can be used over large or small areas, but the technical difficulty and cost of installing DPT injection points becomes prohibitive when depths exceed approximately 75 ft bls.

Effectiveness

In-situ chemical oxidation and precipitation is an established and fairly well-proven technology for the immobilization of a range of metals in groundwater. A combination of a mild oxidant such as ORC with a co-precipitant such as ferric chloride or sulfate would likely be effective for the immobilization of the arsenic that is the primary COC of the Southern Plume. However, treatability testing, preferably at the pilot-scale, would be required to confirm this. There would also be a slight possibility that the arsenic that had been removed from groundwater and immobilized in the surrounding soil could be redissolved and remobilized over the long term as a result of naturally occurring changes in groundwater chemistry.

Simple in-situ chemical oxidation without precipitation and using nano-scale ZVI particles could also be effective for the removal of the pesticides that are the primary COCs of the Northern Plume. The basic effectiveness of this technology for the removal of pesticides has been demonstrated through bench-scale treatability testing (TtNUS, 2007), but its site-specific effectiveness for PSC 47 would have to be verified and design parameters developed through pilot-scale testing.

Implementability

In-situ chemical oxidation and precipitation would be relatively easy to implement. Numerous qualified contractors are available to provide this service. Installation of multiple DPT injection points would not unduly interfere with current site activities. As previously mentioned, pilot-scale treatability would be required to verify the site-specific effectiveness of this technology and to develop design parameters. A permit might be required for the subsurface injection of chemicals.

Cost

Capital and O&M costs of in-situ chemical oxidation and precipitation for the Southern Plume with an oxygen enhancer and ferric salts would be moderate. Capital and O&M costs of in-situ chemical oxidation for the Northern Plume with nano-scale ZVI would be high because of reagent costs.

Conclusion

In-situ chemical oxidation and precipitation with an oxygen enhancer and ferric salts is retained for the development of groundwater remedial alternatives for the Southern Plume. In-situ chemical oxidation with nano-scale ZVI is eliminated from further consideration because it would not be as cost effective as enhanced bioremediation for the treatment of the Northern Plume.

10.5.5 Ex-Situ Treatment

Although, as shown on Table 10-2, a number of ex-situ treatment technologies were retained for detailed screening, none of these would be applicable to PSC 47 because the only removal technology retained for detailed screening, groundwater extraction, was eliminated from further consideration as a result of that screening (see Section 10.5.3).

10.5.6 Disposal

Although, as shown on Table 10-2, indirect discharge was retained as a disposal technology for detailed screening, it would not be applicable to PSC 47 because the only removal technology retained for detailed screening, groundwater extraction, was eliminated from further consideration as a result of that screening (see Section 10.5.3).

10.6 SELECTION OF GROUNDWATER REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

The following remediation technologies and process options are retained to develop groundwater remedial alternatives:

- No Action
- Limited Action: LUCs, Monitoring, and Natural Attenuation
- In-Situ Treatment: Enhanced Bioremediation (Northern Plume) and Oxidation and Precipitation (Southern Plume)

11.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

11.1 INTRODUCTION

This section 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 as required by the NCP and the relative importance of these criteria are described in the following subsections.

11.1.1 Evaluation Criteria

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

Threshold Criteria

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Balancing Criteria

- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, and Volume through Treatment
- Short-term Effectiveness
- Implementability
- Cost

Modifying Criteria

- 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 both short- and 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 ARARs that are applicable cannot be complied with, then 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.

Long-term Effectiveness and Permanence

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

Magnitude of Residual Risk:

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 institutional controls that are necessary to manage treatment residuals and untreated waste must be shown reliable. In particular, 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 the specification of which reduction(s) are 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 mitigative 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 obtaining 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, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any 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) 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 that must be assessed include 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

These concerns cannot be evaluated at this time until the state has reviewed and commented on the RI/FS. These concerns will be discussed, to the extent possible, in the Proposed Plan to be issued to 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 be done after comments on the proposed plan are received from the public.

11.1.2 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 in order for an alternative to be eligible for selection.

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

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

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

The remaining two of the nine criteria, namely: State Acceptance and Community Acceptance are considered to be modifying criteria that must be considered during remedy selection. These last two criteria can be evaluated after the document has been reviewed by the state of Florida and the Proposed Plan has been discussed in a public meeting. Therefore, this document addresses only seven out of the nine criteria.

11.1.3 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 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 and determination of whether or not the preferred alternative continues to be the most appropriate remedial action for the site, in consultation with the state of Florida.

11.2 DEVELOPMENT OF SOIL ALTERNATIVES

The following alternatives for soil remediation have been developed for PSC 47:

Alternative S-1: No Action
Alternative S-2: Capping to Allow Industrial Use and Prevent Leaching, LUCs, and Monitoring
Alternative S-3: Excavation and Off-Site Disposal to Allow Industrial Use, Capping to Prevent Leaching, LUCs, and Monitoring
Alternative S-4: Excavation and Off-Site Disposal to Allow Residential Exposure and to Prevent Leaching

Alternative S-1 was developed and analyzed to serve as a baseline for other alternatives, as required by the CERCLA and the NCP. Alternatives S-2 and S-3 were developed and analyzed to evaluate the adequacy of moderate action to address environmental concerns under current site use. Alternatives S-4 was developed and analyzed to evaluate complete contaminated soil cleanup for unrestricted site use.

A description and detailed analysis of these alternatives are provided in the following sections.

11.2.1 Alternative S-1: No Action

11.2.1.1 Description

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. This alternative cannot be chosen if waste remains on site.

11.2.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative S-1 would not be protective of human health and the environment. The potential for direct human and ecological exposure to contaminated soil would remain unchanged, leading to unacceptable risks under the current industrial site use and to even greater risks under a hypothetical future residential use. Soil COCs would continue to migrate to groundwater and no monitoring would be performed to assess this migration. Alternative S-1 would not meet the soil RAOs.

Compliance with ARARs

Alternative S-1 would not comply with chemical-specific ARARs because no action would be taken to reduce concentrations of COCs. Alternative S-1 would also not comply with location-specific ARARs. Action-Specific ARARs are not applicable.

Long-Term Effectiveness and Permanence

Alternative S-1 would not be long-term effective and permanent because it would involve no action and leave contaminated soil unchanged on site with unacceptable concentrations of COCs. In addition, because no controls would prevent a hypothetical future residential development, the potential would exist for increased risk to human and ecological receptors. Because no monitoring would be performed there would be no assessment of the migration of soil COCs to groundwater. Although concentrations of soil COCs might eventually decrease to acceptable levels through natural attenuation, no monitoring would verify this occurrence.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative S-1 would not reduce toxicity, mobility, or volume of the soil COCs through treatment because no treatment would occur. The toxicity and volume of the soil COCs might eventually be reduced through natural attenuation, but this would not be verified through monitoring.

Short-term Effectiveness

Because no action would occur, implementation of Alternative S-1 would not result in any short-term risks to on-site workers or adversely impact the local community and the environment.

Alternative S-1 would not meet the soil RAOs and, although the soil PRGs might eventually be achieved through natural attenuation, this would not be verified through monitoring.

Implementability

Alternative S-1 would be very easy to implement because there would be nothing to implement. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. The implementability of administrative measures is not applicable because no such measures would be taken.

Cost

There would be no costs associated with Alternative S-1.

11.2.2 Alternative S-2: Capping To Allow Industrial Use and Prevent Leaching, LUCs, and Monitoring

11.2.2.1 Description

Alternative S-2 would consist of four major components: (1) capping to allow industrial use and prevent leaching, (2) disposal of excavated soil, (3) LUCs, and (4) monitoring.

Component 1: Capping to Allow Industrial Use and Prevent Leaching

Areas of the site with concentrations of soil COCs greater than the industrial and/or leachability SCTLs would be capped with an impervious cover system to allow industrial use and to prevent leaching of soil COCs to groundwater. Pre-construction sampling would be performed to verify the exact extent of the contamination.

To maintain the current topography of the site and to allow unimpeded access to existing buildings, surface preparation of the areas to be capped would require excavation to a depth equal to the thickness of the cap. Because the planned thickness of the cap is 2 ft, this pre-excavation would result in the removal of all surface soil exceeding industrial and/or leachability SCTLs, leaving only subsurface soil with concentrations of COCs greater than industrial and/pr leachability SCTLs to be capped. The areas to be capped would be covered with a 2-ft thick layer of compacted soil with a permeability of 10^{-6} centimeters per second (cm/sec). The pre-excavated areas that do not require capping would be backfilled with clean fill. The capped and backfilled areas would be re-vegetated or re-paved to match original surface conditions.

It is estimated that approximately 6,300 yd^3 of surface soil would be excavated as part of site preparation from a total area of 85,100 ft^2 (1.95 acres). Subsequently, an estimated 52,000 ft^2 (1.19 acres) of the exposed subsurface soil would be capped and the remaining 33,100 ft^2 (0.76 acres) of excavated area

would be backfilled with 2,450 yd^3 of clean fill material. The extent of site preparation, excavation, and areas to be capped are illustrated on Figures 11-1 and 11-2, respectively.

During construction activities, temporary exposure controls such as water sprinkling and perimeter air quality monitoring would be implemented to ensure that fugitive dust emissions are kept to an acceptable minimum. Appropriate controls such as silt fences, sediment traps, and hay bales would also be used to minimize erosion and sedimentation. In addition, during the excavation of contaminated soil in close proximity to existing buildings, care would be taken not to undermine the foundations of these buildings.

Component 2: Disposal of Excavated Soil

To determine the proper method of disposal, composite samples would be collected from the excavated soil at the rate of approximately one sample per 100 yd^3. These samples would be analyzed for soil COCs (SVOCs, pesticides, and arsenic) to sort the excavated soil in the following three disposal categories:

- Soil with concentrations of COCs lower than the PRGs (residential or leachability SCTLs) would be identified as non-contaminated and could be re-used on site or offsite. For the purpose of this FS, it is assumed that 1,150 yd^3 of excavated soil would fall in this category.

- Soil with concentrations of COCs lower than the industrial SCTLs, but greater than the PRGs would be identified as RCRA non-hazardous and would be disposed at an offsite RCRA Subtitle D solid waste landfill. For the purpose of this FS, it is assumed that 4,150 tons of excavated soil would fall in this category.

- Soil with any concentrations of COCs greater than the industrial SCTLs would be identified as RCRA hazardous and would be disposed at an off-site RCRA Subtitle C hazardous waste landfill. For the purpose of this FS, it is assumed that 1,000 tons of excavated soil would fall in this category.

During off-site transportation of contaminated soil, appropriate spill prevention and control measures would be taken and DOT regulations would be adhered to.

For the purpose of this FS, it is assumed that the contaminated soil disposed offsite would not require treatment prior to landfilling.

