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REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORK PLAN FOR OPERABLE UNIT 3 (OU 3) WITH TRANSMITTAL LETTER NTC ORLANDO FL

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# REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN

## OPERABLE UNIT 3
## STUDY AREAS 8 AND 9

## NAVAL TRAINING CENTER
## ORLANDO, FLORIDA

**UNIT IDENTIFICATION CODE: N65928**
**CONTRACT NO.: N62467-89-D-0317/136**

**OCTOBER 1997**

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

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## ORLANDO, FLORIDA

Unit Identification Code: N65928

Contract No.: N62467-89-D-0317/136

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October 1997

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND

This document that describes the Remedial Investigation and Feasibility Study for Operable Unit 3, Naval Training Center, Orlando, Florida, has been prepared under the direction of a Florida-Registered Professional Geologist. The work and professional opinions rendered in this report were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice.

Manuel Alonso, P.G.
Professional Geologist No.: 0001256
Expires: 7/31/98

Date: 11/3/97

CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/136 are complete and accurate and comply with all requirements of this contract.

DATE: October 29, 1997

NAME AND TITLE OF CERTIFYING OFFICIAL: Shannon B. Gleason, P.E.
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Jennifer M.C. Healey
Project Technical Lead

(DFAR 252.227-7036)

# FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and 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 (DOD) initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

One of these programs is the Base Realignment and Closure (BRAC) Cleanup Plan (BCP). This program complies with the Base Closure and Realignment Act of 1988 (Public Law 100-526, 102 Statute 2623) and the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510, 104 Statute 1808), which require the DOD to observe pertinent environmental legal provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Order 12580, and the statutory provisions of the Defense Environmental Restoration Program (DERP), the National Environmental Policy Act (NEPA), and any other applicable statutes that protect natural and cultural resources.

CERCLA requirements, in conjunction with corrective action requirements under Subtitle C of the Resource Conservation and Recovery Act (RCRA), govern most environmental restoration activities. Requirements under Subtitles C, I, and D of RCRA, as well as the Toxic Substances Control Act, the Clean Water Act, the Clean Air Act, the Safe Drinking Water Act, and other statutes, govern most environmental mission-related, operational-related, and closure-related compliance activities. These compliance laws may also be applicable or relevant and appropriate requirements for selecting and implementing remedial actions under CERCLA. NEPA requirements govern the Environmental Impact Analysis and Environmental Impact Statement preparation for the disposal and reuse of BRAC installations.

The BCP process centers on a single goal: expediting and improving environmental response actions to facilitate the disposal and reuse of a BRAC installation, while protecting human health and the environmental.

The Southern Division, Naval Facilities Command (SOUTHNAVFACENGCOM), the U.S. Environmental Protection Agency, and the Florida Department of Environmental Protection collectively coordinate the cleanup activities through the BRAC Cleanup team. This team approach is intended to foster partnering, accelerate the environmental cleanup process, and expedite timely, cost-effective, and environmentally responsible disposal and reuse decisions.

Questions regarding the BCP process at Naval Training Center (NTC), Orlando should be addressed to the SOUTHNAVFACENGCOM BRAC Environmental Coordinator for NTC, Orlando, Mr. Wayne Hansel at (407)646-5294 or the Southern Division Engineer-in-Charge, Barbara Nwokike at (803) 820-5566.

## EXECUTIVE SUMMARY

This Remedial Investigation and Feasibility Study Workplan has been developed by ABB Environmental Services, Inc. (ABB-ES), to enable proper conduct of work at Operable Unit 3, Study Areas 8 and 9, at Naval Training Center (NTC) in Orlando. The workplan has incorporated elements of the Project Operations Plan (ABB-ES, 1997), which contains the requirements of a Quality Assurance Project Plan, Health and Safety Plan, and elements of a Field Sampling Plan (FSP) related to sampling equipment, procedures, and sample handling and analysis. Other FSP elements specific to this site, including sampling objectives and sample location and frequency, will be addressed in this workplan. This workplan is intended to be a dynamic document permitting flexibility during the conduct of this investigation at NTC, Orlando.

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## GLOSSARY

| | |
|---|---|
| ABB-ES | ABB Environmental Services, Inc. |
| AOC | area of concern |
| ARAR | applicable or relevant and appropriate requirement |
| AST | aboveground storage tank |
| bls | below land surface |
| BRAC | Base Realignment and Closure (Act) |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CLP | Contract Laboratory Program |
| COC | contaminants of concern |
| CPC | chemical of potential concern |
| CT | central tendency |
| DDD | dichlorodiphenyldichloroethane |
| DDE | dichlorodiphenyldichloroethene |
| DDT | dichlorodiphenyltrichloroethane |
| DOD | Department of Defense |
| EBS | environmental baseline survey |
| EPC | exposure point concentration |
| ERA | ecological risk assessment |
| FDEP | Florida Department of Environmental Protection |
| FSA | Field Staging Area |
| FR | *Federal Register* |
| FRED | Fast Retrieval Environmental Data |
| gpd/ft | gallons per day per foot |
| HEAST | Health Effects Assessment Summary Tables |
| HHRA | human health risk assessment |
| HI | hazard index |
| HQ | hazard quotient |
| IAS | initial assessment study |
| IDW | investigation-derived waste |
| IR | installation restoration |
| IRA | interim remedial action |
| IRIS | Integrated Risk Information System |
| J | estimated value |
| LDR | land disposal restriction |
| MCL | maximum contaminant level |
| $\mu g/\ell$ | micrograms per liter |
| $\mu g/kg$ | micrograms per kilogram |
| mg/kg | milligrams per kilogram |

# GLOSSARY (Continued)

| | |
|---|---|
| NACIP | Navy Assessment and Control of Installation Pollutants |
| NTC | Naval Training Center |
| OAFB | Orlando Air Force Base |
| OPT | Orlando Partnering Team |
| OU | operable unit |
| PAH | polynuclear aromatic hydrocarbons |
| PARCC | precision, accuracy, representativeness, completeness, and comparability |
| PCB | polychlorinated biphenyl |
| PDE | potential dietary exposure |
| PPE | personal protective equipment |
| POP | Project Operations Plan |
| POTW | publicly owned treatment works |
| QA/QC | quality assurance and quality control |
| RAGs | Risk Assessment Guidance for Superfund |
| RAO | remedial action objective |
| RBC | risk-based concentrations |
| RCRA | Resource Conservation and Recovery Act |
| RI/FS | remedial investigation and feasibility study |
| RME | reasonable maximum exposure |
| ROD | Record of Decision |
| RTV | reference toxicity value |
| SA | Study Area |
| SCG | soil cleanup goal |
| SDWA | Safe Drinking Water Act |
| SOUTHNAV-FACENGCOM | Southern Division, Naval Facilities Engineering Command |
| SQL | sample quantitation limit |
| SVOC | semivolatile organic compound |
| TAL | target analyte list |
| TBC | to be considered |
| TCL | target compound list |
| TCLP | toxicity characteristic leaching procedure |
| TOC | total organic carbon |
| UCL | upper confidence limit |
| USAF | U.S. Air Force |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| VOC | volatile organic compound |
| WWTP | wastewater treatment plant |

# 1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB-ES), under contract to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), has prepared this Remedial Investigation and Feasibility Study (RI/FS) Workplan for Operable Unit (OU) 3, which consists of Study Area (SA) 8 (Greenskeeper's Storage Area) and SA 9 (Former Pesticide Handling and Storage Area) at Naval Training Center (NTC) in Orlando, Florida. The RI/FS is being conducted under Contract Number N62467-89-D-0317-136.

The approach to the RI/FS at OU 3 was developed in conjunction with the Orlando Partnering Team (OPT), which includes representatives from the Florida Department of Environmental Protection (FDEP), the U.S. Environmental Protection Agency (USEPA) Region IV, SOUTHNAVFACENGCOM and their consultants, and the NTC, Orlando Public Works Department.

The following sections describe the regulatory and facility background for NTC, Orlando.

**1.1 REGULATORY BACKGROUND**. To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and 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 (DOD) initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities. Two of these programs are the Installation Restoration (IR) program and the Base Realignment and Closure (BRAC) program.

The IR program complies with the Base Closure and Realignment Act of 1988 (Public Law 100-526,102 Statute 2623) and the Defense Base Closure and Realignment Act of 1990 (Public Law 101-510,104 Statute (1808), which require the DOD to observe pertinent environmental legal provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Executive Order 12580, and the statutory provisions of the Defense Environmental Restoration Program, the National Environmental Policy Act, and any other applicable statutes that protect natural and cultural resources.

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

The goal of the BRAC program is to expedite and improve environmental response actions to facilitate the disposal and reuse of a BRAC installation while protecting human health and the environment.

**1.2 FACILITY BACKGROUND**. NTC, Orlando encompasses 2,072 acres in Orange County, Florida, and consists of four discrete facilities: Main Base, Area C, Herndon Annex, and McCoy Annex (Figures 1-1 and 1-2). OU 3 is located on the Main Base.


**FIGURE 1-1**
**VICINITY MAP**

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**RI/FS WORKPLAN, OPERABLE UNIT 3, STUDY AREAS 8 AND 9**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

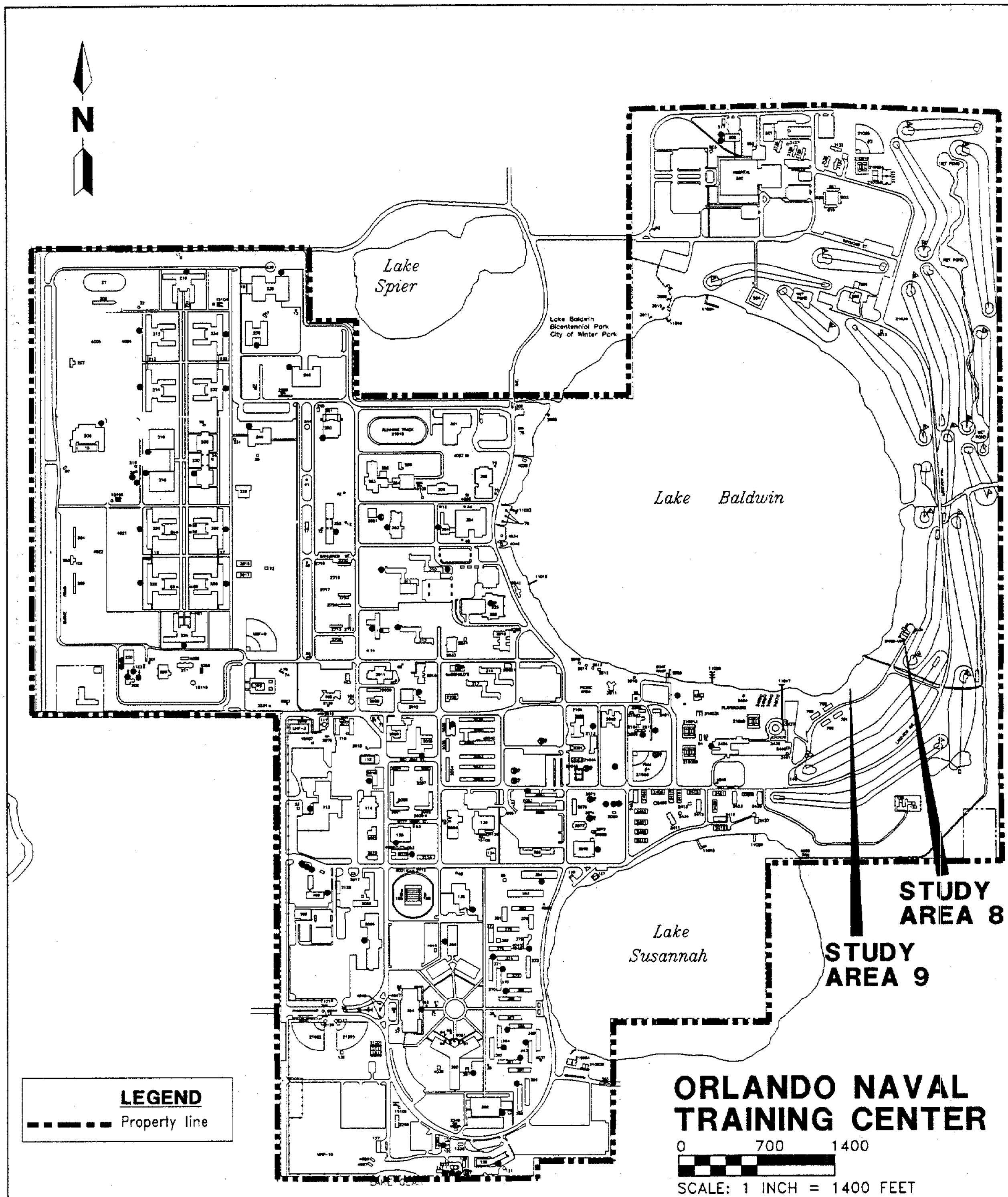


**FIGURE 1-2**
**MAIN BASE**
**SITE LOCATION MAP**

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**RI/FS WORKPLAN, OPERABLE UNIT 3, STUDY AREAS 8 AND 9**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

The Main Base occupies 1,095 acres and is located approximately 3 miles east of Interstate 4 and north of State Road 50. The Main Base is surrounded by urban development, including single and multifamily housing, schools, and commercial buildings. Land uses directly west and northeast of the area are primarily residential. Small areas of commercial development occur to the southwest. No industrial facilities exist adjacent to the Main Base, with the exception of automotive repair facilities along Bennett Road on the southwest property line.

The history of NTC, Orlando dates to the construction of the original Orlando Municipal Airport prior to 1940. In August 1940, the municipal airport was taken over by the U.S. Army Air Corps. Shortly thereafter, the construction program for Orlando Air Base began, culminating in its official opening on December 1, 1940. During the following 2 years, the Army Air Corps acquired additional property, and auxiliary landing fields were built in the surrounding area.

In 1947, the U.S. Air Force (USAF) assumed command of the facilities as the Orlando Air Force Base (OAFB). The base was deactivated on October 28, 1949, and remained on standby status until January 1, 1951, when it was reactivated as an Aviation Engineers' training site. During this period, the airfield and other excess property needs were scheduled for disposition under the War Surplus Act. The airport facilities and adjoining tracts were transferred to the City of Orlando. The USAF remained in control of the Main Base, Area C and Herndon Annex.

In 1968, the USAF ceased operations at OAFB, and the Navy acquired the properties now referred to as Main Base, Area C and Herndon Annex. These properties were commissioned as the NTC on July 1, 1968 (ABB-ES, 1997).

The stated mission of NTC, Orlando is to exercise command over and coordinate the efforts of the assigned subordinate activities in recruit training of enlisted personnel; to provide initial skill, advanced, and/or specialized training for officer and enlisted personnel of the regular Navy and Naval Reserve; and to support other activities as directed by a higher authority (ABB-ES, 1994a). The Main Base is composed primarily of operational and training facilities in support of this mission.

<u>1.3 WORKPLAN SCOPE AND ORGANIZATION</u>. OU 3 was investigated during the Initial Assessment Study (IAS) (C.C. Johnson, 1985), Verification Study (Geraghty & Miller, 1986), and the BRAC environmental baseline survey (EBS) (ABB-ES, 1994c). In addition to the site-specific information contained in these documents, descriptions of IR and BRAC program investigations at NTC, Orlando can be found in the Project Operations Plan (POP) (ABB-ES, 1997), the BRAC cleanup plan (ABB-ES, 1994a), and the background sampling plan (ABB-ES, 1994b).

To facilitate their assessment, the IR program sites at NTC, Orlando have been separated into groups known as OUs. An OU is composed of sites that

- are in close proximity to each other,
- have similar contaminant exposure histories, and/or
- will likely require similar remedial measures.

ABB-ES has prepared this workplan for conducting an RI/FS at OU 3, which consists of SA 8 (Greenskeeper's Storage Area) and SA 9 (Former Pesticide Handling and Storage Building)(Figure 1-2).

Although NTC, Orlando is not listed on the National Priorities List, under BRAC, the RI/FS will be conducted in accordance with the methods described in the USEPA *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988).

The objectives of the investigations are to

- determine the nature and distribution of contaminants at the sites;
- identify potential threats to human health or the environment posed by the potential release of contaminants from the sites; and
- evaluate potential remedial alternatives based on engineering factors, implementability, environmental and public health concerns, and costs.

This workplan presents the technical scope of services necessary to achieve these objectives and the schedule for conducting field activities, preparing reports, and developing and evaluating remedial alternatives. The program has been designed to be as efficient and streamlined as possible to effect a rapid data acquisition and evaluation process during the RI/FS. To this end, investigators begin with the understanding that it will not be possible to <u>completely</u> characterize this site or any other similar site with even a very large number of explorations and chemical analyses. Rather, the approach will be to <u>sufficiently</u> characterize the site with a limited number of explorations and analyses that will permit development and refinement of a conceptual model based on reasonable conclusions drawn from those data. Remedial alternatives will be selected such that planned contingencies may be invoked at any time during the investigation when it becomes apparent that probable conditions have given way to deviations in those assumptions. Thus, a working hypothesis will have been formulated that will evolve and grow along with increased knowledge. In this way, a balance between managed uncertainties and the implementation of remedial alternatives is achieved, resulting in improved efficiencies.

The workplan consists of the following 10 chapters and an appendix:

- Chapter 1.0 provides an introduction to the process and a description of the components of the workplan.
- Chapter 2.0 summarizes the site background and setting and includes a description of the sites and their history, the hydrogeologic setting, and a brief description of previous investigations.
- Chapter 3.0 provides a conceptual site model, a summary of the analytical results from previous investigations, preliminary human health and ecological exposure assessments, a preliminary identification of remedial action technologies, and a general description of the approach to the investigation.

- Chapter 4.0 describes the site characterization methodology, including soil and groundwater investigations.
- Chapter 5.0 describes the laboratory analytical program.
- Chapter 6.0 describes the risk assessment process.
- Chapter 7.0 describes how investigation-derived waste (IDW) generated during the field investigations will be managed.
- Chapter 8.0 describes the RI report.
- Chapter 9.0 describes the FS report.
- Chapter 10.0 contains the project schedule.
- Appendix A contains a synopsis of potential Federal and State applicable or relevant and appropriate requirements (ARARs) that may apply during the OU 3 RI/FS.

This workplan has incorporated elements of the POP (ABB-ES, 1997), which contains the requirements of a Quality Assurance Project Plan, Health and Safety Plan, and elements of a Field Sampling Plan related to sampling equipment, procedures, and sample handling and analysis. Other Field Sampling Plan elements specific to this site, including sampling objectives and sample location and frequency, will be addressed in this workplan.

## 2.0 PHYSICAL CONDITIONS AND SITE BACKGROUND

OU 3 consists of two sites: SA 8 and SA 9. These sites were combined into one OU because they are only 800 feet apart and both have histories of pesticide and herbicide use and storage.

The following subsections describe the site background and physical settings for SA 8 and SA 9.

**2.1 GENERAL LAND USE**. The Main Base occupies approximately 1,095 acres within the Orlando city limits and consists mainly of operational and training facilities. The area west, north, and east of NTC, Orlando is composed primarily of single family residential homes. The Herndon Municipal Airport is located to the south. Glenridge Elementary School is located north of the installation property.

The operational and training facilities on the Main Base are used for training new and recently graduated recruits, as well as enlisted and officer personnel in the nuclear power engineering program. Land use at the Main Base is dominated by barracks, training facilities, administrative buildings, drill fields, and recreational areas. There are two lakes within the Main Base property (Baldwin and Susannah), and four lakes (Spier, Howard, Shannon, and Gear) are located in the residential areas adjacent to the facility.

**2.2 REGIONAL GEOLOGY AND HYDROLOGY**. The Main Base property is located within the City of Orlando in Orange County, Florida. The county is underlain mostly by marine limestone, dolomite, shale, sand, and anhydride to a depth of approximately 6,500 feet below land surface (bls), at which depth granite and other crystalline rock of the basement complex are found. From the surface, in descending order, Recent and Pleistocene undifferentiated sediments occur. These undifferentiated sediments consist of quartz sand with varying amounts of silt, clay, and shells. Near the surface, hardpan layers and peat layers may occur. The undifferentiated sediments are approximately 40 to 75 feet thick in the Orlando area. The Caloosahachee Marl, which is thought to be Pliocene in age, may be found at the base of the undifferentiated sediments.

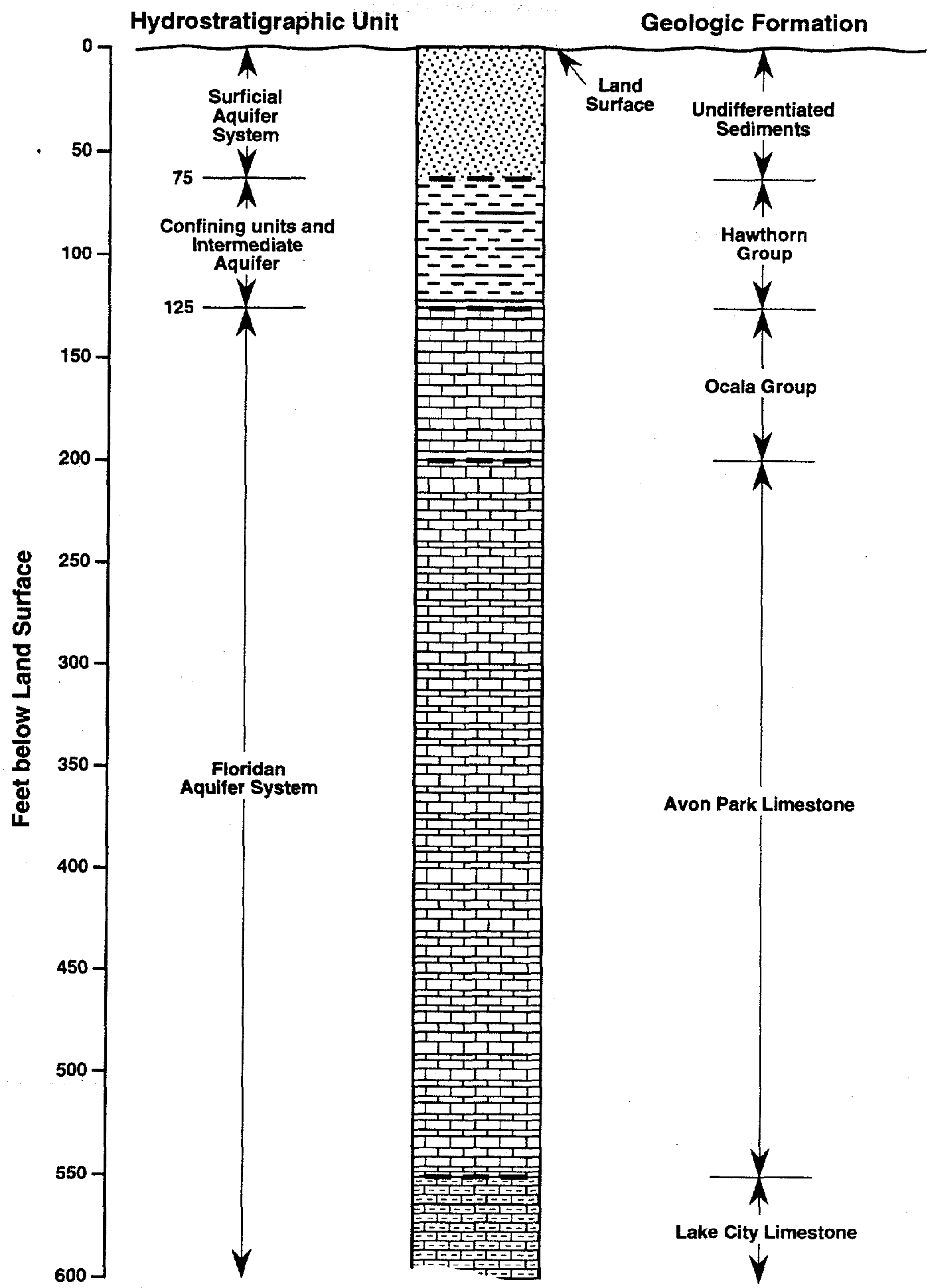
Below the undifferentiated sediments lies the Hawthorn Group of Miocene Age. In Orange County, the Hawthorn Group consists of the Peace River Formation and the underlying Arcadia Formation (Scott, 1978). The Peace River Formation consists of interbedded quartz sand, clay, and carbonates. The Arcadia Formation consists predominantly of limestone and dolostone containing varying amounts of quartz sand, clay, and phosphate grains. The Hawthorn Group is estimated to be from 40 to 80 feet in thickness in the Orlando Area and lies unconformably on top of the Ocala Group. The Hawthorn Group acts as the confining unit for the Floridan aquifer. The Ocala Group is composed of the Crystal River, the Williston, and the Inglis Formations. The formations of the Ocala Group consist mostly of cream to tan, fine, soft to medium-hard, granular, porous, sometimes dolomitic limestone. The Ocala Group is considered upper Eocene in age and in the Orlando area is approximately 150 feet thick. Underlying the Ocala Group is the middle Eocene Age Avon Park Limestone. The upper section of the Avon Park consists mostly of cream to tan, granular limestone, and is distinguished from the overlying formation by the occurrence of abundant cone-shaped foraminifera. The lower section of the Avon Park consists mostly of hard, dense crystalline layers of limestone. Underlying the Avon Park Limestone is the Lake City Limestone.

The Lake City Limestone is a dark brown crystalline dolomite. The dolomite of both the Avon Park Limestone and Lake City Limestone is usually extremely dense and fractured. The fractures and solution cavities act as a major water reservoir (Lichtler et al., 1968). Underlying the Lake City Limestone is the Oldsmar Formation of lower Eocene Age. The Oldsmar Formation consists of two units: upper Oldsmar and lower Oldsmar. The upper Oldsmar consists of chalky limestone and dolomite. The lower Oldsmar consists of dolomite, which is extremely hard, crystalline, dense, cavernous, and fractured. Underlying the Oldsmar Formation is the Ceder Key Formation of Paleocene Age. This unit consists of dolomite and gypsum/anhydride units. Below the Cedar Key Formation are upper Cretaceous and lower Cretaceous limestone units, below which lies the crystalline bedrock of Paleozoic Age.

The regional hydrogeology of Orange County is divided into two major aquifer systems, which are separated by a secondary artesian aquifer within a confining unit. The surficial, or water table, aquifer and the Floridan aquifer are separated by the lithologic unit known as the Hawthorn Group (described above), which acts as an upper confining unit to the Floridan aquifer system. Groundwater in the surficial aquifer and the Floridan aquifer system at NTC, Orlando is classified as Class G-II groundwater suitable for potable use. Figure 2-1 illustrates the stratigraphic units underlying NTC, Orlando.

Surficial Aquifer System. The Recent to Pleistocene undifferentiated deposits that contain the surficial aquifer extend to a depth of approximately 70 feet bls in the vicinity of the Orlando area (Scott, 1978). The surficial aquifer exists under unconfined or water table conditions in the SA. Recharge to the aquifer comes predominantly from rainfall in the area and seepage from streams, lakes, and septic systems. The surficial aquifer in Orange County varies widely in both quality and quantity of water produced. Generally, the surficial aquifer produces low quantities of water used mainly for irrigation and livestock watering. Water quality varies considerably from area to area due to contamination in some areas from fertilizers, pesticides, septic tank systems, and other surface contamination.

Secondary Artesian Aquifer. The Miocene marine deposits of the Hawthorn Group contain the secondary artesian aquifer and generally occur at depths ranging from 60 feet to more than 150 feet bls at NTC, Orlando. The Hawthorn Group is composed of gray-green, clayey, quartz sand and silt with some phosphatic sand, limestone, and shell beds. The secondary artesian aquifer is contained within the discontinuous shell beds, thin limestone lenses, and permeable sand and gravel zones of the Hawthorn Group. These zones can produce enough water for domestic use and have produced as much as 1,000 gallons per minute, but are not the major water source in the area (Lichtler et al., 1968). Clay layers within the Hawthorn Group form confining units between the surficial aquifer system, the secondary artesian aquifer, and the deeper Floridan aquifer system. Recharge to the secondary artesian aquifer is produced by leakage from the overlying surficial and underlying Floridan aquifers. Discharge from the aquifer is from leakage and well pumpage. The water quality of the aquifer varies, but is generally potable. Information on the direction of groundwater flow in the secondary artesian aquifer is not available.




Source: ABB-ES, 1994a

FIGURE 2-1

GENERALIZED GEOLOGIC CROSS SECTION, NTC ORLANDO

RI/FS WORKPLAN, OPERABLE UNIT 3, STUDY AREAS 8 AND 9

NAVAL TRAINING CENTER ORLANDO, FLORIDA

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Floridan Aquifer System. The Floridan aquifer system, underlying the lower confining units of the Hawthorn Group, consists of limestone from the upper Eocene Ocala Group Limestone, Avon Park Limestone, and Lake City Limestone of middle Eocene Age. The Floridan aquifer system is estimated to be approximately 2,000 feet thick in the Orlando area (Lichtler et al., 1968).

The Floridan aquifer system is the major source of potable water in Orange County and has two primary water producing zones. The lithology of the upper zone is formed by a cream to tan, sometimes dolomitic limestone of the Ocala Group and Avon Park Limestone. The upper producing zone of the Floridan aquifer system ranges from 150 to 600 feet bls and has estimated transmissivity values ranging between 270,000 and 596,000 gallons per day per foot (gpd/ft). The lower producing zone consists of dark brown, dense, hard, crystallized dolomite of the Lake City Limestone. This zone ranges from 1,000 to 1,500 feet bls and has estimated transmissivity values ranging between 4,300,000 and 5,000,000 gpd/ft (Boyle Engineering Corporation, 1982). Separating the two zones is a 300-to 400-foot series of relatively impermeable layers composed of soft limestone and dolomitic limestone.

Groundwater flow in the Floridan aquifer system is generally to the east discharging toward the Atlantic Ocean (Healy, 1982). Recharge to the Floridan aquifer system is derived mainly from rainfall in the northwest part of Orange County and underground flow from other counties, sinkholes, and drainage wells in the area. There are numerous solution caverns and channels within the producing zones of the Floridan aquifer system. Most of the water movement within the aquifer is through these interconnected caverns and channels (Lichtler et al., 1968).

The sediments of the Hawthorn Group contain the intermediate aquifer (which may have more than one water-production zone) and collectively act as a confining unit for both the surficial aquifer and the Floridan aquifer system. The Hawthorn Group acts as a lower aquitard for the surficial aquifer by impeding the downward migration of groundwater and an upper aquitard for the Floridan aquifer system causing it to be confined or semiconfined. The Hawthorn Group is 80 to 100 feet thick on the eastern side of Orlando, as presented in geologic sections by Lichtler et al. (1968).

The net effect of the Hawthorn Group in the hydrogeologic framework for the NTC, Orlando area is to restrict the vertical flow of groundwater in the surficial aquifer and cause the primary direction of groundwater flow (in the surficial aquifer) to be horizontal. This is important in the consideration of the potential transport of contaminants in groundwater. Horizontal flow in the surficial aquifer is a common occurrence in the northern and central parts of Florida where the Hawthorn Group is present. For these reasons, the primary unit of hydrogeologic interest to the investigation of potential groundwater contamination at OU 3 will be the surficial aquifer. Groundwater flow in the surficial aquifer, as discussed above, is generally horizontal, following topography to the nearest surface water body or drainage ditch that intersects the water table.

The potential does exist in the NTC, Orlando area for groundwater to migrate vertically into the intermediate aquifer and eventually into the Floridan aquifer system, depending on the elevation of the potentiometric surface for these two lower aquifers, relative to the elevation of the water table. The low vertical permeability of the clayey Hawthorn Group sediments, however, would result in extremely slow vertical flow rates (i.e., long travel times) relative to horizontal flow rates in the surficial aquifer. The prevalence of Karst activity and sinkhole development throughout the greater Orlando area must be considered in any hydrogeologic characterization.

**2.3 STUDY AREA 8**. SA 8, the Greenskeeper's Storage Area, is located at the north end of Trident Lane, at the southern end of the golf course, and east of Lake Baldwin (Figure 1-2).

Originally SA 8 consisted of the Greenskeeper's Storage Area (Building 2134 and associated structures) and the Former Wastewater Treatment Plant (WWTP) Lagoons (Unnumbered Facility 15). However, sampling results for the site screening at the WWTP Lagoons indicated that remedial action was not necessary. The final report for the WWTP Lagoons was submitted and approved by the OPT in April 1997. Therefore, SA 8 now consists of only the Greenskeeper's Storage Area.

Building 2134, an 800-square-foot concrete block structure built in 1943, is currently used for the storage and routine maintenance of golf course greenskeeper's equipment (Figure 2-2). A fence surrounds Building 2134 and several storage sheds and containers, including

- two aluminum mobile buildings, one for paint and one for pesticide storage;
- a storage locker for gasoline cans and motor oil;
- a new hazardous materials storage locker;
- two large metal storage lockers that have been used for herbicide storage;
- a covered open-air shed for vehicles, equipment, and seed storage;
- a deteriorating mobile building for general storage (quonset hut),
- two aboveground storage tanks (ASTs), one containing unleaded gasoline and one containing diesel fuel. Both tanks have secondary containment structures with a roof. A third AST with no secondary containment is used to store used oil.

A second fenced area containing three sheds abuts the south side of the Greenskeeper's Storage Area. This area was formerly used by the NTC, Orlando grounds maintenance crew. However, it has been transferred to the golf course greenskeepers who now use it for seed storage.

The present greenskeeper has indicated that, under current practices, most of the pesticides and herbicides are stored at Building 139 (Pest Control Building) and that only pesticides and herbicides intended for use in the immediate future are stored at the Greenskeeper's compound.

