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CORRECTIVE MEASURES STUDY ADDENDUM FOR SOLID WASTE MANAGEMENT UNITS 6 AND 7 (SWMU6) (SWMU7) NS MAYPORT FL
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TETRA TECH

Comprehensive Long-term Environmental Action Navy

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Corrective Measures Study Addendum
for
Solid Waste Management Units (SWMUs) 6 and 7

Naval Station Mayport
Jacksonville, Florida

Contract Task Order 0033

June 2009

NAVFAC
Naval Facilities Engineering Command
NAVFAC SOUTHEAST
NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH NUS, Inc.

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CORRECTIVE MEASURES STUDY ADDENDUM
FOR
SOLID WASTE MANAGEMENT UNITS 6 AND 7

NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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PROFESSIONAL ENGINEER CERTIFICATION

This document, *Corrective Measures Study Addendum for SWMU 6 and 7, Naval Station Mayport, Jacksonville, Florida*, has been prepared under the direction of a Florida Registered Professional Engineer. 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. This document was prepared for Naval Station Mayport, Jacksonville, Florida, and should not be construed to apply to any other site.

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FOREWORD

To meet its mission objectives, the United States 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 initiated various programs to investigate and remediate conditions related to suspect past releases of hazardous materials at their facilities.

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

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

The IR program is conducted in several stages as follows:

- The preliminary assessment (PA) identifies potential sites through record searches and interviews.
- A site inspection (SI) then confirms which areas contain contamination, constituting actual "sites." (Together, the PA and SI steps were called the Initial Assessment Study under the NACIP program.)
- Next, the remedial investigation and the feasibility study (RI/FS) together determine the type and extent of contamination, establish criteria for cleanup, and identify and evaluate any necessary

remedial action alternatives and their costs. As part of the RI/FS, a risk assessment identifies potential effects on human health or the environment to help evaluate remedial action alternatives.

- The selected alternative is planned and conducted in the remedial design and remedial action stages. Monitoring then ensures the effectiveness of the effort.

A second program to address present hazardous material management is the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. This program is designed to identify and cleanup releases of hazardous substances at RCRA-permitted facilities. RCRA ensures that solid and hazardous wastes are managed in an environmentally sound manner. The law applies primarily to facilities that generate or handle hazardous waste.

The RCRA program is conducted in the following three stages.

- The RCRA facility assessment (RFA) identifies solid waste management units (SWMUs), evaluates the potential for releases of contaminants, and determines the need for future investigations.

- The RCRA facility investigation (RFI) then determines the nature, extent, and fate of contaminant releases.

- The Corrective Measures Study (CMS) identifies and recommends measures to correct the release.

The hazardous waste investigations at Naval Station (NAVSTA) Mayport are presently being conducted under the RCRA Corrective Action Program. Earlier preliminary investigations had been conducted at NAVSTA Mayport under the Navy's NACIP program and IR program following Superfund guidelines. In 1988, in coordination with the United States Environmental Protection Agency (USEPA) and the Florida Department of Environmental Regulation, now known as the Florida Department of Environmental Protection (FDEP), the hazardous waste investigations were formalized under the RCRA program.

Mayport is conducting the cleanup at their facility by working through the Naval Facilities Engineering Command Southeast. The USEPA and the FDEP oversee the Navy environmental program. All aspects of the program are conducted in compliance with state and federal regulations, as ensured by the participation of these regulatory agencies.

Questions regarding the RCRA program at NAVSTA Mayport should be addressed to Cheryl Mitchell (Code N4E) (904) 270-6730.

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ACRONYMS AND ABBREVIATIONS

ABB	ABB Environmental Services, Inc.
AOC	Area of Concern
bgs	Below Ground Surface
BSV	Background Screening Value
CAMP	Corrective Action Management Plan
CAO	Corrective Action Objective
CH2M Hill	CH2M Hill Constructors, Inc.
CMS	Corrective Measures Study
COC	Contaminant of Concern
COI	Contaminant of Interest
COPC	Contaminant of Potential Concern
CTL	Cleanup Target Level
CTO	Contract Task Order
DPT	Direct Push Technology
ECPC	Ecological Chemical of Potential Concern
ELCR	Excess Lifetime Cancer Risk
EPC	Exposure Point Concentration
EPH	Extractable Petroleum Hydrocarbon
ESI	Expanded Site Investigation
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
ft/day	Feet (or Foot) per Day
ft/ft	Feet (or Foot) per Foot
GCTL	Groundwater Cleanup Target Level
GIR	General Information Report
HLA	Harding Lawson Associates
HI	Hazard Index
HQ	Hazard Quotient
HSWA	Hazardous and Solid Waste Amendment
IM	Interim Measure
IR	Installation Restoration
LNAPL	Light Non-Aqueous Phase Liquid
LTTD	Low Temperature Thermal Desorption
LUC	Land Use Control
MCS	Media Cleanup Standard

ACRONYMS AND ABBREVIATIONS (Continued)

µg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
NACIP	Navy Assessment and Control of Installation Pollutants
NADSC	Natural Attenuation Default Source Concentration
NAVFAC SE	Naval Facilities Engineering Command Southeast
NAVSTA	Naval Station
ND	Nondetect
NIRP	Naval Installation Restoration Program
NPW	Net Present Worth
O&M	Operations and Maintenance
OWTP	Oily Waste Treatment Plant
ORC	Oxygen-Releasing Compound
ORP	Oxygen/Reduction Potential
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PPE	Personal Protective Equipment
PRB	Permeable Reactive Barrier
RBCA	Risk Based Corrective Action
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI/FS	Remedial Investigation/Feasibility Study
SI	Site Inspection
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TPHCWG	Total Petroleum Hydrocarbon Criteria Working Group
TRPH	Total Recoverable Petroleum Hydrocarbon
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbon

EXECUTIVE SUMMARY

A Corrective Measures Study (CMS) Addendum has been conducted for Solid Waste Management Units (SWMUs) 6 and 7 at Naval Station (NAVSTA) Mayport, in Jacksonville, Florida, for the United States Navy, Naval Facilities Engineering Command Southeast (NAVFAC SE), pursuant to the Resource Conservation and Recovery Act (RCRA). This CMS Addendum was conducted in accordance with the Hazardous and Solid Waste Amendments (HSWA) Permit 72442-H0-003, revised and reissued by the Florida Department of Environmental Protection (FDEP) in August 2005. The HSWA/RCRA program is designed to identify and cleanup releases of hazardous substances at RCRA-permitted facilities. RCRA ensures that solid and hazardous wastes are managed in an environmentally sound manner. The law applies primarily to facilities that generate or handle hazardous waste. This report is an addendum to the CMS for Group II SWMUs, which was issued in January 1996.

The RCRA program is conducted in the following three stages:

1. The RCRA Facility Assessment (RFA) identifies SWMUs, evaluates the potential for releases of contaminants, and determines the need for future investigations.
2. The RCRA Facility Investigation (RFI) then determines the nature, extent, and fate of contaminant releases.
3. The CMS Addendum identifies and recommends measures to correct the releases.

The RFI for SWMUs 6 and 7 was conducted as part of the RFI for Group II SWMUs. The RFI report for Group II SWMUs was issued in January 1996. This report presents the results of the CMS for SWMUs 6 and 7, including the following:

1. Determination of the Media Cleanup Standards (MCSs) using the regulation Chapter 62-777, Florida Administrative Code (FAC).
2. Selection of contaminants of concern (COCs).
3. Determination of areas and volumes of impacted media exceeding the MCSs.
4. Development, screening, and evaluation of corrective measure alternatives.
5. Recommendation of corrective action to address contaminated media.

This CMS Addendum report contains the results of the identification, screening, and evaluation of corrective measure alternatives for all media at SWMUs 6 and 7.

SWMU 6, Former Waste Oil Pit and Sludge Drying Bed

SWMU 6, former Waste Oil Pit and Sludge Drying Bed, is located in the northern portion of the NAVSTA Mayport near the southern shore of the St. Johns River. SWMU 6 was located beneath the westernmost bed of the four existing oily waste treatment plants (OWTPs) Sludge Drying Beds (SWMU 7). The Waste Oil Pit and the Sludge Drying Bed was used from 1973 to 1978 to store bilge water that contained oily waste. It is believed that other items such as solvents and transformer oils may also have been disposed of in the Waste Oil Pit and the Sludge Drying Bed. The Waste Oil Pit and the Sludge Drying Bed were triangular in shape, approximately 0.2 acre in size, and was excavated to a depth of approximately 6 feet below ground surface (bgs) (Kearney, 1989).

An estimated 250,000 gallons of bilge water and several thousand gallons of waste oil were disposed of at SWMU 6. The bilge water and oily waste disposed of in the unlined pit were allowed to seep into the underlying soil. In 1979, the Waste Oil Pit was filled and covered, and the four existing OWTP Sludge Drying Beds (SWMU 7) were constructed (Kearney, 1989).

SWMU 7, OWTP Sludge Drying Beds

SWMU 7, OWTP and Sludge Drying Beds, is located in the northern portion of the NAVSTA Mayport near the southern shore of the St. Johns River. SWMU 7 was constructed in 1979 to receive and dewater sludge from the OWTP. Each of the four sludge drying beds are approximately 150 feet in length and 50 feet wide, unlined, and enclosed by earthen berms which are approximately 8 feet above the surrounding land surface. The drying beds received sludge collected from the clarifier of the OWTP (SWMU 9) and from bilge water receiving Tanks 99 and 100 (SWMU 51). Bilge water overflow was pumped directly into the sludge drying beds when Tanks 99 and 100 were at capacity (Kearney, 1989).

Approximately 1,500 gallons of sludge were conveyed to the drying beds each day that the OWTP was in operation. At the time of the RFA in 1989, the OWTP was operated twice per week. The design of the drying beds allowed the supernate to be recirculated back to the OWTP. No sludge has been removed from the drying beds since operations began; however, during the construction of three new bilge water receiving tanks in 1989, sludge from the easternmost bed was excavated and deposited into an adjacent bed. A lined dike enclosure for the three new bilge water receiving tanks was constructed in the easternmost drying bed, and the adjacent drying bed that received the excavated sludge was taken out of service and no longer receives sludge (Kearney, 1989). The two westernmost drying beds received sludge from the new bilge water tanks and the OWTP clarifier until late 1994, at which time sludge was conveyed to a new dewatering unit. After dewatering, sludge is currently collected for offsite disposal by a subcontractor.

Soil – SWMUs 6 and 7

Soils were not evaluated in this CMS Addendum because an Interim Measure (IM) was conducted in September 2007 to remove contaminated soils associated with the sludge beds, and there have been no reported releases outside of the sludge lagoons. During the IM, petroleum-impacted soils at SWMUs 6 and 7 were removed to the practical extent possible [CH2M Hill Constructors, Inc. (CH2M Hill), 2008].

Surface Water – SWMUs 6 and 7

No surface water COCs were identified for SWMUs 6 and 7. No action is recommended for surface water at SWMUs 6 and 7.

Groundwater – SWMUs 6 and 7

1-Methylnaphthalene, 2-methylnaphthalene, benzo(a)anthracene, and total petroleum hydrocarbons (TPH) (C8-C40) were the only contaminants in groundwater that exceeded their respective MCSs at SWMUs 6 and 7. Approximately 9,896,492 gallons of contaminated groundwater would require corrective action. Three alternatives were developed for groundwater contamination at SWMUs 6 and 7. The alternatives are as follows:

- Groundwater Alternative 1: No Action
- Groundwater Alternative 2: Natural Attenuation, Land Use Controls (LUCs), and Monitoring
- Groundwater Alternative 3: In-Situ Bioremediation, LUCs, and Monitoring

The recommended corrective measure alternative for groundwater at SWMU 6 is Alternative 2. Alternative 2 would implement LUCs to address the limited groundwater contamination at SWMUs 6 and 7 and prevent the surficial aquifer from being used as a potable water source. Monitoring would assess groundwater quality on an ongoing basis and provide data to verify if the contaminant concentrations in groundwater are decreasing. This alternative would rely on natural attenuation processes in addressing the contaminated groundwater. Natural attenuation has been successful at many sites to address limited groundwater contamination. A more aggressive treatment process is not required because the surficial aquifer is not currently used as a potable water source and impact to the ecological receptors is minimal.

The contaminated soil that serves as the source for the groundwater contamination was removed to the maximum extent possible by an IM in 2007. With the source of groundwater contamination removed, LUCs with monitoring would provide adequate and cost-effective protection of human health and the

environment. Monitoring of LUCs would ensure the surficial aquifer is not used as a potable water source or for residential use (e.g., irrigation). Monitoring the groundwater would verify if any potential danger to the environment or human health was present. Upon completion of one year of quarterly monitoring, groundwater data from the site will be evaluated against criteria in Chapter 62-780.680, FAC, for potential site closure using Risk Based Corrective Action (RBCA). The estimated net present worth (NPW) of the total project cost for Alternative 2 over a 30-year timeframe is $368,000.

1.0 INTRODUCTION

A CMS Addendum has been conducted for SWMUs 6 and 7 at NAVSTA Mayport, in Jacksonville, Florida, by NAVFAC SE, pursuant to the RCRA. Tetra Tech NUS, Inc. (TtNUS) has been contracted by the Navy, NAVFAC SE, to complete this CMS Addendum under Contract Task Order (CTO) 0033, Comprehensive Long-term Environmental Action Navy IV Contract Number N62467-94-D-0055. This report presents the results of the CMS Addendum.

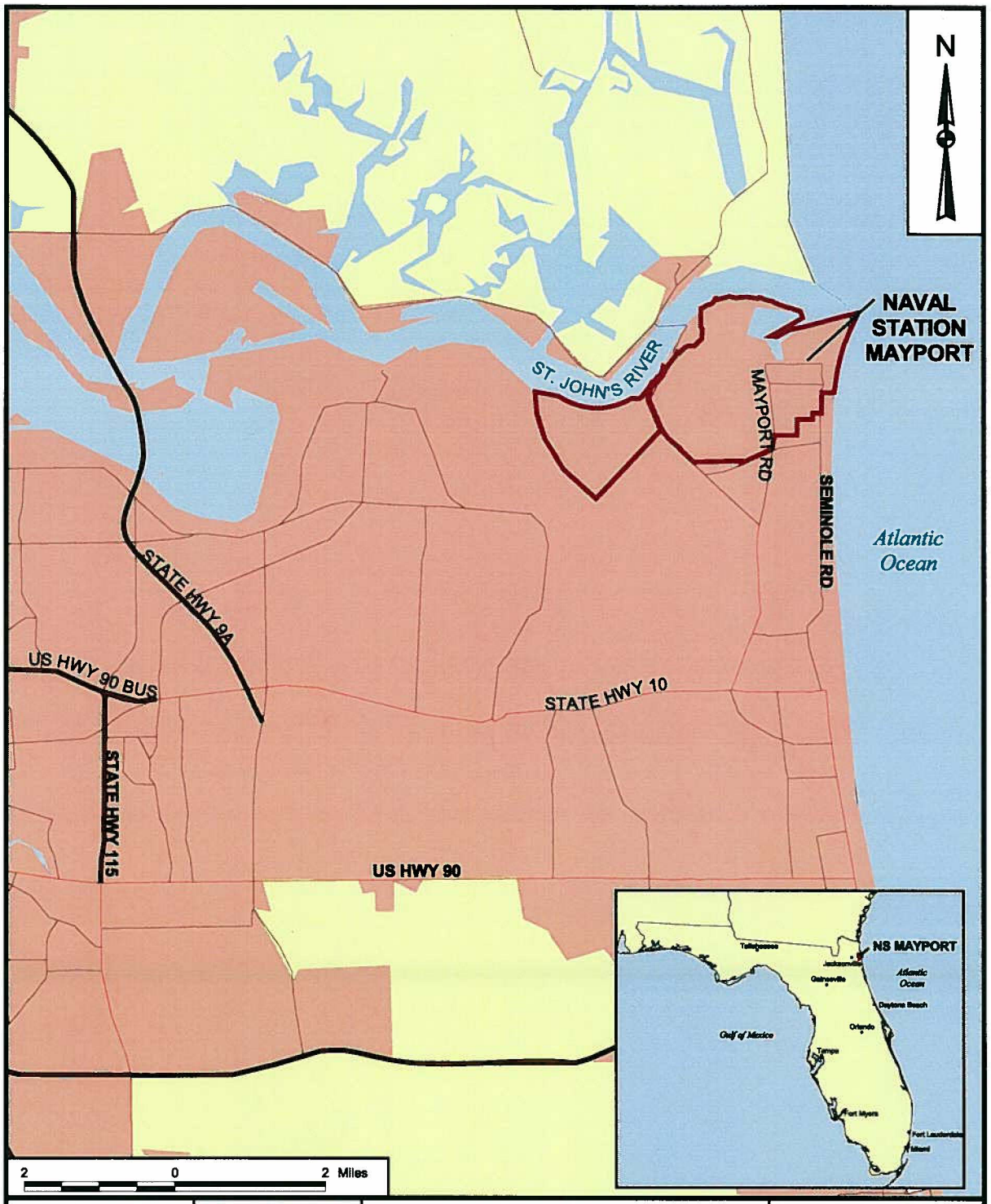
1.1 SITE BACKGROUND

SWMUs 6 and 7 are located just west of the OWTP (SWMU 9) and about 200 feet south of the St. Johns River. SWMU 6, located directly adjacent to SWMU 7 to the west, served as a waste oil pit and sludge drying bed prior to the installation of SWMU 7 in 1979. SWMU 7 is made up of four OWTP sludge drying beds, which are enclosed by earthen berms. The sludge drying beds received sludge from the OWTP clarifiers and bilge water from receiving tanks. The easternmost drying bed was excavated in 1989, at which time a lined, diked enclosure and three bilge water receiving tanks were constructed. Records indicate that approximately 1,500 gallons of sludge were transferred to the drying beds on an average of twice per week until late 1994 when operations were discontinued. SWMUs 6 and 7 were identified in the 1989 RFA/Visual Site Inspection, and were included in Group II SWMUs for the RFI. The Group II SWMUs RFI was completed in 1996 and recommended that a CMS be conducted for the Group II SWMUs. A CMS was conducted for the Group II SWMUs and was completed in 1996. From 1996 through December 2000, three source removal projects have been conducted at SWMUs 6 and 7 to remove petroleum-impacted soil and light non-aqueous phase liquids (LNAPL). Approximately 3,357 gallons of LNAPL and 5,234 tons of petroleum-impacted soil were removed from SWMUs 6 and 7 for disposal during the source removal projects.

1.2 FACILITY DESCRIPTION

NAVSTA Mayport is located within the corporate limits of the city of Jacksonville, Duval County, Florida, approximately 12 miles to the northeast of downtown Jacksonville, and adjacent to the town of Mayport (see Figure 1-1). The station complex is located on the northern end of a peninsula bound by the Atlantic Ocean to the east and the St. Johns River to the north and west. NAVSTA Mayport occupies the entire northern part of the peninsula except for the town of Mayport, located to the west between the station and the St. Johns River.

NAVSTA Mayport was commissioned in 1942 on approximately 700 acres of land. The station initially consisted of a harbor and an airfield located near the mouth of the St. Johns River. The harbor and airfield were constructed from the dredging and filling of Ribault Bay. The harbor was initially dredged to



DRAWN BY	DATE			CONTRACT NUMBER
S. PAXTON	2/26/07	NAVFAC	FACILITY LOCATION MAP CORRECTIVE MEASURE STUDY ADDENDUM SWMU 6 AND 7 NAVAL STATION MAYPORT	0195
CHECKED BY	DATE			APPROVED BY / DATE
K. WIMBLE	2/26/07			— —
COST/SCHEDULE-AREA				APPROVED BY / DATE
				— —
SCALE				DRAWING NO. / REV
AS NOTED				FIGURE 1 - 1 / 0

P:\GIS\MAYPORT_NS\MAPDOCS\APR\SWMU47_53_55.APR SITE LOCATION LAYOUT 3 2/26/07 SP

a depth of 29 feet below mean sea level and is referred to as the Mayport Turning Basin. The Mayport Turning Basin is surrounded on three sides by ship piers and wharves.

