

7/1/06 - 01466

---

**FINAL**  
**PRELIMINARY ASSESSMENT**  
**NAVAL AMPHIBIOUS BASE**  
**LITTLE CREEK, VIRGINIA**

---

**JULY 2006**

Prepared for:

**Navy Public Works Center**  
Naval Station Norfolk  
9742 Maryland Avenue  
Building Z-140, Suite 211  
Norfolk, Virginia 23511-3095

Prepared by:

**MALCOLM PIRNIE, INC.**  
300 East Lombard Street  
Suite 610  
Baltimore, Maryland 21202

**FINAL**  
**PRELIMINARY ASSESSMENT**  
**NAVAL AMPHIBIOUS BASE**  
**LITTLE CREEK, VIRGINIA**

DoD Contract Number: N62472-02-D-1300

Reviewed and Approved by:

---

Jeffrey R. Bennett, P.E., DEE  
Program Officer  
Malcolm Pirnie, Inc.

---

Al Larkins  
Team Leader  
Malcolm Pirnie, Inc.

Malcolm Pirnie, Inc. prepared this report at the direction of the Engineering Field Activity, Northeast. This document should be used only with the approval of the Engineering Field Activity, Northeast. This report is based, in part, on information provided in other documents and is subject to the limitations and qualifications presented in the referenced documents.

**July 2006**

**Table of Contents**

**ACRONYMS..... IV**

**GLOSSARY OF TERMS..... VI**

**EXECUTIVE SUMMARY ..... 1-1**

**1. INTRODUCTION..... 1-1**

**1.1. PURPOSE ..... 1-2**

**1.2. PROGRAMMATIC FRAMEWORK ..... 1-2**

**1.3. PROJECT MANAGEMENT..... 1-4**

**1.4. PRELIMINARY ASSESSMENT APPROACH ..... 1-4**

**2. INSTALLATION BACKGROUND..... 2-1**

**2.1. LOCATION AND SETTING..... 2-1**

**2.2. INSTALLATION HISTORY ..... 2-2**

**2.3. MUNITIONS RELATED TRAINING/STORAGE/USAGE ..... 2-4**

**3. PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS..... 3-1**

**3.1. CLIMATE..... 3-1**

**3.2. TOPOGRAPHY ..... 3-1**

**3.3. GEOLOGY ..... 3-2**

**3.4. SOIL AND VEGETATION TYPES ..... 3-3**

**3.5. HYDROLOGY..... 3-5**

**3.6. HYDROGEOLOGY..... 3-6**

**3.7. CULTURAL AND NATURAL RESOURCES..... 3-7**

**3.8. ENDANGERED AND SPECIAL STATUS SPECIES..... 3-8**

**4. SUMMARY OF DATA COLLECTION EFFORT..... 4-1**

**4.1. HISTORICAL ARCHIVE REPOSITORIES (OFF-SITE)..... 4-1**

**4.2. PERSONAL INTERVIEWS ..... 4-3**

**4.3. ON-SITE DATA REPOSITORIES..... 4-3**

**4.4. VISUAL SURVEY..... 4-4**

**4.5. OFF-SITE DATA SOURCES ..... 4-4**

**5. SITE CHARACTERISTICS..... 5-1**

**5.1. MWR SKEET RANGE ..... 5-1**

**5.1.1. History and Site Description..... 5-1**

            5.1.1.1. Topography ..... 5-2

            5.1.1.2. Geology ..... 5-2

            5.1.1.3. Soil and Vegetation Types ..... 5-2

            5.1.1.4. Hydrology ..... 5-3

            5.1.1.5. Hydrogeology ..... 5-4

            5.1.1.6. Cultural and Natural Resources ..... 5-4

            5.1.1.7. Endangered and Special Status Species ..... 5-4

**5.1.2. Visual Survey Observations and Results..... 5-5**

**5.1.3. Munitions and Munitions Related Materials Associated with the Site ..... 5-5**

5.1.4. *MEC Presence* ..... 5-6  
5.1.4.1. Known MEC Areas ..... 5-6  
5.1.4.2. Suspected MEC Areas ..... 5-6  
5.1.4.3. Areas Not Suspected to Contain MEC..... 5-6  
5.1.5. *Ordnance Penetration Estimates* ..... 5-7  
5.1.6. *Munitions Constituents* ..... 5-7  
5.1.7. *Contaminant Migration Routes*..... 5-9  
5.1.8. *Receptors*..... 5-10  
5.1.8.1. Nearby Populations ..... 5-10  
5.1.8.2. Buildings Near/Within Site..... 5-10  
5.1.8.3. Utilities On/Near Site..... 5-10  
5.1.9. *Land Use* ..... 5-11  
5.1.10. *Access Controls/Restrictions* ..... 5-11  
5.1.11. *Conceptual Site Model*..... 5-11  
5.1.12. *Summary* ..... 5-19

**APPENDICES**

APPENDIX A: REFERENCES

APPENDIX B: PROJECT SOURCE DATA – GENERAL

APPENDIX C: PROJECT SOURCE DATA – SITE SPECIFIC

APPENDIX D: ORDNANCE TECHNICAL DATA SHEETS

**MAPS**

MAP 2.3-1: AREA LOCATION ..... 2-5  
MAP 5.1-1: VISUAL SURVEY: MWR SKEET RANGE ..... 5-20  
MAP 5.1-2: RANGE/SITE DETAILS: MWR SKEET RANGE ..... 5-21  
MAP 5.1-3: MUNITIONS CHARACTERIZATION: MWR SKEET RANGE ..... 5-22

**FIGURES**

FIGURE 5.1-1: LCAC PAD COVERING A PORTION OF THE FORMER MWR SKEET RANGE ..... 5-1  
FIGURE 5.1-2: EARTHEN BERM CONSTRUCTED OVER A PORTION OF THE FORMER MWR SKEET RANGE ..... 5-2  
FIGURE 5.1-3: VEGETATION AT THE FORMER MWR SKEET RANGE ..... 5-3

FIGURE 5.1-4: CONSTRUCTION DEBRIS ON THE SOUTH SIDE OF THE FORMER  
MWR SKEET RANGE ..... 5-5

FIGURE 5.1-5: TYPICAL SHOT FALL LAYOUT FOR A SKEET RANGE ..... 5-8

FIGURE 5.1-6: 1975 AERIAL OF THE MWR SKEET RANGE ..... 5-9

FIGURE 5.1-7: MC EXPOSURE PATHWAY ANALYSIS ..... 5-18

**TABLES**

TABLE 2.2-1: NAB LITTLE CREEK TIMELINE OF SIGNIFICANT EVENTS ..... 2-3

TABLE 3.8-1: SUMMARY OF KNOWN OR POTENTIAL PROTECTED SPECIES ..... 3-9

TABLE 5.1-1: CONCEPTUAL SITE MODEL INFORMATION PROFILES – MWR SKEET  
RANGE ..... 5-12

**ACRONYMS**

°F	Degrees Fahrenheit
BRAC	Base Realignment and Closure
CD	Compact Disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSM	Conceptual Site Model
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
EFANE	Engineering Field Activity, Northeast
FUDS	Formerly Used Defense Site
FY	Fiscal Year
GIS	Geographic Information Systems
ITRC	Interstate Technology and Regulatory Council
LANTDIV	Atlantic Division
LCAC	Landing Craft Air Cushion
MEC	Munitions and Explosives of Concern
MC	Munitions Constituents
MD	Maryland
mm	Millimeter
MRP	Munitions Response Program
msl	Mean Sea Level
MWR	Morale Welfare and Recreation
NAB	Naval Amphibious Base
NAVFAC	Naval Facilities Engineering Command
NC	North Carolina
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbon
POC	Point of Contact
RG	Record Groups
RPM	Remedial Project Manager
SARA	Superfund Amendment and Reauthorization Act

**FINAL PRELIMINARY ASSESSMENT**

SDZ	Safety Danger Zone
SWMU	Solid Waste Management Unit
U.S.	United States
USACE	United States Army Corps of Engineers
U.S.C.	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VA	Virginia
VDCR-DNH	Virginia Department of Conservation and Recreation, Division of Natural Heritage
WWII	World War II

## **GLOSSARY OF TERMS**

**Base Realignment and Closure (BRAC)** – A Department of Defense (DoD) program that focuses on compliance and cleanup efforts at military installations undergoing closure or re-alignment, as authorized by Congress in four rounds of base closures for 1988, 1991, 1993, and 1995. (DERP Management Guidance, September, 2001)

**Closed Range** – A range that has been taken out of service as a range and that either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a DoD component. (DERP Management Guidance, September, 2001)

**Defense Site** – All locations that are or were owned by, leased to, or otherwise possessed or used by the DoD. The term does not include any operational range, operating storage or manufacturing facility, or facility that is used or was permitted for the treatment or disposal of military munitions. (10 U.S.C. 2710(e)(1))

**Discarded Military Munitions** – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2))

**Explosive Ordnance Disposal (EOD)** – The detection, identification, field evaluation, rendering-safe, recovery, and final disposal of unexploded explosive ordnance (UXO). It may also include the rendering-safe and/or disposal of EO (explosive ordnance) which has become hazardous by damage or deterioration, when disposal of such EO requires techniques, procedures, or equipment which exceed the normal requirements for routine disposal. (OPNAVINST 8027.1G, 14 Feb 92)

**Explosives Safety** – A condition where operational capability and readiness, personnel, property, and the environment are protected from the unacceptable effects of an ammunition or explosives mishap. (DoD Directive 6055.9, July, 1996)

**Formerly Used Defense Site (FUDS)** – Real property that was formerly owned by, leased by, possessed by, or otherwise under the jurisdiction of the Secretary of Defense or the Components (including governmental entities that are the legal predecessors of DoD or the Components) and those real properties where accountability rested with DoD, but where activities at the property were conducted by contractors (i.e., government-owned, contractor-operated (GOCO) properties) that were transferred from DoD control prior to October 17, 1986. The status of a site as a FUDS is irrespective of current ownership or current responsibility within the federal government. (DERP Management Guidance, September, 2001)

**Munitions Constituents (MC)** – Any materials originating from unexploded ordnance, discarded military munitions or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710 (e)(3))

**Munitions and Explosives of Concern (MEC)** – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means unexploded ordnance, discarded military munitions, or munitions constituents (e.g., TNT, RDX) present in high enough concentrations to pose an explosive hazard. (OUSD (AT&L), 18 December 2003)

**Operational Range** – A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities, or, although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities. (10 U.S.C. 101 (e)(3))

**Other than Operational Range** – This term encompasses closed, transferred, and transferring ranges.

**Range** – A designated land or water area set aside, managed, and used for range activities of the DoD. Ranges include firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access and exclusionary areas, and airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 U.S.C. 101(e)(3))

**Transferred Range** – A property formerly used as a military range that is no longer under military control and had been leased by the DoD, transferred, or returned from the DoD to another entity, including federal entities. This includes a range that is no longer under military control but was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager. (DERP Management Guidance, September, 2001)

**Transferring Range** – A range that is proposed to be transferred or returned from the DoD to another entity, including federal entities. This includes a range that is used under the terms of a withdrawal, executive order, act of Congress, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the federal land manager or property owner. An operational or closed range will not be considered a “transferring range” until the transfer is imminent. (DERP Management Guidance, September, 2001)

**Unexploded Ordnance** – Military munitions that have been primed, fused, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. (10 U.S.C. 101(e)(5))

## **EXECUTIVE SUMMARY**

The Department of Defense (DoD) has established the Military Munitions Response Program under the Defense Environmental Restoration Program (DERP) to address munitions and explosives of concern (MEC) (including unexploded ordnance (UXO) and discarded military munitions (DMM)) and munitions constituents (MC) at other than operational military ranges and other sites. Closed, transferred, and transferring military ranges and sites not located on an operational range are considered other than operational. This report addresses other than operational ranges and sites at an active installation. It may include transferring and/or transferred ranges and munitions disposal sites associated with an active installation if they are not included in Base Realignment and Closure (BRAC) or Formerly Used Defense Sites (FUDS).

This report represents a Preliminary Assessment (PA) for the Naval Amphibious Base (NAB) Little Creek, Virginia. The DoD, United States (U.S.) Navy, and U.S. Environmental Protection Agency guidance for conducting and documenting PAs were followed and tailored, where appropriate, to address the unique aspects of MEC and MC.

NAB Little Creek is a 2,215-acre facility located in the northeast corner of Virginia Beach, at the mouth of the Chesapeake Bay in the Tidewater area of Virginia. The official mission of NAB Little Creek is to provide continuously improving support and services to operating forces and shore commands. NAB Little Creek currently serves as the major operating installation for the U.S. Atlantic Fleet Amphibious Forces and supports 80 shore commands.

One site was identified through the inventory process at NAB Little Creek: Morale, Welfare and Recreation (MWR) Skeet Range. The MWR Skeet Range consists of approximately 31 acres located in the northwestern portion of the installation, adjacent to Desert Cove and the Little Creek Channel. The range was used sporadically from approximately 1962 to 1985 for recreational use only by installation personnel. Activities on the range were limited to shooting skeet with shotguns from a firing pad in the southern portion of the site.

## **1. INTRODUCTION**

The Department of Defense (DoD) has established the Military Munitions Response Program under the Defense Environmental Restoration Program (DERP) to address munitions and explosives of concern (MEC) (including unexploded ordnance (UXO) and discarded military munitions (DMM)) and munitions constituents (MC) at other than operational military ranges and other sites. Closed, transferred, and transferring military ranges and sites not located on an operational range are considered other than operational. This report addresses other than operational ranges and sites at an active installation. It may include transferring and/or transferred ranges and munitions disposal sites associated with an active installation if they are not included in Base Realignment and Closure (BRAC) or Formerly Used Defense Sites (FUDS).

The DoD and the United States (U.S.) Navy (Navy) are currently establishing policy and guidance for munitions response actions under the Navy Munitions Response Program (MRP). However, key program drivers developed to date conclude that munitions response actions will be conducted under the process outlined in the National Contingency Plan (40 Code of Federal Regulations 300) as authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 United States Code (U.S.C.) 9605, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), Pub. L. 99-499 (hereinafter CERCLA). This report represents a Preliminary Assessment (PA) for the Naval Amphibious Base (NAB) Little Creek, Virginia (VA), located within the city of Virginia Beach and adjacent to the city of Norfolk. DoD, Navy, and U.S. Environmental Protection Agency (USEPA) guidance for conducting and documenting PAs were followed and tailored, where appropriate, to address the unique aspects of MEC and MC.

This PA Report is organized into the following sections:

- [Section 1](#) – Introduction
- [Section 2](#) – Installation Background
- [Section 3](#) – Physical and Environmental Characteristics
- [Section 4](#) – Summary of Data Collection Effort
- [Section 5](#) – Site Characteristics

The following supporting information is appended to this PA:

- References ([Appendix A](#))
- Project Source Data – General ([Appendix B](#))
- Project Source Data – Site Specific ([Appendix C](#))
- Ordnance Technical Data Sheets ([Appendix D](#))

Two interactive compact discs (CDs) are included with this final version of this report. The first CD includes electronic files of the report text, tables, and figures; appendices; and project source data. The second CD includes interactive Geographical Information System (GIS) maps of the installation and sites.

### **1.1. Purpose**

This PA summarizes the history of munitions use for the Morale, Welfare, and Recreation (MWR) Skeet Range at the NAB Little Creek. The PA provides an assessment of the current conditions with respect to MEC and MC. The PA provides the necessary information for Navy and regulatory decision-makers to: 1) eliminate from further consideration those MEC sites that pose minimal or no threat to public health or the environment; 2) differentiate MEC sites that may not require further munitions response actions from those that will require further investigation and/or munitions response actions; 3) determine if an imminent explosives safety hazard from MEC is present that warrants an accelerated response action; and 4) determine if an imminent hazard from MC to human health or the environment is present and warrants an accelerated response action.