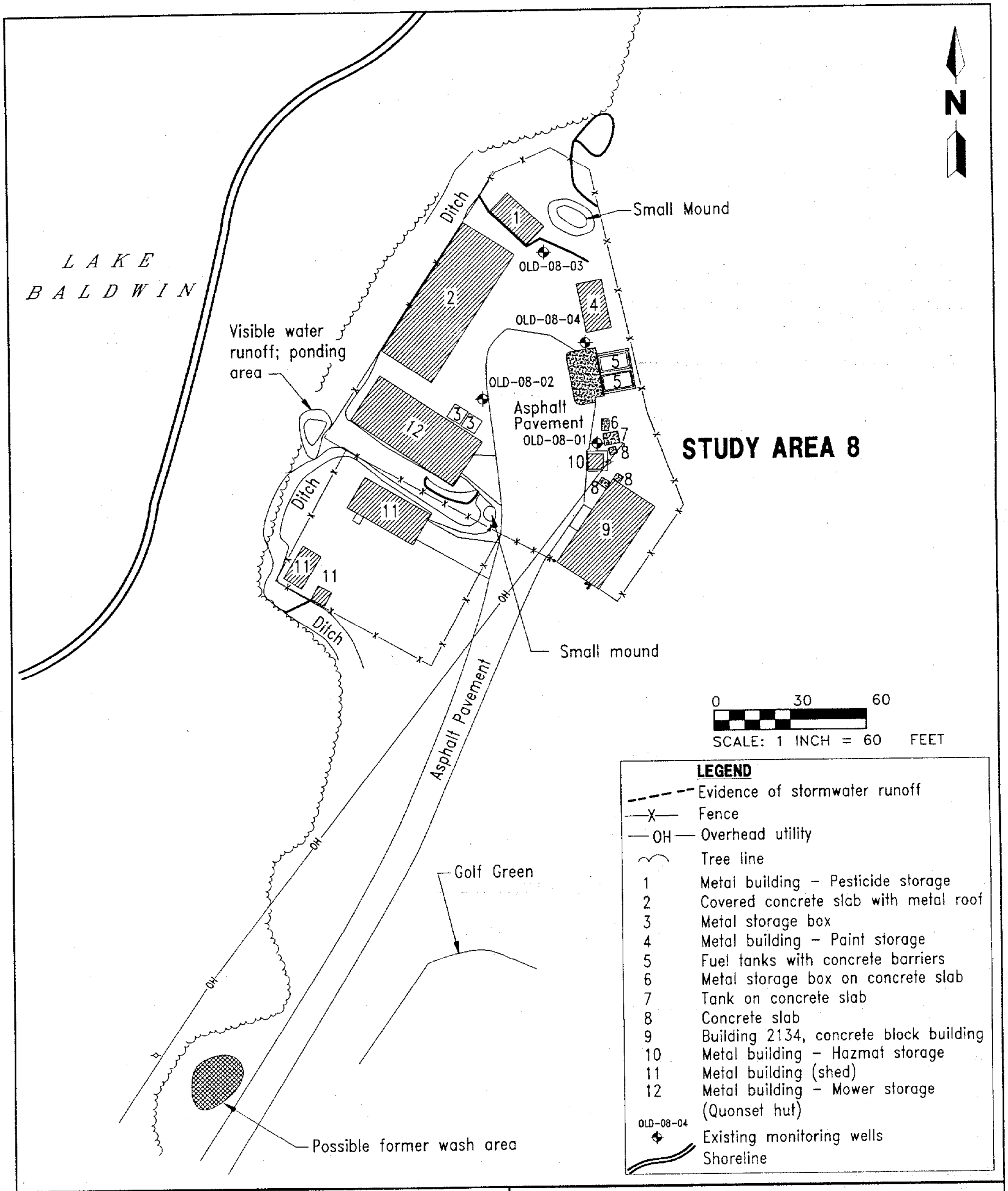


**FIGURE 2-2**
**STUDY AREA 8 SITE PLAN**

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**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

In the records reviewed for SA 8, there was no record of connections to a sanitary sewer, septic system, or dry well. A wash sink and a shower, outside Building 2134, and an eye wash and water fountain inside the building, drain to the ground next to the building. The source of the potable water for these structures at SA 8 is unknown.

Over the past few years, the area outside the fence surrounding SA 8 has been sprayed with herbicides (i.e., Roundup™) to keep the vegetation from growing on the fence.

South of SA 8 on the west side of Trident Lane is a paved area that measures approximately 10 feet by 30 feet and is overgrown by grass. Because there is a water supply connection across Trident lane from this area, and based on conversations with base personnel, it is suspected that this area may have been a wash area.

**2.3.1 Site History** Aerial photographs taken prior to 1962 show that the only structure at SA 8 was Building 2134, and Trident Lane was not paved or well defined. Additional structures are observed in aerial photographs taken between 1975 and 1987, which may indicate increased activity at the site (Figure 2-3). In a 1987 aerial photograph, most of the current structures are present, the area is surrounded by a fence, and Trident Lane is better defined. The only information available regarding the use of Building 2134 prior its designation as the greenskeeper's storage building is a drawing called the title building schedule (dated 1945) that lists Buildings 2134, 2133, and 2132 as radio shacks. The site is currently (1997) used as the central maintenance facility for the golf course.

**2.3.2 Site-Specific Geology and Hydrology** The groundwater flow direction in the surficial aquifer is expected to be primarily horizontal, following the topography of SA 8. The land surface at SA 8 slopes to the west, toward Lake Baldwin (Figure 2-4). Additionally, field observations indicate that surface water flows towards Lake Baldwin by means of erosional features on the west side of SA 8. There is not a defined stormwater system to handle runoff from the golf course. Therefore, surface water flows across the fairways and over SA 8 towards Lake Baldwin.

Potentiometric data presented in the Site Screening Report (ABB-ES, 1995) is consistent with this interpretation of groundwater flow directions. Existing groundwater monitoring wells at SA 8 have been completed in the upper part of the surficial aquifer to depths of 13 feet bls. Because of the shallow completion of the monitoring wells, lithologic data are not available for the remaining thickness of the surficial sands. Geologic sections presented by Lichtler et al. (1968) indicate that clays have been identified in the surficial sands in the Orlando area. The presence of clayey horizons (layers) in the surficial sand at SA 8, however, has not been verified by subsurface borings. The elevation for Lake Baldwin, reported to be 91 feet above mean sea level (U.S. Geological Survey [USGS], 1980), suggests that some clayey horizons may be present locally, but other hydraulic factors may also be responsible for the presence of the lakes. For these reasons, ABB-ES has made the assumption that the entire thickness of the surficial sand at SA 8 is available for the potential transport of contaminants in the surficial aquifer.

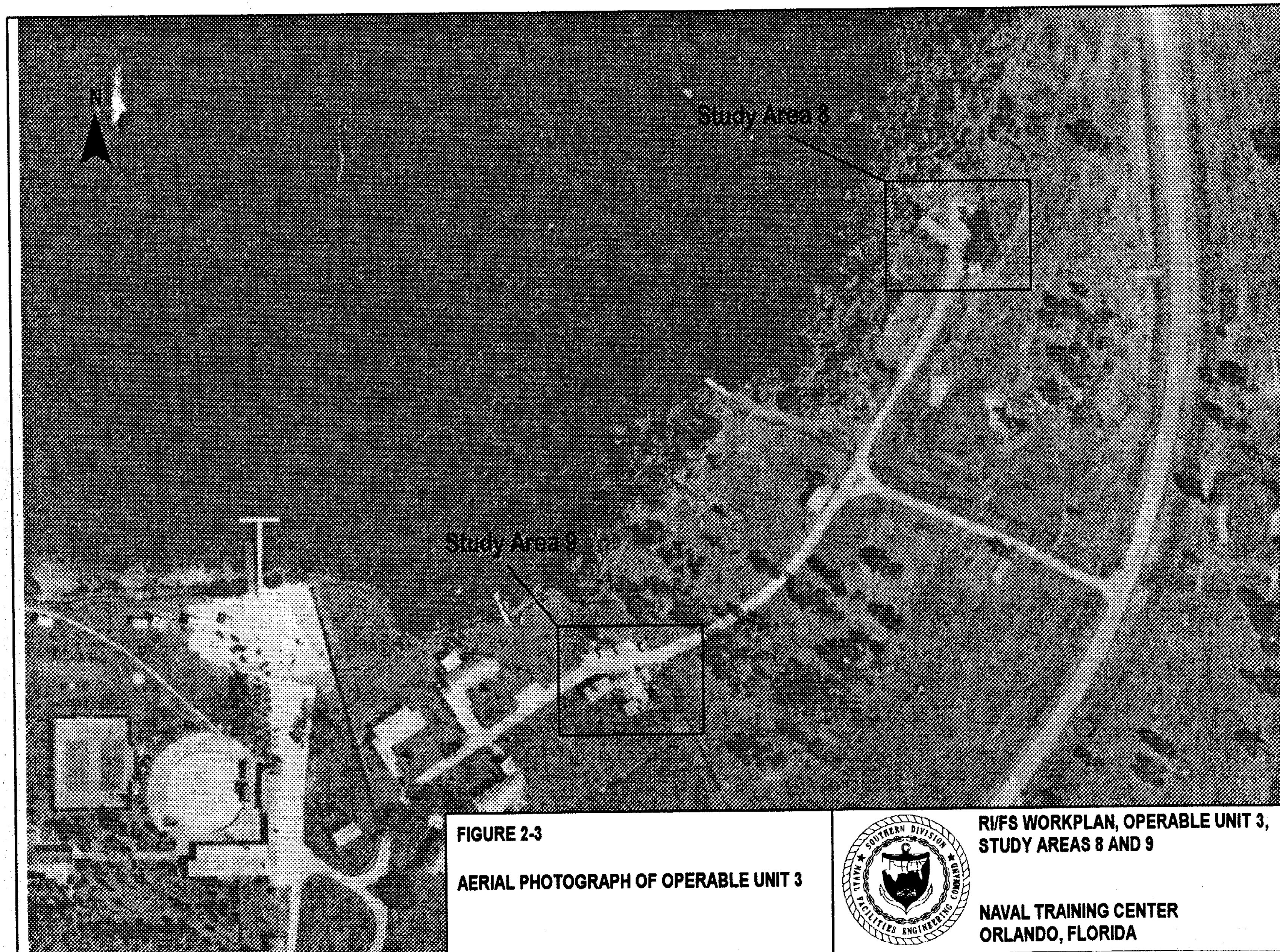


FIGURE 2-3

AERIAL PHOTOGRAPH OF OPERABLE UNIT 3

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

RI/FS WORKPLAN, OPERABLE UNIT 3,
STUDY AREAS 8 AND 9

NAVAL TRAINING CENTER
ORLANDO, FLORIDA

H:\HEIDI\ORLANDO\MISC\FIG2-3.PM5, PHOTO H:\HEIDI\ORLANDO\MISC\OU3ST8&9.BMP 061297HAS

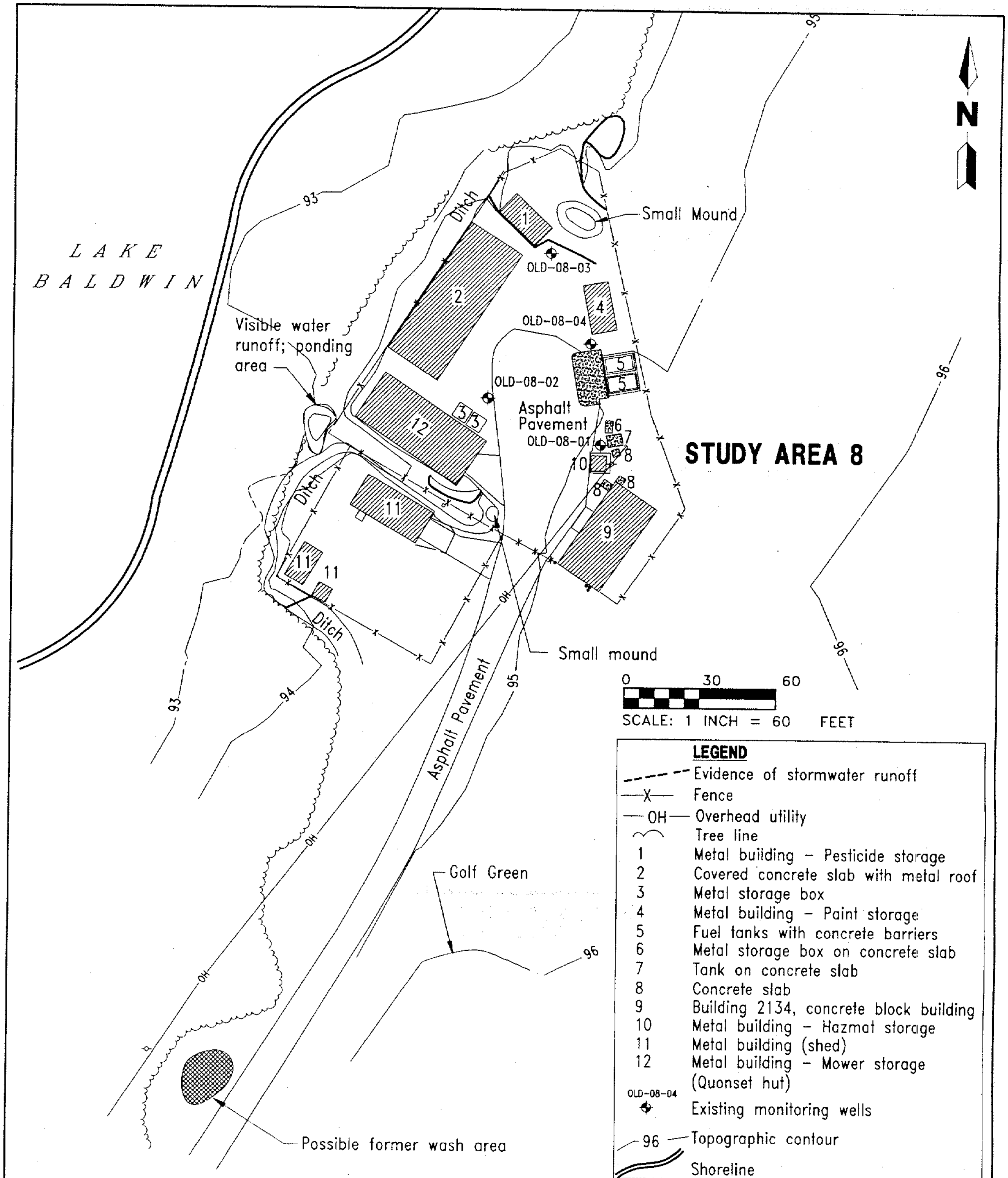


**FIGURE 2-4**
**TOPOGRAPHIC MAP OF STUDY AREA 8**

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**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

The groundwater investigation at SA 8 will be based on the following conceptual model of groundwater flow:

- The aquifer of primary interest to the groundwater investigation at SA 8 is the surficial aquifer.

- Groundwater flow in the surficial aquifer is primarily horizontal and follows topography.

- The topography of the area indicates that groundwater likely flows in a westerly direction.

- The entire thickness of the surficial sand (from the water table to the top of the Hawthorn Group) is available for the potential transport of contaminants.

<u>2.3.3 Land Use</u> The greenskeeper's area occupies approximately 1/3 of an acre in the eastern part of the Main Base west of the golf course's third fairway. Trident Lane ends as a cul-de-sac in the Greenskeeper's Storage Area and is the only paved area inside of the fenced compound. The predominant land use surrounding SA 8 is recreational with the golf course to the east, north, and south and Lake Baldwin to the west. Several base residences are southwest of the golf course.

<u>2.3.4 Previous Investigations</u> The first phase of the IR program at SA 8 was the EBS, which was conducted in 1994 (ABB-ES, 1994c). This program included a record search and site walkovers. Based on the findings of the EBS, further investigation under the site screening program was recommended.

ABB-ES conducted a site screening investigation at SA 8 in August 1994 (ABB-ES, 1995). To evaluate soil contamination at the SA, eight surface soil samples were collected from the suspected areas of contamination. To evaluate groundwater quality, four monitoring wells were installed and sampled. Subsurface soil samples were also collected during the monitoring well installation.

Arsenic and polynuclear aromatic hydrocarbons (PAH) concentrations greater than regulatory and/or guidance concentrations were detected in surface soil and groundwater samples. Based on these findings, the Site Screening Report recommended that an RI be conducted at SA 8. Results of the site screening are summarized in Paragraph 3.1.2.1.

<u>2.4 STUDY AREA 9</u>. SA 9, the former location of the pesticide and herbicide storage building (Building 2132), is located south of Trident Lane, at the southern end of the golf course, and southeast of Lake Baldwin (Figure 1-2).

Currently, the site is a grassy field with drainage swales bordering the south and east sides (Figure 2-5). A U.S. Geological Survey benchmark is located approximately 100 feet southeast of the site. Farther south is the fairway for hole number 4 of the 18-hole golf course. There is a small concrete slab in the northwest corner of the site, approximately 15 feet south of Trident Lane; old aerial photographs indicate that the concrete slab was the foundation for a small shed that postdates the former pesticide and herbicide storage area.

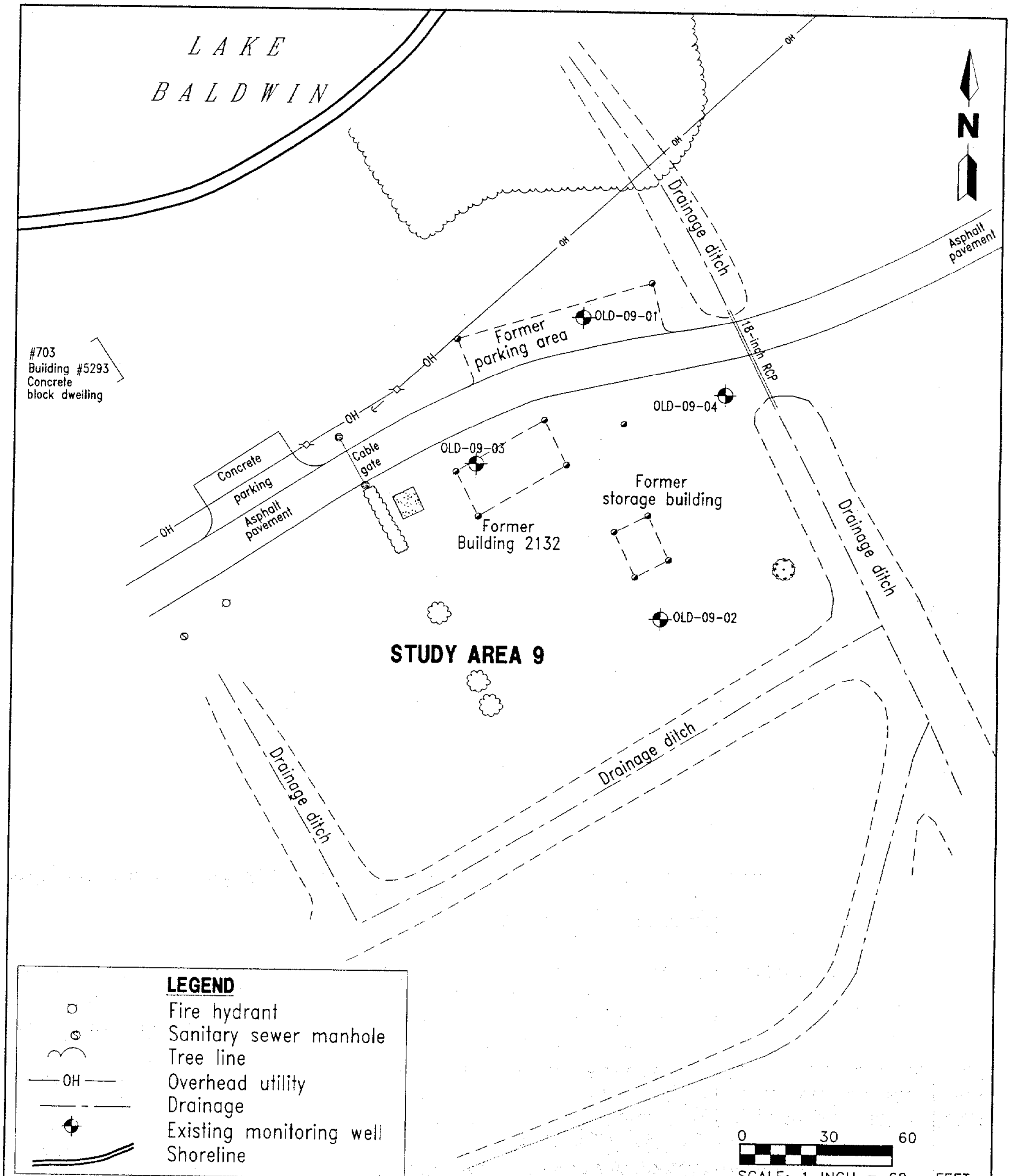


**FIGURE 2-5**
**STUDY AREA 9 SITE PLAN**

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SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

In portions of the site, a layer of top soil up to 8 inches thick overlies crushed limestone. The crushed limestone appears to be the surface of the former parking and work areas associated with Building 2132.

2.4.1 Site History The USAF used Building 2132 from the early 1950s to 1969, and the U.S. Navy used it from 1969 to 1972. The building was demolished in 1981, but records do not reveal its use from 1972 to 1981. The 20- by 40-foot building was a concrete-block structure with a wood-framed roof similar to Building 2134 at SA 8.

Aerial photographs dated prior to 1981 show Building 2132, a 15- by 20-foot shed, some equipment in what appears to be a work area to the south of Trident Lane, and a parking area north of Trident Lane across from Building 2132. The parking lot north of Trident Lane appears to have been used as employee parking. The building and the shed were demolished in 1981 (C.C. Johnson, 1985).

The site was used to store and mix pesticides and herbicides and to clean application equipment for all pest control activities at the Main Base. Operations reportedly consisted of mixing the pesticides and herbicides in containers on the ground (C.C. Johnson, 1985). During these operations, spills are likely to have occurred. In addition, rinse water used to clean application equipment and empty containers was reportedly discharged inside the building to a drain connected to a gravel sump (C.C. Johnson, 1985). Typical annual quantities of pesticides and herbicides used (based on 1970 data) included approximately 62,000 gallons of liquid material and 43,000 pounds of dry material. Chemicals reportedly used included Baygon, Diazinon, Chlordane, Dieldrin, Malathion, 2,4-D, anticoagulant, mineral oils, arsenic, Pyrethrum, Paraquat, Kepone, Endothall, Diuron, Naled, Monuron, Dichlorvos, Hydrothol, and Dimethoate (C.C. Johnson, 1985).

Approximately 300 gallons of pesticides and herbicides were reportedly found in the building when it was demolished in 1981 (C.C. Johnson, 1985). Previous studies have cited reports that the debris from Building 2132 was buried onsite and covered with a thin layer of sand. However, visual inspection of the area and geophysical surveys indicate that these reports are incorrect.

2.4.2 Site-Specific Geology and Hydrology The geology and hydrologic setting of the Main Base property has been described in Section 2.2 of this report. The following paragraphs describe the conditions at SA 9.

The topography of SA 9 is generally flat with a slight drop in elevation from the south (the golf course) to the north toward the shoreline of Lake Baldwin (Figure 2-6). Two distinct drainage swales border the site. One is on the east side and is oriented nearly north-south (Figure 2-5). A second intersects the first swale and is south of SA 9. No standing water has been reported or observed in the drainage swales. During heavy rains, surface water runoff from the golf course and SA 9 flows to the drainage swales and is transported to Lake Baldwin by the north-south swale.

As described in Section 2.2, the primary unit of hydrogeologic interest at SA 9 is the surficial aquifer. The groundwater flow in the surficial aquifer is predominantly horizontal, following the site's topography to Lake Baldwin. The Verification Study reported hydraulic conductivity of 23 ft/yr by conducting a slug test on monitoring well OLD-09-02 (Geraghty & Miller, 1986).

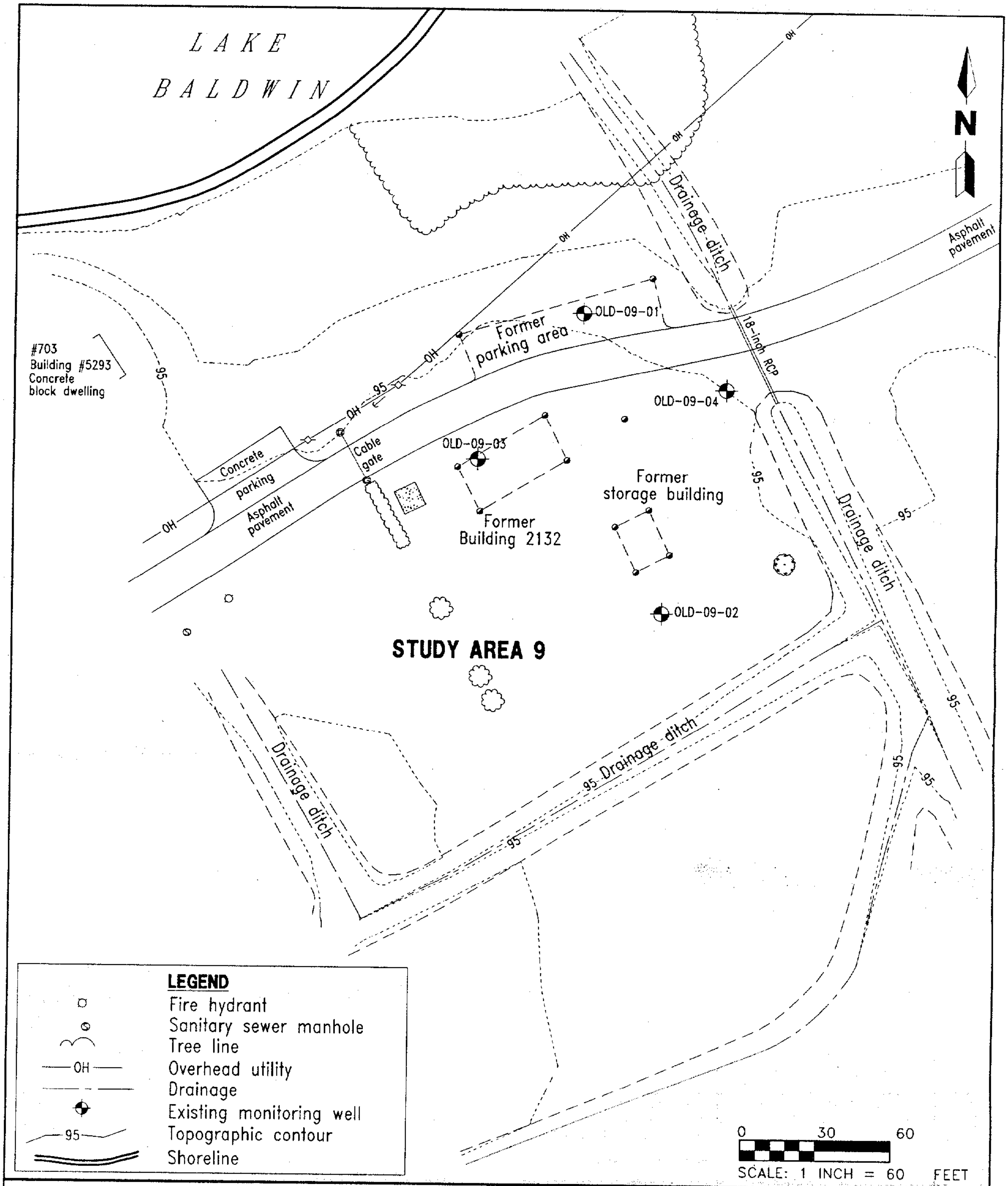


**FIGURE 2-6**
**TOPOGRAPHIC MAP OF STUDY AREA 9**

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**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

The groundwater investigation at SA 9 will be based on the following conceptual model of groundwater flow:

- The aquifer of primary interest to the groundwater investigation at SA 9 is the surficial aquifer.
- Groundwater flow in the surficial aquifer is primarily horizontal and follows topography.
- The topography of the area indicates that groundwater flows northwesterly toward Lake Baldwin.
- The entire thickness of the surficial sand (from the water table to the top of the Hawthorn Group) is available for the potential transport of contaminants.

**2.4.3 Land Use** The land use for the Main Base is described in Section 2.1. Based on aerial photographs, the former pesticides and herbicides storage area occupies approximately 0.42 acre in the east part of the Main Base on the southwest side of the golf course. The predominant use for the land surrounding SA 9 is recreational with the golf course on the east and south, and Lake Baldwin to the north. Several residences are located approximately 120 feet west of the site.

**2.4.4 Previous Investigations** The first phase of the IR program at SA 9, NTC, Orlando was the IAS conducted in 1985 (C.C. Johnson, 1985). This phase included an archival search and site walkovers. Based on the findings of the IAS, a Verification Study was conducted in 1986 (Geraghty & Miller, 1986). During these investigations, the Former Pesticide Handling and Storage Area was designated Site 8. In later investigations, this designation was changed to SA 9.

During the Verification Study, investigators found that the former pesticide and herbicide storage area was incorrectly identified as being in the vicinity of former Building 2133. Following discussions with the golf course greenskeeper and Public Works Department personnel, it was determined that the former pesticide and herbicide storage area was Building 2132. During the Verification Study, three shallow monitoring wells were installed to assess the affects of SA 9 on groundwater quality. Ethylbenzene, phenol, 2-chlorophenol, 2,4-dichlorophenol and chlordane were detected in samples from these wells. Based on the groundwater data, a recommendation was made in the Verification Study (Geraghty & Miller, 1986) for the installation of a fourth monitoring well hydraulically downgradient (north) of the site, between the site and Lake Baldwin. In addition, a recommendation was also made in the Verification Study for quarterly monitoring of the site for a period of 1 year.

ABB-ES conducted a site screening investigation at SA 9 in August 1994 (ABB-ES, 1995). To evaluate soil at the SA, four surface soil samples were collected from the suspected areas of contamination. Because the buildings have been demolished, suspected areas of contamination were identified by reviewing aerial photographs. To further evaluate groundwater quality, one monitoring well was installed between the SA and Lake Baldwin as recommended in the Verification Study (Geraghty & Miller, 1986). A subsurface soil sample was collected at the water table interface during the monitoring well installation (ABB-ES, 1995).

Arsenic, lead and semivolatiles were detected at concentrations greater than regulatory and/or guidance concentrations in groundwater samples. PAHs and pesticides were detected at concentrations greater than regulatory and/or guidance concentrations in soil samples. Based on the analytical results, the Site Screening Report (ABB-ES, 1995) concluded that further evaluation of surface soil and groundwater at SA 9 was required. Results of the site screening are summarized in Paragraph 3.1.2.2.

**2.5 INTERIM REMEDIAL ACTIONS AT STUDY AREAS 8 AND 9**. An interim remedial action (IRA) was completed for SAs 8 and 9 surface soil in September 1997. The IRA was conducted to address arsenic contamination at SA 8 and pesticide contamination at SA 9, and included excavation and off-site disposal of contaminated soil. The IRA was conducted by SOUTHNAVFACENGCOM, Environmental Detachment from Charleston, South Carolina.

Approximately 40 cubic yards of soil were removed from SA 8, and 3,000 tons of soil were removed from SA 9 during the IRA. Samples from the excavation areas were collected for analysis prior to backfilling the excavation. A report summarizing IRA activities and the analytical results from the sampling conducted will be available in late 1997.

The impact of the IRA on the proposed sampling program in this RI/FS workplan has been considered. This impact is discussed in Chapter 4.0.

# 3.0 INITIAL EVALUATION AND TECHNICAL APPROACH

**3.1 INITIAL EVALUATION**. The following subsections contain an initial assessment of conditions at SA 8 and SA 9 based on the previous investigations. This initial assessment was used as the basis for developing the technical approach to the RI at OU 3.

**3.1.1 Conceptual Site Model** Because SA 8 and SA 9 have similar backgrounds and settings, one conceptual model can represent both sites (Figure 3-1). This model shows the source of contaminants, release mechanisms, exposure pathways, and potential current and future receptors.

The source of contaminants at both sites was the storage and handling of pesticides and herbicides. Through spills and leaks, contaminants were released to surface soil, making the soil a secondary source of contaminants. Another potential release mechanism at SA 9 is discharge of rinse water to a "gravel sump," mentioned in the IAS report (C.C Johnson & Associates, 1985).

Contaminants that are expected to be present based on site histories are pesticides and herbicides, some of which may have contained metals (primarily arsenic and possibly lead). Additionally, PAHs are likely to be found in surface soil at these sites. The PAHs may be associated with pesticide carriers, fuel used for vehicles, or incomplete combustion of fuel from vehicles.

Pesticides, herbicides, PAHs, and arsenic typically are not very soluble in water. They sorb strongly to soil particles and are not typically transported downward through the soil column. Contaminants that are sorbed to soil particles may be transported as suspended particles in surface runoff during rain storms, or by wind if the soil is dry and not covered by vegetation or gravel. Wind is not a significant migration pathway because most of the area at OU 3 is covered by pavement or grass.

Although pesticides, herbicides, PAHs, and arsenic typically sorb to soil they may be transported deeper into the soil and eventually to groundwater if they are mixed with a carrier, in a form with increased solubility (e.g., different species of arsenic are more soluble than others), and/or discharged directly to groundwater (e.g., via a sump). Soil chemistry can also influence the mobility of some contaminants (e.g., arsenic).

Based on the exposure pathways identified for these sites, receptors may be exposed to contaminants by any of the exposure routes listed below.

- Ingestion or direct contact with contaminated soil at the site.
- Inhalation of contaminants sorbed to soil particles that are carried by the wind. However, this does not appear to be a significant pathway at these sites.
- Ingestion of or inhalation of volatiles while showering while using the surficial aquifer as a potable water supply.