The original mission of the station included use by patrol craft, target boats, and rescue boats. The station was placed in caretaker status from 1946 to 1948. In 1948, the station was reopened, and in 1952, an aircraft carrier was assigned to the station. The turning basin was dredged to a depth of 40 feet to allow aircraft carriers and other large ships to berth at NAVSTA Mayport. Using dredge material to fill areas south of the turning basin increased the amount of uplands at NAVSTA Mayport.

NAVSTA Mayport provides all necessary support services for the surface fleet and aircraft stationed at or visiting Mayport. This support includes a variety of services including infrastructure support, personnel support, facilities support, and ship and aircraft repair and maintenance.

Industrial operations conducted at NAVSTA Mayport involve intermediate level maintenance for both ships and aircraft and vehicle maintenance and repair. Any maintenance activities that can be conducted without putting a ship into dry-dock are considered intermediate. Squadron personnel perform aircraft maintenance in the hangar buildings.

1.3 REGULATORY SETTING AND FACILITY BACKGROUND

The United States Environmental Protection Agency (USEPA) issued RCRA Permit Number H016-118598 and HSWA Permit Number FL9 170 024 260 to NAVSTA Mayport on March 25, 1988. The permit was revised and renewed on June 15, 1993. Full RCRA authority to issue HSWA permits was delegated to the State of Florida in November 2000, and the FDEP issued the current RCRA operating permit, including the HSWA Corrective Action, to NAVSTA Mayport on August 30, 2006.

The Corrective Action Management Plan (CAMP) contained in the final RFI Work Plan grouped 56 SWMUs into four groups. Three of these groups were defined geographically by their proximity to one another and to site features such as wetlands, rivers, and land use patterns. The fourth group contains SWMUs and Area of Concerns (AOCs) associated with utility networks and appurtenances that span multi-geographic regions at NAVSTA Mayport. The CAMP also prioritized the SWMUs according to the perceived relative risks posed by the SWMUs based on the existing knowledge of the sites and past releases. Group I was the highest priority group of SWMUs. The Groups II, III, and IV were assigned sequentially lower priorities. A revised CAMP was issued in March 1995 in response to the HSWA permit renewal [ABB Environmental Services, Inc. (ABB), 1995a]. The CAMP is revisited every year to incorporate the latest descriptions of the phased approach, proposed schedule, and strategy to

implement the RCRA Corrective Action Program at NAVSTA Mayport. SWMUs 6 and 7 were included in the Group II SMWUs.

SWMUs 6 and 7 RFI field activities were conducted between 1993 and 1994. The Final RFI for the Group II SWMUs dated January 1996 recommended that a CMS be conducted to evaluate and recommend a remedial action to mitigate free-phase hydrocarbons and surface and subsurface soil contamination at SWMUs 6 and 7.

Three source removal projects were conducted from 1996 through December 2007 at SWMUs 6 and 7 to remove petroleum impacted soil and LNAPL. A technology demonstration of low temperature thermal desorption (LTTD) was conducted in 1996. The LTTD demonstration resulted in the excavation and treatment of 1,900 tons of petroleum-impacted soil from SWMU 7 and 480 tons of petroleum-impacted sludge from the area north of SWMU 7 (ABB, 1997). Two mobile bioslurping systems and a bioventing system were operated at SWMUs 6 and 7 from January 1997 until August 2000 and recovered approximately 1,420 gallons of LNAPL. An additional 137 gallons of LNAPL were recovered from the sites by hand bailing after cessation of operation of the systems until March 2001 (Battelle, 2001). From September through December 2007, CH2M Hill conducted an IM that removed and disposed of 2,853.67 tons of petroleum-impacted soil and 1,800 gallons of LNAPL from SWMUs 6 and 7. The IM resulted in the removal of petroleum-impacted soil and LNAPL from SWMUs 6 and 7 to the practicable extent possible (CH2M Hill, 2008). A total of approximately 3,357 gallons of LNAPL and 5,234 tons of petroleum-impacted soil were removed from SWMUs 6 and 7 for disposal during the three source removal projects.

1.4 PURPOSE

The purpose of this CMS Addendum for SWMUs 6 and 7 at NAVSTA Mayport is as follows:

1. Determination of the Media Cleanup Standard (MCSs) using regulation Chapter 62-777, FAC.
2. Selection of COCs.
3. Determination of areas and volumes of impacted media exceeding the MCSs.
4. Development, screening, and evaluation of corrective measure alternatives.
5. Recommendation of corrective action to address contaminated media at SWMUs 6 and 7.

1.5 CMS METHODOLOGY

This CMS Addendum for SWMUs 6 and 7 uses the CMS process described in the CMS Work Plan (ABB, 1995b) for NAVSTA Mayport. The purpose of the CMS is to identify, evaluate, and recommend corrective action for SWMUs or AOCs that warrant such action based on the results of the RFI.

Investigation data documented in the station-wide General Information Report (GIR), the RFI Report, and subsequent IM programs conducted at SWMUs 6 and 7 were reviewed to gain an understanding of their physical setting, past history, current conditions, and future land uses. Available validated analytical data for all environmental media were assembled into a single CMS database. The following key components were considered in identifying appropriate corrective action:

- Corrective Action Objectives (CAOs). CAOs are developed to specify the contaminants, media of interest, exposure pathways, and corrective action goals for a SWMU.

- MCSs. MCSs are developed based on regulatory requirements, when available, site-specific risk-based factors, or other available information (e.g., leachability of contaminants from soil to groundwater). MCSs were derived for both human and ecological receptors from information presented in the RFI and IM reports, or were developed based on the State of Florida Chapter 62-777, FAC, Cleanup Target Level (CTL) criteria for each medium of concern.

- COCs. Contaminants detected in the media of concern were compared against promulgated regulatory standards or other applicable or relevant and appropriate requirements criteria to identify contaminants of potential concern (COPCs) in each environmental medium for both human and ecological receptors. COCs are developed from the list of COPCs determined in the RFI Report or as updated in the CMS. COCs define the contaminants that will be evaluated for corrective action in the CMS.

- Volumes of Media of Concern. The volumes (or areas) of media of concern at SWMUs 6 and 7 are determined by considering the requirements for protectiveness as identified in the CAOs and the chemical and physical characterization of the site (i.e., the results and conclusions of the RFI and post-RFI activities). Essentially, the area and depth of a given medium containing concentrations of COCs that exceed the MCSs were used to define the volumes of media of concern.

- Applicable Technologies. Technologies applicable to remediating contaminated media at SWMUs 6 and 7 are identified and screened. Technologies that cannot be implemented technically are eliminated.

- Corrective Measure Alternatives. Technologies that pass the screening phase are assembled into corrective measure alternatives.

- Evaluation of Corrective Measure Alternatives. Recommended corrective measure alternatives are described and evaluated using the following four criteria: technical, environmental, human health, and institutional factors.

- Recommendation of Corrective Action. The results of the evaluation of alternatives are summarized and a corrective action is recommended for SWMUs 6 and 7.

These components are described further in the CMS Work Plan for NAVSTA Mayport (ABB, 1995b). More detailed discussion of the methodology for MCSs, COCs, and COPCs used in this CMS is provided in the following sections.

1.5.1 Contaminants of Concern

The determination of COCs for each medium at SWMUs 6 and 7 involved the following three-step process:

1. Determine the Contaminants of Interest (COIs).
2. Identify the COPCs.
3. Select the COCs.

COIs and COPCs were determined in the RFI; however, since the RFI was issued additional data has been collected and new regulations have been promulgated. The additional analytical data that was collected since the RFI utilized new analytical methods that analyzed the individual fraction ranges for the Total Recoverable Petroleum Hydrocarbon (TRPH). The new regulations updated by FDEP were effective as of April 17, 2005, and updated the regulatory CTLs. COIs and COPCs were reevaluated using the most current data and CTLs.

1.5.2 Contaminants of Interest

COIs include any contaminant detected at least once in validated analytical results for environmental samples in any medium at the site during any sampling event. Lists of COIs for SWMUs 6 and 7 are presented in Section 3.

1.5.3 Contaminants of Potential Concern

The selection of COPCs was based on the list of COIs and considered the concentration of contaminants detected in the environmental media at SWMUs 6 and 7 compared against FDEP CTLs. The COPC selection considered only validated soil and groundwater sample results from the most recent sampling events.

1.5.3.1 Soil

The COPC selection process for soil was conducted in two separate evaluations: direct exposure and leachability. The direct exposure evaluation was performed in a two step process: initial COPCs and final COPCs.

For direct exposure, the published CTLs provided in Chapter 62-777, FAC, were used to identify COPCs. The maximum detected concentration for each COI was compared to the residential direct exposure table value in Chapter 62-777, FAC to determine the COPCs. Contaminants whose maximum concentration was less than the background screening value (BSV) (or under certain conditions, contaminants whose maximum concentration was within the background range) were screened out. BSVs for surface and subsurface soil that were developed for NAVSTA Mayport are presented in Section 2.4 of this report.

For leachability, the maximum concentration for each COI was compared to the leachability table value in Chapter 62-777, FAC. Contaminants whose maximum concentration was less than the BSV (or under certain conditions, contaminants whose maximum concentration was within the background range) were screened out. If the maximum concentration exceeded the leachability CTL, then the contaminant became a COPC.

1.5.3.2 Groundwater

The COPC selection process for groundwater was performed following a similar process that was used for soil.

The maximum detected COI concentration was compared to the FDEP CTL to determine the COPCs. Contaminants whose maximum concentration was less than the BSV (or under certain conditions, contaminants whose maximum concentration was within the background range) were screened out. BSVs for groundwater and surface water that were developed for NAVSTA Mayport are presented in Section 2.4 of this report.

For contaminants with a primary or secondary standard, the maximum concentration was compared to the Groundwater Cleanup Target Level (GCTL). Contaminants, whose maximum concentration was less than the BSV, or under certain conditions, contaminants whose maximum concentration was within the background range, were screened out. A contaminant with a primary or secondary standard became a COPC if the maximum concentration exceeded the GCTLs listed in Chapter 62-777, FAC.

1.5.4 Selection of Contaminants of Concern

The list of contaminants identified as COPCs may not represent a true picture of the media-specific contaminant concentrations or realistic risk exposure at a site. In order to represent overall contaminant concentration levels and exposures, COCs were developed from the list of COPCs. COCs were determined by comparing a maximum concentration for each COPC to a CTL value from Chapter 62-777, FAC. In addition, the concentration was compared to the background value.

The maximum concentration of each COPC was compared to the site-specific MCSs for each medium. The MCSs for each medium were calculated as the published CTLs or the Mayport BSVs, whichever was greater. COPCs whose concentration exceeded the MCSs were then selected as the COCs to be evaluated in the CMS Addendum.

1.6 ORGANIZATION OF THIS REPORT

This CMS report consists of six sections that describe SWMUs 6 and 7 by summarizing the RFI findings pertinent to conducting the CMS, identifying the contaminants and media that present unacceptable risk to human and ecological receptors, and evaluating and recommending a preferred alternative for addressing those risks. Section 1.0 includes a general facility description and background and presents the general methodology used in the CMS to identify contaminants and media of concern. Section 2.0 describes the current conditions and physical and environmental settings of SWMUs 6 and 7, identifies the primary sources of information, and presents the RFI conclusions. Section 3.0 presents the evaluation and selection of COCs, with corresponding MCSs, and lists the media of concern with their CAOs. Section 4.0 identifies and screens corrective measures technologies and develops corrective measures alternatives. Section 5.0 evaluates corrective measures alternatives according to standard criteria. Section 6.0 identifies and evaluates remedial alternatives, and selects the recommended alternatives for soil and groundwater at SWMUs 6 and 7. Appendix A presents historical figures, Appendix B contains the CMS Data Set (analytical data), Appendix C contains the areas and volume calculations, Appendix D contains the ORC injection design calculations, and Appendix E contains the cost estimates for the corrective measures alternatives.

2.0 DESCRIPTION OF CURRENT SITE CONDITIONS AND SUMMARY OF SITE-SPECIFIC INVESTIGATIONS

A detailed description of the physical characteristics of NAVSTA Mayport is provided in the NAVSTA Mayport GIR (ABB, 1995a). Information including topography, demography, climate, soil types, and regional geology and hydrogeology has been presented in the GIR and will not be repeated in this report. The following discussion is a summary of geologic and hydrologic data collected at SWMUs 6 and 7 from current and past investigations dating from 1988 through 2007.

2.1 SITE DESCRIPTION AND BACKGROUND

SWMUs 6 and 7 are located in the northern portion of the NAVSTA Mayport near the southern shore of the St. Johns River (see Figure 2-1). SWMUs 6 and 7 were organized into the Group II SWMUs for the RFI and initial CMS. Figure 2-2 is a site location map of SWMUs 6 and 7 showing the major site features.

SWMU 6, former Waste Oil Pit and Sludge Drying Bed, was located beneath the westernmost bed of the four existing OWTP Sludge Drying Beds (SWMU 7). The Waste Oil Pit and the Sludge Drying Bed was used from 1973 to 1978 to store bilge water that contained oily waste. It is believed that other items such as solvents and transformer oils may also have been disposed of in the Waste Oil Pit and the Sludge Drying Bed. The Waste Oil Pit and the Sludge Drying Bed was triangular in shape, approximately 0.2 acre in size, and was excavated to a depth of approximately 6 feet bgs (Kearney, 1989).

An estimated 250,000 gallons of bilge water and several thousand gallons of waste oil were disposed of at SWMU 6. The bilge water and oily waste disposed of in the unlined pit were allowed to seep into the underlying soil. In 1979 the Waste Oil Pit was filled and covered, and the four existing OWTP Sludge Drying Beds (SWMU 7) were constructed (Kearney, 1989).

SWMU 7, OWTP and Sludge Drying Beds, was constructed in 1979 to receive and dewater sludge from the OWTP. Each of the four sludge drying beds are approximately 150 feet in length and 50 feet wide, unlined, and enclosed by earthen berms which are approximately 8 feet above the surrounding land surface. The drying beds receive sludge collected from the clarifier of the OWTP (SWMU 9) and from bilge water receiving Tanks 99 and 100 (SWMU 51). Bilge water overflow was pumped directly into the sludge drying beds when Tanks 99 and 100 were at capacity (Kearney, 1989).

Approximately 1,500 gallons of sludge were conveyed to the drying beds each day that the OWTP was in operation. At the time of the RFA in 1989, the OWTP was operated twice per week. The design of the drying beds allowed the supernate to be recirculated back to the OWTP. No sludge has been removed

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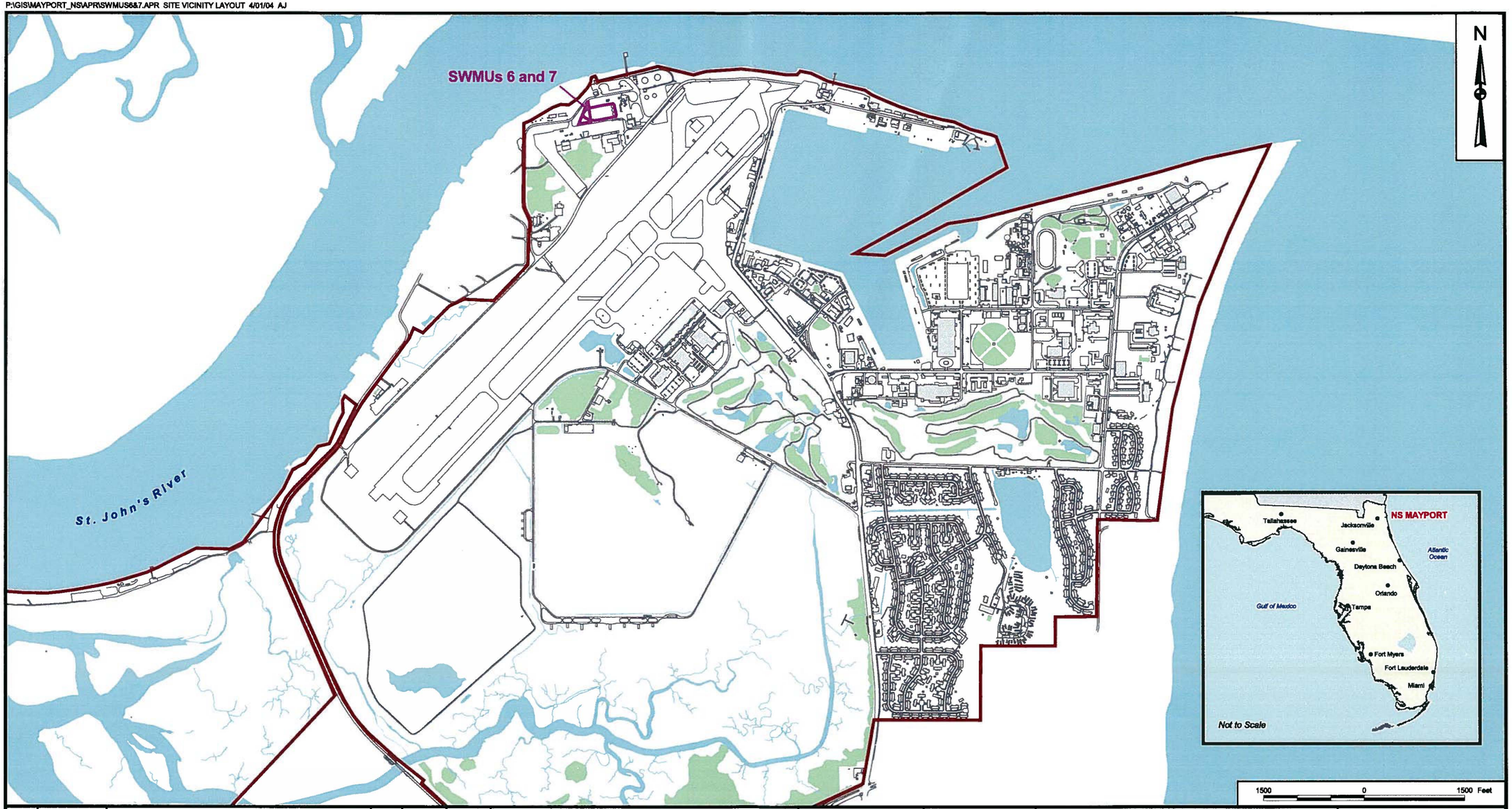

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY A. JANOCHA	DATE 8/01/03
CHECKED BY C. METZ	DATE 4/01/04
COST/SCHED-AREA	
SCALE AS NOTED	