### **1.2. Programmatic Framework**

The regulatory structure for managing Navy MRP sites is guided by a complex mixture of federal, state, and local laws, as well as DoD and Navy regulations and guidance, and provides the necessary information for Navy decision makers. The key legislation, policy, and guidance directing the program includes, but is not limited to, the following:

**Defense Environmental Restoration Program (DERP) Management Guidance (September 2001)**

The DERP Management Guidance establishes a MRP element for MEC and MC defense sites. The history of DERP dates back to the SARA of 1986<sup>1</sup>. The scope of the DERP is defined in 10 U.S.C. §2701(b), which states that the: “Goals of the program shall include the following: ... (1) The identification, investigation, research and development, and cleanup of contamination from hazardous substances, and pollutants and contaminants. (2) Correction of other environmental damage (such as detection and disposal of unexploded ordnance) which creates an imminent and substantial endangerment to the public health or welfare or to the environment ...”

**Draft DoD Directive Military Munitions Response Policy on Other Than Operational Ranges**

The Draft DoD Directive 4715.MRP (September 2003 version) states that munitions response will be conducted “in accordance with CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP)”.

**National Defense Authorization Act (FY02) (Sections 311-312)**

Sections 311-312 of the National Defense Authorization Act of FY02 reinforced the DoD’s 2001 DERP Management Guidance by tasking the DoD to develop and maintain an inventory of defense sites that are known or suspected to contain MEC and MC. Section 311 requires the DoD to develop a protocol for prioritizing defense sites for response activities in consultation with the states and tribes. Section 312 requires the DoD to create a separate program element to ensure that the DoD can identify and track munitions response funding.

The September 2001 Management Guidance for the DERP and the 2002 National Defense Authorization Act, described above, established the MRP. The DoD provides program guidance and methods for conducting a baseline inventory of defense sites containing, or potentially containing, MEC and/or MC. The Navy baseline inventory of sites was completed in FY 2002 and was used to establish the sites where PAs are needed to further evaluate the potential for MEC and MC.

---

<sup>1</sup> SARA was signed into law on October 17, 1986 and amended the CERCLA of 1980, 42 U.S.C. §9601 et seq. Related sections in Title 10 of the U.S.C. (10 U.S.C. §§2702-2710 and §§2810-2811) further define the program.

### **1.3. Project Management**

This PA has been coordinated and managed by the Navy Engineering Field Activity Northeast (EFANE), a component of Naval Facilities Engineering Command (NAVFAC) Atlantic Division. The EFANE performs engineering functions for Navy installations throughout the northeast U.S. and is the Program Manager for this PA. Malcolm Pirnie, Inc. has been contracted to prepare this PA. The Navy Remedial Project Manager (RPM) and the installation points of contact (POCs) for NAB Little Creek provided valuable information and assistance throughout the PA data collection process.

### **1.4. Preliminary Assessment Approach**

CERCLA implementing guidance, which was prepared for sites contaminated with hazardous substances, describes the PA as a limited-scope investigation based upon existing and available data. However, the guidance also states that the PA process developed under CERCLA is not equally applicable to all sites and all contaminants and that variation from the guidance may be necessary. Sites containing MEC are prime examples of sites where the generic CERCLA process is incomplete. Unique explosives safety issues associated with MEC cannot be assessed solely with the parameters developed for chemical and hazardous waste contaminants. While this PA generally follows CERCLA guidance, certain elements of the report have been tailored to address the unique explosives safety aspects of MEC.

The PA process involved collecting and reviewing existing and available information about the site. Data collection activities included off-site and on-site research and interviews. It also included a visual survey to assess physical evidence that might indicate the presence of MEC (e.g., discarded munitions items, ordnance penetration holes, scarred trees) and MC (e.g., ground scarring, stressed vegetation, chemical residue) at the site. The Malcolm Pirnie data collection team conducted the on-site portion of the data collection and visual survey from March 28 through March 29, 2005.

This PA is inclusive and makes use of all available data relating to munitions use at NAB Little Creek, including historical records, field data, anecdotal evidence, interviews with site personnel, and professional knowledge and experience. It is based, in part, on information provided in documents referenced in [Appendix A](#) and is subject to the limitations and qualifications presented in the referenced documents.

## **2. INSTALLATION BACKGROUND**

NAB Little Creek is centrally located near several military installations and the largest Fleet concentration on the Atlantic coast. The official mission of NAB Little Creek is to provide support and services to the Atlantic Fleet operating forces and over 80 shore commands. In addition, NAB Little Creek provides logistics facilities and support services for local commands, organizations, home-ported ships, and other units to meet the amphibious warfare training requirements of the Armed Forces of the U.S.

There are over 75 tenants located at the NAB Little Creek facility, most of which are directly involved with amphibious operations. There are two primary training commands at NAB Little Creek. The mission of the Fleet Training Unit is to provide refresher and underway training of Navy and U.S. Coast Guard ships. The missions of the Expeditionary Warfare Training Group Atlantic are to provide instruction and training for personnel and units of the U.S. Atlantic Fleet, Reserve components, and allied military personnel in order to achieve and maintain an optimum state of readiness for amphibious operations; to provide training in shipboard engineering, naval gunfire support, naval science, and seamanship; and to conduct training for the total force in the doctrine, tactics and techniques of amphibious, Maritime Prepositioned Forces, and waterborne operations, with emphasis on landing forces matters for the Atlantic Fleet. Other tenants at the installation include the Surface Warfare Development Group the Navy and Marine Corps Readiness Reserve Center, the Ordnance Handling Safety/Assist Team Atlantic Fleet, the Aegis Combat Systems Center, and several Amphibious Squadrons and SEAL Teams.

The following sections provide general information about NAB Little Creek, including its location and setting; a brief history of the installation; its missions over time; and a history of munitions related training, storage, and usage.

### **2.1. Location and Setting**

The NAB Little Creek is located in the northeast corner of Virginia Beach at the mouth of the Chesapeake Bay in the Tidewater area of Virginia (see [Map 2.1-1](#)). The 2,215-acre installation includes a 470-acre harbor and over two miles of shoreline along the bay. NAB Little Creek is bordered by the Chesapeake Bay to the north U.S. Highway 60 and Norfolk International Airport Industrial Park to the south and southwest the city of Norfolk to the west and Lake Bradford and

Chubb Lake to the east. In addition, residential communities and several marinas border the NAB Little Creek area. NAB Little Creek is primarily an industrial facility located around three saltwater bodies: Little Creek Cove, Desert Cove, and Little Creek Channel (which connects the two coves with the Chesapeake Bay). The facility is located approximately 20 miles southeast of Newport News, VA, and 30 miles southwest of Suffolk, VA.

The facility formerly controlled three annex properties, including the 6,013-acre Naval Gunfire Support Range at Bloodsworth Island, Maryland (MD); 350 acres at Camp Pendleton, VA; and 21 acres known as Radio Island at Morehead City, North Carolina (NC). Bloodsworth Island is currently under Patuxent River control, and Camp Pendleton is under Oceana control. Radio Island is now controlled by Naval Station Norfolk.

## **2.2. Installation History**

NAB Little Creek was officially commissioned in August 1945 from the combination of four separate but contiguous bases. The development of NAB Little Creek began during the early stages of World War II (WWII) with the purchase of approximately 500 acres of land known as the “Bradford Tract”. The land included sections of the New York, Philadelphia, and Norfolk Railroad property and included a channel that passed through Little Creek Harbor into the Chesapeake Bay. In 1942, approximately 1,800 acres of adjacent farmland were purchased specifically for Navy use. At the start of WWII, Navy planners foresaw a need for landing large numbers of American troops on foreign shores. Four separate bases were constructed: Camp Bradford, Camp Shelton, the U.S. Naval Frontier Base, and the Amphibious Training Base. Camps Bradford and Shelton were named for the former owners of the land. During WWII, Camp Bradford contained approximately half of the present NAB Little Creek. Originally a training base for Navy Seabees, Camp Bradford changed into an amphibious training center for the crews of Landing Ship Tanks in 1943. Camp Shelton was an armed guard training center for bluejackets serving as gun crews on board merchant ships. At the end of WWII, Camp Shelton also served as a separation center. The Frontier Base was the forwarding center for Amphibious Force personnel and equipment. The Amphibious Training Base was the center for all types of amphibious training. Crews at the Amphibious Training Base were trained for Landing Ship Medium, Landing Craft Infantry, Landing Craft Utility, and Landing Craft Vehicle Personnel.

In 1946, NAB Little Creek was designated a permanent installation. During WWII, over 200,000 Naval personnel and 160,000 Army and Marine Corps personnel trained at NAB Little Creek. Troops trained at NAB Little Creek conducted amphibious landings from Africa to Normandy. In 1950, the Navy acquired additional land on the south side of Little Creek Cove for the U.S. Army’s Coastal Defense System. The remaining strip of privately owned land along the east side of Little Creek Cove was purchased in 1976.

Currently, the base supports 61 Navy piers that are home to 28 Navy ships, 36 landing craft air cushions (LCACs), and 27 conventional waterborne landing crafts utilities. Approximately 7,700 military personnel and 1,600 civilians are employed at NAB Little Creek.

[Table 2.2-1](#) provides a timeline of the significant events in the history of NAB Little Creek, VA.

**Table 2.2-1: NAB Little Creek Timeline of Significant Events**

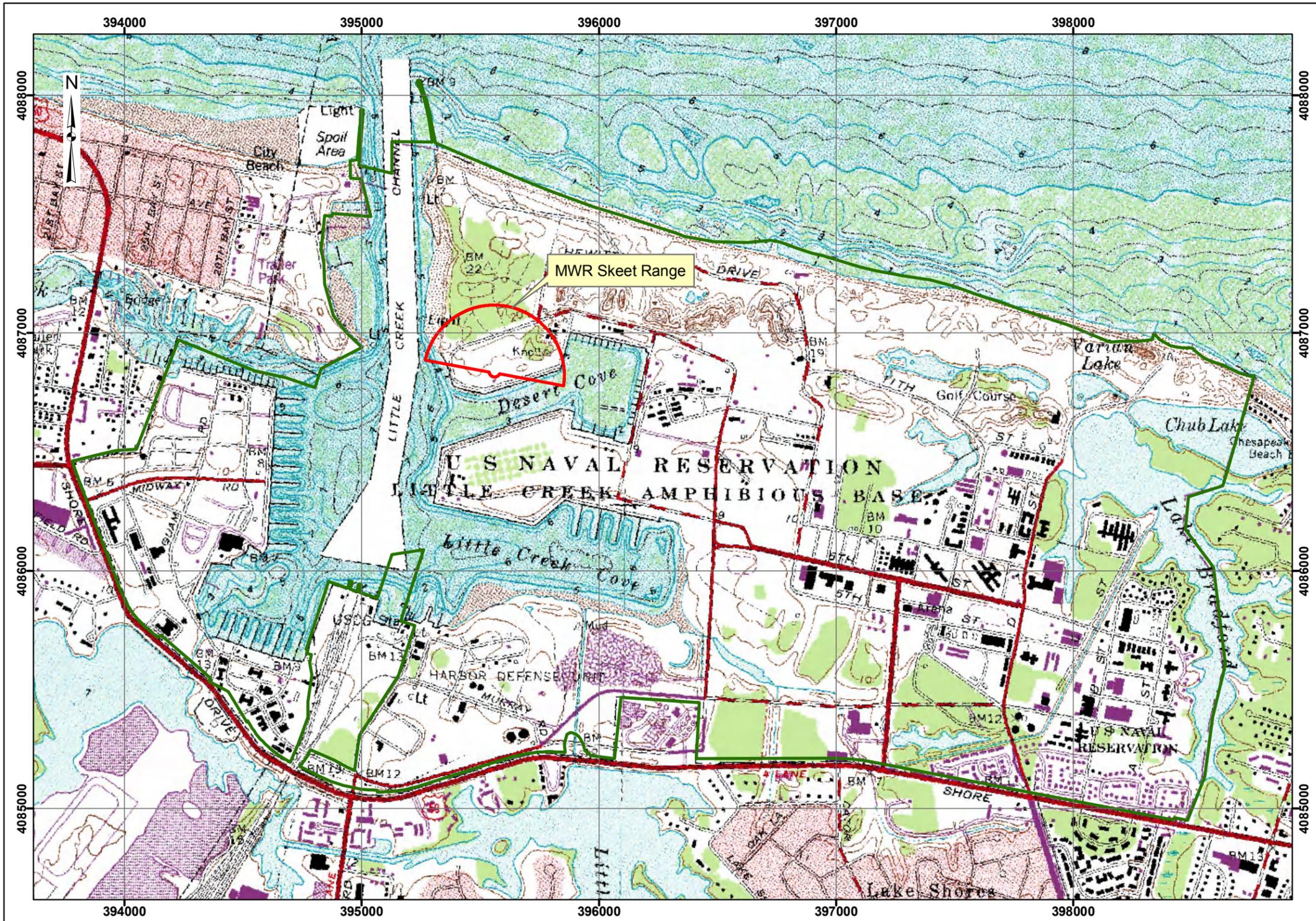
Time Period	Significant Events
1939-1942	<ul style="list-style-type: none"> <li>• The government purchased 500 acres of railroad property prior to WWII. This land was known as the “Bradford Tract”.</li> <li>• In 1941, the Amphibious Training Base was established to train landing craft crews.</li> <li>• In 1942, the government purchased approximately 1,800 acres for Navy use, and Camp Bradford and Frontier Base were constructed. Bradford served as a training base for Seabees. The Frontier Base expanded the area used for training landing craft crews.</li> </ul>
1943-1946	<ul style="list-style-type: none"> <li>• Camp Shelton was established in 1943 as a Naval Armed Guard Training Center.</li> <li>• In 1945, the four bases were combined to form NAB Little Creek.</li> <li>• In 1946, NAB Little Creek was officially designated a permanent installation.</li> </ul>
1947-1950	<ul style="list-style-type: none"> <li>• In 1950, land was added to NAB Little Creek for the U.S. Army’s Coastal Defense System.</li> </ul>
1951-1960	<ul style="list-style-type: none"> <li>• Throughout the mid-1950s, barracks, training facilities, a new water supply system and several piers were constructed.</li> <li>• Total area of installation increased to 2,000 acres by 1959.</li> </ul>
1961-present	<ul style="list-style-type: none"> <li>• U.S. Naval and Marine Corps Reserve Training Center was built in 1964.</li> <li>• In 1968, a port control office was established at Morehead City, NC.</li> <li>• The Navy purchased a strip of land on the east side of Little Creek Cove in 1976.</li> </ul>

### 2.3. Munitions Related Training/Storage/Usage

NAB Little Creek was originally established as a Naval amphibious training base at which thousands of troops trained for beach landings and assaults during WWII. The installation encompasses 2,215 acres on its main facility and over 6,300 acres in annex property that contains numerous training areas, administrative buildings, industrial facilities, and housing facilities. Since the construction of the installation, portions of NAB Little Creek have been used for beach assault training, small arms ranges, landfills, disposal areas, weapons maintenance, and munitions storage. Ordnance components, scrap metal, asbestos, paint, solvents, inorganics, heavy metals, polychlorinated biphenyls, nickel plating baths, chromic acid, silver cyanide, copper cyanide, lacquer, lacquer stripper, perchloroethylene sludge, degreasers, and pesticides have been generated, disposed of, or stored at NAB Little Creek. NAB Little Creek was placed on the National Priorities List in 1999.

