

Final

Site Management Plan

**Naval Air Station Oceana
Virginia Beach, Virginia**

Contract Task Order WE44

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Contents

Acronyms and Abbreviations	v
1 Introduction	1-1
2 NAS Oceana Description and Environmental History	2-1
2.1 NAS Oceana Description.....	2-1
2.2 NAS Oceana—Dam Neck Annex Description.....	2-1
2.3 NAS Oceana—NALF Fentress Description	2-1
2.4 NAS Oceana – Other than Operational Range Descriptions.....	2-1
2.5 Oceana Salvage Yard Access Road and Surrounding Property Description	2-2
2.6 Installation Restoration Investigations and Regulatory History.....	2-2
2.6.1 Initial Installation Restoration Program Investigations	2-2
2.6.2 RCRA Corrective Action Process	2-3
2.6.3 CERCLA Process.....	2-4
2.7 Munitions Response Program Investigations	2-6
2.8 PRP Site Investigations.....	2-6
3 Solid Waste Management Units	3-1
3.1 SWMU 2B—Line Shacks 130-135	3-1
3.2 SWMU 2C—Line Shack 400	3-2
3.3 SWMU 2E—Line Shack 109	3-3
4 Munitions Response Program Sites	4-1
4.1 NAS Oceana MRP Sites	4-1
4.1.1 Machine Gun Boresight Range	4-1
4.2 NALF Fentress MRP Sites	4-1
4.2.1 Machine Gun Boresight Range	4-1
4.2.2 Dive Bombing Targets.....	4-2
4.3 Dam Neck Annex MRP Sites.....	4-2
4.3.1 Skeet and Trap Range	4-2
4.3.2 Moving Target/Mortar Range (South).....	4-3
4.3.3 Mortar Impact Area	4-3
4.4 OTO MRP Sites.....	4-4
4.4.1 Tangier Island Target Site	4-4
4.4.2 North Landing River Target Site.....	4-4
4.4.3 Northern Currituck Sound Target.....	4-5
4.4.4 Palmetto Point Bombing Range.....	4-5
5 Potentially Responsible Party Sites	5-1
5.1 Oceana Salvage Yard Access Road and Burial Unit.....	5-1
6 Management Schedules for Active Sites and SWMUs	6-1
7 References	7-1

Tables

- 3-1 Current Status Summary of Environmental Restoration Program SWMUs
- 4-1 Current Status Summary of Munitions Response Program Sites

Figures

- 2-1 Base and Site Map
- 3-1 NAS Oceana Site Location Map
- 3-2 SWMU 2B Layout
- 3-3 SWMU 2C Layout
- 3-4 SWMU 2E Layout
- 4-1 NALF Fentress Site Location Map
- 4-2 Dam Neck Annex Site Location Map
- 4-3 NAS Oceana Machine Gun Boresight Range Layout
- 4-4 NALF Fentress Machine Gun Boresight Range Layout
- 4-5 NALF Dive Bombing Targets Layout
- 4-6 Dam Neck Skeet and Trap Range Layout
- 4-7 Dam Neck Moving Target/Mortar Range (South) and Mortar Impact Area Layout
- 4-8 OTO Tangier Island Target Site Layout
- 4-9 OTO NLRT and NCST Site Layout
- 4-10 OTO PPBR Layout
- 5-1 Oceana Salvage Yard Access Road and Burial Unit Layout
- 6-1 Schedule for SWMUs 2B, 2C, and 2E
- 6-2 Schedule for MRP Sites

Acronyms and Abbreviations

BERA	Baseline Ecological Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
COC	constituent of concern
COPC	chemical of potential concern
DBT	dive bombing target
DD	Decision Document
DGM	digital geophysical mapping
DPT	direct push technology
EE/CA	Engineering Evaluation/Cost Analysis
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FS	Feasibility Study
FY	Fiscal Year
HHRA	Human Health Risk Assessment
HHRS	Human Health Risk Screening
IAS	Initial Assessment Study
IC	institutional control
IRP	Installation Restoration Program
LTM	long-term monitoring
LUC	land use control
µg/L	micrograms per liter
MATWING	Medium Attack Wing
MC	munitions constituent
MCL	maximum contaminant level
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
MIA	Mortar Impact Area
MIP	Membrane Interface Probe
mm	millimeter
MNA	monitored natural attenuation
MRP	Munitions Response Program
MTMR	Moving Target/Mortar Range
mV	millivolt
NALF	Naval Auxiliary Landing Field
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NCST	Northern Currituck Sound Target
NEESA	Naval Energy and Environmental Support Activity
NERP	Navy Environmental Restoration Program
NFA	No Further Action
NLRT	North Landing River Target

ORC	Oxygen Release Compound
OTO	other than operational
PA	Preliminary Assessment
PAH	polynuclear aromatic hydrocarbon
PMT	Project Management Team
POL	petroleum, oil, and lubricant
PPBR	Palmetto Point Bombing Range
PRP	Potentially Responsible Party
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RPM	Remedial Project Manager
SERA	Screening Ecological Risk Assessment
SI	Site Investigation
SMP	Site Management Plan
SVOC	semivolatile organic compound
SWMU	solid waste management unit
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UXO	unexploded ordinance
VC	vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound

SECTION 1

Introduction

This document presents the Fiscal Years (FYs) 2013 through 2017 Site Management Plan (SMP) for Naval Air Station (NAS) Oceana, Virginia Beach, Virginia. The purpose of the SMP is to provide a management tool for Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, the United States Environmental Protection Agency (USEPA), Virginia Department of Environmental Quality (VDEQ), and activity personnel to be used in planning, scheduling, and determining the future of the NAS Oceana solid waste management units (SWMUs), Munitions Response Program (MRP) sites, and Potentially Responsible Party (PRP) sites. The SMP provides long-term projections for these sites in accordance with the Navy Environmental Restoration Program (NERP) and focuses on upcoming activities that are planned for FY 2014.

The SMP presents the rationale for all ongoing environmental investigations and the estimated schedule for completion of these activities for each active SWMU or site. Detailed activity schedules are provided for FY 2014.

Previous SWMU investigations have been conducted under provisions of the Resource Conservation and Recovery Act (RCRA) Corrective Action Program. As of July 1998, cleanup activities have been accomplished under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) via a Consent Order. MRP and PRP sites are managed under their own programs, with state oversight only, but are included in this document for the purpose of completeness.

The SMP is intended to be a working document that is updated regularly to maintain current documentation and summaries of environmental actions at NAS Oceana. This SMP updates and supersedes all previous SMPs. Detailed information is provided for active SMWUs and sites located at NAS Oceana and its associated range areas and annexes. For SWMUs which have already been closed out via a No Further Action (NFA) Decision Document (DD), only summary information is included.

NAS Oceana Description and Environmental History

2.1 NAS Oceana Description

NAS Oceana (**Figure 2-1**) was established in 1940 as a small auxiliary airfield. Since 1940, NAS Oceana has grown to more than 16 times its original size and is now a 6,000-acre Master Jet Base supporting a community of more than 9,700 Navy personnel and 12,300 dependents. The primary mission of NAS Oceana is to provide personnel, operations, maintenance, and training facilities to ensure that fighter and attack squadrons on aircraft carriers of the United States Atlantic Fleet are ready for deployment.

2.2 NAS Oceana—Dam Neck Annex Description

Dam Neck Annex (**Figure 2-1**) is located approximately 5 miles southeast of NAS Oceana, in Virginia Beach, and covers approximately 1,400 acres. Dam Neck Annex was established in 1941 as an anti-aircraft gunnery range to train fleet personnel in the operation of 20- and 40-millimeter (mm) anti-aircraft guns. The current mission of this installation is to provide force-level engineering solutions, mission-critical and associated testing, and training technologies for the maritime, joint, special warfare, and information operations domains (Malcolm Pirnie, 2008).

2.3 NAS Oceana—NALF Fentress Description

Naval Auxiliary Landing Field (NALF) Fentress (**Figure 2-1**) is located in Chesapeake, Virginia, approximately 7 miles southwest of NAS Oceana. Established in 1940, the installation encompasses just over 2,500 acres and approximately 8,700 acres in restrictive easements. The facility is primarily used by squadrons stationed at NAS Oceana or Naval Station Norfolk Chambers Field for field carrier landing practice operations (Malcolm Pirnie, 2008).

2.4 NAS Oceana – Other than Operational Range Descriptions

Four other-than-operational (OTO) water ranges have been utilized as targets by naval aircraft.

Tangier Island Target Site (**Figure 2-1**) is located approximately 2,800 yards west of Tangier Island in the Chesapeake Bay and approximately 65 miles north of Norfolk, Virginia. The site consists of two scuttled cargo ships used as surface targets for aerial bombardment and rocketry training from approximately 1970 until 1996.

North Landing River Target (NLRT) Site (**Figure 2-1**) is located approximately 20 miles south of NAS Oceana and consists of one “hard target.” The target area is located near the mouth of the North Landing River in the Currituck Sound. The site was used for day and night dive bombing by naval aircraft from the mid-1950s until the mid-1960s.

Northern Currituck Sound Target (NCST) Site (**Figure 2-1**) is located approximately 25 miles south of NAS Oceana in the northern portion of the Currituck Sound, with the Atlantic Intracoastal Waterway immediately to the west. The site consists of one hard target according to nautical charts and 33 Code of Federal Regulations (CFR) 334.410, although no visual signs of the target still remain. Similar to the NLRT site, the NCST site was used for day and night dive bombing by naval aircraft from the mid-1950s until the mid-1960s.

Palmetto Point Bombing Range (PPBR) Site (**Figure 2-1**) is located off the south shore of Albemarle Sound in North Carolina and is approximately 55 miles south of NAS Oceana. The PPBR Site is believed to have contained approximately six hard targets. The site was used for basic loft bombing and high-altitude dive bombing from approximately 1957 until mid-1998. The targets were also used for pilot training to test skills and develop proficiency.

2.5 Oceana Salvage Yard Access Road and Surrounding Property Description

The Oceana Salvage Yard is a privately-owned business located to the east of NAS Oceana, across Oceana Boulevard. Ingress and egress to the site is possible only through use of an access road located on NAS Oceana property. Disposal of Salvage Yard and other miscellaneous waste has occurred on Navy property alongside and beneath the road; therefore, the site is considered a PRP site and the Navy is considered a PRP.

2.6 Installation Restoration Investigations and Regulatory History

2.6.1 Initial Installation Restoration Program Investigations

Prior to state and federal environmental regulatory involvement at NAS Oceana, the Navy investigated the base to identify and correct problems related to possible environmental contamination caused by operations at the facility. Three investigations were conducted: the Initial Assessment Study (Rogers, Golden, & Halpern, 1984), the Final Round 1 Verification Study (CH2M HILL, 1986), and the Line Shack Inspection Study (CH2M HILL, 1989). These investigations are discussed briefly in the following sections. Detailed results of the investigations that specifically pertain to active NAS Oceana Installation Restoration sites are included in Section 3 of this document.

Initial Assessment Study (1984)

In order to identify and assess sites posing a potential threat to human health or to the environment due to contamination from past operations, the Naval Energy and Environmental Support Activity (NEESA) conducted an IAS at NAS Oceana and Fentress Field in 1984 (Rogers et al., 1984). Information from historical records, aerial photographs, field inspections, and personnel interviews was collected and evaluated. A total of 16 potentially contaminated sites were identified at NAS Oceana. Each of these 16 sites was evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors. Following this evaluation, six of the 16 sites were recommended for field investigation to evaluate the presence or absence and extent of contamination at the sites. These sites comprised:

- Site 1, West Woods Oil Disposal Area
- Site 2, Line Shack Oil Disposal Areas
- Site 5, Old Static Engine Test Cell Mercury Spill
- Site 7, Fifth Green Landfill
- Site 8, North Station Landfill
- Site 14, Fentress Landfill

Round 1 Verification Step (1986)

Consistent with the recommendations included in the IAS, a Round 1 Verification Step was conducted in 1986 (CH2M HILL, 1986) to further evaluate Sites 1, 2, 5, 7, 8, and 14. Due to the presence of metals and organics in media from these sites, additional investigation was recommended for all sites included in this study.

Line Shack Inspection Study (1988)

As a result of the IAS and Round 1 Verification Step, additional investigation of Site 2 was conducted. Specifically, two areas of Site 2 designated as Site 2B and Site 2C were subjected to additional soil and groundwater sampling as part of the Line Shack Inspection Study (CH2M HILL, 1989). The results indicated that chemical concentrations in soils were not indicative of hazardous waste and did not warrant immediate action at either site. Volatile organic compounds (VOCs) were detected in groundwater at Sites 2B and 2C. Therefore, further investigations were recommended to evaluate potential risks to human health and the environment.

2.6.2 RCRA Corrective Action Process

RCRA Facility Assessment

Application of RCRA corrective action began in June 1988, when USEPA contractors conducted a RCRA Facility Assessment (RFA) of the base (USEPA, 1988). The RFA redesignated existing sites as SWMUs, and used a different numbering strategy than used in previous investigations. In later documents, however, the original site designators were used to label SWMUs; for example, “Site 1” from the IAS was referred to as “SWMU 1,” and so forth, in the Corrective Measures Study (CMS), even though the RFA referred to this SWMU as “SWMU 57.” Several additional SWMUs were also identified and reviewed during the RFA.

Interim RCRA Facility Investigation

According to the RCRA protocol, a RCRA Facility Investigation (RFI) should follow the RFA when known or potential contamination warrants further study. Prior to the initiation of a full scale RFI, CH2M HILL conducted an Interim RFI in August 1990 to guide the RFI’s scope of work (CH2M HILL, 1991). Ten total SWMUs were investigated. The Interim RFI recommended further investigation of SWMUs 1, 2B, 2C, 2E, 2D, and 11. No further investigation was recommended for SWMUs 2A, 6, 7, and 8.