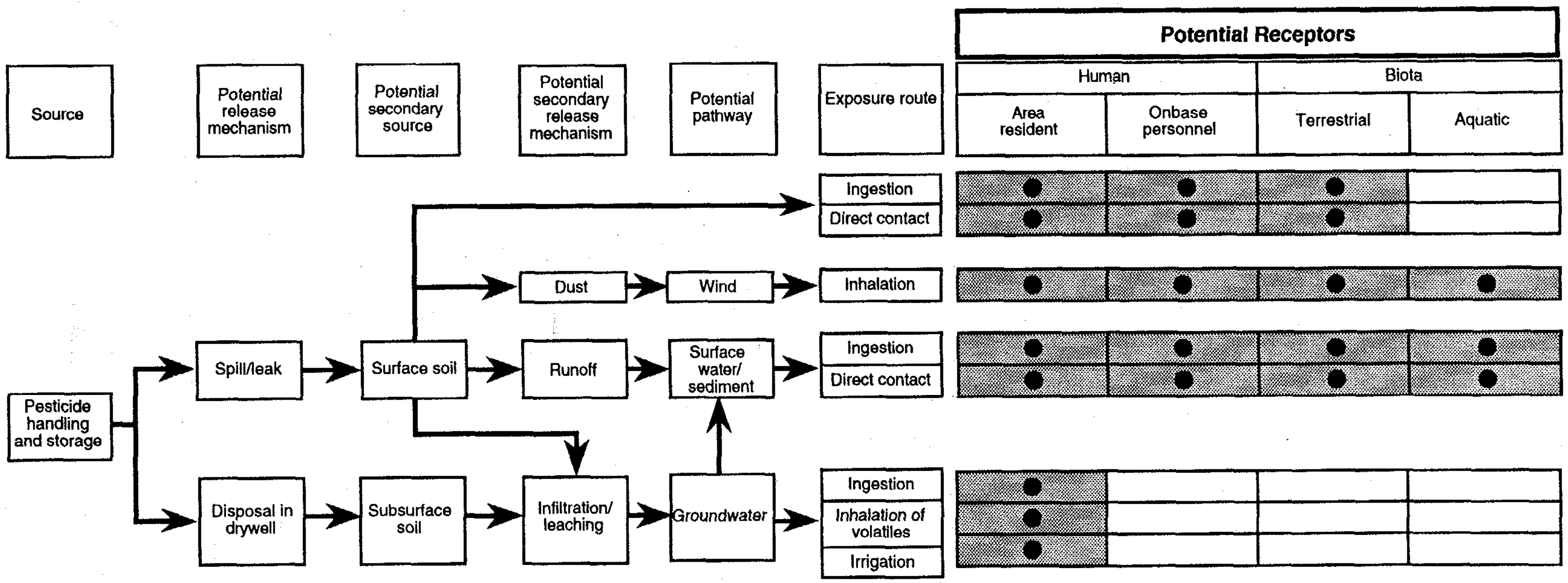


**FIGURE 3-1**
**SITE CONCEPTUAL MODEL**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**

**NAVAL TRAINING CENTER**
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3.1.2 <u>Types and Concentrations of Contaminants</u> The following paragraphs describe the contaminants detected at SA 8 and SA 9 during previous investigations.

3.1.2.1 **Study Area 8** The only laboratory analytical results available for SA 8 were generated during the preparation of the Site Screening Report (ABB-ES, 1995). Information regarding the types, quantity, and use of herbicides and pesticides stored on SA 8 is not available. Today, the site has several storage sheds and containers for storing pesticides, herbicides, paints, gasoline, and motor oil. During site screening, petroleum and pesticide odors were noted around the storage facilities.

Site screening activities were conducted to evaluate the potential for soil or groundwater contamination related to the golf course maintenance activities at the greenskeeper's storage area. Eight surface soil samples (08S001 through 08S008) were obtained from 0 to 1 feet bls using a hand auger (Figure 3-2). These samples were collected adjacent to potential sources of contamination and in areas of stained soil or stressed vegetation. Surface soil samples were submitted to an off-site laboratory for Contract Laboratory Program (CLP) target compound list (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs), target analyte list (TAL) metals, and herbicides analyses.

A summary of chemicals detected in surface soil samples is presented in Table 3-1. The complete set of soil and groundwater analytical results is presented in Appendix A of the Site Screening Report (ABB-ES, 1995).

Pesticides, including 4,4'-dichlorodiphenyldichloroethane (DDD), 4,4'-dichlorodiphenyldichloroethene (DDE), 4,4'-dichlorodiphenyltrichloroethane (DDT), chlordane, and dieldrin (sample 08S003 only) were detected in each surface soil sample, but at concentrations below the corresponding Florida residential soil cleanup goals (SCGs) and residential risk-based concentrations (RBCs). Aroclor-1260 was detected in surface soil samples 08S001 at 200 micrograms per kilogram ($\mu$g/kg) and 08S004 at 150 $\mu$g/kg. The concentrations of PCBs are below the Florida residential SCG, but exceed the residential RBC.

Several PAHs were detected in surface soil sample 08S005, collected near an aluminum mobile building currently used to store paint. Benzo(a)pyrene was detected at 280 J $\mu$g/kg, which is above the Florida residential SCG and the residential RBC. Di-n-butylphthalate was detected in every surface soil sample, but at concentrations less than the Florida residential SCG.

Although 16 metals were detected in surface soil at concentrations above background screening concentrations, only arsenic concentrations exceeded Florida SCGs. Arsenic concentrations exceeded the Florida residential SCG in seven of the eight surface soil samples. Arsenic was reported at concentrations ranging from 4 to 577 milligrams per kilogram (mg/kg). (At the time the Site Screening Report was produced, the Florida residential SCG for arsenic was 0.7 mg/kg; it has since been revised to 0.8 mg/kg).

In addition to surface soil samples, four subsurface soil samples were collected from soil borings (08B001 through 08B004) from a depth of 2 to 4 feet bls. These soil borings were completed as monitoring wells (OLD-08-01 through OLD-08-04) (Figure 3-2). Soil boring identification numbers usually correspond to the

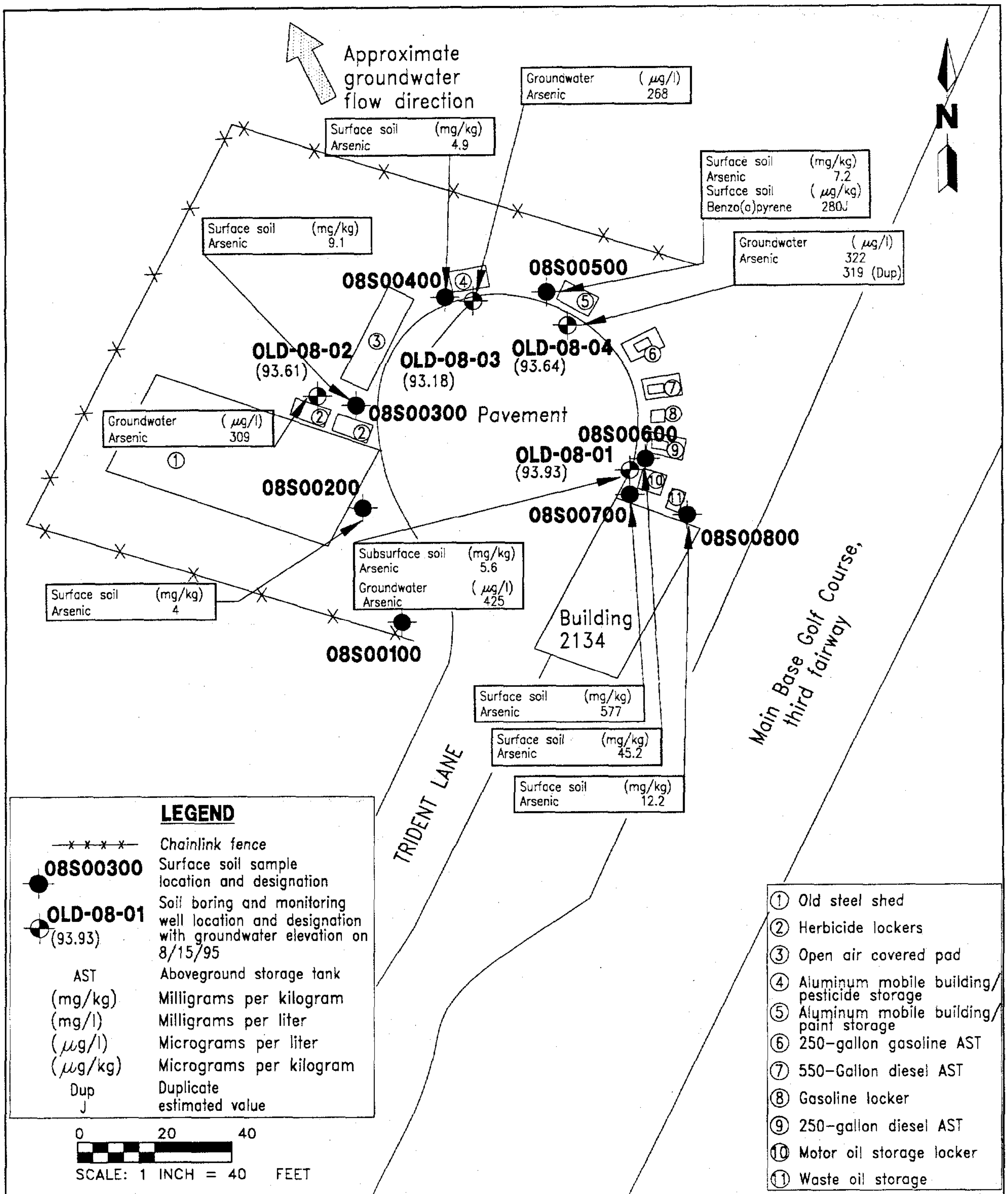


**FIGURE 3-2**
**STUDY AREA 8, SURFACE SOIL SAMPLE AND MONITORING WELL LOCATIONS, 1994 SITE SCREENING**

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**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

## Table 3-1
## Chemicals Detected in Surface Soil Samples, Study Area 8
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Identifier: / Sampling Date: / Feet bls: | Background[1] | SCG[2] | RBC[3] for Residential Soil | RBC[3] for Industrial Soil | 08S00100 / 30-Aug-94 / 1 | 08S00200 / 30-Aug-94 / 1 | 08S00300 / 30-Aug-94 / 1 | 08S00400 / 30-Aug-94 / 1 |
|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organic Compounds** (µg/kg) | | | | | | | | |
| Benzo(a)anthracene | -- | -- | -- | -- | -- | -- | -- | -- |
| Benzo(a)pyrene | -- | -- | -- | -- | -- | -- | -- | -- |
| Benzo(b)fluoranthene | -- | -- | -- | -- | -- | -- | -- | -- |
| Benzo(g,h,i)perylene | 100 | -- | -- | -- | -- | -- | -- | -- |
| Benzo(k)fluoranthene | -- | -- | -- | -- | -- | -- | -- | -- |
| Chrysene | -- | -- | -- | -- | -- | -- | -- | -- |
| Di-n-butylphthalate | 442 | 7,300,000 | 7,800,000 n | 200,000,000 n | 350 J | 270 J | 280 J | 470 |
| Fluoranthene | -- | -- | -- | -- | -- | -- | -- | -- |
| Ideno(1,2,3-cd)pyrene | -- | -- | -- | -- | -- | -- | -- | -- |
| Phenanthrene | -- | -- | -- | -- | -- | -- | -- | -- |
| Pyrene | -- | -- | -- | -- | -- | -- | -- | -- |
| **Pesticides/PCBs** (µg/kg) | | | | | | | | |
| 4,4'-DDD | -- | 4,500 | 2,700 c | 76,000 n | -- | -- | -- | 18 |
| 4,4'-DDE | 39.2 | 3,000 | 1,900 c | 17,000 c | 92 | 31 | -- | 37 |
| 4,4'-DDT | 22.8 | 3,100 | 1,900 c | 17,000 c | 130 | 28 | -- | 7.9 NJ |
| alpha-Chlordane | 6.1 | 800 | 490 c | 4,400 c | 21 | 21 | -- | 11 J |
| gamma-Chlordane | 4.3 | 800 | 490 c | 4,400 c | 18 | 16 | -- | 11 J |
| Dieldrin | 95 | 70 | 40 c | 360 c | 20 | -- | 35 | 7.9 J |
| Aroclor-1260 | -- | 900 | 83 c | 740 c | 200 | -- | -- | 150 |
| **Inorganic Analytes** (mg/kg) | | | | | | | | |
| Aluminum | 2088 | 75,000 | 78,000 n | 1,000,000 n | 152 | 153 | 145 | 1,420 |
| Arsenic | 1.0 | 0.7 | 0.37 c/23 n | 3.3 c/610 n | -- | 4 | 9.1 | 4.9 |

See notes at end of table.

## Table 3-1 (Continued)
## Chemicals Detected in Surface Soil Samples, Study Area 8
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Identifier:<br>Sampling Date:<br>Feet bls: | Background[1] | SCG[2] | RBC[3] for Residential Soil | RBC[3] for Industrial Soil | 08S00100<br>30-Aug-94<br>1 | 08S00200<br>30-Aug-94<br>1 | 08S00300<br>30-Aug-94<br>1 | 08S00400<br>30-Aug-94<br>1 |
|---|---|---|---|---|---|---|---|---|
| **<u>Inorganic Analytes</u> (mg/kg) (Continued)** | | | | | | | | |
| Barium | 8.7 | 5,200 | 5,500 n | 140,000 n | 57.2 | 3.5 B | 1.6 B | 9.9 B |
| Cadmium | 0.98 | 37 | 39 n | 1,000 n | -- | 0.93 B | -- | -- |
| Calcium | 25,295 | ND | 1,000,000 | 1,000,000 | 6,600 | 11,500 | 1,410 | 9,490 |
| Chromium | 4.6 | 290 | 390 n | 10,000 n | -- | -- | -- | 43.7 |
| Copper | 4.1 | ND | 2,900 n | 76,000 n | 7.4 | 3.9 B | 1.7 B | 9.4 |
| Iron | 712 | ND | 47,824 | 47,824 | 782 J | 115 J | 63.7 J | 600 |
| Lead | 14.5 | 500 | 400 | 400 | 134 | 21 | 5.2 | 38.1 |
| Magnesium | 328 | ND | 460,468 | 460,468 | 96.1 B | 110 B | 21.3 B | 118 B |
| Manganese | 8.1 | 370 | 390 n | 10,000 n | 15.1 | 4.2 | 1.8 B | 9.7 |
| Mercury | 0.07 | 23 | 23 n | 610 n | 0.03 B | 0.03 B | -- | 0.19 |
| Nickel | -- | -- | -- | -- | -- | -- | -- | -- |
| Potassium | -- | -- | -- | -- | -- | -- | -- | -- |
| Silver | 1.8 | 390 | 390 n | 10,000 n | -- | 0.79 B | 0.62 B | 103 |
| Sodium | 91.4 | ND | 1,000,000 | 1,000,000 | 31.8 B | -- | -- | -- |
| Vanadium | 3.1 | 490 | 550 n | 14,000 n | 1.1 B | -- | -- | 1.9 B |
| Zinc | 17.2 | 23,000 | 23,000 n | 610,000 n | 301 | 24.9 | -- | 37.7 |

See notes at end of table.

# Table 3-1 (Continued)
## Chemicals Detected in Surface Soil Samples, Study Area 8
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Identifier:<br>Sampling Date:<br>Feet bls: | Background[1] | SCG[2] | RBC[3] for Residential Soil | RBC[3] for Industrial Soil | 08S00500<br>30-Aug-94<br>1 | 08S00600<br>30-Aug-94<br>1 | 08S00700<br>30-Aug-94<br>1 | 08S00800<br>30-Aug-94<br>1 |
|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organic Compounds** (μg/kg) | | | | | | | | |
| Benzo(a)anthracene | -- | 1,400 | 880 c | 7,800 c | 220 J | -- | -- | -- |
| Benzo(a)pyrene | -- | 100 | 88 c | 780 c | 280 J | -- | -- | -- |
| Benzo(b)fluoranthene | -- | 1,400 | 880 c | 7,800 c | 440 | -- | -- | -- |
| Benzo(g,h,i)perylene | 100 | 14,000 | ND | ND | 370 J | -- | -- | -- |
| Benzo(k)fluoranthene | -- | 14,000 | 8,800 c | 78,000 c | 310 J | -- | -- | -- |
| Chrysene | -- | 140,000 | 88,000 c | 780,000 c | 430 | -- | -- | -- |
| Di-n-butylphthalate | 442 | 7,300,000 | 7,800,000 n | 200,000,000 n | 590 | 380 J | 750 | 390 |
| Fluoranthene | -- | 2,900,000 | 3,100,000 n | 82,000,000 n | 670 | -- | -- | -- |
| Indeno(1,2,3-cd)pyrene | -- | 1,400 | 880 c | 7,800 c | 280 J | -- | -- | -- |
| Phenanthrene | -- | 1,700,000 | ND | ND | 140 J | -- | -- | -- |
| Pyrene | -- | 2,200,000 | 2,300,000 n | 61,000,000 n | 510 | -- | -- | -- |
| **Pesticides/PCBs** (μg/kg) | | | | | | | | |
| 4,4'-DDD | -- | 4,500 | 2,700 c | 76,000 n | -- | 460 | 81 J | -- |
| 4,4'-DDE | 39.2 | 3,000 | 1,900 c | 17,000 c | 82 J | 250 J | 65 J | -- |
| 4,4'-DDT | 28 | -- | -- | -- | -- | -- | -- | -- |
| alpha-Chlordane | 6.1 | 800 | 490 c | 4,400 c | 270 | 35 J | 100 | 63 |
| gamma-Chlordane | 4.3 | 800 | 490 c | 4,400 c | 300 | 40 | 120 | 68 |
| Dieldrin | 95 | -- | -- | -- | -- | -- | -- | -- |
| Aroclor-1260 | -- | -- | -- | -- | -- | -- | -- | -- |
| **Inorganic Analytes** (mg/kg) | | | | | | | | |
| Aluminum | 2088 | 75,000 | 78,000 n | 1,000,000 n | 812 | 1750 | 2160 | 252 |
| Arsenic | 1.0 | 0.7 | 0.37 c/23 n | 3.3 c/610 n | 7.2 | 45.2 | 577 | 12.2 |

See notes at end of table.

## Table 3-1 (Continued)
## Chemicals Detected in Surface Soil Samples, Study Area 8
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Identifier:<br>Sampling Date:<br>Feet bls: | Background[1] | SCG[2] | RBC[3] for Residential Soil | RBC[3] for Industrial Soil | 08S00500<br>30-Aug-94<br>1 | 08S00600<br>30-Aug-94<br>1 | 08S00700<br>30-Aug-94<br>1 | 08S00800<br>30-Aug-94<br>1 |
|---|---|---|---|---|---|---|---|---|
| **Inorganic Analytes (mg/kg) (Continued)** | | | | | | | | |
| Barium | 8.7 | 5,200 | 5,500 n | 140,000 n | 11.2 B | 26.3 B | 33.8B | 2.7 B |
| Cadmium | 0.98 | 37 | 39 n | 1,000 n | 0.98 B | 1.6 | 1.3 | -- |
| Calcium | 25,295 | ND | 1,000,000 | 1,000,000 | 4510 | 97900 | 47000 | 8420 |
| Chromium | 4.6 | 290 | 390 n | 10,000 n | 15.4 | 39.4 | 12.7 | 3.3 |
| Copper | 4.1 | ND | 2,900 n | 76,000 n | 11.2 | 14.5 | 6.4 | 6.3 |
| Iron | 712 | ND | 47,824 | 47,824 | 577 J | 1210 J | 776 J | 1010 J |
| Lead | 14.5 | 500 | 400 | 400 | 38.8 | 140 | -- | 30.3 |
| Magnesium | 328 | ND | 460,468 | 460,468 | 124 B | 1040 B | 1410 | 95.4 B |
| Manganese | 8.1 | 370 | 390 n | 10,000 n | 25.4 | 45.5 | 80.7 | 10.8 |
| Mercury | 0.07 | 23 | 23 n | 610 n | 0.23 | 0.67 | 0.08 | 0.06 |
| Nickel | 4.4 | 1,500 | 1,600 n | 41,000 n | -- | 3.3 B | -- | -- |
| Potassium | 157 | ND | 1,000,000 | 1,000,000 | -- | 179 B | 213 B | -- |
| Silver | 1.8 | 390 | 390 n | 10,000 n | 28.5 | 5.1 | 7.3 | 1.1 B |
| Sodium | 91.4 | ND | 1,000,000 | 1,000,000 | -- | 24.3 B | 29.5 B | 13.2 B |
| Vanadium | 3.1 | 490 | 550 n | 14,000 n | 1.5 B | 6.6 B | 3.8 B | 0.69 B |
| Zinc | 17.2 | 23,000 | 23,000 n | 610,000 n | 63.1 | 75.1 | 64.2 | 70.2 |

See notes at end of table.

## Table 3-1 (Continued)
## Chemicals Detected in Surface Soil Samples, Study Area 8
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

[1] The background screening value is twice the average of detected concentrations for inorganic analytes. For organics, values are the mean of detected concentration, presented for comparison purposes only.
[2] Soil Cleanup Goals (Florida Department of Environmental Protection memorandum, September 29, 1995). Values indicated are from a residential scenario. Chromium values are for chromium VI.
[3] Risk-Based Concentration Table, U.S.Environmental Protection Agency Region III, March, 1995, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (Office of Solid Waste and Emergency Response, Directive 9355-4-12). For essential nutrients (calcium, iron, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

Notes: All inorganics results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.
Source of data is the Site Screening Report, Groups I and II, (ABB-ES, 1995).

SCG = Soil Cleanup Goals.
RBC = risk-based concentration.
bls = below land surface.
μg/kg = micrograms per kilogram.
-- = Analyte/compound was not detected at reporting limit.
n = noncarcinogenic pathway.
J = Reported concentration is an estimated quantity.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
░ = Bold/shaded values indicate exceedance of regulatory guidance and background.

c = carcinogenic pathway.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
N = Indicates presumptive evidence of the compound.
mg/kg = milligrams per kilogram.
B = Reported concentration is between the instrument detection limit and contract-required detection limit.
ND = Not determined.

monitoring well identification number. However, at SA 8, the relationship is as follows: soil boring 08B001 was completed as monitoring well OLD-08-02; soil boring 08B003 was completed as monitoring well OLD-08-04; and boring 08B004 was completed as monitoring well OLD-08-01.

Subsurface soil samples were analyzed for the same parameters as the surface soil. A summary of the chemicals detected in subsurface soil is presented as Table 3-2.

Di-n-butylphthalate and acetone were found in subsurface soil at concentrations below the corresponding residential RBCs. Although several metals were detected at concentrations greater than background, only one arsenic concentration (5.6 mg/kg) exceeded the screening values (e.g., background, RBCs, and SCGs)

Four monitoring wells (OLD-08-01, OLD-08-02, OLD-08-03, and OLD-08-04, Figure 3-2) were installed following the collection of subsurface soil samples. Groundwater samples collected from these wells were analyzed for CLP TCL VOCs, SVOCs, pesticides and PCBs, TAL metals, and herbicides. A summary of the detected chemicals is presented in Table 3-3.

Naphthalene was detected in groundwater from monitoring well OLD-08-04 at 4 J micrograms per liter ($\mu g/\ell$), which is below the FDEP guidance concentration of 6.8 $\mu g/\ell$.

Arsenic concentrations detected in groundwater samples ranged from 268 to 425 $\mu g/\ell$. All these concentrations exceed Florida's primary drinking water standard and the Federal maximum contaminant level (MCL) of 50 $\mu g/\ell$. No other inorganics were detected above screening values.

3.1.2.2 **Study Area 9** The types and quantity of herbicides and pesticides used and stored at SA 9 were described in the IAS (C.C. Johnson, 1985). This information has been summarized in Subsection 2.4.2 of this report.

Four surface soil samples (09S001 through 09S004) were collected during site screening and analyzed for CLP TCL VOCS, SVOCs, pesticides, and PCBs, TAL metals, and herbicides (Figure 3-3). Table 3-4 summarizes the chemicals detected in surface soil samples collected at SA 9.

PAHs and DDT were detected in surface soil sample 09S001. DDD, DDE, and DDT were detected in surface soil sample 09S004. Chlordane and di-n-butylphthalate were detected in all surface soil samples. However, only the concentrations of benzo(a)pyrene (780 $\mu g/kg$ and 940 $\mu g/kg$) and chlordane (2,300 $\mu g/kg$ to 2,900 $\mu g/kg$) detected in the duplicate samples collected at 09S001 exceed the corresponding Florida residential SCGs and residential RBCs.

In surface soil sample 09S004, arsenic was detected at 2.8 mg/kg, which exceeds its background screening concentration, Florida residential SCG, and residential RBC. Although other inorganics were detected at concentrations above background concentrations, all concentrations were below the Florida residential SCGs and residential RBCs.

Di-n-butylphthalate and acetone were detected in the subsurface soil sample collected at the water table from soil boring 09B001 (same location as monitoring

## Table 3-2
## Chemicals Detected in Subsurface Soil Samples, Study Area 8
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Identifier:<br>Sampling Date:<br>Feet bls: | Background [1] | RBC [2] for Residential Soil | RBC [2] for Industrial Soil | 08B00101<br>31-Aug-94<br>2 | 08B00201<br>31-Aug-94<br>2 | 08B00301<br>01-Sep-94<br>3 | 08B00401<br>01-Sep-94<br>7 |
|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** **(μg/kg)** | | | | | | | |
| Acetone | -- | 7,800,000 n | 200,000,000 n | -- | -- | 30 | 22 |
| **Semivolatile Organic Compounds** **(μg/kg)** | | | | | | | |
| Di-n-butylphthalate | 560 | 7,800,000 n | 200,000,000 n | 560 | 640 | 610 | 530 |
| **Inorganic Analytes (mg/kg)** | | | | | | | |
| Arsenic | **1.1** | **0.37** c/23 n | **3.3** c/610 n | -- | -- | -- | **5.6** |
| Barium | 3.6 | 5,500 n | 140,000 n | 0.29 B | 0.32 J | 0.39 J | 0.29 B |
| Beryllium | -- | 0.15 c | 1.3 c | -- | 0.14 B | -- | -- |
| Calcium | 115 | 1,000,000 | 1,000,000 | 43.6 B | 45.5 B | 58.2 B | 123 B |
| Chromium | 3.7 | 390 n | 10,000 n | -- | -- | -- | -- |
| Copper | -- | 2,900 n | 76,000 n | -- | 0.5 B | -- | -- |
| Iron | 264 | 47,824 | 47,824 | -- | 61.5 | 28.3 | 121 |
| Magnesium | 32.8 | 460,468 | 460,468 | -- | 5.1 B | -- | -- |
| Manganese | 2.1 | 390 n | 10,000 n | 0.39 B | 0.45 B | 0.15 B | 0.89 B |
| Mercury | -- | 23 n | 610 n | -- | -- | 0.01 B | -- |
| Thallium | -- | 6.3 n | 160 n | -- | -- | 1 B | -- |
| Vanadium | 3.4 | 550 n | 14,000 n | -- | -- | -- | -- |
| Zinc | 5.6 | 23,000 n | 610,000 n | 1 B | 20 | -- | -- |

See notes at end of table.

**Table 3-2 (Continued)**
**Chemicals Detected in Subsurface Soil Samples, Study Area 8**
**Results As Reported in Groups I and II Site Screening Report**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

[1] The background screening value is twice the average of detected concentrations for inorganic analytes. For organics, values are the mean of detected concentration, presented for comparison purposes only.
[2] Risk-Based Concentration Table, U.S.Environmental Protection Agency Region III, March 1995, R.L. Smith. RBC indicated for Aroclor-1260 is based on carcinogenic effects for polychlorinated biphenyl compounds. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (Office of Solid Waste and Emergency Response, Directive 9355.4-12). RBC for thallium is based on thallium chloride. For essential nutrients (calcium, iron, magnesium, potassium, and sodium) screening values were derived-based on recommended daily allowances.

Notes: 08B00101, 08B00201, 08B00301, and 08B00401 were collected from OLD-08-02, OLD-08-03, OLD-08-04, and OLD-08-01, respectively.
*All inorganics results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.*
Source of data is the Site Screening Report, Groups I and II, (ABB-ES, 1995).

bls = below land surface.
RBC = risk-based concentration.
c = carcinogenic pathway.
μg/kg = micrograms per kilogram.
*n = noncarcinogenic* pathway.
-- = Analyte/compound not detected at reporting limit.
mg/kg = milligrams per kilogram.
c = carcinogenic pathway.
B = Reported concentration is between the instrument detection limit and contract-required detection limit.
J = Reported concentration is an estimated quantity.
░ = Bolded/shaded values indicate exceedance of regulatory guidance and background.

# Table 3-3
## Chemicals Detected in Groundwater, Study Area 8
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Well ID: / Identifier: / Sampling Date: | Background[1] | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-08-01 08G00101 16-Sep-94 | OLD-08-02 08G00201 16-Sep-94 | OLD-08-03 08G00301 16-Sep-94 | OLD-08-04 08G00401 16-Sep-94 | OLD-08-04 08G00401D 16-Sep-94 |
|---|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organic Compounds (μg/ℓ)** | | | | | | | | | |
| Naphthalene | -- | [3]6.8 | ND | 1,500 n | -- | -- | -- | 3 J | 4 J |
| **Inorganic Analytes (μg/ℓ)** | | | | | | | | | |
| Aluminum | 4,067 | [4]200 | ND | 37,000 n | 150 B | 263 | 370 | 269 | 235 |
| Antimony | 4.1 | [5]6 | 6 | 15 n | 1.6 B | 2.3 B | 4.8 B | 4.6 B | 5.6 |
| Arsenic | **5.0** | **[5]50** | **50** | 0.038 c/11 n | **425** | **309** | **268** | **322** | **319** |
| Barium | 31.4 | [5]2,000 | 2,000 | 2,600 n | 10.1 B | 18.6 B | 8.7 B | 10 B | 8.8 B |
| Calcium | 36,830 | ND | ND | 1,000,000 | 72,300 | 46,700 | 44,900 | 70,200 | 64,700 |
| Chromium | 7.8 | [5]100 | 100 | 180 n | 3.8 B | 7.2 B | 6.9 B | 6 B | 5.1 B |
| Copper | 5.4 | [4]1,000 | ND | 1,400 n | -- | -- | -- | 1.8 B | -- |
| Iron | 1,227 | [4]300 | ND | 13,267 | 114 | 391 | 64.2 B | 611 | 539 |
| Magnesium | 4,560 | ND | ND | 118,807 | 5,830 | 5,360 | 5,020 | 6,220 | 5,750 |
| Manganese | 17 | [4]50 | ND | 180 n | 11.3 B | 26.6 | 14.4 B | 8.8 B | 8.5 B |
| Nickel | -- | [5]100 | 100 | 730 n | 15.9 B | 28.9 B | -- | -- | 14.3 B |
| Potassium | 5,400 | ND | ND | 297,016 | 14,300 | 13,200 | 14,600 | 20,600 | 19,300 |
| Sodium | 18,222 | [5]160,000 | ND | 396,022 | 14,800 | 9,080 | 8,970 | 13,300 | 12,200 |
| Vanadium | 20.6 | [6]49 | ND | 260 n | -- | -- | -- | 2.8 B | -- |
| Zinc | 4.0 | [4]5,000 | ND | 11,000 n | -- | -- | 83.9 | -- | -- |

See notes at end of table.

## Table 3-3 (Continued)
## Chemicals Detected in Groundwater, Study Area 8
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

[1] Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
[2] Risk-Based Concentration Table, U.S. Environmental Protection Agency (USEPA) Region III, March, 1995, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995f). For essential nutrients (calcium, iron, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
[3] Organoleptic.
[4] Secondary Standard.
[5] Primary Standard.
[6] Systemic Toxicant.

Notes: Analytical results are expressed in $\mu g/\ell$.
Source of data is the Site Screening Report, Groups I and II, (ABB-ES, 1995). ID = inside diameter.

ID = identification.
FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.
FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, May 1995.
RBC = risk based concentrations.
$\mu g/kg$ = micrograms per kilogram.
-- = Analyte/compound was not detected at reporting limit.
ND = not determined.
*n = noncarcinogen.*
J = Reported concentration is an estimated quantity.
$\mu g/\ell$ = micrograms per liter.
B = Reported concentration is between the instrument detection limit and the contract-required detection limit.
░ = Bold/shaded numbers indicate exceedance of groundwater guidance and background.