**Other than Operational Ranges:** One other than operational range, the MWR Skeet Range, was identified during the inventory and is included within this PA report for NAB Little Creek.

**MWR Skeet Range** – The MWR Skeet Range consists of approximately 31 acres located in the northwestern portion of the installation. The former range was used exclusively for recreational purposes by facility personnel from approximately 1962 to 1985. Activities at the MWR Skeet Range were limited to shooting skeet with shotguns. Firing occurred from a launching pad in the southern portion of the site along Desert Point Road. The Safety Danger Zone (SDZ) extends in a 900-foot arc from the firing area. The location of the MWR Skeet Range at NAB Little Creek is provided on [Map 2.1-1](#).



**Preliminary Assessment  
NAB Little Creek, VA**

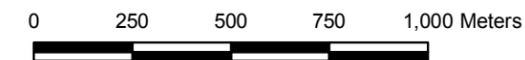


**MALCOLM  
PIRNIE**

Map 2.1-1  
Area Location Map

**Legend**

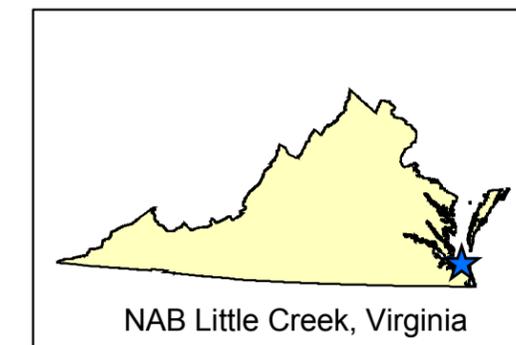
-  Installation Boundary
-  MWR Skeet Range



Data Source: USGS. 7.5 Minute Series  
Topographic Survey Map  
Little Creek, VA

Coordinate System: UTM Zone 18N  
Datum: NAD83  
Units: Meters

Contract: N62472-02-D-1300  
Edition: Final Preliminary Assessment  
Date: July 2006



### **3. PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS**

The following sections provide general information for NAB Little Creek, including its climate, topography, geology, soil and vegetation types, hydrology, hydrogeology, cultural and natural resources, and endangered species.

#### **3.1. Climate**

NAB Little Creek has a continental-type climate with four well-defined seasons. It is located in the middle latitudes of North America, where the atmospheric flow is from west to east. The regional climate and temperatures are moderated by the proximity to the Chesapeake Bay and the Atlantic Ocean, resulting in mild winters and warm summers. High humidity occurs frequently along the coast, with an average relative humidity of 62 percent. The average yearly temperature is 60 degrees Fahrenheit (°F). The coldest period at NAB Little Creek occurs in late January, with an average low of 32°F. Temperatures intermittently drop below freezing from October through March. July is the warmest month, with an average high of 87°F. The growing season lasts approximately 250 days, from mid-March to late November. The average annual precipitation is 45 inches and is concentrated in the late summer months. Prevailing winds average 10 miles per hour from the southwest in summer and northeast in winter.

Due to its coastal location, the NAB Little Creek area is subject to hurricanes and other easterly storms throughout late summer and early fall that can cause high winds, high tides, high precipitation, and flooding. The area is also subject to occasional strong winter storms that travel along the eastern coastline that bring severe storm surge conditions and snow.

#### **3.2. Topography**

NAB Little Creek is positioned in the lowland subprovince of Virginia's Coastal Plain. The surrounding area is characterized by flat, low relief areas ranging from zero to 60 feet in elevation. The area's physiography consists of stepped terraces with gently eastward sloping plains separated by linear, steeper, northward and eastward facing scarps. Elevations at the installation range from mean sea level (msl) along the Chesapeake Bay shoreline and tidal marshes to approximately 12 feet above msl in the inland areas. The greatest change in elevation occurs near the golf course and in the sand dunes along the beaches, where elevations reach up to 40 feet above msl and slopes approach 30 percent.

### **3.3. Geology**

NAB Little Creek lies within the Tidewater region of Virginia, directly adjacent to the Chesapeake Bay, in the coastal most portion of the Atlantic Coastal Plain physiographic province. This portion of southeastern Virginia is underlain by an eastward thickening wedge of marine and non-marine sediments from early Cretaceous to Holocene in age. The thickness of the sedimentary wedge varies from approximately 2,000 feet in the western Tidewater Area to more than 4,000 feet thick in the southeastern portion of the region. Several thousand feet of interlayered unconsolidated sediment, consisting of gravel, sand, silt, and clay deposits, overlay pre-Cretaceous crystalline basement rock.

Historical Coastal Plain sedimentation and deposition were controlled by fluctuations in sea level on a subsiding continental margin. The sediments of the Atlantic Coastal Plain are mostly undeformed, but structurally dip gently to the southeast. Differential subsidence produced a series of regional structural highs and lows, creating a series of arches and basins, or embayments. The Virginia Tidewater Region is located along the axis of a regional structural feature known as the Norfolk Arch, which represents an east-west trending structural ridge that separates the Salisbury Embayment to the north from the Albemarle Embayment to the south. The separation of the basins helped produce characteristic depositional sequences within each. Sediment of both basins consists of unconsolidated marine, alluvial, and lagoonal deposits with those of the Salisbury Embayment characteristically glauconite-rich, while those of the Albemarle Embayment are characteristically carbonate-rich.

Based on the generalized regional stratigraphic column, the geologic units underlying the study area include, from youngest to oldest: Holocene (Recent) deposits, undifferentiated Pleistocene sediments, the Bacons Castle Formation, the Miocene to Pliocene Chesapeake Group, the Paleocene to Eocene Pamunkey Group, Late Cretaceous undifferentiated sediments, and the Early to Late Cretaceous Potomac Formation. The Holocene to Miocene units making up the uppermost 350 to 400 feet of the lithologic section at NAB Little Creek are those most likely to be affected by installation operations. They are discussed in more detail below.

Holocene age deposits include alluvial, marsh, swamp, and beach sediments, while Pleistocene age sediments are considered to be undifferentiated in the region of Virginia. Together, these units have been termed the Columbia Aquifer and consist of beds and lenses of shell containing

light-colored clay, sand, gravel, and silt. Sandy and shelly beds are discontinuous due to the complex marine estuarine environments in which they were deposited.

The Pliocene age Bacons Castle Formation underlies the Columbia Aquifer and was deposited on a shallow, marine shelf in broad lagoonal and bay areas. The unit consists of very fine sandy to silty clay beds containing shells and fine-grained sand. The majority of the Bacons Castle Formation also constitutes a hydrogeologic unit called the Yorktown Confining Unit. The unit is approximately 56 feet thick near the installation and pinches out in the western portion of southeastern Virginia.

The Yorktown and Eastover Formations underlie the Bacons Castle Formation, are Pliocene and later Miocene in age, respectively, and constitute the upper portion of the Chesapeake Group. The Yorktown formation represents a fining upward marine depositional sequence generally consisting of a basal coarse sand and gravel which fines upward through a fine to medium, shelly sand facies into a fine silty clay. The Eastover Formation consists of muddyfine sand interbedded with finer and coarser sand lenses. The unit also contains shells and shell hash, may be locally glauconitic and micaceous, and was deposited in restricted to open shallow seas. The basal portion of the Yorktown Formation combines with the upper portion of the underlying Eastover Formation and the basal portion of the overlying Bacons Castle Formation to constitute the Yorktown-Eastover Aquifer. The lower portion of the Eastover Formation and the upper portion of the St. Marys Formation combine to constitute the St. Marys Confining Unit, which ranges from approximately 40 to 60 feet in thickness. The formations which constitute the lower portion of the Chesapeake Group (the Choptank, Calvert, and Old Church Formations) are unlikely to be affected by installation operations.

### **3.4. Soil and Vegetation Types**

The soils at NAB Little Creek were surveyed in 1988 by the U.S. Department of Agriculture (USDA). According to the soil survey, 68 percent of the soils at NAB Little Creek are mapped as Udorthents, Psammments, or Urban Land complexes. The Udorthents complexes are deep, moderately well drained, loamy soils altered by excavation or covered by earthy fill that are located in primarily urban areas or canals that were once natural tributaries to Little Creek Harbor. Udorthents are characterized by 0-25% slopes, severe erosion potential, variable permeability, and rapid surface runoff. Psammments complexes are deep, well to moderately well

drained, sandy material located in coastal areas where sand dunes have been disturbed or where dredging has occurred. Psamments have 0-25% slopes, very rapid permeability, and slow surface runoff. Urban Land complexes occur in developed portions of the installation where more than 80 percent of the land is covered by impermeable surfaces. This primarily occurs in the administrative and operational areas of NAB Little Creek.

The natural soils at NAB Little Creek consist of Augusta loam, Corolla fine sand, Duckston fine sand, Newhan fine sand, Rappahannock mucky peat, State loam, and Tetotum loam. Augusta loam, State loam, and Tetotum loam are designated as prime farmland and are regulated under the Farmland Protection Policy Act. Only soils of these types that are not built upon are considered prime farmland. The Duckston and Rappahannock soil series are considered hydric by the Natural Resources Conservation Service. These soils form under conditions of saturation or flooding and may indicate the presence of a wetland.

Augusta loams are deep, poorly drained soils with slight erosion potential located on low inland ridges and side slopes. They are characterized by 0-2% slopes, low fertility, moderate permeability, and slow surface runoff. Corolla sands are deep, moderately well to somewhat poorly drained soils occurring on gently sloping low coastal dunes and flats. Corollas have 0-4% slopes, rapid permeability, and slow surface runoff. Duckston sands are deep, poorly drained soils in shallow depressions between dunes and low flats between dunes and marshes. They are characterized by 0-2% slopes, low fertility, very rapid permeability, and slow surface runoff. Newhan sands are deep, excessively drained soils located on undulating to steep grass and shrub covered sand dunes in coastal areas. Newhan soils have 2-30% slopes, low fertility, very rapid permeability, and slow surface runoff. Rappahannock mucky peats are deep, very poorly drained organic soils found in tidal marshes that are flooded daily by saltwater. They have very low slopes (<1%) and moderate permeability. State loams are deep, well drained soils located on broad inland ridges and side slopes. State loams have 0-2% slopes, low fertility, moderate permeability, and slow surface runoff. Tetotum loams are deep, moderately well drained soils on low ridges and side slopes. They are characterized by 0-2% slopes, low fertility, moderate permeability, and slow surface runoff.

NAB Little Creek is primarily developed, with vegetation consisting of mowed lawns, shade trees, and ornamental trees and shrubs. In the undeveloped areas of the installation, ten community types have been identified. Forested areas on NAB Little Creek consist of mesic

mixed hardwood, mesic mixed pine and hardwood, and pine forests, which are common forest types throughout the region. The shoreline areas include vegetated primary and secondary dune systems and adjacent beaches. Several natural communities occur along the shoreline areas, including evergreen maritime forest, maritime dune woodlands, maritime scrub, and maritime dune grasslands.

A recent wetlands survey revealed 650 acres of wetlands at NAB Little Creek. Wetlands are grouped into five major systems: marine, estuarine, riverine, lacustrine, and palustrine. There are no marine or riverine wetlands at NAB Little Creek. Estuarine wetland at the installation includes Little Creek Harbor, several tidal marshes around the harbor, and the shoreline along the Chesapeake Bay. The marshes consist of saltmarsh cordgrass (*Spartina alterniflora*), common reed (*Phragmites australis*), saltmeadow cordgrass (*Spartina patens*), marsh elder (*Iva frutescens*), black needlerush (*Juncus roemerianus*) and saltgrass (*Distichlis spicata*). The lacustrine wetlands at NAB Little Creek include the larger lakes, such as Lake Bradford, Chubb Lake, Bigalow Hall Lake, and Lake 2. Vegetation is comprised of the yellow pond lily (*Nuphar lutea*), pickerelweed (*Pontederia cordata*), and common arrowhead (*Sagittaria latifolia*). Palustrine wetlands primarily include the freshwater marshes and forested and scrub-shrub communities around the installation's lake and pond margins. The forested communities are dominated by black gum (*Nyssa sylvatica*) and sweet gum (*Liquidambar styraciflua*) trees. Scrub-shrub communities contain sweet pepperbush (*Clethra alnifolia*), swamp rose (*Rosa palustris*), groundsel tree (*Baccharis halimifolia*), swamp rosemallow (*Hibiscus moscheutos*), and buttonbush (*Cephalanthus occidentalis*).

### **3.5. Hydrology**

Approximately 586 acres of NAB Little Creek are covered by water. Surface water bodies at the installation include Little Creek Harbor, Lake Bradford, Chubb Lake, Varian Lake, Bigalow Hall Lake, and several small lakes and ponds surrounding the golf course area. Little Creek Harbor is a 470-acre tidal estuary of the Chesapeake Bay. The harbor includes Desert Cove, Little Creek Cove, Little Creek Channel, and Fisherman's Cove. Apart from the saltmarsh fringe on Little Creek Cove and an undeveloped beach along the LCAC landing pad, the shoreline consists almost entirely of bulkhead, riprap, and quay walls. According to the installation's Integrated Natural Resources Management Plan, water quality in Little Creek Harbor is fair; however, sediments have been found to contain excessive amounts of heavy metals and volatile/semi-volatile organic compounds. Little Creek is the major tributary that flows into the harbor from

the west through Fisherman's Cove. Lake Bradford is the largest freshwater body, consisting of 68 acres. Chubb Lake is the second largest at 21 acres. Varian Lake, Bigalow Hall Lake, and the golf course water bodies are smaller, ranging from 1.5 to 1.7 acres in area. In addition to surface water bodies, NAB Little Creek contains two miles of Chesapeake Bay shoreline.

NAB Little Creek is located within the Chesapeake Bay watershed. Little Creek Harbor is a major tributary to the Chesapeake Bay, which directly or indirectly drains all but the beachfront area of the installation. The eastern half of the installation drains into Lake Bradford or Chubb Lake, both of which drain into the harbor through a canal. A weir on the canal artificially controls the flow from these lakes. The golf course area drains into the smaller lakes and ponds, which are connected to Chubb Lake through pipes and channels. Two municipal reservoirs immediately south of NAB Little Creek (Lake Whitehurst and Little Creek Reservoir) have overflow channels that also discharge into the harbor.

A large portion of the installation lies within the 100-year or 500-year floodplain associated with the Chesapeake Bay, Little Creek Harbor, and installation lakes, ponds, and channels. The installation also contains 650 acres of wetlands. Wetlands and floodplains are valuable habitat for wildlife, important groundwater recharge areas, and filters for surface water runoff, thus minimizing siltation and erosion. They are also important aesthetic buffers, recreational areas (in some cases), and scientific resources.

### **3.6. Hydrogeology**

NAB Little Creek lies within the Lynnhaven River Basin, which drains into the Chesapeake Bay. The hydrogeologic framework of the NAB Little Creek area consists of a surficial aquifer and eight underlying confined aquifers separated by eight confining units. Only the surficial Columbia Aquifer and the underlying confined Yorktown-Eastover Aquifer are likely to be affected by installation operations; thus, they are the only units that will be discussed further.

*Columbia Aquifer:* The Columbia Aquifer is a Virginia Hydrostratigraphic Unit which represents any Holocene or Pleistocene deposits within the region. Sandy and shelly units occur as thin beds and lenses and represent the major water bearing units. These units are heterogeneous and discontinuous due to the complex depositional environments in which they were deposited. The Columbia Aquifer is generally unconfined, but clayey beds and lenses within the unit may

produce leaky or confined conditions. The Columbia Aquifer is underlain by the Yorktown Confining Unit. There are no potable wells from the Columbia Aquifer near NAB Little Creek.