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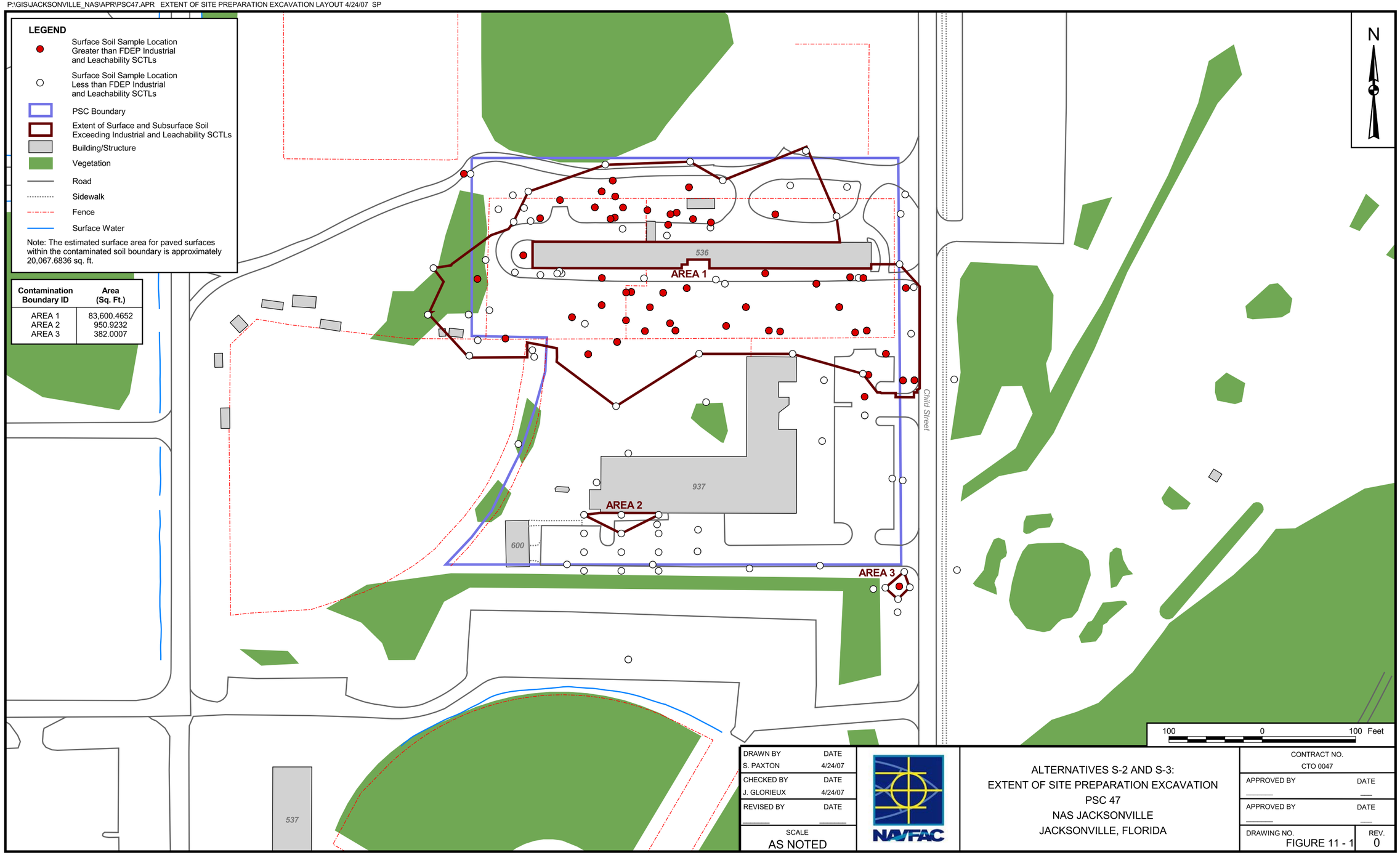

Contamination Boundary ID	Area (Sq. Ft.)
AREA 1	83,600.4652
AREA 2	950.9232
AREA 3	382.0007

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REVISED BY	DATE
SCALE AS NOTED	

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ALTERNATIVES S-2 AND S-3:
EXTENT OF SITE PREPARATION EXCAVATION
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NO. CTO 0047	
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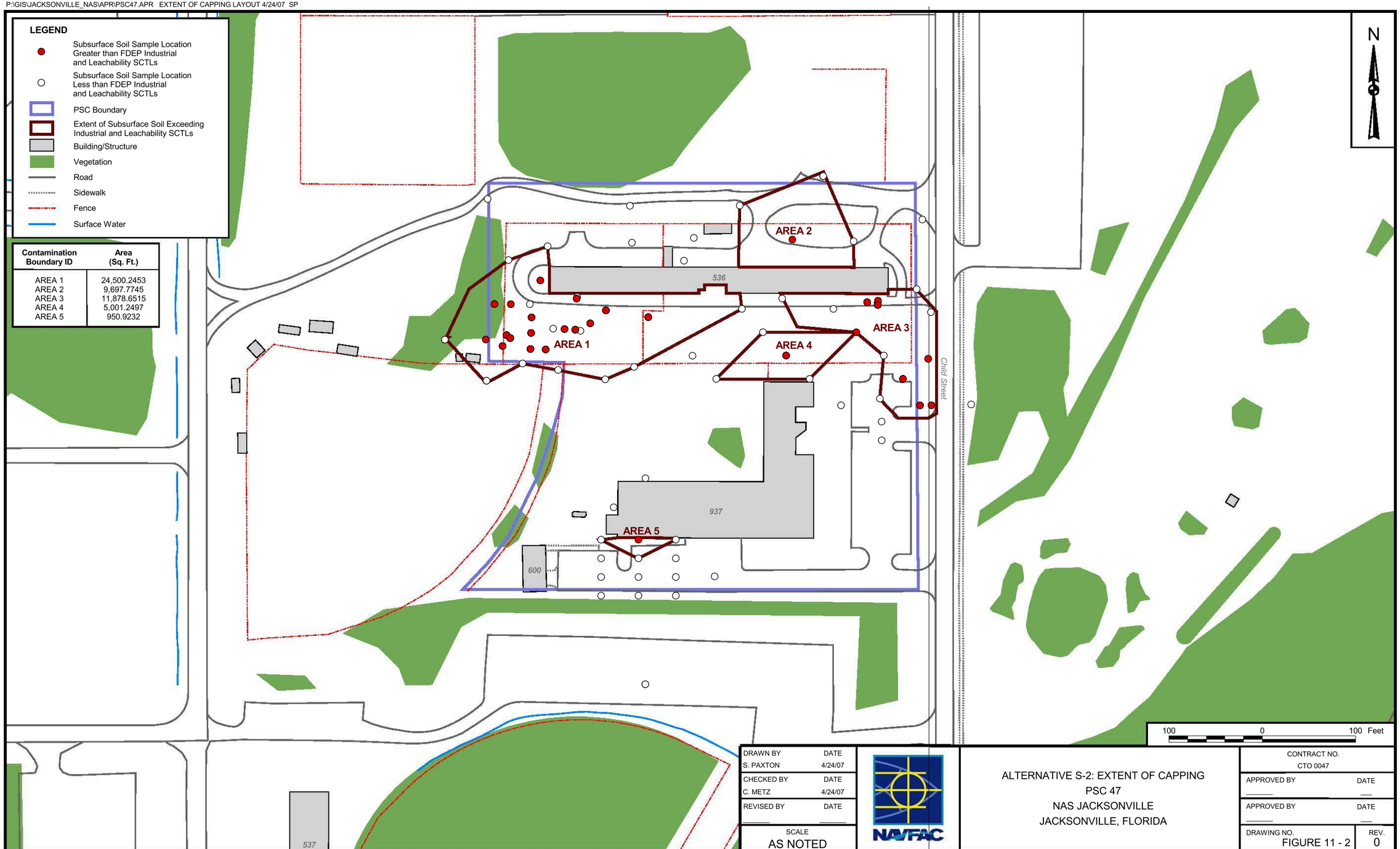

Contamination Boundary ID	Area (Sq. Ft.)
AREA 1	24,500.2453
AREA 2	9,697.7745
AREA 3	11,878.6515
AREA 4	5,001.2497
AREA 5	950.9232

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ALTERNATIVE S-2: EXTENT OF CAPPING
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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Component 3: LUCs

LUCs in the form of institutional and engineering controls will be implemented at PSC 47 to protect human health and the environment from site COCs. Institutional controls that would restrict land use will be implemented. An impermeable cap will be constructed and serve as an engineering control. The objective of these LUCs would be to:

- Prohibit residential or agricultural reuse of the site unless prior written approval is obtained from the USEPA and FDEP. Prohibited residential or residential-like uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, or full-time adult convalescent or nursing care facilities.

- Restrict future use of the site to non-residential activities involving less than full-time human contact by on-site workers with 8 hours per day (average) exposures to surface and subsurface soils.

- Ensure no construction on or excavation of the contaminated soil without special handling and disposal procedures for the soil. Ensure that removal and disposal of soil with contaminant concentrations greater than FDEP SCTLs for direct residential exposure is approved in writing by the USEPA and FDEP prior to the action.

- Maintain the integrity of any existing or future monitoring or remediation system(s).

These LUCs will be maintained by the Navy until the concentration of hazardous substances in the soil and groundwater at the site are at such levels as to allow for unrestricted uses(s) and unlimited exposure(s). Should this particular remedial alternative be selected for implementation, the Navy will develop a LUC RD document to address how the LUC component of this alternative will be implemented, maintained, enforced, and reported on. The LUC RD (a primary document under the FFA) would be submitted to USEPA and FDEP for review and concurrence after finalization of the ROD for PSC 47 and in accordance with the SMP schedule for NAS Jacksonville.

Component 4: Monitoring

A groundwater monitoring program would be developed and implemented to verify the long-term effectiveness of the cap and to evaluate the potential leaching (fluctuating groundwater levels under the cap) of soil COCs into groundwater. Monitoring requirements would be determined during final design of capping. For the purposes of this FS, the following monitoring strategy is assumed for costing purposes.

A total of five monitoring wells would be sampled and the collected samples would be analyzed for pesticides. Monitoring frequency would be semi-annually for the first two years and annually thereafter until the site meets requirements for unrestricted use.

11.2.2.2 Detailed Analysis

Overall Protection of Human Health and Environment

Alternative S-2 would be protective of human health and the environment. Placement of a cap over the area of soil with concentrations of COCs greater than the industrial SCTLs would be protective of current site users. In addition, the cap would also protect human health and the environment by minimizing the leaching of pesticides from soil to groundwater. LUCs would be protective of human health and the environment by preventing potential future residential development that could have resulted in unacceptable human health and ecological risks. Monitoring would be protective of human health and the environment by providing an assessment of on-site concentrations of COCs and a warning of their migration. Alternative S-2 would meet the soil RAOs.

Compliance with ARARs

Alternative S-2 would not meet the chemical-specific ARARs in the short-term. Compliance with these ARARs should eventually be achieved through natural attenuation and this would be verified through monitoring. Alternative S-2 would comply with the location- and action-specific ARARs and fully take into consideration, as appropriate, all TBCs.

Long-term Effectiveness and Permanence

Alternative S-2 would be long-term effective. Installation of a cap would effectively cover soil with concentrations of COCs to which current site users should not be exposed. The cap would also effectively minimize water infiltration, which is the primary pathway for migration of pesticides from soil to groundwater. LUCs would effectively prevent residential development and thus no future resident would be exposed to contaminated soil. Monitoring would be an effective mean to assess reduction of soil COCs concentrations through natural attenuation and to detect migration of soil COCs to groundwater.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative S-2 would reduce the toxicity, mobility, and volume of the soil COCs, but not through treatment. The mobility of soil COCs would be reduced through capping and, as a result of cap construction, approximately 3,678 tons of the most highly contaminated soil would be permanently and irreversibly removed from PSC 47 and disposed offsite at a RCRA solid waste or hazardous waste

landfill. In addition, the toxicity and volume of the remaining soil COCs might eventually be reduced through natural attenuation as verified through monitoring.

Short-term Effectiveness

Implementation of Alternative S-2 could result in moderate short-term risks to on-site workers as a result of exposure to contamination during soil excavation and installation of a cap and also as a result of monitoring. However, these risks would be adequately mitigated by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures. Alternative S-2 could also have a minimal adverse impact on the surrounding community and the environment as a result of the installation of a cap and excavation and off-site transportation of contaminated soil. This impact would also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative S-2 could be completed in approximately four months and would achieve the soil RAOs at completion. The soil PRGs might eventually be met through natural attenuation and this would be determined through monitoring.

Implementability

Alternative S-2 would be easy to implement and resources, equipment, and materials would be readily available for this purpose. The capping component of this alternative could be performed with normal construction equipment by a wide range of contractors. As noted in the above detailed description of this component, preliminary excavation and off-site disposal of a certain volume of surface soil may be required prior to cap installation to maintain normal access to existing buildings. Off-site borrow locations for clean soil as well as RCRA solid waste or hazardous waste landfills for the disposal of the excavated soil would be readily available. A number of monitoring events have already been implemented at PSC 47 and additional monitoring could easily be performed.

The administrative aspects of Alternative S-2 would be simple to implement. A construction permit would have to be obtained for installation of the cap. The off-site transportation and disposal of the excavated soil would have to be properly documented, which could readily be accomplished. A LUC RD would be easy to prepare and LUCs could be readily implemented and enforced.

Cost

Estimated costs for Alternative S-2 are as follows:

Capital:	$1,708,000
30-Year NPW of O&M:	$393,000
30-Year NPW:	$2,101,000

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 M.

