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FINAL SITE INSPECTION REPORT
Wallops Flight Facility Main Base Ranges (Skeet Range)
Accomack County, Virginia
FUDS Project No. C03VA030109

Site Inspections at Multiple Sites, NAB Region
Formerly Used Defense Sites
Military Munitions Response Program

Contract No. W912DR-05-D-0026
Delivery Order No. 0050

August 2012

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Formerly Used Defense Sites
Military Munitions Response Program

Conducted by:

U.S. Army Corps of Engineers
Baltimore District
CENAB-EN-HN
10 Howard Street
Room 10040-H
Baltimore, MD 21201

Prepared by:

Shaw Environmental, Inc.
4696 Millennium Drive, Suite 320
Belcamp, MD 21017

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Prepared/Reviewed by:

Shaw Technical Lead:	Greg Sisco
Shaw Project Chemist:	Tim Roth
Shaw Quality Control:	Rachel Vavra
Shaw Project Manager:	Peter Kelsall

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List of Acronyms and Abbreviations

ºF	degrees Fahrenheit
amsl	above mean sea level
ASR	*Archives Search Report*
ASTM	ASTM International
bgs	below ground surface
BuOrd	Bureau of Ordnance
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
CNAAS	Chincoteague Naval Auxiliary Air Station
COC	constituent of concern
COPC	chemical of potential concern
CSM	Conceptual Site Model
CTE	central tendency exposure
CWM	chemical warfare materiel
CZM	Coastal Zone Management
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DQO	Data Quality Objective
Eco-SSL	Ecological Soil Screening Level
EDR	Environmental Data Resources, Inc.
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ER	Engineer Regulation
ft	foot/feet
FUDS	Formerly Used Defense Site
FUDSMIS	FUDS Management Information System
HRS	Hazard Ranking System
HTRW	hazardous, toxic, or radioactive waste
IEP	Important Ecological Place
IEUBK	Integrated Exposure and Uptake Biokinetic
INPR	Inventory Project Report
µg/dL	micrograms per deciliter
µg/L	micrograms per liter
MC	munitions constituents
MD	munitions debris
MDC	maximum detected concentration
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MRS	munitions response site
MRSPP	Munitions Response Site Prioritization Protocol
NAB	USACE North Atlantic Division, Baltimore District

List of Acronyms and Abbreviations (Cont.)

NACA	National Advisory Committee for Aeronautics
NAD	North American Datum
NAOTS	Naval Aviation Ordnance Test Station
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAI	No Department of Defense Action Indicated
NOAA	National Oceanic and Atmospheric Administration
PA	*Preliminary Assessment*
PAH	polycyclic aromatic hydrocarbon
RAC	Risk Assessment Code
RI/FS	Remedial Investigation/Feasibility Study
ROE	right-of-entry
RME	reasonable maximum exposure
RSL	regional screening level
Shaw	Shaw Environmental, Inc.
SI	Site Inspection
TAL	target analyte list
Tetra Tech	Tetra Tech NUS, Inc.
TPP	Technical Project Planning
URS	URS Group, Inc.
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
UTM	Universal Transverse Mercator
UXO	unexploded ordnance
VaDCR	Virginia Department of Conservation and Recreation
VaFWIS	Virginia Department of Fish and Wildlife Information Service
VDEQ	Virginia Department of Environmental Quality
WFF	Wallops Flight Facility

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) – Also known as "Superfund," this congressionally enacted legislation provides the methodology for the removal of hazardous substances resultant from past / former operations. Response actions must be performed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (U.S. Environmental Protection Agency [EPA], 2012a). CERCLA was codified as 42 USC 9601 et seq., on December 11, 1980, and amended by the Superfund Amendments and Reauthorization Act (SARA) on October 17, 1986.

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

Discarded Military Munitions (DMM) – 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 USC 2710(e)(2)).

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded ordnance and of other munitions that have become an imposing danger, for example, by damage or deterioration (10 USC 2710(e)(2)).

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 organizations that predate DoD. Some FUDS properties include areas formerly used as military ranges (10 USC 2710(e)(2)).

Military Munitions – Ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the U.S. Coast Guard, the U.S. Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives, and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunitions, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components of the above.

The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non-nuclear components of

nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 USC 2011 et seq.) have been completed (10 USC 101(e)(4)(A) through (C)).

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

Munitions Debris (MD) – Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal (10 USC 2710(e)(2)).

Munitions and Explosives of Concern (MEC) – This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded ordnance (UXO), as defined in 10 USC 101(e)(5); (B) Discarded military munitions (DMM), as defined in 10 USC 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard (10 USC 2710(e)(2)).

Munitions Response Area (MRA) – Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples are former ranges and munitions burial areas. An MRA comprises one or more munitions response sites (32 CFR§179.3).

Munitions Response Site (MRS) – A discrete location within an MRA that is known to require a munitions response (32 CFR§179.3).

Munitions Response Site Prioritization Protocol (MRSPP) – The MRSPP was published as a rule on October 5, 2005. This rule implements the requirement established in section 311(b) of the National Defense Authorization Act for Fiscal Year 2002 for the Department of Defense (DoD) to assign a relative priority for munitions responses to each location in the DoD's inventory of defense sites known or suspected of containing unexploded ordnance (UXO), discarded military munitions (DMM), or munitions constituents (MC). The DoD adopted the MRSPP under the authority of 10 USC 2710(b). Provisions of 10 USC 2710(b) require that the Department assign to each defense site in the inventory required by 10 USC 2710(a) a relative priority for response activities based on the overall conditions at each location and taking into consideration various factors related to safety and environmental hazards (70 FR 58016).

Range – A designated land or water area that is set aside, managed, and used for range activities of the Department of Defense. The term includes 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. The term also includes airspace areas designated for

military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration (10 USC 101(e)(1)(A) and (B)).

Range Activities – Research, development, testing, and evaluation of military munitions, other ordnance, and weapons systems; and the training of members of the armed forces in the use and handling of military munitions, other ordnance, and weapons systems (10 USC 101(e)(2)(A) and (B)).

Risk Assessment Code (RAC) – An interim risk assessment procedure developed by the U.S. Army Engineering and Support Center, Huntsville (USAESCH), Ordnance and Explosives Directorate (CEHNC-OE) to address explosives safety hazards related to munitions. The RAC score was formerly used by the USACE to prioritize response actions at FUDS. The RAC procedure, which does not address environmental hazards associated with munitions constituents, has been superseded by the MRSPP.

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

Executive Summary

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program to address DoD sites suspected of containing munitions and explosives of concern (MEC) or munitions constituents (MC). Under the MMRP, the U.S. Army Corps of Engineers (USACE) is conducting environmental response activities at Formerly Used Defense Sites (FUDS) for the Army, DoD's Executive Agent for the FUDS program. Shaw Environmental, Inc. (Shaw) is responsible for conducting Site Inspections (SIs) at select FUDS in the North Atlantic region managed by the Baltimore District Military Munitions Design Center.

SI Objectives and Scope

The primary objective of the MMRP SI is to determine whether a FUDS project warrants further response action under the Comprehensive Environmental Response, Compensation, and Liability Act. The SI collects the minimum amount of information necessary to make this determination, as well as it (i) determines the potential need for a removal action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System scoring by the U.S. Environmental Protection Agency (EPA); and (iii) collects data, as appropriate, to characterize the release for effective and rapid initiation of the Remedial Investigation and Feasibility Study. An additional objective of the MMRP SI is to collect the additional data necessary to complete the Munitions Response Site Prioritization Protocol.

The scope of the SI reported herein is restricted to evaluation of the presence of MEC or MC related to historical use of the FUDS prior to transfer. Potential releases of hazardous, toxic, or radioactive wastes are not addressed within the current scope. The intent of the SI is to confirm the presence or absence of MEC and/or associated MC.

Main Base Ranges (Skeet Range)

This report presents the results of an SI conducted on the Skeet Range portion of the Main Base Ranges complex, FUDS project number C03VA030109, located in the northern portion of the Main Base for the Wallops Flight Facility (WFF). The WFF is located in Accomack County, Virginia, on the Delmarva Peninsula near the Atlantic Coast approximately 5 miles south of the Maryland- Virginia border and about 5 miles west of Chincoteague Island. The Main Base Ranges complex includes a Skeet Range, an Aircraft Gun Testing/Machine-Gun/Pistol Range, and a Rifle Range.