*Yorktown-Eastover Aquifer:* The Yorktown Confining Unit is underlain by the Pliocene and late Miocene age units that constitute the Yorktown-Eastover. The aquifer is thickest in the northeast Virginia Coastal Plain and is approximately 280 feet thick at NAB Little Creek. The aquifer is confined in the westernmost portion of the Virginia Coastal Plain, but is confined in eastern Virginia. The formation is heterogeneous and anisotropic. The formation is recharged primarily through leakage from the overlying Columbia Aquifer. The Yorktown Aquifer is used extensively for domestic and public water supply throughout the eastern Coastal Plain; however, there are no reported potable wells from this aquifer on NAB Little Creek.

In Virginia Beach, domestic supplies of groundwater are available from depths of less than 200 feet. Naturally high concentrations of dissolved metals, such as iron and chloride, often give an unpleasant taste to the groundwater. Saltwater intrusion is often a problem with shallow aquifers in this region. Groundwater from depths greater than 200 feet is generally too saline for drinking water. The entire region surrounding Virginia Beach was designated a Groundwater Management Area by the state in 1976 due to concerns over declining water levels.

The drinking water at NAB Little Creek comes from several sources: the municipal water supply, which obtains water from Lake Gaston, a reservoir 100 miles away; the city of Norfolk system; and several in-town supplemental reservoirs. Three of these smaller reservoirs, including Lake Whitehurst, Smith Lake, and Little Creek Reservoir, are located immediately south of the installation. The city of Norfolk maintains four deep wells, screened in the Upper/Middle or Middle Potomac Aquifers, that are used as a secondary source for emergency or severe drought conditions. There are four wells, screened in the Yorktown Aquifer, at NAB Little Creek. These wells are located on the golf course and are used for irrigation purposes only.

### **3.7. Cultural and Natural Resources**

A preliminary archeological study performed in 1999 revealed that there are no archeological resources of concern at NAB Little Creek. In addition, there are no structures on installation eligible for the National Historic Preservation Act.

NAB Little Creek is divided into three natural management units based on ecological and land use considerations: Urban Areas (77 %), Natural Areas (15 %), and Beaches and Dunes Areas (8 %). These units are used to effectively manage the natural resources issues at NAB Little Creek. Natural resources include the diverse marine and coastal habitats present at NAB Little Creek, including several rare habitats and species. Marine resources, including marine mammals, sea turtles, fish, and shellfish, are protected by such regulations as the Marine Mammal Protection Act and the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801-1883). Natural coastal resources include wetlands, floodplains, estuaries, beaches, and dunes, as well as the wildlife supported by these habitats. The Virginia Coastal Resources Management Program enforces several policies on coastal resources at NAB Little Creek, including dune protection and nonpoint/point source pollution control.

Several species of birds are protected at NAB Little Creek through the Nest Box Program, which provides artificial nest boxes or platforms in areas where there are few natural trees. Common species that utilize these structures include ospreys, eastern bluebirds, and ducks.

Although hunting is not permitted at NAB Little Creek, saltwater and freshwater fishing are permitted in specific areas along the shore and freshwater lakes. Freshwater fishing at Lake Bradford, Chubb Lake, Varian Lake, and Bigalow Hall Lake is permitted year-round.

### **3.8. Endangered and Special Status Species**

The Virginia Department of Conservation and Recreation, Division of Natural Heritage (VDCR-DNH) is responsible for inventory and management of Virginia's natural heritage resources. VDCR-DNH conducted a survey in 1998 for rare, threatened, or endangered plant and animal species at NAB Little Creek. There are no federally listed threatened or endangered species documented at the installation; however, there are five state-listed rare plants and one state-listed rare bird. The survey also identified several rare natural communities. Only the maritime evergreen forest and maritime mixed forest are ranked in Virginia as extremely rare locally. Other rare communities include maritime dune woodlands, maritime dune grasslands, maritime swamp forests, and interdune ponds and are rare in Virginia, but do not have a state rare rank.

Protected species that are known or have the potential to inhabit NAB Little Creek are listed in [Table 3.8-1](#):

<b>Table 3.8-1: Summary of Known or Potential Protected Species</b>	
<b>Ecological Receptors</b>	<b>Species</b>
Federal Endangered	None
Federal Threatened	None
State Endangered	None
State Threatened	None
State Rare	Plants: bluejack oak, Virginia beach pinweed, tall yellow-eyed grass, wild olive, and Spanish moss Birds: least tern
Other Ecological Receptors	Common fauna includes ospreys, eastern bluebirds, green turtles, northern water snakes, muskrats, gray fox and largemouth bass.

## **4. SUMMARY OF DATA COLLECTION EFFORT**

Five primary sources of information were researched as part of the data collection effort for the PA. The sources of data included:

- 1) Historical archives
- 2) Personal interviews
- 3) Installation data repositories
- 4) Visual survey
- 5) Off-site data sources and repositories, such as local libraries and museums

These five sources of data are discussed below, along with their relative application to this PA.

### **4.1. Historical Archive Repositories (off-site)**

The data collection team reviewed archival records located at the National Archives in College Park, MD, and in Washington, D.C. The data collection team researched the following records and record groups (RG) for documents relating to munitions usage at NAB Little Creek. An asterisk (\*) indicates the material was photocopied.

#### **Textual Records:**

##### **RG 71, Bureau of Yards and Docks**

Naval Property Case Files, Boxes 1269\*, 1270\*, 1271\*, 1272\*  
Entry 1024, Miscellaneous Correspondence, Box 1\*

##### **RG 72, Bureau of Aeronautics**

Entry 67, Confidential Correspondence, 1922-1944, Boxes  
Entry 67-A, Confidential General Correspondence, 1945, Box  
Entry 62-B, General Correspondence, 1943-1945, Boxes  
Entry 1001-A, Unclassified General Correspondence, 1948-1949, Box  
Entry 1001-B, Unclassified General Correspondence, 1950, Box  
Entry 1001-C, Unclassified General Correspondence, 1951, Box 203  
Entry 1001-E, Unclassified General Correspondence, 1953, Box 281  
Entry 1001-F, Unclassified General Correspondence, 1954, Box  
Entry 1001-G, Unclassified General Correspondence, 1955, Box 215  
Entry 1001-H, Unclassified General Correspondence, 1956, Box 203  
Entry 1001-I, Unclassified General Correspondence, 1957, Box 208  
Entry 1001-J, Unclassified General Correspondence, 1958, Box 161  
Entry 1001-K, Unclassified General Correspondence, 1959, Box 149

**RG 74, Bureau of Ordnance**

Entry 25-I, General Correspondence, 1942, Confidential, Boxes  
Entry 25-J, General Correspondence, 1942, Restricted, Boxes  
Entry 25-O, General Correspondence, 1943, Restricted, Boxes  
Entry 25-U, General Correspondence, 1944, Confidential, Box  
Entry 25-V, General Correspondence, 1944, Restricted, Boxes  
Entry 1001, General Correspondence, 1907-1949, Box  
Entry 1003 A-B, General Correspondence, 1948-1959, Boxes  
Entry 1003-A, Office of Administration, General Subject Files, 1945, Box  
Construction and Procurement Subject Files  
    1945, Box 1221\*  
    1946, Box 265  
    1947, Box 199

**RG 407, Adjutant General**

Entry 363, Unclassified Project Decimal Files, 1953-1954, Box

**Cartographic Records:**

**RG 23, Coast and Geodetic Survey**

Charts: 137, 404, 1227

**RG 71, Bureau of Yards and Docks**

Maps for facilities 562\*  
Series I Microfilm, Roll 598  
Series II Microfilm, Reels 533\*, 534\*, 535\*, 536\*, 1364, 1365

**RG 77, Department of the Army**

Army Mapping Service, AMS-

**RG 385, Naval Facilities Engineering Command, 1917-1989**

Architectural and Engineering Plans, Boxes 23-32  
Restricted UIC Architectural and Engineering Plans, Boxes A22-A24

**Aerial Photos:**

**RG 145, ASCS**

Can ON 40042\*

**RG 373, Defense Intelligence Agency**

Cans ON 3440\*, 3865\*, 4406\*, 4833, 4844\*, 4860\*, 4920\*

**Still Photos:**

**RG 71, Bureau of Yards and Docks**

Entry 71-CA, Construction Projects, 1879-1943, Boxes  
Entry 71-CB, Construction Projects, 1940-1943, Boxes  
Entry 71-CP, Construction and Aerials, 1941-1953, Boxes

**RG 80, Department of the Navy**

80-G, Boxes 48\*, 96\*, 185, 278\*, 290\*, 486\*, 661\*, 953\*, 961, 1041\*, 1915\*, 1916\*

**RG 428, Department of the Navy**

Entry 428-GX, Index to Photo Files, Box

The archival data provided general information about the installation, including historical munitions use.

#### **4.2. Personal Interviews**

During the site visit, the following NAB Little Creek personnel were interviewed:

- Ms. Lora Fly (RPM, NAVFAC Mid-Atlantic Division)
- Ms. Dawn Hayes (NAVFAC, Atlantic Division)
- Mr. Bill Niven (Public Works, NAB Little Creek)
- Ms. Mary Lou Willard (MWR, NAB Little Creek)
- Mr. Kent Lyons (Real Estate, NAB Little Creek)
- Mr. Billy Sandros (Architect, NAB Little Creek)

In addition, the following personnel were contacted after the site visit:

- Mr. Neil Barnes (NAVFAC Mid-Atlantic IT Department)
- Mr. Eric Jackson (Regional Geographic Information Systems (GIS) Division, Naval Station Norfolk)

#### **4.3. On-Site Data Repositories**

Several environmental reports and related documents were available at the NAB Little Creek Environmental Office. Documents included: Final Site Investigation for Solid Waste Management Units (SWMUs) 7 and 8; Final Remedial Investigation, Human Health Risk Assessment, and Ecological Risk Assessment for SWMU 7; and the Integrated Natural Resources Management Plan. These documents provided the majority of the information collected for NAB Little Creek. This specifically included information on the habitat, geology, hydrogeology, soil, historical background and documented weapons usage at the installation. Several installation maps and one 1975 aerial photomap were also available at the NAB Little Creek Environmental

Office. The maps from 1962, 1971, 1985, 2000 and 2005 provided useful information on land use associated with the installation over time.

#### **4.4. Visual Survey**

The data collection team conducted a visual survey of the site as part of the data collection effort for the PA. The purpose of the visual survey was to identify any MEC ordnance related materials (e.g., expended rounds, fragmentation, range debris, or old targets), any evidence of MC (such as ground scarring, stressed vegetation, or chemical residue) or surface features that could provide additional information to aid in the characterization of the site. The visual survey was also used to enhance, augment, or confirm the archival data and, in some cases, provide new data to the team. A description of the area surveyed and the results of the survey are provided in [Section 5](#).

#### **4.5. Off-Site Data Sources**

The data collection team contacted the Geo-Readiness Center to obtain basic GIS layers for the report mapping effort. The Geo-Readiness Center is a GIS center for the NAVFAC, administered by NAVFAC Headquarters for the purposes of DoD and Navy BRAC analysis, force protection, anti-terrorism, and homeland defense. All GIS layers for NAB Little Creek are updated and regulated through the Geo-Readiness Center.

## 5. SITE CHARACTERISTICS

The following sections provide site-specific information about the site located on NAB Little Creek, including history and site description, land use, access controls and restrictions, visual survey observation and results, contaminant migration routes, and receptors.

### 5.1. MWR Skeet Range

#### 5.1.1. *History and Site Description*

The MWR Skeet Range is approximately 31 acres located in the northwestern portion of the installation, adjacent to Desert Cove and the Little Creek Channel. According to installation personnel, the range was used exclusively for recreational purposes from approximately 1962 to 1985. Activities on the range were limited to shooting skeet with shotguns from a firing pad in the southern portion of the site. There were three buildings associated with the range: the high house, the low house and a storage building (Building 3902). A 1962 installation map labels a 900-foot SDZ extending north from the MWR Skeet Range. The SDZ overlaps a portion of Desert Cove and the Little Creek Channel. The MWR Skeet Range is not labeled on any maps prior to 1962.



**Figure 5.1-1: LCAC pad covering a portion of the former MWR Skeet Range**

In approximately 1985, a concrete landing pad for LCACs was constructed on top of the majority of the former MWR Skeet Range ([Figure 5.1-1](#)). The entire area was graded prior to construction. A man-made, earthen berm and concrete wall were constructed around the LCAC pad, which cut across the middle of the former firing area. The buildings on-site were demolished prior to construction of the landing pad. Approximately 75% of the former MWR Skeet Range is currently covered with concrete. The majority of the firing area is currently under the earthen berm. A portion of the SDZ overlaps a

small, undisturbed beach to the far west and a group of trees on the far eastern portion of the former range. There are no visible signs of the former skeet range remaining.

#### **5.1.1.1. Topography**

While an operational range, topography of the MWR Skeet Range was primarily flat to gently sloping towards Desert Cove and Little Creek Channel. The elevation ranged from zero to 15 feet above msl, with the higher elevations in the northern portion of the SDZ. In 1985, an LCAC landing pad was constructed on top of the former skeet range, and the majority of the area was either covered by concrete or graded. The entire topography of the area changed when a steep earthen berm was constructed across the middle of the firing



**Figure 5.1-2: Earthen berm constructed over a portion of the former MWR Skeet Range**

area leading up to the concrete LCAC pad. The earthen berm and steep topography of the site are shown in [Figure 5.1-2](#). Desert Point Road, along the southern edge of the former range, is at an elevation of zero feet above msl. The area of the LCAC landing pad is currently a plateau at approximately seven feet above msl.

#### **5.1.1.2. Geology**

There is no well data available for the MWR Skeet Range; therefore, the site-specific geology of the range is unknown. A description of the regional geology can be found in [Section 3.3](#).

#### **5.1.1.3. Soil and Vegetation Types**

The majority of the former MWR Skeet Range is developed and covered by concrete for the LCAC landing pad. A portion of the SDZ overlaps adjacent water bodies and beaches. According to the 1988 soil survey conducted by the USDA, there are three soils types associated with the former MWR Skeet Range. The central and northern portion of the site is classified as Corolla Fine Sand, which are deep, moderately well to poorly drained soils with rapid

permeability, slow surface runoff, and moderate erosion potential. This portion of the former range is almost entirely covered by concrete with no exposed soil remaining. The southern and eastern portions of the former range are classified as Undulating Psamments, which are deep, sandy soils that are well to moderately well drained, with very rapid permeability, slow surface runoff, and severe erosion potential. The grassy and wooded areas of the former MWR Skeet Range fall into this soil classification. A small portion of the site is classified as



**Figure 5.1-3: Vegetation at the former MWR Skeet Range**

Newhan-Corolla Fine Sand, which are moderately well to poorly drained soils with severe erosion potential. This portion of the site is currently developed.

There is very little vegetation remaining at the MWR Skeet Range. The western portion of the SDZ overlaps a natural beach and a small area of Mesic mixed pine hardwood forest. The forests are dominated by various oak species, sweet gum, and tulip poplar. The southern portion of the site and former firing point is currently an open, grassy area surrounded by a narrow strip of pine forest bordering Desert Point Road. The pine forests at NAB Little Creek are dominated by loblolly pine with a sparse understory of greenbrier and honeysuckle. The pine forest continues into the southeastern portion of the site. The current vegetation in the southern portion of the range is shown in [Figure 5.1-3](#).