11.2.3 Alternative S-3: Excavation and Off-Site Disposal to Allow Industrial Use, Capping to Prevent Leaching, LUCs, and Monitoring

11.2.3.1 Description

Alternative S-3 would consist of four major components: (1) excavation and capping to allow industrial use and to prevent leaching, (2) disposal of excavated soil, (3) LUCs, and (4) monitoring.

Component 1: Excavation and Capping to Allow Industrial Use and to Prevent Leaching

Areas of the site with concentrations of soil COCs greater than the industrial SCTLs would be excavated to allow industrial use. Remaining areas with concentrations of soil COCs greater than the leachability SCTLs would then be capped with an impervious cover system to prevent leaching of soil COCs to groundwater. Pre-construction sampling would be performed to verify the exact extent of the contamination.

The same 6,300 yd^3 of surface soil that were removed from a total area of 85,100 ft^2 (1.95 acres) as part of site preparation for Alternative S-2 (see Figure 11-1) would also be excavated as part of Alternative S-3. An additional estimated 3,500 yd^3 would then be excavated to the groundwater table at approximately 5 ft bls from a total area of 31,600 ft^2 (0.72 acres) of exposed subsurface soil and 20,500 ft^2 (0.47 acres) of exposed subsurface soil would be covered with the same type of 2-ft thick impervious cap as used for Alternative S-2. Figure 11-3 illustrates the areas of subsurface soil to be excavated and those to be capped. Excavated areas that are not capped would be backfilled with an estimated 7,150 yd^3 of clean fill material. The capped and backfilled areas would be re-vegetated or re-paved to match original surface conditions.

During excavation, temporary exposure controls such as water sprinkling and perimeter air quality monitoring would be implemented to ensure that fugitive dust emissions are kept to an acceptable

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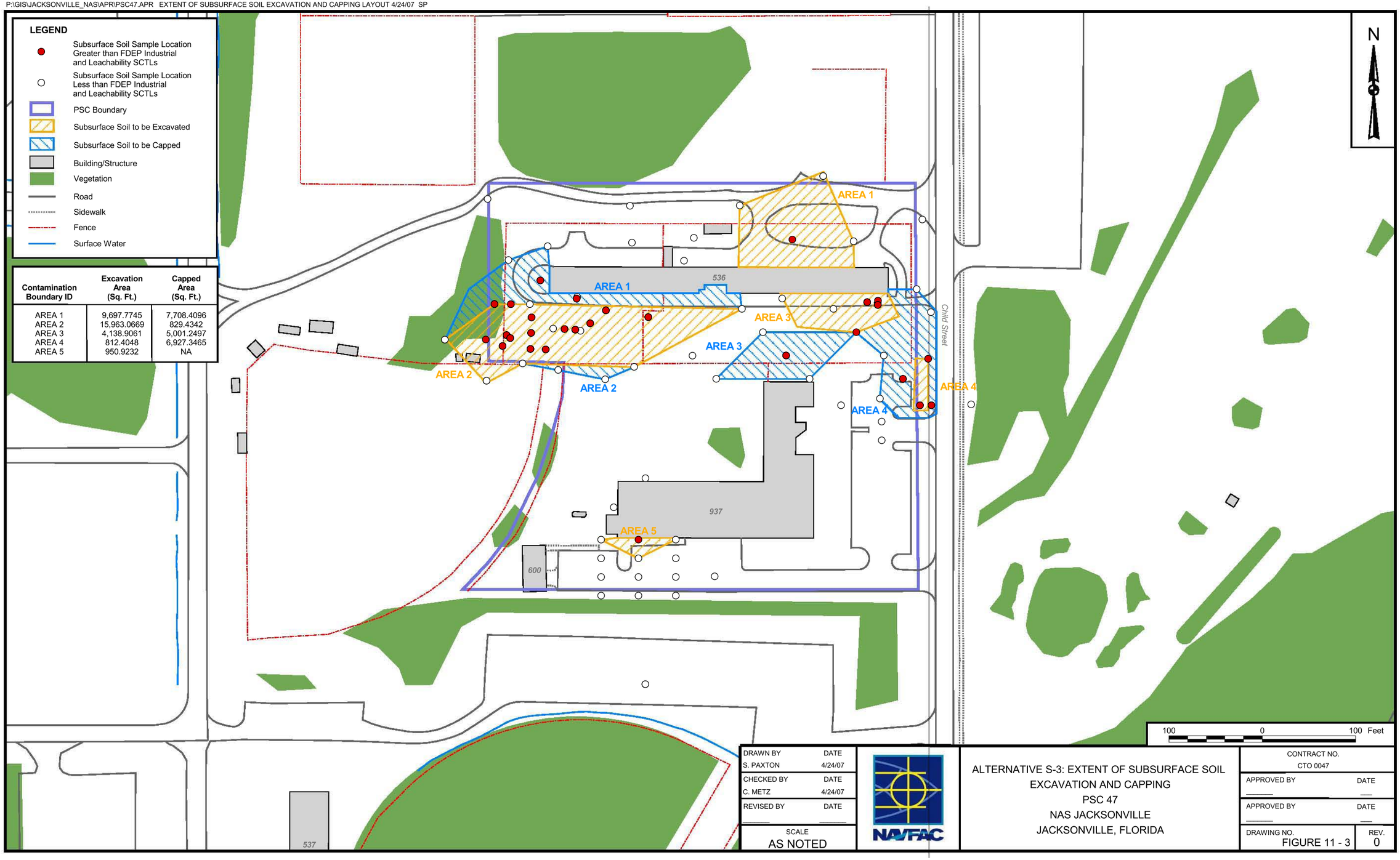

Contamination Boundary ID	Excavation Area (Sq. Ft.)	Capped Area (Sq. Ft.)
AREA 1	9,697.7745	7,708.4096
AREA 2	15,963.0669	829.4342
AREA 3	4,138.9061	5,001.2497
AREA 4	812.4048	6,927.3465
AREA 5	950.9232	NA

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ALTERNATIVE S-3: EXTENT OF SUBSURFACE SOIL EXCAVATION AND CAPPING
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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minimum. The excavated areas would be backfilled as soon as possible and on-site staging and stockpiling of excavated soil would be kept to a minimum. Any on-site stockpiles of excavated soil/sediment would be covered with an impervious synthetic liner at the end of each day's work. In addition, during the excavation of contaminated soil in close proximity to existing buildings, care would be taken not to undermine the foundations of these buildings.

Component 2: Disposal of Excavated Soil

This component would be similar to Component 2 of Alternative S-2, except that the estimated volumes of soil for the three disposal categories would be: 1,150 yd^3 of non-contaminated soil, 11,350 tons of RCRA non-hazardous soil, and 1,625 tons of RCRA hazardous soil.

Component 3: LUCs

This component would be identical to Component 3 of Alternative S-2.

Component 4: Monitoring

This component would be identical to Component 4 of Alternative S-2.

11.2.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative S-3 would be protective of human health and the environment. Excavation and off-site disposal of soil with concentrations of COCs greater than the industrial SCTLs would be protective of the human health under the current industrial use scenario. Placement of a cap over soil with concentrations of pesticides greater than their leachability SCTL would also protect human health and the environment by minimizing the leaching of pesticides from soil to groundwater. LUCs would be protective of human health and the environment by preventing potential future residential development that could have resulted in unacceptable human health and ecological risks. Monitoring would be protective of human health and the environment by providing an assessment of on-site concentrations of COCs and a warning of their migration. Alternative S-3 would meet the soil RAOs.

Compliance with ARARs

Alternative S-3 would not meet the chemical-specific ARARs in the short-term. Compliance with these ARARs should eventually be achieved through natural attenuation and this would be verified through

monitoring. Alternative S-3 would comply with the location- and action-specific ARARs and fully take into consideration, as appropriate, all TBCs.

Long-term Effectiveness and Permanence

Alternative S-3 would be long-term effective and permanent. Excavation and off-site disposal would effectively and permanently remove soil with concentrations of COCs to which current site users and anticipated future industrial site workers should not be exposed. Installation of a cap would effectively minimize water infiltration, which is the primary pathway for migration of pesticides from soil to groundwater. LUCs would effectively prevent residential development and thus no future resident would be exposed to contaminated soil. Monitoring would be an effective mean to assess reduction of soil COCs concentrations through natural attenuation and to detect migration of soil COCs to groundwater.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative S-3 would reduce the toxicity, mobility, and volume of the soil COCs, but not through treatment. Approximately 8,650 yd^3 of the most highly contaminated soil would be permanently and irreversibly removed from PSC 47 and disposed off-site at a RCRA solid waste or hazardous waste landfill. In addition, the mobility of the soil COCs most likely to leach to groundwater would be reduced through capping. The toxicity and volume of the residual soil COCs should also be eventually reduced through natural attenuation; however, no soil monitoring is planned under this alternative.

Short-term Effectiveness

Implementation of Alternative S-3 could result in moderate short-term risks to on-site workers as a result of exposure to contamination during soil excavation and installation of a cap and also as a result of monitoring. However, these risks would be adequately mitigated by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures. Alternative S-3 could also have a minimal adverse impact on the surrounding community and the environment as a result of the off-site transportation of contaminated soil. Capping could also have a minimal adverse impact on the environment. These impacts would also be adequately mitigated by implementation of temporary exposure controls, adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative S-3 could be completed within approximately five months and would achieve the soil RAOs at completion. The soil PRGs might eventually be met through natural attenuation.

Implementability

Alternative S-3 would be easy to implement and resources, equipment, and materials would be readily available for this purpose. The excavation and capping components of this alternative could be performed with normal construction equipment by a wide range of contractors. Because excavation would be limited to approximately 5 ft bls and would not extend below the water table, the need for shoring would be limited to the temporary support of exposed existing buildings foundations as may be required and there will be no need for dewatering. Off-site borrow locations for clean soil as well as RCRA solid waste and hazardous waste landfills for the off-site disposal of the excavated soil would be readily available. Additional monitoring at PSC 47 would be easy to perform.

The administrative aspects of Alternative S-3 would be simple to implement. An excavation/digging permit could be easily obtained from the base. The off-site transportation and disposal of the excavated soil would have to be properly documented, which could readily be accomplished. A LUC RD would be easy to prepare and LUCs could be readily implemented, maintained, and enforced.

Cost

The estimated costs for Alternative S-3 are:

Capital Cost:	$2,598,000
30-Year NPW of O&M Cost:	$274,000
30-Year NPW:	$2,872,000

A detailed cost estimate for this alternative is provided in Appendix M.

11.2.4 Alternative S-4: Excavation and Off-Site Disposal To Allow Residential Exposure and Prevent Leaching

11.2.4.1 Description

Alternative S-4 would consist of two major components: (1) excavation of soil to allow residential exposure and to prevent leaching and (2) disposal of excavated soil.

Component 1: Excavation to Allow Residential Exposure and Prevent Leaching

Areas of the site with concentrations of soil COCs greater than the residential and/or leachability SCTLs would be excavated to allow residential and to prevent leaching of soil COCs to groundwater. Pre-construction sampling would be performed to verify the exact extent of the contamination.

An estimated 8,200 yd^3 of surface soil would be excavated from a total area of 110,500 ft^2 (2.54 acres) as illustrated on Figure 11-4. An additional estimated 7,350 yd^3 would then be excavated to the groundwater table at approximately 5 ft bls from a total area of 66,400 ft^2 (1.52 acres) of exposed subsurface soil as illustrated on Figure 11-5. Excavated areas would be backfilled with an estimated 15,550 yd^3 of clean fill material. The backfilled areas would be re-vegetated or re-paved to match original surface conditions. No cap maintenance of any kind would be required with this component.

The same procedures would be followed and precautions taken as for implementation of Component 1 of Alternatives S-2 and S-3.

Component 2: Disposal of Excavated Soil

This component would be similar to Component 2 of Alternative S-2, except that the estimated volumes of soil for the three disposal categories would be: 1,300 yd^3 of non-contaminated soil, 19,750 tons of RCRA non-hazardous soil, and 1,625 tons of RCRA hazardous soil.

11.2.4.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative S-4 would be fully protective of human health and the environment under the current industrial exposure scenario and any other foreseeable site use. Excavation and off-site disposal of soil with concentrations of COCs greater than their PRGs would eliminate unacceptable risks from direct exposure to contaminated soil or from migration of soil COCs either offsite or to other media. Alternative S-4 would meet the soil RAOs.