In April 1944, the Bureau of Aeronautics constructed a Shotgun Range (also referred to as the Skeet Range) at the Chincoteague Naval Auxiliary Air Station. This original range had a northeasterly direction of fire and was replaced with a skeet range with an easterly direction of fire sometime after June 1945 and prior to 1948, according to installation maps and historical aerial photographs. Much of the original northeast-facing skeet range is overlapped by the

repositioned east-facing skeet range, the former Rifle Range and the Aircraft Gun Testing/Machine-Gun/Pistol Range. The Skeet Range MRS is comprised of the entire east-facing skeet range and those portions of the northeast-facing skeet range that are not overlapped by the east-facing skeet range, the adjacent Rifle Range, and the Aircraft Gun Testing/Machine-Gun/Pistol Range. The MRS acreage is approximately 30.2 acres.

Technical Project Planning

The approach for the SI was developed by Shaw in consultation with site stakeholders. A Technical Project Planning meeting conducted in September 2010 was attended by representatives from the National Aeronautics and Space Administration [NASA] - WFF Environmental Office (comprised of contractors from URS Group, Inc., Tetra Tech NUS, Inc. [Tetra Tech], and EA Engineering Science and Technology, Inc.), the USACE – North Atlantic Division Baltimore District and Norfolk District, the Virginia Department of Environmental Quality, EPA Region 3, and Shaw. The stakeholders agreed to the approach and identified one MRS, the Skeet Range.

Ongoing stakeholder coordination has occurred throughout the project through several rounds of stakeholder comments and USACE comment responses. USACE and NASA have initiated discussions regarding the DoD contribution of the northeast-facing skeet range within the adjacent Rifle Range and the Aircraft Gun Testing/Machine-Gun/Pistol Range.

SI Field Activities

An environmental site investigation was performed by Tetra Tech in 2007 and 2009 at the Main Base Ranges Complex for the Naval Facilities Engineering Command Mid-Atlantic under the Comprehensive Long-Term Environmental Action Navy contract. A total of 63 surface soil samples and two groundwater samples were collected from the Skeet Range MRS portion of the Main Base Ranges Complex. The findings and results of that investigation are presented in this SI Report.

SI Recommendations

Results of the SI provide the basis for conclusions and/or recommendations for further actions at the MRS. Based on historical evidence, NASA-WFF site knowledge, and the results from the site investigation performed in 2007 and 2009, evidence of MEC (other than small arms use) is not present at the MRS. Therefore, further investigation or removal action is not required regarding the presence of MEC at the Skeet Range MRS.

Based on the analytical results from the site investigation performed by Tetra Tech in 2007 and 2009, concentrations of munitions constituents (lead) and MMRP-related constituents (polycyclic aromatic hydrocarbons) exceed background, human health, and ecological screening values at the Skeet Range MRS. Therefore, a Remedial Investigation/Feasibility Study is recommended regarding the presence of lead and PAHs at the Skeet Range MRS.

Remedial investigation scoping should include an evaluation of those portions of the original northeast-facing skeet range that are outside of the adjacent Rifle Range and the Aircraft Gun Testing/Machine-Gun/Pistol Range. It is further recommended that the acreage of the Skeet Range MRS be revised in the MRS Inventory to 30.2 acres.

1.0 Introduction

This Site Inspection (SI) Report presents the results of an SI conducted at the Wallops Flight Facility (WFF), Main Base Ranges (Skeet Range Munitions Response Site [MRS]) Formerly Used Defense Site (FUDS) located near Chincoteague, Virginia. Shaw Environmental, Inc. (Shaw) has prepared this report for the U.S. Army Corps of Engineers (USACE) in accordance with Delivery Order 0050, issued under USACE Contract No. W912DR-05-D-0026. Shaw is responsible for conducting SIs at select FUDS in the North Atlantic Division managed by the USACE – North Atlantic Division, Baltimore District (NAB) Military Munitions Design Center as directed by the Performance Work Statement (Appendix A). The technical approach is based on the *Formerly Used Defense Sites, Military Munitions Response Program, Site Inspections, Program Management Plan* (USACE, 2005) and the *FUDS MMRP Site Inspection Program Supplemental Execution Guidance, Military Munitions Center of Expertise Interim Guidance Document (IGD) 07-04* (USACE, 2007).

An environmental site investigation was performed in 2007 by Tetra Tech NUS, Inc. (Tetra Tech) at the Main Base Ranges for the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Tetra Tech, 2009a). The Main Base Ranges include the Skeet Range MRS, the Aircraft Gun Testing Range (Machine-Gun Range), the Pistol Range, and the Rifle Range. Tetra Tech performed additional follow-up sampling in 2009 (Tetra Tech, 2009b). This SI presents the results and findings of these prior investigations; however, only the Skeet Range MRS is the subject of this SI.

1.1 Project Authorization

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) to address DoD sites suspected of containing munitions and explosives of concern (MEC) or munitions constituents (MC). Under the MMRP, the USACE is conducting environmental response activities at FUDS for the Army, DoD's Executive Agent for the FUDS program.

Pursuant to USACE's Engineer Regulation (ER) 200-3-1 (USACE, 2004a) and the *Management Guidance for the Defense Environmental Restoration Program* (DERP) (Office of the Deputy Under Secretary of Defense [Installations and Environment], September 2001), USACE is conducting FUDS response activities in accordance with the DERP statute (10 USC 2701 et seq.), the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC 9601), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). As such, USACE is conducting remedial SIs, as set forth in the NCP, to evaluate hazardous substance releases or threatened releases from eligible FUDS.

While not all MEC/MC constitute CERCLA hazardous substances, pollutants, or contaminants, the DERP statute provides DoD the authority to respond to releases of MEC/MC, and DoD policy states that such responses shall be conducted in accordance with CERCLA and the NCP.

1.2 Site Name and Location

The WFF (FUDS property number C03VA0301), is located in Accomack County, Virginia, near the Atlantic Coast on the Delmarva Peninsula approximately 5 miles south of the Maryland-Virginia border and about 5 miles west of Chincoteague Island (Figure 1-1). The entire WFF property consists of three geographically separated areas referred to as Sectors: Main Base, Mainland, and Wallops Island. Only the Main Base Sector and a portion of Wallops Island are under the jurisdiction of the DoD and are eligible for the FUDS under DERP.

The Main Base sector of the FUDS is situated to the west of several smaller embayments that comprise Chincoteague Bay, north of Highway 175, and is bordered to the north by Little Mosquito Creek.

The Skeet Range MRS was first included in the MRS Inventory in the *Defense Environmental Programs Annual Report to Congress Fiscal Year 2010* (DoD, 2010). However, the MRS Inventory does not provide a mapped location for the Skeet Range MRS that is the subject of this SI. The following information is provided in the 2010 Annual Report to Congress:

Site ID	MRSPP Score	Nearest City	County	MRS Acreage	Land Use Restrictions	Land Use Access Controls
09OEW	Evaluation Pending	Wallops Island	Accomack	31.6	None Specified	None Specified

According to the FUDS Management Information System (FUDSMIS) database (USACE, 2011), the following revised information is provided for FUDS Project No. C03VA030109:

Federal Facility ID	Range Name	Range Identification	MRS	MRS Area	UTM Coordinates/ Degrees-Minutes-Seconds
VA9799F1697	Main Base Ranges	C03VA030109	Skeet Range	29.4 acres	UTM X: 986664.7 UTM Y: 4214330.4 37˚56'46.2" N 75˚27'47.2" W

* Coordinates for the ranges are in Universal Transverse Mercator (UTM) Zone 18N, North American Datum (NAD) 83.

The discrepancy in the MRS acreage estimates is discussed in Section 2.2.1.