#### **5.1.1.4. Hydrology**

The MWR Skeet Range firing area is positioned approximately 150 feet north of Desert Cove and 600 feet east of Little Creek Channel. Portions of the SDZ overlap Little Creek Channel to the west and Desert Cove to the east. Surface water runoff from the site drains directly into either of the adjacent water bodies. The MWR Skeet Range is located within two different flood zones. The shoreline areas of the range are located within the 100-year floodplain. The remaining area is located within the 500-year floodplain.

#### **5.1.1.5. Hydrogeology**

[Section 3.6](#) provides a description of hydrogeology for NAB Little Creek. There are no wells located on the MWR Skeet Range; however, there are two monitoring wells adjacent to the southeast side of the range. The two wells, OG-6 and OG-7, are part of the monitoring network for the adjacent fuel pipeline and are sampled annually for petroleum constituents. Depth to groundwater in the first quarter of 2006 averaged 7.9 ft and 8.8 ft for OG-6 and OG-7, respectively. The wells are not used for drinking water. The nearest groundwater supply wells at NAB Little Creek are located on the golf course approximately one-half mile east of the MWR Skeet Range and are used for irrigation purposes only.

#### **5.1.1.6. Cultural and Natural Resources**

There are no cultural resources identified on NAB Little Creek, including the area of the former MWR Skeet Range. Natural resources general to NAB Little Creek can be found in [Section 3.7](#). Apart from the beach area, the MWR Skeet Range is located within the Urban Area Natural Resources Management Unit of the installation, characterized by developed areas with wooded patches. There are only a few patches of woods and beach along the southern and eastern portions of the MWR Skeet Range. The remaining area is developed and primarily covered by concrete.

One osprey platform is located on the western portion of the range adjacent to the beach area. Osprey nesting season lasts from April until July or August. Fishing is permitted from the beach area only.

#### **5.1.1.7. Endangered and Special Status Species**

While there are no site-specific endangered or special status species known to inhabit the MWR Skeet Range, there are several species identified on the installation as a whole. There is no information available on the specific locations of the species within the installation; however, these species have the potential to occupy the MWR Skeet Range. While there are no federally listed species, there are several state rare species. State rare plants include Virginia Beach pinweed, Bluejack oak, Spanish moss, wild olive, and tall yellow-eyed grass. There is also one identified state rare bird, the least tern, which is known to inhabit the NAB Little Creek area.

### 5.1.2. *Visual Survey Observations and Results*

A site visit to NAB Little Creek took place March 28 through March 29, 2005. The visual survey of the range was conducted by Mr. Al Larkins and Ms. Jennifer Buckels of Malcolm Pirnie, Ms. Hayes, NAVFAC Atlantic Division, and Ms. Fly, NAVFAC Mid-Atlantic Division. The MWR Skeet Range is accessible by Desert Point Road, which runs along the southern edge of the site. The southern portion of the site is an open grassy area extending approximately 150 feet from the



**Figure 5.1-4: Construction debris on the south side of the former MWR Skeet Range**

road, up an earthen berm, to a concrete wall that surrounds the LCAC area. The berm is approximately 20 feet high, and the wall is six feet high. The concrete wall was constructed as a noise attenuation barrier and encloses the entire LCAC landing pad. The berm and wall cut through the middle of the former skeet range firing area. The remainder of the firing area and the 900-foot SDZ are currently a concrete landing pad for LCACs. There were no visible signs of the former high or low houses, the former storage building, or the firing pad. A pile of construction debris, including wood, concrete, and a portion of a chain link fence, is located adjacent to the road on the southern portion of the site, as shown in [Figure 5.1-4](#). The origin of the debris is unknown. Results of the visual survey are illustrated on [Map 5.1-1](#) located at the end of [Section 5.1](#). Only a small portion of the site was visually observed due to security restrictions surrounding the LCAC landing pad. Additional range details are provided on [Map 5.1-2](#).

### 5.1.3. *Munitions and Munitions Related Materials Associated with the Site*

This section describes the munitions or munitions related materials known or suspected to be at the site. This includes both MEC and non-hazardous munitions related scrap (e.g., fragmentation, base plates, inert mortar fins).

The MWR Skeet Range was used by facility personnel for recreational purposes only. As only small arms were used on-site, there are no MEC associated with the MWR Skeet Range.

Based on the information obtained during the data collection process, the MWR Skeet Range is not suspected to contain chemical warfare materiel filled munitions, electrically fuzed munitions, or depleted uranium associated munitions.

#### ***5.1.4. MEC Presence***

The entire site has been subdivided and categorized into one of three levels of MEC presence including: known MEC areas, suspect MEC areas, and areas where no evidence exists to indicate that MEC are known or suspected to be at the site. The MEC presence is discussed below. [Map 5.1-3](#) illustrates the munitions characterization of the MWR Skeet Range and is provided at the end of [Section 5.1](#).

##### **5.1.4.1. Known MEC Areas**

According to historical documents and information obtained during the data collection process, there is no evidence of MEC on-site. Thus, there are no known MEC areas associated with this site.

##### **5.1.4.2. Suspected MEC Areas**

According to historical documents and information obtained during the data collection process, there is no evidence of MEC on-site. Thus, there are no suspected MEC areas associated with this site.

##### **5.1.4.3. Areas Not Suspected to Contain MEC**

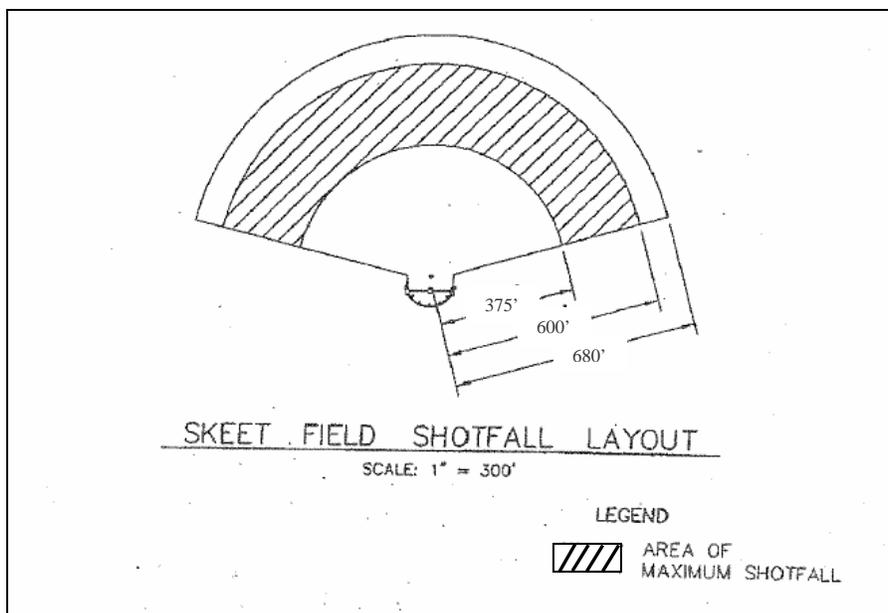
According to historical documents and information obtained during the data collection process, there is no evidence of MEC on-site. Thus, the entire MWR Skeet Range is considered an area not suspected to contain MEC.

### ***5.1.5. Ordnance Penetration Estimates***

For small arms ranges, the Interstate Technology and Regulatory Council (ITRC) has prepared a document titled, “Characterization and Remediation of Soils at Closed Small Arms Firing Ranges”, dated January 2003, to provide information on the general layout of small arms ranges, as well as information on areas that may be impacted with MC and/or MEC as a result of range use and the characteristics of the munitions used. According to the ITRC guidance, the penetration depth of small arms on the range floor is one foot or less. The document states that rounds that impact the range floor are typically a flat trajectory that fell short of or missed the target or those resulting from ricochet, and these fragments are usually found within the top six inches of soil. For trap and skeet ranges, the ammunition is dispersed as pellets over a small area in the direction of fire. According to the 1958 United States Naval Aeronautical Shore Facilities Programming Guide, the minimum safe distance from a skeet/trap range is 900 feet. Pellets dispersed from a shotgun would be deposited on the ground surface and not significantly penetrate the ground unless disturbed.

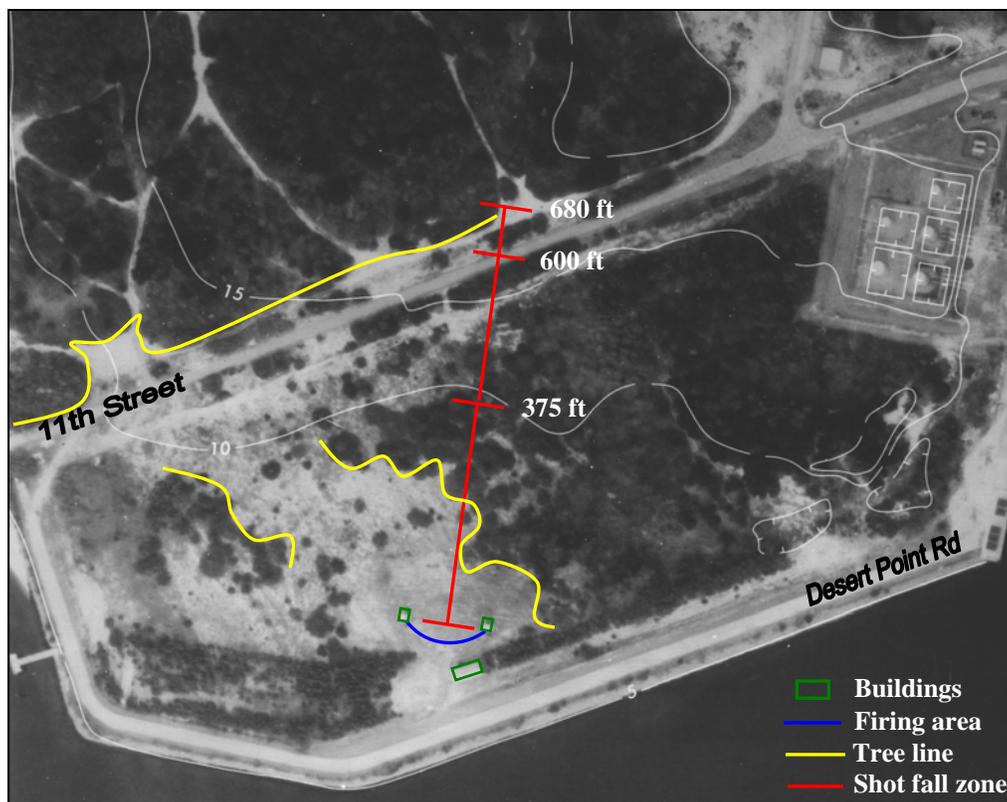
### ***5.1.6. Munitions Constituents***

The potential for lead contamination exists over the entire 900-foot arc covered by the MWR Skeet Range; however, due to the development of the range, the majority of the lead contamination would exist only in the subsurface. According to the ITRC guidance, the positions of the shooters and the angles at which the skeet targets are thrown create a fan shaped shot fall zone. [Figure 5.1-5](#) provides the typical shot fall layout of a skeet range. Depending upon the shot angle, wind, and the blocking effect of the trees, the typical shot fall zone extends up to 680 feet. As illustrated in the figure, the overlapping fans create an area of maximum shot fall, which is positioned approximately 375 to 600 feet from the firing point. The maximum shot fall zone is the area in which the highest concentrations of lead and skeet are expected.



**Figure 5.1-5: Typical shot fall layout for a skeet range**

While the MWR Skeet Range was active, the firing area was bordered by woods to the north and east. Scattered trees were also located to the west and northwest; however, this portion of the range was fairly open. Based on the shot fall layout for a typical skeet range, the trees would have provided some blocking effect, limiting the distance of small arms ammunition fired. The typical shot fall layout at the MWR Skeet Range is labeled on a 1975 aerial photograph of the site, provided as [Figure 5.1-6](#). Also shown on the figure is the potential blocking effect of the trees. Prior to the development of the site, potential MC would have been concentrated along the tree line to the north and east and dispersed at a greater distance to the northwest and west along the tree line across 11<sup>th</sup> Street. The shot fall zone would thus be limited to the area between the firing area and the tree line, which is currently entirely covered by the LCAC concrete landing pad.



**Figure 5.1-6: 1975 aerial of the MWR Skeet Range**

Potential MC may include elevated metals, such as lead, antimony, copper, zinc and arsenic from bullets, fragments and bullet jackets. Clay targets normally contain approximately 32 percent petroleum pitches (CAS 68334-31-6, CAS 68187-58-6) and 67 percent dolomitic limestone (CAS 16389-88-1). Petroleum pitch contains Polycyclic Aromatic Hydrocarbons (PAHs), some of which are classified as carcinogens. The targets are not considered explosive or fire hazards.

### ***5.1.7. Contaminant Migration Routes***

Contaminants at the MWR Skeet Range may potentially migrate within soil and groundwater. Grading prior to construction of the LCAC concrete pad may have redistributed the original soil over the area. The LCAC concrete pad is an effective barrier over approximately 75% of the former MWR Skeet Range. Based on the blocking effect of the former trees, the likely shot fall zone area is entirely covered by the concrete landing pad. One potential migration route includes leaching from soil to groundwater. Although contaminants may be present in groundwater, there are no receptors, as drinking water in this region is taken from municipal supply and off-base

surface water reservoirs. However, the Commonwealth of Virginia views all groundwater as a potentially potable resource and strives to ensure that resource is protected for future use.

### ***5.1.8. Receptors***

Potential human receptors include authorized Navy personnel (military and civilian), visitors, contractors, maintenance workers, recreational users, and trespassers. Plant and animal biota are also potential receptors. Receptor fauna that could be affected are common woodland mammals, birds, reptiles, fish, amphibians and invertebrates.

#### **5.1.8.1. Nearby Populations**

NAB Little Creek is within the city of Virginia Beach (1,712 people per square mile) and adjacent to the city of Norfolk (4,363 people per square mile). The installation employs approximately 7,700 military personnel and 1,600 civilians. Approximately 3,650 military personnel and their families live at NAB Little Creek. Recreation on and around the installation includes fishing by permit. Hunting is not permitted on the installation.

#### **5.1.8.2. Buildings Near/Within Site**

There are currently no buildings or structures present on the former MWR Skeet Range. A low house, high house, and storage building (Building 3902) were located on the southern portion of the range. These three structures are visible on the 1975 aerial photograph provided previously as [Figure 5.1-6](#). The buildings were demolished prior to construction of the LCAC landing pad in 1985.

#### **5.1.8.3. Utilities On/Near Site**

A 1971 plan of the storage building at the MWR Skeet Range provides details on water, electrical, and sewer lines. A water line ran from the storage building to the fuel depot buildings located 900 feet to the northeast. It is unknown whether the utilities were removed when the building was demolished and the area was graded prior to construction of the LCAC landing pad. Currently, a fuel pipeline borders Desert Point Road on the south side of the former range.

### **5.1.9. Land Use**

Prior to construction of the MWR Skeet Range, the area was used as a radio communications and fuel farm in the 1940s and 1950s. From 1962 to 1985, the land was used by facility personnel for recreational skeet shooting. While the range was active, the fuel farm was located in the far northeast corner of SDZ. In approximately 1985, the entire area was graded, and an LCAC landing pad was constructed on top of the majority of the MWR Skeet Range.

### **5.1.10. Access Controls/Restrictions**

NAB Little Creek property is surrounded by locked, secured gates, with security at all entrances, as well as a security patrol. There is a locked chain link fence along the southeast portion of the site restricting access to Desert Point Road. Water borders the former range to the south and west. Access is restricted to the LCAC landing pad entrance, and a six-foot high concrete wall surrounds the entire pad. The former range is located both on the inside and outside of the LCAC landing pad area.