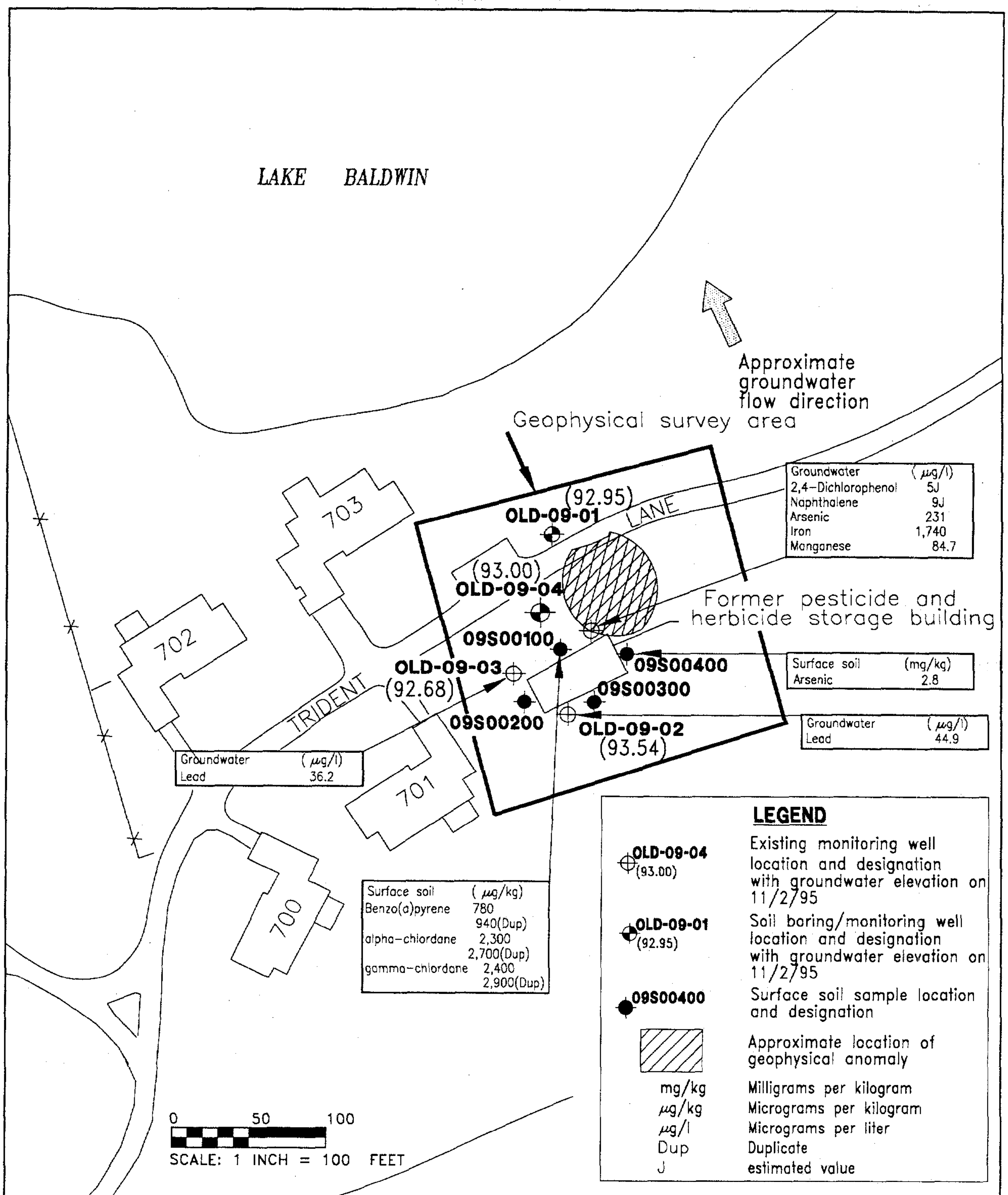


**FIGURE 3-3**
**STUDY AREA 9, SURFACE SOIL SAMPLE AND MONITORING WELL LOCATIONS, 1994 SITE SCREENING**

H:\08545\08545-14\SSR\NANTEST.DWG, PDP-NAB 10/28/97 14:39:09, AutoCAD R12

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

**Table 3-4**
**Chemicals Detected in Surface Soil Samples, Study Area 9**
**Results As Reported in Groups I and II Site Screening Report**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Identifier:<br>Sampling Date:<br>Feet bls: | Background[1] | SCG[2] | RBC[3] for Residential Soil | RBC[3] for Industrial Soil | 09S00100<br>26-Aug-94<br>1 | 09S00100D<br>26-Aug-94<br>1 | 09S00200<br>26-Aug-94<br>1 | 09S00300<br>26-Aug-94<br>1 | 09S00400<br>26-Aug-94<br>1 |
|---|---|---|---|---|---|---|---|---|---|
| **Semivolatile Organic Compounds** (μg/kg) | | | | | | | | | |
| Acenaphthene | -- | 670,000 | 4,700,000 n | 120,000,000 n | 280 J | 270 J | -- | -- | -- |
| Anthracene | -- | 20,000,000 | 23,000,000 n | 610,000,000 n | 360 J | 430 | -- | -- | -- |
| Benzo(a)anthracene | -- | 1,400 | 880 c | 7,800 c | 1,000 | 1,300 | -- | -- | -- |
| Benzo(a)pyrene | -- | **100** | **88 c** | 780 c | **780** | **940** | -- | -- | -- |
| Benzo(b)fluoranthene | -- | 1,400 | 880 c | 7,800 c | 930 | 1,100 | -- | -- | -- |
| Benzo(g,h,i)perylene | 100 | 14,000 | ND | ND | 540 | 610 | -- | -- | -- |
| Benzo(k)fluoranthene | -- | 14,000 | 8,800 c | 78,000 c | 640 J | 930 J | -- | -- | -- |
| Carbazole | -- | 42,000 | 32,000 c | 290,000 c | 240 J | 260 J | -- | -- | -- |
| Chrysene | -- | 140,000 | 88,000 c | 780,000 c | 920 | 1,200 | -- | -- | -- |
| Di-n-butylphthalate | 442 | 7,300,000 | 7,800,000 n | 200,000,000 n | -- | 350 J | 340 J | 360 J | 320 J |
| Dibenzofuran | -- | 240,000 | 310,000 n | 8,200,000 n | 140 J | 150 J | -- | -- | -- |
| Fluoranthene | -- | 2,900,000 | 3,100,000 n | 82,000,000 n | 1,900 | 2,400 | -- | -- | -- |
| Fluorene | -- | 2,400,000 | 3,100,000 n | 82,000,000 n | 240 J | 240 J | -- | -- | -- |
| Indeno(1,2,3-cd)pyrene | -- | 1,400 | 880 c | 7,800 c | 530 | 630 | -- | -- | -- |
| Naphthalene | -- | 1,300,000 | 3,100,000 n | 82,000,000 n | 140 J | -- | -- | -- | -- |
| Phenanthrene | -- | 1,700,000 | ND | ND | 1,600 | 1,900 | -- | -- | -- |
| Pyrene | -- | 2,200,000 | 2,300,000 n | 61,000,000 n | 1,600 | 2,000 | -- | -- | -- |
| **Pesticides/PCBs** (μg/kg) | | | | | | | | | |
| 4,4'-DDD | -- | 4,500 | 2,700 c | 76,000 n | -- | -- | -- | -- | 39 NJ |
| 4,4'-DDE | 39.2 | 3,000 | 1,900 c | 17,000 c | -- | -- | -- | -- | 130 |
| 4,4'-DDT | 22.8 | 3,100 | 1,900 c | 17,000 c | 700 J | 1,300 J | -- | -- | 48 J |
| alpha-Chlordane | 6.1 | **800** | **490 c** | 4,400 c | **2,300** | **2,700** | 7.2 | 7.7 J | 19 J |
| gamma-Chlordane | 4.3 | **800** | **490 c** | 4,400 c | **2,400** | **2,900** | 3.3 J | 5.6 | 15 J |

See notes at end of table.

# Table 3-4 (Continued)
## Chemicals Detected in Surface Soil Samples, Study Area 9
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Identifier:<br>Sampling Date:<br>Feet bls: | Background[1] | SCG[2] | RBC[3] for Residential Soil | RBC[3] for Industrial Soil | 09S00100<br>26-Aug-94<br>1 | 09S00100D<br>26-Aug-94<br>1 | 09S00200<br>26-Aug-94<br>1 | 09S00300<br>26-Aug-94<br>1 | 09S00400<br>26-Aug-94<br>1 |
|---|---|---|---|---|---|---|---|---|---|
| **Inorganic Analytes (mg/kg)** | | | | | | | | | |
| Aluminum | 2,088 | 75,000 | 78,000 n | 1,000,000 n | 660 | 679 | 197 | 145 | 484 |
| Arsenic | 1.0 | 0.7 | 0.37 c/23 n | 3.3 c/610 n | -- | -- | -- | -- | 2.8 |
| Barium | 8.7 | 5,200 | 5,500 n | 140,000 n | 12.8 B | 13.4 B | 3.4 B | 1.9 B | 9.8 B |
| Calcium | 25,295 | ND | 1,000,000 | 1,000,000 | 1,600 | 1,750 | 481 B | 591 B | 17,500 |
| Chromium | 4.6 | 290 | 390 n | 10,000 n | 4.4 | -- | -- | -- | -- |
| Copper | 4.1 | ND | 2,900 n | 76,000 n | 4.8 B | 4 B | 2.7 B | 0.69 B | 8 |
| Iron | 712 | ND | 47,824 | 47,824 | 347 J | 243 J | 135 J | 200 J | 422 J |
| Lead | 14.5 | 500 | 400 | 400 | 18.7 | 23.4 | 2.9 | 3 | 9.5 |
| Magnesium | 328 | -- | 460,468 | 460,468 | 41.2 B | 32.4 B | 23.3 B | 16.3 B | 166 B |
| Manganese | 8.1 | 370 | 390 n | 10,000 n | 6.2 | 4.4 | 1.4 B | 1.4 B | 12.3 |
| Mercury | 0.07 | 23 | 23 n | 610 n | 0.08 | 0.08 | 0.02 B | -- | 0.02 B |
| Nickel | 4.4 | 1,500 | 1,600 n | 41,000 n | -- | -- | -- | -- | 2.4 B |
| Silver | 1.8 | 390 | 390 n | 10,000 n | 0.88 B | 0.84 B | -- | -- | -- |
| Vanadium | 3.1 | 490 | 550 n | 14,000 n | 1.3 B | -- | -- | -- | 2.1 B |
| Zinc | 17.2 | 23,000 | 23,000 n | 610,000 n | 45.7 | 34.3 | -- | -- | 13.2 |

See notes at end of table.

## Table 3-4 (Continued)
## Chemicals Detected in Surface Soil Samples, Study Area 9
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

[1] Background values are for subsoils and surface soils, respectively. The background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
[2] Soil Cleanup Goals for Florida (Florida Department of Environmental Protection memorandum, September 29, 1995). Values indicated are from a residential scenario. Chromium values are for chromium VI.
[3] Risk-Based Concentration Table, U.S. Environmental Protection Agency Region III, March 1995, R.L. Smith. RBC for chromium is based on chromium VI. RBC for lead is not available, value is Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (Office of Solid Waste and Emergency Response Directive 9355.4-12). For essential nutrients (calcium, iron, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.

Notes: All metals results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.
Source of data is the Site Screening Report, Groups I and II, (ABB-ES, 1995).

SCG = Soil Cleanup Goals.
RBC = risk-based concentration.
n = noncarcinogenic pathway.
c = carcinogenic pathway.
ND = not determined.
bls = below land surface.
B = Reported concentration is between the instrument detection limit and contract required detection limit.
-- = Analyte/compound was not detected or regulatory guidance (RBC or SCG) not found.
J = reported concentration is an estimated quantity.
μg/kg = micrograms per kilogram.
PCB = polychlorinated biphenyl.
DDD = dichlorodiphenyldichloroethane.
DDE = dichlorodiphenyldichloroethene.
DDT = dichlorodiphenyltrichloroethane.
mg/kg = milligrams per kilogram.
░ = Bolded/shaded value indicate exceedance of regulatory guidance and background.

well OLD-09-01), but at concentrations below screening values. Table 3-5 summarizes the chemicals detected in subsurface soil at SA 9.

During the Verification Study, groundwater samples were collected from wells OLD-09-02, OLD-09-03, and OLD-09-04 (identified as OLM-16, OLM-17 and OLM-18 in the published Verification Study [Geraghty & Miller, 1986]). In the sample collected from monitoring well OLD-09-03, bis(2-ethylhexyl)phthalate was detected at 6 $\mu g/\ell$, ethylbenzene at 13 $\mu g/\ell$, phenol was estimated at 7 $\mu g/\ell$, 2-chlorophenol was estimated at 7 $\mu g/\ell$, and 2,4-dichlorophenol was reported at 33 $\mu g/\ell$. In addition, one pesticide, chlordane, was detected at 7 $\mu g/\ell$.

Groundwater samples were also collected during site screening. Table 3-6 summarizes the chemicals detected in groundwater at SA 9 during that study.

Naphthalene was detected at 9 J $\mu g/\ell$ and 2,4-dichlorophenol at 5 J $\mu g/\ell$ in the sample from monitoring well OLD-09-04. Both of these concentrations exceed the corresponding FDEP guidance concentrations. Ethylbenzene, toluene, 2-butanone, xylenes, bis(2-ethylhexyl)phthalate, 4-methylphenol, 2-methylnaphthalene, and the pesticides dicamba and chlordane were detected in the same sample but at concentrations below screening values.

Although 11 metals were detected at concentrations greater than background, only concentrations of arsenic, lead, iron, and manganese exceed screening values. Lead was detected in groundwater from wells OLD-09-02 and OLD-09-03 at 44.9 $\mu g/\ell$ and 36.2 $\mu g/\ell$, respectively. These concentrations are above the Florida's primary drinking water standards and the Federal MCL of 15 $\mu g/\ell$. Arsenic was detected in monitoring well OLD-09-04 at 231 $\mu g/\ell$, which is above Florida's primary drinking water standard and Federal MCL of 50 $\mu g/\ell$. Iron was detected at 1,740 $\mu g/\ell$ and manganese at 84.7 $\mu g/\ell$ in monitoring well OLD-09-04, which are above the corresponding Florida's secondary drinking water standards.

<u>3.1.3 Exposure Assessment</u> Potentially site-related chemicals from SA 8 and SA 9 are pesticides, metals, and solvents (which were used as pesticide dispersants). These chemicals of potential concern (CPCs) are only of concern to human health and/or the environment when the following three conditions exist:

- there is a chemical source or release,
- there is an exposure route, and
- there are potential exposure points.

At SA 8 and SA 9, there are known sources of contamination. Based on site history and results from past investigations, releases of pesticides are known to have occurred at SA 8 and SA 9.

The following subsections describe potential receptors and exposure pathways that may be evaluated in the human health risk assessments (HHRAs) and ecological risk assessments (ERAs). These descriptions are based on observations at SA 8 and SA 9 and investigations conducted at other sites (e.g., OU 1). During the RI, exposure routes and receptors will be identified through human health and ecological surveys of the SAs.

**3.1.3.1 Human Health** Potential receptors and exposure pathways that will be evaluated in the human health risk assessment are described in the following paragraphs.

## Table 3-5
## Chemicals Detected in Subsurface Soil Samples, Study Area 9
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Identifier:<br>Sampling Date:<br>Feet bls: | Background[1] | RBC[2] for Residential Soil | RBC[2] for Industrial Soil | 09B00101<br>30-Aug-94<br>2 |
|---|---|---|---|---|
| **Volatile Organic Compounds** (μg/kg) | | | | |
| Acetone | -- | 7,800,000 n | 200,000,000 n | 110 |
| **Semivolatile Organic Compounds** (μg/kg) | | | | |
| Di-n-butylphthalate | 560 | 7,800,000 n | 200,000,000 n | 490 |
| **Inorganic Analytes** (mg/kg) | | | | |
| Barium | 3.6 | 5,500 n | 140,000 n | 0.67 B |
| Calcium | 115 | 1,000,000 | 1,000,000 | 36.1 B |

[1] The background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
[2] Risk-Based Concentration Table, U.S. Environmental Protection Agency Region III, March 1995, R.L. Smith. For essential nutrients (calcium) screening values were derived based on recommended daily allowances.

Notes: All metals results expressed in mg/kg soil dry weight; organics in μg/kg soil dry weight.
Source of data is the Site Screening Report, Groups I and II, (ABB-ES, 1995).

μg/kg = micrograms per kilogram.
mg/kg = milligrams per kilogram.
bls = below land surface
n = noncarcinogenic pathway.
B = Reported concentration is between the instrument detection limit and contract required detection limit.
-- = Analyte/compound was not detected or regulatory guidance (RBC or SCG) was not found.

# Table 3-6
## Chemicals Detected in Groundwater Samples, Study Area 9
## Results As Reported in Groups I and II Site Screening Report

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Well ID:<br>Identifier:<br>Sampling Date: | Background[1] | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-09-01<br>09G00101<br>16-Sep-94 | OLD-09-02<br>09G00201<br>20-Sep-94 | OLD-09-03<br>09G00301<br>20-Sep-94 | OLD-09-04<br>09G00401<br>20-Sep-94 |
|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds (µg/ℓ)** | | | | | | | | |
| Ethylbenzene | -- | [3]30/[4]700 | 7001,300 2 | | | | | |
| Toluene | -- | [3]40/[4]1,000 | 1,000 | 750 n | -- | -- | -- | 0.4 J |
| 2-Butanone | -- | [5]4,200 | ND | 1,900 n | -- | -- | -- | 3 J |
| Xylene (total) | -- | [3]20/[4]10,000 | | | 10,000 | -- | -- | --5 J |
| 2-Methylnaphthalene | -- | ND | ND | 1,500 n | -- | -- | -- | 25 |
| Naphthalene | -- | [6]6.8 | -- | 1,500 n | -- | -- | -- | 9 J |
| **Pesticides/PCBs (µg/ℓ)** | | | | | | | | |
| Dicamba | -- | [4]210 | -- | 1,100 n | -- | -- | -- | 1.5 |
| alpha-Chlordane | -- | [5]2 | 2 | 0.052 c | -- | -- | -- | 1.2 |
| gamma-Chlordane | -- | [5]2 | 2 | 0.052 c | -- | -- | -- | 1.4 |
| **Inorganic Analytes (µg/ℓ)** | | | | | | | | |
| Aluminum | 4,067 | [3]200 | ND | 37,000 n | 1,090 | 858 | 476 | 368 |
| Antimony | 4.1 | [5]6 | 6 | 15 n | -- | -- | -- | 3.4 B |
| Arsenic | **5.0** | [5]**50** | **50** | 0.038 c/11 n | 10 J | 2.6 J | | **231** |
| Barium | 31.4 | [5]2,000 | 2,000 | 2,600 n | 32.6 B | 0.74 B | 3.4 B | 4.5 B |
| Calcium | 36,830 | ND | ND | 1,000,000 | 34,900 | 5,670 | 12,800 | 53,600 |
| Cobalt | -- | ND | ND | 2,200 n | -- | -- | -- | 3.7 B |
| Copper | 5.4 | [3]1,000 | ND | 1,400 n | -- | -- | -- | 36.2 |
| Iron | **1,227** | [3]**300** | ND | 13,267 | 676 | 85.7 B | 189 | **1,740** |
| Lead | **4.0** | [7,5]**15** | **15** | 15 | 1.4 B | **44.9** | **36.2** | 6 |
| Magnesium | 4,560 | ND | ND | 118,807 | 2,570 B | 1,740 B | 4,970 B | 1,550 B |
| Manganese | **17.0** | [3]**50** | ND | 180 n | 15.9 | -- | 0.59 B | **84.7** |
| Mercury | 0.12 | [5]2 | 2 | 11 n | -- | -- | -- | 0.07 B |

See notes at end of table.

# Table 3-6 (Continued)
## Summary of Detections in Groundwater Analytical Results, Study Area 9
## Results As Reported in Groups I and II Site Screening Report

*Remedial Investigation and Feasibility Study Workplan*
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Well ID:<br>Identifier:<br>Sampling Date: | Background[1] | FDEPG | FEDMCL | RBC[2] for Tap Water | OLD-09-01<br>09G00101<br>16-Sep-94 | OLD-09-02<br>09G00201<br>20-Sep-94 | OLD-09-03<br>09G00301<br>20-Sep-94 | OLD-09-04<br>09G00401<br>20-Sep-94 |
|---|---|---|---|---|---|---|---|---|
| **<u>Inorganic Analytes</u> (µg/ℓ) (Continued)** | | | | | | | | |
| Nickel | -- | [5]100 | 100 | 730 n | 10.8 B | -- | -- | -- |
| Potassium | 5,400 | ND | ND | 297,016 | 3,830 B | 3,300 B | 2,210 B | 3,220 B |
| Sodium | 18,222 | [5]160,000 | ND | 396,022 | 6,090 | 3,560 B | 4,240 B | 4,470 B |
| Thallium | 3.8 | [5]2 | 2 | 2.9 n | -- | -- | -- | 1.4 J |
| Vanadium | 20.6 | [4]49 | ND | 260 n | -- | -- | -- | -- |
| Zinc | 4.0 | [3]5,000 | ND | 11,000 n | -- | -- | -- | 35.8 |

[1] Groundwater background screening value is twice the average of detected concentrations for inorganic analytes. For organic compounds, values are the mean of detected concentration, presented for comparison purposes only.
[2] Risk-Based Concentration Table, U.S. Environmental Protection Agency (USEPA) Region III, March, 1995, R.L. Smith. RBC for chromium is based on chromium VI. RBC for 2-methylnaphthalene is based on naphthalene. RBC for lead is not available, value is treatment technology action limit for lead in drinking water distribution system identified in Drinking Water Standards and Health Advisories (USEPA, 1995f). For essential nutrients (calcium, iron, magnesium, potassium, and sodium) screening values were derived based on recommended daily allowances.
[3] Secondary Standard.
[4] Primary Standard.
[5] Systemic Toxicant.
[6] Organoleptic.
[7] Value is the treatment technology action level.

Notes: Analytical results expressed in µg/ℓ.
Source of data is the Site Screening Report, Groups I and II, (ABB-ES, 1995).

ID = identification.
c = carcinogenic effects.
n = noncarcinogenic effects.
FDEPG = Florida Department of Environmental Protection, Groundwater Guidance Concentrations, June 1994.
FEDMCL = Federal Maximum Contaminant Levels, Primary Drinking Water Regulations and Health Advisories, May 1993.
B = Reported concentration is between the instrument detection limit and the contract required detection limit.
-- = Analyte/compound was not detected at the reporting limit.
ND = not determined.
J = reported concentration is an estimated quantity.
µg/ℓ = micrograms per liter.
USEPA = U.S. Environmental Protection Agency.
░ = Bold/shaded numbers indicate exceedance of groundwater guidance and background.

Potential Exposure Points. Potential receptors exposed to contamination associated with SA 8 and SA 9 have been identified by considering present and future land and groundwater uses. SA 8 is currently operational as a golf course maintenance area, and lawn maintenance equipment is currently housed in several buildings (Figure 2-2). SA 9 is currently a grassy area along Trident Lane. This area may be used for recreational purposes.

SA 8 and SA 9 are within the Main Base and are adjacent to or in close proximity to Lake Baldwin, a golf course, and onbase officer housing. Current land use at the Main Base consists of activities associated with the barracks, training facilities, administrative buildings, drill fields, and recreational areas. The Main Base is surrounded by urban development, including single and multifamily housing, schools, and commercial development. Land uses directly west and northwest of the facility are mainly residential. To the southwest of the Main Base, land use is commercial. Herndon Airport is located 1.5 miles to the south of the Main Base. No industrial facilities exist adjacent to the Main Base, except for automotive repair facilities on the southwest property line (ABB-ES, 1997).

The Main Base obtains its drinking water supply from the Orlando Utilities Commission and Winter Park Utilities (ABB-ES, 1997). One of the Orlando Utilities Commission's supply wells is located at the southeast corner of the Main Base. In addition, 10 irrigation wells are present on the Main Base. The exact location of any wells near SA 8 and 9 will be determined in a well survey conducted during the RI as part of the human health survey.

All surface water in the vicinity of NTC, Orlando is classified by the State of Florida as Class III surface water suitable for fish and wildlife propagation and water contact sports (ABB-ES, 1997). Groundwater in the surficial aquifer and the Floridan aquifer system at NTC, Orlando is classified as Class G-II groundwater suitable for potable use. The water table is less than 4 feet bls in this area and the surficial aquifer is assumed to discharge to the lake.

The receptors that are reasonable to consider under current exposure scenarios are recreational land users (SAs 8 and 9) and maintenance workers (SA 8). Because NTC, Orlando is slated for closure as a BRAC facility, it is conceivable that land use may change. However, the proposed land-use scenarios for OU 3 include parks and recreation, with adjacent residential areas.

Recognizing probable future land uses, the potential receptors have been identified and are listed below.

- Site maintenance workers, who perform routine lawn maintenance activities, such as mowing, weed control, and irrigation system repairs.
- Commercial workers (assumes only indoor exposures, i.e., minimal contact with site soils).
- Excavation workers.
- Recreational users.
- Future area residents.

A recreational user of surface water is not evaluated because Lake Baldwin was evaluated as a separate SA and has been approved for transfer (ABB-ES, 1996).

Potential Exposure Routes. The conceptual site model for SA 8 and SA 9 was presented in Subsection 3.1.1. The exposure pathways anticipated are shown in the conceptual model.

The reasonable potentially complete pathways to be considered are described below.

- Incidental ingestion and dermal contact with contaminants in soil and subsurface soil (excavation workers only). For evaluation of maintenance and excavation workers, inhalation is a potential exposure pathway for soil contaminants.

- Ingestion of and inhalation of volatiles while showering with groundwater by a future area resident.

Existing data suggest that contaminant exposure through ingestion of groundwater from within the Floridan aquifer is not probable or potential due to the presence of the Hawthorn Group, the principal aquitard impeding vertical flow between the surficial aquifer and the Floridan aquifer system.

3.1.3.2 **Ecological** The following paragraphs describe the potential ecological receptors and exposure pathways for OU 3. This information is based on previous investigations at OU 3 and other sites at NTC, Orlando.

Terrestrial Habitat and Receptors. Approximately 5 percent of the NTC, Orlando installation (roughly 100 acres basewide) is undeveloped, providing a limited amount of habitat for ecological receptors.

Three tree species provide the predominant vegetative cover at the base: live oak, slash pine, and cabbage palm. Wetland habitat is dominated by bald cypress (C.C. Johnson, 1985). Red maple and pines are additional dominant wetland tree species noted by ABB-ES ecologists during a brief reconnaissance of the installation (ABB-ES, 1994b). Additional information regarding vegetative cover types in the vicinity of OU 3 is not currently available, but will be obtained and incorporated into the habitat characterization of the RI.

Limited information is currently available regarding terrestrial fauna at NTC, Orlando and specifically at OU 3. Potential wildlife habitats in the vicinity of OU 3 will be evaluated and included in the RI.

Small mammals that may exist at the site include the eastern cottontail rabbit, hispid cotton rat, and cotton mouse. Predatory mammals such as the red fox and gray fox may feed on small mammals at the base.

Birds of prey such as the black vulture, turkey vulture, red-tailed hawk, red-shouldered hawk, bald eagle, and osprey may forage for prey items in the vicinity of the OU. An osprey nest has been observed along the shore of Lake Baldwin half- way between SA 8 and SA 9. Granivorous birds, such as the mourning dove, are likely to be found occasionally in the grassy areas that comprise the majority of habitats at the site. Other bird species that may exist at NTC, Orlando include the brown-headed cowbird, brown thrasher, bobwhite quail, mockingbird, common grackle, killdeer, northern cardinal, blue jay, rufous-sided towhee, common flicker, and red-bellied woodpecker.

Several species of venomous snakes may exist in the area, including the eastern coral snake, dusky pygmy rattlesnake, and eastern diamondback rattlesnake. These snakes are among the top predators in the food chain at the installation. Rattlesnakes feed on rodents, birds, amphibians, and small reptiles. Coral snakes ingest other snakes, lizards, and amphibians.

Aquatic Habitat and Receptors. All surface water in the vicinity of NTC, Orlando is classified by the State of Florida as Class III waters, suitable for fish and wildlife propagation and water contact sports.

The majority of aquatic habitat in the vicinity of OU 3 is located in Lake Baldwin, located approximately 100 to 200 feet downgradient of the OU. This lake provides habitat for a number of fish species, including smallmouth bass, bluegill sunfish, redear sunfish, golden shiner, yellow bullheads, and killifish, as well as aquatic invertebrates (C.C. Johnson, 1985). According to the NTC, Orlando Master Plan Update (SOUTHNAVFACENGCOM, 1985), grass carp have been introduced into several of the larger lakes (including Lake Baldwin) to control Florida elodea, an invasive, rapidly growing aquatic weed that chokes waterways, rendering them impassable to boat traffic (C.C. Johnson, 1985).

Amphibians that may live in the vicinity of the OU include frogs and toads, and possibly some salamanders. The Florida cottonmouth, a venomous aquatic snake inhabiting lakes, rivers, swamps, and ditches, also could exist in small, intermittent surface water bodies, such as the subtle drainage swales that exist near the site. Cottonmouths feed on fish, amphibians (e.g., frogs and salamanders), small- to medium-sized reptiles (e.g., lizards, small turtles, and baby alligators), small birds, and mammals. Turtles and other aquatic and semiaquatic reptiles (e.g., the American alligator) may exist in some of the lakes and other water bodies at the installation.

Rare, Threatened, and Endangered Species. Limited information is currently available regarding rare, threatened, and endangered species at NTC, Orlando. Additional information regarding rare, threatened, and endangered plants and animals will be requested from State and Federal authorities (i.e., Florida's Natural Heritage Program, the Florida Game and Fresh Water Fish Commission, and the U.S. Fish and Wildlife Service) during the RI.

Exposure Pathways The contaminant source for OU 3 is considered to be pesticide-contaminated soil. Contaminants from the source may migrate into environmental media. The contaminated media at OU 3 to which ecological receptors are potentially exposed include soil and groundwater (only as it contributes to sediment and surface water contamination).

Exposure of ecological receptors to contaminants can occur directly via contact with contaminated media or indirectly via the food chain. Significant exposures via the food chain, however, are only expected for chemicals known to bio-accumulate (i.e., organochlorine pesticides).

Terrestrial wildlife, plants, and invertebrates may be exposed to contaminants in surface soil. Aquatic organism exposures are unclear because available site data are insufficient to evaluate whether or not contaminants in groundwater are transported to Lake Baldwin. If these exposures represent a viable pathway, it is likely that sediment-dwelling invertebrates may primarily be exposed to contaminants in groundwater prior to discharge. In addition, water column invertebrates, fish, and amphibians may also be exposed to contaminants in groundwater; however, impacts to these receptors may not be significant since groundwater concentrations would be diluted upon discharge to surface water.

3.1.4 Preliminary Identification of Remedial Action Technologies The identification of preliminary remedial action technologies requires the identification of ARARs, remedial action objectives (RAOs), and probable treatment technologies.

3.1.4.1 **ARARs** Identification of Federal and State ARARs, along with other available nonpromulgated advisories, to be considered criteria (TBC) and guidance material is mandated by Section 121(d) of the CERCLA (as amended by the Superfund Amendment of 1986) and is a key component in the planning, evaluation, and selection of remedial actions. Although NTC, Orlando is not a CERCLA site, the process of identifying ARARs for sites managed under the Navy's IR program may be useful in the development of cleanup goals and the determination of appropriate remedial actions.

Applicable requirements. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site (55 Federal Register [FR] 8814, March 8, 1990 [National Oil and Hazardous Substances Pollution Contingency Plan]). Examples of applicable requirements include cleanup standards and standards of control for a hazardous substance.

Relevant and appropriate requirements. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal or State law that, although not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site (55 FR 8814). For example, the MCLs promulgated under the Safe Drinking Water Act (SDWA) would be considered relevant and appropriate at a site where surface or groundwater contamination could affect a potential (not actual) drinking water source.

A table is presented in Appendix A of this workplan that represents a preliminary compilation of potential ARARs for OU 3. As site-specific contaminants are identified and remedial actions are evaluated during the FS, ARARs will be added to or removed from this list. The ARARs in the table are identified by the following categories: chemical-, location-, and action-specific ARARs, and TBC criteria.

Chemical-specific ARARs. Chemical-specific requirements are standards that limit the concentration of a chemical found in or discharged to the environment. They govern the extent of site remediation by providing either actual cleanup levels or the basis for calculating such levels. Chemical-specific ARARs for a site may also be used to indicate acceptable levels of discharge for determining treatment and disposal requirements and to assess the effectiveness of future remedial alternatives.

Currently, there are no promulgated Federal or State chemical-specific ARARs that provide limits for the concentration of chemicals in soil. However, the State of Florida has provided guidance values for soil cleanups (FDEP, 1995).

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

Action-specific ARARs. Action-specific ARARs are technology- or activity-based limitations controlling activities for remedial actions. Action-specific ARARs generally set performance or design standards, controls, or restrictions on particular types of activities. To develop technically feasible alternatives, applicable performance or design standards must be considered during the detailed analysis of remedial alternatives.

TBCs. In the absence of Federal or State promulgated regulations, there are other criteria, advisories, guidance values, and proposed standards that are not legally binding, but may serve as useful guidance for setting protective cleanup levels. These are not potential ARARs, but are "to-be-considered" guidance.

The list of ARARs in Appendix A was used for the development of the probable remedial actions required at OU 3.

3.1.4.2 **Preliminary RAOs** Preliminary RAOs were identified through the assessment of the conceptual site model and the preliminary list of ARARs for OU 3 (Appendix A).

The intent of an RAO is to specify the media, contaminant, and probable exposure pathway that must be addressed through a remedial action to protect the public and environment. The preliminary RAOs identified in this subsection were developed to protect public health and the environment for both existing and potential future site conditions as presented by the conceptual site model. Under CERCLA guidance, the RAO should be calculated, on a cumulative basis, based on the list of CPCs detected in the media of concern and the corresponding acceptable exposure levels and routes. These criteria establish specific maximum allowable concentrations for each CPC detected at OU 3.

The probable contaminated media at OU 3 are surface soil, subsurface soil, and groundwater; potential contaminated media include air, surface water, and sediment.

Based on previous investigations, the CPCs at OU 3 are organic compounds, including chlorinated pesticides and PAHs, and inorganic compounds, including arsenic. Based on the list of ARARs, probable and potential contaminated media, and exposure pathways, specific RAOs for each of the CPCs will be developed for OU 3 and presented within the FS. However, preliminary RAOs, presented in this document, were developed based on probable and potential exposure pathways to support the development of the RI sampling requirements and contingent actions.

Therefore, the preliminary RAOs for OU 3 include (1) the elimination of dermal contact for maintenance workers and future recreational users through addressing contaminated surface soil through remedial action, and (2) the containment and/or treatment of contaminated groundwater and subsurface soil. Surface water and sediment are not considered in this evaluation.

3.1.4.3 **Preliminary Remedial Action Technologies** A limited evaluation of potential remedial action technologies was conducted to support the identification of data needs and development of remedial investigative requirements. The potential list of remedial technologies, including innovative and emerging technologies, was developed based on a literature review and the site conceptual model prepared for OU 3 (Figure 3-1). This site model identified the probable and potential contaminated media and the potential exposure pathway(s) and receptor(s) to these contaminated media.

Surface Soil. Exposure to contamination in surface soil is considered likely. Excavation of the "hot spots" of contamination in the surface soil with onsite treatment or off-site disposal is likely. Onsite treatment could be accomplished with various technologies, including soil washing, solvent extraction, or thermal desorption (or a combination of these methods). Off-site disposal could entail the delivery of the contaminated soil to a landfill suitable to receive such wastes.

Subsurface Soil. Remediation of subsurface soil could also be an option if very high contaminant concentrations are found. Dewatering of the contaminated area and excavation of the hot spots (if identified) could occur with onsite treatment or off-site disposal methods similar to those mentioned for surface soil.