1.3 Purpose, Scope, and Objectives of the Site Inspection

The primary objective of the MMRP SI is to determine whether a FUDS project warrants further response action under CERCLA or not. The SI collects the minimum amount of information necessary to make this determination, as well as it (i) determines the potential need for a removal action; (ii) collects or develops additional data, as appropriate, for Hazard Ranking System

(HRS) scoring by the U.S. Environmental Protection Agency (EPA); and (iii) collects data, as appropriate, to characterize the release for effective and rapid initiation of the Remedial Investigation and Feasibility Study (RI/FS). An additional objective of the MMRP SI is to collect the additional data necessary to complete the Munitions Response Site Prioritization Protocol (MRSPP).

The scope of the SI reported herein is restricted to evaluation of the presence of MEC or MC related to historical use of the FUDS prior to DoD transfer of the property to the National Aeronautics and Space Administration (NASA). Potential releases of hazardous, toxic, or radioactive wastes (HTRW) are not addressed within the current scope. The intent of the SI is to confirm the presence or absence of contamination from MEC and/or MC. The general approach for each SI is to conduct records review and site reconnaissance to evaluate the presence or absence of MEC, and to collect samples at locations where MC might be expected based on the conceptual site model (CSM). The following decision rules are used to evaluate the results of the SI:

Is No DoD Action Indicated (NDAI)? An NDAI recommendation may be made if:

- There is no indication of MEC; and
- MC contamination does not exceed screening levels determined from Technical Project Planning (TPP).

Is an RI/FS warranted? An RI/FS may be recommended if:

- There is evidence of MEC hazard. MEC hazard may be indicated by direct observation of MEC during the SI, by indirect evidence (e.g., a crater potentially caused by impact of unexploded ordnance [UXO]), or by a report of MEC being found in the past without record that the area was subsequently cleared; or
- MC contamination exceeds screening levels determined from TPP.

Is a removal action warranted? A removal action may be needed if:

- High MEC hazard is identified. An example of a high hazard would be finding sensitive MEC at the surface in a populated area with no barriers to restrict access; or
- Elevated MC risk is identified. Identification of an imminent threat to human health, safety, or the environment (e.g., confirming MC concentrations above health-based risk standards in a well used as a source of drinking water) would trigger notification of affected stakeholders. Data would be presented at a second TPP meeting regarding the possible need for a removal action.

For purposes of applying these decision rules, USACE has provided guidance that evidence of MEC will generally be a basis of recommending RI/FS. Evidence of MEC may include confirmed presence of MEC from historical sources or SI field work, or presence of munitions debris (MD).

1.4 Munitions Response Site Prioritization Protocol

The MRSPP was published as a rule on October 5, 2005 (70 Federal Register [FR] 58028). This rule implements the requirement established in section 311(b) of the National Defense Authorization Act for Fiscal Year 2002 for the DoD to assign a relative priority for munitions responses to each location in the DoD's inventory of defense sites known or suspected of containing UXO, discarded military munitions, or MC (70 FR 58016).

This report includes draft MRSPP scoring sheets for the MRS identified in this SI Report (Appendix K). The MRSPP scoring will remain draft after this SI Report is finalized, pending Army MRSPP Quality Assurance Panel review. The scoring will be reviewed on an annual basis and reapplied as necessary to incorporate new information.

2.0 Property Description and History

Historical information contained in this SI was obtained from the *Project Summary Sheet* (USACE, 2009); the *Draft Final Defense Environmental Restoration Program for Formerly Used Defense Sites Preliminary Assessment* (PA) (USACE, 2010); the *Site Investigation Report Revision 1 for the Main Base Firing Range Complex, NASA Wallops Flight Facility* (Tetra Tech, 2009a); and the *Follow-Up Sampling, Skeet Range – Drainage Area, Main Base Firing Range Complex, NASA Wallops Flight Facility* (Tetra Tech, 2009b).

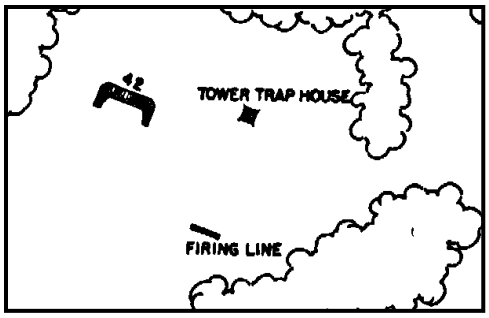
2.1 Historical Military Use

The U.S. Government acquired property in fee in 1942 for use as a naval auxiliary air station. The airfield was commissioned March 5, 1943, and was originally known as Chincoteague Naval Auxiliary Air Station (CNAAS). The airfield was used primarily as a training facility for naval aviation units; however, it was also used for anti-submarine operations. In May 1945, the National Advisory Committee for Aeronautics (NACA) commissioned the Pilotless Aircraft Research Station on 84 leased acres located on the south end of Wallops Island as an auxiliary base of NACA Langley Aeronautical Laboratory. In July 1945, NACA opened a missile test station on the southern and central portions of Wallops Island as an auxiliary base of NACA Langley Laboratory of Langley Field, Virginia. On January 26, 1946, the Bureau of Ordnance (BuOrd) established the Naval Aviation Ordnance Test Station (NAOTS) at CNAAS. The NAOTS provided a test range and training for personnel to test, modify, and develop guided missiles, aircraft weapons, and aviation fire control equipment. Naval use commenced in 1946 when NAOTS established a range and constructed support facilities for research and development and to test and evaluate aviation ordnance and related systems and equipment (USACE, 2010). Based on historical documentation obtained, no known chemical warfare materiel (CWM) activities were conducted on the WFF property (USACE, 2010).

2.2 Munitions Information

2.2.1 Skeet Range MRS

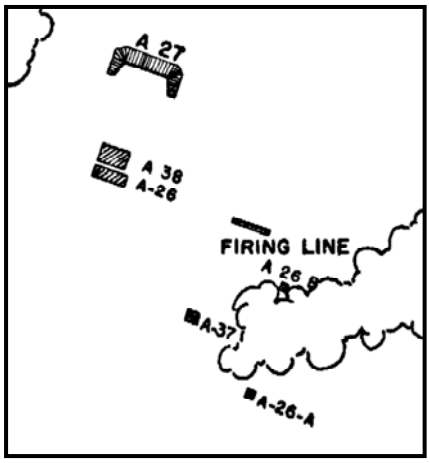
In April 1944, the Bureau of Aeronautics provided funds in the amount of $3,600 for the construction of a Shotgun Range (also referred to as the Skeet Range) at CNAAS. The range was located immediately adjacent to and east of the Rifle Range. Installation development maps for CNAAS, dated June 1944 (shown in figure below) and June 1945, portray a northeasterly firing direction for the range and show a firing line and a "Tower Trap House."



June 1944. CNAAS Installation Map.

According to installation maps and historical aerial photographs, this range was repositioned sometime after June 1945 and prior to 1948. Approximately half of the original northeast-facing skeet range is contained within the footprint of the repositioned east-facing skeet range.

The June 1949 version of the installation map (shown in figure below) shows three new skeet trap houses (Buildings A-37, A-26A, and A-26-B) arranged in a semicircle with an approximate 60-foot (ft) radius. These trap houses are oriented for an easterly firing direction at the skeet range.



June 1949. CNAAS Installation Map.

The June 1952 iteration of the installation development map confirms that the skeet range direction of fire is due east. The northeasterly facing firing line and Tower Trap House are no longer displayed; only the three easterly facing trap houses are present at the shooting arc semicircle. Historical aerial photographs taken in 1948, 1949, and 1954 clearly display the three trap houses and the skeet range shooting arc semicircle facing east (Figures 2-1a, 2-1b, and 2-c). By 1957 only the central-most trap house remained (Figure 2-1d).

Standard military range specifications for skeet ranges from the WWII period indicated a safety fan consisting of a semicircle with a 900-ft radius. Shooters fired from several stations positioned around a semicircle with a 63-ft radius. Skeet shooting results in a wide distribution of shot over a fan-shaped fall zone (Interstate Technology and Regulatory Council [ITRC],

2003). The size of the potentially affected area for a single skeet range, such as the east-facing skeet range, is typically 30 acres. Much of the original northeast-facing skeet range is overlapped by the repositioned east-facing skeet range, the former Rifle Range and the Aircraft Gun Testing/Machine-Gun/Pistol Range. The Skeet Range MRS is comprised of the entire east-facing skeet range and those portions of the northeast-facing skeet range that are not overlapped by the east-facing skeet range, the adjacent Rifle Range, and the Aircraft Gun Testing/Machine-Gun/Pistol Range. The MRS acreage is approximately 30.2 acres.