Phase I RFI Investigation

The first phase of the RFI was conducted in 1992 and 1993 (CH2M HILL, 1993). Seventeen SWMUs were investigated including the six recommended for further study in the Interim RFI. As a result of this investigation, SWMUs were classified into four categories:

- SWMUs that could advance to a CMS (SWMUs 1, 2B, and 2C)
- SWMUs that required additional characterization under a second phase of the RFI (SWMUs 2D, 2E, 15, 24, and 25)
- SWMUs where contamination could be remediated immediately on the basis of existing data (SWMUs 11, 18, 19, and 20)
- SWMUs requiring no additional study or remediation (SWMUs 16/16GC, 21, 22, 23, and 26).

The SWMUs were divided into separate study tracks on the basis of these recommendations.

Phase II RFI Investigation

In early 1994 a Phase II RFI was conducted on five SWMUs (SWMUs 2D, 2E, 15, 24, and 25) that the Phase I RFI identified as requiring additional characterization. The Phase II RFI advised NFA at SWMUs 2D and 25, but recommended CMSs at SWMUs 2E, 15, and 24 to address remediation options for free-phase petroleum and dissolved-phase groundwater contamination. The investigation is fully documented in the Phase II RFI Report (CH2M HILL, 1995a).

Petroleum, Oil, and Lubricant Corrective Measures Study

A CMS was conducted for SWMUs contaminated with petroleum, oil, and lubricant (POL) wastes (SWMUs 11, 18, 19, 20, and 24) in soils. The CMS for Petroleum Contaminated Soils Report (CH2M HILL, 1994) and the Excavation, Transportation, and Disposal of Petroleum Contaminated Soils Report (CH2M HILL, 1995b) describe the sampling conducted to delineate specific areas of contamination and the interim cleanup action to address these areas of contaminated soils.

Corrective Measures Studies

Two CMSs were completed at NAS Oceana between 1994 and 1995. The first CMS investigation was performed for SWMUs 1, 2B, and 2C. Field activities were conducted during the investigation in order to determine the extent of soil contamination and refine the selection of remediation approaches. Based on these activities and an evaluation of remediation alternatives, the CMS recommended free-product removal using skimmers for SWMU 1

and groundwater containment and air stripping for SWMUs 2B and 2C. The results of this investigation are further described in the CMS Report for SWMUs 1, 2B, and 2C (CH2M HILL, 1995c).

As a follow-up to the Phase II RFI, a CMS was conducted in the fall of 1994 to evaluate contamination at SWMUs 2E, 15, and 24. After evaluation of remediation alternatives, the CMS recommended plume containment and source-area remediation for the groundwater of SWMUs 2E and 24, excavation and onsite composting for the soil of SWMU 15, and natural attenuation for the groundwater of SWMU 15. The CMS investigation is documented in CMS Report for SWMUs 2E, 15, and 24 (CH2M HILL, 1996).

Phase III RFI

The USEPA issued comments on the Phase I RFI, Phase II RFI, the POL CMS, and the Excavation, Transportation, and Disposal of Petroleum Contaminated Soils Report in the fall of 1997. Based on these comments, it was determined that additional data were needed at some of the SWMUs in order to determine an appropriate path forward. These additional data were collected during the 1997 Phase III RFI field investigation (CH2M HILL, 1999a). SWMUs investigated included 1, 2B, 2C, 2D, 18, 21, 24, 25, and 26.

A draft-final report was submitted to the USEPA for review and comment in July 1998, but due to regulatory comments on the draft-final report, additional fieldwork was required. Based on additional samples collected, the Final Phase III RFI recommended NFA to address soils at all SWMUs included in the study. It was also recommended that quantitative Human Health Risk Assessments (HHRAs) be performed for groundwater at SWMUs 1, 2B, 2C, and 24. No quantitative HHRAs were recommended for the other SWMUs because there were no constituents detected at concentrations exceeding risk screening values. Additional quantitative Ecological Risk Assessments (ERAs) were recommended for SWMUs 1, 21, 25, and 26.

2.6.3 CERCLA Process

In 1998, it was determined that management of NAS Oceana SWMUs would be conducted following the CERCLA process. There is no Federal Facilities Agreement (FFA) for Oceana. However, following this team agreement, all investigations and documents have been completed in accordance with CERCLA.

Ecological Risk Assessments

In accordance with the recommendations in the Phase III RFI, ERAs were proposed for SWMUs 1, 21, 25, and 26. Ecological site conceptual models were recommended for SWMUs 2B, 2C, 2D, 18, and 24. SWMUs 11, 16/16GC, 19, 20, 21, 22, 23, 25, and 26 were recommended for NFA in previous documents; however, these recommendations were based on Human Health Risk Screening (HHRS) only. In order to ensure that risks to ecological receptors were adequately addressed, the NAS Oceana Project Management Team (PMT) decided to further evaluate ecological concerns at all NAS Oceana SWMUs using the ERA process under CERCLA.

The Navy prepared a Screening Ecological Risk Assessment (SERA) for SWMUs 2C, 2D, 2E, 18, 19, 20, 23, and 24 in October 1999 (CH2M HILL, 1999b). The report proposed NFA for ecological concerns at these eight SWMUs based on the lack of complete exposure pathways.

Screening and the initial step of the Baseline Ecological Risk Assessment (BERA) were finalized for SWMUs 2B, 11, 16, 16GC, 21, 22, and 26 in August 2001 (CH2M HILL, 2001a). The risk assessment recommended no further remedial action or investigation to address ecological concerns at SWMUs 11, 16, 16GC, 22, and 26. It did, however, identify that additional evaluation was necessary to address ecological concerns when evaluating remedial alternatives for SWMU 2B in a Feasibility Study (FS).

A BERA for SWMUs 1 and 15 was completed in June 2001 (CH2M HILL, 2001b) and recommended no further study to address ecological risk at these SWMUs.

A separate SERA was completed for SWMU 25 in December of 2001 (CH2M HILL, 2001c). Risks associated with metals and one pesticide were identified based on concentrations in one sediment sample. However, the risks were minimal and it could not be determined whether they were associated with the SWMU. Therefore, NFA was recommended for SWMU 25.

Human Health Risk Assessments

Soil and groundwater analytical results from samples collected during the various phases of the RFI, CMS, and groundwater investigation activities were used in support of two HHRAs, one conducted in 2001 at SWMUs 1, 15, and 24, and the other in 2002 at SWMUs 2B, 2C, and 2E. At SWMU 24, concentrations of organics did not exceed the corresponding maximum contaminant level (MCL) values in any of the samples that were collected. Therefore, the alternative proposed in the 2001 FS (institutional controls [ICs] with long-term monitoring [LTM]) was deemed no longer necessary to address organics at SWMU 24. However, arsenic concentrations remained above the MCL in samples collected at SWMU 24 during the 2004 groundwater monitoring. Unacceptable risks associated with exposure to groundwater were identified for all other SWMUs evaluated. Detailed information regarding the HHRAs for SWMUs 2B, 2C, and 2E is provided in Section 3.

Feasibility Studies

An FS Report was completed for SWMUs 1, 15, and 24 in 2001. Based on conclusions made in the 2001 FS and follow-up investigations supporting the FS, NFA was recommended at SWMU 1. ICs and LTM were recommended in the 2001 FS for SWMU 24. A separate FS was completed for SWMUs 2B, 2C, and 2E in 2002. Details of the 2002 FS are provided in Section 3.

SWMU 24 Arsenic Technical Memorandum

A statistical evaluation of arsenic in groundwater was completed to support an NFA determination at SWMU 24. Following guidelines for making risk management decisions developed by the Navy, USEPA, and VDEQ Remedial Project Managers (RPMs)/supervisors, the NAS Oceana partnering team determined no action is warranted to address arsenic in groundwater at SWMU 24.

SWMU 15 POL Transfer

Although human health risks associated with future potable use of groundwater were identified at SWMU 15, constituents posing risk were determined to be associated with the POL constituents present at the site. Consequently, it was determined that future actions at the SWMU could be conducted under the VDEQ POL-Underground Storage Tank (UST) Program.

SWMU 1 POL Transfer

The September 2008 DD concluded that NFA under CERCLA was necessary at SWMU 1. However, free product was found in the water table at SWMU 1, thus regulation of this site was transferred to the VDEQ POL- UST Program.

NFA Decision Documents

Based on the recommendations of previous investigations summarized above, the Navy has completed site closure for 15 of the 18 NAS Oceana Installation Restoration Program (IRP) SWMUs under the following NFA DDs:

- *Final Decision Document SWMUs 2D, 18, 19, 20, and 23, NAS Oceana, Virginia Beach, Virginia* (CH2M HILL, 2001d)
- *Final Decision Document SWMUs 11, 16, 16GC, 21, 22, and 26, NAS Oceana, Virginia Beach, Virginia* (CH2M HILL, 2001e)
- *Final Decision Document, SWMU 15, NAS Oceana, Virginia Beach, Virginia* (CH2M HILL, 2003a)
- *Final Decision Document, SWMU 25, NAS Oceana, Virginia Beach, Virginia.* (CH2M HILL, 2003b)
- *Final Decision Document, SWMUs 1 and 24, NAS Oceana, Virginia Beach, Virginia.* (CH2M HILL, 2008a)

SWMU 25 Ditch Scraping

The no action DD for SWMU 25 was signed in 2003 with the understanding that the sediments in a ditch at the SWMU would be removed during a concrete recycling project scheduled for 2004 (CH2M HILL, 2003c). However,

funding was not available for the project at that time. In order to fulfill the no action determination agreement by NAS Oceana PMT, the Navy excavated 6 inches of sediment from the ditch in May of 2004 (CH2M HILL, 2004a).

2.7 Munitions Response Program Investigations

Ranges associated with NAS Oceana and its surrounding annexes were first evaluated as part of Preliminary Assessments (PA) conducted by Malcolm Pirnie in 2008 and 2009. The PAs evaluated the history of munitions use at the base and its annexes and recommended additional investigation for the sites listed below:

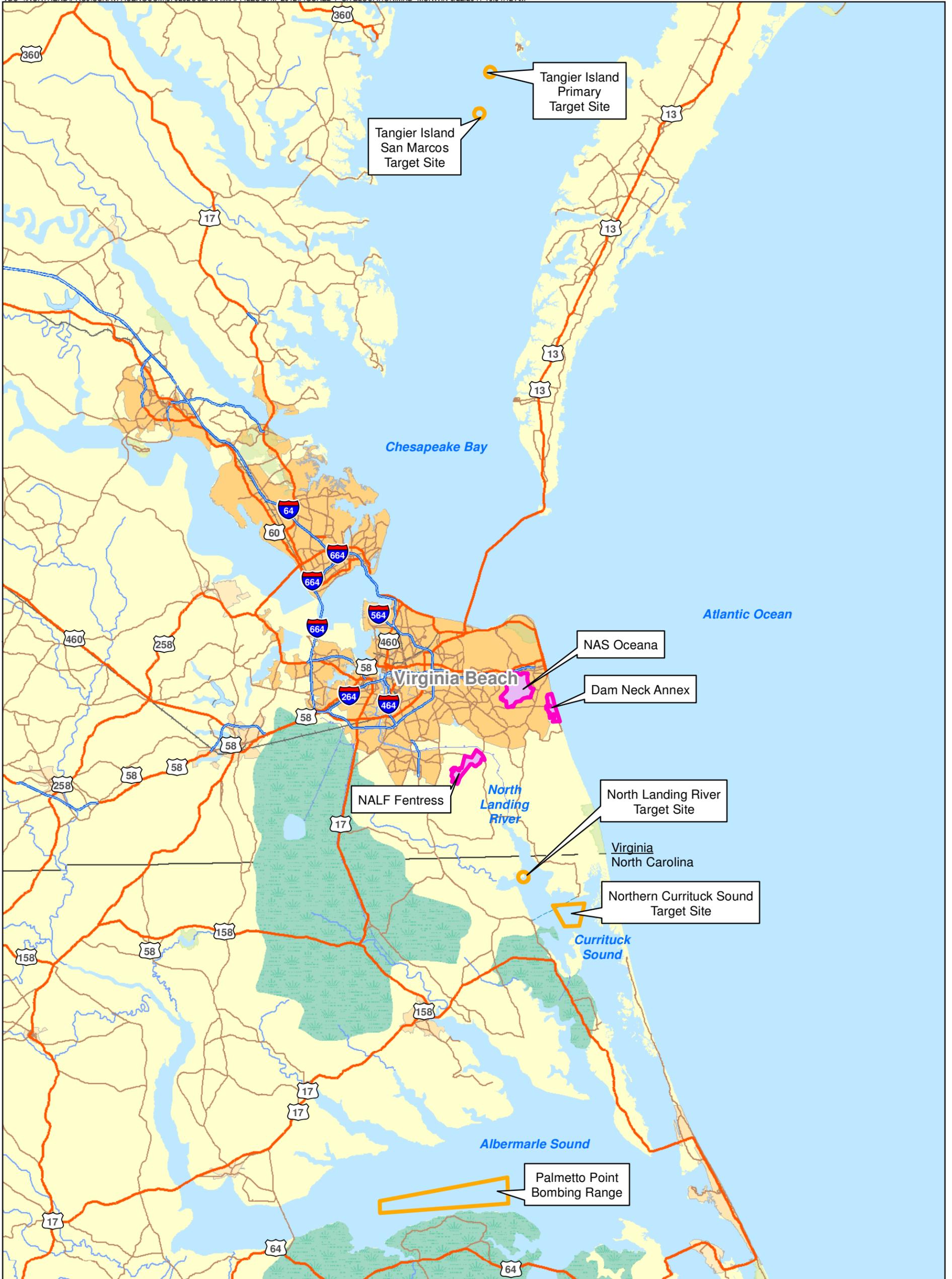
- NAS Oceana Machine Gun Boresight Range
- NALF Fentress Machine Gun Boresight Range
- NALF Fentress Dive Bombing Targets
- Dam Neck Annex Machine Gun Range
- Dam Neck Annex Pistol Range (North)
- Dam Neck Annex Pistol Range (South)
- Dam Neck Annex Rifle Range
- Dam Neck Annex Skeet and Trap Range
- Dam Neck Annex Moving Target/Mortar Range (MTMR) (North)
- Dam Neck Annex MTMR (South)
- Dam Neck Annex Mortar Impact Area (MIA)
- OTO Tangier Island Target Site
- OTO NLRT Site
- OTO NCST
- OTO PPBR

These ranges were further evaluated during Site Investigations (SIs) completed from 2009 to 2012. No additional investigation was determined to be necessary for these ranges at Dam Neck Annex: Machine Gun Range, Pistol Range (North), Pistol Range (South), Rifle Range, MTMR-North and MIA.