### **5.1.11. Conceptual Site Model**

This Conceptual Site Model (CSM) was developed following guidance documents issued by the USEPA for hazardous waste sites and the U.S. Army Corps of Engineers (USACE) for ordnance and explosives (OE) sites. Guidance documents included the USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA/540/G-89/004) and the Final USACE CSM Guidance Development of Integrated Conceptual Site Models for Environmental Ordnance and Explosives Sites (USACE, 2003).

The CSM describes the site and its environmental setting. The CSM presents information regarding: 1) MEC and/or MC known or suspected to be at the site; 2) current and future reasonably anticipated or proposed uses of the real property; and 3) actual, potentially complete, or incomplete exposure pathways that link them. The CSM is the basis for the prioritization, and remediation cost estimate.

The CSM is presented in a series of information profiles that presents information about the site. The information profiles are included in [Table 5.1-1](#).

**Table 5.1-1: Conceptual Site Model Information Profiles – MWR Skeet Range**

<b>Profile Type</b>	<b>Information Needs</b>	<b>Preliminary Assessment Findings</b>
<b>Range/Site Profile</b>	Installation Name	NAB Little Creek
	Installation Location	Virginia Beach, VA
	Range/Site Name	MWR Skeet Range
	Range/Site Location	The former MWR Skeet Range is located in the northwestern portion of the installation along Desert Point Road.
	Range/Site History	The range was used sporadically from approximately 1962 to 1985 by installation personnel. The range was used for recreational purposes only.
	Range/Site Area and Layout	The MWR Skeet Range is approximately 31 acres in area. Firing took place from the concrete pads at the southern portion of the site towards the north. The SDZ extended 900 feet from the firing points. While operational, the firing area was a flat open field. Currently, the firing area is covered by a man-made, earthen berm leading up to a concrete wall and LCAC landing pad.
	Range/Site Structures	The range had three buildings on-site: the high house, the low house, and a storage building (Building 3902). The buildings were demolished after the range was closed.
	Range/Site Boundaries	N: Concrete LCAC pad S: Desert Point Road, Desert Cove W: Little Creek Channel E: Desert Cove, fuel farm
	Range/Site Security	NAB Little Creek is a fenced and guarded installation. There is a locked fence along the southeast portion of the site restricting access to Desert Point Road. The southern and western portions of the site are bounded by water. The LCAC area is limited to authorized personnel.
<b>Munitions/Release Profile</b>	Munitions Types	Small caliber ammunition, primarily shotgun shot
	Maximum Probability Penetration Depth	Surface (0-12 inches)
	MEC Density	None
	Munitions Debris	None
	Associated Munitions Constituents	MC may include lead, antimony, copper, zinc, arsenic, and PAHs from clay targets and related sporting material.

Table 5.1-1: Conceptual Site Model Information Profiles – MWR Skeet Range		
Profile Type	Information Needs	Preliminary Assessment Findings
	Migration Routes/Release Mechanisms	Possible contaminant migration routes include leaching from soil to groundwater.
Physical Profile	Climate	NAB Little Creek is located in an area where the temperatures are highly moderated by the Atlantic Ocean. The average yearly temperature is 60°F. January is the coldest month, with an average temperature of 41°F; July is the warmest month, with an average of 80°F. The average annual precipitation is 45 inches and is concentrated in the summer. The NAB Little Creek area is subject to hurricanes and other northeasterly storms that can cause high winds, high precipitation and flooding.
	Topography	During its operational use, the skeet range was primarily flat (by the firing area) to gently sloping in the northern portion of the SDZ. The elevation ranged from zero to 15 feet above msl. Prior to construction of the LCAC pad, the area was graded and a man-made hill was constructed across the center of the former firing area. The firing area is currently a steeply sloped hill. The area of the landing pad is a plateau at approximately seven feet above msl.
	Geology	NAB Little Creek is located within the Atlantic Coastal Plain that is underlain with unconsolidated sediments of Cretaceous, Tertiary, and Quaternary ages. They have a combined depth of about 1,900 feet and are overlain with sandy or silty clays. There is no site-specific information on the geology of the MWR Skeet Range area.
	Soil	There are three soils types associated with the former MWR Skeet Range. The central and northern portion of the site is classified as Corolla Fine Sand. This portion of the former range is almost entirely covered by concrete with no exposed soil remaining. The southern and eastern portions of the former range are classified as Undulating Psammments. A small portion of the site is classified as Newhan-Corolla Fine Sand.

**Table 5.1-1: Conceptual Site Model Information Profiles – MWR Skeet Range**

<b>Profile Type</b>	<b>Information Needs</b>	<b>Preliminary Assessment Findings</b>
	Hydrogeology	The shallow aquifer system at Virginia Beach is composed of the Columbia Aquifer, the Yorktown confining unit, and the Yorktown-Eastover Aquifer. Domestic supplies of groundwater are available from depths of less than 200 feet. Potable water for NAB Little Creek comes from municipal water supply, which originates from Lake Gaston Reservoir located 100 miles away; the city of Norfolk system; and several in-town supplemental reservoirs. There are no drinking water wells located on or adjacent to the MWR Skeet Range. Two monitoring wells were observed southeast of the site.
	Hydrology	The majority of the MWR Skeet Range is covered with concrete. A portion of the SDZ crosses over Desert Cove and the Little Creek Channel. Runoff from the site drains into these water bodies.
	Vegetation	The majority of the MWR Skeet Range is covered with ten inches of concrete. A small portion of the former firing area is an open grass area surrounded by mesic mixed pine hardwood and pine forests.
<b>Land Use and Exposure Profile</b>	Current Land Use	Currently, the majority of the site is a LCAC landing pad. The remainder of the site is unused and un-maintained. A fuel pipeline runs along the southern edge of the site.
	Current Human Receptors	Authorized Navy personnel, Navy-escorted visitors, contractors, and trespassers
	Current Activities (frequency, nature of activity)	There is minimal activity on the undeveloped portion of the site and high activity on the LCAC landing pad, which is used daily.
	Potential Future Land Use	According to installation personnel, there is no known future change in land use.
	Potential Future Human Receptors	Authorized Navy personnel, Navy-escorted visitors, contractors, and trespassers
	Potential Future Land Use-Related Activities:	There is no known future change in land use related activities.
	Zoning/Land Use Restrictions	There are no known zoning or land use restrictions associated with the former MWR Skeet Range location.

**Table 5.1-1: Conceptual Site Model Information Profiles – MWR Skeet Range**

<b>Table 5.1-1: Conceptual Site Model Information Profiles – MWR Skeet Range</b>		
<b>Profile Type</b>	<b>Information Needs</b>	<b>Preliminary Assessment Findings</b>
	Demographics/Zoning	NAB Little Creek is located within the city of Virginia Beach (1,712 people per square mile) and adjacent to the city of Norfolk (4,363 people per square mile). The installation employs approximately 7,700 military and 1,600 civilian personnel. About 3,650 military personnel and families live in base housing.
	Beneficial Resources	There is one osprey platform maintained by the installation along the western edge of the former MWR Skeet Range. There are no known cultural resources within NAB Little Creek. Striped bass, spot, bluefish, croaker, sea trout, and blue crabs are commonly encountered within the Little Creek Channel.
<b>Ecological Profile</b>	Habitat Type	The majority of the former range is covered by ten inches of concrete with no associated habitat. The area surrounding the LCAC landing pad is a mix of open grasses and forest along Desert Cove and Little Creek Channel. A small beach area is located in the far southwestern portion of the site.
	Degree of Disturbance	Low – The MWR Skeet Range is already developed, except for a small strip of land along the southern and western portion of the former site. The entire area has been graded. A fence surrounds the southern portion of the site with access required prior to entry. Access is also required to gain entry to the LCAC landing pad covering the remainder of the site. Due to the use of the area, there is little additional disturbance anticipated.
	Ecological Receptors	
	Federal Endangered Species:	None
	Federal Threatened Species:	None
State Endangered Species:	None	
State Threatened Species:	None	
State Rare Species:	Plants: bluejack oak, Virginia beach pinweed, tall yellow-eyed grass, wild olive, and Spanish moss Birds: least tern	

Table 5.1-1: Conceptual Site Model Information Profiles – MWR Skeet Range		
Profile Type	Information Needs	Preliminary Assessment Findings
	Other Ecological Receptors:	Other ecological receptors common to the area include many species of birds, fish, and mammals, such as the southeastern shrew, the harvest mouse, and the gray fox. While these receptors were not observed during the visual survey, they are known to inhabit the area and are expected to be on or near the MWR Skeet Range.
	Relationship of MEC/MC Sources to Habitat and Potential Receptors	MC present in soil has the potential to leach into groundwater. There are no receptors of groundwater in this region.

A key element of the CSM is the exposure pathway analysis. For MC, a complete or potentially complete exposure pathway must include the following components: 1) a source (e.g., locations where MC are expected to be found); 2) an exposure medium (e.g., surface soil); 3) an exposure route (e.g., dermal contact); and 4) receptors (e.g., Navy personnel, construction workers, recreational users or authorized visitors). If the point of exposure is not at the same location as the source, the pathway may also include a release mechanism (e.g., volatilization) and a transport medium (e.g., air).

Interaction between the source and receptors involves a release mechanism for the MC, an exposure medium that contains the MC, and an exposure route that places the receptor into contact with the contaminated medium.

As indicated earlier, there is no potential for MEC to be located on the site. As such, an MEC Exposure Pathways Analysis figure was not created. As seen in the MC Exposure Pathway Analysis figure ([Figure 5.1-7](#)), the potential for MC exists on the range.

Surface soil

Soil impacted by MC does represent a potential source medium, as illustrated in the Exposure Pathway Analysis Figure for MC. Although the majority of the site has been graded and covered with concrete from the LCAC landing pad, there is potential for MC to exist in surface soils within the undeveloped portions of the site. Potentially complete pathways exist for receptors of MC including both human (Navy personnel, contractor/visitor, and trespasser) and ecological receptors (biota).

Subsurface soil

Although not anticipated, any intrusive activities on the site would create potentially complete exposure pathways for MC in subsurface soil. Excavation activities would be performed either by installation personnel or contractors, so potential receptors include both human (Navy personnel, contractor/visitor, and trespasser) and ecological receptors (biota). Exposure routes to these receptors are identified as ingestion, dermal contact, and inhalation. Potential intrusive activities on the site would be performed either by installation personnel or contractors. Biota may also come into direct contact with subsurface soil through burrowing or feeding activities.

Biota

As hunting and fishing is not permitted on the MWR Skeet Range, there are no potentially complete exposure pathways to human receptors through the food web. Ecological receptors may be affected through uptake of MC in contaminated soil or surface water/sediments.

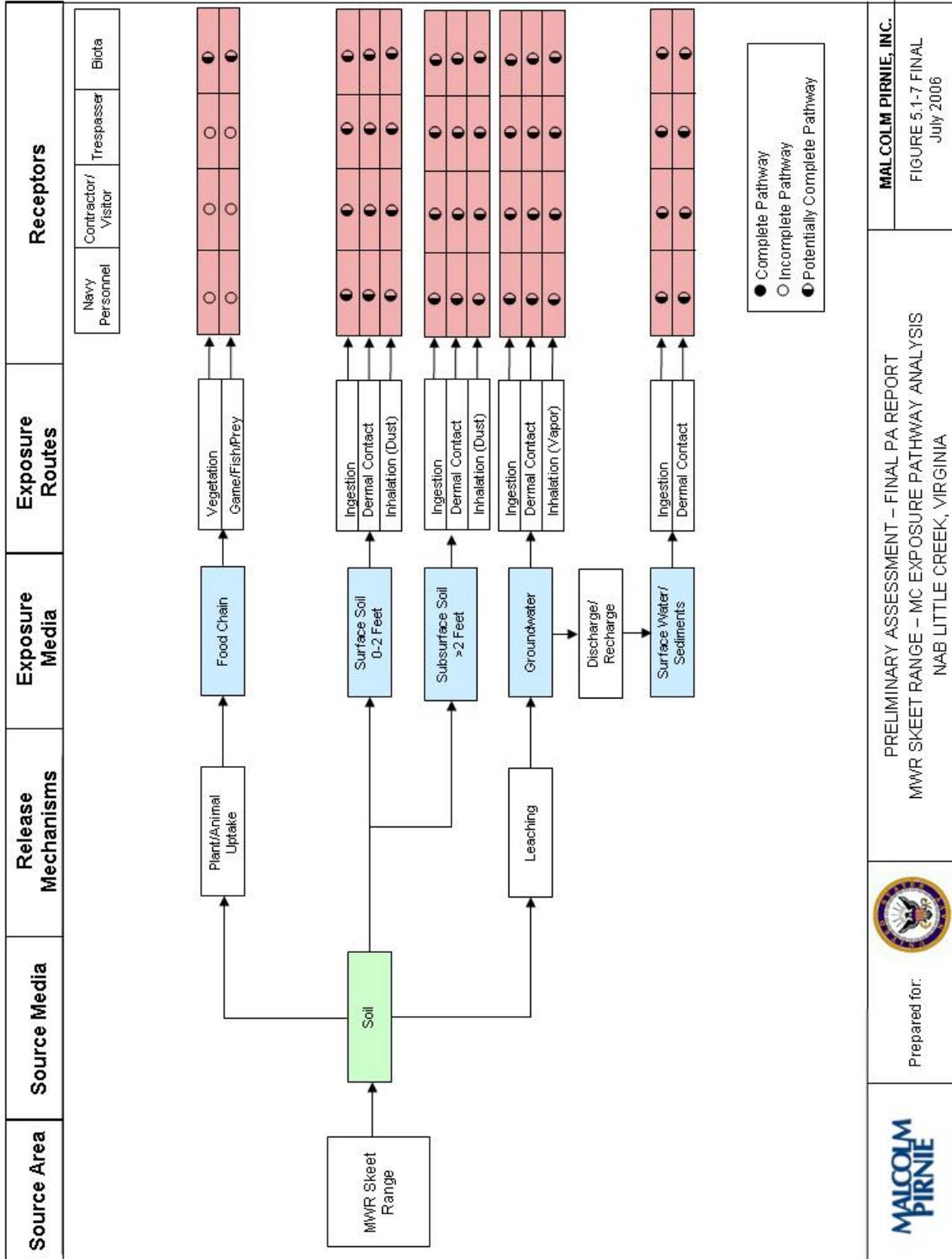
Groundwater

Leaching from soil to groundwater is a potential release mechanism. Although there are currently no receptors of groundwater in this region the Commonwealth of Virginia views all groundwater as a potentially potable resource and strives to ensure that resource is protected for future use. Thus, there are potentially complete pathways from groundwater to all human and ecological receptors.

Surface water/sediments

Potentially complete pathways exist for all human and ecological receptors of surface water/sediments through ingestion and dermal contact. Although erosion of soil and MC contaminated runoff to surface water is considered minimal for this site, MC leaching to groundwater and subsequent discharge to surface water bodies is also a potential release mechanism.

Figure 5.1-7: MC Exposure Pathway Analysis



***5.1.12. Summary***

The MWR Skeet Range consists of approximately 31 acres adjacent to Desert Cove and the Little Creek Channel. The range was used for recreational purposes from 1962 to 1985. The SDZ extends 900 feet from the firing point and overlaps a portion of Desert Cove and the Little Creek Channel. After the range was closed, the entire area was graded, and a LCAC landing pad was constructed. The majority of the MWR Skeet Range is currently covered by ten-inch thick concrete. The remaining natural areas include a beach to the southwest and a narrow strip of forest along the southern and southeastern portions of the former range. No indication of the former range was observed during the visual survey.

There is no MEC concern on the site, as only shotgun ammunition was used at the former range. Potential MC include lead, antimony, copper, zinc, arsenic, and PAHs from pellets, fragments, and related sporting material such as clay targets. Based on the current site conditions, there are no receptors of potential MC.