Skeet ranges were used to train gunners to lead aerial targets using clay pigeons thrown at varying angles toward, away from, and crossing the firing positions. This allowed the gunners to practice attacking approaching, retreating, and crossing targets.

The former northeast-facing skeet range was most likely a variation of a basic deflection range. This is suspected because the range consisted of a single tower trap house and a single straight firing line positioned approximately 175 ft from the trap house (as shown on the June 1944 CNAAS Installation Map and on Figures 2-1a and 2-1b). At these ranges, targets are thrown at varying angles toward the firing position. The danger zone for the high tower range was approximately 500 ft square (AAF, 1945).

The east-facing skeet range was known as a basic deflection range. The basic deflection range was a modification of the standard modern skeet range. This type of range consisted of a high trap house to the left of the shooting arc, a low trap house to the right of the shooting arc, and a control tower positioned behind the shooting arc in the center (as shown on the June 1949 CNAAS Installation Map and on Figures 2-1b and 2-1c). The shooting arc consisted of up to eight firing points around a semicircular arc. The distinct land scarring downrange of the high and low trap houses and straight out from the shooting arc (shown on Figures 2-1a, 2-1b, 2-1c, and 2-1d) is typical of basic deflection ranges.

Munitions used at the northeast-facing skeet range and at the east-facing skeet range (which partially overlapped the original northeast range) would only be small arms munitions, specifically shotguns. Although the 12-gauge shotgun was standard, other gauges may have been used (.410 bore and 16- or 20-gauge). No. 7½, 8, and 9 lead shot were used for clay pigeon target shooting. Commercial ammunition was often acquired for shotguns.

The likely distribution of lead as predicted from a model for skeet ranges published by the ITRC and supported by Shaw project experience occurs as follows (shown on Figure 2-2):

- Lead: The highest density of lead shot is expected to fall between approximately 375 and 600 ft from the firing line, with the maximum range of a typical lead skeet load expected to be about 680 ft.
- Polycyclic aromatic hydrocarbons (PAHs): The highest density of clay pigeon target fragments, and therefore the greatest potential concentration of PAHs, is expected to fall

from the firing line to a distance of approximately 600 ft, with a higher concentration within approximately 200 ft.

Although PAHs from pitch-based targets at skeet ranges are not MC, PAHs are being investigated under the MMRP because their presence could be the result of MMRP activities. Currently manufactured trap and skeet clay pigeon targets are composed predominately of dolomitic limestone and petroleum pitch, bound together under heat and pressure. Coal-tar pitch was used as the target binder prior to the use of petroleum pitch. Soils at skeet ranges have been shown to contain low levels of PAHs as a result of the use of clay pigeons (ITRC, 2003). Table 2-1 summarizes the munitions information for the Skeet Range MRS.

2.2.2 Other Main Base Ranges Munitions Response Sites

Other military operations that were conducted on the Main Base Ranges involving munitions included the Aircraft Gun Testing Range (Machine-Gun Range), the Pistol Range, and the Rifle Range. The Rifle Range was constructed in June 1951 by the BuOrd and used for small arms ammunition, specifically the .30-caliber rifle (USACE, 2010). The 300-yard firing range was located immediately adjacent to and west of the Skeet Range MRS and consisted of 100-, 200-, and 300-yard firing lines (Figures 2-1c and 2-1d). This MRS was investigated as part of the Tetra Tech site investigation for the Main Base Ranges (Tetra Tech, 2009a). The Rifle Range is being addressed separately under the MMRP.

The Aircraft Gun Testing Range, located in the northern portion of the Main Base in an area northeast of runway 17/35, was constructed around 1944 and was used to test and harmonize aircraft machine guns and munitions including: .30-caliber, .50-caliber, 20-millimeter (mm), 30-mm, .38-caliber, and .45-caliber. Firing was to the northeast into an earthen berm (gun butt) constructed for the impact area for the range (Figures 2-1a, 2-1b, 2-1c and 2-1d). In July 1951, the first 30-mm aircraft machine gun designed and manufactured in the U.S. was test fired at the Aircraft Gun Testing Range. The Aircraft Gun Testing Range was also referred to as the Machine Gun Bore Sight Range/Butt. The approximate distance from the former firing point to the gun butt is 970 ft. At some period prior to 1953, the gun butt portion of the Aircraft Gun Testing range was also used by the Navy as a Pistol Range. The Pistol Range extended approximately 150 ft from the gun butt to the firing point, thus occupying only the upper portion of the original Aircraft Gun Testing Range. Only small arms munitions were fired on the Pistol Range. According to recent conversations with current NASA personnel, NASA also used the Pistol Range after 1959 (USACE, 2010). The Pistol Range was investigated as part of the Tetra Tech site investigation for the Main Base Ranges (Tetra Tech, 2009a). The Aircraft Gun Testing Range/Pistol Range is being addressed separately under the MMRP.

Much of the portion of the northeast-facing skeet range that is outside of the Skeet Range MRS (as described in Section 2.2.1 and shown on Figures 2-1a and 2-1b) is overlapped by the former Rifle Range and Aircraft Gun Testing Range/Pistol Range. USACE and NASA have initiated

discussions regarding the DoD contribution of the northeast-facing skeet range within the Aircraft Gun Testing Range/Pistol Range and the Rifle Range.

2.3 Ownership History

The U.S. Government acquired the FUDS property in 1942 for use as a naval auxiliary air station. The airfield was commissioned in March 1943 as CNAAS. The airfield was used primarily as a training facility for naval aviation units but was also used for anti-submarine operations. In May 1945, NACA commissioned the Pilotless Aircraft Research Station on the south end of Wallops Island as an auxiliary base of NACA Langley Aeronautical Laboratory. In July 1945, NACA opened a missile test station on the southern and central portions of Wallops Island for Langley Field operations. In January 1946, the BuOrd established the NAOTS at CNAAS. The NAOTS provided a test range and training for personnel to test, modify, and develop guided missiles, aircraft weapons, and aviation fire control equipment. Ownership of the CNAAS was transferred to NASA in December 1961. In 1982, the WFF was consolidated with Goddard Space Flight Center and was renamed NASA - Wallops Flight Facility (USACE, 2010).

2.4 Physical Setting

2.4.1 Topography and Vegetation

The WFF is located within the Tidewater region of the Atlantic Coastal Plain physiographic province. This region is characterized by a gently east-dipping, seaward thickening wedge of sediments. The edge of the coastal plain sediments is the farthest western extent of the continental margin sediments and covers igneous and metamorphic basement rock as well as Triassic rift basins (U.S. Geological Survey [USGS], 2004).

The WFF is characterized by low and high terraces separated by a discontinuous escarpment approximately 25 ft above mean sea level (amsl). Low terraces are broad narrow flats bordered by tidal marshes to the east and the escarpment to the west. The high terraces are more complex in topography and are characterized by broad, level terraces that are broken up by elliptical ridges, gentle escarpments, tidal creeks and drainage ways. The tidal marshes lie between the mainland and barrier island: this area is extensively flooded with the tides and drained with an extensive system of creeks (USACE, 2010).

As shown on Figure 2-3, elevations at the WFF range from approximately 3 ft amsl to 40 ft amsl. Vegetation at the WFF varies from maintained landscaping and heavily vegetated areas within developed portions of the facility, to marshland on the eastern coast and northern perimeter along Little Mosquito Creek.

The majority of the MRS is located on open areas covered by grassy areas and asphalt roads and pavement for NOAA's operations. This portion of the MRS located south of the asphalt road is predominantly flat at 34 to 38 ft amsl. A small portion of the MRS to the north is located within

federally-designated wetlands along the Little Mosquito Creek. This area slopes from roughly 30 ft amsl to 3 ft amsl towards Little Mosquito Creek and is densely covered with tree, shrub and wetland vegetation.