Additional investigation was recommended for the NAS Oceana Machine Gun Boresight Range, the NALF Fentress Machine Gun Boresight Range and Dive Bombing Targets (DBTs), these ranges at Dam Neck Annex: MTMR-South, Skeet and Trap Range, and all of the OTO water ranges.

2.8 PRP Site Investigations

The Oceana Salvage Yard Access Road and Burial Unit were first investigated as part of an Environmental Survey of the entire salvage yard (ABB, 1997). From 1993 through 1995, the Salvage Yard property owners purportedly engaged in a cleanup of the Burial Unit. However, the owners did not create a closure plan during the purported cleanup period. In January 2005, CH2M HILL completed a direct push investigation to determine whether the roadway was constructed on crushed car batteries (CH2M HILL, 2005d). The 2005 field investigation confirmed the presence of crushed battery casings beneath the Oceana Salvage Yard Access Road; however, the extent of the contamination was not delineated. Subsurface soil analytical results from the Oceana Salvage Access Road indicated contamination above the USEPA lead screening toxicity values for residential and industrial soil. The presence or absence of surface soil contamination was not determined. Additional investigation was recommended to further evaluate the nature and extent of contamination at this site.



Legend

-  NAS Oceana and Annex Boundaries
-  Other Than Operational Range Boundaries including Tangier Island
-  State Boundary



Figure 2-1
Base and Site Map
NAS Oceana
Virginia Beach, Virginia

Solid Waste Management Units

The SWMUs at the NAS Oceana are grouped into two categories: active and NFA. Previous investigations and DDs for NFA SWMUs were summarized in Section 2. Only active SWMUs are discussed in detail in this section.

Table 3-1 summarizes the current status of all SWMUs, both active and NFA. **Figure 3-1** shows the locations of each SWMU and depicts whether or not the SWMU requires further action.

Three of the 18 NAS Oceana SWMUs are currently active (SWMUs 2B, 2C, and 2E). The following paragraphs describe the history, previous investigations, and planned activities for each of these SWMUs.

3.1 SWMU 2B—Line Shacks 130-135

SWMU 2B is located in the central to east portion of NAS Oceana, southeast of main Medium Attack Wing (MATWING) Hangar 122. A detailed map of SWMU 2B is depicted on **Figure 3-2**. Most of the ground surface in the vicinity of SWMU 2B is now covered with concrete and asphalt. The limited exposed ground surface between the buildings, parking areas, and tarmac is grassy and maintained as mowed lawn. SWMU 2B contains a stormwater drainage ditch, surrounded by a band of vegetation, that is used to convey surface runoff from the site to the southwest. Groundwater discharges to this drainage ditch, which maintains a perennial base flow. No submerged aquatic vegetation has been observed in the ditch. The SWMU includes five aircraft cleaning stations and six line shacks. Chemicals such as waste oil, hydraulic fluid, PD 680, paint thinners and strippers, Turco, naphthalene, benzene, toluene, and derivatives were disposed between 1963 and the early 1980s, when a hazardous waste recovery program was initiated. An oil-water separator was installed in the 1980s.

Soil and groundwater analytical results from samples collected during the various phases of the RFI, CMS, and groundwater investigation activities were used in support of an HHRA (CH2M HILL, 2002a). The risk assessment involved characterizing potential risks to current and future receptors from exposure to site media. It was concluded that soil does not pose an unacceptable risk based on current and future land use. However, it was concluded that potable use of groundwater at SWMU 2B may pose an unacceptable risk to future receptors because of the presence of VOCs and metals (arsenic, iron, and manganese).

Potentially complete exposure pathways were identified for ecological receptors at this site via exposure to surface soil, surface water, and sediment in the ditch southeast of the site (CH2M HILL, 2001a). Constituent data were collected from these habitat areas, and potential risks were identified for sediment and surface soil. However, based on the spatial distribution of contaminants in the drainage ditch, the continual impacts to the ditch from non-point sources, and the potential ecological damage that could result from removal of ditch sediments, it was concluded that no action was necessary to address ecological risks at SWMU 2B in the drainage ditch. Based on the recommendations in the ERA, additional surface soil data were subsequently collected to refine the ecological risk evaluation. The results, presented in the FS Report (CH2M HILL, 2002b), indicated that although some small areas may pose risks to ecological receptors, these areas are isolated and are not migrating. Therefore, NFA was recommended at SWMU 2B based on ecological considerations.

ICs and LTM was recommended as the preferred alternative in the FS completed in 2002 (CH2M HILL, 2002b) in order to address potential human health risks from exposures to VOCs and metals in groundwater at SWMU 2B. A VOC Groundwater Treatability Study (CH2M HILL, 2006) was conducted in August and September 2004, which included the injection of Hydrogen Release Compound (HRC). Post-injection monitoring events were conducted in November 2004, January 2005, May 2005, and September 2005. In order to address the inorganic constituents of concern (COCs) identified in the HHRA, additional data evaluation and statistical analysis were conducted to further assess the presence and source of arsenic, iron, and manganese in SWMU 2B groundwater. Based on the results of this analysis, it was concluded that NFA was warranted for metals present in groundwater at SWMU 2B (CH2M HILL, 2005a and 2005b).

Changes in site status were evaluated via an addendum to the 2002 FS Report (CH2M HILL, 2005c) as a result of implementing the treatability studies and the information contained in the metals risk management technical memoranda.

The DD for SWMU 2B (CH2M HILL, 2008b) identified the selected remedy, continued enhanced bioremediation, LTM, and Land Use Controls (LUCs), to address chlorinated VOCs in groundwater at the SWMU. Eight rounds of groundwater monitoring have been completed since the 2004 Treatability Study was conducted. In accordance with the DD, one upgradient well and one downgradient well were installed and monitored prior to the 2008 LTM in order to ensure that the extent of contamination at the site had been addressed by the initial 2004 treatment. During the 2008 and subsequent 2009 sampling events, concentrations of chlorinated VOCs in the upgradient and downgradient wells exceeded MCLs. Consequently, a delineation of the contaminated area was completed in 2010 using Membrane Interface Probe (MIP) technology and confirmatory direct push technology (DPT) groundwater sampling in order to facilitate the planning of additional treatment at the SWMU (CH2M HILL, 2012a).

Following the LTM data from 2008 to 2010 (well installation, MIP investigation, and DPT confirmation results), it was observed that conditions were no longer optimal for degradation of chlorinated VOCs. Consequently, the NAS Oceana Tier I PMT recommended additional treatment of the SWMU 2B area. Anticipated further action at SWMU 2B include plans to inject 3DMe into the shallow aquifer to treat chlorinated VOC contamination during late summer of FY 2013.

The Final Groundwater Treatment Plan (CH2M HILL, 2012a) documents the approach for the groundwater treatment to be implemented at SWMU 2B. This treatment will be consistent with the *Final Decision Document, SWMUs 2B, 2C and 2E, Naval Air Station Oceana, Virginia Beach, Virginia* (Navy, 2008b).

Monitoring of the treatment effectiveness will continue and LUCs will remain in place until VOC concentrations are reduced to acceptable levels for unlimited use and unrestricted exposure. Until officially closed, annual inspections of SWMU 2B will continue.

3.2 SWMU 2C—Line Shack 400

SWMU 2C is located in the central portion of NAS Oceana and includes Line Shack 400 and Buildings 301, 401, and 404. A detailed map of the SWMU is presented as **Figure 3-3**. Most of the ground surface in the vicinity SWMU 2C is impervious. Mowed lawn represents the only exposed ground surface in the area. A previously existing drainage ditch at SWMU 2C has been filled in and paved over. Activities in this area include aircraft maintenance and cleaning. Disposal of chemicals, such as waste oil, hydraulic fluid, PD 680, paint thinners and strippers, Turco, naphtha, and B&D 3400 Engine Cleaner, occurred near Line Shack 400 from 1963 to the early 1980s, when a hazardous waste recovery program was initiated. The area was capped with concrete in the 1980s.

The RFI identified VOCs in concentrations of concern in SWMU 2C media. Following the Phase III sampling, the drainage ditch area at SWMU 2C was removed, eliminating the exposure point for human and ecological receptors. In 1999, SWMU 2C was included in a multi-site SERA to identify potentially complete exposure pathways for ecological receptors (CH2M HILL, 1999b). No complete exposure pathways to ecological receptors were identified and NFA was recommended to address potential ecological impacts at SWMU 2C.

In 2001, additional groundwater sampling was conducted to delineate the horizontal and vertical extents of the chlorinated VOC plume and to evaluate naturally occurring conditions for treatment options. Discrete groundwater samples were collected using DPT and the vertical extent of the plume was verified using an MIP. The results of this investigation indicated that the VOC groundwater plume was present at 9 to 24 feet below ground surface and that the vertical and lateral extents were primarily controlled by lithology. Additionally, the report concluded that aquifer conditions at the site were favorable for natural degradation of chlorinated solvents in groundwater. In order to achieve complete degradation of chlorinated VOCs in groundwater, groundwater treatment was recommended.

Soil and groundwater analytical results from samples collected during the various phases of the RFI, CMS, and groundwater investigation activities were used in support of an HHRA (CH2M HILL, 2002a). It was concluded that potable use of groundwater at SWMU 2C may pose an unacceptable risk to future receptors because of the presence of vinyl chloride (VC), arsenic, benzo(b)fluoranthene, naphthalene, and iron. Enhanced bioremediation with monitored natural attenuation (MNA) and ICs was recommended as the preferred alternative in the FS (CH2M HILL, 2002b). Based on the alternatives considered in the FS, a groundwater treatability study, which included injection of Oxygen Release Compound (ORC) and emulsified vegetable oil, was conducted in August and September 2004. Post-injection monitoring events were conducted in November 2004, January 2005, May 2005, and September 2005. Monitoring indicated that contaminant concentrations were significantly reduced, but that concentrations of VC remained above the corresponding MCL of 2 micrograms per liter ($\mu\text{g/L}$). In order to address the inorganic COCs identified in the HHRA, additional data evaluation was completed. Risks associated with arsenic were not present under central tendency exposure assumptions. Additionally, concentrations of iron and manganese were determined to be present at concentrations consistent with human nutrient intake values.

Based on the results of the treatability studies and further evaluation of the metals at SWMU 2C, an addendum to the 2002 FS recommending institutional controls and enhanced bioremediation was completed (CH2M HILL, 2005c).

The DD for SWMU 2C (Navy, 2008b) identified the selected remedy, continued enhanced bioremediation, LTM, and LUCs, to address chlorinated VOCs in groundwater at the SWMU. Groundwater monitoring has been completed on an annual basis since the 2004 Treatability Study was conducted. Chlorinated VOC concentrations in samples from site monitoring wells have generally decreased following the initial treatment at the SWMU. The only chlorinated VOC present at SWMU 2C at levels greater than the MCL is VC. All parent compounds of VC have been degraded to concentrations less than MCLs at SWMU 2C. On the basis of the 2009 and 2010 sampling results, it appears that conditions are no longer conducive to degradation of VC at SWMU 2C. Consequently, the NAS Oceana Tier I PMT recommended additional treatment at SWMU 2C.

In December 2012, ORC socks were installed in selected wells in accordance with the 2012 Groundwater Treatment Plan (CH2MHILL, 2012a) to address residual VC contamination. Anticipated further action at SWMU 2C includes plans to remove the ORC socks during late summer of FY 2013.

Monitoring of the treatment effectiveness will continue and LUCs will remain in place until VOC concentrations are reduced to acceptable levels for unlimited use and unrestricted exposure. Until officially closed, annual inspections of SWMU 2C will continue.

3.3 SWMU 2E—Line Shack 109

SWMU 2E is located in the central portion of NAS Oceana and includes Line Shack 109, Building 110, and the surrounding storage yard. A detailed map of the SWMU is presented as **Figure 3-4**. As with the other Line Shacks, most of the ground surface in the vicinity of SWMU 2E is paved with asphalt or covered in concrete. The only exposed ground surface in the site boundary is maintained turf grass. SWMU 2E was used for aircraft maintenance and cleaning and for equipment and materials storage since 1963. Waste chemicals generated during aircraft maintenance and cleaning were disposed of on the ground in this area, and floating free-phase hydrocarbons were discovered in 1991.

The results of the Phase I RFI indicated that media at SWMU 2E were potentially contaminated by VOCs, semivolatile organic compounds (SVOCs), and free product. The results of the Phase II RFI indicated the presence of a dissolved-phase VOC groundwater plume and confirmed the presence of free-phase petroleum at the soil-groundwater interface. In 1999, SWMU 2E was included in a multi-site SERA to identify potentially complete exposure pathways for ecological receptors; no complete exposure pathways were identified. Therefore, NFA was recommended to address potential ecological impacts at SWMU 2E (CH2M HILL, 1999b).

Soil and groundwater analytical results from samples collected during the various phases of the RFI, CMS, and groundwater investigation activities were used in support of an HHRA (CH2M HILL, 2002a). It was concluded that

potable use of groundwater at SWMU 2E may pose an unacceptable risk to future receptors due to the presence of VOCs and metals (arsenic, iron, and manganese). Free-phase removal, ICs, and LTM was recommended as the preferred alternative in the FS completed in 2002 (CH2M HILL, 2002b). An addendum to the FS was completed in 2002 (CH2M HILL, 2002b) to provide technical justification for transferring regulatory oversight of the petroleum-impacted area of the SWMU from CERCLA to the VDEQ UST-POL Program as the principal COCs were fuel-related products (which are exempt from CERCLA actions). Since this time, the northern part of the SWMU has been transferred to the VDEQ POL-UST Program to address the petroleum contamination. Public Works Department maintains a monthly program of removing free-phase hydrocarbons from selected monitoring wells in the northern portion of the SWMU but does not address CERCLA-related contamination. Results of product removal and monitoring are reported to VDEQ quarterly. Information provided includes plume thickness, quantity of product removed, and a means of tracking fuel product in groundwater within the flight line area. The monitoring strategy and path forward for the petroleum-impacted portion of SWMU 2E is included in the *Site Management Plan, Fiscal Year 2006, Petroleum, Oil and Lubricant Sites* (CH2M HILL, 2006).