SITE VICINITY MAP
CORRECTIVE MEASURE STUDY
ADDENDUM
SWMU 6 AND 7
NAVAL STATION MAYPORT

CONTRACT NO. 4259	
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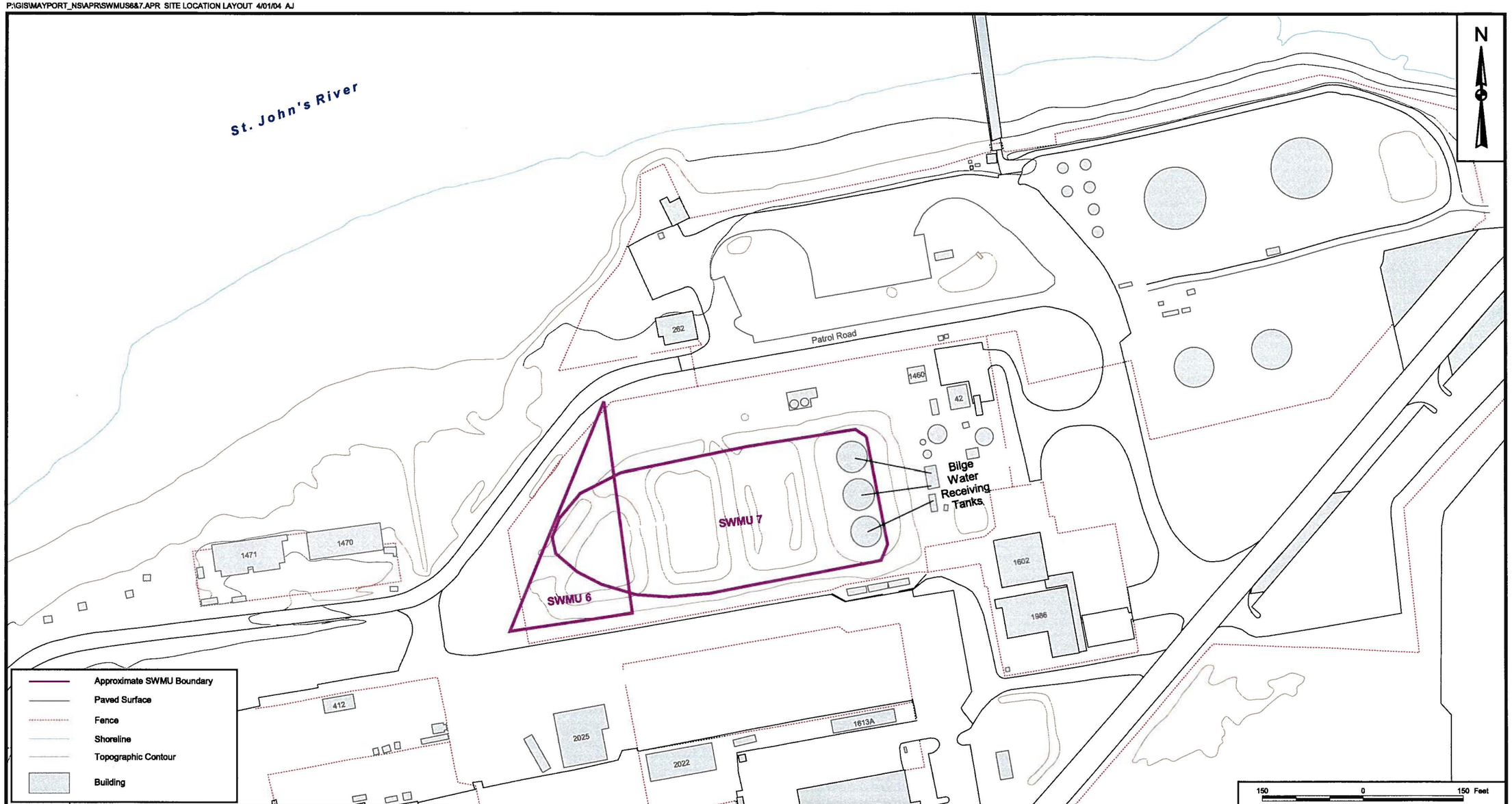

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DRAWN BY A. JANOCHA	DATE 8/01/03
CHECKED BY C. METZ	DATE 4/01/04
COST/SCHED-AREA	
SCALE AS NOTED	

SITE LOCATION MAP
CORRECTIVE MEASURE STUDY
ADDENDUM
SWMU 6 AND 7
NAVAL STATION MAYPORT

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from the drying beds since operations began; however, during the construction of three new bilge water receiving tanks in 1989, sludge from the easternmost bed was excavated and deposited into an adjacent bed. A lined dike enclosure for the three new bilge water receiving tanks was constructed in the easternmost drying bed, and the adjacent drying bed that received the excavated sludge was taken out of service and no longer receives sludge (Kearney, 1989). The two westernmost drying beds received sludge from the new bilge water tanks and the OWTP clarifier until late 1994, at which time sludge was conveyed to a new dewatering unit. After dewatering, sludge is currently collected for offsite disposal by a subcontractor.

2.2 SITE GEOLOGY AND HYDROGEOLOGY

Site-specific geological information from the Groups II SWMUs RFI was compiled and documented in Section 3.1 of the Mayport GIR (ABB, 1995a). The compiled data is summarized below.

A surficial deposit of dredge material from the Mayport Turning Basin and St. Johns River makes up the interior areas of NAVSTA Mayport covering former marshes and sand flats. Beach and riverbank sands predominate in areas along the Atlantic Ocean and St. Johns River. The dredge material typically consists of fine-grained, well sorted sands, and/or marine shell fragments (ABB, 1995a).

Undifferentiated post-Hawthorne deposits are typically encountered beneath the surficial dredge depositional material. This unit consists of fairly uniform, well-sorted, poorly graded, very fine-grained sand, which typically contains minor quantities of fines consisting of silt and clay. It also typically has numerous shell fragments and subrounded pea-size gravel. Color ranges from tan to light gray with color change typically gradational over several feet (ABB, 1995a).

The Upper Hawthorne Group is encountered beneath the undifferentiated post-Hawthorn deposits. This formation consists of fine- to medium-grained, tan to greenish-gray sand with black phosphatic nodules, and/or lithic limestone fragments. Sandy clay, typically gray or olive green in color, may be found within this zone. In addition, clay seams may be encountered varying in thickness from inches to several feet along the zone between the Upper Hawthorne Group and the overlying post-Hawthorne deposits (ABB, 1995a).

Shallow soils in the vicinity of SWMUs 6 and 7 consist of fine to medium grained sand or silty sand, which may contain shell fragments at some locations. Thin seams (less than 1 foot) of sand with organics were observed at some locations at depths below 5 feet bgs. Seams of clay were also encountered at several locations, but were not widespread across the site.

2.3 SITE HYDROLOGY

Three primary aquifer systems are recognized beneath NAVSTA Mayport (in descending order): the surficial aquifer, the intermediate Hawthorn aquifer, and the Floridan aquifer system. The surficial aquifer, which extends from near the surface to a depth of nearly 100 feet bgs at NAVSTA Mayport, is the first aquifer beneath SWMUs 6 and 7 and is the groundwater zone considered in this CMS. It includes all of the undifferentiated post-Hawthorn deposits and consists of unconsolidated sand, shell, and clay, which vary horizontally and vertically in lithology, thickness, and permeability. It is recharged primarily by precipitation at a countywide estimated rate of 10 to 16 inches per year. Discharge in the vicinity of NAVSTA Mayport is primarily by seepage into surface water bodies and evapotranspiration. At SWMUs 6 and 7 the direction of groundwater flow in the surficial aquifer is generally to the north, toward the St. Johns River. It has also been reported that groundwater becomes brackish below a depth of 40 feet bgs at NAVSTA Mayport. The water table at SWMUs 6 and 7 is at an approximate depth of 8 to 11 feet bgs.

The surficial aquifer is underlain by the Hawthorn aquifer. The Hawthorn aquifer consists of sand and limestone layers interbedded with clayey sand and sandy clay. It was noted in the RFI that the most productive limestone layer in the upper part of the Hawthorn aquifer is absent in the Mayport area. Thus, the intermediate Hawthorn aquifer may be in hydraulic contact with the surficial aquifer at NAVSTA Mayport. Overall, the Hawthorn Group is a complex aquiclude that acts as a confining bed to the underlying Floridan aquifer. The primary recharge mechanism for the intermediate Hawthorn aquifer is precipitation in areas approximately 30 miles to the west of NAVSTA Mayport where the Hawthorn Group sediments occur at shallow depths. Because the surficial aquifer is the preferred pathway for groundwater flow and chemical migration at NAVSTA Mayport, groundwater in the intermediate Hawthorn aquifer and the Floridan aquifer were not considered in the CMS.

Horizontal hydraulic gradients at the Group II SWMUs were calculated as 0.011 and 0.041 foot per foot (ft/ft) using averaged water-level data from four monitoring wells (ABB, 1995a). The vertical hydraulic gradient for the Group II SWMUs was calculated using data from well pair MPT-8-MW05S and MPT-8-MW05D. The calculated gradient using the average water-level data from 1992 and 1993 was 0.033 ft/ft. The vertical gradient was recalculated using data from August 30, 1994 to be 0.019 ft/ft. These values represent a net downward gradient.

Hydraulic conductivity tests have been conducted for various sites at NAVSTA Mayport. Testing within the Group II SWMUs consisted of in situ slug test in 17 monitoring wells or piezometer locations to characterize radial hydraulic conductivity, and laboratory testing of three undisturbed soil samples to characterize vertical hydraulic conductivity. Detail results of the hydraulic conductivity testing are

discussed in Section 3.2.4 of the NAVSTA Mayport GIR (ABB, 1995a). Radial hydraulic conductivities for the shallow aquifer in the vicinity of SWMUs 6 and 7 ranged from 1 to 7.1 feet per day (ft/day) with an average of 3.0 ft/day. Vertical hydraulic conductivities in this area ranged from 2.4 to 5.4 ft/day with an average of 3.9 ft/day.

An approximation of horizontal flow velocity of groundwater in the water table zone of the surficial aquifer at SWMUs 6 and 7 is based on the potentiometric surface (hydraulic gradient) of the water table, estimate of hydraulic conductivities at monitoring well locations, and an estimate of porosity of the saturated subsurface soil. The horizontal linear velocities were calculated from a modified form of Darcy's equation and represent the ratio of linear travel distance to travel time between two points. The horizontal linear velocity is expressed as V_D/N_e where V_D is the Darcy velocity ($V_D = KI$, K = radial hydraulic conductivity, and I = hydraulic gradient) and N_e is the effective porosity of the saturated geologic stratum. An effective porosity of 0.35 was used in the calculations [see Subsection 3.2.3, Physical Characteristics of Soil, in the NAVSTA Mayport GIR (ABB, 1995a)]. Based on the values for horizontal linear velocity and assuming no dilution, dispersion, or retardation, a contaminant in the water table zone of the surficial aquifer may travel at rates of 69 to 87 feet per year.

Tidal Influence

A tidal influence survey was conducted to assess the impact of tidal fluctuations on the surficial aquifer at NAVSTA Mayport. Monitoring wells located near the banks of the St. Johns River, tidally influenced creeks, drainage ditches, and areas distant from tidally affected surface water were included in the survey. These wells were monitored electronically during periods of expected maximum tidal fluctuations. The specific methods used to conduct the survey are documented in Section 2.1.5.2 of the Mayport GIR (ABB, 1995a). Ten monitoring wells at the Group II SWMUs were included in the tidal influence survey. Results of the survey indicated that the water table responds strongly to diurnal tidal fluctuations in areas adjacent to tidally influenced water bodies, and that tidal influence decreases with distance from the shoreline up to approximately 400 feet inland from the St. Johns River, where its impact is negligible. The effect of diurnal and lunar tidal variations on the shallow groundwater table may result in variations in groundwater flow directions.

2.4 BACKGROUND SCREENING VALUES FOR NAVSTA MAYPORT

BSVs were originally calculated and presented in the RCRA GIR (ABB, 1995a). The calculation was based on analytical results for samples from each medium of concern including groundwater, surface soil, subsurface soil, sediment, and surface water. During review of the background data, it was determined that certain procedures used during the original background calculations were not consistent with current

regulatory guidelines, and apparent spurious or problematic results were present in the data used to perform the calculations. A recalculation of the BSVs was therefore performed primarily to conform with newer regulatory guidance that recommends how concentrations below analytical detection limit are used in the mathematical treatment of the data [Tetra Tech NUS, Inc. (TtNUS), 2000].

It was noted during review of the background data sets that many of the results for each medium sampled were below the detection limits of the laboratory methods used. Consequently, the use of one-half the detection limit for results below analytical detection limit in the recalculation methodology may result in an unnatural lowering of the mean concentration. Therefore, the BSV was compared with the maximum background concentration in each medium's data set. If the BSV (i.e., 2 times the mean of the background data set) for a contaminant was less than the maximum concentration for that contaminant, then the BSV for that contaminant was bolded and footnoted in Tables 2-1 through 2-5. For these contaminants, if a contaminant was detected in a site medium at a concentration between the BSV and the maximum detected concentration, then these contaminants received additional evaluation on a case by case basis to determine if the site detection represents the upper range of background or a site release. Tables 2-1 through 2-5 present the recalculated BSVs for each medium at NAVSTA Mayport.

2.5 SUMMARY OF PREVIOUS INVESTIGATIONS

This section summarizes previous investigations applicable to SWMUs 6 and 7 at NAVSTA Mayport. The reports listed below (in chronological order) were written to document the results of the previous investigations at SWMUs 6 and 7.

- Naval Installation Restoration Program (NIRP) Expanded Site Investigation, NAVSTA Mayport, Florida (Jordan, 1988).
- RFI Group II SWMUs, NAVSTA Mayport, Florida (ABB, 1996a).
- CMS Group II SWMUs, NAVSTA Mayport, Florida (ABB, 1996b).
- Technology Demonstration for the Thermal Desorption of Petroleum–Impacted Soil at SWMUs 6 and 7 (ABB, 1997).
- IM Monitoring Plan for Bioventing and Bioslurping at SWMUs 6 and 7 [Harding Lawson Associates, (HLA), 1998].

TABLE 2-1
STATISTICS AND BACKGROUND SCREENING VALUES – SURFACE SOIL

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection [1]	Range of Reporting Limits [2]	Range of Detected Concentrations [2]	Arithmetic Mean [3]	BSV [4]
Inorganics (mg/kg)					
Antimony	0 / 6	5.2 -- 6	-- [5]	ND [5]	ND [5]
Arsenic	0 / 6	0.76 -- 2.6	-- [5]	ND [5]	ND [5]
Barium	6 / 6	-- [6]	0.76 -- 5	2.75	5.50
Beryllium	1 / 6	0.06 -- 0.07	0.09	0.05	0.09
Cadmium	1 / 6	0.83 -- 0.96	1 -- 1	0.5	1.1
Chromium	6 / 6	-- [6]	0.68 -- 2.5	1.3	2.6
Cobalt	0 / 6	0.47 -- 0.55	-- [5]	ND [5]	ND [5]
Copper	1 / 6	0.35 -- 0.41	2.1	0.35	**0.69** [7]
Cyanide	0 / 6	0.16 -- 0.18	-- [5]	ND [5]	ND [5]
Lead	0 / 6	0.25 -- 1.7	-- [5]	ND [5]	ND [5]
Mercury	0 / 6	0.03 -- 0.07	-- [5]	ND [5]	ND [5]
Nickel	0 / 6	2.6 -- 3	-- [5]	ND [5]	ND [5]
Selenium	5 / 6	0.45 -- 0.45	0.47 -- 0.86	0.6	1.2
Silver	0 / 6	0.51 -- 0.59	-- [5]	ND [5]	ND [5]
Thallium	4 / 6	0.53 -- 0.62	0.77 -- 1.1	0.7	1.4
Tin	0 / 6	7.3 -- 8.5	-- [5]	ND [5]	ND [5]
Vanadium	5 / 6	0.46 -- 0.46	1.2 -- 2.5	1.7	3.4
Zinc	6 / 6	-- [6]	0.35 -- 1.9	1.3	2.7
Miscellaneous Parameters (mg/kg)					
Total Organic Carbon	6 / 6	-- [6]	1,440 -- 8,030	3,499	**6,998** [7]

Notes:
1 Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed (excluding rejected results); duplicates were included but not counted.
2 Ranges include duplicate and/or resample results, where appropriate.
3 The mean includes detected concentrations and one-half the laboratory reporting limit for ND results; duplicate samples and resample results were averaged prior to calculation of the mean.
4 BSV is twice the arithmetic mean of the data.
5 All results were ND; mean and BSV not applicable.
6 All results were positive detects.
7 Bold BSV indicates that value is less than maximum concentration of that chemical.

mg/kg = milligrams per kilogram
ND = nondetect

TABLE 2-2
STATISTICS AND BACKGROUND SCREENING VALUES – SUBSURFACE SOIL

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection [1]	Range of Reporting Limits [2]	Range of Detected Concentrations [2]	Arithmetic Mean [3]	BSV [4]
Inorganics (mg/kg)					
Antimony	0 / 4	1.1 -- 1.2	--[5]	ND[5]	ND[5]
Arsenic	3 / 4	0.13 -- 0.13	0.33 -- 0.58	0.35	0.70
Barium	4 / 4	--[6]	1.9 -- 6.8	3.6	7.2
Beryllium	1 / 4	0.07 -- 0.07	0.07	0.04	0.09
Cadmium	0 / 4	0.22 -- 0.23	--[5]	ND[5]	ND[5]
Chromium	3 / 4	0.57 -- 0.57	1.4 -- 3	1.4	2.7
Cobalt	1 / 4	0.67 -- 0.72	0.71	0.4	0.8
Copper	2 / 4	0.2 -- 0.9	1.4 -- 2.3	1.0	**2.1**[7]
Cyanide	1 / 4	0.15 -- 0.16	0.58	0.1	**0.3**[7]
Lead	2 / 4	0.58 -- 0.59	0.75 -- 1.9	0.83	**1.66**[7]
Mercury	3 / 4	0.03 -- 0.03	0.03 -- 0.03	0.02	0.05
Nickel	0 / 4	1.3 -- 1.4	--[5]	ND[5]	ND[5]
Selenium	0 / 4	0.13 -- 0.14	--[5]	ND[5]	ND[5]
Silver	0 / 4	0.45 -- 0.49	--[5]	ND[5]	ND[5]
Thallium	0 / 4	0.13 -- 0.14	--[5]	ND[5]	ND[5]
Tin	4 / 4	--[6]	2.2 -- 4	2.7	5.4
Vanadium	4 / 4	--[6]	0.71 -- 2.5	1.6	3.1
Zinc	4 / 4	--[6]	2 -- 2.9	2.4	4.9

Notes:
1 Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed (excluding rejected results); duplicates were included but not counted.
2 Ranges include duplicate and/or resample results, where appropriate.
3 The mean includes detected concentrations and one-half the laboratory reporting limit for ND results; duplicate samples and resample results were averaged prior to calculation of the mean.
4 BSV is twice the arithmetic mean of the data.
5 All results were ND; mean and BSV not applicable.
6 All results were positive detects.
7 Bold BSV indicates that value is less than maximum concentration of that chemical.