2.4.2 Land Use

The WFF (including the Skeet Range MRS) is owned by NASA and is developed with commercial and industrial facilities associated with NASA operations. Current improvements include NASA-owned airport, offices, laboratories, air traffic control facilities, hangars, runways, and maintenance and ground support buildings. The WFF also supports tenant organizations including a Naval Surface Combat Systems Center, engineering training center and housing operations, NOAA satellite antennae and data acquisition operations, U.S. Coast Guard housing operations, and the Mid-Atlantic Regional Space Port office complex at the Main Base (USACE, 2010). Accomack County lists the WFF as zoned for industrial use with exception of the marshland area located on the northeastern portion of WFF: this area is classified as marshland. This marshland is also a designated wetland area. Future land use for WFF is expected to remain the same as the current land use.

According to the current Facility Master Plan, the Main Base Range complex area will remain undeveloped because of height and occupancy restrictions in place as a result of the close proximity of the active airport runways that are important to NASA's mission.

The majority of the MRS is located on open areas covered by upland grasslands and asphalt roads and pavement for NOAA's radar antennae stations. The grass is regularly mown, but the height of the grass is changed seasonally (approximately six inches high in the spring and summer and about 18 inches high in fall and winter) to discourage birds from foraging onsite. NOAA is presently planning to construct two additional radar facilities in the eastern portion of the Skeet Range MRS, as shown on Figure 2-2. Site preparation activities have begun including some tree removals from the central portion of the MRS, and some soil disturbance has occurred in the areas where the new NOAA antennae will be constructed. A small portion of the MRS to the north is located within federally-designated wetlands along the Little Mosquito Creek.

2.4.3 Nearby Population

The WFF is located approximately 5 miles west of the city of Chincoteague, in Accomack County, Virginia. The U.S. Census 2009 estimate for Chincoteague is 4,316 people. Accomack County has a 2010 population of 33,164 and a population density of 73 persons present per square mile (U.S. Census, 2010). Within a 2-mile radius of the MRS, the U.S. Census Bureau tract contains 203.6 people per square mile. Within 2 miles of the MRS, there is an estimated population of 4,400 individuals and 1,659 housing units (Figure 2-4).

Three churches are located within a 4-mile radius of the WFF. The Wallops Island National Wildlife Refuge is located immediately south of the WFF, and the Chincoteague National

Wildlife Refuge is located on Assateague Island, approximately 4 miles to the east-southeast (Figure 2-5).

2.4.4 Climate

The climate of the area is a humid continental warm summer climate, which is characterized by seasonal temperature and precipitation variations during the course of a year. Winter is dominated by polar continental air masses and summer by tropical maritime air masses. Clashes between these two air masses create frontal systems, resulting in thunderstorms, high winds, and precipitation (URS Group, Inc. [URS], 2005). The highest monthly median temperature is 76.3 degrees Fahrenheit (°F), occurring in the month of July. The highest mean daily temperature of 84.1°F occurs in July. The lowest mean temperature is 36.3°F occurring in January. Precipitation at the WFF occurs throughout the year with the average annual precipitation approximately 40 inches (NOAA, 2009).

2.4.5 Area Water Supply

According to the Safe Drinking Water Information System, there are 13 active community public water systems located in Accomack County, including the system that provides water to the WFF (EPA, 2010). The primary water source for the water systems is groundwater.

The Virginia Department of Environmental Quality (VDEQ) database lists 23 wells located within the WFF boundary. These wells are designated as public water supply, research, "W," and other. Potable wells are located upgradient, downgradient and cross-gradient to the Skeet Range MRS. The nearest potable well to the MRS is located approximately 3,000 ft to the east and downgradient (Figure 2-6). This Town of Chincoteague well is screened in the Yorktown Aquifer. Three of the wells operated by the Town of Chincoteague are 60 ft or less in depth and withdraw water from the Columbia Aquifer (Town of Chincoteague, 2009). The nearest Town of Chincoteague well withdrawing water from the Columbia aquifer is located approximately 3,100 ft to the southeast of the MRS. The depth to groundwater in the Columbia aquifer ranges from 0 to 30 ft below ground surface (bgs): the depth to groundwater in the Yorktown-Eastover Multiaquifer System is approximately 100 ft bgs.

The sources of drinking water for the WFF are five drinking water supply wells located on the Main Base. These wells are screened in the Yorktown-Eastover Multiaquifer System and range from 150 to 265 ft deep. Routine analytical sampling is conducted of the WFF's water systems. In 2010, sampling of the drinking water system on the WFF identified concentrations of one regulated constituent above the regulatory limits. The Water Quality Report states that the concentration of total trihalomethanes (TTHM), a by-product of the chlorination process, exceeded the regulatory drinking water limit (URS, 2011).

2.4.6 Surface Water

The WFF is covered with numerous inlets, marshes, and creeks. The Atlantic Ocean is located approximately 6 miles to the southeast of the Skeet Range MRS, beyond Wallops Island. The

northern portion of the Main Base drains into Little Mosquito Creek. The eastern and southeastern portions of the Main Base drain into several creeks (Cedar Creek, Jenneys Gut, Little Simoneaston Creek, Big Simoneaston Creek), unnamed intermittent creeks, and three major bays (Simoneaston Bay, Shelly Bay, and Chincoteague Bay) before discharging into the Atlantic Ocean. Natural drainage on the western and southwestern WFF flows from Wattsville Branch into Mosquito Creek and then the Atlantic Ocean (Figure 2-7).

The Skeet Range MRS does not have any perennial or intermittent surface water features. A wet weather conveyance is located on the MRS that provides drainage for the MRS and surrounding areas. Drainage from the southern, central, and western portions of the Skeet Range MRS generally flows northeasterly into a concrete culvert beneath the asphalt roadway (Figure 2-8). This drainage feature is a wet weather conveyance only and does not carry natural stream flow. Surface water runoff flowing in the wet weather conveyance empties into the small palustrine wetland first and then into the estuarine wetlands along the Little Mosquito Creek (Figure 2-8).

2.4.7 Geologic and Hydrogeologic Setting

The following subsections provide information on the geology and hydrogeology of the FUDS.

2.4.7.1 Bedrock Geology

The major stratigraphic units underlying the WFF (and the MRS) consist of surficial Quaternary beach and marsh deposits. These deposits are underlain by the Miocene age Calvert formation which can be up to 400 ft thick. This formation consists of bluish gray sandy silt. Next is the Tertiary age Piney Point formation. The Piney Point is greenish, fine to coarse, glauconitic quartzose sand and sandy silt, and is 150 to 200 ft thick. The Piney Point is underlain by the Pamunkey Formation. The Pamunkey is greenish to dark gray, glauconitic silts and clays. The thickness of the Pamunkey can be over 500 ft in the WFF area. The basement rocks are over 4,500 ft deep and dip to the southeast (USACE, 2010).

2.4.7.2 Overburden Soils

The soils at the WFF consist primarily of sandy loams. The majority of the MRS soils are the Bojac fine sandy loam and the Molena fine sandy loam. The Bojac fine sandy loam soil is a well-drained soil formed from marine sediments and typically found on terraces. From zero to 7 inches, the soil is loamy sand; from 7 to 40 inches, the soil is loam; and from 40 to 85 inches, the soil is sand. This soil has a low available water capacity and a high capacity to transmit water (U.S. Department of Agriculture [USDA], 2008).

The Molena fine sandy loam (0 to 35 percent slopes) is a well-drained soil formed from marine sediments and typically found on terraces. From 0 to 45 inches, the soil is loamy sand; and from 40 to 85 inches, the soil sand. This soil is characterized by a high capacity to transmit water (USDA, 2008).

A small portion of the northernmost part of the MRS located in and adjacent to the tidal marshes consists of Chincoteague silt loam. The Chincoteague silt loam is a poorly drained soil formed from marine sediments and typically found on salt marshes. From 0 to 40 inches, the soil is silt loam; and from 40 to 85 inches, the soil is loamy fine sand. This soil is characterized by frequent ponding and flooding and is moderately too strongly saline (USDA, 2008).