In order to address the inorganic COCs identified in the HHRA, additional data evaluation and statistical analysis were conducted to further assess the presence and source of metals in SWMU 2E groundwater. Metals concentrations in SWMU 2E groundwater were determined to be either unrelated to a source release or were within acceptable criteria. Based on this evaluation it was determined that NFA was warranted for metals present in groundwater at SWMU 2E.

Following the POL exclusion and supplemental evaluation of metals concentrations in groundwater, the only remaining CERCLA-related organic COC at SWMU 2E was VC.

A Groundwater Treatability Study was conducted in August and September 2004 in order to address the one well in which the concentration of VC exceeded the MCL (CH2M HILL, 2006). The treatability study involved injection of ORC. Post-injection monitoring events were conducted in November 2004, January 2005, May 2005, and September 2005. The most recent round of available analytical data indicated that the concentration of VC is just above the MCL (2 micrograms per liter [$\mu\text{g}/\text{L}$]).

Based on the results described above, an addendum to the 2002 FS recommending ICs and enhanced bioremediation was completed (CH2M HILL, 2005c).

The DD for SWMU 2E (Navy, 2008b) identified the selected remedy, continued enhanced bioremediation, LTM, and LUCs, to address chlorinated VOCs in groundwater at the SWMU. Seven rounds of groundwater monitoring have been completed since the 2004 Treatability Study was conducted. VC concentrations in samples from site monitoring wells have generally decreased following the initial treatment at the SWMU. However, on the basis of the 2010 sampling results, it appears that conditions are no longer conducive to degradation of VC at SWMU 2E. Consequently, the NAS Oceana Tier I Partnering Team recommended additional treatment at SWMU 2E.

ORC socks were installed in selected wells in December 2012 in accordance with The Groundwater Treatment Plan (CH2M HILL, 2012a) to address residual VC contamination. Anticipated further action at SWMU 2E include plans to remove the ORC socks during late summer of FY 2013. In addition, the 2012 LTM data indicates that clean up goals have been achieved for all COCs, therefore all LTM monitoring wells will be sampled in November 2013. Until officially closed, annual inspections of SWMU 2E will continue.

TABLE 3-1

Current Status Summary of ERP SWMUs, June 2013

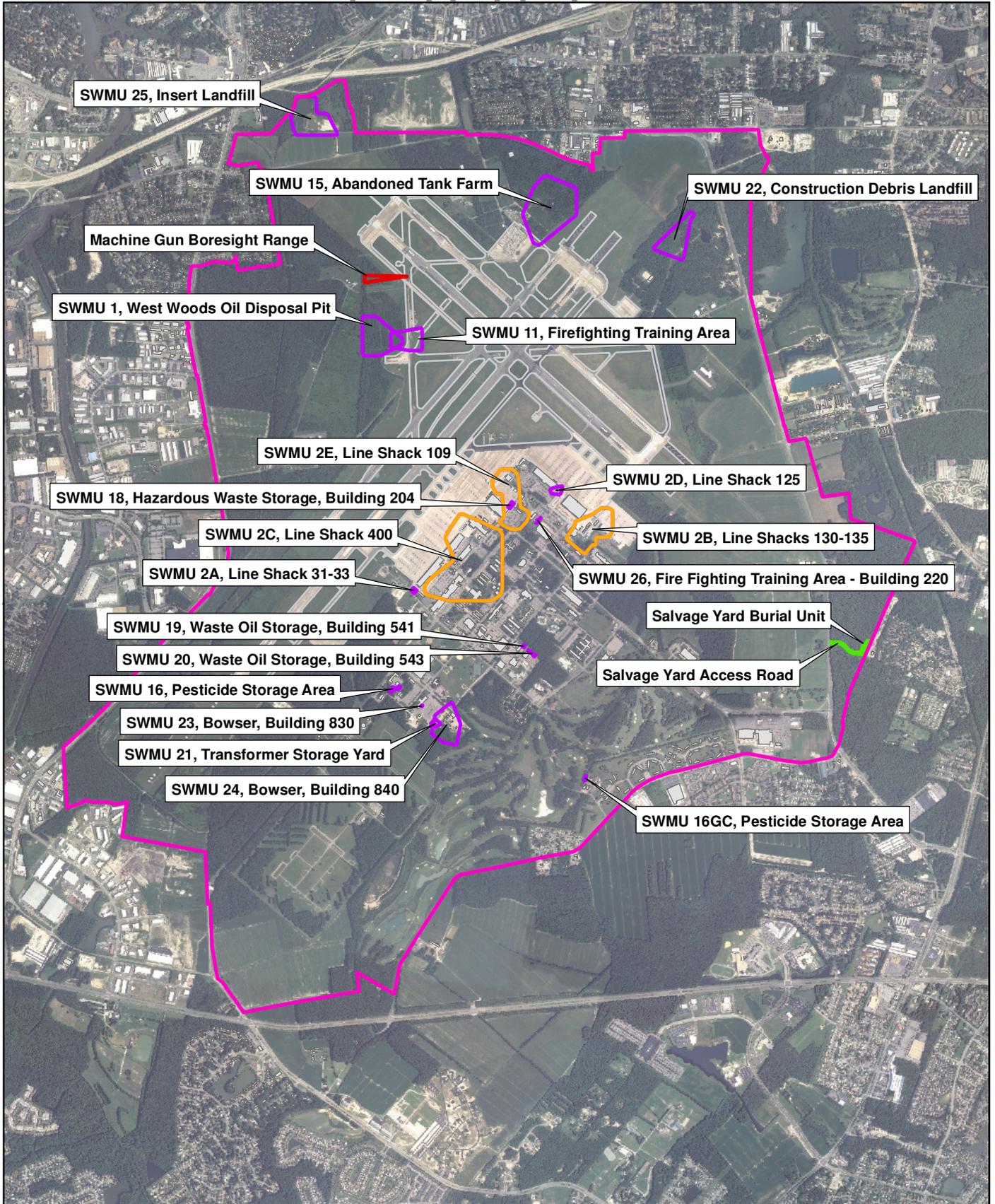
Naval Air Station, Oceana, Site Management Plan for FY 2014

Solid Waste Management Unit (SWMU)		IAS	RFA	Interim RFI	Phase I RFI	POL CMS	Phase II RFI	CMS	Phase III RFI	HHRA	ERA	PRAP	DD	Closure Status	Comments
1	West Woods Oil Pit	1984	1988	1991	1993			1995	1998	Jan-01	Jun-01	Sep-07	Sep-07	NFA	Transferred to VDEQ POL-UST Program
2B	Line Shack 130-131	1984	1988	1991	1993			1995	1998	Jan-02	Aug-01	Sep-07	Sep-08		DD recommend Continued Enhanced Bioremediation, LTM, and LUCs
2C	Line Shack 400	1984	1988	1991	1993			1995	1998	Jan-02	Oct-99	Sep-07	Sep-08		DD recommend Continued Enhanced Bioremediation, LTM, and LUCs
2D	Line Shack 125	1984	1988	1991	1993		1995		1998		Oct-99	Feb-01	Jul-01	NFA	
2E	Line Shack 109, Bldg. 23	1984	1988	1991	1993		1995	1996		Jan-02	Oct-99	Sep-07	Sep-08		DD recommend Continued Enhanced Bioremediation, LTM, and LUCs
11	Fire Fighting Training Ring	1984	1988	1991	1993	1994					Aug-01		Dec-01	NFA	
15	Abandoned Tank Farm,	1984	1988		1993		1995	1996		Jan-01	Jun-01				Transferred to VDEQ POL- UST Program
16	Pesticide Storage Area, Bldg. 821	1984	1988		1993						Aug-01		Dec-01	NFA	
16GC	Golf Course Support Facilities		1988		1993						Aug-01		Dec-01	NFA	
18	Haz. Waste Storage Area, Bldg. 204		1988		1993	1994			1998		Oct-99	Feb-01	Jul-01	NFA	
19	Waste Oil Storage Areas, Bldg. 541		1988		1993	1994					Oct-99	Feb-01	Jul-01	NFA	
20	Waste Oil Storage Areas, Bldg. 543		1988		1993	1994					Oct-99	Feb-01	Jul-01	NFA	
21	Transformer Storage Yard, Bldg. 830		1988		1993				1998		Aug-01		Dec-01	NFA	
22	Construction Debris Landfill		1988		1993						Aug-01		Dec-01	NFA	
23	Bowser, Bldg. 830		1988		1993						Oct-99	Feb-01	Jul-01	NFA	
24	Bowser, Bldg. 840		1988		1993	1994	1995	1996	1998	Jan-01	Oct-99	Sep-07	Sep-07	NFA	
25	Inert Landfill		1988		1993		1995		1998		Dec-01	Sep-03	Oct-03	NFA	
26	Fire Fighting Burn Pit, Bldg. 220		1988		1993				1998		Aug-01		Dec-01	NFA	

Legend

1998 - Year Activity Completed (fiscal year)
 2000 - Activity Planned & expected completion
 CMS - Corrective Measures Study
 DD - Decision Document
 ERP - Environmental Restoration Program
 IAS - Initial Assessment Study
 NFA - No Further Action
 PA - Preliminary Assessment
 PRAP - Proposed Remedial Action Plan

LTM - Long Term Monitoring
 LUC - Land Use Controls
 POL - Petroleum-Oil-Lubricant SWMUs
 RA - Remedial Action/Removal Action
 RD - Remedial Design
 RFA - RCRA Facility Assessment
 RFI - RCRA Facility Investigation
 X - Applicable to the Solid Waste Management Unit (SWMU)
 Active SWMUs with DD



Legend

- NAS Oceana Proper Boundary
- Action DD SWMU Boundary
- Active MRP Site Boundary
- PRP Site Boundary
- NFA SWMU Boundary
- Buildings
- Runways

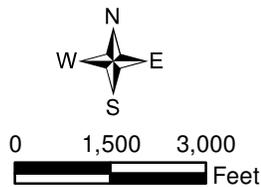
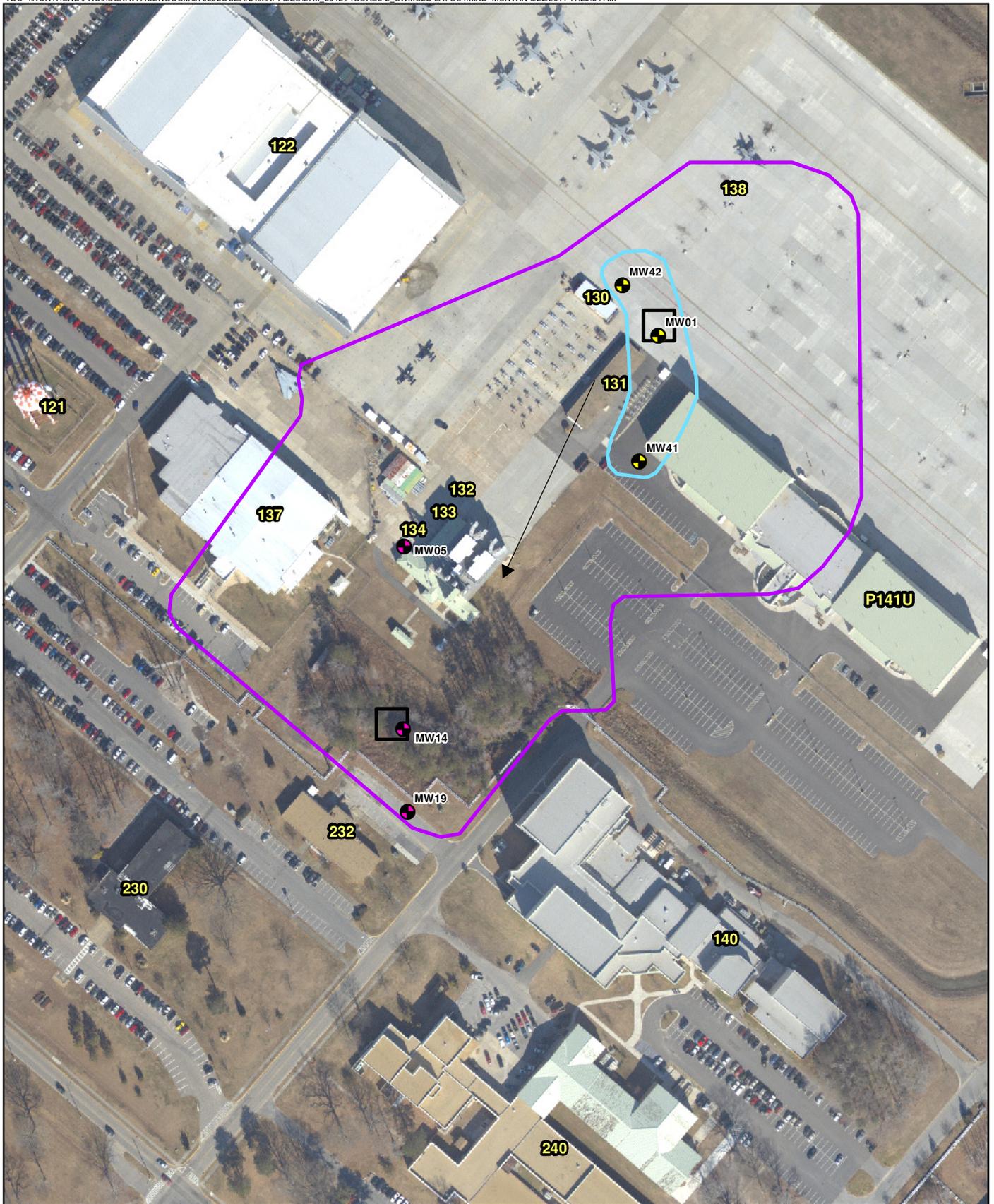