Compliance with ARARs

Alternative S-4 would comply with all chemical-, location-, and action-specific ARARs and fully take into consideration, as appropriate, all TBCs.

Long-term Effectiveness and Permanence

Alternative S-4 would be long-term effective and permanent. Excavation and off-site disposal would effectively and permanently remove soil with concentrations of COCs to which current or potential future site users should not be exposed. Excavation and off-site disposal would also remove soil with concentrations of COCs high enough to leach to groundwater.

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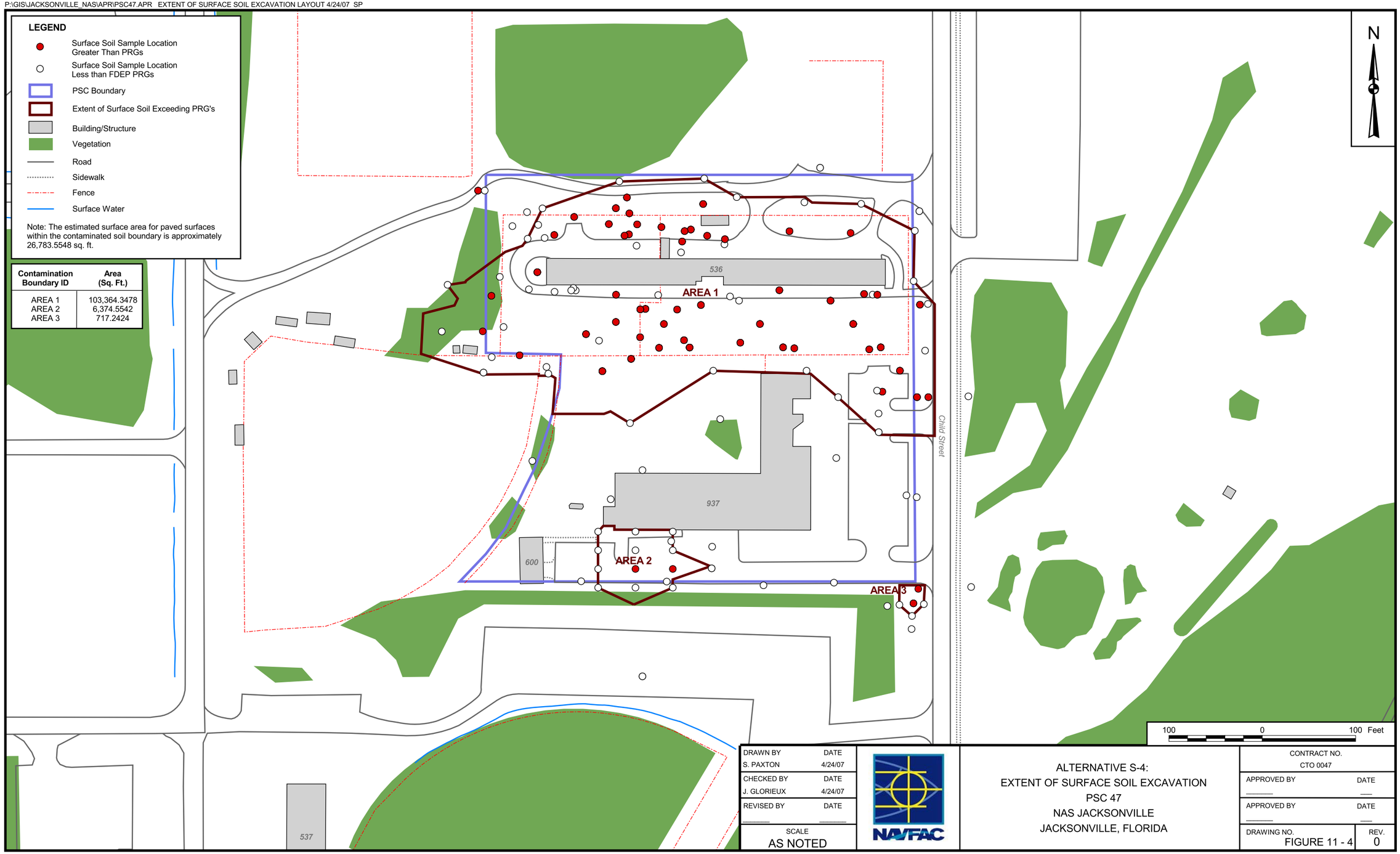

Contamination Boundary ID	Area (Sq. Ft.)
AREA 1	103,364.3478
AREA 2	6,374.5542
AREA 3	717.2424

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S. PAXTON	4/24/07
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J. GLORIEUX	4/24/07
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ALTERNATIVE S-4:
EXTENT OF SURFACE SOIL EXCAVATION
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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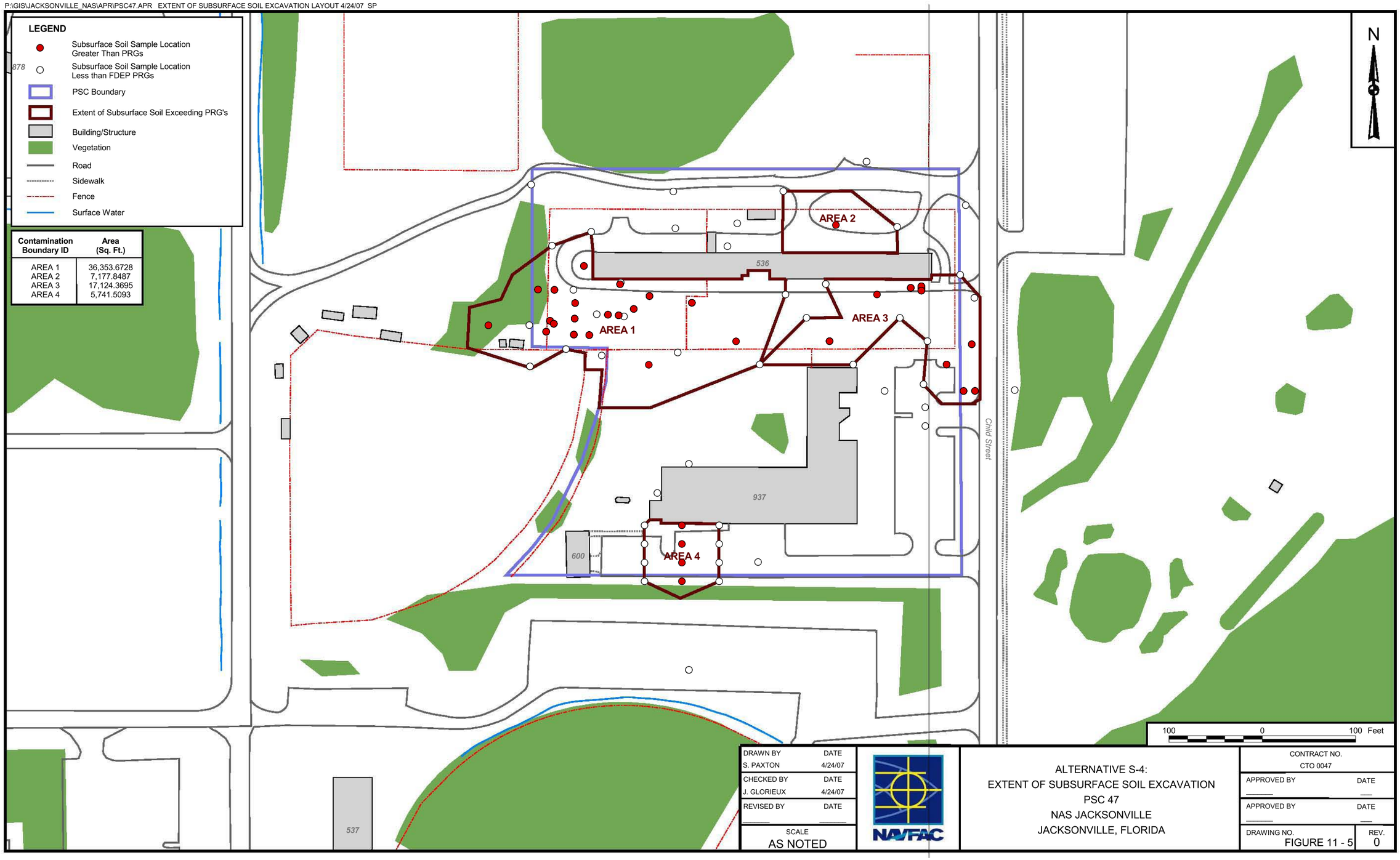

Contamination Boundary ID	Area (Sq. Ft.)
AREA 1	36,353.6728
AREA 2	7,177.8487
AREA 3	17,124.3695
AREA 4	5,741.5093

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CHECKED BY J. GLORIEUX	DATE 4/24/07
REVISED BY	DATE
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ALTERNATIVE S-4:
EXTENT OF SUBSURFACE SOIL EXCAVATION
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative S-4 would reduce the toxicity, mobility, and volume of the soil COCs, but not through treatment. Approximately 14,250 yd^3 of contaminated soil would be permanently and irreversibly removed from PSC 47 and disposed in an off-site solid waste or hazardous waste landfill.

Short-term Effectiveness

Implementation of Alternative S-4 could result in significant short-term risks to on-site workers as a result of exposure to contamination during soil excavation. However, these risks could be adequately mitigated by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures. Alternative S-4 could also adversely impact the surrounding community and the environment as a result of the excavation and off-site transportation of contaminated soil. This adverse impact could also be adequately mitigated by the implementation of temporary exposure controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative S-4 could be completed within approximately six months and could achieve the soil RAOs and meet the soil PRGs at completion.

Implementability

Alternative S-4 would be easy to implement and resources, equipment, and materials would be readily available for this purpose. The excavation component of this alternative could be performed with normal construction equipment by a wide range of contractors. Because excavation would be limited to approximately 5 ft bls and would not extend below the water table, the need for shoring would be limited to the temporary support of exposed existing buildings foundations as may be required and there be no need for dewatering. RCRA solid waste and hazardous waste landfills are readily available for the off-site disposal of the excavated soil.

The administrative aspects of Alternative S-4 would be simple to implement. A base excavation/digging permit is easily obtained. The off-site transportation and disposal of the excavated soil would have to be properly documented, which could readily be accomplished.

Cost

The estimated costs for Alternative S-4 are:

Capital Cost:	$3,514,000
NPW of O&M Cost:	$0
NPW:	$3,514,000

A detailed cost estimate for this alternative is provided in Appendix M.

11.3 DEVELOPMENT OF GROUNDWATER REMEDIAL ALTERNATIVES

The following alternatives have been developed for groundwater remediation at PSC 47:

Alternative GW-1:	No Action
Alternative GW-2:	Monitored Natural Attenuation and LUCs
Alternative GW-3A:	Northern Plume In-Situ Treatment (Enhanced Bioremediation), Monitored Natural Attenuation and LUCs
Alternative GW-3B:	Southern Plume In-Situ Treatment (Chemical Oxidation & Precipitation), Monitored Natural Attenuation and LUCs

Alternative GW-1 was developed and analyzed to serve as a baseline for other alternatives, as required by the by CERCLA and the NCP. Alternative GW-2 was developed and analyzed to evaluate the adequacy of minimal action according to Chapter 62-780, FAC, RBCA RMO Level III. Alternatives GW-3A and GW-3B were developed and analyzed to evaluate active remediation with relatively innovative in-situ treatment approaches for the Northern and Southern Plumes, respectively.

A description and detailed analysis of these alternatives are provided in the following sections.

11.3.1 Alternative GW-1 - No Action

11.3.1.1 Description

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.

11.3.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative GW-1 would not be protective of human health and the environment. Although there are no unacceptable human health risks from exposure to contaminated groundwater under the current industrial site use, Alternative GW-1 would not prevent unacceptable human health risks that would result from a hypothetical future residential site use. In addition, in the absence of monitoring, the progress of natural attenuation would remain unknown and potential future migration of groundwater COCs to surface water would remain undetected, which could adversely impact ecological receptors.

Compliance with ARARs

Alternative GW-1 would not comply with chemical-specific ARARs because no action would be taken to reduce contaminant concentrations. Chemical-specific ARARs might eventually be met through natural attenuation, but this would not be verified through monitoring. Compliance with location-specific ARARs would be purely incidental. Action-specific ARARs are not applicable.