TABLE 2-3
STATISTICS AND BACKGROUND SCREENING VALUES – GROUNDWATER

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection [1]	Range of Reporting Limits [2]	Range of Detected Concentrations [2]	Arithmetic Mean [3]	BSV [4]
Inorganics (µg/L)					
Arsenic	5 / 8	0.6 -- 6	0.6 -- 6	2.6	**5.3** [5]
Antimony	0 / 8	2.2 -- 50	-- [6]	ND [6]	ND [6]
Barium	5 / 8	1.2 -- 3.3	6.4 -- 75.5	18.9	**37.8** [5]
Beryllium	0 / 8	0.18 -- 0.3	-- [6]	ND [6]	ND [6]
Cadmium	0 / 8	1 -- 3	-- [6]	ND [6]	ND [6]
Calcium	8 / 8	-- [7]	65,000 -- 251,000	113,063	**226,125** [5]
Chromium	0 / 8	2 -- 2.6	-- [6]	ND [6]	ND [6]
Cobalt	0 / 8	2.7 -- 3.1	-- [6]	ND [6]	ND [6]
Copper	0 / 8	0.9 -- 12.7	-- [6]	ND [6]	ND [6]
Cyanide	1 / 8	0.81 -- 2.7	0.95	1	2
Iron	6 / 8	68.2 -- 78.6	15.4 -- 660	247	**494** [5]
Lead	1 / 8	0.6 -- 6	1.5	1	2
Magnesium	6 / 8	18,800 -- 19,700	28,60 -- 419,000	92,196	**184,393** [5]
Manganese	6 / 8	20.1 -- 23.6	7.1 -- 228	70	**141** [5]
Mercury	2 / 8	0.08 -- 0.5	0.08 -- 0.1	0.08	0.16
Nickel	0 / 8	5.9 -- 7.3	-- [6]	ND [6]	ND [6]
Selenium	0 / 6	0.6 -- 13.2	-- [6]	ND [6]	ND [6]
Silver	0 / 8	2.1 -- 2.3	-- [6]	ND [6]	ND [6]
Sodium	6 / 8	31,500 -- 39,500	9,300 -- 3,310,000	762,294	**1,524,588** [5]
Thallium	0 / 8	0.6 -- 6	-- [6]	ND [6]	ND [6]
Tin	0 / 8	8 -- 9.4	-- [6]	ND [6]	ND [6]
Vanadium	6 / 8	1.5 -- 1.7	2.3 -- 5.8	3	6
Zinc	1 / 8	1.82 -- 8.8	4.3	2.9	5.8
Miscellaneous Parameters (mg/L)					
Ammonia, as nitrogen	3 / 3	-- [7]	0.7 -- 1.3	1.0	2.1
Chloride	6 / 6	-- [7]	15 -- 6,600	1,142	**2,284** [5]
Sulfate	6 / 6	-- [7]	36.4 -- 1,230	257	514
Total dissolved solids	6 / 6	-- [7]	417 -- 8,150	1,881	3,762

Notes:
1 Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed (excluding rejected results); duplicates were included but not counted.
2 Ranges include duplicate and/or resample results, where appropriate.
3 The mean includes detected concentrations and one-half the laboratory reporting limit for ND results; duplicate samples and resample results were averaged prior to calculation of the mean.
4 BSV is twice the arithmetic mean of the data.
5 Bold BSV indicates that value is less than maximum concentration of that chemical.
6 All results were ND; mean and BSV not applicable.
7 All results were positive detects.

mg/L = milligrams per liter
µg/L = micrograms per liter

TABLE 2-4
STATISTICS AND BACKGROUND SCREENING VALUES – SEDIMENT

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection [1]	Range of Reporting Limits [2]	Range of Detected Concentrations [2]	Arithmetic Mean [3]	BSV [4]
Inorganics (mg/kg)					
Antimony	0 / 8	0.94 -- 18.2	--[5]	ND[5]	ND[5]
Arsenic	4 / 8	0.01 -- 0.21	0.68 -- 6.6	1.2	**2.5**[6]
Barium	8 / 8	0 -- 0	3.6 -- 16.1	7.2	**14.3**[6]
Beryllium	2 / 8	0.045 -- 0.59	0.1 -- 0.47	0.1	**0.2**[6]
Cadmium	1 / 8	0.44 -- 1.3	0.82	0.5	0.9
Chromium	8 / 8	0 -- 0	1.3 -- 28.1	7.3	**14.7**[6]
Cobalt	1 / 8	0.56 -- 6.4	2.4	1.0	**2.0**[6]
Copper	7 / 8	0.43 -- 0.43	0.88 -- 7.5	2.5	**5.0**[6]
Cyanide	0 / 5	0.07 -- 0.22	--[5]	ND[5]	ND[5]
Lead	6 / 8	0.2 -- 1.2	1.5 -- 10	3.4	**6.8**[6]
Mercury	3 / 8	0.04 -- 0.24	0.22 -- 1.1	0.2	**0.3**[6]
Nickel	3 / 8	2 -- 3.6	5.1 -- 7.1	3.1	**6.2**[6]
Selenium	6 / 8	0.56 -- 1.1	0.32 -- 0.81	0.5	1.1
Silver	0 / 8	0.6 -- 1.1	--[5]	ND[5]	ND[5]
Thallium	1 / 8	0.39 -- 0.74	0.88	0.3	**0.7**[6]
Tin	1 / 8	5 -- 94.8	12.3	17.9	35.8
Vanadium	8 / 8	--[7]	1.6 -- 28.4	7.1	**14.3**[6]
Zinc	8 / 8	--[7]	2.1 -- 34.3	12.1	**24.2**[6]
Miscellaneous Parameters (mg/kg)					
Total organic carbon	5 / 5	--[7]	5,160 -- 20,400	9,364	**18,728**[6]

Notes:
1 Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed (excluding rejected results); duplicates were included but not counted.
2 Ranges include duplicate and/or resample results, where appropriate.
3 The mean includes detected concentrations and one-half the laboratory reporting limit for ND results; duplicate samples and resample results were averaged prior to calculation of the mean.
4 BSV is twice the arithmetic mean of the data.
5 All results were ND; mean and BSV screening value not applicable.
6 Bold BSV Screen result indicates that value is less than maximum concentration of that chemical.
7 All results were positive detects.

TABLE 2-5
STATISTICS AND BACKGROUND SCREENING VALUES – SURFACE WATER

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Chemical	Frequency of Detection [1]	Range of Reporting Limits [2]	Range of Detected Concentrations [2]	Arithmetic Mean [3]	BSV [4]
Inorganics (µg/L)					
Antimony	1 / 8	3.1 -- 40	57.5	17.5	**35** [5]
Arsenic	5 / 8	0.9 -- 6.9	0.86 -- 8.1	2.8	**5.6** [5]
Barium	8 / 8	-- [6]	6.8 -- 15.4	11.4	22.9
Beryllium	0 / 8	0.1 -- 0.27	-- [7]	ND [7]	ND [7]
Cadmium	1 / 8	1.6 -- 4	2.4	1.6	3.1
Calcium	4 / 4	* -- [6] *	71,100 -- 168,000	141,088	282,175
Chromium	1 / 8	1.9 -- 2.4	4	1.3	**2.6** [5]
Cobalt	2 / 8	2.3 -- 5.1	5.6 -- 9.7	3.2	**6.4** [5]
Copper	3 / 8	1.4 -- 29.5	2.4 -- 37.2	7.2	**14.5** [5]
Cyanide	2 / 8	1.8 -- 3	0.92 -- 3.0	1.5	3.0
Iron	3 / 4	187 -- 187	85.7 -- 435	193	**386** [5]
Lead	2 / 4	0.78 -- 2.6	0.91 -- 1.5	1.0	2.1
Magnesium	4 / 4	-- [6]	54,000 -- 490,000	335,575	671,150
Manganese	4 / 4	-- [6]	10.4 -- 98.7	41.7	**83.5** [5]
Mercury	0 / 8	0.09 -- 0.16	-- [7]	ND [7]	ND [7]
Nickel	1 / 8	7 -- 19.8	13 -- 13	6.3	**12.6** [5]
Selenium	3 / 8	1.1 -- 10.6	1.8 -- 13.7	4.3	**8.5** [5]
Silver	0 / 8	2.1 -- 2.4	-- [7]	ND [7]	ND [7]
Sodium	1 / 4	55.6 -- 55.6	386,000	95,771	**191,542** [5]
Thallium	2 / 5	1.4 -- 1.4	1.8 -- 73.7	10.0	**19.9** [5]
Tin	1 / 8	9.4 -- 208	776	108	**216** [5]
Vanadium	6 / 8	2.2 -- 2.7	3.4 -- 5.2	3.2	6.4
Zinc	1 / 8	1.6 -- 23.5	3.2	4.4	8.8
Miscellaneous Parameters (mg/L)					
Chloride	5 / 5	-- [6]	710 -- 11,500	6,075.0	12,150
Sulfate	5 / 5	-- [6]	130 -- 1,320	839	1,679
Total dissolved solids	4 / 4	-- [6]	1,550 -- 18,600	11,263	22,525
Total organic carbon	4 / 4	-- [6]	10.8 -- 21.6	15	29

Notes:
1 Frequency of detection is the number of samples in which the analyte was detected divided by the total number of samples analyzed (excluding rejected results); duplicates included but not counted.
2 Ranges include duplicate and/or resample results, where appropriate.
3 The mean includes detected concentrations and one-half the laboratory reporting limit for ND results; duplicate samples and resample results were averaged prior to calculation of the mean.
4 BSV is twice the arithmetic mean of the data.
5 Bold BSV indicates that value is less than maximum concentration of that chemical.
6 All results were positive detects.
7 All results were ND; mean and BSV not applicable.

- Project Report for Free-Product Source Removal Via Bioslurping at Naval Station Mayport (Battelle, 2001).

- Annual Monitoring Report for SWMUs 6 and 7, NAVSTA Mayport, Florida (TtNUS, 2001).

- Massachusetts Extractable Petroleum Hydrocarbon (EPH) and Volatile Petroleum Hydrocarbon (VPH) Analytical Results for NAVSTA Mayport SWMUs 6 and 7 Soil as Compared to FDEP Chapter 62-777, FAC, Technical Report CTLs for TRPH (TtNUS, 2002).

- Source Removal at SWMUs 6 and 7, NAVSTA Mayport, Florida (CH2M Hill, 2008).

2.5.1 NIRP Expanded Site Investigation

The NIRP Initial Assessment Study identified the waste oil pit and sludge drying beds as Site 8, and recommended an expanded site investigation (ESI). The ESI was conducted in May 1988 and included the collection of soil and groundwater samples. Constituents detected in groundwater included bis(2-ethylhexyl)phthalate, naphthalene, benzene, ethylbenzene, endrin aldehyde, gamma-benzenehexachloride, and lead. Trichlorofluromethane (Freon) was detected in one soil sample and 0.9 foot of free-phase hydrocarbon was present in monitoring well MPT-8-MW03.

2.5.2 RFI Investigation Group II SWMUs

The RFI for SWMUs 6 and 7 was conducted as a part of the Group II SWMUs RFI by ABB between 1993 and 1994. Field activities consisted of the collection of subsurface soil samples, surface water, sludge samples, and groundwater samples. Thirty-six subsurface soil samples were collected with a TerraProbe™ at depths that ranged from 3 to 10 feet bgs. The subsurface soil samples were field screened, and 15 of the samples were submitted to a fixed-base laboratory for TPH analysis. Twelve subsurface soil samples were collected with a split spoon sampler from the monitoring well borings, and submitted to a fixed-base laboratory for volatile organic compound (VOC), semivolatile organic compound (SVOC), pesticides, polychlorinated biphenyl (PCB), inorganic, and cyanide analysis. Two surface water samples were collected from SWMU 7 and submitted to a fixed-base laboratory for VOC, SVOC, pesticides, PCB, metals, and cyanide analysis. Twenty-two sludge samples were collected from the OWTP sludge drying beds and submitted to a fixed-base laboratory for VOC, SVOC, pesticides, PCB, metals, and cyanide analysis. Sixty-five groundwater samples were collected using a TerraProbe™. The groundwater samples were field screened, and 38 of the groundwater samples were submitted to a fixed-based laboratory for TPH analysis. Thirty-eight groundwater samples were collected from monitoring wells installed at the Group II SWMU sites and submitted to a fixed-based laboratory for VOC,

SVOC, pesticides, PCB, metals, and cyanide analysis. RFI Figure 4-2 (see Appendix A) presents the TerraProbe™ soil, and groundwater screening locations used in the RFI. RFI Figure 4-4 (see Appendix A) presents the monitoring well locations used in the RFI.

2.5.2.1 RFI Conclusions

The following conclusions were presented in the Group II SWMUs RFI:

- RFI data indicates that hydrocarbon related compounds have been released from the former Waste Oil Pit and Sludge Drying Beds (SWMUs 6 and 7). These compounds have migrated into the subsurface soils and have spread laterally in the soil immediately above the water table. These compounds are affecting groundwater quality and are the likely source of LNAPL measured in the monitoring wells located downgradient of SWMUs 6 and 7.

- Sludge samples collected from SWMU 7 contained petroleum related chemicals at concentrations greater than Florida clean soil criteria under Chapter 62-777, FAC.

2.5.2.2 RFI Human Health Risk Assessment Conclusions

The following conclusions were presented in Group II SWMUs RFI:

- The excess lifetime cancer risk (ELCR) estimate for groundwater (2×10^{-4}) exceeds the FDEP acceptable cancer risk range. The cancer risk at the site is attributable to arsenic.

- The calculated non-cancer risk associated with the future use of groundwater at the OWTP Area (10) exceeds the FDEP Hazard Index (HI) of 1. Manganese [Hazard Quotient (HQ) = 7] and iron (HQ = 3) are the major contributors to this HI, and are likely the result of diffusion of marine water in the surficial aquifer during tidal fluctuations.

2.5.2.3 RFI Ecological Risk Assessment Conclusions

Based on the RFI findings, no ecological risk to terrestrial wildlife populations was determined to be likely due to exposure to surface soil or surface water at SWMUs 6 and 7. The RFI stated that SWMUs 6 and 7 provide limited ecological habitation and contamination is not present at the surface.

Potential risks for aquatic receptors were evaluated for exposure to ecological chemicals of potential concern (ECPCs) in groundwater at the point of discharge to the St. Johns River. Comparison of the

average and maximum exposure point concentration (EPC) of each ECPC with available criteria and toxicity benchmarks is the basis of the ecological risk characterization.

The RFI concluded that groundwater from SWMUs 6 and 7 is not expected to pose a risk to aquatic receptors. The presumption of no risks for aquatic life resulting from potential exposures to ECPC detected in groundwater samples assumes that groundwater containing these chemicals has not yet reached the St. Johns River.

2.5.2.4 RFI Recommendations

The RFI recommended that a CMS be conducted to evaluate remedial alternatives and recommend a remedial action to mitigate free-phase hydrocarbons present on the groundwater and surface and subsurface soils that contain hydrocarbons at concentrations greater than Florida clean soil criteria (Chapter 62-777, FAC).

2.5.3 CMS Group II SWMUs

The CMS for SWMUs 6 and 7 was conducted as a part of the Group II SWMUs CMS by ABB in 1996. The CMS present a CAO to remove LNAPL in excess of 0.01 foot in the vicinity of SWMUs 6 and 7. The CMS recommended the replacement of an existing sump recovery system with a bioslurping and bioventing system. A CAO to eliminate petroleum contaminated soil at the site was also presented in the CMS.

2.5.4 Technology Demonstration for the Thermal Desorption of Petroleum–Impacted Soil

A technology demonstration of LTTD was conducted at SWMUs 6 and 7 in 1996 to treat petroleum-impacted soil. A total of 1,900 tons of petroleum-impacted soil was excavated from the westernmost sludge bed of SWMU 7, and 480 tons of soil was excavated from SWMU 6 in an area north of SWMU 7. LTTD was used to treat the excavated soil to meet the requirements of Chapter 62-770, FAC (ABB, 1997).

2.5.5 IM Monitoring Plan for Bioventing and Bioslurping

This report was prepared by HLA in 1998, and was developed to address the LNAPL present at the site. The plan presented the design for the bioventing and bioslurping system recommended in the CMS. The plan included the system design, procedures, and goals for site characterization and LNAPL recovery.

2.5.6 Project Report for Free Product Source Removal via Bioventing and Bioslurping

This report was prepared by Battelle in 2001, and summarized the activities of the bioventing and bioslurping IM. The system recovered 1,420 gallons of free-phase product during 31 months of operation. The system was shut down when free product recovery dropped to less than 0.1 gallons per month. After deactivation of the system free product thicknesses were measured on a monthly basis, and hand bailing was used to recovery any free product present. During these recovery efforts 137 gallons of free-phase product was recovered and monitoring was discontinued when recovery levels were less than 0.1 gallon per month.

2.5.7 Annual Monitoring Report for SWMUs 6 and 7 – 2001

The annual report provided a summary of four quarterly groundwater monitoring events conducted in 2000 and 2001. The report included groundwater flow data, sampling results, free-product thickness measurements, and historical comparisons. The results of the fourth quarter groundwater sampling were as follows:

- Seven VOCs were detected in the groundwater samples.
- No VOCs were detected at concentrations greater than FDEP GCTLs.
- Five polynuclear aromatic hydrocarbons (PAHs) were detected in the groundwater samples.
- Two of the PAHs were detected at concentrations greater than FDEP GCTLs. 1-Methylnaphthalene and 2-methylnaphthalene were detected at 89 and 88 µg/L, respectively exceeding their FDEP GCTLs of 20 µg/L.
- TRPH concentrations exceeded the FDEP GCTL of 5,000 µg/L in two of the monitoring wells (MPT-8-MW04 and MPT-8-MW09) at concentrations of 9,300 and 14,000 µg/L.

2.5.8 Massachusetts EPH and VPH Analytical Results for NAVSTA Mayport SWMUs 6 and 7 Soil

This report was prepared in April 2004 by TtNUS and presents the results of four soil samples collected at SWMUs 6 and 7 on March 14, 2002, and analyzed for the TPH criteria working group (TPHCWG) analytical method. The report also provided a summary of soil samples collected in 2002 and analyzed for Massachusetts EPH and VPH. The soil results were compared to FDEP Chapter 62-777, FAC, Technical Report CTLs for TRPH. Results of the comparison indicated that many of the carbon ranges

did not exceed TRPH criteria and further soil analysis using TPHCWG may provide additional information for the characterization of petroleum constituents.

2.5.9 Post RFI/IM Sampling

Additional soil and groundwater sampling was conducted in November 2006 to delineate the extent of TPH-contaminated soil, determine if contaminated groundwater was present within and around SWMUs 6 and 7, and to delineate the extent of groundwater contamination (if present). This sampling was conducted to support an IM to remove contaminated soil and to complete the delineation of contamination that would be addressed in the CMS. Thirty-four subsurface soil samples were collected using Direct Push Technology (DPT) to complete the delineation of contaminated soil. Twenty groundwater samples were collected from permanent and temporary monitoring wells installed in the vicinity of SWMUs 6 and 7 to evaluate the current condition of the groundwater for the IM and CMS.

2.5.10 Interim Measures Source Removal at SWMUs 6 and 7

From September through December 2007, IM activities were conducted to remove petroleum-impacted soil and LNAPL from SWMUs 6 and 7. Approximately 2,854 tons of petroleum-impacted soil was excavated and removed for disposal, and 1,800 gallons of LNAPL were removed from the excavation for disposal during the IM activities. The conclusions of the IM Report indicated that petroleum-impacted soil at SWMUs 6 and 7 was removed to the practical extent possible (CH2M Hill, 2008).

3.0 CORRECTIVE ACTION OBJECTIVES

Once the site COCs and corresponding MCSs are defined, the media(s) of concern will be known, the volumes of contaminated media can be calculated, and the CAOs can then be identified for the site.

3.1 CMS ADDENDUM DATA SET

The results of environmental samples collected during the Post-RFI/IM sampling conducted in 2006 were used to evaluate COPCs and to select COCs for groundwater in this CMS. Table 3-1 provides a list of all samples for each medium that was used in the CMS. Tables listing the complete analytical results of all sampling events per medium are included in Appendix B.

3.2 CHEMICALS OF CONCERN – HUMAN HEALTH

The determination of COCs for subsurface soil and groundwater at SWMUs 6 and 7 involved the following three-step process as described in Section 1.5.3:

1. Determination of COIs.
2. Identification of the COPCs.
3. Selection of COCs.

COIs and COPCs for SWMUs 6 and 7 are evaluated in the following sections to select the COCs to be carried forward in the CMS corrective action selection process.