Groundwater. The release of contaminants to groundwater has been considered as a potential exposure pathway. Collection of the shallow groundwater downgradient of SA 8 and SA 9 could be successfully accomplished by subdrain trenches and/or a network of wells. Once the contaminated groundwater has been collected, it could be treated. Treatment methods could include either physical (e.g., filtration) or chemical (e.g., ultraviolet light and oxidation) treatment technologies. Discharge options include injection and recirculation; discharge to a publicly owned treatment works (POTW), and surface water discharge. Potential *in situ* technologies were also evaluated and will continue to be evaluated throughout the RI/FS process.

Data collection during the RI will determine the need for this remedial action and support the evaluation of multiple treatment alternatives.

A preliminary list of remedial technologies and process options has been prepared based on the information available for OU 3. Within each technology, there may be several process options, such as biological treatment of contaminated groundwater by aerobic and anaerobic processes. These remedial technologies and process options are presented on Figure 3-4. Additional technologies and process options may be identified following the remedial investigation. The screening of the remedial technologies and development of remedial alternatives is discussed in Chapter 8.0 of this workplan.

**3.2 TECHNICAL APPROACH**. Through BRAC, OU 3 will be transferred from the Navy to the City of Orlando. Before this can happen, an RI/FS must be conducted. Potential risks to human or ecological receptors from exposure to contaminants

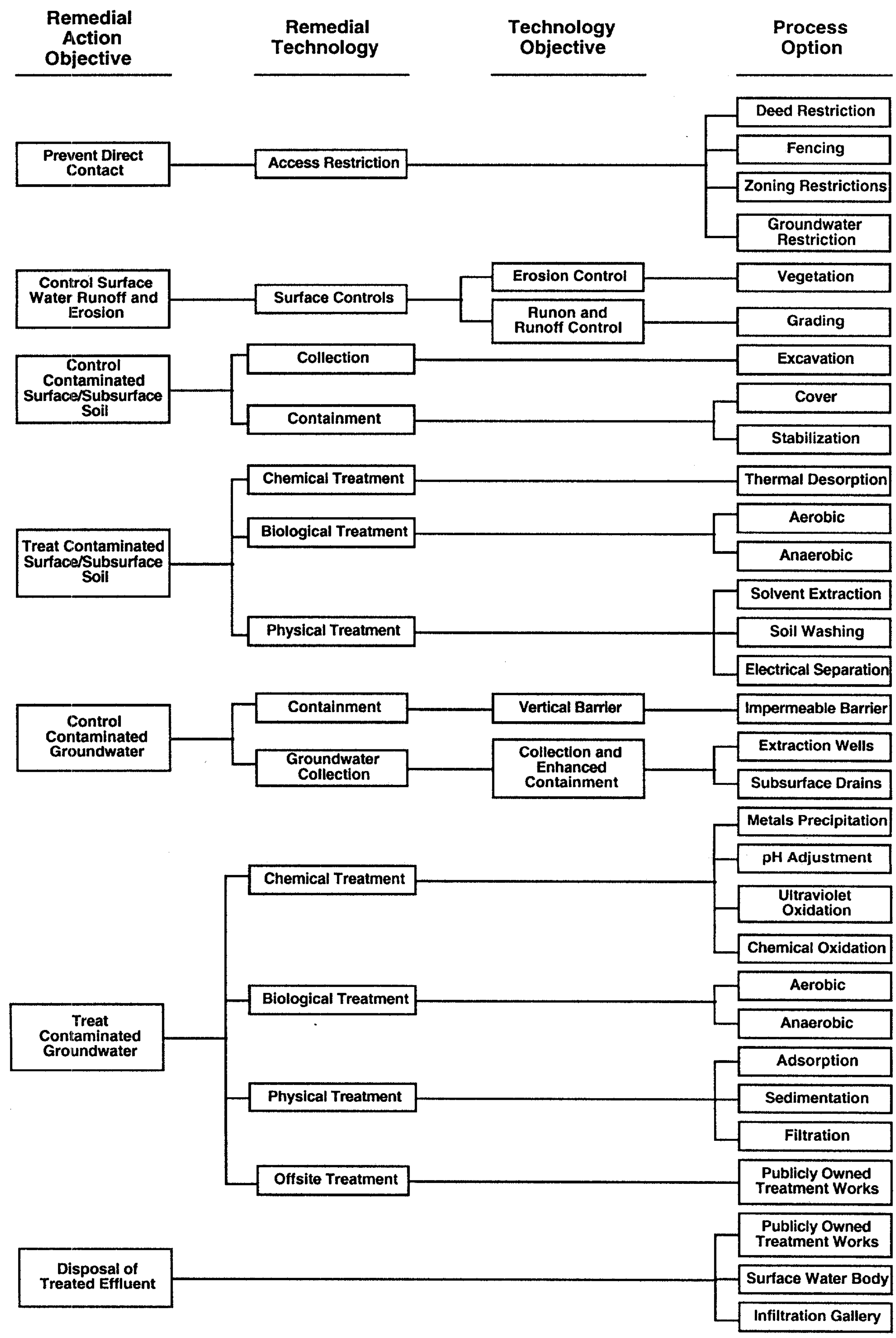


FIGURE 3-4
PRELIMINARY REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

RI/FS WORKPLAN, OPERABLE UNIT 3, STUDY AREAS 8 AND 9
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

8557-07-TKA FIG 3-4 061297HAS

must be evaluated. If unacceptable risks are identified, remedial alternatives will have to be developed and implemented to reduce the risk to acceptable levels.

The first step in this process will be a field investigation to collect the information needed to conduct a risk assessment and, if necessary, proceed with an FS. The technical approach to the investigation at OU 3 was developed by applying the "observational approach."

The basic premise of the observational approach is recognizing uncertainty. It is often assumed that investing more time and resources in the investigation and study phases of a project will greatly reduce the uncertainties encountered in later stages. However, as has been demonstrated in previous Superfund projects, major technical uncertainties exist in all phases of hazardous waste site characterization and remediation. There remains uncertainty in characterizing the affected media, predicting contaminant fate and transport, assessing risk, and predicting technology performance. The observational approach recognizes that complete site characterization is not possible or necessary and, therefore, characterization only needs to be sufficient to manage remaining uncertainties.

Therefore, only data that are required to support remedial decisions will be collected.

For example, when conducting an FS for soil, engineers need to know the distribution of contaminants. However, the distribution of contaminants only needs to be sufficient to develop a conceptual model that can be used as a basis to develop, evaluate, and compare alternatives. Frequently, the distribution of contaminants will be further defined by collecting confirmatory samples during the implementation of an alternative.

Based on the initial evaluation of OU 3, soil and groundwater need to be investigated during the RI. Surface water and sediment will not be directly assessed because Lake Baldwin has already been the subject of an investigation. Additionally, contaminants detected in surface water and sediment may be from sources other than OU 3. By evaluating the migration pathways at SA 8 and SA 9 (surface water runoff and groundwater), the effects of OU 3 on the lake can be predicted.

Table 3-7 lists the data needs identified for SA 8 and SA 9. The table also describes how the data will be collected to meet these needs. Table 3-8 lists and describes the data quality levels that will be used. Data quality levels are described in more detail in the Project Operations Plan (POP, ABB-ES, 1997).

Based on the data needs and the conceptual model, the following approaches have been developed for the groundwater and soil assessments at SA 8 and SA 9:

<u>Groundwater Assessment</u>.

- Microwells will be installed in "fences" roughly perpendicular to the direction of groundwater flow. Existing monitoring wells will be used as part of these fences.

- Groundwater samples will be collected from the microwells and existing monitoring wells.

## Table 3-7
## Summary of Data Needs and Uses

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
*Naval Training Center, Orlando, Florida*

| Data Need | Uses | Data Collection |
|---|---|---|
| nature of contaminants | RA - estimate effects to receptors<br>FS - select remedial technologies, develop cleanup goals | Collect and analyze soil and groundwater samples for suspected contaminants. Conduct further analyses to provide more detail (e.g., speciation of inorganics) |
| contaminant distribution | RA - calculate exposure concentrations<br>FS - estimate costs and assess the implementability of alternatives | Collect soil samples from grids in source areas and from migration pathways. Collect groundwater samples from well "fences." |
| exposure pathways | RA - develop exposure scenarios | Conduct ecological and human health surveys at the sites. Collect samples from potential migration pathways |
| receptors | RA - develop exposure scenarios | Conduct ecological and human health surveys at the sites. Collect samples from potential migration pathways |
| physical properties of media (e.g., pH, TOC, hydraulic conductivity) | FS - evaluate the potential effectiveness and limitations of remedial alternatives | Collect samples and analyze for physical properties. Some tests may be conducted *in situ* (e.g., hydraulic conductivity testing) |
| ARARs | FS - evaluate implementability and compare alternatives | Investigate and identify ARARs |

Notes: RA = Risk Assessment.
FS = Feasibility Study.
TOC = total organic carbon.
ARAR = applicable or relevant and appropriate requirement.

**Table 3-8**
**Data Quality Levels**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center, Orlando, Florida

| Data Quality Level | Data Type | Definition |
|---|---|---|
| A | Field Screening | Characterized by use of portable field instruments that can provide real time data both for personnel health and safety and to optimize locating sampling points. |
| B | Field Analysis | Characterized by use of portable analytical instruments for onsite use or in mobile laboratories near a site. |
| C | Laboratory Analysis | Characterized by use of methods other than the CLP-RAS, but which may be equivalent without the CLP requirements for documentation. |
| D | Laboratory Analysis CLP-RAS | Characterized by rigorous quality assurance and quality control protocols and documentation, providing qualitative and quantitative analytical data. |
| E | Nonstandard Methods | Includes analyses that may require modification and/or development. |

The data quality levels used in this investigation are equivalent to those described in *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation and Restoration Program* (Naval Energy and Environmental Support Activity, 1988). These data quality levels correspond to USEPA's former data quality levels I through V.

Notes: CLP - Contract Laboratory program.
RAS - Routine Analytical Services.
USEPA - U.S. Environmental Protection Agency.

- Data from the first phase of the groundwater investigation will be evaluated and used to develop a conceptual model of contaminant nature, distribution, and transport in the aquifer.

- Based on the conceptual model, well points will be installed along the shore of Lake Baldwin downgradient from the SAs. Groundwater samples will be collected from the well points and analyzed. The results of these samples will be used to evaluate what concentrations of contaminants may be entering the lake.

- Based on the conceptual model, locations for conventional monitoring wells will be selected. A technical memorandum or presentation that describes the conceptual model and the proposed well locations will be submitted to or discussed with the OPT. The OPT will approve the locations of conventional monitoring wells.

- After conventional wells are installed and developed, groundwater samples will be collected from the new wells.

Soil Assessment.

- Soil sampling grids will be established in and around the work areas at SA 8 and SA 9. These are the areas where contaminants are known to be present. If groundwater data indicate that there are sources of contaminants outside the work areas, the grid will be expanded to include those areas where the other source area(s) may be located.

- Surface soil samples will be collected from the grid nodes. Exact sample locations will be modified as necessary based on field conditions.

- Additional surface soil samples will be collected from areas of suspected contamination outside of the grids (e.g., the possible former wash area south of SA 8). Locations of these additional samples will be based on historical information and/or site observations.

- Surface soil samples will be collected from drainage swales that lead away from the SAs. Results from these samples will be used to evaluate the migration of contaminants via surface water runoff.

- Surface soil data will be evaluated, and locations with the highest concentrations will be selected for subsurface and supplemental surface soil sampling. The subsurface soil samples will be collected to evaluate the depth of contamination. The supplemental surface soil samples will be collected and analyzed for soil characteristics and to further evaluate the nature of contaminants (e.g., determining the species of arsenic that are present).

The approaches to the soil and groundwater investigations are described in more detail in Chapter 4.0. These approaches were based on the following assumptions, which will be verified during the field investigation:

- The primary sources of contamination are confined to the "work areas" where most of the activities at the sites took place. These areas were identified by analyzing aerial photographs taken throughout the history of the sites.

- The highest concentrations of chemicals will be detected in surface soil because the primary release mechanism was spills, and the suspected contaminants (e.g., pesticides, PAHs, and arsenic) sorb strongly to soil and are relatively immobile.

- The most likely migration pathways for contaminants from the sites are groundwater and surface water runoff.

- The potential impacts, if any, that these sites have on Lake Baldwin can be assessed by evaluating samples collected from the migration pathways (i.e., groundwater samples collected from well points near the shoreline and soil samples collected from drainage swales).

## 4.0 SITE CHARACTERIZATION METHODS

This chapter describes how the RI field investigation at OU 3 will be conducted. Specific sampling procedures are described in the POP (ABB-ES, 1997) and are referenced in the appropriate sections of this chapter.

**4.1 SOIL INVESTIGATIONS**. The following objectives have been established for the soil investigations at OU 3:

- evaluate the nature and distribution of soil contamination,
- identify potential sources of groundwater contamination,
- evaluate potential migration of contaminants off site via surface water runoff, and
- develop sufficient information to complete the risk assessment and the FS.

These objectives will be met by using a two-phased approach. As described in the preceding chapter, based on the nature of the contaminants detected at OU 3, the highest concentrations are expected in surface soil. Therefore, the first phase of the soil investigation will consist of surface soil sampling. Three types of surface soil samples will be collected: (1) grid samples, (2) biased samples, and (3) drainage swale samples.

The sampling grids established at each SA will cover those portions of the site where contamination is considered most likely based on historical information and site screening data. The grid node spacing has been selected using statistical methods. The biased samples will be collected from areas where contamination is possible but considered less likely than in the grid areas. The grid samples and biased samples will be used to evaluate the nature and distribution of contaminants in the source areas. Samples will also be collected from drainage swales that are in or adjacent to the SAs and carry storm water runoff to Lake Baldwin. Samples from the drainage swales will be used to evaluate the migration of contaminants via surface runoff.

It should be noted that the IRAs discussed in Section 2.5 have been implemented since issuing the draft RI/FS workplan for OU 3. As such, surface soil sampling in certain areas at the sites is not warranted because the soil has been removed from the site. However, as agreed upon by the OPT in September 1997, all grid samples proposed in the draft workplan and located outside the areas of excavation during the IRA will be collected during the first phase of soil sampling. The remaining samples may be collected during the second phase of sampling, if necessary.

In the second phase of the soil investigation, investigators will return to locations where the highest concentrations of contaminants were detected in surface soil and collect additional surface soil samples. These samples will be analyzed for soil characteristics (e.g., pH, total organic carbon [TOC]) and other parameters to further evaluate the nature of the contaminants (e.g., arsenic speciation). Subsurface soil samples will also be collected from these locations to evaluate the depth of contamination. If necessary, investigators may also expand the surface soil sampling grids and collect samples from the additional grid nodes during this phase.

Table 4-1 provides a summary of the soil sampling program. The following subsections describe, in more detail, how the soil investigation will be conducted.

__4.1.1 Sampling Grids__ Grids will be established at each site; the approximate orientation of the grids are shown on Figures 4-1 and 4-2. As previously discussed, the IRAs (Section 2.5) have been implemented since issuing the draft RI/FS workplan for OU 3, thereby eliminating the necessity of collecting surface soil samples from certain areas at the sites. The OPT has agreed to collect all grid samples proposed in the draft workplan located outside the areas of excavation during the IRA. The remaining samples may be collected during the second phase of sampling, if necessary. The grid node spacing at SA 8 will be 30 feet, and the grid will cover an area of approximately 150 feet by 210 feet. The grid node spacing at SA 9 will be 20 feet, and the grid will cover an area approximately 80 feet by 100 feet.

The node spacing for the grids was calculated using procedures presented in "Statistical Methods for Environmental Pollution Monitoring" (Gilbert, 1987). Site screening data were the basis for these calculations. At SA 8, arsenic was detected at concentrations greater than 12 mg/kg in 3 soil samples collected near Building 2134. The distance between these samples is approximately 40 feet. Assuming that all three samples are associated with the same source area, the hot spot is estimated to be 50 feet long. Because the width of the hot spot is not known, it was assumed that the width was half the length or 25 feet. Based on these dimensions and a confidence interval of 95 percent, the grid spacing for SA 8 was calculated to be approximately 30 feet. The size of the hot spot used in these calculations is consistent with groundwater data that suggest a broad source area at SA 8.

The site screening data from SA 9 do not provide as much information about the size of potential hot spots because the samples were more widely distributed. To compensate for this uncertainty, a reduced grid spacing of 20 feet has been selected for SA 9.

Grids will be established using the procedures described in the POP. After the grids are established, the field crew will record the grid location of existing monitoring wells or microwells with respect to the grid (this information can be used to locate the grid on maps). Some grid nodes will be surveyed (see Subsection 4.3.3). Exact sample locations will be modified as necessary based on field conditions.

__4.1.2 Soil Sampling - First Phase__ The first phase of soil sampling will include the collection of surface soil samples. Surface soil samples will be collected from each grid node, and additional samples will be collected at the following locations:

- the wash area south of SA 8,
- the drainage swale east of SA 9,
- around the west side of the former Building 2132 at SA 9,

**Table 4-1**
**Summary of Soil Sampling Program**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Sample Type | Total Samples | Analytical Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SVOC | Pesticides/ PCB | Herbicides | Metals | Iron Oxides | Arsenic Speciation | pH | Redox | TOC |
| First Phase | | | | | | | | | | |
| SA 8 Grid Samples | 41 | X | X | X | X | | | | | |
| SA 8 Biased Samples | 3 | X | X | X | X | | | | | |
| SA 9 Grid Samples | 23 | X | X | X | X | | | | | |
| SA 9 Biased Samples | 9 | X | X | X | X | | | | | |
| SA 9 Drainage Swale Samples | 6 | X | X | X | X | | | | | |
| First Phase Quality Control | | | | | | | | | | |
| Equipment Rinsate Blanks | (a) | X | X | X | X | | | | | |
| Field Blanks | (d) | X | X | X | X | | | | | |
| Field Duplicates | 9 | X | X | X | X | | | | | |
| MS/MSDs | 4 | X | X | X | X | | | | | |
| Second Phase | | | | | | | | | | |
| SA 8 Grid Samples | (b) | X | X | X | X | | | | | |
| SA 8 Follow-on Surface Samples | 4 | | | | | X | X | X | X | X |
| SA 8 Subsurface Soil Samples | 15 | X | X | X | X | X | X | X | X | X |
| SA 9 Grid Samples | (b) | X | X | X | X | | | | | |
| SA 9 Follow-on Surface Samples | 4 | | | | | X | X | X | X | X |
| SA 9 Subsurface Soil Samples | 15 | X | X | X | X | X | X | X | X | X |

See notes at end of table.

**Table 4-1 (Continued)**
**Summary of Soil Sampling Program**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Sample Type | Total Samples | Analytical Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SVOC | Pesticides/ PCB | Herbicides | Metals | Iron Oxides | Arsenic Speciation | pH | Redox | TOC |
| Second Phase Quality Control | | | | | | | | | | |
| Equipment Rinsate Blanks | (a) | X | X | X | X | X | X | | | |
| Field Blanks | (d) | X | X | X | X | X | X | | | |
| Field Duplicates | (c) | X | X | X | X | X | X | | | |
| MS/MSDs | (c) | X | X | X | X | X | X | | | |

(a) One equipment rinsate blank will be collected each day that samples are collected.
(b) The number of grid samples collected during the second phase will be determined based on data from the first phase.
(c) One field duplicate will be collected for each 10 samples collected during the second phase of sampling, and MS/MSDs will be collected for each 20 samples collected.
(d) Source water blanks will be collected. One sample will be collected at the beginning of the field program, and one sample will be collected at the end of the program.

Notes: SVOC = Contract Laboratory Program Target Analyte List semivolatile organics.
Pesticides = Contract Laboratory Program Target Analyte List pesticides
PCB = Contract Laboratory Program Target Analyte List polychlorinated biphenyls
Metals = Contract Laboratory Program Target Compound List Metals.
Redox = reduction/oxidation potential.
TOC = total organic carbon.
SA = study area.
MS/MSD = matrix spike/matrix spike duplicate.

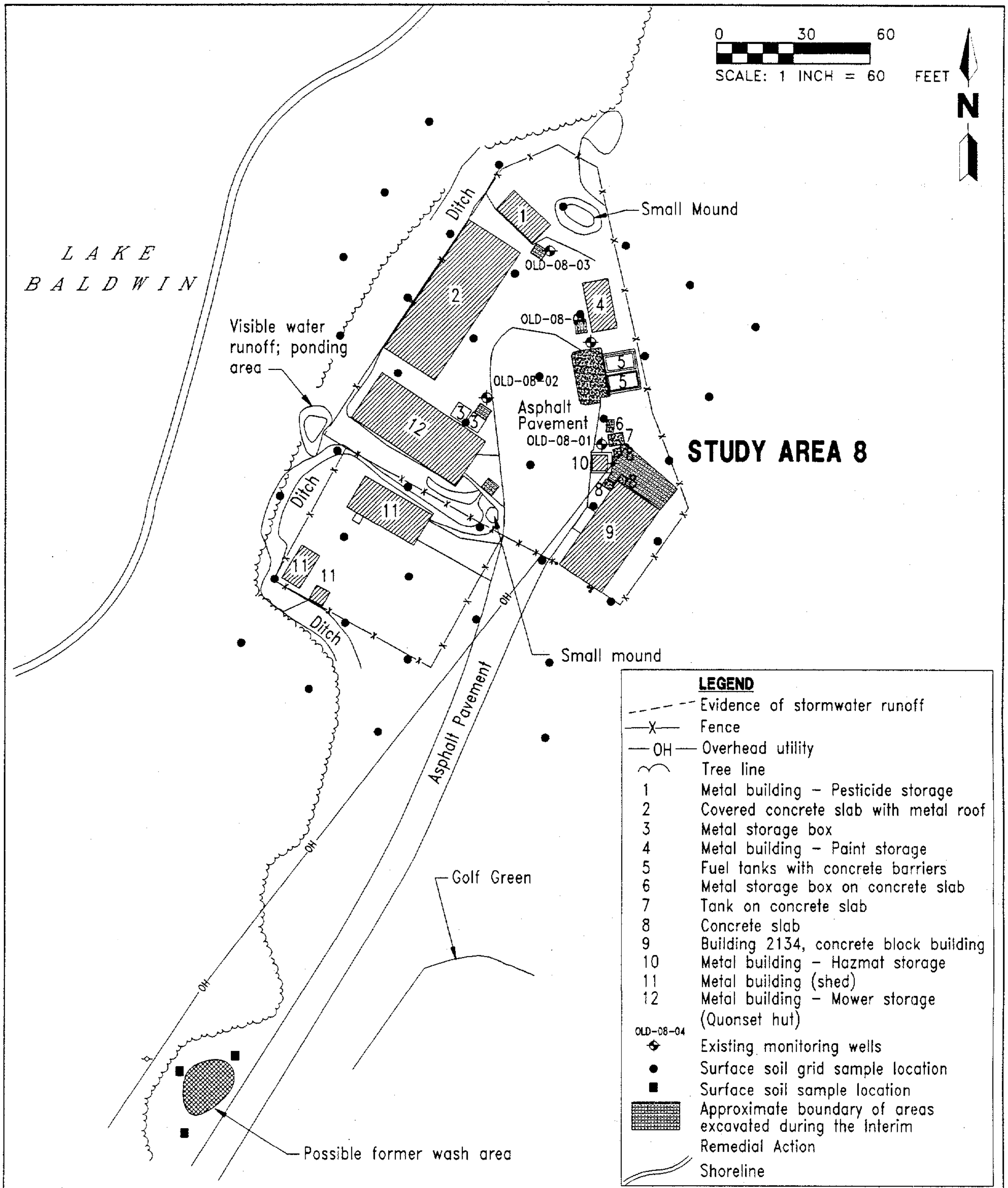


**FIGURE 4-1**
**STUDY AREA 8**
**SURFACE SOIL SAMPLE LOCATIONS**

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**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

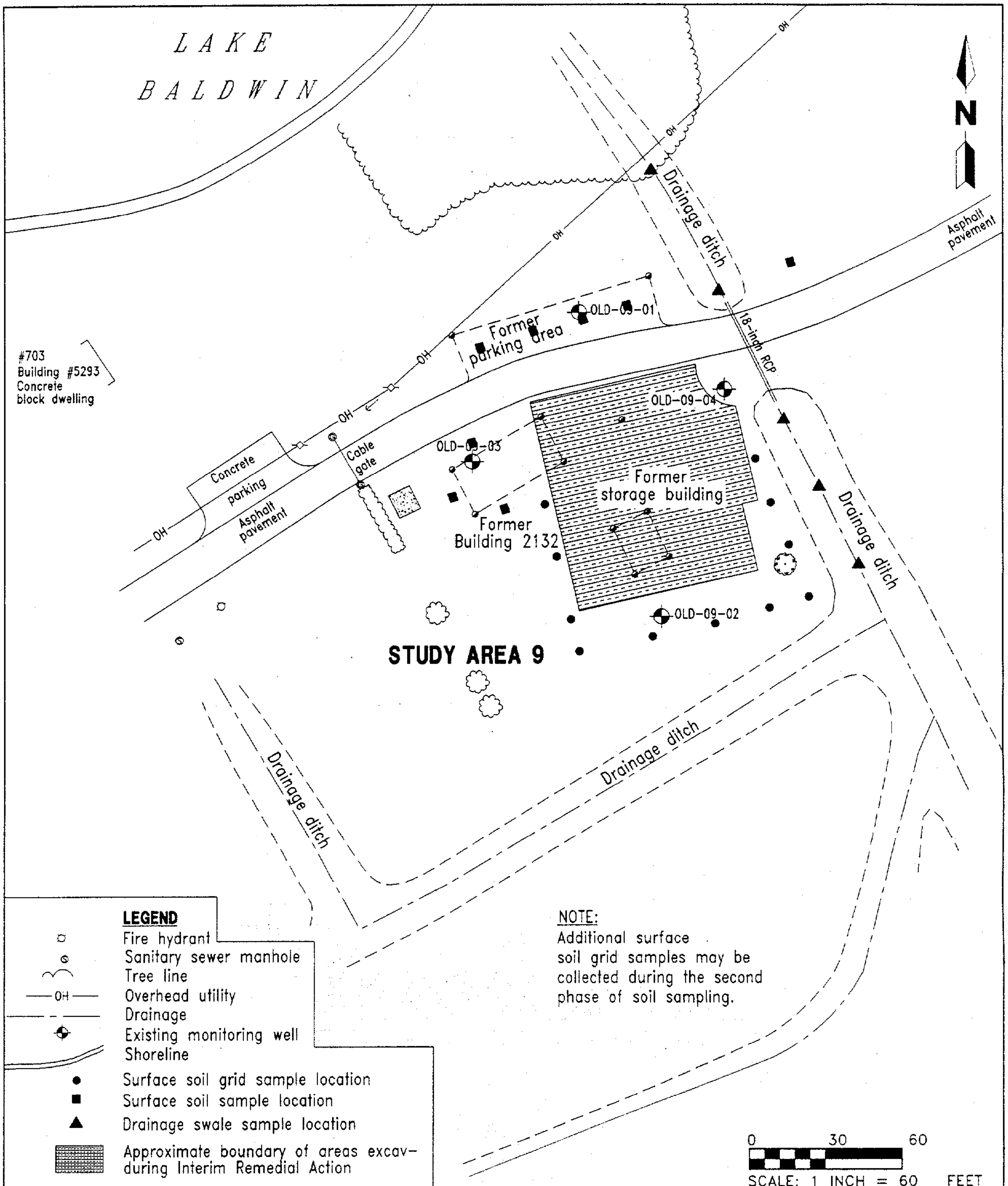


**FIGURE 4-2**
**STUDY AREA 9**
**SURFACE SOIL SAMPLE LOCATIONS**

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**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

- the former parking area at SA 9 on the north side of Trident Lane, and

- the north side of Trident Lane east of the drainage ditch at SA 9 (to evaluate a potential migration pathway via surface water runoff).

The locations of the grid samples and the additional samples are shown on Figures 4-1 and 4-2.

At SA 9, there is a drainage swale that borders the eastern side of the site. This swale is dry except during rain storms; therefore, samples collected from the swale will be considered soil and not sediment. Water in the swale flows north into Lake Baldwin. Samples of soil will be collected from within this swale at the inlet and outlet of the culvert under Trident Lane, the end of the swale near Lake Baldwin, and several other locations (Figure 4-2).

Because of the brush between SA 8 and Lake Baldwin, no well-defined drainage swales have been identified at SA 8. Therefore, no drainage swale sample locations have been identified. However, based on field observations, surface runoff from rain storms flows toward Lake Baldwin. To characterize the soil along this migration pathway, the locations of the grid nodes closest to Lake Baldwin may be adjusted based on field observations during the sampling event. Grid node samples that are relocated to evaluate migration via runoff will be staked and surveyed.

Paragraph 4.5.1.1 of the POP describes the procedures for collecting surface soil samples. However, sampling procedures will vary from the POP in the following cases:

- at SA 9, in areas where crushed stone underlies a layer of topsoil (see Figure 4-2), samples will be collected and composited from 0 to 2 feet bls and

- a TerraProbe℠ may be used to penetrate the pavement at SA 8 and collect samples.

Soil samples collected during this phase will be analyzed for CLP TCL SVOCs, pesticides and PCBs, TAL metals, and herbicides. Data quality level D will be used for all surface soil samples. Samples will be numbered consecutively starting with 08S009 at SA 8 and 09S005 at SA 9.

<u>4.1.3 Soil Sampling - Second Phase</u> The second phase of soil sampling will include subsurface soil sampling and follow-on surface soil sampling. The sampling locations for the second phase will be selected based on the results from soil samples collected during the first phase.

At each SA, investigators will identify the four locations where the highest concentrations of contaminants were detected in soil samples collected during the first phase. At these locations, one surface soil sample and three subsurface soil samples will be collected. Subsurface soil samples will also be collected from the locations where samples 09S001 and 08S007 were collected during the site screening (these samples had the highest concentration of contaminants detected during the site screening).

The subsurface samples will be collected at 2 to 3, 3 to 4, and 4 to 5 feet bls. Subsurface soil samples collected from these locations will be used to identify the maximum depth at which contaminants can be expected. If a remedial action is implemented, the depth of contamination in other portions of the sites can be assessed by confirmatory samples.

The surface soil samples during the second phase will be analyzed for pH, iron oxides, redox potential, TOC, and to evaluate what species of arsenic are present. Subsurface soil samples will be analyzed for these same parameters and TAL metals. In addition, these subsurface soil samples will be analyzed for those organic compounds detected in the associated surface soil samples. For example, if pesticides were detected the surface soil grid sample, the subsurface soil sample collected from this location will be analyzed for pesticides.

If contaminants are detected in surface soil samples collected from outer grid nodes in the first phase at concentrations greater than background screening values, the grid may be expanded and additional surface soil samples may be collected. The decision to expand the grid will be based on an evaluation of contaminant distribution and discussion with the OPT. If additional samples are collected, they will be analyzed for TCL SVOCs, pesticides, and PCBs, TAL metals, and herbicides.

Data quality level C will be used for the second phase of soil sampling, including, surface soil samples collected for supplemental parameters and all subsurface soil samples. Data quality level D will be used for surface soil samples collected from new grid nodes. Subsurface soil samples will be numbered consecutively beginning with 08B010 at SA 8 and 09B002 at SA 9.

The procedures for subsurface soil sampling are described in Paragraph 4.5.1.3 of the POP.

4.2 <u>GROUNDWATER INVESTIGATIONS</u>. The objectives of the groundwater investigation at OU 3 are

- characterize the vertical and horizontal distribution of groundwater contamination and
- develop sufficient information to complete the risk assessment and the FS.

These objectives will be met by using a two-phased approach. The first phase will include the installation of microwells. These microwells, along with the existing monitoring wells, will form well "fences." Groundwater samples collected from the microwells and existing wells will be used to develop a conceptual model of the conditions in the shallow surficial aquifer, which will include the horizontal distribution of potential contaminants in the groundwater. Proposed locations for the microwells are shown on Figures 4-3 and 4-4.

Microwells have been selected for the initial phase of the groundwater assessment for the reasons below.

- Cost Effective - Several microwells can be installed for the price of a conventional well.