Figure 3-1
 NAS Oceana Site Location Map
 NAS Oceana
 Virginia Beach, Virginia

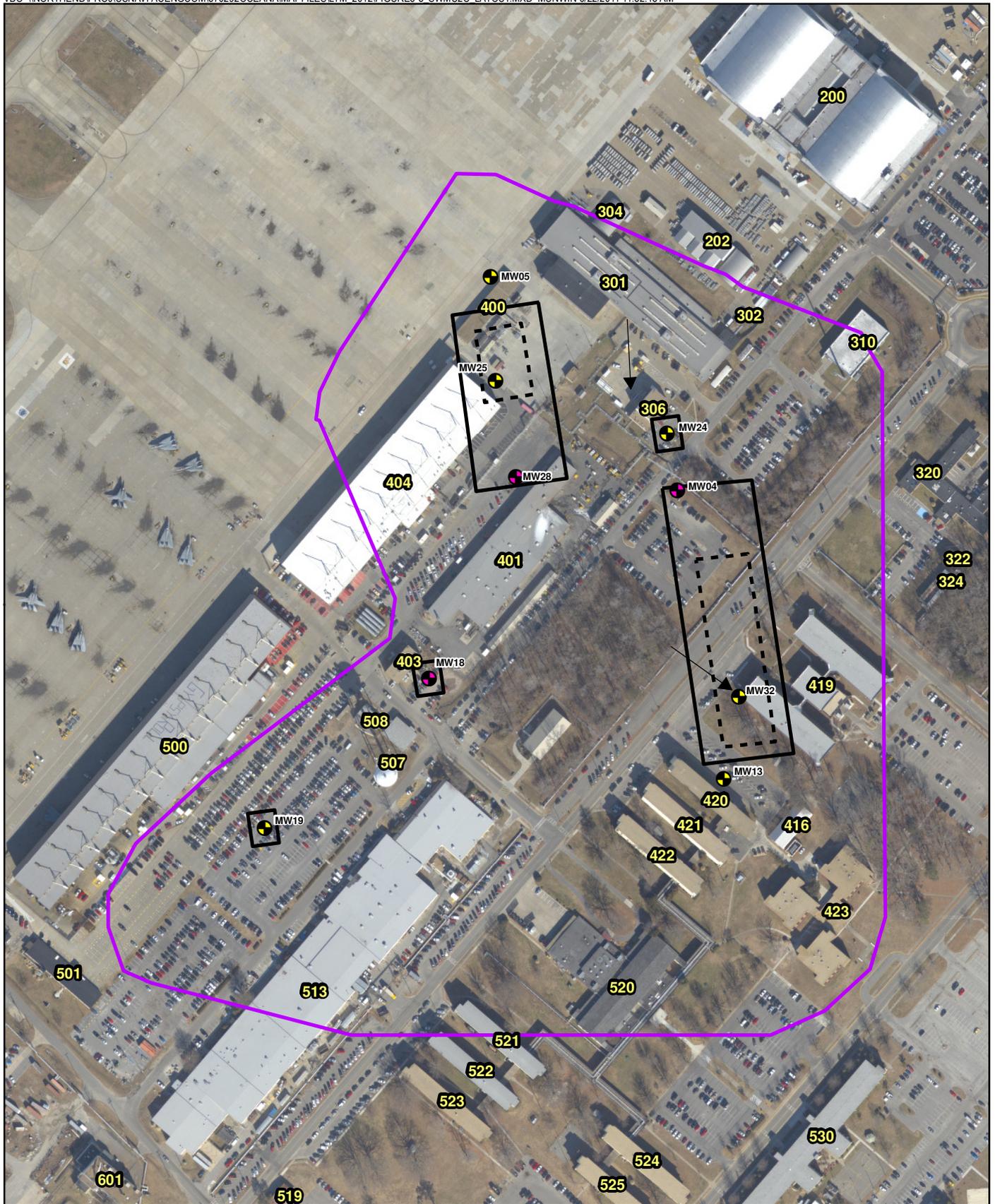


Legend

- Monitoring Well in Current LTM Network
- Wells Not Currently Monitored
- Target Treatment Area (2004)
- ▭ SWMU/LUC Boundary
- ▭ Approximate Extent of VOCs at Concentrations > MCLs
- Groundwater Flow Direction (2009)



Figure 3-2
SWMU 2B Layout
NAS Oceana
Virginia Beach, Virginia

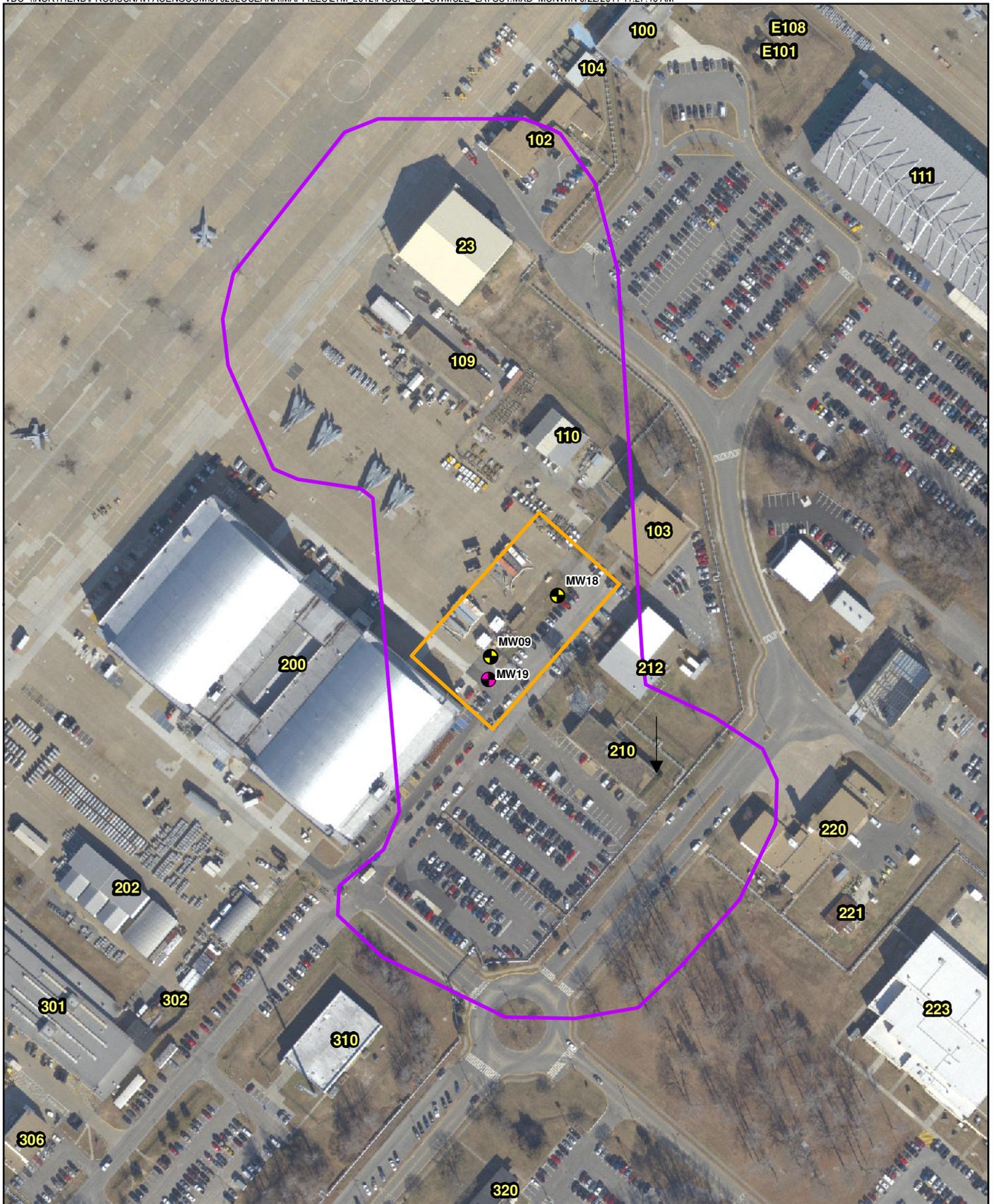


Legend

- Monitoring Well in Current LTM Network
- Wells Not Currently Monitored
- 2004 Target Treatment Area (Non-Core)
- - 2004 Target Treatment Area (Core)
- SWMU/LUC Boundary
- Groundwater Flow Direction (2009)



Figure 3-3
SWMU 2C Layout
NAS Oceana
Virginia Beach, Virginia



Legend

- Monitoring Well in Current LTM Network
- Well Not Currently Monitored
- SWMU Boundary
- LUC Boundary
- ➔ Groundwater Flow Direction (2009)



0 100 200
Feet

Figure 3-4
SWMU 2E Layout
NAS Oceana
Virginia Beach, Virginia

Munitions Response Program Sites

MRP sites associated with NAS Oceana and its associated annexes were investigated during the PA and SI; NFA sites were listed in Section 2. Only active MRP sites are discussed in detail in this section. **Table 4-1** summarizes the current status of all sites, both active and NFA. **Figures 3-1, 4-1, and 4-2** show the locations of each site and depict whether the site requires further action. Nine of the 15 NAS Oceana MRP sites are currently active. The following paragraphs describe the history, investigations, and planned activities for each of these sites. Sites are grouped together based on location.

4.1 NAS Oceana MRP Sites

4.1.1 Machine Gun Boresight Range

The former Machine Gun Boresight Range covers approximately 1.7 acres and is north of Dorr Place and west of Runway 14 (**Figure 4-3**). The eastern half of the site is generally flat and consists of maintained grass, while the western portion is overgrown and contains a concrete backstop. The site was initially used as a maintenance and testing range for aircraft-mounted machine guns and was later converted to a small arms firing range (Malcolm Pirnie, 2008). Ammunition was likely limited to .50 and .30 caliber rounds for aircraft guns and small arms ammunition.

Only surface and subsurface soils at the site were evaluated during the SI. Groundwater is not anticipated to be affected at the site; therefore, the SI did not evaluate groundwater as a potential route of exposure. There is no surface water or sediment present onsite.

The SI identified antimony, copper, lead, and zinc as constituents of potential concern (COPCs) in soil. All COPC results exceeded established background values for eastern Virginia (Gustavsson et al., 2001) and the eastern United States (Shacklette et al., 1984), indicating a potential release occurred at the site. Based on the HHRS and ecological evaluations, potential unacceptable human health and ecological risks were identified for both surface soil and subsurface soil. Although the magnitude of the screening value exceedances was relatively high, the spatial extent of the potentially affected area was hypothesized to be relatively small and likely confined to the backstop area (CH2M HILL, 2012b). Consequently, the Navy is proposing completion of an Engineering Evaluation/Cost Analysis (EE/CA) to address contaminated soil at the site. The EE/CA was initiated in 2013, with a projected completion date in FY 2014. The removal action will occur in FY 2014, based on availability of funding.

4.2 NALF Fentress MRP Sites

4.2.1 Machine Gun Boresight Range

The former Machine Gun Boresight Range (**Figure 4-4**) at NALF Fentress encompasses about 1 acre and lies southwest of Runway 1-19, on the northern portion of the NALF Fentress facility (**Figure 4-2**). The southwestern half of the site is overgrown with brush and trees and features a deteriorating concrete backstop, while the northeastern half is generally flat and consists of maintained grass along the border of an active aircraft runway. Although there are no water bodies on the site, shrub wetlands are located within the site boundaries. The range backstop and the northeastern half of the site, consisting of maintained grass, are not located in a wetland area.

The site was initially used as maintenance and testing range for aircraft-mounted machine guns, but was later converted to a pistol range (Malcolm Pirnie, 2008). Ammunition used at the former Machine Gun Boresight Range was likely limited to .50 and .30 caliber rounds for aircraft guns. Additionally, expended 7mm, 9mm, .38 and .30 caliber, and shotgun rounds have been found (Malcolm Pirnie, 2008); however, the additional rounds appeared to be from more-recent, recreational use. Potential sources of contamination present at the former range are debris related to small-arms firing range ammunition, and potential munitions constituent (MC) associated with these types of ammunition are composed of lead, antimony, arsenic, copper, nickel, and zinc (Malcolm Pirnie, 2008).

Only surface and subsurface soils at the site were evaluated during the SI. Groundwater is not anticipated to be affected at the site; therefore, the SI did not evaluate groundwater as a potential route of exposure. There is no surface water or sediment present onsite.

The SI identified antimony, copper, lead, and zinc as COPCs in soil. All COPC results exceed established background values for eastern Virginia (Gustavsson et al., 2001) and the eastern United States (Shacklette et al., 1984), indicating a potential release occurred at the site. Based on the HHRS and ecological evaluations, potential unacceptable human health and ecological risks were identified for both surface soil and subsurface soil. Although the magnitude of the screening value exceedances was relatively high, the spatial extent of the potentially affected area was hypothesized to be relatively small and likely confined to the backstop area (CH2M HILL, 2012b). Consequently, the Navy is proposing completion of an EE/CA to address the contaminated soil. The EE/CA was initiated in 2013 with a projected completion date in FY 2014. The removal action will occur in FY 2014, based on availability of funding.

4.2.2 Dive Bombing Targets

Two adjacent DBTs dating from 1955 are located in a currently forested and undeveloped area (**Figure 4-5**). The first, and northernmost, target is located at the end of Runway 1-19, while the second target is located approximately 500 feet southwest of the other target (**Figure 4-1**). Each target is approximately 6.5 acres in size and the MRP-eligible acreage for the DBTs is approximately 13 acres. Probable munitions used at the DBTs include practice bombs, as well as MK4 signal cartridges, spotting/witness charges, and bomb signal cartridges (Malcolm-Pirnie, 2008).