Long-term Effectiveness and Permanence

Alternative GW-1 would not be long-term effective and permanent because it would not involve any action and it would allow for unrestricted future use of site groundwater, which would result in unacceptable human health risks. In addition, because there would be no monitoring, the progress of natural attenuation would remain unknown and potential migration of groundwater COCs to surface water would not be detected.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative GW-1 would not reduce toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of contaminant toxicity or volume might occur through natural attenuation. but no monitoring would verify this.

Short-term Effectiveness

Because no on-site remedial activities would be undertaken, the implementation of Alternative GW-1 would not pose any short-term risks to on-site workers or result in potential adverse impacts to the local community and the environment.

Alternative GW-1 would not meet the groundwater RAOs and, although the groundwater PRGs might eventually be achieved through natural attenuation, this would not be verified through monitoring.

Implementability

Alternative GW-1 would be very easy to implement because no on-site remedial activities would be undertaken. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. The implementability of administrative measures is not applicable because no such measures would be taken.

Cost

There would be no costs associated with the No Action alternative.

11.3.2 Alternative GW-2: Monitored Natural Attenuation and LUCs

11.3.2.1 Description

Alternative GW-2 would consist of three major components: (1) natural attenuation, (2) monitoring, and (3) LUCs.

Component 1: Natural Attenuation

Natural attenuation relies on naturally occurring processes within the aquifer to reduce the concentrations of VOCs, SVOCs, pesticides, and arsenic. Biodegradation, dispersion, and dilution through aquifer movement, and adsorption on soil particles are expected to be the processes primarily responsible for this natural attenuation. Initial data suggest that natural attenuation of COCs is occurring at the site, however additional data collection would be necessary to fully evaluate natural attenuation effectiveness. Under this scenario, aquifer conditions and quality would be continually monitored to track the progress of remediation through natural attenuation.

Component 2: Monitoring

Monitoring would consist of regularly collecting and analyzing groundwater samples both from within the Northern and Southern Plumes to assess natural attenuation and downgradient of the leading edge of the plumes to detect potential migration of groundwater COCs to surface water. The specific scope for monitoring would be detailed in a monitored natural attenuation work plan to be developed after approval of the remedy.

For costing purposes, it is assumed that monitoring for natural attenuation would be performed over a period of up to 30 years and would consist of collecting samples from 15 existing monitoring wells and analyzing them for groundwater COCs (VOCs, SVOCs, pesticides and arsenic). During the initial period of monitoring, samples would also be analyzed for natural attenuation indicator parameters, such as ORP, dissolved oxygen, pH, alkalinity, temperature, conductivity, BOD, COD, TOC, ferrous and total iron, sulfur compounds (sulfates, sulfides), nitrogen compounds (nitrates, nitrites), orthophosphates, chlorides, and metabolic gases (methane, ethane, ethene, and carbon dioxide). Sampling frequency would be quarterly for the first year, semi-annually for the next two years, and annually thereafter.

Monitoring for potential migration of COCs would be performed over a period of up to 30 years and would consist of collecting samples from six existing monitoring wells and analyzing them for groundwater COCs. Sampling frequency would be quarterly for the first year, semi-annually for the next two years, and annually thereafter.

Component 3: LUCs

LUCs in the form of institutional and engineering controls will be implemented at PSC 47 to protect human health and the environment from site COCs in groundwater. Institutional controls that would restrict land uses would be implemented. Engineering controls could be potentially implemented if site groundwater was exposed. The objective of these LUCs would be to:

- Prohibit the disturbance of any existing or future monitoring or remediation system(s) unless prior written approval is obtained from USEPA and FDEP.

- Except for the purposes of assessing groundwater quality or remediating groundwater contamination, the withdrawal or use of groundwater from the surficial aquifer for any purpose (including, but not limited to, human consumption, dewatering, irrigation, heating/cooling purposes, and industrial processes) is prohibited unless prior written approval is obtained from USEPA and FDEP.

- Ensure that any workers potentially exposed to the contaminated groundwater at this site are properly trained.

These LUCs will be maintained by the Navy until the concentration of hazardous substances in the soil and groundwater at the site are at such levels as to allow for unrestricted uses(s) and unlimited exposure(s). Should this particular remedial alternative be selected for implementation, the Navy will develop a LUC RD document to address how the LUC component of this alternative will be implemented, maintained, enforced and reported on. The LUC RD (a primary document under the FFA) would be

submitted to USEPA and FDEP for review and concurrence after finalization of the ROD for PSC 47 and in accordance with the SMP schedule for NAS Jacksonville.

11.3.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative GW-2 would be protective of human health and the environment. Natural attenuation would be protective of human health and the environment because it would reduce concentrations of COCs until the PRGs are eventually achieved. LUCs would be protective because they would prevent unacceptable human health risks from exposure to contaminated groundwater until the groundwater PRGs have been met. Monitoring would be protective because it would assess the progress of natural attenuation and also because it would detect the potential migration of groundwater COCs to surface water, which would allow the prevention of unacceptable human health and ecological risks. Alternative GW-2 would meet the groundwater RAOs.

Compliance with ARARs

Alternative GW-2 would not comply in the short-term with chemical-specific ARARs, but compliance would eventually be achieved through natural attenuation. Alternative GW-2 would comply with location-, and action-specific ARARs.

Long-term Effectiveness and Permanence

Alternative GW-2 would be long-term effective and permanent. Natural attenuation would effectively reduce concentrations of groundwater COCs and eventually achieve the groundwater PRGs as verified through monitoring. Until this occurs, LUCs would effectively prevent groundwater access and use, which would result in unacceptable human health risk, Monitoring would effectively determine whether or not groundwater COCs are migrating to surface water, which might result in unacceptable ecological risks.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative GW-2 would reduce the toxicity, mobility, and volume of groundwater COCs, but not through treatment. The toxicity and volume of groundwater COCs would be reduced through natural attenuation and this reduction would be quantified by monitoring.

Short-term Effectiveness

Implementation of Alternative GW-2 could result in minimal short-term risks to on-site workers as a result of exposure to contamination during monitoring. However, these risks would be adequately mitigated by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures. Alternative GW-2 would also not adversely impact the surrounding community or the environment.

Alternative GW-2 could be implemented within approximately three months and would achieve the groundwater RAOs at completion. The groundwater PRGs would eventually be met through natural attenuation and this would be determined through monitoring.

Implementability

Alternative GW-2 would be easy to implement. A number of groundwater monitoring events have been implemented at PSC 47 and additional monitoring would be easy to perform.

The administrative aspects of Alternative GW-2 would be simple to implement. A LUC RD would be easy to prepare and LUCs could be readily implemented and enforced. No construction permits would be required for this alternative.

Cost

The estimated costs for Alternative GW-2 are:

Capital Cost:	$16,000
30-Year NPW of O&M Cost:	$754,000
30-Year NPW:	$770,000

A detailed cost estimate for this alternative is provided in Appendix M.

11.3.3 Alternative GW-3A: Northern Plume In-Situ Treatment (Enhanced Bioremediation), Monitored Natural Attenuation, and LUCs

11.3.3.1 Description

Alternative GW-3A would consist of four major components: (1) In-situ enhanced bioremediation of Northern Plume, (2) natural attenuation, (3) monitoring, and (4) LUCs.

Component 1: In-Situ Enhanced Bioremediation of Northern Plume

In-situ bioremediation would consist of using electron donor injection to enhance the growth of indigenous microorganisms and augment the natural biodegradation of the Northern Plume COCs, particularly the pesticides. As previously discussed in Section 10.5.4.1, the results of bench-scale treatability tests (TtNUS, 2007) have tentatively identified emulsified food-grade vegetable oil as a suitable electron donor. For the purposes of this FS, it is assumed that this emulsified oil would be injected in the contaminated groundwater using DPT wells and that a single injection sequence would be required. Based upon experience with similar applications, it is assumed that 230 DPT wells would be installed to a depth of 25 ft bls as illustrated on Figure 11-6. Emulsified oil would be injected in these wells at the rate of approximately 10 pounds of concentrate per foot of depth in the 5 to 25 ft bls interval, for a total emulsified oil concentrate use of approximately 46,000 pounds (6,200 gallons). The oil concentrate is typically diluted with water in the ratio of 10 to 1 prior to injection and a certain volume of water is added into the wells following injection to promote dispersion. Because the contaminant-degrading microorganisms function optimally in a pH range of 6.0 to 8.0 SU, pH adjustment would probably be required with controlled injection of an alkaline reagent such as sodium hydroxide (caustic soda) at the same time as that of the emulsified oil. The exact design of the treatment system would be verified through pilot-scale treatability testing prior to implementation. Conceptual design calculations for the in-situ bioremediation system are provided in Appendix M.

Component 2: Natural Attenuation

This component would be identical to Component 1 of Alternative GW-2.

Component 3: Monitoring

This component would be identical to Component 2 of Alternative GW-2, except that the samples collected from the six wells in the Northern Plume would be analyzed for natural attenuation parameters after completion of the in-situ enhanced bioremediation that is from Year 4 to Year 8 instead of from Year 1 to Year 5.

Component 4: LUCs

This component would be identical to Component 3 of Alternative GW-2.

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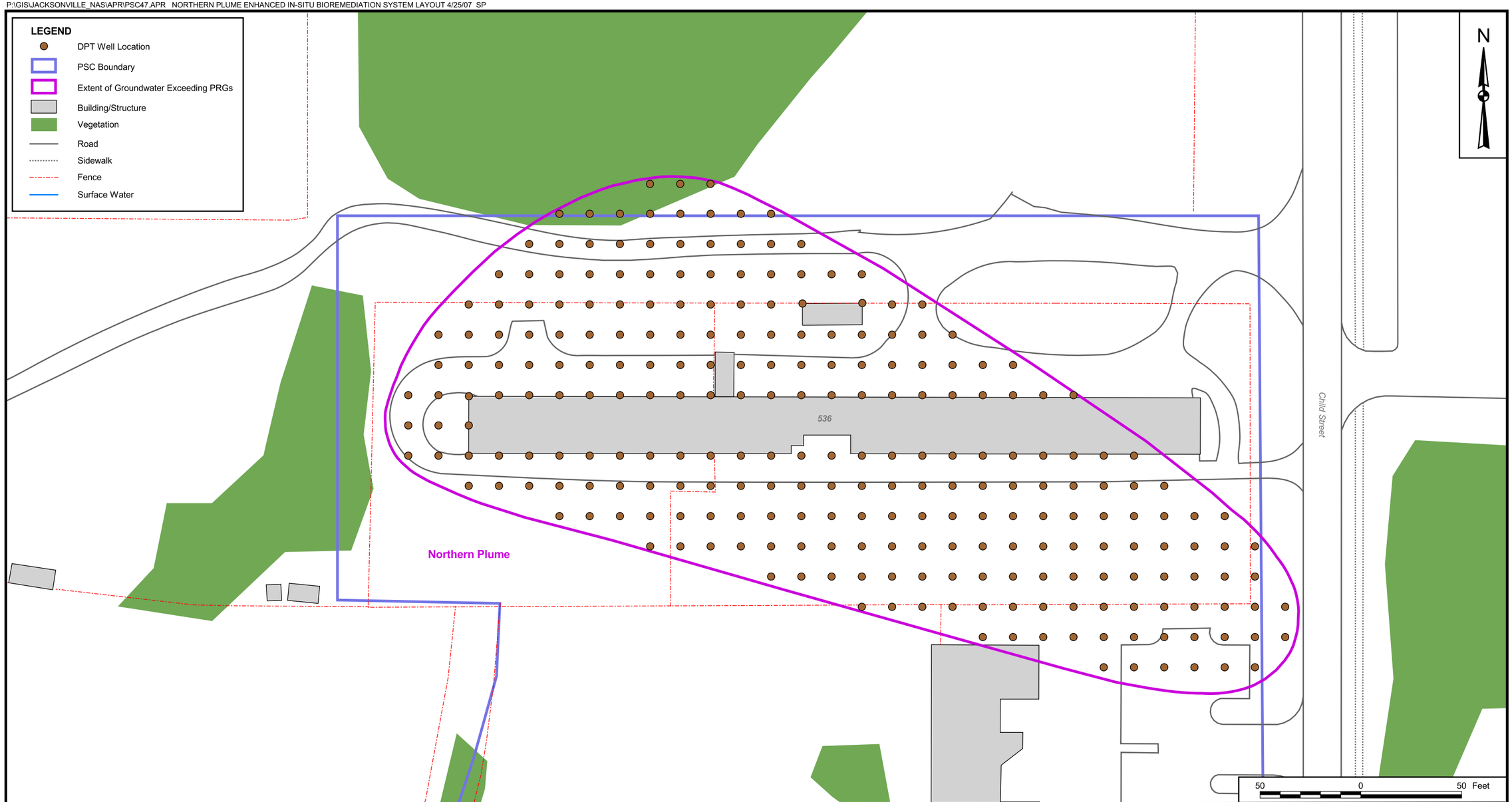

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ALTERNATIVE GW-3A: NORTHERN PLUME
ENHANCED IN-SITU BIOREMEDIATION SYSTEM
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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11.3.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative GW-3A would be protective of human health and the environment. In-situ enhanced bioremediation of the Northern Plume would be protective of human health and the environment because it would significantly accelerate the natural attenuation of this area of contaminated groundwater. LUCs would be protective because they would prevent unacceptable human health risks from exposure to contaminated groundwater until the groundwater cleanup goals have been met. Monitoring would be protective because it would assess the progress of in-situ bioremediation and natural attenuation and also because it would detect the potential migration of groundwater COCs to surface water, which would allow the prevention of unacceptable human health and ecological risks. Alternative GW-3A would meet the groundwater RAOs.