3.2.1 COIs – Human Health

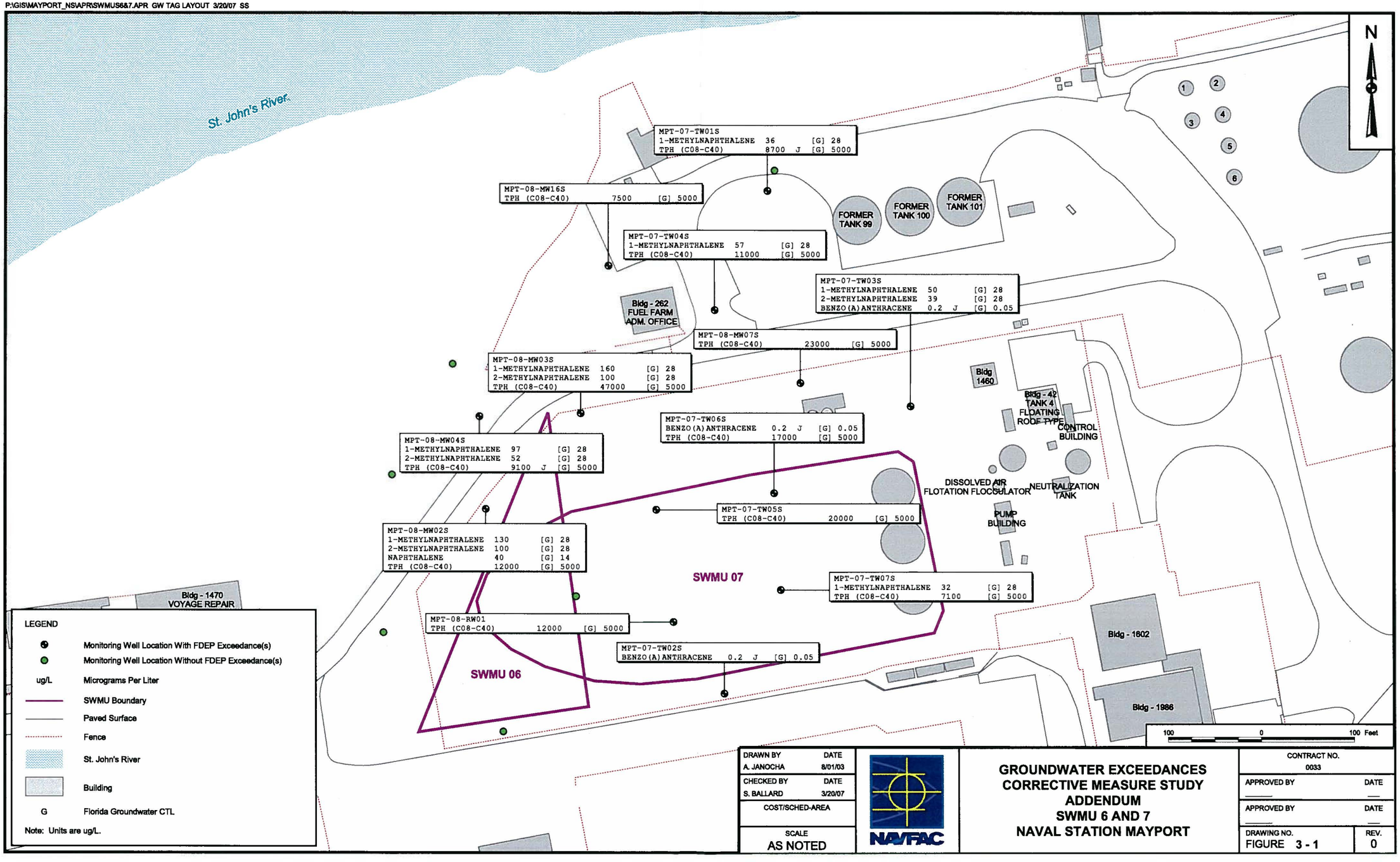
The COIs include any contaminant detected at least once in validated analytical results for environmental samples collected at SWMUs 6 and 7 during the Post-RFI/IM sampling events. The locations of Post-RFI/IM sampling groundwater sample locations at SWMUs 6 and 7 are shown on Figure 3-1. The list of COIs is provided in Table 3-2.

TABLE 3-1
SAMPLE IDENTIFICATION

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Sample Location	Sample Identification	Sample Date	VOCs	PAHs	TPH
GROUNDWATER					
MPT-06-TW01S	MPT-06-TW01S-112706	11/27/2006	✔	✔	✔
MPT-07-TW01S	MPT-07-TW01S-110806	11/8/2006	✔	✔	✔
MPT-07-TW02S	MPT-07-TW02S-112806	11/28/2006	✔	✔	✔
MPT-07-TW03S	MPT-07-TW03S-112706	11/27/2006	✔	✔	✔
MPT-07-TW04S	MPT-07-TW04S-112806	11/28/2006	✔	✔	✔
MPT-07-TW05S	MPT-07-TW05S-112706	11/27/2006	✔	✔	✔
MPT-07-TW06S	MPT-07-TW06S-112706	11/27/2006	✔	✔	✔
MPT-07-TW07S	MPT-07-TW07S-112706	11/27/2006	✔	✔	✔
MPT-08-MW01S	MPT-08-MW01S-111306	11/13/2006	✔	✔	✔
MPT-08-MW02S	MPT-08-MW02S-111306	11/13/2006	✔	✔	✔
MPT-08-MW03S	MPT-08-MW03S-111306	11/13/2006	✔	✔	✔
MPT-08-MW03S	MPT-08-MW03S-112706	11/27/2006	✔	✔	✔
MPT-08-MW04S	MPT-08-MW04S-112906	11/29/2006	✔	✔	✔
MPT-08-MW06S	MPT-08-MW06S-111306	11/13/2006	✔	✔	✔
MPT-08-MW07S	MPT-08-MW07S-112706	11/27/2006	✔	✔	✔
MPT-08-MW15SR	MPT-08-MW15SR-112806	11/28/2006	✔	✔	✔
MPT-08-MW16S	MPT-08-MW16S-112806	11/28/2006	✔	✔	✔
MPT-08-MW17S	MPT-08-MW17S-112906	11/29/2006	✔	✔	✔
MPT-08-MW18S	MPT-08-MW18S-112906	11/29/2006	✔	✔	✔
MPT-08-RW01	MPT-08-RW01-112706	11/27/2006	✔	✔	✔

P:\GIS\MAYPORT_NS\APR\SWMUS6&7.APR GW TAG LAYOUT 3/20/07 SS



DRAWN BY	DATE
A. JANOCHA	8/01/03
CHECKED BY	DATE
S. BALLARD	3/20/07
COST/SCHED-AREA	
SCALE	AS NOTED

NAVFAC

GROUNDWATER EXCEEDANCES
CORRECTIVE MEASURE STUDY
ADDENDUM
SWMU 6 AND 7
NAVAL STATION MAYPORT

CONTRACT NO. 0033	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 3 - 1	REV. 0

TABLE 3-2
CONTAMINANTS OF INTEREST DETECTED IN SUBSURFACE SOIL AND GROUNDWATER

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

List of COIs	Groundwater
VOCs	
ETHYLBENZENE	X
M+P-XYLENES	X
O-XYLENE	X
TOLUENE	X
SVOCs	
2-METHYLNAPHTHALENE	X
ACENAPHTHENE	X
ANTHRACENE	X
BENZO(A)ANTHRACENE	X
FLUORENE	X
NAPHTHALENE	X
PHENANTHRENE	X
PYRENE	X
TPH	
TPH (C8-C40)	X

3.2.1.1 Selection of Surface Soil COPCs – Human Health

Surface soils were not evaluated in this CMS Addendum because an IM was conducted to remove contaminated soils associated with the sludge beds and there have been no reported releases outside of the sludge lagoons. The IM was conducted in 2007 and concluded that petroleum-impacted soils at SWMUs 6 and 7 were removed to the extent practicable (CH2M Hill, 2008).

3.2.1.2 Selection of Subsurface Soil COPCs – Human Health

Subsurface soils were not evaluated in this CMS Addendum because an IM was conducted to remove contaminated soils associated with the sludge beds. The IM was conducted in 2007 and concluded that petroleum-impacted soils at SWMUs 6 and 7 were removed to the extent practicable (CH2M Hill, 2008).

3.2.1.3 Selection of Groundwater COPCs – Human Health

The initial COPC screening process for groundwater begins with separating COIs that have a primary or secondary standard. COIs with a primary or secondary standard are compared directly to the GCTLs to determine initial COPCs. The COPC screening process identified five contaminants [1-methylnaphthalene, 2-methylnaphthalene, benzo(a)anthracene, naphthalene, and TPH (C8-C40)] that exceeded the GCTLs, as shown in Table 3-3.

TABLE 3-3
OCCURRENCE, DISTRIBUTION, AND SELECTION OF COPCs - GROUNDWATER

SWMUs 6 and 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

CAS Number	Chemical	Minimum Concentration[1]	Maximum Concentration[1]	Location of Maximum Concentration	Detection Frequency[2]	Range of Nondetects[3]	Concentration Used for Screening[4]	Background Value	FDEP Residential GCTL [5]		USEPA MCL [6]	COPC Flag[7]	Rationale for Contaminant Deletion or Selection
Volatile Organics (µg/L)													
100-41-4	ETHYLBENZENE	0.3	0.6	MPT-07-TW07S	2/20	0.3 - 0.3	0.6	NA	30	N	700	NO	BSL
TTNUS054	M+P-XYLENES	2	2	MPT-07-TW07S	1/20	1 - 1	2	NA	20	N	10000	NO	BSL
95-47-6	O-XYLENE	0.6	0.8	MPT-08-MW03S	5/20	0.4 - 0.4	0.8	NA	20	N	10000	NO	BSL
108-88-3	TOLUENE	0.6	1	MPT-08-MW03S	4/20	0.4 - 0.4	1	NA	210	N	1000	NO	BSL
1330-20-7	TOTAL XYLENES	0.6	3	MPT-07-TW07S	5/20	1 - 1	3	NA	20	N	10000	NO	BSL
Polyaromatic Hydrocarbons (µg/L)													
90-12-0	**1-METHYLNAPHTHALENE**	0.4	160	MPT-08-MW03S	16/20	0.1 - 0.1	160	NA	28	N	NA	**YES**	ASL
91-57-6	**2-METHYLNAPHTHALENE**	0.09	100	MPT-08-MW02S, MPT-08-MW03S	15/20	0.07 - 0.07	100	NA	28	N	NA	**YES**	ASL
83-32-9	ACENAPHTHENE	0.2	7	MPT-08-MW03S	16/20	0.07 - 0.07	7	NA	20	N	NA	NO	BSL
120-12-7	ANTHRACENE	0.2	0.6	MPT-08-MW03S	9/20	0.06 - 2	0.6	NA	2100	N	NA	NO	BSL
56-55-3	**BENZO(A)ANTHRACENE**	0.2	0.2	MPT-07-TW02S, MPT-07-TW03S, MPT-07-TW06S	3/20	0.07 - 0.7	0.2	NA	0.05	C	NA	**YES**	ASL
86-73-7	FLUORENE	0.1	11	MPT-08-MW03S	16/20	0.07 - 0.07	11	NA	280	N	NA	NO	BSL
91-20-3	**NAPHTHALENE**	0.1	40	MPT-08-MW02S	14/20	0.1 - 0.1	40	NA	14	N	NA	**YES**	ASL
85-01-8	PHENANTHRENE	0.1	6	MPT-08-MW03S	12/20	0.05 - 0.05	6	NA	210	N	NA	NO	BSL
129-00-0	PYRENE	0.2	0.2	MPT-08-MW02S	1/20	0.06 - 0.6	0.2	NA	40	N	NA	NO	BSL
Petroleum Hydrocarbons (µg/L)													
TTNUS599	**TPH (C08-C40)**	2800	47000	MPT-08-MW03S	15/20	210 - 1600	47000	NA	5000	N	NA	**YES**	ASL

Footnotes

1 - Sample and duplicate are considered as two separate samples when determining the minimum and maximum concentrations.

2 - Sample and duplicate are counted as one sample when determining frequency of detection.

3 - Values presented are sample-specific quantitation limits.

4 - The maximum detected concentration is used for screening purposes.

5 - The FDEP GCTL from Table I, Chapter 62-777, FAC (FDEP, 2005) is used as the screening level.

6 - USEPA Maximum Contaminant Levels (MCLs) (USEPA, 2007).

7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the FDEP GCTL or USEPA MCL.

Shading indicates that the maximum detected concentration exceeded the screening criteria; therefore, the chemical was retained as a COPC.

Definitions:

C = Carcinogen

N = Non-carcinogen

NA = Not Applicable/Not Available

Rationale Codes:

For selection as a COPC

ASL = Above COPC Screening Level

For elimination as a COPC:

BSL = Below COPC Screening Level

3.2.2 COCs – Human Health

The representative concentration of the COPCs for groundwater was compared to the FDEP CTLs (Chapter 62-777, FAC). Section 1.5.1.2 provides a detailed description of the process for the identification of COCs. No COC evaluation was performed for surface or subsurface soils since the petroleum-impacted soil was removed to the extent practicable by an IM in 2007.

3.2.2.1 Selection of Groundwater COCs – Human Health

Five contaminants [1-methylnaphthalene, 2-methylnaphthalene, benzo(a)anthracene, naphthalene, and TPH (C8-C40)] were identified as COPCs in groundwater at SWMUs 6 and 7. The GCTLs for all final COPCs in groundwater were based on primary or secondary standards. No adjustments were made to the GCTLs for either of the final COPCs evaluated. The MCSs for 1-methylnaphthalene, 2-methylnaphthalene, benzo(a)anthracene, and TPH (C8-C40) were determined by their respective GCTLs. As shown in Table 3-4, all five exceeded their respective MCSs during the human health evaluation and were identified as final groundwater COCs.

TABLE 3-4
PRELIMINARY RISK EVALUATION - GROUNDWATER

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Chemical	Maximum Detected Concentration (µg/L)	FDEP GCTL[1] (µg/L)	Health Based Value[2] (µg/L)	C or N?[3]	COPC	Cancer Risk	Hazard Quotient
1-METHYLNAPHTHALENE	160	28	28	N	YES	NA	5.7
2-METHYLNAPHTHALENE	100	28	28	N	YES	NA	3.6
BENZO[A]ANTHRACENE	0.2	0.05	0.05	C	YES	4.0E-06	NA
NAPHTHALENE	40	14	140	N	YES	NA	0.3
TPH (C8-C40)	47,000	5,000	5,000	N	YES	NA	9.4
					TOTAL	4.0E-06	19.0

Concentration units are µg/L.
1 - GCTLs for Chapter 62-777, FAC, FDEP, April 17, 2005.
2 - Calculated in accordance with Figures 1 and 2 in Technical Report: Development of CTLs for Chapter 62-777, FAC.
3 - Carcinogenic (C) or Noncarcinogenic (N)
4 - Was COPC detected in groundwater at concentration greater than GCTL?
NA = Not Available

3.3 COCs – ECOLOGICAL

Based on the RFI findings, no ecological risk to terrestrial wildlife populations was determined to be likely due to exposure to surface soil or surface water at SWMUs 6 and 7. The RFI stated that SWMUs 6 and 7 provide limited ecological habitation and contamination is not present at the surface.

Potential risks for aquatic receptors were evaluated for exposure to ECPCs in groundwater at the point of discharge to the St. Johns River. Comparison of the average and maximum EPC of each ECPC with available criteria and toxicity benchmarks is the basis of the ecological risk characterization.

The RFI concluded that groundwater from SWMUs 6 and 7 is not expected to pose a risk to aquatic receptors. The presumption of no risks for aquatic life resulting from potential exposures to ECPC detected in groundwater samples assumes that groundwater containing these chemicals has not yet reached the St. Johns River.

3.3.1 COC Summary

Five COCs were selected for groundwater [1-methylnaphthalene, 2-methylnaphthalene, benzo(a)anthracene, naphthalene, and TPH (C8-C40)]. The summary list of COCs is shown in Table 3-5. A figure depicting groundwater sample locations with exceedances is provided as Figure 3-1.

TABLE 3-5
FINAL COCs

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

COCs	Maximum Concentration (µg/L)	Background Concentration (µg/L)	Media Cleanup Standard (µg/L)	Media Cleanup Standard Basis
Groundwater (µg/L)				
1-methylnaphthalene	160	-	28	GCTL
2-methylnaphthalene	100	-	28	GCTL
Benzo(a)anthracene	0.2	-	0.05	GCTL
naphthalene	40	-	40	GCTL
TPH (C8-C40)	47,000	-	5,000	GCTL

3.3.2 Media Cleanup Standards

MCSs establish acceptable exposure levels that are protective of human health and the environment and were estimated for SWMUs 6 and 7 using baseline assumptions and inputs. MCSs are determined based on federal and state standards, contaminants and media of interest, and exposure pathways. These calculations are based on the State of Florida CTLs (Chapter 62-777, FAC), BSVs (presented and discussed in Section 2.4 of this document) and assumptions regarding ultimate land uses. The current and future use of SWMUs 6 and 7 is for industrial purposes; therefore, the exposure pathways are to commercial/industrial workers. Specifically, MCSs are used to determine COCs, to estimate areas and volumes of impacted media, and to set performance standards for potential remedial alternatives.

Groundwater

The MCSs established for this CMS Addendum are the State of Florida GCTLs (Chapter 62-777, FAC).

3.4 VOLUMES OF CONTAMINATED MEDIA

Estimates of contaminated media volumes are made by identifying the areas exceeding the MCSs. Groundwater analysis data were compared with the corresponding MCS only (no ecological concerns were present due to the absence of terrestrial ecological receptors). Perimeter areas surrounding the contaminated monitoring wells were also included, based on interpolation, as part of the impacted areas so that the area and volume estimates reflect adequate delineation of the contaminants.

Volume of Groundwater

Groundwater contamination comprises approximately 4.6 acres of the site and surrounding areas. A figure showing the locations of monitoring wells containing a COC concentration greater than the groundwater MCS is provided as Figure 3-1. Plume thickness was conservatively estimated to be 15 feet (from 10 to 25 feet bgs). Estimates of the pore volume of the plume resulted in approximately 6,735,366 gallons of contaminated groundwater. For further information on the volume estimates of contaminated groundwater, see Appendix C.

3.5 CORRECTIVE ACTION OBJECTIVES

At SWMUs 6 and 7, the media of concern is groundwater. CAOs were based on the COPCs, the exposure pathway, and the present and future receptors at SWMUs 6 and 7. Development of the CAOs considered the results of the Post-RFI/IM sample results as well as the applicable federal and state standards.

For this CMS, CAOs were formulated based on unacceptable human health risk that existed for direct exposure to groundwater based on the current and anticipated future use of the sites. The current use of the property at SWMUs 6 and 7 is industrial and is expected to remain industrial in the future. The current and future receptors are commercial/industrial workers and shoreline benthic aquatic receptors in the St. Johns River. Based on the current and future use receptors, the following CAOs were developed for SWMUs 6 and 7.

Groundwater

CAO 1: Prevent ingestion of aquifer groundwater containing carcinogens in excess of the Florida GCTLs (Chapter 62-777, FAC) for groundwater criteria until CAO 3 has been met. The cumulative risk for all COCs shall not exceed an ELCR of 1.0×10^{-6} for exposure to groundwater.

CAO 2: Prevent ingestion of aquifer groundwater containing noncarcinogens in excess of the Florida GCTLs groundwater criteria until CAO 3 has been met. The HQ for each contaminant shall not exceed 1.0 for the exposure to groundwater. The HI (which is the sum of the HQs) shall not exceed 1.0 for exposure to groundwater.

CAO 3: Restore the groundwater aquifer to the Florida GCTLs for groundwater criteria.

4.0 IDENTIFICATION AND SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES

Corrective measure technologies are identified and screened to address the CAOs identified for SWMUs 6 and 7. Each technology is then screened based on contaminant characteristics. The technology screening process reduces the number of potentially applicable technologies by evaluating the applicability of each technology to contaminant factors. Technologies deemed ineffective or not implementable were eliminated from further consideration.

4.1 PRELIMINARY SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES

Table 4-1 identifies and provides a preliminary screening of corrective measures technologies for groundwater. This preliminary screening is conducted to eliminate those technologies that are not applicable to conditions at SWMUs 6 and 7.

The preliminary technology screening is based on overall applicability (technical implementability) to the medium of concern (groundwater), COCs, and conditions present at SWMUs 6 and 7. The purpose of this screening effort is to investigate all available technologies and process options and to eliminate those obviously not applicable to the site. Table 4-2 summarizes the groundwater technologies retained from the preliminary screening.

4.2 DETAILED SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES

The technologies retained from the preliminary screening are broadly evaluated in this section. The evaluations are based on criteria of effectiveness, implementability, and relative cost, which are defined as follows:

- Effectiveness - This criterion focuses on the potential effectiveness of process options in protecting human health and the environment and in meeting the CAOs and MCSs. This criterion considers potential impacts to human health and the environment during construction and implementation and how proven and reliable the process is with respect to the contaminants and site conditions.