In support of the SI, a reconnaissance-level digital geophysical mapping (DGM) survey was performed in the primary cardinal directions at each DBT. During the site reconnaissance activities performed at the DBTs, three AN-MK23 practice bombs and an unfuzed M18 Signal Smoke Grenade were found on the ground surface of the southern target (CH2M HILL, 2011b). Several subsurface anomalies were also identified at the north and south DBTs. It was determined that the signal charges in two of the AN-MK23 practice bombs found in the southern target were intact during unexploded ordinance (UXO) clearance activities performed prior to the DGM survey. Local Navy Explosive Ordnance Disposal personnel responded and removed these items (CH2M HILL, 2011b).

The SI recommended further investigation, including additional vegetation removal and DGM survey activities with positioning at a high enough accuracy for reacquisition of anomalies, as well as an intrusive investigation to inspect and identify a selected subset of the anomalies. MC sampling was also recommended if the sources of the anomalies are identified as munitions and explosives of concern (MEC). Expanded SI activities were completed in March 2013 to conduct an intrusive investigation and evaluate select anomalies. Following the Expanded SI, the site moved into the RI phase to determine the hazards posed by the MEC. MC will not be part of the RI since the MEC encountered during the Expanded SI were practice rounds that do not contain high explosives, only black powder as an expelling charge for the spotting cartridges.

4.3 Dam Neck Annex MRP Sites

4.3.1 Skeet and Trap Range

The former Skeet and Trap Range (**Figure 4-6**), located on the southwestern portion of Dam Neck Annex on the eastern shore of Lake Tecumseh, was composed of four skeet ranges and four trap ranges, with approximately half of the former range area extending into Lake Tecumseh. The site area covers approximately 39 acres and was identified as the Surface Danger Zone, with a direction of fire toward the northwest, along Bullpup Street and over Lake Tecumseh (Malcolm Pirnie, 2008). The southeast portion of the site along Bullpup Street has been developed into Building 470 and an associated parking lot. The remaining portion is composed of undeveloped forest and open water and features the foundation of an abandoned building believed to have been used as a target launching shed for the skeet range.

Ammunition used at the former Skeet and Trap Range was expected to be 12-gauge or smaller shotgun ammunition. Thus, potential sources of contamination present at the former range are debris related to small-

arms firing range ammunition. The primary contaminant associated with shotgun ammunition is lead. Polynuclear aromatic hydrocarbons (PAHs) were also identified as potential contaminants due to their association with clay targets (Malcolm Pirnie, 2008).

The SI completed at the Skeet and Trap Range included soil sampling. Based on the HHRS evaluation, potential unacceptable risks were identified for surface soil associated with PAHs and lead. Additionally, lead in soil was identified as a COPC due to the potential for this contaminant to pose unacceptable ecological risks (CH2M HILL, 2012b).

The SI concluded that human health and ecological risks may extend into Lake Tecumseh given the magnitude of the lead and PAH concentrations found in site surface soil and the expected shot and clay target distribution over the entire site. Based on the COPC concentrations detected in soil and the target distribution for the site from the SI, a sediment investigation was completed to supplement the SI. A revised SI incorporating the sediment data was finalized in January 2012 and concluded that lead was a COPC in sediment for direct exposures to lower trophic receptors; however, the potential risks would likely be spatially restricted based on the distribution of lead and pellets in the sediment.

The SI recommended remedial investigation to achieve the following objectives:

- Delineate the lateral and vertical extent of soil contamination
- Further investigate and evaluate the limited potential risks from lead in the sediment
- Establish site-specific background levels for the COPCs
- Quantitatively assess risks

The site moved to the RI phase in August 2012 and RI activities are currently in progress.

4.3.2 Moving Target/Mortar Range (South)

The MTMR-South (**Figure 4-7**) is located in the southeastern portion of Dam Neck Annex, east of the Regulus Avenue and Bullpup Street intersection. The range was used in the 1940s and 1950s. Approximately 10 percent of the eastern portion of the site is developed and covered by parking lots and buildings, while the remainder of the site is undeveloped and heavily wooded. The historic range boundary overlaps a small portion of another MRP eligible site, the MIA. The acreage that is shared by the overlapping MRP sites is assigned to the MTMR-South. As such, the resulting MRP-eligible portion of the historical MTMR-South is approximately 17 acres. Based on the range boundaries and period of use, probable munitions used at the MTMR-South were determined to include .30 and .50 caliber small-arms projectiles and practice 60mm and 81mm mortars; only practice mortars are believed to have been used based on the distance between the probable firing point and impact area.

In support of the SI, a DGM survey was performed in undeveloped and accessible areas (portions of the site were heavily vegetated) in the eastern portion of both the MIA and MTMR-South; approximately 2.2 acres were surveyed in all. 125 anomalies were determined most likely to represent subsurface MEC at the site (60mm or 81mm mortars in the top 2 feet); however, non-munitions related metallic items can create similar responses in the geophysical data (CH2M HILL, 2011b). Additionally, a very low concentration of discreet high density/high millivolt (mV) anomalies potentially representing MEC was identified within the sand dunes at the site.

The SI recommended further investigation of the portion of MTMR-South and MIA sites east of Regulus Avenue. An intrusive investigation to inspect and identify a selected subset of the anomalies located, during the SI was completed in June 2012 and identified several 81 mm mortar fragments. Consequently, RI activities will be required at MTMR-S and the site moved to the RI phase in December 2012.

4.3.3 Mortar Impact Area

The MIA (**Figure 4-7**) is a cone-shaped area located in the southernmost portion of the Dam Neck Annex used in the 1940s and 1950s. Based on orientation of the range it is assumed that mortars were fired from west to the east (Malcolm Pirnie, 2008). The eastern portion of the site is included in the Beaches/Dunes Natural Resource Management Unit and features Building 474, a control tower, while the western portion is within the Natural

Areas Natural Resource Management Unit. The western portion of the site is an undeveloped wetland area. The historical range fan also partially overlaps another MRP Site, the MTMR-South. The overlapping acreage was assigned to the MTMR-S, and the resulting acreage for the MIA is 23 acres. Probable munitions used at the MIA based on the period of use and the size of the range fan includes practice and high explosive mortars.

As summarized in the MTMR section above, a DGM survey was performed in support of the SI and identified a number of anomalies on the site. Further investigation was completed in June 2012 for the portion of the MIA located East of Regulus Avenue, including an intrusive investigation to inspect and identify a selected subset of the anomalies located during the SI to determine if the sources of the anomalies are MEC (CH2M HILL, 2011b). Although fragments of 81 mm mortars were identified in the adjacent/overlapping MTMR-S, no items were discovered exclusively in the MIA. Additionally, an historical aerial analysis was performed as part of these expanded SI activities and determined that the MIA was never built or operated. Consequently, the MIA was recommended for NFA and accomplished in January 2013 (CH2M HILL, 2012c).

4.4 OTO MRP Sites

4.4.1 Tangier Island Target Site

The Tangier Island Target Site (**Figure 4-8**) is located approximately 2,800 yards southwest of Tangier Island and approximately 65 miles north of Norfolk, Virginia, in the lower portion of the Chesapeake Bay, in relatively shallow waters ranging from 10 to over 30 feet deep. The site consists of a 1,000-yard radius prohibited area and a 3-nautical-mile radius restricted area surrounding a Primary Target location. It features multiple targets used for aerial bombardment and rocketry training from approximately 1970 until 1996, including Navy Targets 1 and 2, located northeast of the Primary Target, and since-sunken ships. The site also encompasses a 1,000-yard radius prohibited area around the San Marcos Wreck, which was utilized in the 1920s and is located 5.5 miles south of the Primary Target. Only practice rockets and bombs were dropped on the targets but there may exist an explosive hazard due to spotting and witness charges. Munitions usage around the San Marcos target is unknown, but live munitions may have been dropped there (Malcolm-Pirnie, 2008).

A DGM investigation was completed during the SI and resulted in the detection of 4,148 anomalies within the investigation areas of the Tangier Island Target Site. The majority of these anomalies are concentrated around presumed target locations, with the lowest anomaly densities observed at the San Marcos Target location and the highest observed surrounding Navy Target 1. The site is located in a sandy, shallow water environment that is exposed to wind and wave action. The Target area has been identified as a net depositional environment, so MEC, if present at the site, is likely to be gradually buried if it remains in place (CH2M HILL, 2011a).

The conclusion section of the SI Report recommended additional investigation to inspect and identify individual anomalies at each of the targets located at the Tangier Island Target Site. The SI also recommended additional sediment sampling for MC if a significant number of the items identified are determined to be MEC.

Because Navy Targets 1 and 2 were confirmed to be hard targets, the SI recommended the areas surrounding the hard targets to be added to the MRP Tangier Island Target Site definition and in the CFR to restrict access within the vicinity of the hard targets. To inform boaters of the potential navigational hazards associated with the former targets, the placement of signage or buoys near the hard targets should be considered (CH2M HILL, 2011a). No additional work is planned at this time for the Tangier Island Target Site for FY 2014.

4.4.2 North Landing River Target Site

The NLRT Site (**Figure 4-9**) consists of the waters of the North Landing River within a 1,000-yard radius from a target, though no visual signs of the target still remain. The range is approximately 20 miles south of NAS Oceana, near the mouth of the North Landing River in the Currituck Sound, and is 649 acres in size. Approximately 60 percent of the site is located in open water in the shallow northern part of the Currituck sound, while the remaining 40 percent is located on coastal salt marshes on a peninsula called Troublesome Point.

The site was used for day and night dive bombing by naval aircraft from the mid-1950s until the mid-1960s. Only practice bombs with “small explosive charges for producing smoke puffs to mark point of impact” were dropped on the target; however, the specific quantities and types of munitions usage at the site could not be identified. No munitions have been used at the NLRT Site since the mid-1960s (Malcolm Pirnie, 2009), but the range was suspected to contain MEC and therefore required further investigation.

The SI identified numerous anomalies scattered throughout the range area; however, no notable evidence of significant range use or specific target location was observed (CH2M HILL, 2010). Current speeds and a lack of tides in the Northern Currituck Sound imply that any potential MEC is unlikely to be moved by currents, except possibly in extreme storm conditions. The SI report indicated MEC is likely to be buried if it remains in place, though a long period of time would be required to completely isolate the MEC beneath newly deposited sediment (CH2M HILL, 2010).

The SI report recommended additional investigation in select locations at the NLRT Site within high density anomaly areas to determine if the anomalies at the site are MEC or range related debris. Additionally, evaluation of the nature and extent of the MEC and MC in the sediments and investigation of the land portion of Troublesome Point may be required if MEC is identified during future investigations. No additional work is planned at this time for the NLRT Site for FY 2014.

4.4.3 Northern Currituck Sound Target

The NCST Site (**Figure 4-9**) contained one hard target (no visual signs of the target remain at the site) and has a total area of approximately 3,831 acres. The hard target is located in the approximate center of the site, in shallow waters of the northern portion of the Currituck Sound. The Atlantic Intracoastal Waterway lies immediately to the west, and the range is located approximately 25 miles south of NAS Oceana.

Similar to the NLRT Site, this NCST was used for day and night dive bombing by naval aircraft from approximately 1950 until the mid-1960s. Only practice bombs with “small explosive charges for producing smoke puffs to mark point of impact” were dropped on the target; however, specific quantities and types of munitions usage for the site have not been identified (Malcolm-Pirnie, 2009). No munitions have been used at the NCST Site since the mid-1960s.

A DGM investigation was completed at the site in support of the SI. The data resulting from the DGM investigation indicated a significant concentration of anomalies in the vicinity of the target, suggesting the target coordinates are accurate and the anomalies surrounding the target are likely range-related. The high response concentration of anomalies was confined to a relatively small elliptical area, approximately 235 yards, around the target center (CH2M HILL, 2010). Current speeds and a lack of tides in the Northern Currituck Sound imply that any potential MEC is unlikely to be moved by currents, except possibly in extreme storm conditions. The SI report indicated that MEC is likely to be buried if it remains in place, though a long period of time would be required to completely isolate the MEC beneath newly deposited sediment (CH2M HILL, 2010).

The SI Report recommended additional investigation in select locations at the NCST Site within high density anomaly areas to determine if the anomalies at the site are MEC or range-related debris. Additionally, evaluation of the nature and extent of the MEC and MC in the sediments may be required if MEC is identified during future investigations. No additional work is planned at this time for the NCST Site for FY 2014.

4.4.4 Palmetto Point Bombing Range

The PPBR Site (**Figure 4-10**) has an area of approximately 18,440 acres and is located in relatively shallow waters off of the south shore of the Albemarle Sound in North Carolina, approximately 55 miles south of NAS Oceana. The site was used for basic loft bombing and high-altitude dive bombing from approximately 1957 until 1998. It is believed to have contained approximately six hard targets, two of which survive in remnant form. Only non-explosive munitions (practice munitions, water filled, or smoke bombs) were used at the site, but it was suspected to contain MEC and therefore required further investigation (Malcolm-Pirnie, 2009).

Of the five targets in its main target area, results of the SI indicated significant anomaly concentrations in three locations: Target NAB 42, the Primary Target, and an area approximately 630 yards northwest of Target D (CH2M HILL, 2010). The anomaly concentrations surrounding these three targets are believed to indicate range-related usage. A high density area was identified between Target NAB 42 and Target #42, with two separate areas of metal protruding above the water surface. Anomalies identified during the SI were confined to a relatively small area (approximately 110 yards) just to the southeast of the target and extending eastwards. An evaluation of sedimentation completed in support of the SI indicated that MEC is unlikely to be transported away from their original location within the range due to weak wind-driven currents at the site, indicating that MEC is likely to be buried if it remains in place (CH2M HILL, 2010).

The SI recommended additional investigation in select locations within high density anomaly areas (near Target NAB 42, Primary Target, the area northwest of Target D, and Lewis Point) to determine if the anomalies at the site are MEC or range-related debris or not and the nature and extent of contamination if MEC is confirmed. Additionally, signage or buoys placed near the hard targets were also recommended to warn boaters of the potential navigational hazards associated with the former targets. No additional work is planned at this time for the PPBR Site for FY 2014.