**Preliminary Assessment  
NAB Little Creek, VA**



**Map 5.1-1  
Visual Survey  
MWR Skeet Range**

**Legend**

-  Installation Boundary
-  Site Reconnaissance
-  MWR Skeet Range



Data Source: Aerial Image, NAB Little Creek, VA, 2003  
 Coordinate System: UTM Zone 18N  
 Datum: NAD83  
 Units: Meters  
 Contract: N62472-02-D-1300  
 Edition: Final Preliminary Assessment  
 Date: July 2006

**Preliminary Assessment  
NAB Little Creek, VA**



**MALCOLM  
PIRNE**

**Map 5.1-2  
Range/Site Details  
MWR Skeet Range**

**Legend**

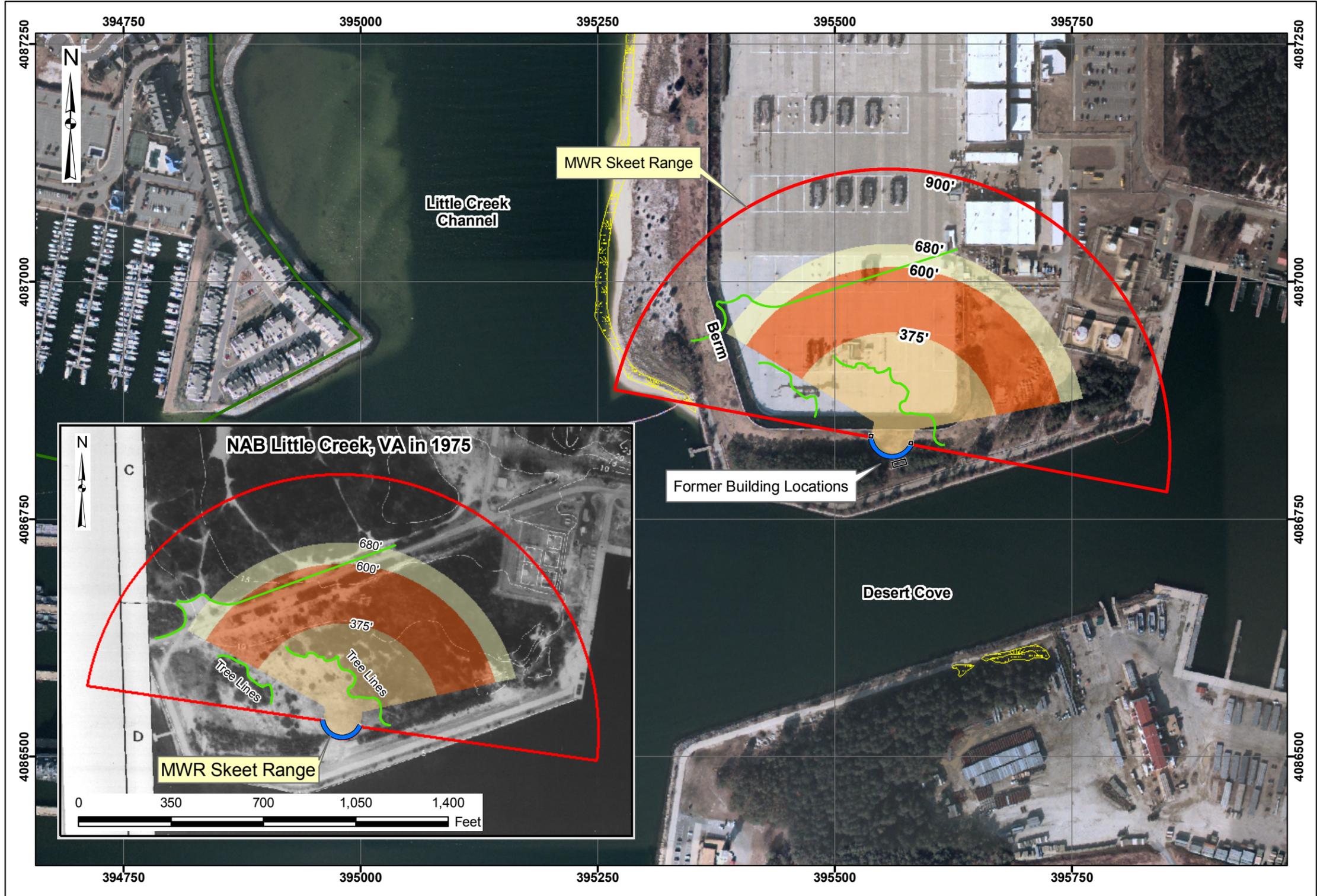
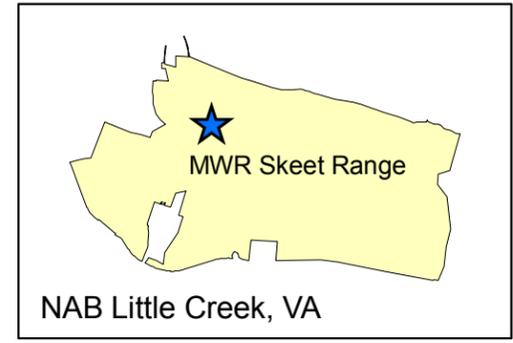
- Installation Boundary
- MWR Skeet Range
- Wetlands
- Firing Line
- Shotfall Zones**
- 375 Feet Shotfall
- 600 Feet Shotfall (Area of Maximum Shotfall)
- 680 Feet Shotfall
- Former Building Locations
- Tree Line



Data Source: Aerial Image, NAB Little Creek, VA, 2003  
Aerial Image, NAB Little Creek, VA, 1975

Coordinate System: UTM Zone 18N  
Datum: NAD83  
Units: Meters

Contract: N62472-02-D-1300  
Edition: Final Preliminary Assessment  
Date: July 2006





**Preliminary Assessment  
NAB Little Creek, VA**



**MALCOLM  
PIRNIE**

**Map 5.1-3  
Munitions Characterization  
MWR Skeet Range**

**Legend**

-  Installation Boundary
-  MWR Skeet Range
- MEC Presence\***
-  Known
-  Suspect

\*There is no evidence of MEC Presence as determined through historical documentation, interview, and visual survey. Visual observations and/or historical documentation indicate that MC may be present at the site, but MC Presence has not been confirmed by sampling or other means.



Data Source: Aerial Image, NAB Little Creek, VA, 2003

Coordinate System: UTM Zone 18N  
Datum: NAD83  
Units: Meters

Contract: N62472-02-D-1300  
Edition: Final Preliminary Assessment  
Date: July 2006

## **Appendix A: References**

## **REFERENCES**

### **Reports**

*Final Site Investigation SWMU 7 and SWMU 8 for Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* Prepared by: CH2MHILL, Baker Environmental Inc. and CDM Federal Programs Corp. August 2001.

*Installation Survey Report U.S. Naval Amphibious Base Little Creek, Norfolk, Virginia, dates of Field Survey October 18-21 1971.* Prepared by: Department of Defense Office, Assistant Secretary of Defense for Installations and Logistics. January 1972.

*Integrated Natural Resources Management Plan, Naval Amphibious Base, Little Creek, Plan Years 2004 – 2008.*

*Remedial Investigation, Human Health Risk Assessment, and Ecological Risk Assessment for SWMU 7, Small Boats Sandblasting Yard, Naval Amphibious Base Little Creek, Virginia Beach, Virginia.* Prepared by: CH2MHILL. December 2004.

### **Aerial Photographs**

Aerial oblique view of Little Creek, Virginia. Prepared: August 27, 1940.

Series II Microfilm, Reel 535. Prepared: 1941.

Amphibious Training Base Little Creek, Virginia, aerial oblique looking north. Prepared: April 25, 1944.

Smoke screen during trial amphibious operations at ATB Little Creek, Virginia. Prepared: September 22, 1944.

### **Maps**

Topographic Map. Prepared: April 10, 1942.

General Map Little Creek Area. Prepared: July 28, 1942.

Magazine Locations Section Base Little Creek, Virginia. Prepared: August 4, 1942.

Amphibian Force Base, Little Creek, Virginia. Prepared: November 11, 1942.

Amphibious Training Base Little Creek, Virginia, showing improvements to June 30, 1943. Prepared: December 15, 1943.

Index of Structures. Prepared: April 8, 1944.

Amphibious Training Base Little Creek, Virginia. Prepared: April 8, 1944.

Amphibious Training Base Little Creek, Virginia, showing conditions on June 30, 1948.

U.S. Naval Amphibious Base Little Creek, Virginia, Development of Permanent Station.  
Prepared: November 30, 1949.

Amphibious Training Base Little Creek, Virginia, General Plan. Prepared: March 2, 1951.

Naval Amphibious Base Little Creek, Virginia, Dredging, Filling and Drainage General Plan.  
Prepared: July 17, 1953.

Naval Amphibious Base Little Creek, Virginia, Dredging, Disposal and Drainage General Plan.  
Prepared: July 1953.

Amphibious Training Base Little Creek, Virginia, Incinerator Building Location Plan and Boring  
Logs. Prepared: April 22, 1953.

Amphibious Training Base Little Creek, Virginia, Water Distribution Location Plan. Prepared:  
1954.

Amphibious Training Base Little Creek, Virginia, Water Distribution General Arrangement II.  
Prepared: 1954.

Amphibious Training Base Little Creek, Virginia, Water Distribution General Arrangement III.  
Prepared: 1954.

Naval Amphibious Base, Little Creek, Norfolk, Virginia, Master Shore Station Development Plan  
Part III Section 2. Prepared: June 30, 1955.

Naval Amphibious Base Little Creek, Norfolk, Virginia, General Development Map Existing and  
Planned Pre – M Day. Prepared: June 26, 1962.

Naval Amphibious Base Little Creek, Virginia, New Skeet Range. Prepared: April 28, 1971.

Naval Amphibious Base Norfolk, Virginia, Little Creek Semi – Controlled Photo Mosaic.  
Prepared: January 1975.

Installation Map. Prepared: February 1985.

Locations of IR Sites, SWMUs and AOCs Five-Year Site Management Plan for FY 2002 Naval  
Amphibious Base Little Creek, Virginia Beach, Virginia. Prepared: March 15, 2000.

Installation Map. Prepared: February 17, 2005.

U.S. Naval Amphibious Base Bus Routes and General Information Map, Little Creek, Norfolk,  
Virginia. No date.

Naval Amphibious Base Little Creek, Virginia, Roads – Grading and Drainage General Plan. No  
date.

Naval Amphibious Base Little Creek, Virginia, Roads – Grading and Drainage Culverts &  
Ditches Locations Profiles and Sections. No date.

## Websites

Agency for Toxic Substances and Disease Registry (ATSDR) public health assessment (PHA). Accessed April 2005. [http://www.atsdr.cdc.gov/HAC/PHA/littlecreek/nab\\_p1.html](http://www.atsdr.cdc.gov/HAC/PHA/littlecreek/nab_p1.html).

USEPA NAB Little Creek Current Site Information. Accessed April 2005. <http://epa.gov/reg3hwmd/npl/VA5170022482.htm>.

NAB Little Creek Administrative Record. Accessed April 2005. <http://nabl.c.lantops-ir.org/Administrative%20Record/default.aspx>.

NAB Little Creek Homepage. <http://www.nabl.c.navy.mil/>.

U.S. Census Bureau website. Accessed April 2005. <http://quickfacts.census.gov/qfd/states/00000.html>.

## **Appendix B: Project Source Data – General**

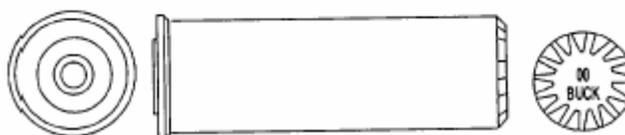
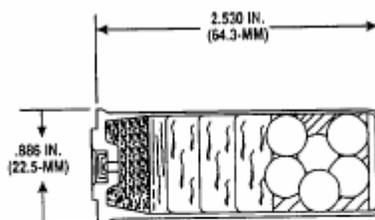
## **Appendix C: Project Source Data – Site Specific**

## **Appendix D: Ordnance Technical Data Sheets**

# Ordnance Technical Data Sheet

## 12 GAGE SHOTGUN, NO 00

CARTRIDGE, 12 GAGE, SHOTGUN, NO. 00, M162



<b>Nomenclature:</b>	12 Gage Shotgun, NO 00
<b>Ordnance Family:</b>	Small Arms
<b>DODIC:</b>	A011
<b>Filler:</b>	Smokeless Powder
<b>Filler weight:</b>	± Various
<b>Item weight:</b>	0.736 grams
<b>Diameter:</b>	.886 inches
<b>Length:</b>	2.53 inches (64.3 millimeters [mm])

**Usage:** Military issue shotgun, 2-3/4 inch chamber. The cartridge is intended for guard and combat use.

**Description:** The cartridge case is all plastic and is loaded with smokeless powder and No. 00 commercial shot.

**Reference:** TM 43-0001-27

# SMALL-ARMS AMMUNITION

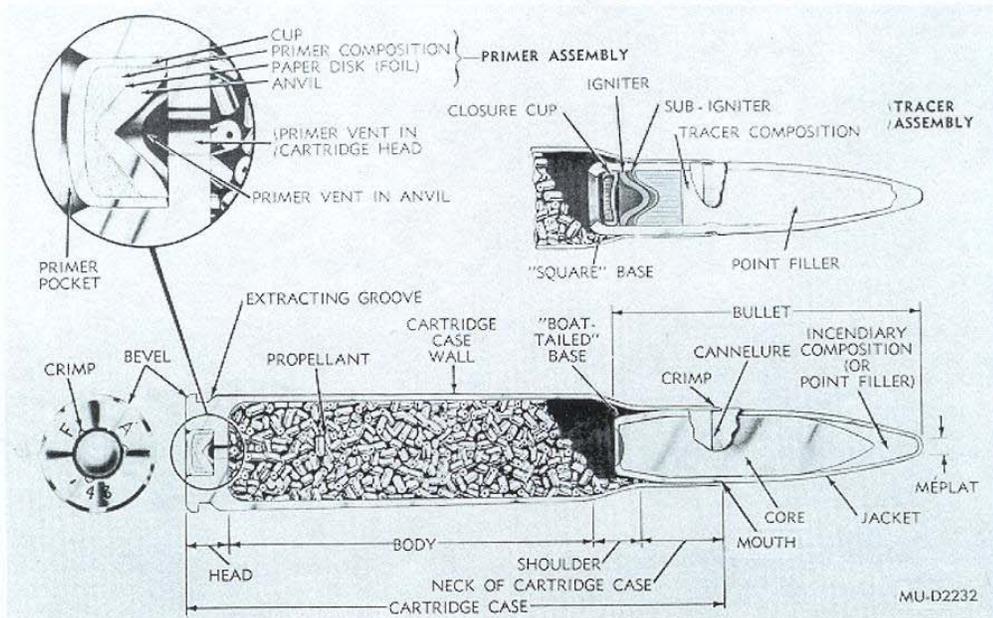


Figure 1. Typical cartridge (sectional)

**General.** Small-arms ammunition, as used herein, describes a cartridge or families of cartridges intended for use in various types of hand-held or mounted weapons through 30 millimeter. Within a caliber designation, these weapons may include one or more of the following: rifles (except recoilless), carbines, pistols, revolvers, machineguns and shotguns. For purposes of this publication, small-arms ammunition may be grouped as cartridges intended primarily for combat or training purposes (API, HEI, tracer or ball); for training purposes only (blank or dummy); or for special purposes (rifle grenade or spotter-tracer). Refer to TM 9-1306-200 for more detailed information on small-arms ammunition.