Compliance with ARARs

Alternative GW-3A would eventually comply with chemical-specific ARARs through the combination of active in-situ biological treatment and natural attenuation. Alternative GW-3A would also comply with location- and action-specific ARARs and fully take into consideration, as appropriate, all TBCs.

Long-term Effectiveness and Permanence

Alternative GW-3A would be long-term effective and permanent. In-situ enhanced bioremediation of the Northern Plume would effectively and permanently reduce concentrations of COCs within that area of contaminated groundwater. However the site-specific effectiveness of the proposed electron donor injection technology would have to be verified through pilot-scale testing, particularly for the removal of pesticides. Natural attenuation would effectively reduce concentrations of groundwater COCs and eventually achieve the groundwater PRGs as verified through monitoring. Until this occurs, LUCs would effectively prevent groundwater access and use, which would result in unacceptable human health risk, Monitoring would effectively determine whether or not groundwater COCs are migrating to surface water, which might result in unacceptable ecological risks.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative GW-3A would reduce the toxicity, mobility, and volume of the Northern Plume COCs through treatment. An estimated 2.7 pounds of VOCs, SVOCs, and pesticides would be permanently and irreversibly removed through in-situ enhanced bioremediation. Additional reduction in the toxicity, mobility, and volume of groundwater COCs would be achieved through natural attenuation and this

reduction would be quantified by monitoring. Alternative GW-3A would not generate any treatment residue.

Short-term Effectiveness

Implementation of Alternative GW-3A could result in moderate short-term risks to on-site workers as a result of exposure to contamination during the installation and operation of an in-situ chemical injection system and as a result of monitoring. However, these risks would be adequately mitigated by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures. Alternative GW-3A would also not adversely impact the surrounding community or the environment.

Alternative GW-3A could be implemented within approximately one year and would achieve the groundwater RAOs at completion. Alternative GW-3A would also meet the groundwater PRGs for the Northern Plume within an estimated three years. The remaining groundwater PRGs would eventually be met through natural attenuation and this would be determined through monitoring.

Implementability

Alternative GW-3A would be relatively easy to implement. In-situ enhanced bioremediation services are available from a number of qualified contractors. Installation of a large number (230) of DPT wells for electron donor injection would likely interfere, at least temporarily, with the normal use of the site, especially the installation of those DPT wells that would be located on existing parking lots and next to Building 536. Pilot-scale treatability testing would have to be performed to verify the site-specific effectiveness and the design parameters for the electron donor injection technology for the in-situ bioremediation of pesticides. A number of groundwater monitoring events have been implemented at PSC 47 and additional monitoring would be easy to perform.

The administrative aspects of Alternative GW-3A would be simple to implement. A LUC RD would be easy to prepare and LUCs could be readily implemented and enforced. No construction permits would be required for this alternative.

Cost

The estimated costs for Alternative GW-3A are:

Capital Cost:	$1,219,000
30-Year NPW of O&M Cost:	$813,000
30-Year NPW:	$2,032,000

Detailed cost estimates for this alternative are provided in Appendix M.

11.3.4 Alternative GW-3B: Southern Plume In-Situ Treatment (Chemical Oxidation & Precipitation), Monitored Natural Attenuation, and LUCs

Alternative GW-3B would consist of four major components: (1) chemical oxidation and precipitation of the Southern Plume, (2) natural attenuation, (3) monitoring, and (4) LUCs.

11.3.4.1 Detailed Description

Component 1: Chemical Oxidation and Precipitation of the Southern Plume

This component would consist of installing a DPT injection system for the in-situ chemical oxidation and precipitation of the Southern Plume Arsenic Hot Spot. Treatment would include two rounds of injection in rapid succession, with the first round providing the iron necessary for the arsenic co-precipitation process and the second round providing an oxygen rich environment to oxidize arsenic from the trivalent to the pentavalent state, resulting in the co-precipitation of an arsenic ferro-oxide.

For the purpose of this FS, the conceptual design of this component was based on general experience with DPT injection systems for the remediation of plumes similar to the PSC 47 Southern Plume Arsenic Hot Spot. Conceptual design calculations are provided in Appendix M. The exact design of the in-situ chemical oxidation and precipitation system would be verified through treatability testing prior to implementation.

The DPT injection system would consist of a grid of 55 DPT injection wells installed to a depth of 25 ft bls. The proposed arrangement of the DPT injection system is illustrated on Figure 11-7. For the first round of injection, the DPT injection system would be used to feed a total of approximately 5,850 pounds of a 40-percent (by weight) solution of ferric chloride (approximately 500 gallons), which corresponds to a total iron III addition of approximately 800 pounds, which corresponds to twice the stochiometric demand for arsenic co-precipitation. To promote dispersion, the ferric chloride solution would be diluted 100 to 1 providing approximately 920 gallons of dilute solution to be injected at each DPT point. For the second round of injection, 200 pounds of an oxygen enhancer such as ORC or similar compound would be injected in each of the DPT well for a total injection of 11,000 pounds of an oxygen enhancer into the Arsenic Hot Spot.

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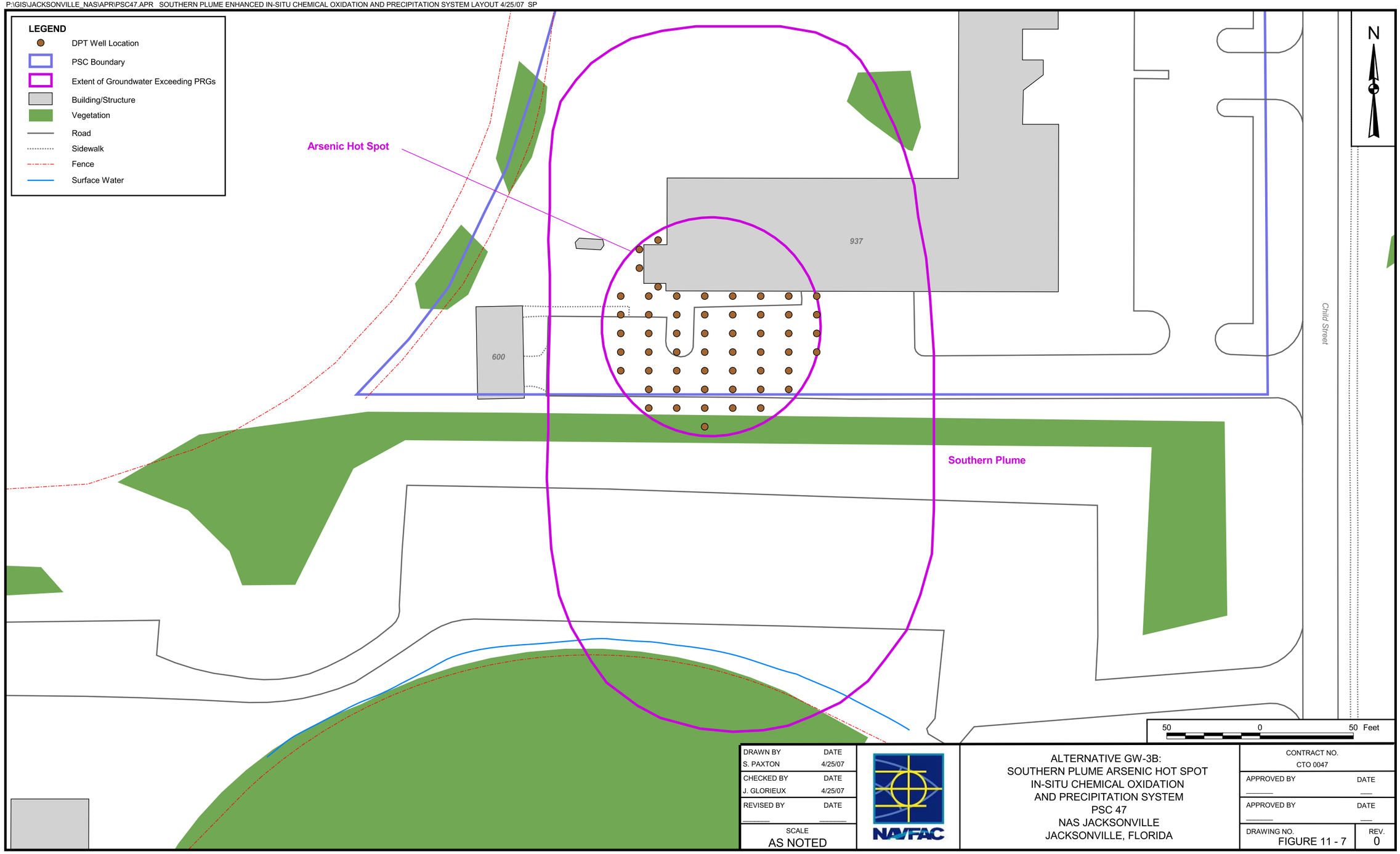

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ALTERNATIVE GW-3B:
SOUTHERN PLUME ARSENIC HOT SPOT
IN-SITU CHEMICAL OXIDATION
AND PRECIPITATION SYSTEM
PSC 47
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

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Component 2: Natural Attenuation

This component would be identical to Component 1 of Alternative GW-2.

Component 3: Monitoring

This component would be identical to Component 2 of Alternative GW-2, except that the samples collected from the nine wells in the Southern Plume would be analyzed for natural attenuation parameters after completion of the in-situ chemical oxidation and precipitation, which is from Year 2 to Year 6 instead of from Year 1 to Year 5.

Component 4: LUCs

This component would be identical to Component 3 of Alternative GW-2.

11.3.4.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative GW-3B would be protective of human health and the environment. In-situ chemical oxidation and precipitation of the Southern Plume would be protective of human health and the environment because it would significantly accelerate the natural attenuation of this area of contaminated groundwater. LUCs would be protective because they would prevent unacceptable human health risks from exposure to contaminated groundwater until the groundwater PRGs have been met. Monitoring would be protective because it would assess the progress of in-situ bioremediation and natural attenuation and also because it would detect the potential migration of groundwater COCs to surface water, which would allow the prevention of unacceptable human health and ecological risks. Alternative GW-3B would meet the groundwater RAOs.

Compliance with ARARs

Alternative GW-3B would eventually comply with chemical-specific ARARs through the combination of active in-situ chemical treatment and natural attenuation. Alternative GW-3B would also comply with location- and action-specific ARARs and fully take into consideration, as appropriate, all TBCs.