2.4.7.3 Hydrogeology

As reported in the PA by USACE, the VDEQ has identified four major aquifers on the Eastern Shore of Virginia: the Columbia aquifer and the three aquifers comprising the Yorktown-Eastover aquifer system. These aquifers underlie the Skeet Range MRS. The water table aquifer, known as the Columbia aquifer, primarily consists of Pleistocene sediments of the Columbia Group (Richardson, 1992). It is unconfined and typically overlain by wind-deposited beach sands, silts, and gravel. The aquifer occurs between depths of 15 to 60 ft bgs, and the water table ranges from depths of 0 to 30 ft bgs. Groundwater flow is generally east and north toward nearby creeks and the marsh area that separates Chincoteague Island from the mainland.

2.4.8 Sensitive Environments

The MRS qualifies as an important ecological place (IEP) and a sensitive environment as defined by USACE (2006) and EPA (1997) and discussed below. The entire coastline of the WFF is located within the Virginia Coastal Zone Management (CZM) Area. The Virginia CZM Program is part of a national coastal zone management program, a voluntary partnership between NOAA, the National Ocean Service Office of Ocean and Coastal Resource Management, and U.S. coastal states and territories authorized by the federal Coastal Zone Management Act (NOAA, 2005). The Skeet Range MRS is located within this zone.

The Virginia Department of Game and Inland Fisheries online database lists 492 *Known or Likely Species ordered by Status Concern for Conservation* potentially on and within a 3-mile radius of the WFF. This list includes the state-threatened bald eagle, which is categorized as a "very high conservation need" according to the Virginia Department of Fish and Wildlife Information Service (VaFWIS, 2012).

Information relevant to sensitive environments for this facility was compiled from the U.S. Fish and Wildlife Service (USFWS) and Virginia Department of Game and Inland Fisheries. The status of USFWS listed, federally threatened, endangered, or special protection species in the area of WFF is shown in the chart below:

Class	Status	Common Name	Scientific Name
Federal	Threatened	Piping Plover	*Charadrius melodus*
Federal	Threatened	Northeastern beach tiger beetle	*Cicindela dorsalis dorsalis*
Federal	Endangered	Delmarva peninsula fox squirrel	*Sciurus niger cinereus*
Federal	Threatened	Loggerhead sea turtle	*Caretta caretta*
Federal	Threatened	Seabeach amaranth	*Amaranthus pumilus*
Federal	Bald and Golden Eagle Protection Act	Bald Eagle	*Haliaeetus leucocephalus*

The URS Final Site-Wide Environmental Assessment lists approximately 15 species of shorebirds, including the piping plover, which occupy the inter-tidal zone during the spring and fall migration seasons (URS, 2005). The habitat within the Skeet Range MRS is not conducive to the presence of the piping plover, tiger beetle, sea turtle, or the seabeach amaranth as these species require open sandy beaches or salt water access.

As shown on Figure 2-8, the nearest bald eagle nesting site is located approximately 3,300 ft to the northwest of the shooting arc of the Skeet Range MRS across Little Mosquito Creek (Center for Conservation Biology, 2010). The Skeet Range MRS is located outside of the bald eagle buffer zone established for this nest (URS, 2005).

Shaw requested information regarding the presence of threatened or endangered species and significant natural communities on the WFF in letters sent in July 2010 to the USFWS; the Virginia Department of Game and Inland Fisheries; and the Commonwealth of Virginia Department of Conservation and Recreation (VaDCR), Division of Natural Heritage. A response was provided by the Coastal Zone Locality Liaison of The Division of Natural Heritage Resources in August 2010 (VaDCR, 2010). The Division provides information on Natural Heritage Resources, including rare plant and animal species, rare and exemplary natural communities, and significant geologic features.

The Division determined that the Skeet Range MRS is located within the Little Mosquito Creek Conservation area. A conservation area is designed to represent key areas of landscape that warrant further review for possible conservation action because of resources and habitat. The Little Mosquito Creek Conservation area has been given a biodiversity ranking of "high significance" due to the presence of the Tidal Oligohaline Marsh and the Brown-fruited rush. In the follow-up communication, the Division further concludes that they have "determined that the skeet range configuration with proposed sample locations does not directly impact the Tidal Oligohaline Marsh or the Brown-fruited rush. However, as these natural heritage resources are downslope of the sampling areas, for any greater land disturbance than what was described in your July 26, 2010 letter, DCR continues to recommend the implementation of and strict adherence to applicable state and local erosion and sediment control/storm water management laws and regulations."

Approximately 2 acres of the MRS are located within palustrine and estuarine wetlands along the Little Mosquito Creek (Figure 2-8). This portion of the MRS is positioned too far from the firing points to receive clay pigeon target fragments and at a distance approaching the limits of the typical maximum lead shot fall distance of 680 ft. The area is shielded by heavy tree and shrub cover. Although the wetland portion of the MRS is not expected to have received direct impacts from skeet range activities, it does receive surface runoff from the range as it flows through a centralized drainage swale into a concrete culvert, ultimately draining into the Little Mosquito Creek and the marshes that border it. This portion of the MRS is a sensitive environment that is located in a downslope position that receives surface runoff from the Skeet Range. Therefore, the MRS qualifies as an IEP and as a sensitive environment as defined by USACE (2006) and EPA (1997) and shown in Table 2-2. Figure 2-8 depicts the sensitive receptors in the immediate vicinity of the MRS.

2.5 Previous Investigations for MC and MEC

2.5.1 Archives Search Report, 2005

An *Archives Search Report* (ASR) was prepared for NASA by the USACE St. Louis District in October 2005. Findings from the ASR were incorporated into the PA (USACE, 2010).

2.5.2 Site Investigation for the Main Base Firing Range Complex, 2007-2009

Tetra Tech performed a site investigation at the Main Base Firing Range Complex (commonly referred to as the Main Base Ranges) in two phases in October and November of 2007 with follow-up sampling in July 2009 (Tetra Tech, 2009a and 2009b). The results of these investigations are discussed in detail in Section 4.0 of this report.

2.5.3 Preliminary Assessment, 2010

A PA was initiated by the USACE, St. Louis District and completed by the USACE Baltimore District in March 2010 (USACE, 2010).

2.6 Other Land Uses that May Have Contributed to Contamination

NASA-WFF leases portions of the Skeet Range MRS to NOAA for radar tracking antennae stations. Four of these stations are located within the MRS on asphalt pavement that could contribute sources of PAH compounds from surface water runoff into adjacent soil. The three eastern-most asphalt-paved stations are located at elevations lower than the skeet range fall zones and at a distance that lessens the potential for impacts from runoff. The station located to the north is at a similar elevation to the skeet range fall zones and has the potential to impact the MRS from surface water runoff to the south.

Potential sources of lead contamination other than from shotgun firing at the skeet range could result from surface water runoff from the adjacent former Rifle Range. In particular, the target berm area of the Rifle Range is located in a position of potential influence to the Skeet Range MRS. Concentrations of lead in seven samples collected from the surface (0 to 0.5 ft bgs) and

the shallow subsurface (0 to 2 ft bgs) soil near the Rifle Range's earthen salvage wall and target area ranged from 20.1 milligrams per kilogram (mg/kg) to 2,900 mg/kg with the average concentration at 657.5 mg/kg (Tetra Tech, 2009a).

A search of available environmental records was conducted by Environmental Data Resources Inc. (EDR) as a part of general background information gathering for this SI (EDR, 2010). The EDR report was designed to meet the search requirements of EPA's *Innocent Landowners, Standards for Conducting All Appropriate Inquiries* (40 CFR Part 312) and the ASTM International (ASTM) *Standard Practice for Environmental Site Assessments (E 1527-05)* (ASTM, 2007). Shaw uses the report to further evaluate potential environmental risks associated with the FUDS. A review of the databases provided in the EDR report identified underground storage tank (UST) facilities on the FUDS within 1 mile of the Skeet Range MRS. However, the nearest UST facility is located approximately ¾ of a mile to the south of the Skeet Range MRS and is not in a position of potential influence to the MRS.

2.7 Past Regulatory Activities

The VDEQ has been involved with the site investigation of the Main Base Ranges performed by Tetra Tech. The Final Report for the Main Base Ranges recommended that "further actions be taken to address potential risks associated with soils" located at the target mounds for the Pistol and Rifle Ranges and for soil in selected portions of the Skeet Range (Tetra Tech, 2009a). There have been no regulatory actions, with respect to MEC or MC, reported for the site.