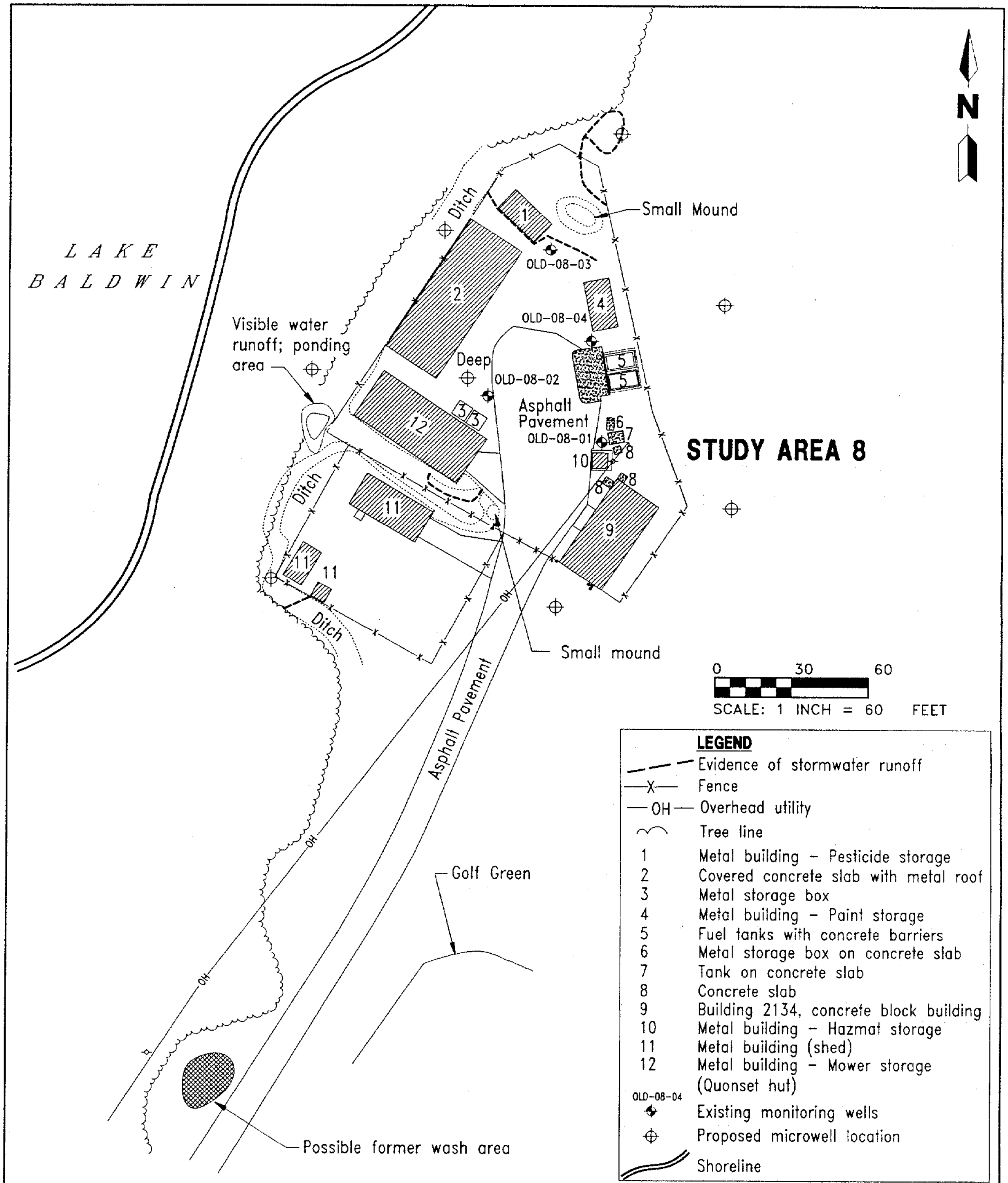


**FIGURE 4-3**
**STUDY AREA 8**
**GROUNDWATER SAMPLE LOCATIONS**

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**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

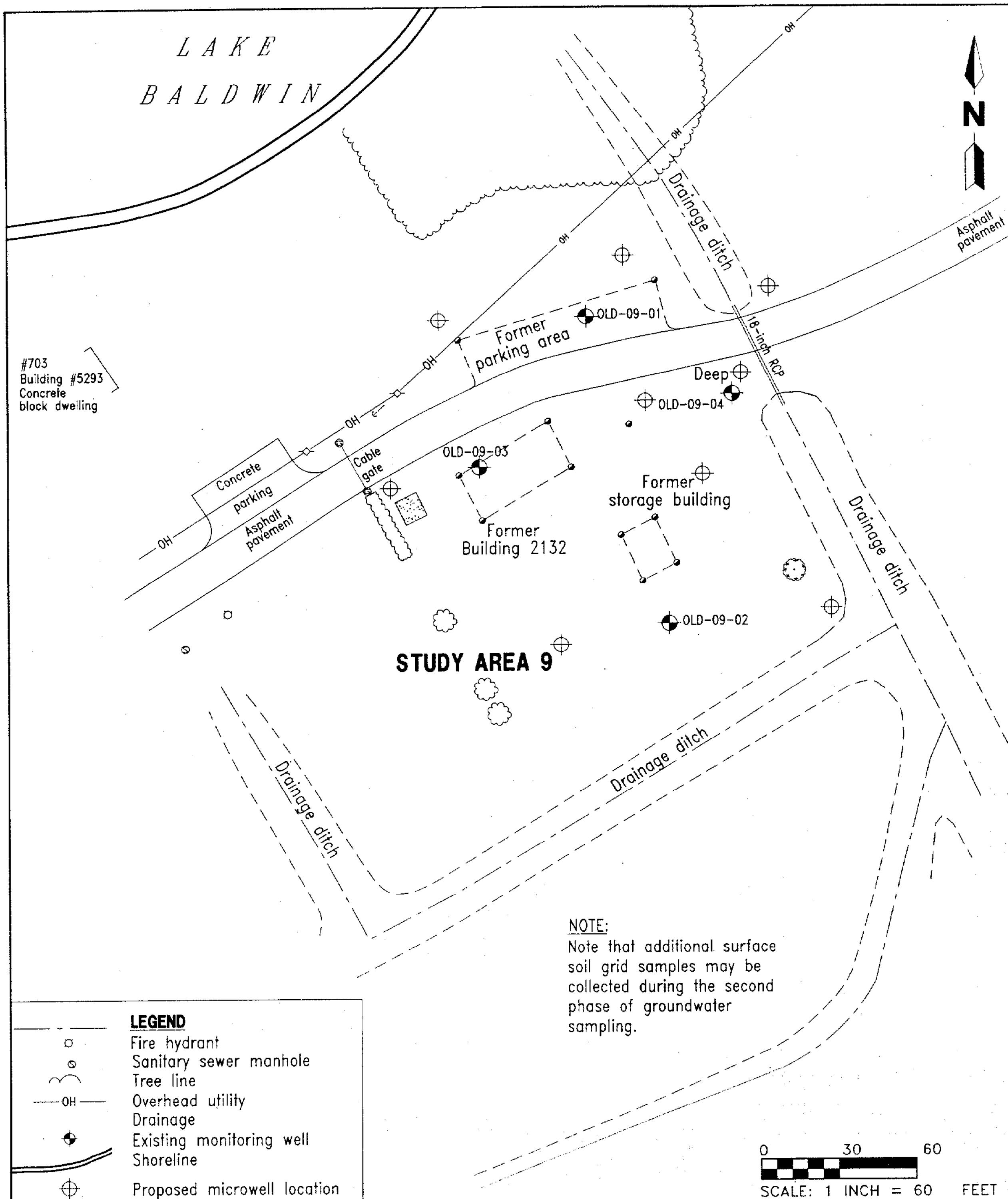


**FIGURE 4-4**
**STUDY AREA 9**
**GROUNDWATER SAMPLE LOCATIONS**

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**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
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- Future Land Use - When the OU 3 property is transferred, it is likely that monitoring wells will have to be abandoned. Microwells can be more easily abandoned.

- OPT Participation - Microwells will provide high quality data that can be used to select conventional well locations.

- Streamlines Groundwater Assessment - The microwells will help remove some of the uncertainty from the groundwater investigation. Evaluating groundwater quality using conventional wells alone could result in an iterative process of well installation and analysis. Microwells will help avoid this iterative process by providing information that investigators can use to select the most appropriate well locations before conventional wells are installed. Results of samples collected from the microwells will be used to select locations for conventional monitoring wells that will supplement the existing monitoring well network and help meet the second objective.

- Less IDW - Microwell installation produces less IDW than conventional well installation.

- Easier Access and Less Disruption - Well locations may be more easily accessible to equipment that is used to install microwells. The equipment used to install the microwells is less disruptive to the area surrounding the well location.

During the second phase of the investigation, data from the first phase will be used to select locations for conventional monitoring wells in and around the SAs and well points downgradient along the shore of Lake Baldwin. The results from the microwells, the conceptual model of site conditions, and the proposed locations for conventional monitoring wells will be presented to the OPT in the form of a brief letter report and at a meeting. The meeting will be a working session at which the final monitoring well locations and depths will be agreed upon. This approach, a screening program followed by a working session to finalize monitoring well locations, will expedite the completion of the RI. An example of conventional well and well point locations is shown on Figure 4-5. Table 4-2 provides a summary of the groundwater sampling program. The following subsections describe, in more detail, how the groundwater investigation will be conducted.

<u>4.2.1 Monitoring Well Installation</u> Three types of wells will be installed during the investigations at OU 3 (i.e., microwells, well points, and conventional wells). The following subsections describe how and where each type of well will be installed.

4.2.1.1 **Microwells** Microwells will be used during the first phase of the groundwater investigation to provide an initial evaluation of the distribution of contaminants in groundwater at the SAs. These microwells will be used in conjunction with existing monitoring wells to form well "fences."

Water table microwells will have screens that are approximately 9 feet long and include a preinstalled filter pack. The top of the screen will be installed approximately 1 foot above the water table. Figures 4-3 and 4-4 show where microwells will be installed at SAs 8 and 9, respectively.

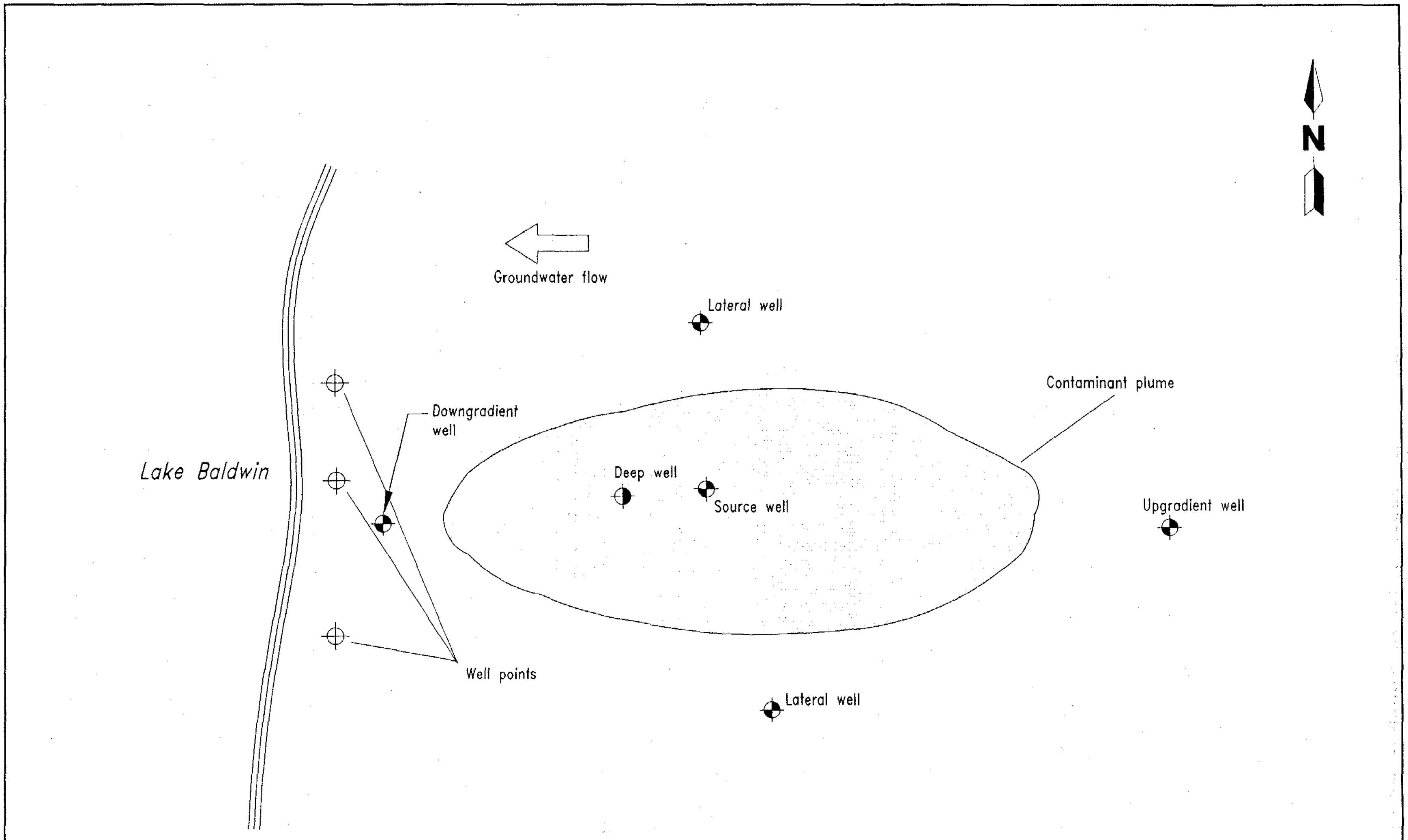


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**FIGURE 4-5**
**EXAMPLE MONITORING WELL LOCATIONS**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**
**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

## Table 4-2
## Summary of Groundwater Sampling Program

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Sample Type | Total Samples | Analytical Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SVOC | Pesticides/ PCB | Herbicides | Metals | Arsenic Speciation[d] | pH[e] | Redox[e] | TOC | TSS |
| First Phase | | | | | | | | | | |
| SA 8 Microwell Samples | 8 | X | X | X | X | | X | X | X | X |
| SA 8 Conventional Well Samples | 4 | X | X | X | X | | X | X | X | X |
| SA 8 Filtered Samples | (a) | | | | X | | | | | |
| SA 9 Microwell Samples | 9 | X | X | X | X | | X | X | X | X |
| SA 9 Conventional Samples | 4 | X | X | X | X | | X | X | X | X |
| SA 9 Filtered Samples | (a) | | | | X | | | | | |
| First Phase Quality Control | | | | | | | | | | |
| Source Water Blanks | (c) | X | X | X | X | | | | | |
| Equipment Rinsate Blanks | (b) | X | X | X | X | | | | | |
| Field Duplicates | 3 | X | X | X | X | | | | | |
| MS/MSDs | 2 | X | X | X | X | | | | | |
| Second Phase | | | | | | | | | | |
| SA 8 Well Point Samples | 3 | X | X | X | X | X | X | X | X | X |
| SA 8 Conventional Well Samples | 5 | X | X | X | X | X | X | X | X | X |
| SA 8 Filtered Samples | (a) | | | | X | X | | | | |
| SA 9 Well Point Samples | 3 | X | X | X | X | X | X | X | X | X |
| SA 9 Conventional Well Samples | 5 | X | X | X | X | X | X | X | X | X |
| SA 9 Filtered Samples | (a) | | | | X | X | | | | |

See notes at end of table.

**Table 4-2 (Continued)**
**Summary of Groundwater Sampling Program**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Sample Type | Total Samples | Analytical Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | SVOC | Pesticides/ PCB | Herbicides | Metals | Arsenic Speciation[d] | pH[e] | Redox[e] | TOC | TSS |
| Second Phase Quality Control | | | | | | | | | | |
| Source Water Blanks | (c) | X | X | X | X | X | | | | |
| Equipment Rinsate Blanks | (b) | X | X | X | X | X | | | | |
| Field Duplicates | 2 | X | X | X | X | X | | | | |
| MS/MSDs | 1 | X | X | X | X | X | | | | |

(a) At least one filtered sample will be collected for each 10 samples collected for metals analysis. Additional filtered samples may be required if samples are turbid.
(b) One equipment rinsate blank will be collected each day that samples are collected.
(c) Source water blanks will be collected. One sample will be collected at the beginning of the field program and one at the end of the program.
(d) Additional groundwater samples may be collected for arsenic speciation analysis during the second phase of groundwater sampling.
(e) pH and Redox potential will be measured in the field during the investigation.

Notes: SVOC = Contract Laboratory Program Target Analyte List semivolatile organics.
Pesticides = Contract Laboratory Program Target Analyte List pesticides.
PCB = Contract Laboratory Program Target Analyte List polychlorinated biphenyls
Metals = Contract Laboratory Program Target Compound List Metals.
Redox = reduction/oxidation potential.
TOC = total organic carbon.
TSS = total suspended solids.
SA = study area.
MS/MSD = matrix spike/matrix spike duplicate.

One deep microwell will be installed in the suspected plume at each site. The deeper microwells will have 6-foot screens, and will also include a preinstalled filter pack. The deep microwells will be screened from approximately 20 to 26 feet bls. Data from these wells will be used to evaluate the vertical distribution of contaminants. The locations of the deep microwells are also shown on Figures 4-3 and 4-4.

These wells will be installed using a TerraProbe℠. The POP describes the procedures for installing microwells.

4.2.1.2 **Well Points** Well points will be used during the second phase of the groundwater assessment to evaluate the quality of groundwater that is discharging from the aquifer to Lake Baldwin. They will be installed downgradient from the source areas and along the shoreline of Lake Baldwin (approximately 5 to 10 feet inland from the high water line of the shore of Lake Baldwin). Three well points will be installed for each SA. Figure 4-5 shows an example of how the well points will be positioned.

The well points will be constructed similar to the microwells; however, they will be installed by hand. The well points will have 6-foot prepack screen sections. The POP describes the procedures for installing well points.

4.2.1.3 **Conventional Monitoring Wells** Conventional monitoring wells will be installed and sampled during the second phase of the investigation to confirm the conceptual model developed using sampling results from the microwells.

For this program, 6¼-inch inside-diameter, hollow-stem augers will be used to advance the boring to the desired depth. This will permit an ample sand pack around the 2-inch-diameter well screen. Wells will be constructed with 2-inch inside-diameter, polyvinyl chloride screen and riser. All water table wells will have 10-foot-long screens. The deep wells will have 5-foot-long screens. Water table wells will be screened across the water table. The procedures for installing monitoring wells are described in the POP, Subsection 4.4.6, Exploratory Drilling.

Up to four shallow and one deeper well will be installed at each SA. New and existing monitoring wells will have the following configuration:

- one shallow and one deep well within the plume
- one shallow well upgradient
- one shallow well downgradient
- two lateral shallow wells (one on each side of the plume)

Figure 4-5 shows an example of how these wells will be positioned. Wells will be numbered consecutively starting with OLD-08-10 at SA 8 and OLD-09-05 at SA 9. At SA 9, it is possible that an upgradient well will not be needed because existing well OLD-09-02 may function as an upgradient well.

Before the first well is installed at each site, a soil boring will be conducted upgradient from the site. Continuous split-spoon samples will be collected for geologic classification from the ground surface to the base of the surficial aquifer. The geologic data obtained from these samples will be used to assess stratigraphy and select the screened interval for the deep well installed at the site.

It is not anticipated that wells will have to be installed in the intermediate or Floridan aquifers. If the groundwater assessment indicates that wells are required in these aquifers, a workplan will be developed and presented to the OPT.

4.2.2 Monitoring Well Development All well points, microwells, and conventional monitoring wells (new and existing) will be developed before they are sampled. The procedures for developing wells are described in Paragraph 4.4.6.4 of the POP.

4.2.3 Monitoring Well Sampling Groundwater samples will be collected from well points, microwells, and conventional monitoring wells using the low-flow method described in Paragraph 4.5.2.2 of the POP.

Groundwater samples will be analyzed for the following parameters:

- arsenic speciation (second phase only)
- pH
- redox potential
- TOC
- total suspended solids
- herbicides and TCL pesticides, PCBs, and SVOCs
- TAL metals

Groundwater samples collected during this investigation will be analyzed using data quality level D. As described in the POP, filtered groundwater samples will be collected from at least 10 percent of the sampling locations. In addition, if purging a well prior to sampling does not reduce the turbidity of water from the well to 10 nephelometric turbidity units or less, a filtered sample will also be collected from that well. Filtered samples will be analyzed for TAL metals.

4.2.4 Hydraulic Conductivity Testing Rising- and falling-head slug tests will be performed on selected conventional wells to characterize the hydraulic conductivity of the surficial aquifer at OU 3. Subsection 4.8.2 of the POP describes the procedures for conducting the slug tests.

4.3 OTHER INVESTIGATIONS. In addition to the soil and groundwater sampling results, other data are needed to meet the RI/FS data needs. The following subsections describe investigations that will collect this additional information.

4.3.1 Ecological Survey An ecological survey will be conducted to identify potential receptors and exposure pathways.

Based on the results of the soil and groundwater investigations, the ecological survey may include collecting samples for site-specific toxicity testing.

4.3.2 Human Health Survey A human health survey will be conducted to identify potential human receptors and exposure pathways. Subsection 4.4.10 of the POP describes the procedures for conducting the survey.

4.3.3 Elevation and Location Survey An elevation and location survey will be conducted so sampling locations can be accurately mapped and located in the future. The following explorations will be surveyed (elevations are not required for soil sample locations):

- all soil samples not associated with sampling grids
- all soil samples collected during the second phase of soil sampling
- corner nodes of sampling grids
- grid node samples that were relocated to evaluate surface water runoff at SA 8 or for other reasons arising from field conditions
- microwells, well points, and conventional monitoring wells

The procedures for conducting the elevation survey are described in Section 4.9 of the POP.

# 5.0 SAMPLE ANALYSES AND VALIDATION

**5.1 DATA VALIDATION**. The approach to providing reliable data that meet the data quality objectives will include quality assurance/quality control (QA/QC) requirements for each of the analytical data types generated during the field investigation. The QA/QC efforts for laboratory analyses will include collection and submittal of QC samples and the assessment and validation of data from the subcontract laboratories. Analytical data will be subjected to independent data validation by a subcontractor as described in the POP, Section 8.2, Validation.

Data quality indicators include the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. These parameters will be used within the data validation process to evaluate data quality. The achievable limits for these parameters vary with the data quality level of the data. The limits used for laboratory analytical data in this program will be those set by the CLP for data quality level D and as specified in the USEPA methods for data quality level C. PARCC parameters are described in the POP, Chapter 12.0, Data Assessment.

**5.2 DATA EVALUATION**. The purpose of this task is to assess usability of validated data based upon data comparisons to nonsite-related conditions. Results that meet the data quality objectives and are considered usable will be compared with background sampling results from a recent investigation (ABB-ES, 1994b). Results of the data evaluation will be documented in the RI report. The following data comparisons and evaluations will be made:

- evaluation of detection limits
- evaluation of counting errors
- evaluation of equilibrium data
- evaluation of qualified data
- comparison of laboratory and field blanks with sample results
- comparison of laboratory and field duplicate results

Contaminants of concern (COCs) will be identified through evaluation of the following criteria:

- background sampling results
- frequency of detection
- extent of contamination
- comparison of concentrations to ARARs

COCs will be used throughout the data evaluation, fate and transport assessment, risk assessment, and FS.

Statistical analyses may be used in the data evaluation process and will involve a variety of analytical methods, including exploratory analyses and the use of the standard t-test and/or the Mann-Whitney test. The following briefly describes each of the methods along with their application.

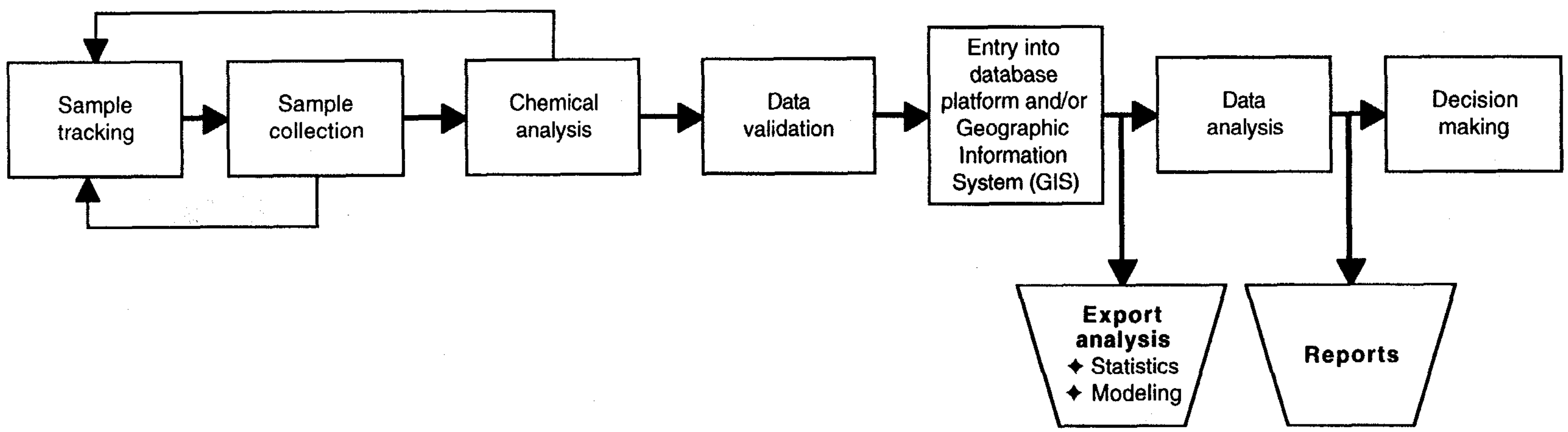
Exploratory analyses consist of graphical methods, including probability plots, boxplots, scatter plot matrices, and identity plots. Probability plots are used to identify data distributions. Boxplots graphically compare distributions from different data subsets (e.g., background versus contaminated media). Scatter-plots and identity plots graphically display relationships among multiple variables and allow identification of variables that can best provide predicted values. Identification of best-predictor variables will be based upon investigative analyses and corroborated with comparison of goodness of fit statistics after fitting appropriate regression and/or classification and regression tree models.

Background to onsite comparisons will be made using either a standard t-test or a Mann-Whitney test. Assuming data are normally or lognormally distributed, the standard t-test will be used to evaluate whether or not differences between background and site-specific samples are statistically significant. If data are not normally distributed and/or cannot be transformed to meet the normality assumptions of the t-test, then comparisons between background and site-specific sampling results will be made using a Mann-Whitney test. The Mann-Whitney test is a nonparametric test analogous to the t-test, which makes no assumptions about the underlying distribution of the data being evaluated and is appropriately applied when data either do not exhibit a normal distribution or are too limited (in number) to evaluate the distribution.

**5.3 DATA MANAGEMENT**. The purpose of this task is to track and manage environmental and QC data collected from the field investigation from the time the data is obtained through data analysis and report evaluation. Coordination and management of the contracted laboratories is also part of this task. RI activities generate data, including sample locations, measurements of field parameters, and the results of laboratory analyses. Reports regarding the collection and analyses of sample data will also be generated. The RI process entails the flow of data collected in the field and generated by the analytical laboratory work to those involved in project evaluation and decision making. Figure 5-1 illustrates the data management life cycle and project information flow. Management of data collected during RI activities will provide accessibility of data to support environmental data analysis, risk assessments, and the evaluation of remedial action alternatives.

Samples will be tracked from the field collection activities to the analytical laboratories following standard ABB-ES chain-of-custody procedures, which may include bar coding. These procedures are described in the POP, Chapter 5.0, Sample Handling and Custody Procedures (ABB-ES, 1997). Samples will be labeled and identified following the ABB-ES Standard Operating Procedures, Identification of Environmental Samples for the CLEAN Program. Sample information recorded from bar coding or chain-of-custody forms will be transferred (electronically or manually) into the sample tracking portion of the database management system (Fast Retrieval of Environmental Data [FRED]), thus enabling the samples to be tracked through final disposition. The sample tracking system will produce reports to inform the project team of potential delays or problems related to sample analysis and validation.

Analytical results, applicable QA/QC data, validation flags, chain-of-custody information, and any other attributed information will be incorporated into FRED. All data will be verified after uploading to ensure completeness and accuracy. FRED resides on an ORACLE™ platform that is integrated with other programs to enable efficient data management and to support data evaluation, risk evaluation, remedial alternative selection, and report generation. FRED is capable of




**Legend**
- Flow path
- Tracking routine

**FIGURE 5-1**

**DATA MANAGEMENT LIFE CYCLE**

**RI/FS WORKPLAN, OPERABLE UNIT 3, STUDY AREAS 8 AND 9**

**NAVAL TRAINING CENTER ORLANDO, FLORIDA**

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generating a variety of reports that were designed to support data evaluation and decision making. Integration of additional software packages to enhance data evaluation and the ability to make informed risk management decisions is in process.

# 6.0 RISK EVALUATION

The following subsections describe how the human health and ERAs for OU 3 will be conducted.

**6.1 HUMAN HEALTH RISK ASSESSMENT (HHRA).** The purpose of the HHRAs at SA 8 and SA 9 is to provide an evaluation of the potential risks to human receptors posed by chemicals present from past site operations, excluding pesticides applied for their intended use.

The HHRAs will consist of the following components, which are discussed below: hazard identification, toxicity assessment, exposure assessment, risk characterization, comparison to health standards and guidelines, and uncertainty assessment.

The approach used in the HHRAs will be consistent with the following guidance:

- Risk Assessment Guidance for Superfund (RAGs), Volume I, Human Health Evaluation Manual (Part A), Interim Final (USEPA, 1989b); and
- USEPA Region IV Supplemental Guidance to RAGS, Human Health Risk Assessment Bulletins (USEPA, 1995e).

**6.1.1 Hazard Identification** This section will present an overview of the type and extent of contamination present at SA 8 and SA 9 and will identify CPCs. CPCs will be selected based on factors such as comparison to background concentrations, frequency of detection, data quality objectives, and a comparison to Federal and Florida State screening criteria and ARARs.

**6.1.2 Toxicity Assessment** The most recent toxicity constants or dose-response values will be obtained from the USEPA Integrated Risk Information System (IRIS) database and the Health Effects Assessment Summary Tables (HEAST). If neither IRIS nor HEAST contain a toxicity constant for a particular CPC, then the USEPA Region 4 and the Environmental Criteria and Assessment Office will be contacted to determine if an appropriate surrogate toxicity value is available.

**6.1.3 Exposure Assessment** The exposure assessment will evaluate the potential for human exposure to site-related contaminants. It will consist of the identification of potential human receptors and potential pathways of exposure based on the exposure point analysis (Subsection 3.1.3) and additional information gathered during the human health exposure survey (Subsection 4.3.2). Lastly, this section will estimate the exposure intake levels.

The results of field investigations and chemical analyses will be used to determine which potential exposure pathways need to be evaluated quantitatively. As discussed in the Human Health Exposure Assessment (Section 3.1.3) and presented in the conceptual site model (Section 3.1.1), the reasonable current and future potential exposure pathways are listed below.

- Current and Future Recreational Users - incidental ingestion and dermal contact with surface soils and incidental ingestion of and dermal contact with surficial groundwater.

- Current and Future Site Maintenance Workers (current scenario considers only SA 8) - incidental ingestion, dermal contact with, and inhalation of surface soils, and incidental ingestion of and dermal contact with surficial groundwater used for irrigation.

- Potential Future Commercial Workers (assumes only indoor exposures) - minimal incidental ingestion and dermal contact with site surface soils.

- Potential Future Excavation Workers - incidental ingestion, dermal contact with, and inhalation of surface and subsurface soils.

- Potential Future Area Residents - incidental ingestion of and dermal contact with surface soils, and incidental ingestion of groundwater as well as inhalation of volatiles while showering (using the surficial aquifer as a potable water supply).

A recreational user of surface water is not evaluated because Lake Baldwin was evaluated as a separate SA.

Exposure point concentrations (EPCs) will be represented as the 95 percent upper confidence limit (UCL) on the mean (with those contaminants not detected set equal to one-half their sample quantitation limit [SQL]). If, however, the UCL exceeds the maximum detected concentration, then the EPC will be set at the maximum.

As described in USEPA Region IV guidance (USEPA, 1991a), reasonable maximum exposure (RME) scenarios will be evaluated. If the risks resulting from the RME scenarios exceed the acceptable regulatory levels, then a central tendency (CT) exposure scenario will be evaluated. The CT exposure concentration will be represented by the mean of all samples (USEPA, 1991a). If the mean exceeds the maximum detected value due to high detection limits on a nondetected sample, then the EPC will be set at the maximum.

6.1.4 Risk Characterization The purpose of the risk characterization will be to combine the findings of the toxicity and exposure assessments to characterize the human health risks associated with past site operations.

Both cancer and noncancer risks will be estimated following the procedures established in RAGs (USEPA, 1989b) and the USEPA Region 4 bulletins (USEPA, 1995e). Excess lifetime cancer risks and hazard indices (HI) will be calculated for the CPCs. These risk estimates will be compared to the National Contingency Plan target risk range for carcinogens of $10^{-4}$ to $10^{-6}$ and noncancer HI of 1 and to the Florida Department of Environmental Protection target risk levels.

6.1.5 Comparison to Health Standards and Guidelines EPCs will be compared to available Federal and Florida State health standards and guidelines. These may include, but not be limited to soil, drinking water, surface water, and/or air standards and published guidelines, such as Florida Soil Cleanup Goals, Federal and State MCLs, and ambient water quality criteria.

6.1.6 Uncertainty Analysis The prediction of human health risks involves a number of assumptions and uncertainties. In this section, the uncertainties in the risk evaluation will be identified and their potential effects upon the results of the risk evaluation will be discussed. Both site-specific and general risk assessment uncertainties and limitations will be included. If the risk results from the RME exposure scenarios exceed acceptable regulatory target levels then the results of the CT exposure scenario will be presented in this section to provide some regulatory and risk perspective.

Additionally, if the risk assessment results warrant additional evaluation, a probabilistic risk assessment may be performed. This probabilistic risk assessment would use appropriate exposure parameter estimates to further define the risks to specific percentages of the population. (Assistance would be requested from USEPA Region IV risk assessors to determine appropriate exposure parameters). This risk management tool would aid in the determination of remediation levels that are protective of the receptor population and yet still technologically and economically feasible. By providing a means to determine the percentage of the population protected at a specific risk level, a probabilistic risk assessment can provide the basis for a regulatory cost-benefit analysis.

**6.2 ERA**. The purpose of the ERA at SA 8 and SA 9 is to provide an evaluation of the potential risks to ecological receptors posed by chemicals present from past site operations, including pesticides and their derivatives (excluding pesticides applied for their intended use) and arsenic.

The ERAs will evaluate actual and potential adverse effects to ecological receptors associated with exposure to contamination in site media. The ERAs will consist of the following elements, which are discussed below in greater detail: site characterization, problem formulation, analysis, risk characterization, and uncertainty analysis.

Although NTC, Orlando is not a "Superfund" site, the ERAs for OU 3 will be conducted in accordance with current guidance available for Superfund sites including

- *Risk Assessment Guidance for Superfund, Environmental Evaluation Manual* (USEPA, 1989c);
- *Ecological Assessment of Hazardous Waste Sites, A Field and Laboratory Reference* (USEPA, 1989a);
- *Ecological Assessment of Superfund Sites, An Overview* (USEPA, 1991e);
- *Framework for Ecological Risk Assessment* (USEPA, 1992a);
- USEPA Region IV Ecological Risk Assessment Bulletins (USEPA, 1995a, 1995b, 1995c, and 1995d);
- *Tri-Service Procedural Guidelines for Ecological Risk Assessments, Volumes I and II* (Wentsel et al., 1996); and
- *USEPA Proposed Guidelines for Ecological Risk Assessment* (USEPA, 1996a).

- Recent risk assessment guidance including the USEPA "Eco Update" bulletins (issued since 1991) and other publications (e.g., Maughan, 1993; Suter, 1993) will also be consulted.