Long-term Effectiveness and Permanence

Alternative GW-3B would be long-term effective and permanent. In-situ chemical oxidation and precipitation of the Southern Plume would effectively and permanently reduce concentrations of arsenic within that area of contaminated groundwater. However, the site-specific effectiveness of the proposed

ferric iron and oxygen enhancer would have to be verified through bench- and pilot-scale testing. In addition, there would also be a slight possibility that the arsenic that had been removed from groundwater and immobilized in the surrounding soil could be redissolved and remobilized over the long term as a result of naturally occurring changes in groundwater chemistry. Natural attenuation would effectively reduce concentrations of groundwater COCs and eventually achieve the groundwater cleanup goals as verified through monitoring. Until this occurs, LUCs would effectively prevent groundwater access and use, which would result in unacceptable human health risk, Monitoring would effectively determine whether or not groundwater COCs are migrating to surface water, which might result in unacceptable ecological risks.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative GW-3B would reduce the toxicity and mobility of the arsenic in the Southern Plume through treatment. An estimated 27 pounds of arsenic would be removed from groundwater and immobilized in the surrounding soil matrix through in-situ chemical oxidation and precipitation. However, as previously remarked, this removal and immobilization might not be fully permanent and irreversible. Reduction in the toxicity, mobility, and volume of other groundwater COCs would be achieved through natural attenuation and this reduction would be quantified by monitoring. Alternative GW-3B would not generate any treatment residue.

Short-term Effectiveness

Implementation of Alternative GW-3B could result in moderate short-term risks to on-site workers as a result of exposure to contamination during the installation and operation of an in-situ chemical injection system and as a result of monitoring. However, these risks would be adequately mitigated by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures. Alternative GW-3B would also not adversely impact the surrounding community or the environment.

Alternative GW-3B could be implemented within approximately one year and would achieve the groundwater RAOs at completion. Alternative GW-3B would also meet the arsenic PRG for the Southern Plume Arsenic Hot Spot within an estimated one year. The remaining groundwater PRGs would eventually be met through natural attenuation and this would be determined through monitoring.

Implementability

Alternative GW-3B could be implemented, but not as readily as some other alternatives. In-situ chemical oxidation and precipitation is a relatively innovative and this kind of service would only be available from a

limited number of qualified contractors. Installation of a relatively large number (90) of DPT wells for chemical injection might interfere, at least temporarily, with the normal use of the site, especially because most of those DPT wells would be located next to Building 937. Pilot-scale treatability testing would have to be performed to verify the site-specific effectiveness and the design parameters for the electron donor injection technology for the in-situ bioremediation of pesticides. A number of groundwater monitoring events have been implemented at PSC 47 and additional monitoring would be easy to perform.

The administrative aspects of Alternative GW-3B would be simple to implement. A LUC RD would be easy to prepare and LUCs could be readily implemented and enforced. No construction permits would be required for this alternative.

Cost

The estimated costs for Alternative GW-3B are:

Capital Cost:	$691,000
30-Year NPW of O&M Cost:	$790,000
30-Year NPW:	$1,481,000

Detailed cost estimates for this alternative are provided in Appendix M.

12.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares the analyses that were presented for each of the remedial in Section 11.0. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

12.1 COMPARISON OF SOIL REMEDIAL ALTERNATIVES BY CRITERIA

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

Alternative S-1: No Action

Alternative S-2: Capping to Allow Industrial Use and Prevent Leaching, LUCs, and Monitoring

Alternative S-3: Excavation and Off-Site Disposal to Allow Industrial Use, Capping to Prevent Leaching, LUCs, and Monitoring

Alternative S-4: Excavation and Off-Site Disposal to Allow Residential Exposure and Prevent Leaching

12.1.1 Overall Protection of Health and Environment

Alternative S-1 would not be protective of human health and the environment because it would allow unacceptable human health risks from exposure to contaminated soil to continue under the current industrial site use as well as the potential for even greater human health risks under a hypothetical future residential site use. In addition, Alternative S-1 would not be protective because it would not prevent the ongoing migration of soil COCs to groundwater. Alternative S-1 would not meet the soil RAOs.

Alternatives S-2, S-3, and S-4 would be protective of human health and the environment and would meet the soil RAOs.

Alternatives S-2 and S-3 would be protective because they would actively prevent unacceptable human health risks from exposure to contaminated soil under the current industrial scenario as well as minimize the migration of soil COCs to groundwater. Alternative S-2 and S-3 would also be protective through the use of LUCs that would prevent hypothetical future residential use of PSC 47. Alternative S-3 would be slightly more protective than Alternative S-2 because it would mostly rely on excavation and off-site disposal to achieve protection, instead of using capping as Alternative S-2.

Alternative S-4 would be most protective of human health and the environment because it would use excavation and off-site disposal to prevent unacceptable human health risks from exposure to

contaminated soil under both current and hypothetical future site uses. Alternative S-4 would also actively prevent the migration of soil COCs to groundwater.

12.1.2 Compliance with ARARs

Alternative S-1 would not comply with chemical- and location-specific ARARs. Chemical-specific ARARs might eventually be met through natural attenuation, but this would not be verified. No action-specific ARARs apply to this alternative.

Alternatives S-2 and S-3 would not comply with chemical-specific ARARs in the short-term. Chemical-specific ARARs might eventually be met through natural attenuation, and this would be verified by monitoring. Alternatives S-2 and S-3 would comply with location- and action-specific ARARs and fully take into consideration, as appropriate, all TBCs.

Alternative S-4 would comply with chemical-, location-, and action-specific ARARs and fully take into consideration, as appropriate, all TBCs.

12.1.3 Long-term Effectiveness and Permanence

Alternative S-1 would not be long-term effective and permanent because it would involve no action.

Alternatives S-2, S-3, and S-4 would be long-term effective and permanent.

The capping, LUCs, and monitoring of Alternatives S-2 would constitute effective means of preventing unacceptable human health risk of exposure under the current industrial scenario, of preventing future hypothetical residential site use, and of minimizing migration of soil COCs to groundwater and detecting it if it occurs. Alternative S-3 would be slightly more effective and permanent than Alternative S-2 because it would replace most of the capping with excavation and off-site disposal, which is the most effective and permanent mean of removing contaminated soil from the site. Both S-2 and S-3 would also reduce the mobility of COCs from soils to groundwater thereby increasing the effectiveness of groundwater alternatives.

Alternative S-4 would be most effective and permanent because it would permanently remove from the site any soil that could constitute an unacceptable human health risk under either current or hypothetical future site uses or that could contribute to the leaching of soil COCs to groundwater.

12.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative S-1 would not reduce toxicity, mobility, or volume of the soil COCs through treatment because no treatment would occur. The toxicity and volume of the soil COCs might eventually be reduced through natural attenuation, but this would not be verified through monitoring.

Alternative S-2 would reduce the toxicity, mobility, and volume of the soil COCs, but not through treatment. The mobility of soil COCs would be reduced through capping and, as a result of cap construction, approximately 5,150 yd^3 of the most highly contaminated soil would be permanently and irreversibly removed from PSC 47 and disposed in an off-site RCRA Subtitle D solid waste landfill. In addition, the toxicity and volume of the remaining soil COCs might eventually be reduced through natural attenuation as verified through monitoring.

Alternative S-3 would reduce toxicity, mobility, and volume of the soil COCs, but not through treatment. Approximately 8,650 yd^3 of the most highly contaminated soil would be permanently and irreversibly removed from PSC 47 and disposed in an off-site RCRA Subtitle D solid waste landfill. In addition, the mobility of the soil COCs most likely to leach to groundwater would be reduced through capping. The toxicity and volume of the residual soil COCs might also be eventually reduced through natural attenuation.

Alternative S-4 would reduce toxicity, mobility, and volume of the soil COCs, but not through treatment. Approximately 14,250 yd^3 of contaminated soil would be permanently and irreversibly removed from PSC 47 and disposed in an off-site RCRA Subtitle D solid waste landfill.

12.1.5 Short-term Effectiveness

Because no action would occur, implementation of Alternative S-1 would not result in any short-term risks to on-site workers or adversely impact the local community and the environment.

Implementation of Alternatives S-2, S-3, and S-4 could result in short-term risks to on-site workers as a result of exposure to contamination. The potential for exposure would be moderate with Alternatives S-2 and S-3 and significant with Alternative S-4 because of the higher level of activities. However, these risks would be adequately mitigated for all alternatives by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures.

Alternatives S-2, S-3, and S-4 could also have an adverse impact on the surrounding community and the environment as a result of on-site activities and off-site transportation of contaminated soil. The potential for adverse impact would be minimal for Alternatives S-2 and S-3 and greater for Alternative S-4 because

of the greater level of activities and the larger volume of contaminated soil. However, this impact would also be adequately mitigated for all alternatives by the implementation of engineering controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative S-1 would not achieve the soil RAOs or meet the soil PRGs. Alternatives S-2 and S-3 could be completed in approximately five months and would achieve the soil RAOs at completion. In addition, Alternatives S-3 and S-2 might eventually meet the soil PRGs as a result of natural attenuation and this would be determined through monitoring. Alternative S-4 could be completed in approximately six months and would achieve the soil RAOs and meet the PRGs at completion.

12.1.6 Implementability

Alternative S-1 would be very easy to implement because there would be nothing to implement. The implementability of administrative measures is not applicable because no such measures would be taken.

Alternatives S-2, S-3, and S-4 would be easy to implement and resources, equipment, and materials would be readily available for this purpose. The technical complexity of all three alternatives would be similar because while Alternative S-4 would involve a significantly higher level of short-term activities, it would not include the long-term monitoring component of Alternatives S-2 and S-3.

The administrative aspects of Alternatives S-2, S-3, and S-4 would be simple to implement. The administrative implementability of Alternatives S-2 and S-3 would be slightly more complex than that of Alternative S-4 because in addition to the securing of a construction permit and the documentation of the off-site disposal of excavated soil, these two alternatives would require the preparation of a LUC RD and the long-term enforcement of LUCs.

12.1.7 Cost

The capital and O&M costs and NPW of the soil 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 M.

Alternative	Capital ($)	NPW of O&M ($)	NPW ($)
S-1	0	0	0
S-2	1,708,000	393,000 (30 Years)	2,101,000 (30 Years)
S-3	2,598,000	274,000 (30 Years)	2,872,000 (30 Years)
S-4	3,514,000	0 (1 Year)	3,514,000 (1 Year)

12.2 PREFERRED SOIL REMEDIAL ALTERNATIVES

Table 12-1 summarizes the above comparative analysis of soil remedial alternatives. Based on this comparison, Alternative S-3 was selected as the preferred soil alternative because it would be most cost effective to provide adequate protection under current site use while providing protection via the reduction and or elimination of COC migration from soils to groundwater at the site.

12.3 COMPARISON OF GROUNDWATER REMEDIAL ALTERNATIVES BY CRITERIA

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

Alternative GW-1: No Action

Alternative GW-2: Monitored Natural Attenuation and LUCs

Alternative GW-3A: Northern Plume In-Situ Treatment (Enhanced Bioremediation), Monitored Natural Attenuation and LUCs

Alternative GW-3B: Southern Plume In-Situ Treatment (Chemical Oxidation & Precipitation), Monitored Natural Attenuation and LUCs

12.3.1 Overall Protection of Human Health and the Environment

Alternative GW-1 would not be protective of human health and the environment. There would be no LUCs to prevent usage or exposure to contaminated groundwater nor would Alternative GW-1 detect the potential migration of groundwater COCs to surface water. Alternative GW-1 would not meet the groundwater RAOs.

Alternatives GW-2, GW-3A, and GW-3B would be protective of human health and the environment and would meet the groundwater RAOs. The LUCs component of these alternatives would be protective because they would prevent access to and use of the surficial aquifer groundwater. The monitoring component of these alternatives would be protective because it would evaluate the progress of remediation and detect potential migration of groundwater COCs to surface water so that appropriate contingency measures could be taken.