TABLE 4-1

Current Status Summary of MRP Sites, June 2013**Naval Air Station, Oceana, Site Management Plan for FY 2014**

MRP Site	PA	SI	SI Recommendation	Path Forward
NAS Oceana Machine Gun Boresight Range	Oct-08	Jan-11	Further Investigation	Removal action to address contaminated soil.
Dam Neck Machine Gun Range	Oct-08	Nov-09	NFA	NFA
Dam Neck Pistol Range (North)	Oct-08	Jan-11	NFA	NFA
Dam Neck Pistol Range (South)	Oct-08	Jan-11	NFA	NFA
Dam Neck Rifle Range	Oct-08	Jan-11	NFA	NFA\
Dam Neck Skeet and Trap Range	Oct-08	Jan-11	Further Investigation	RI ongoing
Dam Neck Moving Target/Mortar Range (North)	Oct-08		NFA	NFA
Dam Neck Moving Target/Mortar Range (South)	Oct-08	11-Feb	Further Investigation	RI ongoing
Dam Neck Mortar Impact Area	Oct-08	Feb-11	Further Investigation	No further investigation per ESI; LUCs enforced
NALF Fentress Machine Gun Boresight Range	Oct-08	Jan-11	Further Investigation	Removal action to address contaminated soil.
NALF Fentress Dive Bombing Targets	Oct-08	Feb-11	Further Investigation	ESI (completed in 2013); RI to be completed 2014
OTO Tangier Island Target Site	Oct-08	Feb-11	Further Investigation	No planned activites during FY 2014
OTO NLRT Site	Feb-09	Dec-10	Further Investigation	No planned activites during FY 2014
OTO NCST	Feb-09	Dec-10	Further Investigation	No planned activites during FY 2014
OTO PPBR	Feb-09	Dec-10	Further Investigation	No planned activites during FY 2014

LEGEND: ERA Environmental Risk Assessment
 HHRA Human Health Risk Assessment
 NALF Naval Auxiliary Landing Field
 NCST Northern Currituck Sound Target
 NLRT North Landing River Target
 OTO other than operational
 PA preliminary assessment
 PPBR Palmetto Point Bombing Range
 SI Site Investigation
 Active Site



Legend

-  NALF Fentress Boundary
-  Active MRP Sites



Figure 4-1
MRP Sites
NALF Fentress
Chesapeake, Virginia



Legend

- NAS Oceana Boundary
- Dam Neck Annex Boundary
- MRP Sites
- Active MRP Sites

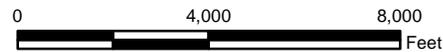
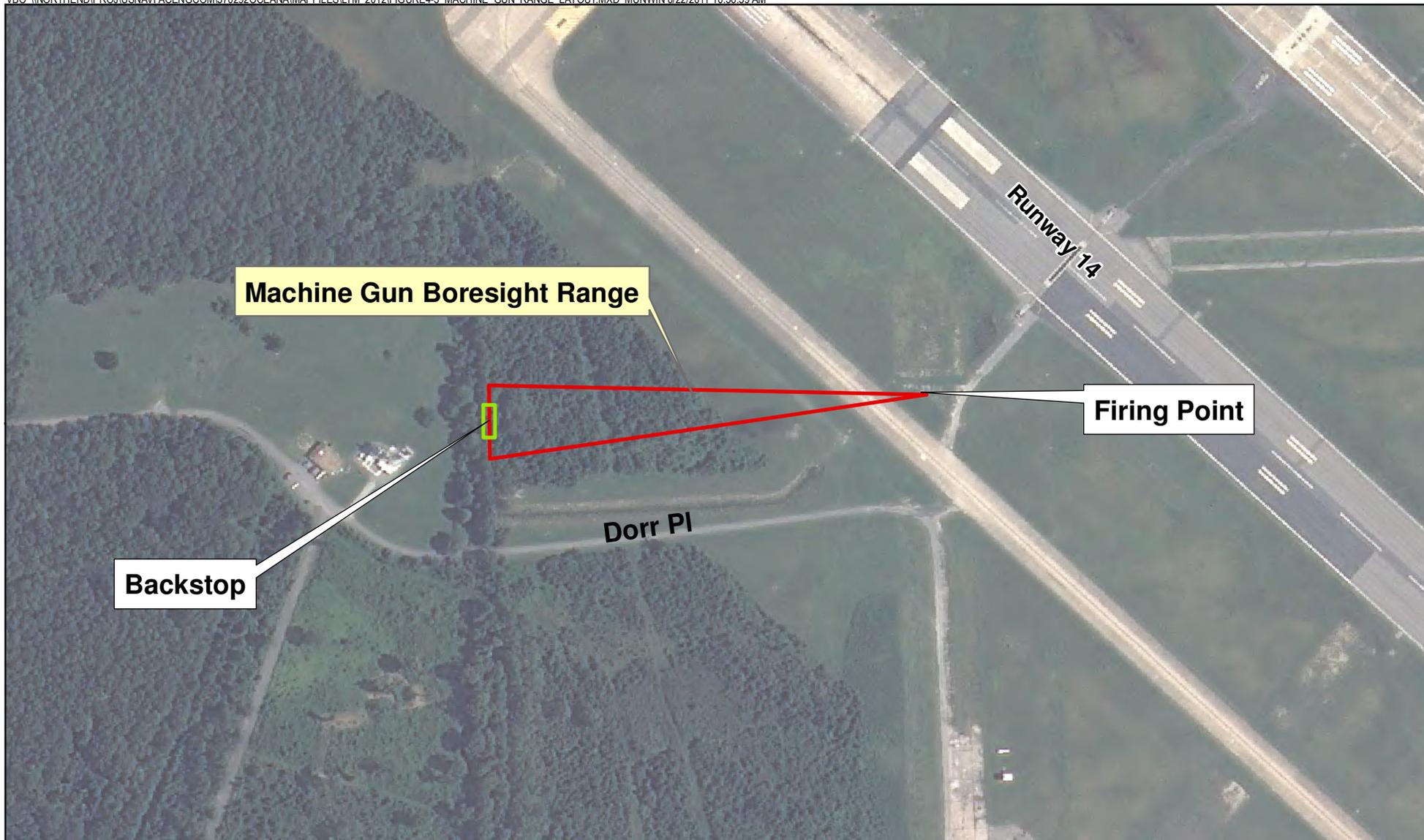


Figure 4-2
MRP Sites
Dam Neck Annex
Virginia Beach, Virginia



Machine Gun Boresight Range

Firing Point

Backstop

Dorr PI

Runway 14

- Legend**
- MRP Site
 - Backstop

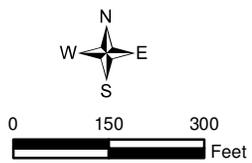
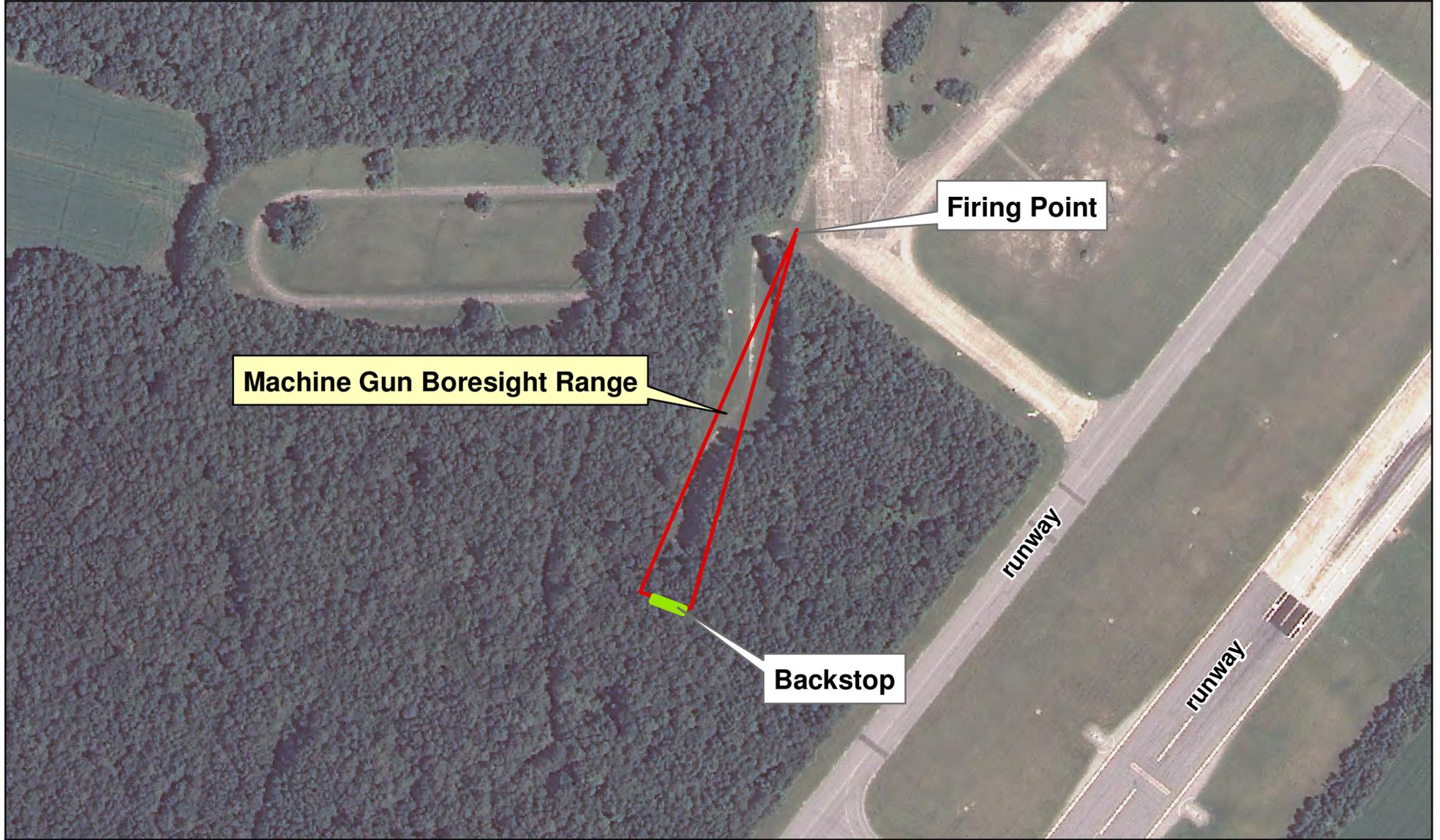


Figure 4-3
Machine Gun Boresight Range Layout
NAS Oceana
Virginia Beach, Virginia



- Legend**
- MRP Site
 - Backstop

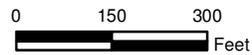
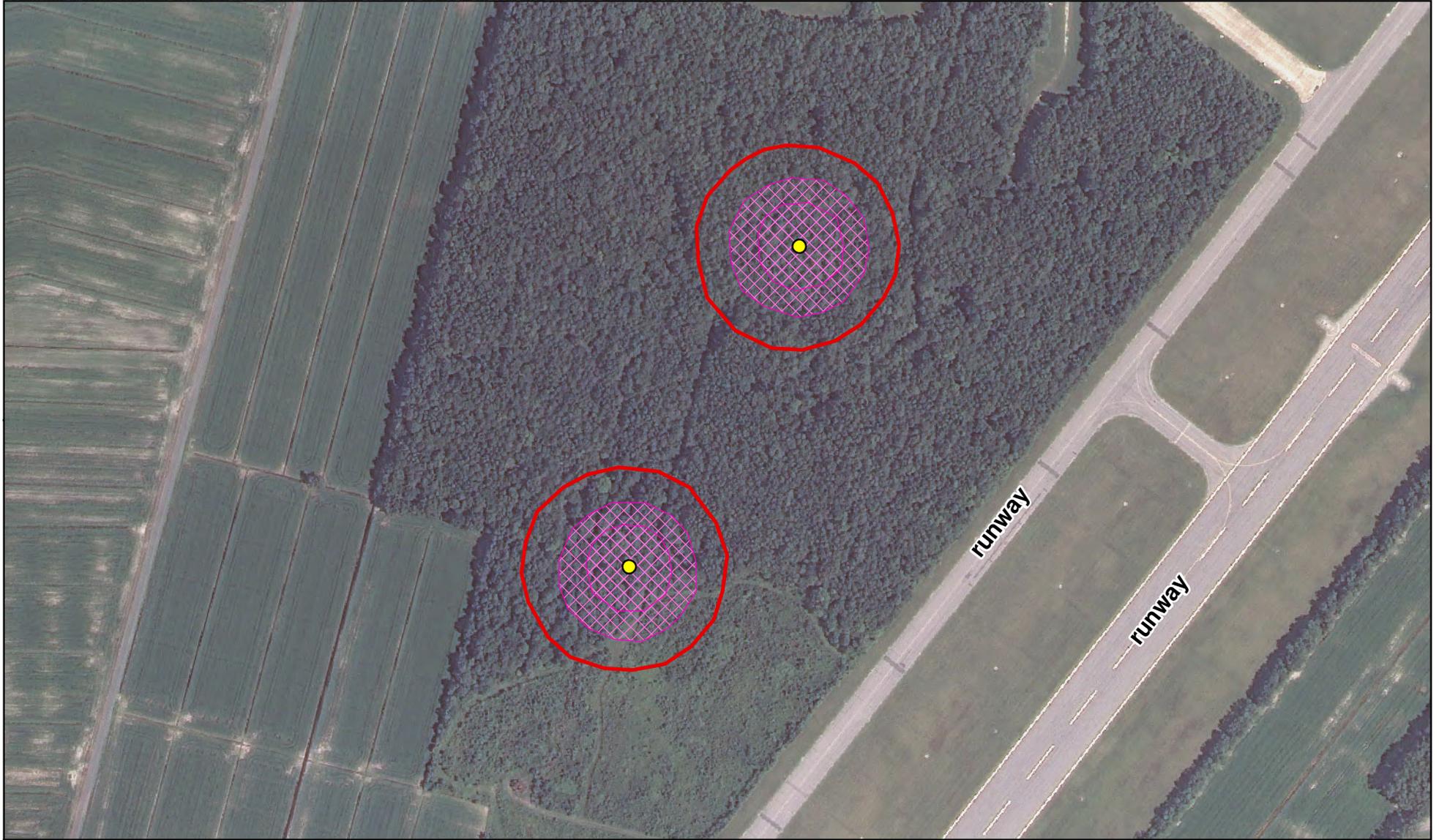