2.8 Previous MEC Finds

There have been no historical or recent reports of MEC at the Skeet Range MRS. Further, there have been no historical or recent reports of unfired shotgun shells at the MRS.

3.0 Site Inspection Tasks

SI tasks conducted for this FUDS property involved compiling and reviewing historical aerial photographs, topographic maps, and other environmental information. This information was used in the TPP process and in the overall SI. This SI Report was prepared to summarize the information reported in the previous site investigations performed by Tetra Tech in 2007 and 2009 to determine whether further actions are required under the MMRP. Based on the extensive sampling conducted by Tetra Tech during the investigation of the Main Base Ranges, additional sampling was not performed during the course of this SI.

3.1 Technical Project Planning

A TPP meeting for the WFF, Main Base Ranges (Skeet Range MRS) was conducted on September 16, 2010, at the NASA, WFF Building E-100 located on Wallops Island, Virginia. Representatives from the NASA-WFF Environmental Office (comprised of contractors from URS, Tetra Tech, and EA Engineering Science and Technology, Inc.), the USACE – NAB and Norfolk District, the VDEQ, EPA Region 3, and Shaw were in attendance. A site walk of the Skeet Range MRS was conducted after the TPP meeting. Appendix B contains information pertaining to the TPP meeting and site visit held on September 16, 2010 (including a copy of the sign in sheet, meeting minutes, site visit photographs and a site visit figure).

Representatives from Shaw presented general background information about the history of the WFF, a review of historical aerial photographs, land use, environmental setting, and groundwater use. After general topics were discussed, a site-specific review of the Skeet Range MRS was begun. The NASA-WFF, Restoration Program Manager briefly described the investigation that was conducted by Tetra Tech at the Main Base Ranges in the fall of 2007 and the summer of 2009 (Tetra Tech, 2009a and 2009b). The EPA and VDEQ representatives were aware of and involved with this investigation. The group discussed whether additional work would be required at the Skeet Range MRS under the FUDS SI MMRP.

The following issues, agreements, and items for further review were discussed.

Stakeholders – All stakeholders necessary to make decisions were in attendance at the TPP meeting.

Munitions Response Sites – The Main Base Ranges include the Aircraft Gun Testing Range/Machine-Gun/Pistol Range, the Rifle Range, and the Skeet Range. All parties agreed that the Skeet Range is the only MRS being investigated for this SI. The other Main Base Ranges MRSs are being investigated separately. No other MRSs were identified or discussed in association with the Skeet Range MRS.

Rights-of-Entry (ROEs) – The MRS is owned by NASA. There are no ROE access issues for the MRS. NASA-WFF representatives accompanied the stakeholders during the site visit performed after the TPP meeting.

Conceptual Site Model – A CSM summary for the Skeet Range MRS was provided in the read-ahead packages sent to TPP team members one week prior to the TPP meeting. The CSM was not discussed at the TPP meeting because the group discussed the findings of the Tetra Tech site investigation.

Important Ecological Place (IEP) – The TPP participants did not discuss whether the Skeet Range MRS is an IEP during the TPP meeting (pending review of the Tetra Tech site investigation report). The *Draft TPP Memorandum*, submitted by Shaw in December 2010, provided the necessary information to demonstrate that the MRS qualifies as an IEP or Sensitive Environment as defined by USACE and the EPA (see Section 2.4.8).

MEC Hazard – All TPP participants agreed that any potential MEC hazard that might exist at the Skeet Range MRS relates only to intact or unfired small arms munitions (which have a low explosive hazard). These small arms munitions would consist only of 12-gauge shotguns (or possibly smaller gauge shotguns). There have been no reports of the discovery of unfired shotgun shells at the MRS.

Shaw proposed performing MEC reconnaissance at the Skeet Range MRS. A discussion followed on the merits of performing a wandering path MEC surface reconnaissance at the MRS using a UXO technician and a magnetometer. Because any potentially identified subsurface anomalies would not be dug, the TPP stakeholders agreed that wandering path limited surface reconnaissance would not provide additional benefit at the Skeet Range MRS. Therefore, it was agreed that MEC reconnaissance would not be necessary for this SI given the site's history as a skeet range and the present land use.

Human Health Screening Values – The TPP participants did not discuss human health screening values pending review of the Tetra Tech site investigation report. Potential human receptors primarily include NASA-WFF and NOAA employees and construction workers. Although unlikely, potential human receptors could also include any future residents (adult or child). Following submittal of the *Draft TPP Memorandum*, VDEQ recommended that the human health screening criteria used for lead and PAHs in soil at the MRS should be based on the lower of the appropriate EPA Regional Screening Levels (RSLs) for residential soil or the soil-to-groundwater migration soil screening levels. Although future land use plans at the former Main Base Range complex do not include residential reuse, stakeholders have agreed that constituents of concern will be screened in the SI Report by comparison to EPA RSLs for residential soil. At the request of USACE NAB, constituents of concern will also be screened by comparison to EPA RSLs for industrial soil.

Ecological Screening Values – The TPP participants did not discuss ecological screening values during the TPP meeting. Because portions of the MRS are located in a sensitive environment, the MRS qualifies as an IEP. Ecological screening values were presented in the *Draft TPP Memorandum*, and stakeholders have agreed that ecological screening is appropriate for the MRS. The ecological screening criteria used for lead and PAHs in soil at the MRS are based on the EPA Ecological Soil Screening Levels (Eco-SSLs).

MC/Sampling of MC – All TPP participants agreed that potential MC consists of lead from the lead shot in the shotgun shells. PAHs, from the clay pigeon target fragments, are addressed as potential MMRP-related constituents of concern (COCs). Based upon the quantity of samples collected by Tetra Tech in the media of concern at the Skeet Range MRS, the TPP participants agreed that additional MC and/or MMRP-related constituents sampling would not be required under the FUDS SI MMRP.

Background Sampling – A background investigation performed in 2004 by Tetra Tech has been used for screening purposes and is discussed in greater detail later in this report.

Site Visit Summary – A site walk of the Skeet Range MRS was conducted on the afternoon of September 16, 2010, after the TPP meeting had concluded. A summary of this activity is provided below. MRS photographs and a figure depicting the areas covered in the site walk are provided in the TPP Summary located in Appendix B (electronic version only). Hard copies of the photographs have also been placed in Appendix E.

- The site walk was led by representatives from the NASA-WFF Environmental Office and attended by representatives from the USACE (NAB and Norfolk Districts), VDEQ, EPA Region 3, and Shaw.
- The site walk participants parked their vehicles near the location of the former Skeet Range shooting arc.
    - The participants walked over cleared grassy areas and paved areas in the vicinity of the former target fragment fall zone.
    - Clay pigeon target fragments were evident over much of this area wherever exposed surface soil was present.
    - No evidence of small arms munitions (such as intact shotgun shells) or MD (such as spent shotgun shells or packing wads) was observed in this area.
    - No lead shot was observed in this area.
- The NASA-WFF escorts then led the TPP project team in their vehicles approximately 750 ft east-southeast to an area that would represent the former outer edge of the target fragment fall zone and the beginning of the zone where only lead shot would fall.
    - The participants walked over cleared grassy areas in the vicinity of the former lead fall zone near one of the fenced radar antennae pads.
    - No evidence of clay pigeon target fragments was observed in this area.

- No evidence of small arms munitions (such as intact shotgun shells) or MD (such as spent shotgun shells or packing wads) was observed in this area.
- No lead shot was observed in this area.

The TPP meeting results were documented in the *TPP Memorandum* (Shaw, 2011), which was issued final on March 17, 2011 after incorporating comments from the stakeholders on the draft. As discussed during the TPP meeting and documented in the *TPP Memorandum*, the following project objectives and Data Quality Objectives (DQOs) were developed.

Objective 1: Determine whether the MRS requires additional investigation or can be recommended for NDAI based on the presence or absence of MEC.

Objective 2: Determine whether the MRS requires additional investigation or can be recommended for NDAI based on the presence or absence of MC above screening values.