Table 12-1
Summary Comparative Analysis of Soil Remedial Alternatives

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Evaluation Criteria	Alternative S-1: No Action	Alternative S-2: Capping to Allow Industrial Use and Prevent Leachability, LUCs, & Monitoring	Alternative S-3: Excavation & Off-Site Disposal to Allow Industrial Use, Capping to Prevent Leachability, LUCs, & Monitoring	Alternative S-4: Excavation & Off-Site Disposal to Allow Residential Use and Prevent Leachability
Overall Protection of Human Health and Environment	Not protective	Protective	As protective as Alternative S-2	Most protective
Compliance with ARARs and TBCs				
Chemical-Specific	Would not comply	Would eventually comply	Would eventually comply	Would comply
Location-Specific	Would not comply	Would comply	Would comply	Would comply
Action-Specific	Not applicable	Would comply	Would comply	Would comply
Long-Term Effectiveness and Permanence	Not effective	Effective	As effective as Alternative S-2	Most effective
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None	No treatment. Mobility reduced by capping and 5,150 yd^3 contaminated soil permanently removed from site and landfilled. Toxicity and volume of remaining COCs might be reduced through natural attenuation as verified by monitoring.	No treatment. 8,650 yd^3 contaminated soil permanently removed from site and landfilled. Toxicity and volume of remaining COCs might be reduced through natural attenuation as verified by monitoring.	No treatment. 14,250 yd^3 contaminated soil permanently removed from site and landfilled.
Short-Term Effectiveness	No short-term risks. Does not attain RAOs.	Moderate potential for short-term risks. Would require approximately six months to attain RAOs.	Moderate potential for short-term risks. Would require approximately five months to attain RAOs.	Significant potential for short-term risks. Would require approximately six months to attain RAOs and PRGs.
Implementability	Nothing to implement	Easy to implement. Implementability similar to Alternatives S-3 and S-4.	Easy to implement. Implementability similar to Alternatives S-2 and S-4.	Easy to implement. Implementability similar to Alternatives S-2 and S-3.

Table 12-1
Summary Comparative Analysis of Soil Remedial Alternatives

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Evaluation Criteria	Alternative S-1: No Action	Alternative S-2: Capping to Allow Industrial Use and Prevent Leachability, LUCs, & Monitoring	Alternative S-3: Excavation & Off-Site Disposal to Allow Industrial Use, Capping to Prevent Leachability, LUCs, & Monitoring	Alternative S-4: Excavation & Off-Site Disposal to Allow Residential Use and Prevent Leachability
Costs:				
Capital	$0	$1,708,000	$2,598,000	$3,514,000
NPW of O&M	$0	$393,000	$274,000	$0
NPW	$0	$2,101,000	$2,872,000	$3,514,000

NOTES:

yd^3	Cubic Yards
ARARs	Applicable or Relevant and Appropriate Requirements
COCs	Chemicals of concern
LUCs	Land use controls
NPW	Net present worth
O&M	Operation and maintenance
PRGs	Preliminary Remedial Goals
RAOs	Remedial Action Objectives
TBCs	To be considered (criteria)

12.3.2 Compliance with ARARs

Alternative GW-1 would not comply with chemical- and location-specific ARARs. Action-specific ARARs would not apply.

Alternatives GW-2, GW-3A, and GW-3B, and GW-4 would eventually comply with chemical-specific ARARs through natural attenuation or a combination of active remediation and natural attenuation. Alternatives GW-2, GW-3A, and GW-3B would also comply with location- and action-specific ARARs and fully take into consideration, as appropriate, all TBCs.

12.3.3 Long-Term Effectiveness and Permanence

Alternative GW-1 would not be long-term effective and permanent because it would not involve any action and it would leave PSC 47 open to unrestricted use, which would result in unacceptable human health risks. In addition, because there would be no monitoring, the progress of natural attenuation would remain unknown and potential migration of groundwater COCs to surface water would not be detected.

Alternatives GW-2, GW-3A, and GW-3B would be long-term effective and permanent. The LUCs component of these alternatives would effectively restrict access to and use of the surficial aquifer groundwater until the groundwater PRGs have been met. The monitoring component of these alternatives would provide an effective means of evaluating the progress of remediation and detecting the potential migration of groundwater COCs to surface water.

Alternative GW-3A would be slightly more effective than Alternative GW-2 because in-situ enhanced bioremediation would very likely accelerate the natural attenuation of the Northern Plume. However, since COC concentration are relatively low and in general fall below natural attenuation default criteria for the northern plume, active treatment may not be warranted. Alternative GW-3B would be approximately as effective as Alternative GW-3A because, although it might significantly accelerate the natural attenuation of the Southern Plume Arsenic Hot Spot that is a greater environmental threat than he Northern Plume, the effectiveness of in-situ chemical oxidation and precipitation is not as well demonstrated or permanent as that of in-situ enhanced bioremediation.

12.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative GW-1 would not reduce toxicity, mobility, or volume of groundwater COCs through treatment because no treatment would occur. The toxicity and volume of the groundwater COCs would be reduced through natural attenuation, but this would not be verified through monitoring.

Alternative GW-2 would reduce the toxicity, mobility, and volume of groundwater COCs, but not through treatment. The toxicity, mobility, and volume of groundwater COCs would be reduced through natural attenuation and this reduction would be quantified by monitoring. This process would only be enhanced by the soil remedial approaches S-2, S-3, or S-4 which would serve to reduce the transfer of COCs from soils to groundwater.

Alternative GW-3A would reduce the toxicity, mobility, and volume of the Northern Plume COCs through treatment. An estimated 2.7 pounds of VOCs, SVOCs, and pesticides would be permanently and irreversibly removed through in-situ enhanced bioremediation. Additional reduction in the toxicity, mobility, and volume of groundwater COCs would be achieved through natural attenuation and this reduction would be quantified by monitoring. However, the relatively low levels of COCs in the northern plume suggest that active treatment is not necessary.

Alternative GW-3B would reduce the toxicity and volume of the arsenic in the Southern Plume Arsenic Hot Spot through treatment. An estimated 27 pounds of arsenic would be removed from the groundwater and immobilized in the surrounding soil matrix through in-situ chemical oxidation and precipitation. However, it should be noted that this removal and immobilization might not be fully permanent and irreversible. Additional reduction in the toxicity, mobility, and volume of groundwater COCs would be achieved through natural attenuation and this reduction would be quantified by monitoring

12.3.5 Short-Term Effectiveness

Because no action would occur, implementation of Alternative GW-1 would not pose any short-term risks to on-site workers or result in adverse impact to the local community and the environment.

Implementation of Alternatives GW-2, GW-3A, and GW-3B could result in short-term risks to on-site workers as a result of exposure to contamination. The potential for exposure would be minimal with Alternative GW-2 and moderate with Alternatives GW-3A and GW-3B because of the increasing level of activities. However, these risks would be adequately mitigated for all alternatives by the wearing of appropriate PPE and by compliance with OSHA regulations and with site-specific health and safety procedures.

Alternatives GW-2, GW-3A, and GW-3B would have no adverse impact on the surrounding community and the environment.

Alternative GW-1 would not achieve the groundwater RAOs or meet the groundwater PRGs. Alternatives GW-2 and GW-3A and GW-3B could be implemented within approximately three months and one year, respectively, and would achieve the groundwater RAOs at completion. GW-3A and GW-3B may meet the

groundwater PRGs for the Northern Plume and southern plume within a few years, but the actual time frame necessary for treatment could be longer depending on the ability to deliver the treatments sufficiently across the impacted media. Alternatives GW-2, GW-3A, and GW-3B would eventually meet the remaining groundwater PRGs through natural attenuation and this would be determined through monitoring.

12.3.6 Implementability

Alternative GW-1 would be very easy to implement because there would be nothing to implement. The implementability of administrative measures is not applicable because no such measures would be taken.

Alternative GW-2 would be easy to implement. A number of groundwater monitoring events have been implemented at PSC 47 and additional monitoring would be easy to perform.

The technical implementability of Alternatives GW-3A and GW-3B would be more difficult than that of Alternative GW-2. In-situ treatment services are available from a number of qualified contractors. Installation of a relatively large number of DPT wells for chemical injection might interfere, at least temporarily, with the normal use of the site. Pilot-scale treatability testing would have to be performed to verify the site-specific effectiveness and the design parameters for the in-situ bioremediation and chemical oxidation and precipitation technologies.

The administrative implementability of Alternatives GW-2 would be easy because these alternatives would only require the preparation of a LUC RD and the enforcement of LUCs. Implementation of alternatives GW-3A and GW-3B would be more difficult and would take longer since treatability studies would likely be necessary to complete a remedial design.

12.3.7 Cost

The capital and O&M costs and NPW of the groundwater alternatives are as follows.

Alternative	Capital ($)	NPW of O&M ($)	NPW ($)
GW-1	0	0	0
GW-2	16,000	754,000 (30 Years)	770,000 (30 Years)
GW-3A	1,219,000	813,000 (30 Years)	2,032,000 (30 Years)
GW-3B	691,000	790,000 (30 Years)	1,481,000 (30 Years)

Detailed cost estimates are provided in Appendix M.

12.4 PREFERRED GROUNDWATER REMEDIAL ALTERNATIVES

Table 12-2 summarizes the above comparative analysis of the groundwater remedial alternatives. Based upon this analysis, Alternative GW-2 was selected as the preferred groundwater alternative. This alternative uses natural attenuation for the remediation of those COCs that are the most prevalent and the most likely to respond to this technology, i.e., the VOCs, SVOCs. In addition, the less transient COCs are not likely to migrate significant distances and may also be reduced in concentrations over time via control/removal of overlying impacted soils. Data collected to date suggests that natural attenuation is occurring at this site and maybe adequate to achieve the site RAOs. It is also anticipated that implementation of soil remedial alternatives will further reduce the potential for migration of COCs from soils to groundwater further enhancing the implementation of GW-2 ; however, additional monitoring data will be necessary to verify the protectiveness of Alternative GW-2 As a result, the preferred remedy would also include a contingency for selection of Alternative GW-3B for treatment of the southern plume should monitoring data indicate a more active treatment be necessary.

Table 12-2
Summary Comparative Analysis of Groundwater Remedial Alternatives

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Evaluation Criteria	Alternative GW-1: No Action	Alternative GW-2: Monitored Natural Attenuation & LUCs	Alternative GW-3A: Northern Plume In-Situ Treatment (Enhanced Bioremediation), Monitored Natural Attenuation, & LUCs	Alternative GW-3B: Southern Plume In-Situ Treatment (Chemical Oxidation & Precipitation), Monitored Natural Attenuation, & LUCs
Overall Protection of Human Health and Environment	Not protective.	Protective.	Slightly more protective than Alternative GW-2.	Slightly more protective than Alternative GW-3A.
Compliance with ARARs and TBCs				
Chemical-Specific	Would not comply	Would eventually comply	Would eventually comply	Would eventually comply
Location-Specific	Would not comply	Would comply	Would comply	Would comply
Action-Specific	Not applicable	Would comply	Would comply	Would comply
Long-Term Effectiveness and Permanence	Not effective	Effective	Slightly more effective than Alternative GW-2.	As effective as Alternative GW-3A.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None	Toxicity, mobility, and volume reduced through natural attenuation.	2.8 pounds of VOCs, SVOCs, and pesticides removed through in-situ enhanced bioremediation. Additional toxicity, mobility, and volume reduced through natural attenuation.	27 pounds of arsenic removed through in-situ chemical oxidation and precipitation. Additional toxicity, mobility, and volume reduced through natural attenuation.
Short-Term Effectiveness	No short-term risks	Minimum potential for short-term risks. 3 months to attain RAOs.	Moderate potential for short-term risks. One year to attain RAOs.	Moderate potential for short-term risks. One year to attain RAOs.
Implementability	Nothing to implement	Implementable and easiest to implement.	Somewhat more difficult to implement than Alternative GW-2	As difficult to implement as Alternative GW-3A.

Table 12-2
Summary Comparative Analysis of Groundwater Remedial Alternatives

Remedial Investigation/Feasibility Study
Potential Source of Contamination 47
Naval Air Station Jacksonville
Jacksonville, Florida

Evaluation Criteria	Alternative GW-1: No Action	Alternative GW-2: Monitored Natural Attenuation & LUCs	Alternative GW-3A: Northern Plume In-Situ Treatment (Enhanced Bioremediation), Monitored Natural Attenuation, & LUCs	Alternative GW-3B: Southern Plume In-Situ Treatment (Chemical Oxidation & Precipitation), Monitored Natural Attenuation, & LUCs
Costs:				
Capital	$0	$16,000	$1,219,000	$691,000
NPW of O&M	$0	$754,000 (30 yr)	$813,000 (30 yr)	$790,000 (30 yr)
NPW	$0	$770,000 (30 yr)	$2,032,000 (30 yr)	$1.48,000 (30 yr)

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
SVOCs Semivolatile organic compounds
TBCs To be considered (criteria)
VOCs Volatile organic compounds

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