Furthermore, the ERA for OU 3 will be consistent with review draft guidance issued by the USEPA Environmental Response Team, entitled *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997).

**6.2.1 Site Characterization** The site characterization section of the ERAs will discuss the characteristic vegetative habitats and the wildlife, aquatic life, and rare, threatened, or endangered species that may potentially be found at OU 3 and downgradient. The characterization, which will be based on a limited site reconnaissance that will occur during the RI, will identify flora and fauna located at or potentially affected by the site. This characterization will serve as the basis for identifying potential ecological receptors at OU 3 and to further develop exposure scenarios for the ecological exposure assessment.

Information regarding the possible occurrence of rare, threatened, or endangered species at the site will be obtained from local, State, and Federal wildlife officials (i.e., Florida's Natural Heritage Program, the Florida Game and Fresh Water Fish Commission, and the U.S. Fish and Wildlife Service). In addition, information on critical habitats in the vicinity of OU 3 will be provided.

**6.2.2 Problem Formulation** Problem formulation is the initial step of the ERA process whereby receptors, exposure pathways, and the assessment and measurement endpoints are selected for evaluation. Ecological exposures to constituents detected in site media (e.g., surface soil and groundwater) will be evaluated in the ERAs.

**6.2.2.1 Identification of Receptors** The ecological receptors that may potentially utilize the available habitat at OU 3 include terrestrial wildlife, plants, and invertebrates. In addition, aquatic organisms, including benthic (i.e., sediment-dwelling) and pelagic (i.e., water-column) invertebrates, fish, and amphibians may utilize the available aquatic habitat in Lake Baldwin, which is located downgradient of OU 3.

All surface water in the vicinity of NTC, Orlando, including Lake Baldwin, are classified by the State of Florida as Class III waters, suitable for fish and wildlife propagation and water contact sports.

**6.2.2.2 Identification of Exposure Pathways** Exposure pathways will be identified in the RI for the groups of ecological receptors discussed above. A complete exposure pathway contains the following four components:

- a contaminant source,
- a transport mechanism to a medium of ecological exposure,
- an exposure route (i.e., direct contact or ingestion), and
- a receptor.

Exposure pathways for OU 3 waste sources to ecological receptors will be depicted in a contaminant pathway model. The model will depict all potential exposure pathways; however, only certain pathways will be evaluated quantitatively, whereas other pathways will be evaluated qualitatively or not at all for reasons discussed in the ERA. Those pathways evaluated quantitatively will be shaded on the pathway model. The number of quantitative or qualitative assessments conducted for the ERA is necessary to focus the risk evaluation on the pathways for which (1) contaminant exposures are the highest and most likely to occur and (2) there are adequate data pertaining to the receptors, contaminant exposures, and toxicity for completion of risk analyses. Exposure pathways that will be evaluated will include portions of food chains (e.g., surface soil → primary consumer → secondary consumer → tertiary consumer), as well as other direct and indirect exposures.

Aquatic organism exposures to groundwater are unclear because the available site data are insufficient to evaluate whether or not contaminants in groundwater are transported to Lake Baldwin. This data gap has been identified and will be addressed during the RI. If this exposure pathway is complete, potential risks to aquatic organisms will be evaluated.

Exposure pathways that will not be quantitatively evaluated include dermal exposures for terrestrial wildlife, and food-chain exposures for reptiles and amphibians. Although dermal exposures may be a viable exposure pathway for amphibians, reptiles (particularly the gopher tortoise) and for young, hairless mammals in subterranean dens (i.e., juvenile muskrats), dermal exposures represent an incomplete pathway for the majority of ecological receptors because fur, feathers, or chitinous exoskeleton limit the transfer of contamination across the dermis (i.e., dermal exposures may not result in populationwide effects). In addition, there are too few data relating dermal exposures to toxic responses in wildlife in order to feasibly evaluate this pathway. Potential food-chain exposures for reptiles and amphibians exist at OU 3, but are not quantitatively evaluated due to a lack of ingestion toxicity data relating contaminant exposures to adverse responses for these taxa. These exposure pathways that are not quantitatively evaluated will be discussed in the Uncertainty Analysis subsection.

Inhalation exposures do not represent a complete exposure pathway at OU 3 for the contaminants associated with past site activities (i.e., pesticides and arsenic).

6.2.2.3 **Assessment and Measurement Endpoints** The assessment and measurement endpoints selected for the OU 3 ERA are listed in Table 6-1. Assessment endpoints represent the ecological component to be protected, whereas the measurement endpoints approximate or provide a measure of the achievement of the assessment endpoint. Measurement endpoints provide a measurable response to a stressor that can be related to the valued characteristic selected as the assessment endpoint (USEPA, 1996b). The measurement endpoints used to gauge the likelihood of population-level effects are literature-derived toxicological values based on laboratory measured effects on reproduction, growth, and survival. In addition to the assessment and measurement endpoints, Table 6-1 also presents the endpoint species, ecological chemicals of potential concern (CPCs), and decision points for each selected endpoint. The decision point represents a level (i.e., hazard quotient > 1, exceedance of Reference Toxicity Values by detected contaminant concentrations at the study area) at which potential risks will be further characterized.

No site-specific toxicological data are currently available for OU 3. If necessary site specific toxicity data may be collected after the initial evaluation of RI data.

**Table 6-1**
**Endpoints for Ecological Assessment**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Assessment Endpoint | Endpoint Species | Ecological CPCs | Measurement Endpoint | Decision Point |
|---|---|---|---|---|
| Survival and reproductive success of mammalian and avian wildlife populations | Mammalian - Shrew<br>Avian - Robin | Arsenic | Literature-reported mammalian and avian ingestion toxicity data | Modeling of exposure to shrews and robins, comparison of literature values and development of hazard quotient (HQ). HQ > 1 indicates potential risk. |
| Maintenance of reproductive success of pisciverous birds | Great blue heron, kingfisher | Pesticides | Avian toxicity data | Exceedance of HQ of 1 based on a Reference Toxicity Value (RTV) specific to reproductive success |
| Survival of terrestrial soil invertebrate populations | Earthworms | Arsenic and Pesticides | Literature-reported invertebrate toxicity data | Exceedance of RTV by study area surface soil concentrations |
| Survival, reproduction, and growth of terrestrial plant populations | Terrestrial plants | Arsenic and Pesticides | Literature-reported phytotoxicity data | Exceedance of phytoxicity data by study area surface soil concentrations |
| Growth, reproduction, and survival of benthic macroinvertebrates and fish populations | Freshwater benthic macroinvertebrates and fish | Arsenic and Pesticides | Contaminant concentrations in groundwater associated with adverse effects to growth, reproduction, and survival | Exceedance of surface water RTVs by contaminant concentrations measured in groundwater discharging to the surface water of Lake Baldwin. |

Note: CPC = chemical of potential concern.

**6.2.3 Analysis** The analysis section includes a hazard assessment and selection of CPCs, an exposure assessment, and an effects assessment.

**6.2.3.1 Hazard Assessment and Selection of Ecological CPCs** The hazard assessment includes a review of analytical data and selection of CPCs. CPCs are the analytes detected in environmental media that are considered in the ERAs to present a potential risk for ecological receptors.

A thorough discussion of data collection activities and a presentation of the analytical data will be provided in the RI. Analytical data for OU 3 will be evaluated to determine their validity for use in risk assessment pursuant to national guidance, *Guidance for Data Useability in Risk Assessment (Parts A and B)* (USEPA, 1992c). The data validation process will be conducted in accordance with Naval Energy and Environmental Support Activity Level C validation requirements, which will include the following activities: sort data by medium, evaluate analytical methods, evaluate quantitation limits, evaluate data quality with respect to qualifiers and validation codes, and evaluate method blanks.

As part of the CPC selection process, potential site-related contamination will be considered for use in the ERA according to the criteria listed below.

- Inorganic CPCs will be selected by comparing site data to background values observed at NTC Orlando. An analyte will not be selected as a CPC if the maximum detected concentration of an inorganic analyte is less than 2 times the average of detected inorganic concentrations in the respective background samples (USEPA, 1991b; ABB-ES, 1993).

- In addition to screening CPC based on background, USEPA Region IV surface water screening criteria (USEPA, 1995c) will be used for screening groundwater CPCs. If the maximum detected concentration of an analyte is less than the USEPA Region IV screening value, then the analyte will not be selected as a CPC for aquatic receptors.

- An analyte will not be selected as a CPC if it is detected in 5 percent or fewer of the samples analyzed, is not detected in any other media, and is not associated with significant ecological impacts.

- Calcium, magnesium, potassium, and sodium will be excluded as CPCs for both media, and iron will be excluded as a wildlife CPC for surface soils; these analytes are considered to be essential nutrients and are only toxic at extremely elevated concentrations. Furthermore, evidence suggests that there is little potential for toxic effects resulting from over-exposure to these essential nutrients. The highly controlled physiological regulatory mechanisms of these inorganics suggest that there is little, if any, potential for bioaccumulation, and available toxicity data demonstrate that high dietary intakes of these nutrients are well-tolerated (Naval Air Station, 1977; National Research Council, 1982; 1984).

All CPCs selected for the ERAs will be summarized in tables that include the following: frequency of detection, range of detection limits, range of detected concentrations, average of detected concentrations, twice the average detected background concentration, the USEPA Region IV surface water screening value (for groundwater) (USEPA, 1995c), and a decision regarding the CPC status for each analyte. For those analytes that are retained as CPCs for the ERAs, the following information will also be provided: average of all concentrations (using one-half the SQL for non-detects), 95 percent UCL (when the sample size is greater than or equal to 10), and maximum and average EPCs.

6.2.3.2 **Exposure Assessment** Exposure assessment is the process of estimating or measuring the amount of an ecological CPC in environmental media (surface soil or groundwater) to which an ecological receptor may be exposed via respective exposure pathways described in the conceptual site model. The following paragraphs discuss selection of EPCs, and the potential exposure pathways and how contaminant exposures will be estimated for each group of receptors (e.g., terrestrial wildlife, terrestrial plants, soil invertebrates, and aquatic organisms).

<u>Selection of EPCs</u>. Maximum and average EPCs will be chosen for all CPCs in the media of concern at OU 3 to evaluate exposures to receptors. When the sample size is greater than or equal to 10, the maximum EPC will be equal to the lesser of the maximum detected concentration and the 95 percent UCL calculated on the log-transformed arithmetic mean (USEPA, 1992e). When the sample size is less than 10, the maximum EPC will be equal to the maximum detected concentration because the 95th percent UCL can not be calculated.

RME scenarios will be evaluated. If the risks resulting from the RME scenarios exceed the decision point criteria, then a CT exposure scenario will be evaluated. The CT exposure concentration will be represented by the mean of all samples. In calculating the mean of all concentrations, a value of one-half of the SQL will be assigned to all samples in which the analyte is not detected. If the mean exceeds the maximum detected value (which may happen if an analyte is only detected in a few samples and the detection limit is higher than most detected concentrations), the EPC will be set at the maximum.

<u>Terrestrial Wildlife</u>. Incidental ingestion of CPCs in surface soil and bioaccumulation of CPCs via the food chain represent the primary exposure pathways for terrestrial wildlife at OU 3. Representative wildlife species will be selected for evaluation in a food-chain model, which considers many factors in estimating exposures via ingestion (i.e., site foraging frequency, habitat and foraging preferences, and dietary intake). The species selected will include species likely to be the most susceptible to exposures and effects from CPCs (i.e., pesticides and arsenic) present at the site. The species that will be selected for food-chain modeling will represent various trophic levels and foraging guilds likely to accumulate organic compounds via the food chain.

Table 6-2 summarizes how contaminant exposure concentrations will be determined for surface soil ecological contaminant of potential concern (ECPCs) for representative wildlife species evaluated in the food-chain model. A total potential dietary exposure (PDE) will be estimated for each representative wildlife species for each surface soil CPC according to the equations in Table 6-2. This model considers exposure concentrations of ECPCs in prey items, the amount of surface soil likely to be ingested, the receptor body weight, and the rate of food ingestion.

For each representative wildlife species, the estimated percentage of soil in the overall diet will be multiplied by the concentration of each CPC in the soil and the food ingestion rate (kilograms per day) to determine the soil exposure

## Table 6-2
## Model for Estimation of Contaminant Exposures for Representative Wildlife Species

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

**Estimation of Contaminant Exposures Related to Surface Soil**

Description: Estimates the amount (dose) of a contaminant ingested and accumulated by a species via incidental ingestion of contaminated surface soil and ingestion of contaminated food items.

Soil Contaminant Concentration:

Maximum: The maximum detected concentration of the CPC when the sample size is ≤ 9, and the lesser of the maximum detected concentration or the 95th percent upper confidence limit (UCL) when the sample size is ≥ 10.

Average: Average of all concentrations. If the average is greater than the maximum exposure point concentration (EPC), the maximum EPC will be selected.

Soil Exposure:

$$\underset{(mg/kg)}{\text{Soil Exposure}} = \left( \text{\% of Diet as Soil} \times \underset{(mg/kg)}{\text{Soil Concentration}} \right)$$

Concentration of a Contaminant in Primary Prey Items ($T_N$):

$$\underset{(mg/kg)}{\text{Primary Prey Item Concentration}} = \left( BAF_{inv\ or\ plant} \times \underset{(mg/kg)}{\text{Soil Concentration}} \right)$$

Concentration of a Contaminant in Secondary Prey Items ($T_N$):

$$\underset{(mg/kg)}{\text{Secondary Prey Item Concentration}} = \left( BAF_{mam\ or\ bird} \times \underset{(mg/kg)}{\text{Tissue Concentration of Prey Items}} \right)$$

where BAF = Bioaccumulation Factor or mg/kg dry weight tissue over mg/kg dry weight soil for invertebrates and plants, and mg/kg dry weight tissue over mg/kg dry weight food for small mammals and small birds.

Total Exposure Related to Surface Soil:

$$\underset{(mg/kgBW\text{-}day)}{PDE} = \frac{[P_1 \times T_1 + \ldots + P_N \times T_N + \text{soil exposure}] \times IR_{Diet} \times SFF \times ED}{BW}$$

where
- PDE = Potential Dietary Exposure (mg/kgBW-day),
- $P_N$ = percent of diet composed of food item N,
- $T_N$ = contaminant concentration in food item N (mg/kg),
- $IR_{Diet}$ = food ingestion rate of receptor (kg of dry weight food or dietary item per day),
- BW = body weight (kg) of receptor,
- SFF = Site Foraging Frequency (site area [acres] divided by home range [acres]) (cannot exceed 1), and
- ED = Exposure Duration (fraction of year species is expected to occur onsite).

Notes: mg/kg = milligrams per kilogram; kg/day = kilograms per day; kg = kilograms; % = percent; mg/kg BW-day = milligrams per kilograms of body weight per day concentration. Incidental soil ingestion associated with foraging activities will be based on available literature values. Inclusion of incidental soil ingestion in the food-chain model will address potential risks for any CPCs that may be present but are not likely to accumulate in food items (e.g., PAHs).

Terrestrial Plants and Invertebrates Terrestrial plants and soil invertebrates may be exposed to contamination in surface soil by direct contact with and root uptake (plants) or ingestion (invertebrates) of these media.

Aquatic Receptors Based on site conditions at OU 3, aquatic receptors in sediment and possibly surface water may be exposed to groundwater CPCs via dermal contact and ingestion. Benthic invertebrates (and possibly pelagic invertebrates, fish, and amphibians) could potentially be exposed to groundwater CPCs. As previously mentioned, the viability of these exposures will be evaluated in the RI.

6.2.3.3 **Ecological Effects Assessment** The ecological effects assessment will contain a description of the ecotoxicological effects (i.e., measurement endpoints) associated with the CPCs that relate to the assessment endpoints. Toxicological effects will be evaluated using concentration- or dose-response toxicity data for the identified ecological receptors. The methods used for identifying and characterizing ecological effects for terrestrial wildlife, terrestrial plants, soil invertebrates, and aquatic organisms are described in the following paragraphs.

Terrestrial Wildlife. Reference toxicity values (RTVs), representing a threshold for effects, will be identified from the literature for each CPC in surface soil for avian and mammalian representative wildlife receptors. The RTV relates the dose of a CPC in a chronic oral exposure with an adverse effect. Relevant effects associated with exposure to pesticides and arsenic include those that impair or prevent successful reproduction. The RTV will reflect the assessment endpoint chosen as the basis for establishing risk.

If no RTVs measuring effects on reproduction are available, or if reproduction measurement endpoints do not provide the most conservative estimate of risk, then RTVs measuring effects on growth or survival (i.e., $LD_{50}$ studies) will be considered as an ecologically relevant measure of population-level effects. RTVs will be derived separately for avian and mammalian species to the extent feasible. However, to conservatively estimate risks from exposure to all CPCs for all receptors, intertaxonomic surrogates may be used. The uncertainties associated with using intertaxonomic surrogates will be discussed in Subsection 6.2.5, Uncertainty Analysis.

Terrestrial Plants and Soil Invertebrates. Site-specific toxicity data for plants and invertebrates are not available for OU 3; therefore, the results of toxicity studies from the literature that relate the soil concentrations of a contaminant with an adverse growth, reproduction, or survival effect on a test population will be used as a measure of the assessment endpoint.

For plants, the effects primarily considered will be measures of growth or yield as these response parameters are most common in phytotoxicity studies. For invertebrates, the effects primarily considered will be measures of reproduction or mortality. If $LC_{50}$ data are used, 1/5 of the $LC_{50}$ will be used to be protective of 99.9 percent of the population (USEPA, 1986).

Aquatic Organisms. Site-specific toxicity data for aquatic organisms exposed to groundwater CPCs are not available. Therefore, literature values that relate the concentration of a contaminant with an effect level (derived from data for adverse growth, reproduction, or survival effects of test populations) will be used as a measure of the assessment endpoint. Benchmark concentrations or doses will be identified for use in the ecological risk characterization section. Sources that will be considered in identifying benchmark values for aquatic receptors include USEPA ambient water quality criteria, FDEP water quality standards, and other sources of toxicological data, including the Aquatic Information Retrieval database.

**6.2.4 Risk Characterization** A comparison of exposure information (Paragraph 6.2.3.2) with the appropriate concentration-response toxicity data (Paragraph 6.2.3.3) is the basis for risk characterization. The following paragraphs provide a discussion of the relationship between concentration-response toxicity data and the exposure dose (wildlife) or exposure concentrations (terrestrial plants, soil invertebrates, and aquatic organisms), and the potential for adverse effects in ecological populations.

Terrestrial Wildlife. Risks for the representative wildlife species associated with ingestion and bioaccumulation of CPCs in site media and prey items will be quantitatively evaluated using hazard quotients (HQs), which are calculated for each CPC by dividing the PDE by the selected RTV. HIs are determined for each receptor by summing the HQs for all CPCs. When the estimated PDE is less than the RTV (i.e., the HQ $< 1$), it is assumed that chemical exposures are not associated with adverse effects on individual receptors, and there is a low potential for risk to wildlife populations. When an HI is greater than 1, a discussion of the ecological significance of the HQs comprising the HI is completed, and risks from exposure to average concentrations of CPCs are evaluated.

The HQs and HIs for OU 3 will be calculated based on RME scenarios for each representative wildlife species. If the HIs for the RME scenarios exceed one, the CT exposure scenarios will also be evaluated. A summary of risks to representative wildlife receptors will be provided in the ERA.

Terrestrial Plants and Invertebrates. Risks for terrestrial plants and invertebrates will be evaluated based on a direct comparison of concentrations detected in surface soil to toxicity benchmarks; these results will be tabulated and discussed in the OU 3 ERA.

Aquatic Receptors. Risks for aquatic receptors will be characterized based on a direct comparison of concentrations of CPCs in groundwater with toxicity benchmarks for surface water; these results will be tabulated and discussed in the ERA for OU 3.

**6.2.5 Uncertainty Analysis** The objective of the uncertainty analysis is to discuss the assumptions of the ERA process that may over- or underestimate risks for ecological receptors. General uncertainties inherent in the risk assessment process and the OU 3 ERA will be discussed.

# 7.0 INVESTIGATION-DERIVED WASTES MANAGEMENT

The purpose of this task is for the management of IDW that is generated during studies conducted at SAs 8 and 9.

This chapter contains definitions and identifies waste categories and classification methods, packaging requirements, and preferred management options. The approach outlined in this section emphasizes the following objectives:

- management of IDW in a manner that is protective of human health and the environment;
- minimization of IDW generation, thereby reducing costs and the use of limited storage facility capacity; and
- compliance, to the extent practical, with Federal and State requirements that are legally ARARs.

**7.1 DEFINITIONS**. The following is a list of terms and their definitions that are to be used during IDW management.

Area of Concern (AOC) is an area delineated by the areal extent of potential contamination on the project site. This boundary may contain varying concentrations and types of hazardous substances and may contain uncontaminated areas. For the purpose of this workplan, the AOC will be considered the area within the boundaries of the investigations at each site.

USEPA "Contained-In" Policy requires any mixture of a nonsolid waste (environmental media) and a Resource Conservation and Recovery Act (RCRA)-listed hazardous waste to be managed as a hazardous waste, as long as the material contains the listed hazardous waste above health-based standards.

Field Staging Area (FSA) is an area within the project site where drums and other containers or IDW are stored until the site investigative activities are completed or a final disposal option is selected in a Record of Decision (ROD). This area will be posted as the FSA and will be checked for leaking containers weekly during field activities. This area will remain active until all containers have been disposed of appropriately. Additional empty drums, overpack, and absorbent materials will be kept at the FSA in the event of a leak or spill. The FSA is not considered an RCRA 90-day storage area.

Hazardous Constituents are those constituents listed in 40 Code of Federal Regulations (CFR) Part 261, Appendix VIII.

Hazardous Substances, for the purposes of this plan, shall have the meaning set forth by Section 101(14) of CERCLA, 42 U.S. Code 9601(14).

IDW is discarded materials resulting from site investigation activities, such as decontamination, which in present form possess no inherent value or additional usefulness without treatment. Such waste may be solid, semisolid, liquid, or gaseous material that may or may not be hazardous as defined in 40 CFR Part 261. IDW may include materials such as used personal protective equipment (PPE), decontamination fluids (wash and rinse), drilling muds and cuttings, pumped monitoring well fluids, purge water, soil, and other materials from collection of samples and spill contaminated materials.

IDW will be classified as RCRA hazardous waste if it meets one of the following criteria:

- contains a USEPA-listed hazardous waste identified in 40 CFR 261 or

- exhibits characteristics of hazardous waste, including ignitability, corrosivity, reactivity, or toxicity, as described in 40 CFR 261.

Land Disposal means placement in or on the land and includes, but is not limited to, placement in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, underground mine or cave, or concrete vault or bunker intended for disposal.

Land Disposal Restrictions (LDRs) are restrictions that prohibit the land disposal of certain RCRA hazardous wastes unless specific treatment standards are met. The USEPA has established standards for specific hazardous wastes that are protective of human health and the environment when the wastes are land disposed. LDRs apply to waste management activities under RCRA and the SDWA, which controls underground injection of hazardous waste in deep wells.

Movement (Nonplacement) is an activity that consists of moving soil within the site, whether excavated or surface soil, along with RCRA hazardous wastes and CERCLA hazardous constituents contained in soil to consolidate the material within the AOC. Note that movement of soil with CERCLA constituents or radioactive constituents that do not contain RCRA hazardous waste would not trigger RCRA LDRs, even if moved outside the AOC.

Placement is an activity that consists of moving soil contaminated with RCRA hazardous wastes offsite or outside the AOC.

Wastewater is liquid waste consisting primarily of water without other liquid phases present that may result from groundwater well installation, development, and sampling activities, or from the cleaning of well installation or sampling equipment.

**7.2 GENERAL MANAGEMENT APPROACH**. The intent of this plan is to return as much as possible of the IDW (excluding PPE and decontamination liquids) generated from sampling activities back to the original source, thereby reducing the volume of waste to be containerized, stored, and managed. This approach minimizes IDW and does not add a greater threat to human health and the environment than existed prior to the investigation. Returning the IDW to the original source will also allow the IDW to be addressed in a manner consistent with the final remedy for the site.

Residuals from hand augers and borings will be returned to the borehole from which they originated. Additional clean fill material will be used to fill any remaining parts of the borehole resulting from the borehole residuals being tamped down.

Wastewater and PPE generated during decontamination operations and sampling activities will be containerized, centralized, and managed in accordance with this plan.

<u>7.3 AOC</u>. Prior to development of this plan, the concept of returning the residual soil back to the original borehole was evaluated regarding compliance with applicable regulations. The most significant ARAR considered included the LDRs under RCRA. For LDRs to be applicable, the action must constitute "placement" of a restricted RCRA hazardous waste in a land disposal unit. To clarify whether or not "placement" occurs, the concept of AOC has been adopted.

IDW that is generated, moved, consolidated, stored, or redeposited within the boundaries of the AOC will not constitute "placement" or trigger LDRs (USEPA, 1992d). However, "placement" will occur as a result of either of the two following activities: (1) IDW is consolidated from different AOCs into a single AOC and redeposited, and (2) IDW is moved outside of an AOC (for example, for treatment or storage) and returned to the same or a different AOC.

<u>7.4 WASTE HANDLING, SEGREGATION, AND PACKAGING</u>. IDW will be containerized for characterization and classification. PPE will be deposited into open-top, 55-gallon steel 17C U.S. Department of Transportation-approved drums with a plastic liner. Wastewater generated will be collected in either 55-gallon drums or a bulk polypropylene-type container mounted to a transportable trailer or vehicle.

Waste containers that are filled will be securely closed, cleaned, and labeled. All labeling will include the date, the specific location (boring or well), waste type, and any field observations that may be appropriate. Labels will be completed with permanent markers and will be attached to the container when it is full or sampling activities are complete.

<u>7.5 WASTE TRANSPORTATION AND STORAGE</u>. IDW generated during field activities will be composited into drums or containers at the FSA within the AOC. Wastewater from the decontamination activities will be sampled for CLP TAL metals and TCL organics (PAHs, PCBs, herbicides, and pesticides).

Once the drums and/or containers are securely sealed and labeled they will be moved to the FSA. At the FSA, the drums will be unloaded onto pallets not to exceed four drums per pallet. Drums will be positioned on the pallets such that the container labels are visible and readable.

IDW will be temporarily stored at the FSA pending analytical results of samples collected. Following receipt of the environmental and IDW sample results and comparison of these data to regulatory levels, disposal options and/or additional classification criteria will be determined with the Navy. Additional information on the handling and temporary storage of IDW is contained in the POP, Section 4.10, Control and Disposal of IDW (ABB-ES, 1997).

**7.6 WASTE CLASSIFICATION CRITERIA**. If needed for final disposal, the Navy will classify the IDW into two categories:

(1) nonhazardous
(2) RCRA hazardous waste

These categories are as defined in the definition section. IDW will be classified on the basis of environmental sample results. All IDW will be disposed of in a manner consistent with the final remedy.

To determine whether or not a waste is a listed waste under RCRA, the source must be identified. Site information, such as disposal records, investigation analyses, etc., will be used to determine source identity. When such documentation is unavailable, it will be assumed that the wastes are not RCRA-listed hazardous wastes. However, if documentation does confirm that IDW waste contains RCRA-listed waste resulting from disposal activities that occurred after the effective date of RCRA regulations (November 19, 1980), the IDW will be managed as a hazardous waste per USEPA's "Contained-In" Policy.

IDW classification (non-PPE) will be evaluated on the basis of comparison of analytical results obtained during the RI to promulgated and guidance regulatory values for water, soil, and sediment. Soil and sediment results will be evaluated for hazardous characteristics, as determined by RCRA, by comparing sample analytical results to total extraction limits as described in 40 CFR 261, Appendix II, Method 1311, Toxicity Characteristic Leaching Procedure (TCLP), item 1.2, which states, "If a total analysis of the waste demonstrates that the individual contaminants are not present in the waste, or that they are present but at such low concentrations that the appropriate regulatory thresholds could not possibly be exceeded, the TCLP need not be run."

Thus, the IDW could not be considered an RCRA hazardous waste. If, however, the sample analytical results meet or exceed the total extraction limit for a constituent, then the IDW may need to be sampled and analyzed for TCLP parameters.

**7.7 DISPOSAL OPTIONS**. Wastewater, PPE, soil cuttings, and drilling muds and fluids are the types of IDW that are anticipated to be generated during the site investigation. The approach recommended in this plan is intended to minimize IDW generation and pursue management options consistent with the final remedy selected for the site.

Wastewater. Wastewater generated from decontamination activities and well installations will be temporarily stored at the FSA. Samples collected for characterization of this IDW will be evaluated for acceptability for disposal at the NTC, Orlando POTW. If the IDW wastewater contamination is at a level that cannot be disposed of at the POTW, then the IDW wastewater will be stored at the FSA until discharge limits can be achieved through treatment.

Soils and Drilling Fluids. Analyses of samples collected that are representative of the applicable IDW will be evaluated regarding onsite disposal of soil IDW as discussed under Section 7.2, General Management Approach. If constituent levels detected are at concentrations that would not affect human health or the environment, then the IDW would be used as clean fill material in areas identified by the Navy. If concentrations are such that onsite disposal is not permitted, then the IDW will be stored at the FSA and disposed of consistent with the final remedy.

PPE. The incidental contact with waste or contaminated media by PPE typical of CERCLA site investigations does not warrant management of PPE as hazardous, solid waste.

## 8.0 REMEDIAL INVESTIGATION REPORT

The draft RI report will be prepared in accordance with the guidance contained in *Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). The report will include appropriate sections on site background, investigation activities, physical characteristics, nature and distribution of contamination, fate and transport, and risk evaluations (both human health and ecological assessments). Numerical modeling may be used to evaluate the distribution, fate, and transport of contaminants detected within OU 3. If so, the USGS in Altamonte Springs, Florida, will provide this capability. Probable conditions and reasonable deviations, as depicted in the current site conceptual model, will be verified and/or revised and presented in the report.

After internal review, the document will be prepared for submission to the NTC, Orlando OPT members for review. A final RI document will include a responsiveness summary based on comments received.

# 9.0 FEASIBILITY STUDY

The purpose of the FS is to identify and evaluate remedial action alternatives to minimize or eliminate exposure to contaminants in OU 3 media. The FS report for OU 3 will include identification of ARARs, identification of RAOs and general response actions, and identification, screening, and analysis of remedial technologies and alternatives. ARARs, preliminary RAOs, and several potentially applicable technologies have been identified in Subsection 3.1.4 based on what is currently known about OU 3. These will be refined in the FS report based on the findings of the RI.

The approach for screening remedial technologies, developing and screening remedial alternatives, and evaluating alternatives in the FS report is presented in the sections that follow.

**9.1 ALTERNATIVE TECHNOLOGY SCREENING**. Preliminary remedial technologies within the general response action categories are identified in this workplan to assist in focusing the scope of the RI/FS. These technologies have been identified for probable and potential contaminated media and exposure pathways (Table 9-1).

The physical and chemical characteristics of OU 3 may require consideration of certain technologies and may make implementation of other technologies infeasible. The technology screening step, which will be conducted in the FS, will serve to eliminate technologies that are infeasible or ineffective for the site conditions and contaminants found at OU 3 during the RI.

In the FS, technologies will be screened on the basis of effectiveness, implementability, and cost, as described below. The technology screening step will be conducted in tabular form.

Effectiveness considers the effect that physical and chemical properties of the medium, individual compounds, and compound mixtures would have on a given technology or process. It also considers the technology's reliability over time, its ability to meet chemical-specific ARARs, and impacts to the community or environment during implementation.

Implementability focuses on the construction, operation, and performance of a technology. The evaluation of technologies against this criterion considers site-specific features such as topography, buildings, utilities, and available space. A technology that has not been demonstrated or is not widely available may also be eliminated under this criterion.

Cost affects the practicality of certain technologies at a site. A technology can be eliminated on the basis of cost if it can be shown that the higher cost technology provides little or no advantage in effectiveness or implementability over another, lower cost technology. At this stage, costs will be presented on an order-of-magnitude, unit cost basis (e.g., per acre or per gallon).

**9.2 ALTERNATIVE DEVELOPMENT AND SCREENING**. The technologies remaining following technology screening will be assembled into remedial alternatives that address the RAOs established for the site. In addition, a "no action" alternative may

**Table 9-1**
**Preliminary Remedial Actions**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Soils | No action | none | none | No actions taken to address contamination at the OU. | Potentially viable. |
| | Limited action | Institutional controls | Deed restriction | Deeds for property within potentially contaminated areas could include restrictions on use of property. | Potentially viable. |
| | | | Fencing | Security fences installed around potentially contaminated areas to limit access. | Potentially viable. |
| | | | Zoning restrictions | Municipal zoning regulations could be revised to limit access, development, and use of the land. | Potentially viable. |
| | | | Groundwater restrictions | Deeds for property within potentially contaminated areas could include restrictions on development and use of groundwater. | Potentially viable. |
| | Containment | Surface controls | Vegetation | Seeding, fertilizing, and watering until a stand of vegetation has established itself. | Potentially viable. |
| | | | Grading | Reshaping of topography to manage infiltration and runoff to control erosion. | Potentially viable. |
| | | Cap | Native soil | Uncontaminated native soil placed over the site. | Viable in cases where direct contact is prime threat. Also may be viable in cases where majority of source is below water table and leaching is not a significant release mechanism. Unless engineered to do so, will not result in reduction in infiltration. |

See notes at end of table.