TABLE 4-1
PRELIMINARY SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES FOR GROUNDWATER

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
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General Corrective Action	Corrective Measures Technology	Technology	Description	General Screening Comments
Limited Action	No Action	Not Applicable	No remedial actions taken.	Retained. Will be considered for baseline comparison and for areas that have not experienced any releases of hazardous substances or for areas determined to have minimal short-term or long-term effects on groundwater quality.
	LUCs	Institutional Controls	Controls to be instituted that would involve restrictions on groundwater use and installation of new wells.	Retained. LUCs are viable and will be considered where no active corrective measures are required due to limited contamination or no elaborate corrective measure warranted and/or in combination with any technology where contaminants exceeding CMS objectives remain.
	Monitoring	Natural Attenuation	Periodic monitoring of groundwater wells in the area of potential groundwater contamination to track natural degradation of contaminants.	Retained. Natural attenuation groundwater monitoring is a viable remedial alternative for low level contamination.
Containment	Hydrodynamic Control	Extraction Wells	Control of plume migration by a system consisting of extraction of the contaminated groundwater.	Eliminated. No technologies are being recommended that remove the groundwater contamination from its current location and could potentially contaminate other medias or create discharge/disposal issues.
		Collection Trench	Control of plume migration by a collection trench and extraction of the contaminated groundwater.	Eliminated. No technologies are being recommended that remove the groundwater contamination from its current location and could potentially contaminate other medias or create discharge/disposal issues.
		Slurry Wall	Trench around areas of contamination is filled with a soil (or cement) bentonite slurry to obstruct/divert the groundwater flow.	Eliminated. Contamination does not appear to be migrating off-site and effective confining unit is not present.
		Grout Curtain	Pressure injection of grout in a regular pattern of drilled holes. Requires integration with confining layer to be effective.	Eliminated. Contamination does not appear to be migrating off-site and effective confining unit is not present.
	Subsurface Barriers	Sheet Piling	Driving interconnecting lengths of steel into the ground to form a thin, impermeable barrier. Requires integration with confining layer to be effective.	Eliminated. Contamination does not appear to be migrating off-site and effective confining unit is not present.
Removal	Extraction	Extraction Wells	Series of pumping wells to extract contaminated groundwater.	Eliminated. No technologies are being recommended that remove the groundwater contamination from its current location and could potentially contaminate other medias or create discharge/disposal issues.
		Collection Trenches	Perforated pipe in trenches backfilled with porous media to collect groundwater. May include sumps and gravity drains.	Eliminated. No technologies are being recommended that remove the groundwater contamination from its current location and could potentially contaminate other medias or create discharge/disposal issues.
In-situ Treatment	Bioremediation	Aerobic	Degradation of organics using microorganisms in an oxygen-enriched environment.	Retained.
		Anaerobic	Degradation of organics using microorganisms in an oxygen-deficient environment.	Eliminated. Contaminants more effectively treated under aerobic conditions.

TABLE 4-1
PRELIMINARY SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES FOR GROUNDWATER

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA
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General Corrective Action	Corrective Measures Technology	Technology	Description	General Screening Comments
In-situ Treatment (continued)	Physical / Chemical	Air Sparging	Injection of air below the water table. Rising bubbles volatilize dissolved and adsorbed phase contaminants and transport them to the vadose where they are removed by a method of collection such as vapor extraction or by in situ aerobic degradation.	Eliminated. No technologies are being recommended that remove the groundwater contamination from its current location and could potentially contaminate other medias or create discharge/disposal issues.
		Permeable Reactive Barriers (PRBs)	An in situ barrier composed of a permeable reactive material that reacts with the contaminants in the water, reducing their concentrations by physical and chemical processes.	Eliminated. This technology requires contaminated groundwater to flow through the PRB. With no contaminant migration, it would be ineffective.

TABLE 4-2
REPRESENTATIVE GROUNDWATER CORRECTIVE MEASURE TECHNOLOGIES

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

General Corrective Action	Corrective Measures Technology	Technology	Representative Technology	Rationale
No Action	No Action	None	None	Required
LUCs	Land Use and Access Restrictions Water Use Restrictions	Institutional Controls	Land Use Restrictions	To impose water and residential use restrictions.
Monitoring with Natural Attenuation	Natural Attenuation Monitoring	Natural Attenuation	Natural Attenuation	Monitoring would track the progress of natural attenuation until MCSs were attained.
In-situ Treatment	Aerobic Bioremediation	Microorganism degradation of organics	PermeOx® or Oxygen-Releasing Compound (ORC)	Stimulating microorganisms with aerobic conditions to effectively reduce organic contaminants.

- Implementability - Implementability is a measure of both the technical and administrative feasibility of implementing a technology. It provides a means of evaluating the ability of a technology to be adapted to site-specific conditions. Technical feasibility includes consideration of construction and operational issues, demonstrated performance, and adaptability to site conditions. Administrative feasibility considerations include the ability to obtain any necessary permits or easements or adherence to applicable laws and concerns of other regulatory agencies. General availability of necessary equipment and resources is also evaluated.

- Cost - Cost evaluations allow a relative comparison between similar technologies and play a limited role in technology screening. The cost analysis is based on engineering judgment and each technology is evaluated as to whether costs are low, medium, or high relative to the other options in the same technology type. If there is only one process option, costs are compared to other candidate technologies.

The process options presented in Table 4-1 and 4-2 for use at SWMUs 6 and 7 are evaluated in the following sections. Because the No Action option must be used as a baseline for comparison with other corrective action alternatives, it is retained.

4.2.1 Limited Action – Groundwater

Two technologies were retained from preliminary screening: LUCs and monitoring with natural attenuation.

4.2.1.1 LUCs

LUCs would prevent use of the groundwater for drinking purpose until the MCSs have been met. A Remedial Design, including land use restrictions, would be prepared and implemented so that, prior to any future development of SWMUs 6 and 7, adequate measures would be taken to minimize potentially adverse human health and environmental risks. A formal notice would be issued to the responsible agency to prevent the issue of permits for the installation of drinking water wells at SWMUs 6 and 7. As part of LUCs, annual site inspections would be conducted to verify and enforce the continued application of these controls. Results of these annual inspections would be reported to regulatory agencies.

Effectiveness

Groundwater use restrictions would be effective in combination with the IM that was conducted in 2007. These controls would minimize potential human health risks associated with exposure to contaminated groundwater. At SWMUs 6 and 7, soil is the source of groundwater contamination, and an IM is planned for 2007 to remove contaminated surface and subsurface soils. As such, LUCs would achieve the CAOs.

Implementability

LUCs would be readily implementable. Federal facilities typically ensure long-term effectiveness of LUCs by implementing Remedial Designs. The Navy could implement a LUC Remedial Design to ensure compliance with land use restrictions and specify other activities or controls necessary to limit exposure to contaminated groundwater at SWMUs 6 and 7. Resources are readily available for the preparation of land use restrictions.

Cost

Costs of LUCs would be low.

Conclusion

LUCs are retained for the development of corrective measures alternatives.

4.2.1.2 Monitored Natural Attenuation

Monitored natural attenuation would consist of using sampling and analysis of groundwater in and around the groundwater plume to evaluate both the trends of COC concentrations and natural attenuation within the plumes and detect potential plume expansion and migration. Natural attenuation includes naturally occurring processes such as biodegradation, abiotic transformation, dispersion, and dilution that would reduce concentrations of COCs over time. To track the progress of the natural attenuation processes, groundwater samples would be regularly collected and analyzed for COCs and natural attenuation

parameters such as oxidation/reduction potential (ORP), dissolved oxygen, pH, alkalinity, temperature, conductivity, total organic carbon (TOC), ferrous and total iron, sulfur compounds (sulfides, sulfates), nitrogen compounds (nitrites, nitrates), orthophosphates, chloride, and metabolic gases (methane, ethane, ethene, and carbon dioxide).

Effectiveness

Naturally occurring processes could reduce groundwater contaminant concentrations over the long term. Groundwater monitoring would provide an effective means of evaluating the concentrations of COCs in groundwater and of assessing the rate of decrease of these concentrations. Monitoring of natural attenuation parameters would help to evaluate the conditions favorable to the natural attenuation process.

Implementability

Monitored natural attenuation would be easy to implement. Monitoring groundwater quality, restricting groundwater use, and periodic reviewing of site conditions could readily be performed, and the necessary resources are available to provide these services.

Cost

Capital and operations and maintenance (O&M) costs for monitored natural attenuation would be low.

Conclusion

Monitored natural attenuation is retained for the development of corrective measure alternatives because its implementation would provide useful information about the progress in reducing contaminants in groundwater and would be easy and inexpensive.

4.2.2 In-Situ Treatment – Groundwater

The only active treatment technology retained from the preliminary screening for groundwater was in-situ bioremediation.

4.2.2.1 In-Situ Bioremediation

This technology typically consists of enhancing naturally occurring biological activity by subsurface injection of chemicals. An ORC, such as hydrogen or magnesium peroxide, would be injected into the groundwater to enhance the aerobic biodegradation of the COCs. Typically, injection is implemented by DPT, but existing and/or new monitoring wells can also be used for this purpose. If necessary, initial injection is followed by a periodic maintenance dosage(s).

Effectiveness

In-situ bioremediation with an ORC injection is a well proven technology for the removal of the fuel constituents in groundwater. However, recalcitrant compounds such as 1-methylnaphthalene, 2-methylnaphtalene and long-chain PAHs are slow to degrade. The technology is fairly reliable, with minimum effects on human health and the environment. This technology is considered applicable to the treatment of the SWMUs 6 and 7 groundwater plumes.

Implementability

In-situ bioremediation could be readily implemented. Qualified contractors are available for the implementation of this technology. This technology typically requires subsurface injection of chemicals at multiple points to create a grid that covers a contaminant plume. DPT has proven to be the most practical and economical means of installing this multiplicity of injection points.

Cost

Capital and O&M costs for in-situ bioremediation would be moderate.

Conclusion

In-situ bioremediation with an ORC injection is retained for the development of corrective measures alternatives.

4.3 DEVELOPMENT OF GROUNDWATER CORRECTIVE MEASURES ALTERNATIVES

Based on the technology screening presented in Sections 4.1 and 4.2, the following technologies and process options were retained for use at SWMUs 6 and 7:

- No Action
- Limited Action: LUCs and Monitored Natural Attenuation
- In-Situ Treatment: In-Situ Bioremediation (aerobic)

Using these technologies, the following three corrective measures alternatives were developed:

- Alternative 1: No Action
- Alternative 2: Monitored Natural Attenuation and LUCs
- Alternative 3: In-Situ Bioremediation, LUCs, and Monitoring

The following sections outline the components of each of the corrective measures alternatives to address the contaminated groundwater at SWMUs 6 and 7.

4.3.1 Alternative 1: No Action

The No Action alternative maintains the site as-is. This alternative does not address the groundwater contamination and is retained to provide a baseline for comparison to other alternatives. There would be no reduction in toxicity, mobility, or volume of the contaminants other than what would result from natural dispersion, dilution, biodegradation, and other attenuating factors. Existing monitoring programs and institutional controls would be discontinued and the site would be available for unrestricted use.

4.3.2 Alternative 2: Monitored Natural Attenuation and LUCs

Alternative 2 would consist of two major components: (1) monitored natural attenuation and (2) LUCs.

4.3.2.1 Component 1: Monitored Natural Attenuation

Natural attenuation would rely on naturally occurring processes to significantly reduce the concentrations of COCs. These processes include a combination of biodegradation, dispersion, dilution, and adsorption in various proportions depending on the type of contaminant and aquifer conditions. Aquifer conditions would be continually monitored to ensure that they are favorable and to verify that concentrations of COCs are being adequately reduced.

Monitoring would consist of regularly collecting and analyzing groundwater samples from monitoring wells in and around SWMUs 6 and 7. The monitoring would take place over a period of 30 years or until the MCSs are consistently achieved and consists of collecting groundwater samples from eight existing monitoring wells. Monitoring the eight wells would occur for 30 years (on a quarterly basis for year 1, semi-annually for years 2 through 5, and annually for years 6 through 30) and the collected groundwater samples analyzed for VOCs, PAHs, and TRPH. In addition, during the first 5 years, samples would also be analyzed for natural attenuation indicator parameters, such as ORP, dissolved oxygen, pH, alkalinity, temperature, conductivity, TOC, ferrous and total iron, sulfur compounds (sulfates, sulfides), nitrogen compounds (nitrates, nitrites), orthophosphates, chlorides, and metabolic gases (methane, ethane, ethene, and carbon dioxide). Wells would only be removed from the monitoring program if two consecutive monitoring events showed that no COCs exceeded MCSs. If all wells are removed from the monitoring program due to no COCs exceeding MCSs, the monitoring program will be stopped and No Further Action will be recommended for groundwater. The thirteen monitoring wells with COCs exceeding MCSs during the groundwater sampling conducted for the CMS Addendum will be sampled as part of a monitoring program for SWMUs 6 and 7. Four of these monitoring wells (MPT-08-MW02S, MPT-08-MW03S, MPT-08-MW07S, and MPT-08-RW01) were abandoned during the IM and will be replaced prior to the initiation of the groundwater monitoring program.

Regulatory reviews would be performed every five years on the monitoring data to evaluate site status, to assess the continued adequacy of remedial activities, and to determine whether further action is necessary.

4.3.2.2 Component 2: LUCs

LUCs would prohibit aquifer use for drinking purposes until the MCSs have been met. A LUC Remedial Design, including land use restrictions, would be prepared and implemented so that, prior to any future development of SWMUs 6 and 7, adequate measures would be taken to minimize potentially adverse human health and environmental risks. As part of institutional controls, annual site inspections would be conducted to verify and enforce the continued application of these controls. Results of these annual inspections would be reported to regulatory agencies.

4.3.3 Alternative 3: In-Situ Bioremediation, LUCs, and Monitoring

Alternative 3 would consist of three major components: (1) in-situ bioremediation with an ORC injection, (2) LUCs, and (3) monitoring.

4.3.3.1 Component 1: In-situ Bioremediation

In-situ bioremediation would consist of using an ORC injection to enhance the growth of indigenous microorganisms and to augment the natural biodegradation of fuel constituents in groundwater. ORC would be injected into the contaminated groundwater area within the boundary of SWMU 6 and 7using DPT. Based upon vendor calculations, it is assumed that 289 DPT injection points within the groundwater plume would be installed to a depth of 25 feet bgs. ORC would be injected at the rate of 11.2 pounds per foot of depth in the 10 to 25 foot bgs interval, for a total application use of 48,552 pounds. Additional injections might be required to deal with residual contamination that might rebound after the initial injection. However, for the purposes of this CMS Addendum, it is assumed that a single ORC application would be required. The exact design of the treatment system would be verified through treatability testing prior to implementation. ORC injection design calculations are included in Appendix D.

4.3.3.2 Component 2: LUCs

LUCs would prohibit aquifer use for drinking purposes until the MCSs have been met. A LUC Remedial Design, including land use restrictions, would be prepared and implemented so that, prior to any future

development of SWMUs 6 and 7, adequate measures would be taken to minimize potentially adverse human health and environmental risks. As part of institutional controls, annual site inspections would be conducted to verify and enforce the continued application of these controls. Results of these annual inspections would be reported to regulatory agencies.

4.3.3.3 Component 3: Monitoring

This component would be similar to the monitoring program outlined in Component 1 of Alternative 2, except that it would only last an estimated five years. Sampling would be conducted quarterly during Year 1, semi-annually during Years 2 and 3, and annually for the remaining two years.

At the end of five years, a review would be performed to evaluate site status, to assess the continued adequacy of remedial activities, and to determine whether further action is necessary.

5.0 EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

The identified corrective measures alternatives are evaluated using the following criteria contained in the Final RCRA Corrective Action Plan (USEPA, 1994):

The alternatives are evaluated against the standards listed below:

1. Protect human health and the environment.
2. Attain MCSs set by the implementing agency.
3. Control the source of releases.
4. Comply with any applicable standards for management of wastes.
5. Other factors –
   - Long-term reliability and effectiveness.
   - Reduction in toxicity, mobility, or volume of wastes.
   - Short-term effectiveness.
   - Implementability.
   - Cost.

The criteria and elements for the above standards to be used for the detailed analysis of alternatives are described below.

Protect Human Health and the Environment

Corrective action remedies must be protective of human health and the environment. Remedies may include those measures that are needed to be protective, but are not directly related to media cleanup, source control, or management of wastes. A discussion of what types of short-term remedies are appropriate for the site and how various corrective measure alternatives meet this standard should be presented.

Attain Media Cleanup Standards Set by the Implementing Agency

Remedies will be required to attain MCSs set by the implementing agency that may be derived from existing state or federal regulations or other standards. Provide the necessary information to address whether the potential corrective action will achieve the preliminary remediation objective as defined by the implementing agency as well as other, alternative remediation objectives that may be proposed to attain the MCSs.

Control the Sources of Releases

A critical objective of any corrective action must be to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health and the environment. The source control standard is not intended to mandate a specific corrective action or class of corrective actions. Instead, a wide range of options should be examined. This standard should not be interpreted to preclude the equal consideration of using other protective remedies to control the source, such as partial waste removal, capping, slurry walls, in-situ treatment/stabilization or consolidation. As part of the CMS Addendum, the issue of whether source control measures are necessary should be addressed, and, if so, the type of actions that would be appropriate should be outlined. Any source control measure proposed should include a discussion on how well the method is anticipated to work given the particular situation at the facility and the known track record of the specific technology.

Comply with any Applicable Standards for Management of Wastes

A discussion of how the specific waste management activities will be conducted in compliance with all applicable Federal or State regulations (e.g., closure requirements and land disposal restrictions) should be presented.

Other Factors

Five general factors represent a combination of technical measures and management controls for addressing the environmental problems at the facility. These factors will be considered as appropriate by the implementing agency in selecting/approving a corrective action that meets the four standards listed above. The five general decision factors and relevant information that may be requested are as follows:

Long-term Reliability and Effectiveness – Demonstrated and expected reliability is a way of assessing the risk and effect of failure. Consideration should be given as to whether the technology or a combination of technologies have been used effectively under analogous site conditions, whether failure of any one technology in the alternative would have an immediate impact on receptors, and whether the alternative would have the flexibility to deal with uncontrollable changes at the site (e.g., heavy rainstorms, earthquakes). Each corrective measure alternative should be evaluated in terms of the projected useful life of the overall alternative and of its component technologies.

Reduction in the Toxicity, Mobility, or Volume of Wastes – As a general goal, remedies will be preferred that are capable of eliminating or substantially reducing the inherent potential for the contaminants to cause future environmental releases or other risks to human health and the environment. However, there may be some situations where substantial reductions in toxicity, mobility, or volume may not be practicable or even desirable. Estimates of how much the corrective measure alternatives will reduce the

waste toxicity, volume, and/or mobility may be helpful in applying this factor. This may be done through a comparison of initial site conditions to expected post-corrective measure conditions.

Short-Term Effectiveness – Short-term effectiveness may be particularly relevant when remedial alternatives will be conducted in densely populated areas, or where waste characteristics are such that risks to workers or to the environment are high and special protective measures are needed. Possible factors to consider include fire, explosion, exposure to hazardous substances, and potential threats associated with treatment, excavation, transportation, and redisposal or containment of waste material.

Implementability – Implementability will often be a determining variable in shaping remedies. Some technologies will require state or local approvals prior to construction and there may be some restrictions or concerns for certain remedial approaches. Typical factors to be considered include administrative activities (e.g., permits, right of way, offsite approvals) and the time these activities will take; constructability of the remedial measure and time for beneficial results, availability of off-site treatment, storage, and disposal facility services; and availability of prospective technology.

Cost – The relative cost of a corrective action may be an appropriate consideration, especially in those situations where several different technical alternatives to remediation will offer equivalent protection of human health and the environment. Cost estimates could include costs for engineering, site preparation, construction, materials, labor, sampling/analysis, waste management/disposal, permitting, health and safety measures, training, O&M, etc.

5.1 EVALUATION OF GROUNDWATER CORRECTIVE MEASURES ALTERNATIVES

The identified corrective measure alternatives are evaluated using the criteria described in Section 5.0.

5.1.1 Alternative 1: No Action

Protect Human Health and the Environment

No Action would allow unacceptable risks to human health and the environment. The No Action alternative would do nothing to effectively address contaminated groundwater or control its potential migration to off-site areas.

Attain Media Cleanup Standards

No Action would not confirm if MCSs were achieved. Natural attenuation may eventually reduce low concentrations of COCs to acceptable levels, but the progress of attenuation would not be monitored.

Control the Source of Releases

No Action would not control or eliminate the source of contamination. Natural attenuation may eventually eliminate the source; however, the potential progress of natural attenuation would not be monitored.

Comply with any Applicable Standards for Management of Wastes

No Action would not involve any waste management activities. Therefore, no standards for management of wastes would apply.

Other Factors

Long-term Reliability and Effectiveness – The No Action alternative would not provide long-term reliability and effectiveness. Contaminants could continue to migrate and might pose a long-term risk to human health and the environment. Aside from the potential reduction of contamination through natural attenuation, this alternative would offer no reduction in risk over long periods of time.