**Cartridges.** In general, a small-arms cartridge is identified as an assembly of a cartridge case, primer, a quantity of propellant within the cartridge case, and a bullet or projectile. Blank and rifle grenade cartridges are sealed with paper closure disks in lieu of bullets. Dummy cartridges are composed of a cartridge case and a bullet. Some dummy cartridges contain inert granular materials to simulate the weight and balance of live cartridges. A typical cartridge and the terminology of its components are shown in figure 1.

**Case.** Although steel, aluminum, zinc and plastic materials have been used experimentally, brass, a composition of 70 percent copper and 30 percent zinc, is the most commonly used material for cartridge cases. Steel, as well as brass, is an approved material for caliber .45 cartridge cases. Brass, paper and plastic are used for 12 gage shotshell bodies. Aluminum is used for military-type .410 gage shotshell bodies. Configurations of cartridges and bullets are illustrated in figures 2 through 11.

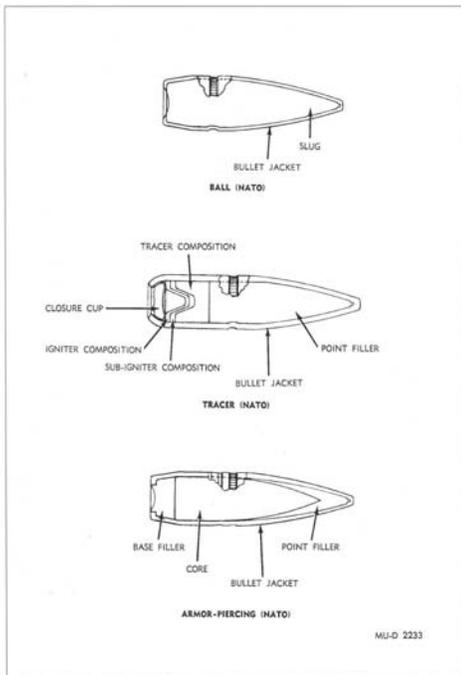


Figure 2. 7.62 mm bullets (sectional)

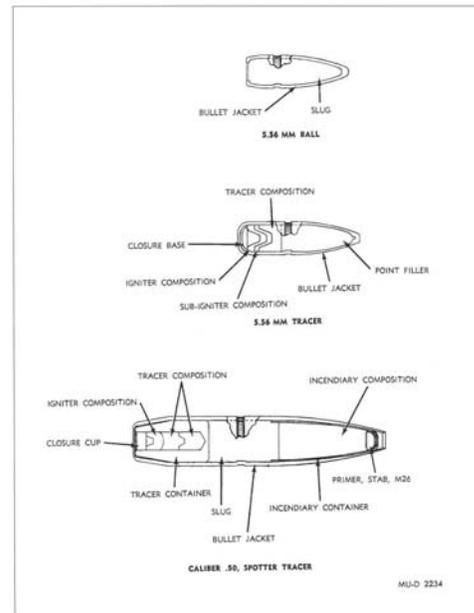


Figure 3. 5.56mm and caliber .50 spotter tracer bullets (sectioned)

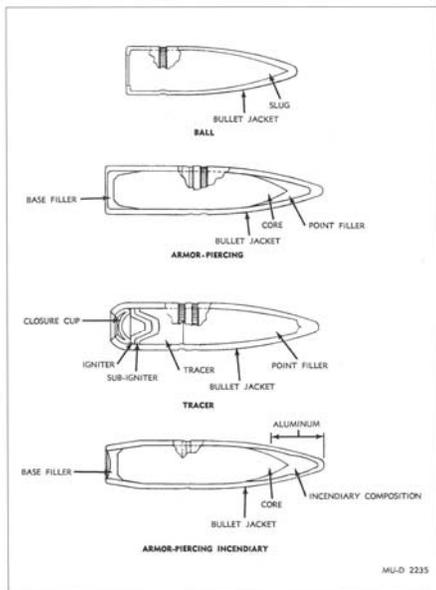


Figure 4. Caliber .30 bullets (sectional)

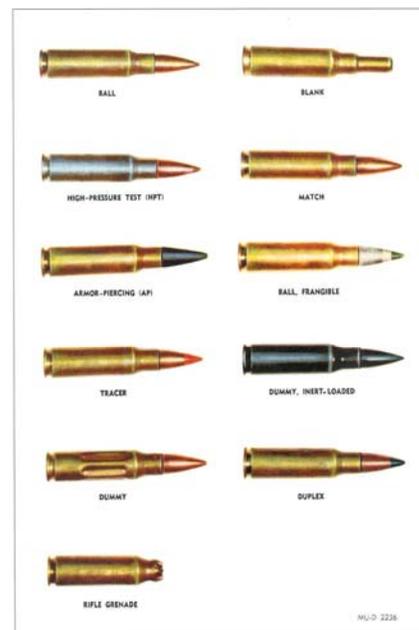


Figure 5. 7.62mm cartridges

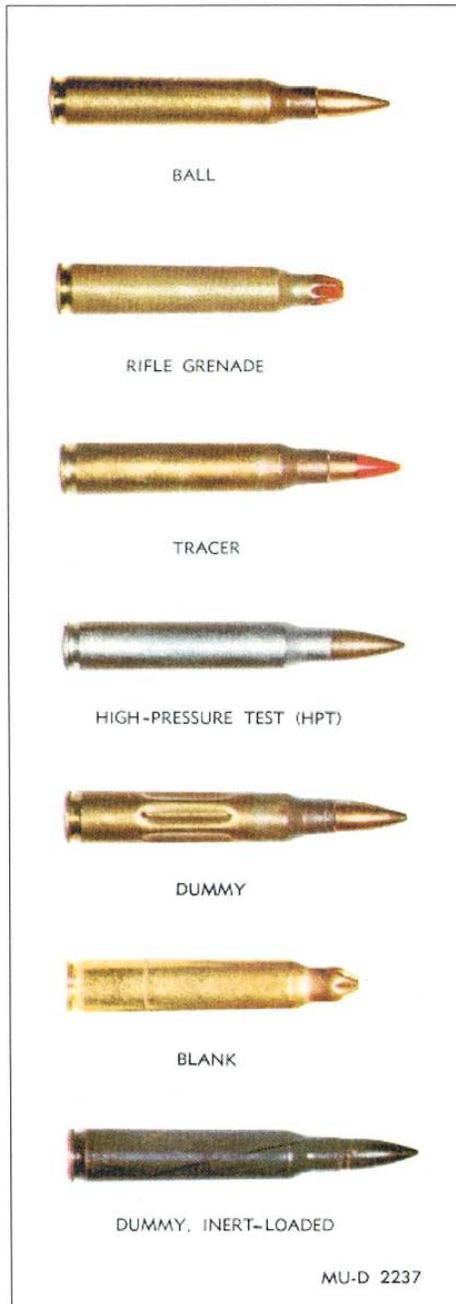


Figure 6. 5.56mm cartridges

*Propellant.* Cartridges are loaded with varying weights of propellant. This is to impart sufficient velocity (within safe pressures) to the projectile to obtain the required ballistic performance. These propellants are either of the single-base (nitrocellulose) or double-base (nitrocellulose and nitroglycerine) type. The propellant grain configuration may be cylindrical with a single, lengthwise perforation, spheroid (ball) or flake. Most propellants are coated with a deterrent (to assist in controlling the rate of combustion) and with a final coating of graphite (to facilitate flow of propellant and eliminate static electricity in loading cartridges).

*Primer.* Small-arms cartridges contain either a percussion or electric primer. The percussion primer consists of a brass or gilding metal cup that contains a pellet of sensitive explosive material secured by a paper disk and a brass anvil. The electric primer consists of an electrode button in contact with the priming composition, a primer cup assembly and insulator. A blow from the firing pin of the weapon on the center of the percussion primer cup base compresses the primer composition between the cup and the anvil. This causes the composition to explode. The function of the electric primer is accomplished by a firing pin with electrical potential, which contacts the electrode button. This allows current to flow through the energy-sensitive priming composition to the grounded primer cup and cartridge case, exploding the priming composition. Holes or vents in the anvil or closure cup allow the flame to pass through the primer vent in the cartridge case and ignite the propellant. Rimfire ammunition, such as the caliber .22 cartridge, does not contain a primer assembly. Instead, the primer composition is spun into the rim of the cartridge case and the propellant is in intimate contact with the composition. On firing, the firing pin strikes the rim of the cartridge case, compressing the primer composition and initiating its explosion.

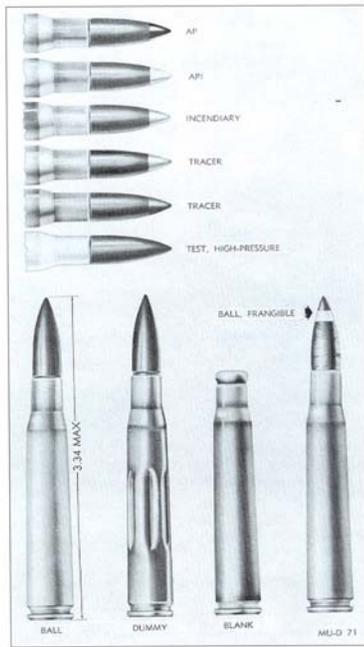


Figure 7. Caliber .30 cartridges

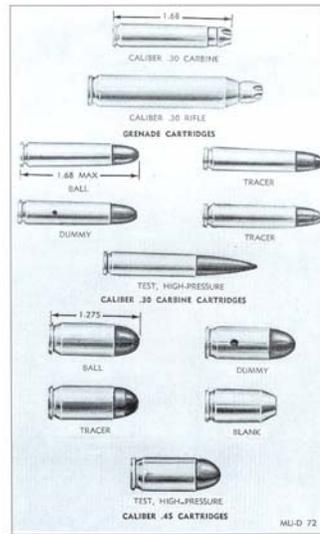


Figure 8. Caliber .30 carbine and caliber .45 cartridges

*Bullet.* With few exceptions, bullets through caliber .50 are assemblies of a jacket and a lead or steel core. They may contain other components or chemicals which provide the terminal ballistic characteristics of the bullet type. The bullet jacket may be either gliding metal, gliding-metal clad steel, or copper plated steel. Caliber .30 and 7.62mm frangible bullets are molded of powdered lead and a friable plastic which pulverizes into dust upon impact with the target. The pellets used in the shotgun shells are spheres of lead alloys varying from 0.08 inch to 0.33 inch in diameter.



Figure 9. Caliber .50 cartridges

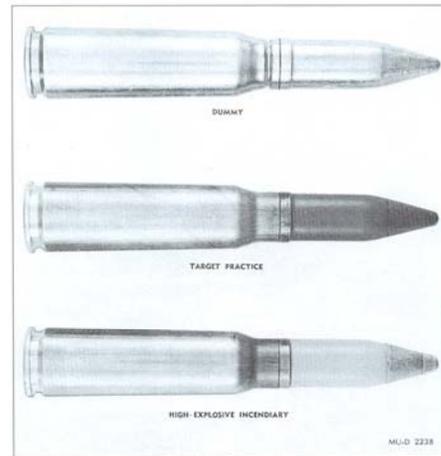


Figure 10. 20mm cartridges

*Ball Cartridge.* The ball cartridge is intended for use in rifles, carbines, pistols, revolvers and/or machineguns against personnel and unarmored targets. The bullet, as designed for general purpose combat and training requirements, normally consists of a metal jacket and a lead slug. Caliber .50 ball bullet and 7.62-mm, Ball M59 bullet contain soft steel cores.

*Tracer Cartridge.* By means of a trail of flame and smoke, the tracer cartridge is intended to permit visible observation of the bullet's in-flight path or trajectory and the point of impact. It is used primarily to observe the line of fire. It may also be used to pinpoint enemy targets to ignite flammable materials and for signaling purposes. The tracer element consists of a compressed, flammable, pyrotechnic composition in the base of the bullet. This composition is ignited by the propellant when the cartridge is fired. In flight, the bullet emits a bright flame which is visible to the gunner. Trace burnout occurs at a range between 400 and 1,600 yards, depending upon the caliber of ammunition.

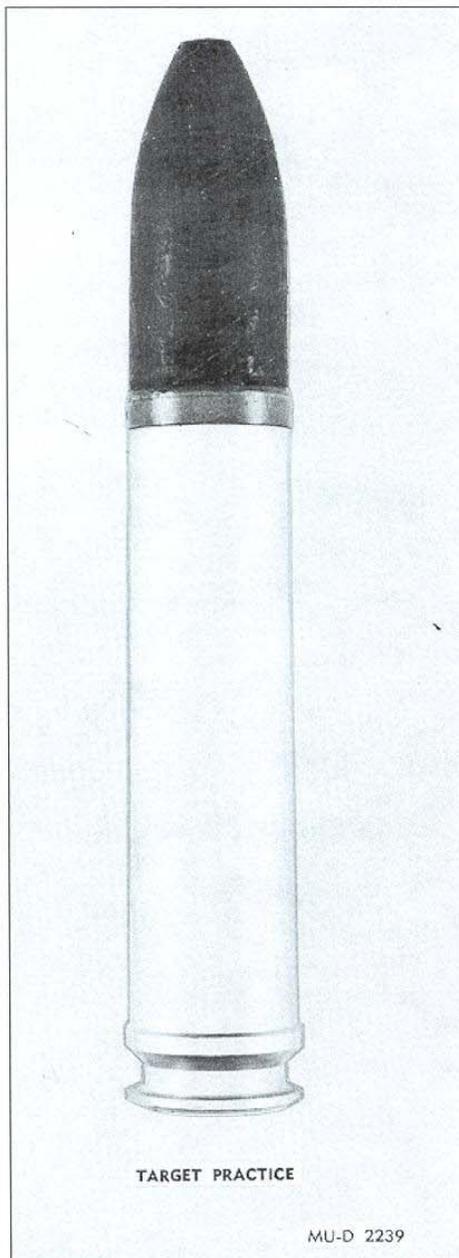


Figure 11. Typical 30mm projectile

*Match Cartridge.* The match cartridge is used in National and International Match Shooting competitions. The bullet consists of a gliding-metal jacket over a lead slug.

The cartridges are identified on the head face with the designation NM (National Match) or Match.

*Armor-Piercing Cartridges.* The armor-piercing cartridge is intended for use in machine-guns or rifles against personnel and light armored and unarmored targets, concrete shelters, and similar bullet-resisting targets. The bullet consists of a metal jacket and a hardened steel-alloy core. In addition, it may have a base filler and/or a point filler of lead.

*Armor-Piercing-Incendiary Cartridge.* The armor-piercing-incendiary cartridge is used in rifles or machineguns as a single combination cartridge in lieu of separate armor-piercing and incendiary cartridges. The bullet is similar to the armor-piercing bullet, except that the point filler is incendiary mixture instead of lead. Upon impact with the target, the incendiary mixture burst into flame and ignites flammable material.

*Armor-Piercing-Incendiary Tracer Cartridge.* The bullet of the armor-piercing-incendiary-tracer cartridge combines the features of the armor-piercing, incendiary, and tracer bullets and may be used to replace those cartridges. The bullet consists of a hard steel core with compressed pyrotechnic mixture in the cavity in the base of the core. The core is covered by a gilding-metal jacket with incendiary mixture between the core point and jacket. This cartridge is for use in caliber .50 weapons only.

*Duplex Cartridge.* The duplex cartridge contains two special ball type bullets in tandem. The front bullet is positioned partially in the case neck, similarly to a standard ball bullet. The rear bullet, positioned completely within the case, is held in position by a compressed propellant charge. The base of the rear bullet is angled so that in flight, it follows a path slightly dispersed from that of the front bullet.