## Table 9-1 (Continued)
## Preliminary Remedial Actions

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Soils | Removal | Excavation | Mechanical excavation | Use of mechanical excavation equipment to remove and load contaminated media for offsite transport. | Potentially viable. |
| | Disposal | Offsite disposal | RCRA landfill | Transport of excavated materials to an RCRA permitted landfill. | Potentially viable. Treatment may be necessary based on land disposal restrictions. |
| | Treatment | Physical | Stabilization | Soil mixed with stabilizing reagents (e.g., lime or fly ash) that can bind contaminants to soil matrix to prevent leaching. | Potentially viable for soil contaminated with inorganics and low concentrations of organics. |
| | | | Thermal treatment | Contaminated soil is thermally destroyed in a controlled oxygen-sufficient environment. | Potentially viable. Ash may require additional treatment for inorganics. |
| | | | Soil washing | Soil is washed with water and surfactants, which removes contaminants. | Potentially viable. Wastestream would be produced requiring further treatment. |
| | | | Solvent extraction | Soil is washed with solvent, which extracts contaminants from the soil matrix to a liquid stream. | Potentially viable. May not be effective for inorganics. Wastestream would be produced requiring further treatment. |
| | | Biological | Bioremediation | Process uses microorganisms and nutrients to metabolize toxic organic contaminants and covert them to simpler and less toxic products. | Potentially viable. |
| | | Chemical | Chemical oxidation | Organic contaminants are oxidized through the addition of chemical oxidizing agents (such as ozone or hydrogen peroxide). Process can be carried out in reactor configuration in aqueous slurry phase. | Potentially viable for some organic contaminants; however, may not be viable for pesticide contaminants detected in site soils. |
| | | | Chemical detoxification | A process that removes and/or substitutes halogen atoms from an organic molecule, thus removing the toxicity associated with the halogenated atoms. | Potentially viable. |

See notes at end of table.

## Table 9-1 (Continued)
## Preliminary Remedial Actions

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Groundwater | Containment | Vertical barriers | Impermeable barrier | Trench around site or hot spot is excavated and filled with a type of impermeable barrier (i.e. HDPE, bentonite slurry, etc.) | Potentially viable. Effectiveness depends on site characteristics. Barrier should be keyed into aquitard or bedrock. |
| | Collection Treatment | Extraction | Extraction wells | Series of wells to extract contaminated groundwater. | Potentially viable. May include perimeter wells along with downgradient wells to capture migration of contaminated groundwater. |
| | | Collection | Trenches | System of perforated pipe laid in trenches to collect contaminated groundwater and lower the water table. | Potentially viable. |
| | Treatment | Biological treatment | Aerobic | The use of aerobic microbes to biodegrade organic wastes. | Potentially viable for organics. Sludge produced. |
| | | | Anaerobic | The use of anaerobic microbes to biodegrade organic wastes. | Potentially viable for organics. Sludge produced. |
| | | Chemical treatment | Chemical oxidation | Oxidizing agents added to waste for oxidation of heavy metals, unsaturated organics, sulfides, phenolics, and aromatic hydrocarbons to less toxic oxidation states. | Potentially viable. |
| | | | UV/oxidation | Destruction of organic contaminants using oxidizing agents and ultraviolet light. | Potentially viable. |
| | | | Metals precipitation | Inorganic constituents altered to reduce the solubility of heavy metals through the addition of a substance that reacts with the metals or changes the pH. | Potentially viable. |
| | | | pH adjustment | Neutralizing agents (such as lime) added to adjust the pH. This may be done to neutralize a waste stream or to reduce the solubility of inorganic constituents as part of the metals precipitation process. | Potentially viable. |

See notes at end of table.

**Table 9-1 (Continued)**
**Preliminary Remedial Actions**

Remedial Investigation and Feasibility Study Workplan
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Environmental Media | General Response Actions | Remedial Technologies | Process Options | Description | Evaluation Comments |
|---|---|---|---|---|---|
| Groundwater (continued) | Treatment (continued) | Physical treatment | Granular activated carbon (GAC) adsorption | Passage of contaminated water through a bed of adsorbent so contaminants adsorb on the surface. | Potentially viable. |
| | | | Sedimentation | Suspended particles are settled out of the wastestream, usually as a pretreatment or primary treatment step. | Potentially viable. |
| | | | Ion Exchange | A separation process in which cations (or anions) in the aqueous phase are exchanged with others that are attached to the exchange resins. | Potentially viable. Resins would require disposal or regeneration. |
| | | | Filtration | Used to filter out suspended particles. May be preceded be a coagulation and flocculation step to increase the effectiveness of sand filtration. | Potentially viable. |
| | Disposal | Offsite discharge | POTW | Extracted groundwater discharged to local POTW for further treatment. | Potentially viable. |
| | | | Surface water discharge | Discharge of treated effluent to an adjacent surface water body. | Potentially viable. A Federal and State NPDES permit would likely be required. |
| | | | Infiltration gallery | Reinjection of treated groundwater upgradient of extraction wells. | Potentially viable. |

Notes: OU = Operable Unit.
RI/FS = Remedial Investigation and Feasibility Study.
RCRA = Resource Conservation and Recovery Act.
UV/oxidation = ultraviolet light and oxidation.
POTW = publicly owned treatment works.
NPDES = National Pollutant Discharge Elimination System.

be identified, if practical. For each alternative developed, a brief description of the components will be provided in the FS report.

Because of the nature of the site, fewer options than are typically identified for FSs may be available to adequately address the OU 3 RAOs. If few alternatives (i.e., less than five) are developed, it may not be necessary to conduct further screening to limit the number of alternatives to be evaluated. However, if the complexity of the site indicates that several options are potentially feasible, a second alternatives screening step may be required. The alternative screening would be conducted employing the same criteria used for technology screening, but would consider how the alternative components function together to meet the RAOs.

**9.3 ALTERNATIVE EVALUATION**. Remedial alternatives that pass the screening step will be evaluated in the FS report to provide information that will help decision-makers select an appropriate alternative for OU 3. The evaluation process will consist of (1) a detailed description of the alternative components, sufficient to support a conceptual design and a cost estimate accurate to +50/-30 percent; (2) an evaluation of each alternative against seven of USEPA's nine evaluation criteria (State and community acceptance will be addressed in the Proposed Plan and ROD); and (3) a comparison of the alternatives relative to one another, with respect to the evaluation criteria.

Where appropriate, the description of alternatives may present preliminary design calculations, process flow diagrams, sizing of key components, and preliminary layouts and cross sections. The description may also include a discussion of limitations, assumptions, and uncertainties associated with each alternative.

The seven criteria that will be used to evaluate each alternative are described below.

Overall protection of human health and the environment considers how risks identified in the conceptual site model are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Compliance with ARARs identifies how the alternative achieves the Federal and State requirements regulating the chemical constituents, location of the site, and the type of action to be implemented.

Long-term effectiveness and permanence considers the integrity of the system or component over time, long-term management of waste, and magnitude of risk associated with waste remaining in place.

Reduction of toxicity, mobility, or volume through treatment does not apply to the containment or other nontreatment components, but applies to treatment components for contaminated media. This criterion considers the amount of material destroyed or treated, and the degree of expected contaminant reduction. It also includes an evaluation of the irreversibility of the treatment technology.

Short-term effectiveness considers the impacts on the surrounding community during construction and operation of the alternative. It also evaluates the amount of time required to achieve the response objectives.

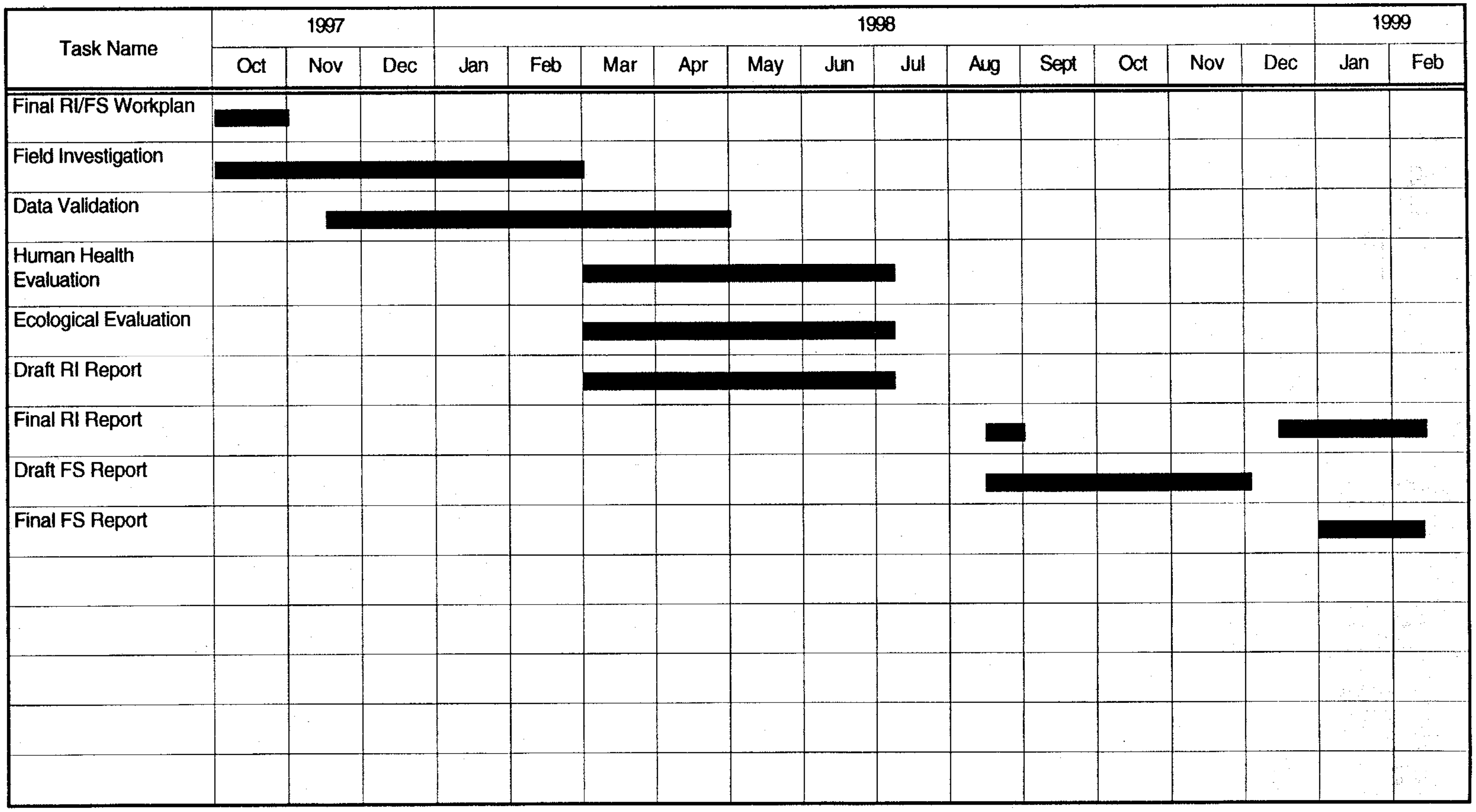
Implementability includes several factors, such as technical feasibility (i.e, the ability to construct and operate the alternative, the reliability of the technology, and the ability to monitor the effectiveness of the remedy), availability of materials and services, and administrative feasibility (i.e., the ease or difficulty of coordinating with or obtaining approvals from other agencies, and enforceability of deed restrictions).

Cost includes a line item cost estimate for construction and operation and maintenance costs, and a total present worth cost for the purpose of comparison with other alternatives. These cost estimates may be presented as a range of values with an accuracy of +50/-30 percent. The cost estimates will include a reasonable contingency factor to cover details and unforeseen circumstances. The estimates may be suitable for budgeting, but should not be considered the final construction cost estimates for the remedial action.

The comparative analysis of alternatives highlights the relative advantages and disadvantages of the alternatives for each of the seven evaluation criteria. This analysis will be presented as a written discussion for each alternative and will be summarized in tabular format for ease of comparison.

# 10.0 PROJECT SCHEDULE

The anticipated schedule for the OU 3 project tasks is presented on Figure 10-1. The schedule for the OU 3 field investigation is shown on Figure 10-2.




**NOTES:**
RI = Remedial Investigation
FS = Feasibility Study

**FIGURE 10-1**
**PROJECT SCHEDULE**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

2546-05 FIG 10-1FRAME102297MAW

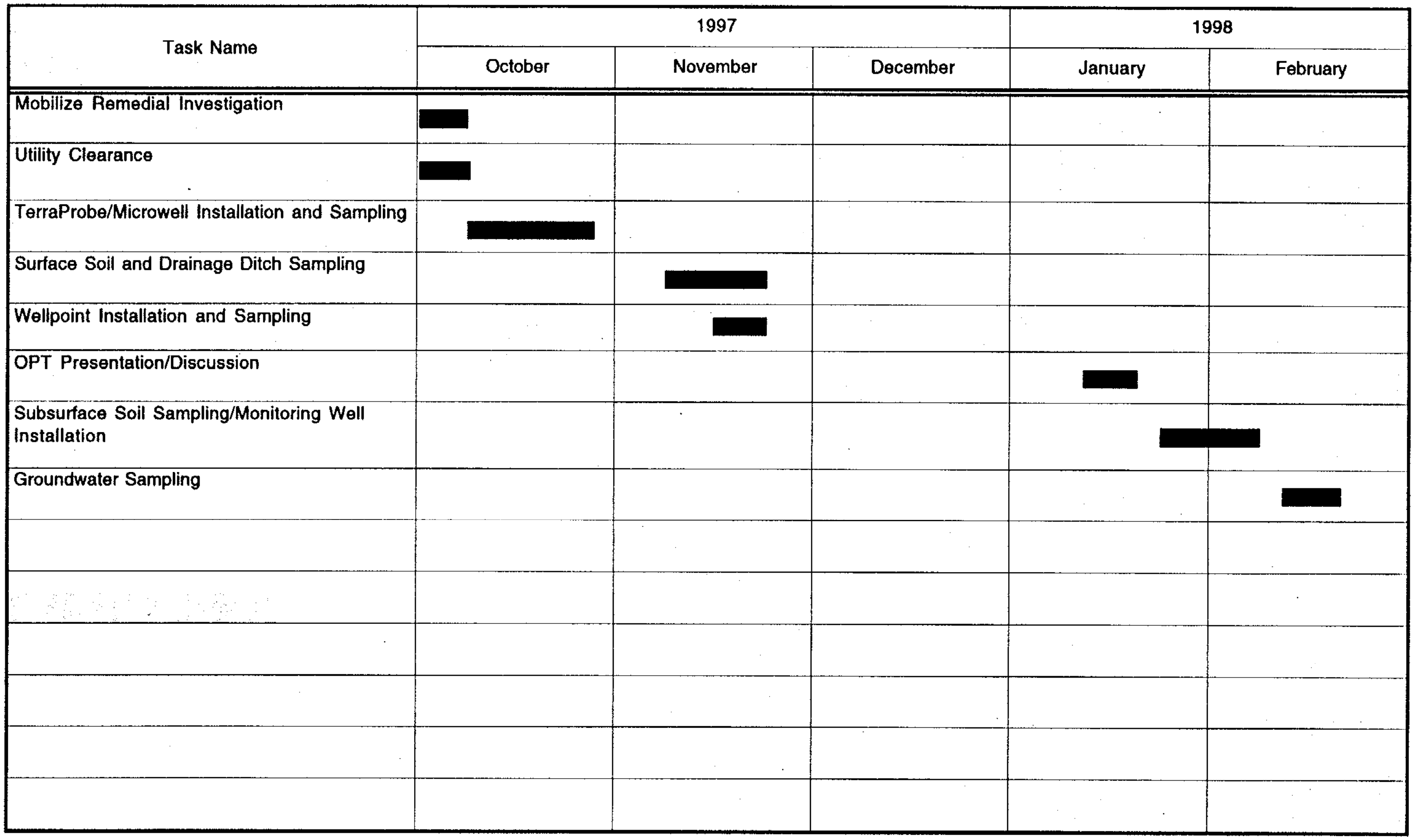



**FIGURE 10-2**
**FIELD INVESTIGATION SCHEDULE**

**REMEDIAL INVESTIGATION AND FEASIBILITY STUDY WORKPLAN**
**OPERABLE UNIT 3**
**STUDY AREAS 8 AND 9**

**NAVAL TRAINING CENTER**
**ORLANDO, FLORIDA**

2546-05 FIG 10-2 FRAME102997MAW

# REFERENCES

ABB Environmental Services, Inc. (ABB-ES). 1993. Correspondence from Marland Dulaney to ABB-ES risk assessors regarding USEPA Region IV Risk Assessment Guidance (October).

ABB-ES. 1994a. Base Realignment and Closure Environmental Baseline Survey Report, Naval Training Center, Orlando, Florida. Prepared for Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) North Charleston, South Carolina (June).

ABB-ES. 1994b. Background Sampling Plan (draft), Naval Training Center, Orlando, Florida. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (October).

ABB-ES. 1994c. Base Realignment and Closure Environmental Baseline Survey Report, Naval Training Center, Orlando, Florida. Prepared for SOUTHNAV-FACENGCOM, North Charleston, South Carolina (June).

ABB-ES. 1995. Draft Base Realignment and Closure Site Screening Report, Naval Training Center, Orlando, Florida. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (November).

ABB-ES. 1996. Base Realignment and Closure Site Screening Report Study Area 7, Naval Training Center, Orlando, Florida. Prepared for SOUTHNAVFACENGCOM, North Charleston, South Carolina (July).

ABB-ES. 1997. Project Operations Plan for Site Investigations and Remedial Investigations, Naval Training Center, Orlando. Prepared for SOUTHNAV-FACENGCOM, North Charleston, South Carolina (August).

Boyle Engineering Corporation. 1982. City of Orlando, Southeasterly Wastewater Treatment Plan Program: OR-012-114-0; pp. 11-12.

C.C. Johnson & Associates. 1985. Initial Assessment Study, Naval Training Center, Orlando, Florida. Prepared for Navy Assessment and Control of Installation Pollutants Program, Naval Energy and Environmental Support Activity, Port Hueneme, California (September).

Florida Department of Environmental Protection (FDEP). 1994. Update of the 1989 Florida Ground/Water Guidance concentrations Booklet (June).

FDEP. 1995. Soil cleanup Goals for Florida (September 27).

Florida Game and Freshwater Fish Commission (FGFWFC). 1991. Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida. Compiled by D.A. Wood, Endangered Species Coordinator.

Gilbert, 1987, R.O. 1987. "Statistical Methods for Environmental Pollution Monitoring"; Pacific Northwest Laboratory; Richland, Washington; pp. 119-131.

Geraghty & Miller. 1986. Verification Study, Assessment of Potential Soil and Ground Water Contamination at Naval Training Center, Orlando, Florida. Prepared for Naval Facilities Engineering Command, Southern Division, Charleston, South Carolina, Contract No. N62467-85-C-0667.

Healy, H.G. 1982. "Potentiometric Surface of the Floridan Aquifer in Florida"; Florida Department of Natural Resources. Bureau of Geology. Map Series No. 104 (May).

Lichtler, W.F., Anderson, Warren, and Joyner, B.F. 1968. "Water Resources of Orange County, Florida. Florida Bureau of Geology. Report of Investigation 50.

Maughan, J.T. 1993. *Ecological Assessment of Hazardous Waste Sites*, 352. New York, New York: Van Nostrand Reinhold.

National Academy of Sciences (NAS). 1977. Drinking Water and Health; Safe Drinking Water Committee, Washington, D.C.

National Research Council (NRC). 1984. "Nutrient Requirements of Poultry". Subcommittee on Poultry Nutrition. Washington, D.C.: National Academy Press.

Naval Energy and Environmental Support Activity (NEESA). 1988. Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program. (NEESA 20.2-047b). Port Hueneme, California.

Scott, T.M. 1978. "Orlando Sheet" Florida Department of Natural Resources. Bureau of Geology. Map Series 85.

Southern Division, Naval Facilities Engineering Command. 1985. *Master Plan Update*.

Suter, Glen W. 1993. Ecological Risk Assessment. Chelsea Michigan: Lewis Publishers.

U.S. Environmental Protection Agency (USEPA) Office of Pesticide Programs. 1986. Hazard Evaluation Division Standard Evaluation Procedure. Ecological Risk Assessment (EPA 540/9-85-001) Office of Solid Waste and Emergency Response. Washington, D.C.

USEPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Washington, D.C. (October).

USEPA. Environmental Research Laboratory. 1989a. *Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference* (EPA 600/3-89/01). Corvallis, Oregon (March).

USEPA. 1989b. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual* (Part A) (EPA/540/1-89/002). Interim Final. (December).

USEPA. 1989c. *Risk Assessment Guidance for Superfund, Volume 2: Environmental Evaluation Manual* (EPA/540/1-89/002) (December).

USEPA. 1991a. Supplemental Region IV Risk Assessment Guidance. U.S. Environmental Protection Agency, Region IV. Atlanta, Georgia (March 26).

USEPA. 1991b. Baseline Risk Assessment Guidance Based on the National Contingency Plan and Directed to Federal Facilities. USEPA Region IV, Waste Management Division. Atlanta, Georgia (April).

USEPA. 1991c. ECO Update Bulletins. Volume 1. Publication 9345.0051 (September).

USEPA. 1991d. ECO Update bulletins. Volume 1: Number 2. Publication 9345.0051 (December).

USEPA. Office of Solid Waste and Emergency Response. 1991e. *Ecological Assessment of Superfund Sites: An Overview*. Publication 9345.0-05I. Washington, D.C. (December).

USEPA. 1992a. Framework for Ecological Risk Assessment (EPA/630/R-92/001) (February).

USEPA. 1992b. ECO Update Bulletins. Volume 1: Number 3. Publication 9345.0-051 (March).

USEPA. Office of Emergency and Remedial Response. 1992c. Guidance for Data Useability in Risk Assessment (Parts A and B). Publication 9285.7-09A. Washington, D.C., (April).

USEPA. 1992d. Guide to Management of Investigation-Derived Waste: Publication 9345.3-03FS (April).

USEPA. Office of Solid Waste and Emergency Response. 1992e. "Supplemental Guidance to RAGS: Calculating the Concentration Term." Pub. 9285.7-081 Washington, D.C. (May).

USEPA. 1995a. Supplemental Guidance to RAGS: Region 4 Bulletin. "Preliminary Risk Evaluation, Ecological Risk Assessment, Bulletin No. 1." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995b. Supplemental Guidance to RAGS: Region 4 Bulletin. "Ecological Screening Values, Ecological Risk Assessment, Bulletin No. 2." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995c. Supplemental Guidance to RAGS: Region 4 Bulletin. "Endpoint Selection. Ecological Risk Assessment, Bulletin No. 3." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995d. Supplemental Guidance to RAGS: Region 4 Bulletin. "Natural Resource Trustees, Ecological Risk Assessment, Bulletin No. 4." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995e. *Supplemental Guidance to RAGS: Region 4 Bulletin*, "Human Health Risk Assessment." USEPA Region IV Waste Management Division. Atlanta, Georgia (November).

USEPA. 1995f. Drinking Water Regulations and Health Advisories. Washington, D.C. (February).

USEPA. 1996. *Proposed Guidelines for Ecological Risk Assessment*: Notice. Federal Register. Vol. 61, No. 175, pp. 47552-47631 (Monday, September 9).

USEPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. USEPA Environmental Response Team.

U.S. Geological Survey. 1980. Orlando East, Florida: 7.5 minute topographic quadrangle, 1956 (photo revised in 1980).

Wentsel, R.S., T.W. La Point, M. Simini, R.T. Checkai, D. Ludwig, and L.W. Brewer. 1996. *Tri-Service Procedural Guidelines for Ecological Risk Assessments, Volumes I and II*. Written for the Air Force Center for Environmental Excellence (AFCEE), the Army Environmental Center (AEC), and the Naval Facilities Engineering Service Center (NFESC) (June).

## APPENDIX A

## A SYNOPSIS OF POTENTIAL FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

## Table A-1
## Synopsis of Potential Federal ARARs

Remedial Investigation and Feasibility Study Workplan,
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Federal Standards and Requirements | Synopsis | ARAR Type | Consideration in the Remedial Response Process |
|---|---|---|---|
| Clean Air Act, National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) | Establishes primary (health based) and secondary (welfare based) air quality standards for carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur oxides emitted from a major source of air emissions. | Action specific | Site remediation activities must comply with NAAQS. The principal application of these standards is during remedial activities resulting in exposures through dust and vapors. In general, emissions from remedial activities are not expected to qualify as a major source and are, therefore, not expected to be applicable requirements. However, the requirements may be determined to be relevant and appropriate for nonmajor sources with significantly similar emissions. |
| Clean Water Act (CWA), Ambient Water Quality Criteria (AWQC) (40 CFR Part 131) | Federal AWQC are nonenforceable, health-based criteria for surface water. AWQC provide levels of exposure from drinking the water and consuming aquatic life that are protective of public health. AWQC also provide acute and chronic concentrations for protection of freshwater and marine organisms. | Chemical specific | In the absence of any Florida Surface Water Quality Standard specific to the pollutant and water body of concern, AWQC may be ARARs for surface-water bodies when protection of aquatic life is a concern or if human exposure from consumption of contaminated fish is a concern. |
| CWA, National Pollutant Discharge Elimination System (NPDES) (40 CFR Parts 122 and 125) | Requires permits specifying the permissible concentration or level of contaminants in the effluent for the discharge of pollutants from any point source into waters of the United States. | Action specific | Offsite discharge from a site to surface waters may require that an NPDES permit be obtained and that both the substantive and administrative NPDES requirements be met. |
| National Environmental Policy Act (NEPA) (40 CFR Part 6) | Requires an EIS or a "functional equivalent" for Federal actions that may impact the human environment. Also requires that Federal agencies minimize the degradation, loss, or destruction of wetlands, and preserve and enhance natural and beneficial values of wetlands and floodplains under Executive Orders 11990 and 11988. | Location specific<br>Action specific | A Federal action may be exempted from an EIS if a functionally equivalent study, such as an ecological risk assessment as performed under CERCLA, is completed. For remedies that may impact wetlands, the intent of NEPA (i.e., that degradation, loss, or destruction of wetlands should be minimized) is a potential ARAR. |

See notes at end of table.

**Table A-1 (Continued)**
**Synopsis of Potential Federal ARARs**

Remedial Investigation and Feasibility Study Workplan,
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| Federal Standards and Requirements | Synopsis | ARAR Type | Consideration in the Remedial Response Process |
|---|---|---|---|
| Resource Conservation and Recovery Act (RCRA), Identification and Listing of Hazardous Waste (40 CFR Part 261) | Defines those solid wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 262-265. | Action specific | These requirements define RCRA-regulated wastes, thereby delineating acceptable management approaches for listed and characteristically hazardous wastes that should be incorporated into the characterization and remediation elements of remedial response projects. |
| RCRA, Closure and Postclosure (40 CFR Part 264, Subpart G) | Details general requirements for closure and postclosure of hazardous waste facilities, including installation of a groundwater monitoring program. | Action specific | This requirement is a potential ARAR for remedial alternatives that involve the closure of a hazardous waste site. |
| RCRA, Use and Management of Containers (40 CFR Part 264, Subpart I) | Sets standards for the storage of containers of hazardous waste. | Action Specific | This requirement would apply if a remedial alternative involves the storage of containers of RCRA hazardous waste. Additionally, the staging of study-generated RCRA-wastes should meet the intent of the regulation. |
| RCRA, Land Disposal Restrictions (LDRs) (40 CFR Part 268) | Establishes restrictions on land disposal of untreated hazardous wastes, and provides treatment standards for hazardous wastes. | Action Specific | Under the LDRs, treatment standards have been established for all "listed" wastes. If it is determined that hazardous wastes are considered subject to LDRs, the material must be handled and treated in compliance with these regulations. No excavation (as treatment), however, could apply to IDW disposal. |
| Safe Water Drinking Act (SDWA), National Primary Drinking Water Standards, Maximum Contaminant Levels (MCLs) (40 CFR Part 141) | Establishes standards for specific contaminants that have been determined to adversely affect human health. These standards, MCLs, are protective of human health for individual chemicals and are developed using MCLGs, available treatment technologies, and cost data. | Chemical specific | MCLs established by the SDWA are relevant and appropriate standards where the MCLGs are not. MCLs apply to ground or surface waters that are current or potential drinking water sources. |
| SDWA, National Secondary Drinking Water Standards (SMLCs) (40 CFR Part 143) | Establishes welfare-based standards for public water systems for specific contaminants or water characteristics that may affect the aesthetic qualities of drinking water. | Chemical specific | SMCLs are nonenforceable limits intended as guidelines for use by States in regulating water supplies. |

See notes at end of table

**Table A-1 (Continued)**
**Synopsis of Potential Federal ARARs**

Remedial Investigation and Feasibility Study Workplan,
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

Notes: ARAR = applicable or relevant and appropriate requirements.
CFR = Code of Federal Regulations.
EIS = Environmental Impact Statement.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
IDW = investigation derived wastes.
MCLGs = maximum contaminant limit goal.

## Table A-2
## Synopsis of Potential State of Florida ARARs

Remedial Investigation and Feasibility Study Workplan,
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| State Citations | Synopsis | ARAR Type | Consideration in the Remedial Response Process |
|---|---|---|---|
| Florida Air Pollution Rules (Chapter 62-2, FAC) | Establishes permitting requirements for owners or operators of any source that emits any air pollutant. This rules also establishes ambient air quality standards for sulfur dioxide, $PM_{10}$, carbon monoxide, and ozone. | Action specific | Where remedial action could result in release of regulated contaminants to the atmosphere, such as may occur during air stripping, this regulation would be a potential ARAR. |
| Florida Rules on Permits (Chapter 62-4, FAC) | Establishes procedures for obtaining permits for sources of pollution. | Action specific | The substantive permitting requirements must be met during a CERCLA remediation. Both substantive and administrative requirements must be met for non-CERCLA activities. |
| Florida Surface Water Quality Standards (Chapter 62-302, FAC) | Defines classifications of surface waters, and establishes water quality standards (WQS) for surface water within the classifications. The State's antidegradation policy is also established in this rule. | Chemical specific<br>Location specific | Remedial actions that potentially impact surface waters of the State will consider surface WQS. WQC may also be relevant and appropriate ARARs for groundwater if no MCL exists, groundwater discharges to surface water and contaminants are affecting aquatic organisms, or other health-based standards are not available. |
| Florida Groundwater Classes, Standards and Exemptions (Chapter 62-520, FAC) | Establishes the groundwater classification system for the State and provides qualitative minimum criteria for groundwater based on the classification. States that groundwater that is Class I or II must be treated to meet primary and secondary standards. | Chemical specific<br>Location specific | The classification system established in this rule defines potable water sources (F-I, G-I and G-II waters). Because groundwater at OU 3 is Class II, the primary and secondary standards in 62-550, FAC, may apply. |
| Groundwater Permitting and Monitoring Requirements (Chapter 62-522, FAC) | Establishes permitting and monitoring requirements for installations discharging to groundwater. | Action specific | This rule should be considered when discharge to groundwater is a possible remedial action. |
| -Florida Drinking Water Standards (Chapter 62-550, FAC) | Established to implement the Federal Safe Drinking Water Act by adopting the national primary and secondary drinking water standards and by creating additional rules to fulfill State and Federal requirements. | Chemical specific<br>Location specific | MCLs are commonly considered applicable regulations for aquifers and related groundwater classified as a current or potential potable water supply source. MCLs should be considered ARARs during a cleanup of ground or surface waters that are current or potential sources of drinking water. |

See notes at end of table.

**Table A-2 (Continued)**
**Synopsis of Potential State of Florida ARARs**

Remedial Investigation and Feasibility Study Workplan,
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

| State Citations | Synopsis | ARAR Type | Consideration in the Remedial Response Process |
|---|---|---|---|
| Florida Water Quality Based Effluent Limitations (Chapter 62-650, FAC) | States that all activities and discharges, except dredge and fill, must meet effluent limitations based on technology or water quality. | Chemical specific<br>Action specific | All activities and discharges, other than dredge and fill activities, are required to meet effluent limitations based on technology (technology based effluent limit) and/or water quality (water quality based effluent limit), as defined in this rule. The substantive permitting requirement established in this rule may be potential relevant and appropriate ARARs for remedial actions where treated water is discharged to a surface water body. |
| Florida Hazardous Waste Rules (Chapter 62-730, FAC) | Adopts by reference appropriate sections of 40 CFR and establishes minor additions to these regulations concerning the generation, storage, treatment, transportation, and disposal of hazardous wastes. | Action specific | The substantive permitting requirements for hazardous waste must be met where applicable for remedial actions. |
| Florida Soil Thermal Treatment Facilities Regulations (Chapter 62-775, FAC) | Establishes criteria for the thermal treatment of petroleum or petroleum product contaminated soils. The rule further outlines procedures for excavating, receiving, handling, and stockpiling contaminated soils prior to thermal treatment in both stationary and mobile facilities. | Chemical specific<br>Action specific | The soil cleanup values established in this rule for TRPH, VOH, metals, and BTEX may be potential relevant and appropriate ARARs for contaminated soils. This requirement does not apply to soils classified as hazardous. Procedures for excavating, receiving, handling, and stockpiling contaminated soils prior to thermal treatment are ARARs for remedial alternatives involving thermal treatment of soils. |
| Groundwater Guidance Concentrations, Bureau of Groundwater Protection, June 1994. | The document establishes maximum concentration levels for groundwater contaminants in the State of Florida. Groundwater with concentrations less than the listed values are considered "free from" contamination. | TBC | The values in this guidance should be considered when determining cleanup levels for groundwater. |
| Approach to the Assessment of Sediment Quality in Florida Coastal Water, 1995. | These guidelines should be considered when evaluating potential biological harm posed by contaminated sediments in Florida coastal waters | TBC | These guidelines may be used for analyzing the sediment quality after air sparging has begun. |
| Soil Cleanup Standards for Florida, September 1995. | This document provides guidance for soil cleanup levels, which can be developed on a site-by-site basis using the calculations found in Appendix B of the guidance. | TBC | These guidelines aid in determining risk-based and leachability-based cleanup goals for soils. |

See notes at end of table.

## Table A-2 (Continued)
## Synopsis of Potential State of Florida ARARs

Remedial Investigation and Feasibility Study Workplan,
Operable Unit 3, Study Areas 8 and 9
Naval Training Center
Orlando, Florida

Notes: ARAR = applicable or relevant and appropriate requirements.
FAC = Florida Administrative Code.
VOH = volatile organic halocarbons.
TRPH = total recoverable petroleum hydrocarbons.
BTEX = benzene, toluene, ethylbenzene, and xylenes.
TBC = to be considered
$PM_{10}$ = particulate matter less than 10 microns..
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
MCL = maximum contaminant level.
OU = Operable Unit.
CFR = Code of Federal Regulations.