Reduction in the Toxicity, Mobility, or Volume of Wastes – Reduction of toxicity, mobility, or volume would potentially occur but only through natural processes. Natural biodegradation would not be documented in the absence of monitoring, and contaminated groundwater could potentially migrate off-site.

Short-term Effectiveness – The No Action alternative would not include any construction or remedial implementation, so there would be no short-term risks to workers, the community, or the environment from these activities. Neither the public nor the workers would be exposed to potential threats associated with construction or transportation.

Implementability – No technical implementability issues would exist because no corrective action would occur. Once the alternative was approved, there would be no administrative issues and no need to coordinate with other agencies or acquire permits. Future remedial actions, if needed, would not be hindered by the No Action alternative.

Cost – No corrective action would occur; therefore, there would be no costs.

5.1.2 Alternative 2: LUCs and Monitored Natural Attenuation

Protect Human Health and the Environment

LUCs would effectively prevent direct human contact with contaminated groundwater by controlling the access to and preventing the withdrawal of contaminated groundwater. LUCs would ensure that no new potable groundwater wells would be installed and that restrictions on land use would be in place. Monitoring would assess the progress of natural attenuation and groundwater quality. No COC migration

has been observed at this site to date and the implementation of monitoring would verify that no migration of contaminants is occurring. Over a period of time the concentrations of COCs in groundwater would reach levels that would be protective to human health and the environment through natural attenuation.

Attain Media Cleanup Standards

Alternative 2 would attain the groundwater MCSs over time. Natural processes would reduce low concentrations of COCs to acceptable levels, which would be indicated by the monitoring. The FDEP has established natural attenuation default source concentrations (NADSCs) for groundwater contaminants. Contaminant concentrations that do not exceed the FDEP NADSC value are permitted to enter into a monitored natural attenuation program. The existing concentrations of COCs at SWMUs 6 and 7 fall within the FDEP acceptable NADSC values that provide adequate protection of human health.

Control the Source of Releases

LUCs would not control or eliminate the source of contamination. Monitored natural attenuation would remove the contaminant source over time principally through biodegradation, and the degradation progress would be monitored.

Comply with any Applicable Standards for Management of Wastes

LUCs and monitored natural attenuation would not involve any waste management activities other than disposal of sampled water that would be disposed of following applicable standards. No other standards for management of wastes would apply.

Other Factors

Long-term Reliability and Effectiveness – LUCs would effectively prevent exposure to groundwater until the MCSs have been met. Natural attenuation would offer reduction in risk over a period of time; the progress of which would be monitored. Monitoring is effective in tracking reduction in contaminant concentrations. Monitoring would also be effective to verify the continued lack of significant migration of COCs.

Reduction in the Toxicity, Mobility, or Volume of Wastes – Alternative 2 would reduce the toxicity and volume through natural attenuation processes, principally biodegradation.

Short-term Effectiveness – Alternative 2 would involve sampling groundwater monitoring wells. The minimal short-term risks to workers and the environment would be manageable using the appropriate controls. Implementation of this alternative would not pose any safety concerns to nearby communities, the environment, or on-site workers. On-site workers would be protected from exposure to hazardous

substances through the following of health and safety procedures mandated by the Occupational Safety and Health Act, including appropriate use of personal protective equipment (PPE).

Implementability – Alternative 2 would be readily implementable. Monitoring would require periodic sampling, maintenance of existing site wells, and the potential installation of new monitoring wells. Materials and labor would be readily available for the periodic sampling. Administrative issues and coordination with other agencies or acquiring permits would be easily achievable. Future remedial actions, if needed, would not be hindered by this alternative.

Cost – The following costs are estimated for Alternative 2:

Capital Costs:	$16,000
O&M Costs:	$0
Monitoring Costs:	$78,000 for Year 1
	$41,000/year for Years 2 and 3
	$22,000/year for Years 4 and 5 plus $17,000 for a site review at Year 5
	$17,000/year for Years 6 through 30 plus $17,000 for a site review at Years 10, 15, 20, 25, and 30
30-Year NPW:	$368,000

Detailed cost estimates are provided in Appendix D.

5.1.3 Alternative 3: In-Situ Bioremediation, LUCs, and Monitoring

Protection of Human Health and the Environment

Alternative 3 would be protective of human health and the environment by moderately accelerating naturally occurring processes through active treatment of contaminated groundwater at SWMUs 6 and 7. In-situ injection of an ORC in the contaminant plume would enhance the biodegradation of fuel constituents; however, a large quantity of ORC would be required. Groundwater monitoring would be conducted to determine the effectiveness of this alternative. Groundwater use would be restricted to prevent exposure to contaminated groundwater until MCSs have been met.

Attainment of MCSs

Past experience with remediation of fuel constituent contamination with an ORC injection indicates that Alternative 3 would eventually meet MCSs in the SWMUs 6 and 7 groundwater. However, the current COC concentrations have a very large oxygen demand in the groundwater. It is possible that the addition

of ORC to the subsurface would not significantly reduce the time required to achieve MSCs without conducting multiple injection events. .

Source Control

Alternative 3 would promote the in-situ biodegradation of the contaminant plumes and thus reduce the most likely source of potential COC migration. An IM was conducted in 2007 to remove contaminated soil at the site which served as a source of groundwater contamination.

Compliance with Waste Management Standards

Alternative 3 would not generate any treatment residues. However, the installation of injection points and periodic sampling activities would generate some construction residues (e.g., decontamination water, purge water) that would have to be disposed appropriately. The volume of residues generated would be small and waste management regulations would be easily met.

Other Factors

Long-term Reliability and Effectiveness – Alternative 3 would most likely be effective because in-situ bioremediation is a well-demonstrated technology for the removal of fuel constituent contamination groundwater. However, the COCs at SWMUs 6 and 7 are recalcitrant and may require multiple ORC injections to meet the oxygen demand created by the elevated COC concentrations. Groundwater monitoring would effectively evaluate the progress of remediation, and institutional controls would effectively prevent risk from exposure to contaminated groundwater until the MCSs have been met.

Alternative 3 would achieve CAOs. Institutional controls would prevent exposure to contaminated groundwater. In-situ bioremediation would restore groundwater quality and ultimately reduce COC concentrations to less than MCSs.

Reduction in Toxicity, Mobility, and Volume – Alternative 3 would reduce the toxicity, mobility, and volume of COCs through active treatment of contaminated groundwater.

Short-term Effectiveness – The short-term impact of Alternative 3 would be minimal. Site workers would receive site-specific health and safety training and wear appropriate PPE. Implementation of this alternative would not result in any threat to the surrounding community or ecological receptors.

Implementability – Alternative 3 would be implementable. The resources, equipment, and materials necessary for the installation of an ORC injection are readily available.

This alternative could be implemented within approximately 6 months. Past experience with ORC remediation of fuel constituent plumes at similar sites indicates that groundwater MCSs would eventually be met.

Cost Analysis – The following costs are estimated for Alternative 3:

Capital Costs:	$1,075,000 (one injection event)
O&M Costs:	$0
Monitoring Costs:	$78,000 for Year 1
	$41,000 for Years 2 and 3
	$22,000 for Year 4 and 5 plus $17,000 for a site review at Year 5
	$17,000/year for Years 6 through 30 plus $17,000 for a site review at Years 10, 15, 20, 25, and 30
5-Year NPW:	$1,413,000

Detailed cost estimates are provided in Appendix E.

6.0 COMPARATIVE ANALYSIS AND RECOMMENDATION

The following sections provide a comparative analysis of the three corrective measures alternatives using the same criteria that were used to evaluate the alternatives in Section 5.0.

6.1 COMPARATIVE ANALYSIS OF GROUNDWATER ALTERNATIVES

A comparative analysis of groundwater alternatives is presented to address how effectively each alternative will comply with the standards listed in the guidance (USEPA, 1994). Soil alternative 1 (no action) is considered for baseline purposes and is not expected to satisfy any of the requirements.

6.1.1 Protection of Human Health and the Environment

Alternative 1 would not be sufficiently protective of human health and the environment. Alternative 2 would provide adequate protection of human health and the environment. Alternative 3 would be more protective than Alternative 2 by significantly accelerating the removal of COCs from SWMUs 6 and 7 groundwater.

Alternatives 2 and 3 include LUCs to prevent use of SWMUs 6 and 7 groundwater as a drinking water source and groundwater monitoring to examine the concentrations and migration of site COCs. The potential for off-site migration is greater under Alternatives 1 and 2 than Alternative 3.

6.1.2 Attainment of MCSs

Alternatives 1 and 2 might eventually attain MCSs through naturally occurring processes, but this would only be verified through monitoring in Alternative 2.

Alternatives 3 would attain MCSs for COCs at SWMUs 6 and 7 before Alternatives 1 and 2. With Alternatives 2 and 3, attainment of the MCSs would be verified through groundwater monitoring.

6.1.3 Source Control

Alternatives 1 and 2 would not provide any source control. Alternatives 3 would provide source control through active treatment of the contaminated groundwater.

6.1.4 Compliance With Waste Management Standards

Alternative 1 would not generate any waste material. Alternatives 2 and 3 would not generate any treatment residues but would generate a minimal amount of waste materials associated with groundwater

monitoring activities (e.g., purge water). Permitted off-site facilities would be readily available for the disposal of the waste materials generated by Alternatives 2 and 3.

6.1.5 Other Factors

6.1.5.1 Long-term Reliability and Effectiveness

Alternative 1 would not be effective and reliable. Alternative 2 would effectively remove COCs through naturally occurring processes. Alternatives 3 would be more effective than Alternative 2 because the removal of COCs would be significantly accelerated through in-situ biodegradation. The institutional controls component of Alternatives 2 and 3 would effectively prevent exposure to contaminated groundwater until the groundwater MCSs have been achieved.

6.1.5.2 Reduction in Toxicity, Mobility, and Volume

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume of COCs through treatment, but some reduction of toxicity and volume might be achieved through naturally occurring processes. Alternatives 3 would reduce the toxicity, mobility, and volume of COCs through active in-situ biodegradation.

6.1.5.3 Short-term Effectiveness

Alternative 1 would not result in any short-term risks to human health or the environment. Alternatives 2 and 3 would result in minimal short-term risks to groundwater monitoring personnel. These risks would be addressed through health and safety training and the wearing of appropriate PPE.

6.1.5.4 Implementability

Alternative 1 would be the easiest to implement because no action would be needed.

The groundwater monitoring and LUCs components of Alternative 2 would be very easy to implement. LUCs would be readily implementable through a LUC Remedial Design because SWMUs 6 and 7 are located within a government-owned facility where such controls are easier to enforce.

Alternative 3 would be somewhat more difficult to implement than Alternative 2. In addition to the same monitoring and institutional controls as Alternative 2, it would require the installation of ORC injection points (via DPT). Contractors and equipment are readily available for implementing the technologies

included in the in-situ biodegradation process. Installation of the Alternative 3 ORC injection points (via DPT) would be relatively simple, but utility clearance and coordination with operations conducted within SWMUs 6 and 7 would be required. Alternative 3 would require approximately 6 months for design and corrective action installation.

6.1.5.5 Cost

The estimated capital, O&M, and net present worth costs are presented in Table 6-1.

TABLE 6-1
COSTS FOR GROUNDWATER ALTERNATIVES

SWMUs 6 AND 7 CORRECTIVE MEASURES STUDY ADDENDUM
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Alternative	Capital Costs	O&M Costs	Monitoring Costs	Total Present Worth Costs[1]
1	$0	$0	$0	$0
2	$16,000	$0	Year 1 -- $78,000 Years 2-3 -- $41,000 Year 4 & 5 -- $22,000 Years 6-30 -- $17,000	$368,000
3	$1,075,000	$0	Year 1 -- $78,000 Years 2-3 -- $41,000 Year 4 & 5 -- $22,000 Years 6-30 -- $17,000	$1,413,000

[1] Includes cost for 5-year site reviews

6.2 RECOMMENDED CORRECTIVE MEASURE FOR GROUNDWATER

Groundwater alternative 2 is recommended for use at SWMUs 6 and 7. The LUCs and monitoring associated with this alternative will provide adequate protection of human health and the environment, and will be easy to implement. Upon completion of one year of quarterly monitoring the groundwater monitoring data will be compared against the criteria in Chapter 62-780.680, FAC, for potential closure using RBCA. A formal site review would be performed to verify the effectiveness of naturally occurring processes after five years of groundwater monitoring. If, at that time, it is determined that these processes are not sufficient to restore groundwater quality or if the contaminant plumes are shown to be migrating, a more active corrective action such as Alternative 3, would be considered.

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USEPA, 2007. Maximum Contaminant Levels, Office of Water, EPA 816-F-03-016.

APPENDIX A

HISTORICAL INFORMATION

LEGEND

	Approximate SWMU Location
MPT-B-T01-10	Terra Probes Soil Sampling Location 1993
MPT-B-T29	Terra Probes Soil Sampling Location 1994
RCRA	Resource Conservation And Recovery Act
U/C	Underground Cable
6' CL W/B	6' Chain-Link Fence
SWMU	Solid Waste Management Unit

0 60 120
SCALE: 1 INCH = 120 FEET

FIGURE 4-2
TERRAPROBE FIELD SCREENING LOCATIONS, 1993 AND 1994

RCRA FACILITY INVESTIGATION REPORT, GROUP II SWMUs

U.S. NAVAL STATION MAYPORT, FLORIDA

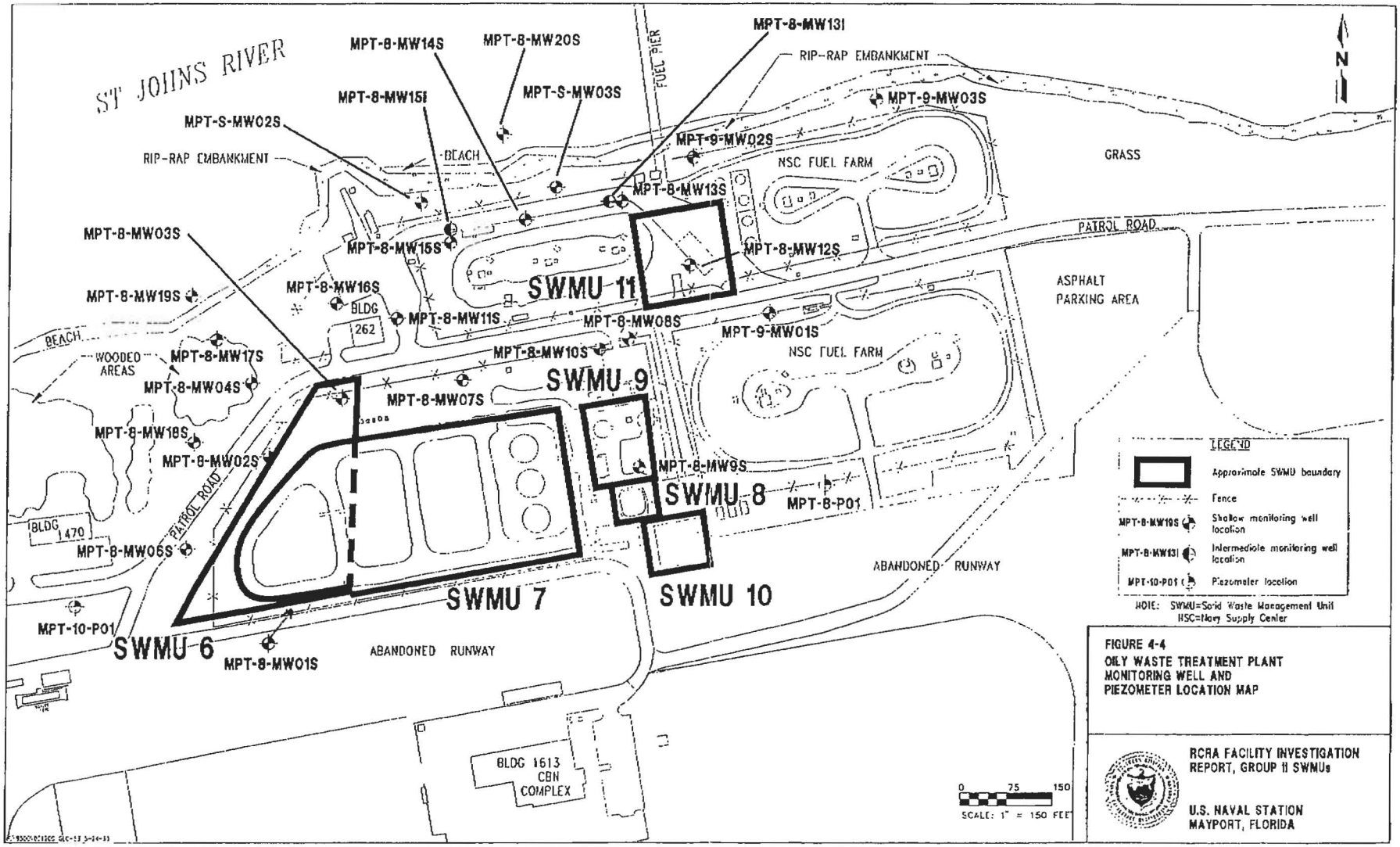

FIGURE 4-4
OILY WASTE TREATMENT PLANT
MONITORING WELL AND
PIEZOMETER LOCATION MAP

RCRA FACILITY INVESTIGATION
REPORT, GROUP II SWMUs

U.S. NAVAL STATION
MAYPORT, FLORIDA

APPENDIX B

CMS DATA SET

MAYPORT - SWMU 6/7
GROUNDWATER

SWMU	FDEP	6	7	7	7	7	7	7	7
LOCATION	GCTLs	MPT-06-TW01S	MPT-07-TW01S	MPT-07-TW02S	MPT-07-TW03S	MPT-07-TW04S	MPT-07-TW05S	MPT-07-TW06S	MPT-07-TW07S
SAMPLE ID		MPT-06-TW01S-112706	MPT-07-TW01S-110806	MPT-07-TW02S-112806	MPT-07-TW03S-112706	MPT-07-TW04S-112806	MPT-07-TW05S-112706	MPT-07-TW06S-112706	MPT-07-TW07S-112706
SAMPLE DATE		20061127	20061108	20061128	20061127	20061128	20061127	20061127	20061127
Volatile Organics (ug/L)									
1,2-DIBROMOETHANE	0.02	0.0066 U	0.0065 U	0.0065 U	0.0065 U	0.0065 U	0.0065 U	0.0065 UJ	0.0065 U
BENZENE	1	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
ETHYLBENZENE	30	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.3 U	0.6 J
M+P-XYLENES	NC	1 U	1 U	1 U	1 U	1 U	1 U	1 U	2
METHYL TERT-BUTYL ETHER	20	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
O-XYLENE	NC	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.7 J	0.4 U	0.6 J
TOLUENE	40	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
TOTAL XYLENES	20	1 U	1 U	1 U	1 U	1 U	0.7 J	1 U	3 J
Polynuclear Aromatic Hydrocarbons (ug/L)									
1-METHYLNAPHTHALENE	28	9	36 [G]	0.1 U	50 [G]	57 [G]	20	2 J	32 [G]
2-METHYLNAPHTHALENE	28	3 J	10	0.07 U	39 [G]	28	4	0.07 UJ	10
ACENAPHTHENE	20	1 J	2	0.07 U	2	2	2	2 J	2
ACENAPHTHYLENE	210	0.06 UJ	0.06 U	0.2 U	0.06 U	0.06 U	0.06 U	0.06 UJ	0.07 U
ANTHRACENE	2100	0.2 J	0.06 U	0.06 U	0.4	0.06 U	0.4	0.4 J	0.4
BENZO(A)ANTHRACENE	0.05	0.07 UJ	0.07 U	0.2 J [G]	0.2 J [G]	0.07 U	0.07 U	0.2 J [G]	0.08 U
BENZO(A)PYRENE	0.2	0.2 U	0.05 U	0.2 U	0.2 U	0.05 U	0.05 U	0.05 UJ	0.06 U
BENZO(B)FLUORANTHENE	0.05	0.1 U	0.08 U	0.08 U	0.1 U	0.08 U	0.1 U	0.2 U	0.2 U
BENZO(G,H,I)PERYLENE	210	0.09 U	0.09 U	0.08 U	0.1 U	0.08 U	0.08 U	0.1 U	0.1 U
BENZO(K)FLUORANTHENE	0.5	0.1 UJ	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 UJ	0.1 U
CHRYSENE	4.8	0.07 UJ	0.07 U	0.07 U	0.07 U	0.07 U	0.07 U	0.07 UJ	0.08 U
DIBENZO(A,H)ANTHRACENE	0.005	0.2 U	0.1 U	0.1 U	0.2 U	0.1 U	0.1 U	0.2 U	0.2 U
FLUORANTHENE	280	0.06 UJ	0.06 U	0.2 U	0.2 U	0.06 U	0.06 U	0.06 UJ	0.07 U
FLUORENE	280	1 J	2	0.07 U	3	3	3	2 J	2
INDENO(1,2,3-CD)PYRENE	0.05	0.1 UJ	0.1 U	0.09 U	0.1 U	0.09 U	0.09 U	0.1 U	0.1 U
NAPHTHALENE	14	0.2 J	0.6	0.1 U	0.6	1	0.5	0.3 J	8
PHENANTHRENE	210	0.2 J	0.05 U	0.05 U	2	0.6	0.5	0.05 UJ	2
PYRENE	210	0.06 UJ	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 UJ	0.07 U
Petroleum Hydrocarbons (ug/L)									
TPH (C08-C40)	5000	3800	8700 J [G]	210 U	2800	11000 [G]	20000 [G]	17000 [G]	7100 [G]