Figure 4-4
Machine Gun Boresight Range Site Layout
NALF Fentress
Chesapeake, Virginia



- Legend**
-  MRP Sites
 -  Target Areas
 -  Target Center



Figure 4-5
Dive Bombing Targets Layout
NALF Fentress
Chesapeake, Virginia



Legend

-  MRP Site
-  Firing Point (Skeet)
-  Firing Point (Trap)

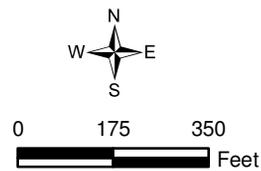


Figure 4-6
Skeet and Trap Range Layout
Dam Neck Annex
Virginia Beach, Virginia



Legend

-  Installation Boundary
-  MRP Site
-  Overlapping MRP Sites



Figure 4-7
Moving Target/Mortar Range (South) and
Mortar Impact Area Layout
Dam Neck Annex
Virginia Beach, Virginia



Legend

-  3-Nautical Mile Restricted Area
-  1000-Yard Prohibited Area
-  Target Location

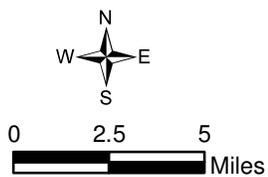
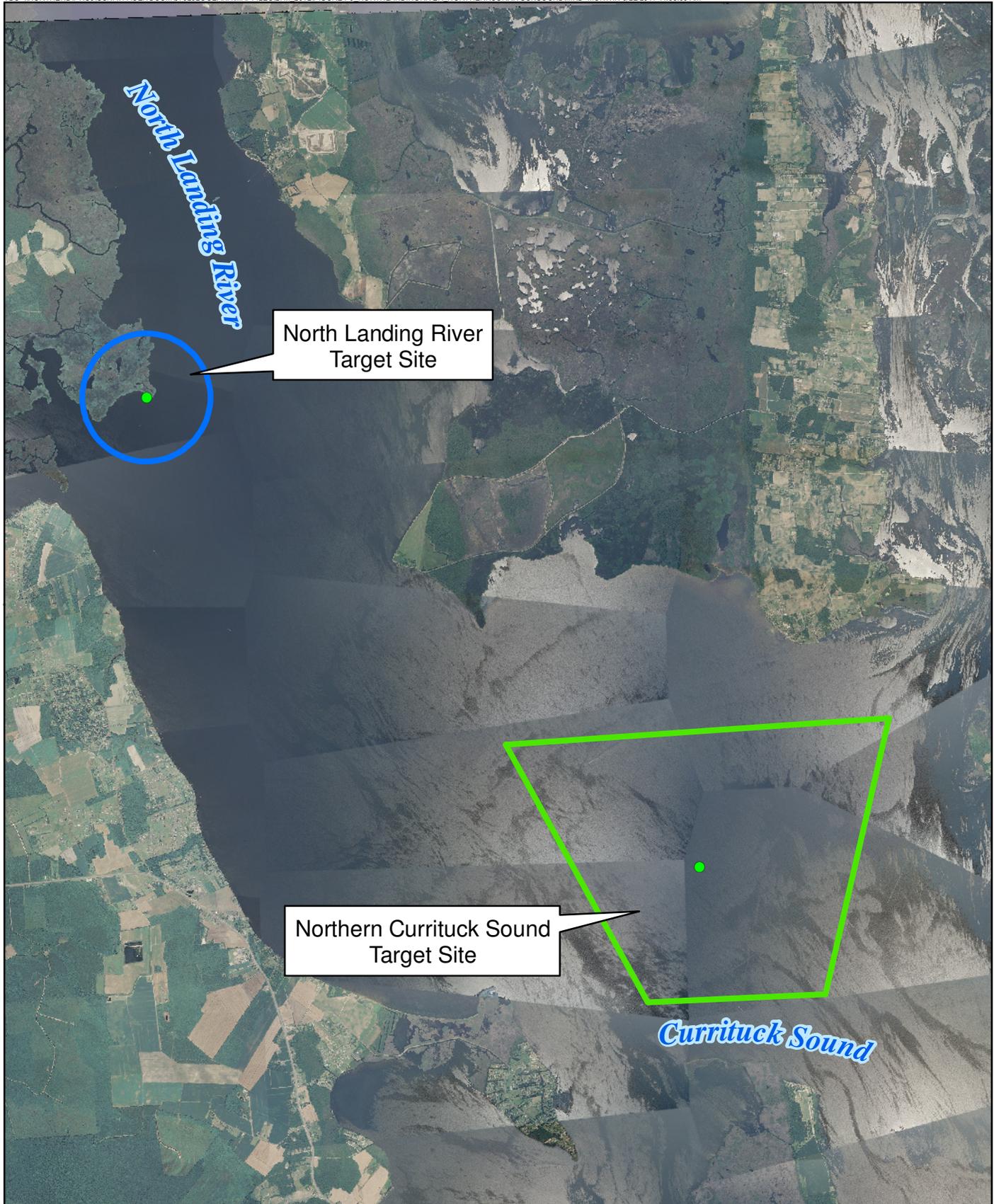


Figure 4-8
Tangier Island Target Layout
NAS Oceana
Virginia Beach, Virginia



Legend

-  Northern Currituck Sound Target Site (3,831 acres)
-  North Landing River Target Site (649 acres)
-  Target Location

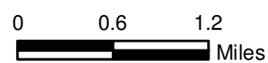
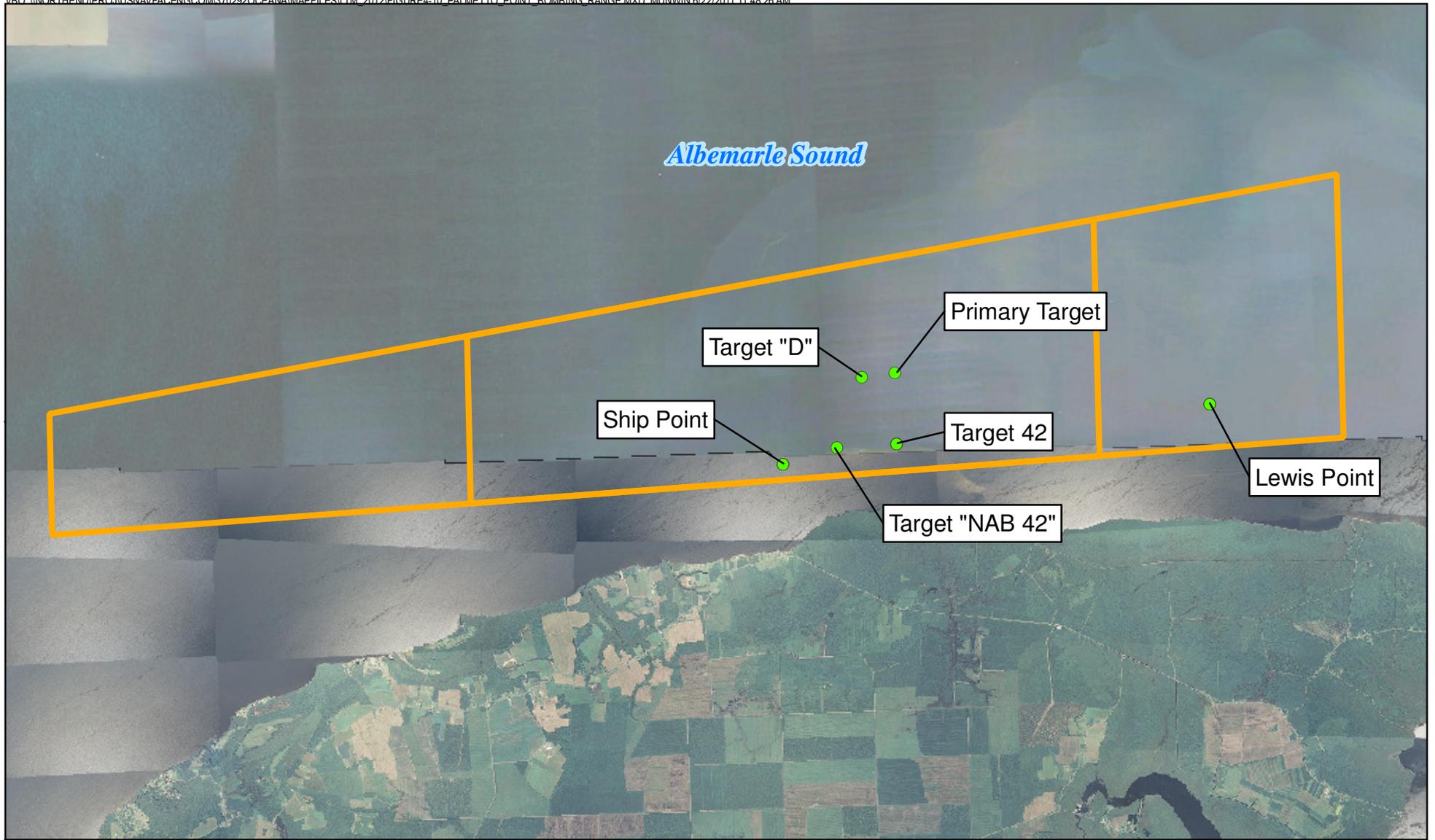


Figure 4-9
North Landing River Target and
Northern Currituck Sound Target
Layout
NAS Oceana
Virginia Beach, Virginia



Albemarle Sound

Legend

-  Palmetto Point Range Area (18,440 acres)
-  Target Location



Figure 4-10
Palmetto Point Bombing Range Layout
NAS Oceana
Virginia Beach, Virginia

Potentially Responsible Party Sites

5.1 Oceana Salvage Yard Access Road and Burial Unit

The only PRP site currently active at NAS Oceana is the Oceana Salvage Yard, located east of NAS Oceana (**Figure 5-1**). The Salvage Yard is privately owned; however, access to the Salvage Yard is provided by a road created between 1955 and 1963, which runs from Oceana Boulevard through Navy property to the Oceana Salvage Yard Property. Use of the Salvage Yard began in the 1960s and has been continuous since that time. During operation of the salvage yard, waste has been disposed on the Navy property to the north and south of the Access Road in numerous debris piles. Additionally, waste was buried in a portion of the Navy property just west of the salvage yard referred to as the "Burial Unit." Interviews of Oceana Salvage Yard personnel indicated that a large volume of crushed car battery casings were brought to the Oceana Salvage Yard in the 1960s and were used as fill material for the road base. From 1993 through 1995, the Salvage Yard property owners purportedly engaged in a cleanup of the Burial Unit. However, the owners did not create a closure plan during the purported cleanup period.

The Oceana Salvage Yard Access Road was first investigated as part of an Environmental Survey of the entire salvage yard (ABB, 1997). In January 2005, CH2M HILL completed a direct push investigation to determine whether the roadway was constructed on crushed car batteries (CH2M HILL, 2005d). Waste containing battery casings was encountered at all but one sample location. The thickness of the layer of battery fragments was approximately 0.5 to 1.0 foot. All soil samples were field screened for lead using field test kits. Many of the samples exceeded the field test kit detection limit of 400 milligrams per kilogram (mg/kg). Four soil samples were collected for laboratory lead analysis. Concentrations of lead detected in these samples ranged from 18.1 mg/kg to 149,000 mg/kg. Lead concentrations detected were found above the USEPA residential soil screening level and therefore were determined to potentially pose unacceptable risks to human receptors.

In 2007, the USEPA issued a Draft Consent Order for the Oceana Salvage Yard Site, including the Access Road and Burial Unit (USEPA, 2007). The Consent Order was never finalized and contamination on the Oceana Salvage property was remediated in accordance with a previous version of the Consent Order. This previous version was finalized, but did not include the Access Road or any other contamination on the Navy portion of the property (USEPA, 2008). However, consistent with the decision of the NAS Oceana Tier I PMT (July 2010), it was agreed that the Navy portion of the site could be remediated in accordance with the 2007 Draft Consent Order. To fulfill the requirements documented by the Draft Consent Order, soil samples were collected in 2010 and 2011 to determine the extent of contamination along the Access Road shoulders and within the Burial Unit. The results of these investigations were used to complete an EE/CA for the site. The preferred alternative identified in the EE/CA was Alternative #2b, Gravel and Asphalt Cap of the Access Road, Excavation of the Access Road Shoulders and Burial Unit with Offsite Disposal and Restoration, and Removal of Non-roadway Associated Debris (CH2M HILL, 2011c). Subsequent to the EE/CA and public comment period, an Action Memorandum was signed by the Navy to serve as a DD for the Site. The non-time critical removal action was completed in 2012 in accordance with the EE/CA (SES-TECH, 2013).

Annual inspections of Ocean Salvage Yard Site including the Access Road and Burial Unit are conducted annually at the site.



- Legend**
-  Extent of Work
 -  Burial Unit Boundary
 -  NAS Oceana Boundary

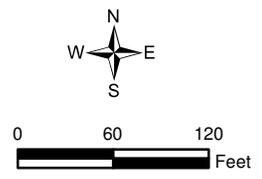


Figure 5-1
Oceana Salvage Yard Access Road
and Burial Unit Layout
NAS Oceana
Virginia Beach, Virginia

SECTION 6

Management Schedules for Active Sites and SWMUs

The current active SWMU and site management schedules are shown in the figures at the end of this section. Schedules for SWMUs 2B, 2C, and 2E are shown on **Figure 6-1** and projected schedules for MRP sites are shown on **Figure 6-2**. A schedule for Oceana Salvage Yard Access Road and Burial Unit was not created since only an annual site inspection occurs at the site.

SECTION 7

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