APPENDIX C

AREAS AND VOLUMES OF CONTAMINATED MEDIA

TABLE C-1
SWMU 6 and 7 - CONTAMINATED GROUNDWATER[1]
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

Locations	Porosity[2]	Plume Thickness (feet)	Calculated Area (feet[2])	Volume (gallons)
SWMU 6 and 7	0.3	15	200100	6,735,366
TOTALS			**200,100**	**6,735,366**

Notes:
[1] Refer to Figure C-1 for additional information regarding the impacted groundwater area.
[2] Porosity values used in calculating the volume(s) of contaminated groundwater were taken from

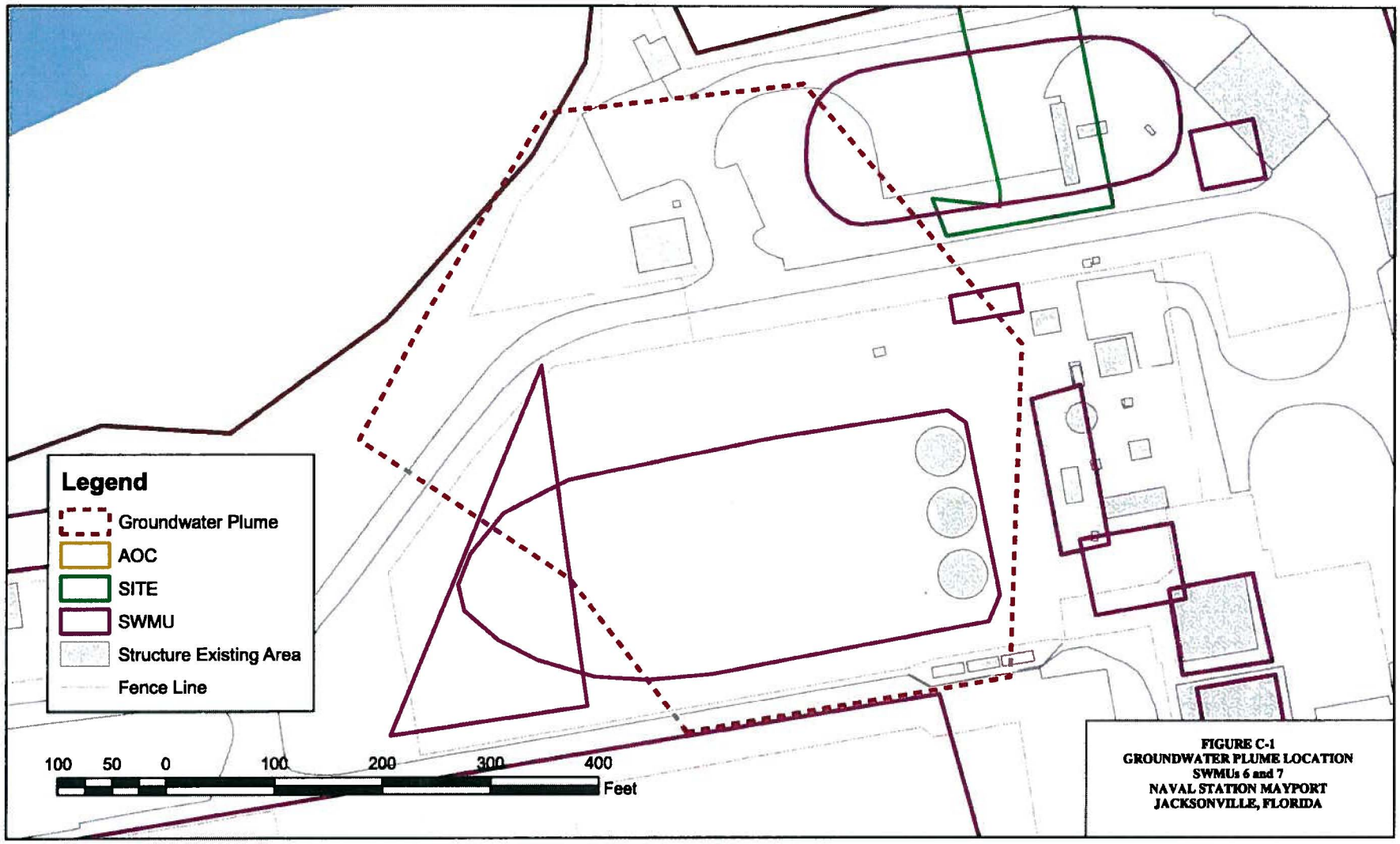

FIGURE C-1
GROUNDWATER PLUME LOCATION
SWMUs 6 and 7
NAVAL STATION MAYPORT
JACKSONVILLE, FLORIDA

This graphic was generated using the TINUS EGIS module.

APPENDIX D

ORC INJECTION CALCULATIONS

ORC *Advanced* Design Software for Grid Applications Using Slurry Injection

August 2004

Regenesis Technical Support: USA (949) 366-8000 www.regenesis.com

Site Name: SWMU 6 and 7
Location: Naval Station Mayport
Consultant: Tetra Tech NUS, Inc.

Estimated Plume Requiring Treatment

Width of plume (intersecting gw flow direction)	250	ft		
Length of plume (parallel to gw flow direction)	250	ft	62,500	ft^2
Depth to contaminated zone	10	ft		
Thickness of contaminated saturated zone	15	ft		
Nominal aquifer soil (gravel, sand, silty sand, silt, clay)	sand			
Total porosity	0.3	Effective porosity:	0.3	
Hydraulic conductivity	25	ft/day	8.8E-03	cm/sec
Hydraulic gradient	0.005	ft/ft		
Seepage velocity	152.1	ft/yr	0.417	ft/day
Treatment Zone Pore Volume	281,250	ft^3	2,104,031	gallons

Dissolved Phase Oxygen Demand: Individual species that represent oxygen demand:	Contaminant Conc. (mg/L)	Contaminant Mass (lb)	Stoichiometry (wt/wt) O_2/contaminant	ORC-Adv Dose (lb)
Benzene	0.00	0.0	3.1	0
Toluene	0.00	0.0	3.1	0
Ethylbenzene	0.00	0.0	3.2	0
Xylenes	0.00	0.0	3.2	0
MTBE	0.00	0.0	2.7	0
cis-1,2-DCE	0.00	0.0	0.7	0
Vinyl Chloride	0.00	0.0	1.3	0
User added, add stoich. demand and Koc (see pull-down)	0.00	0.0	0.0	0
User added, add stoich. demand and Koc (see pull-down)	0.00	0.0	0.0	0
Reduced metals: Fe^{+2} and Mn^{+2}	10.00	175.4	0.1	104
TPH-g	<- pull-down menu			
Measures of total oxygen demand				
Total Petroleum Hydrocarbons (see pull-down for Koc)	14.00	245.6	3.1	4492
Biological Oxygen Demand (BOD)	30.00	526.3	1.0	3105
Chemical Oxygen Demand (COD)	60.00	1,052.6	1.0	6211

Parameters for Sorbed Phase Oxygen Demand:

Soil bulk density	1.76	g/cm^3 =	110	lb/cf
Fraction of organic carbon (foc)	0.002	range: 0.0001 to 0.01		

(Estimated using sorbed phase = foc*Koc*Cgw) (Adjust Koc as necessary to provide realistic estimates)	Koc (L/kg)	Contaminant Conc. (mg/kg)	Contaminant Mass (lb)	Stoichiometry (wt/wt) O_2/contaminant	ORC-Adv Dose (lb)
Benzene	0	0.00	0.0	3.1	0
Toluene	0	0.00	0.0	3.1	0
Ethylbenzene	0	0.00	0.0	3.2	0
Xylenes	0	0.00	0.0	3.2	0
MTBE	0	0.00	0.0	2.7	0
cis-1,2-DCE	0	0.00	0.0	0.7	0
Vinyl Chloride	0.0	0.00	0.0	1.3	0
User added, add stoich. demand and Koc (see pull-down)	0.0	0.00	0.0	0.0	0
User added, add stoich. demand and Koc (see pull-down)	0.0	0.00	0.0	0.0	0
Measures of total oxygen demand					
Total Petroleum Hydrocarbons	373	10.44	1,075.8	3.1	19676

Summary of Estimated ORC-Adv Requirements	Dissolved Phase ORC-Adv Demand (lbs)	Sorbed Phase ORC-Adv Demand (lbs)	Additional Demand Factor (1 to 10x)	Total ORC-Adv Demand (lbs)	ORC-Adv Cost
Total BTEX, MTBE, etc.	104	0	5.0	518	$4,699
Total Petroleum Hydrocarbons	4,492	19,676	2.0	48,337	$386,800 <-
Biological Oxygen Demand (BOD)	3,105	3,105	2.0	12,421	$99,400
Chemical Oxygen Demand (COD)	6,211	6,211	1.5	18,632	$149,200

Required ORC-Adv quantity (in 25 lb increments) ----------> 48,350 pounds ORC-Adv

Delivery Design for ORC-Adv Slurry

Spacing within rows (ft)	15.0	feet
# points per row	17	points/row
Spacing between rows (ft)	15.0	ft
# of rows	17	rows
Advective travel time bet. rows (days)	36	days
Number of points in grid	289	points
ORC-Adv application rate	11.2	lbs/foot
Total ORC-Adv required	48,350	lbs of ORC-Adv

Slurry Mixing Volume for Injections

Pounds per location	167	pounds
Buckets per location	6.7	buckets
Design solids content (20-40% by wt. for injections)	30%	
Volume of water required per hole (gal)	47	gallons
Total water for mixing all holes (gal)	13527	gallons
Simple ORC-Adv Backfilling: min hole dia. for 67% slurry	5.5	inches
Feasibility for slurry injection in sand: ok up to 15 lb/ft	(ok)	
Feasibility for slurry injection in silt: ok up to 10 lb/ft	(call Regenesis)	
Feasibility for slurry injection in clay: ok up to 10 lb/ft	(call Regenesis)	

Project Summary		
Number of ORC-Adv delivery points (adjust as necessary for site)		289
ORC-Adv application rate in lbs/ft (adjust as necessary for site)		11.2
ORC-Adv bulk material for slurry injection (lbs)		48,350
Number of 25 lb ORC-Adv buckets		1934.0
ORC-Adv bulk material cost	$	8.00
Cost for bulk ORC-Adv material	$	386,800
Shipping and Tax Estimates in US Dollars		
Sales Tax rate: 0.00%	$	-
Total Material Cost	$	386,800
Shipping (call for amount)	$	-
Total Regenesis Material Cost	$	386,800

ORC-Adv Slurry Injection Cost Estimate (responsibility of customer to contract work)		
Footage for each point = uncontaminated interval + ORC-Adv injection interval (ft)		25
Total length for direct push for project (ft)		7,225
Estimated daily installation rate (ft per day: 300 for push, 150 for drilling)		300
Estimated points per day (10 to 30 is typical for direct push)		12.0
Required number of days		25
Mob/demob cost for injection subcontractor	$	400
Daily rate for injection subcontractor ($1-2K for push, $3-4K for drill rig)	$	1,500
Total injection subcontrator cost for application	$	37,900
Total Install Cost (not including consultant, lab, etc.)	$	424,700

Other Project Cost Estimates		
Design	$	-
Permitting and reporting	$	-
Construction management	$	-
Groundwater monitoring and rpts	$	-
Other	$	-
Other	$	-
Other	$	-
Other	$	-
Total Project Cost	$	424,700

APPENDIX E

COST ESTIMATES

Naval Station (NAVSTA), Mayport
Jacksonville, Florida
SWMU 6 and 7
GROUNDWATER ALTERNATIVE 2: LAND USE CONTROLS AND MONITORING
CAPITAL COSTS

Table E-1

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare LUC RD Documents	300	hr			$35.00		$0	$0	$10,500	$0	$10,500
Subtotal							$0	$0	$10,500	$0	$10,500
Local Area Adjustments							100.0%	113.5%	87.3%	87.3%	
							$0	$0	$9,167	$0	$9,167
Overhead on Labor Cost @ 30%									$2,750		$2,750
G & A on Labor Cost @ 10%									$917		$917
G & A on Material Cost @ 10%								$0			$0
G & A on Equipment Cost @ 10%										$0	$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment Cost @ 6%								$0		$0	$0
Total Direct Cost							$0	$0	$12,833	$0	$12,833
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$1,283
Subtotal											$14,116
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$14,116
Contingency on Total Field Costs @ 10%											$1,412
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$15,528**

Naval Station (NAVSTA), Mayport
Jacksonville, Florida
SWMU 6 and 7
GROUNDWATER ALTERNATIVE 2: LAND USE CONTROLS AND MONITORING
ANNUAL OPERATION AND MAINTENANCE COSTS

Table E-8

Item	Item Cost year 1	Item Cost years 2 & 3	Item Cost years 4 & 5	Item Cost year 6 to 30	Item Cost every 5 years	Notes
Site Inspection: Visit	$1,860	$1,860	$1,860	$1,860		One-day visit to verify LUC RD
Site Inspection: Report	$800	$800	$800	$800		
Sampling	$24,000	$12,000	$6,000	$6,000		Labor and supplies to collect samples from wells using a crew of two.
Analysis/Water	$20,000	$10,000	$5,000	$5,000		Analyze groundwater samples from 8 wells for VOCs, PAHs, & TRPH in years 1 through 30. Collect samples 4 times a year in year 1, twice a year in years 2 & 3, and once a year for years 4 through 30.
Analysis/Water	$18,400	$9,200	$4,600			Analyze groundwater samples from 8 wells for natural attenuation parameters in years 1 through 5. Collect samples 4 times a year in year 1, twice a year in years 2 & 3, and once a year for years 4 & 5.
Report	$6,000	$3,000	$1,500	$1,500		Document sampling events and results
Site Review					$17,000	Five Year Site Reviews
Subtotal	$71,060	$36,860	$19,760	$15,160	$17,000	
Contingency @ 10%	$7,106	$3,686	$1,976	$1,516	$1,700	
TOTAL	**$78,166**	**$40,546**	**$21,736**	**$16,676**	**$18,700**	

Naval Station (NAVSTA), Mayport
Jacksonville, Florida
SWMU 6 and 7
GROUNDWATER ALTERNATIVE 2: LAND USE CONTROLS AND MONITORING
Present Worth Analysis

Table E-3

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$15,528		$15,528	1.000	$15,528
1		$78,166	$78,166	0.935	$73,085
2		$40,546	$40,546	0.873	$35,397
3		$40,546	$40,546	0.816	$33,086
4		$21,736	$21,736	0.763	$16,585
5		$40,436	$40,436	0.713	$28,831
6		$16,676	$16,676	0.666	$11,106
7		$16,676	$16,676	0.623	$10,389
8		$16,676	$16,676	0.582	$9,705
9		$16,676	$16,676	0.544	$9,072
10		$35,376	$35,376	0.508	$17,971
11		$16,676	$16,676	0.475	$7,921
12		$16,676	$16,676	0.444	$7,404
13		$16,676	$16,676	0.415	$6,921
14		$16,676	$16,676	0.388	$6,470
15		$35,376	$35,376	0.362	$12,806
16		$16,676	$16,676	0.339	$5,653
17		$16,676	$16,676	0.317	$5,286
18		$16,676	$16,676	0.296	$4,936
19		$16,676	$16,676	0.277	$4,619
20		$35,376	$35,376	0.258	$9,127
21		$16,676	$16,676	0.242	$4,036
22		$16,676	$16,676	0.226	$3,769
23		$16,676	$16,676	0.211	$3,519
24		$16,676	$16,676	0.197	$3,285
25		$35,376	$35,376	0.184	$6,509
26		$16,676	$16,676	0.172	$2,868
27		$16,676	$16,676	0.161	$2,685
28		$16,676	$16,676	0.15	$2,501
29		$16,676	$16,676	0.141	$2,351
30		$35,376	$35,376	0.131	$4,634
				TOTAL PRESENT WORTH	**$368,056**

Naval Station (NAVSTA), Mayport
Jacksonville, Florida
SWMU 6 and 7
GROUNDWATER ALTERNATIVE 3: IN-SITU BIOREMEDIATION, LAND USE CONTROLS AND MONITORING
CAPITAL COSTS

Table E-4

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost
1 PROJECT DOCUMENTS/INSTITUTIONAL CONTROLS											
1.1 Prepare Documents & Plans including Permits	200	hr			$40.00		$0	$0	$8,000	$0	$8,000
1.2 Prepare Corrective Measures Implementation Plan	200	hr			$40.00		$0	$0	$8,000	$0	$8,000
1.3 ODCs (copying, shipping, telephone, etc.)	1	ls		$2,000.00			$0	$2,000	$0	$0	$2,000
2 MOBILIZATION/DEMOBILIZATION AND FIELD SUPPORT											
2.1 Drill Rig Mobilization/Demobilization	1	ls	$2,000.00				$2,000	$0	$0	$0	$2,000
2.2 Professional Oversight (2p * 5 days/week)	10	wk			$1,600.00		$0	$0	$16,000	$0	$16,000
3 DECONTAMINATION											
3.1 Decontamination Services	1	ls		$500.00			$0	$500	$0	$0	$500
3.2 Disposal of Decon Waste (liquid & solid)	1	mo	$900.00				$900	$0	$0	$0	$900
4 BIOREMEDIATION											
4.1 DPT Injection Services	53	day	$1,500.00				$79,500	$0	$0	$0	$79,500
4.2 ORC	48,350	lb		$8.00			$0	$386,800	$0	$0	$386,800
5 SITE RESTORATION											
5.1 Vegetate Disturbed Areas	1	ls		$1,000.00	$2,000.00	$500.00	$0	$1,000	$2,000	$500	$3,500
Subtotal							$82,400	$390,300	$34,000	$500	$507,200
Local Area Adjustments							100.0%	100.3%	81.0%	81.0%	
Subtotal							$82,400	$391,471	$27,540	$405	$501,816
Overhead on Labor Cost @ 98%									$26,970		$26,970
G & A on Labor Cost @ 10%									$2,771		$2,771
G & A on Material Cost @ 10%								$39,773			$39,773
G & A on Equipment Cost @ 10%										$41	$41
G & A on Subcontract Cost @ 2%							$1,318				$1,318
Total Direct Cost							$83,718	$431,244	$57,280	$446	$572,689
Indirects on Total Direct Cost @ 30%											$171,807
Profit on Total Direct Cost @ 10%											$57,269
Subtotal											$801,765
Health & Safety Monitoring @ 3%											$24,053
Total Field Cost											$825,818
Contingency on Total Field Cost @ 20%											$165,164
Engineering on Total Field Cost @ 10%											$83,903
TOTAL COST											**$1,074,885**