As agreed upon during the TPP meeting, to address these DQOs, Shaw used the *Site Investigation Report Revision 1 for the Main Base Firing Range Complex, NASA Wallops Flight Facility* (Tetra Tech, 2009a) and the *Follow-Up Sampling Skeet Range – Drainage Area, Main Base Firing Range Complex, NASA Wallops Flight Facility* (Tetra Tech 2009b). The results of these investigations are incorporated into this SI Report.

3.2 Additional Records Research

3.2.1 Review of Cultural Resources

In November 2003, NASA-WFF commissioned a *Cultural Resources Assessment of Wallops Flight Facility*. The findings of the cultural resources assessment were presented as Appendix E of the *Final Site-Wide Environmental Assessment* (URS, 2005). The study was completed to assist WFF in meeting its obligations under Section 106 and Section 110 of the National Historic Preservation Act, as amended, and was reviewed by the State Historic Preservation Office. The Wallops Main Base Sector was evaluated for potential archeological, historical, or cultural resources (including historic structures). The Cultural Resources Assessment identified areas of historic archaeological site sensitivity with both high and moderate sensitivity areas within the Skeet Range MRS (Figure 2-8). One building resource was evaluated at the MRS. WFF Building No. A-131, built in 1955, was determined to be ineligible for the National Registry of Historic Places. The building currently houses communication equipment used by Range Control (URS, 2005).

3.2.2 Review of Natural Resources

Shaw requested information regarding the presence of threatened or endangered species on the WFF with the VaDCR, Division of Natural Heritage. The Division replied that the northern portion of the Skeet Range MRS is located within the Little Mosquito Creek Conservation area (VaDCR, 2010). The Little Mosquito Creek Conservation area has been given a biodiversity ranking of "high significance" because of the presence of the Tidal Oligohaline Marsh and the

Brown-fruited rush. The Division "determined that the skeet range configuration with proposed sample locations [*comparable to the sampling locations used by Tetra Tech in the 2007-2009 investigations*] does not directly impact the Tidal Oligohaline Marsh."

3.2.3 Review of Historical Aerial Photographs

Historical aerial photographs from 1948, 1949, 1954, 1957, and 1959 were evaluated to identify features associated with the skeet range (Figures 2-1a, 2-1b, 2-1c, and 2-1d). The 1948, 1949, and 1954 aerial photographs clearly display the shooting arc (eastward facing) along with three trap houses for the Skeet Range. The Rifle Range and Pistol Range are both visible in the photos. Land scaring is visible to the northeast of the shooting arc that could represent the location of an older skeet range. The land scars are contained entirely within the footprint of the MRS. The trap houses were no longer present in the 1957 photograph.

3.2.4 Environmental Database Search

A search of available environmental records was conducted by EDR as a part of general background information gathering for this FUDS (EDR, 2010). The EDR report was designed to meet the search requirements of EPA's *Innocent Landowners, Standards for Conducting All Appropriate Inquiries* (40 CFR Part 312) and the ASTM *Standard Practice for Environmental Site Assessments (E 1527-05)* (ASTM, 2007). Shaw uses the report to further evaluate potential environmental risks associated with the FUDS.

A review of the databases provided in the EDR report identified UST and leaking UST facilities on the FUDS within 1 mile of the Skeet Range MRS. The nearest UST facility is located approximately ¾ of a mile to the south of the Skeet Range MRS and is not in a position of potential influence to the MRS because of its downslope and downgradient position. Additional information on the databases searched and the results for surrounding properties is included in the EDR report found in Appendix L.

3.3 Field Work

As stated, MEC reconnaissance, MC sampling, or other field work was not included as part of this SI. The findings of the previous investigations are documented in this SI Report.

3.4 Sampling and Analysis

The environmental sampling and the analytical results from the Tetra Tech investigations in 2007 and 2009 were reviewed during this SI (Tetra Tech, 2009a and 2009b). Additional samples were not collected.

3.5 Screening Values

The following subsections describe the development of screening values for this SI.

3.5.1 Background Screening

In 2004, Tetra Tech prepared a *Background Soil and Groundwater Investigation Report for the Main Base NASA Wallops Flight Facility* (Tetra Tech, 2004). The Tetra Tech background data sets were compiled from analytical results from previously collected samples and from samples collected and analyzed specifically for that investigation. A total of 22 soil samples were collected for purposes of the background investigation report and analyzed for target analyte list (TAL) metals and PAHs. Soil samples were collected from both Bojac fine sandy loam and samples characterized as Molena loamy sand. Background concentrations were then calculated based on statistical methods as outlined by EPA guidance. A background screening value was calculated for lead in Bojac surface soils of 21.1 mg/kg. Tetra Tech did not calculate a background screening value for lead in the Molena surface soils because of its nonparametric distribution. Tetra Tech calculated a background screening value for five PAH compounds (benzo[a]pyrene, benzo[b]fluoranthene, chrysene, fluoranthene, and pyrene) on the combined Bojac and Molena data sets. Background screening levels for the remaining PAH compounds in surface soil were established using the laboratory quantitation limit (Table 3-1).

Shaw compared the background distributions of lead in the combined datasets for the Bojac and Molena surface soil samples (methodology described in Appendix L). The background distributions of lead in the Bojac and Molena surface soil data sets were compared via the two-sample Wilcoxon rank sum (WRS) test, which was performed using STATISTICA® software. A single background screening level for lead in surface soil (20.2 mg/kg) was calculated for the combined dataset of Bojac and Molena samples. The two highest lead concentrations of 124 mg/kg and 84.8 mg/kg were omitted because they are elevated with respect to the other concentrations, by one to two orders of magnitude (all other concentrations ranged from 4.9 to 17.9 mg/kg, with a median of 12.1 mg/kg). Further explanation is provided in Appendix L regarding the omission of the highest lead concentrations from the background data set.

One background groundwater sample was collected in 2007 as part of the Tetra Tech site investigation at the Main Base Ranges. The concentration of lead in the background groundwater sample was 2.2 µg/L. For the purpose of this SI, an observed release (of lead in groundwater) is established when the MRS groundwater sample measurements are three times or more above the background concentration, in accordance with HRS criteria (40 CFR Appendix A to Part 300). For analytes not detected in groundwater at the MRS above the laboratory's detection limit (which was the case for the PAH compounds), the background screening levels are equal to the sample quantitation limits of the analytical method, in accordance with HRS criteria (40 CFR Appendix A to Part 300) (Table 3-1).

Shaw compared reported analytical results in site media samples to these background screening levels. A concentration of an analyte exceeding its background screening level is considered to be above the range of naturally occurring concentrations. A summary of the development of the

soil background screening level for lead is presented in Appendix L. The background screening levels for soil and groundwater are presented on Table 3-1.

3.5.2 Human Health Screening

Site sample data that exceed background screening levels were compared to human health screening criteria to determine whether additional investigation should be recommended. Although future land use plans at the former Main Base Range complex do not include residential reuse, stakeholders have agreed that constituents of concern will be screened in the SI Report by comparison to EPA RSLs for residential soil. At the request of USACE NAB, constituents of concern will also be screened by comparison to EPA RSLs for industrial soil.

Because the site-specific MC exposure pathway analysis evaluated groundwater as an incomplete pathway and because an informed analysis of reasonably assumed future on-site conditions (i.e., future land use plans at the former Main Base Range complex do not include residential reuse) the human health screening criteria used for lead and PAHs in surface soil are based on the EPA RSLs for residential soil, which, considering present and assumed future land use, are very conservative (health protective) screening criteria. The human health screening criteria values for soil and groundwater are presented in Table 3-1.

3.5.3 Ecological Screening

Sites that are managed for ecological purposes or qualify as IEPs or sensitive environments require a screening-level ecological risk assessment (USACE, 2006a). Approximately 2 acres of the MRS are located within tidal marshes along Little Mosquito Creek. Although the wetland portion of the MRS is not expected to receive direct impacts from skeet range activities (such as clay pigeon target fragments or lead shot from shotguns), it does receive surface runoff from the range as it flows through a centralized drainage swale into a concrete culvert constructed beneath the road, ultimately draining into the Little Mosquito Creek and the marshes that border it. The wetland portion of the MRS is considered to be a sensitive wetland environment.

Site sample data that exceed background screening levels were compared to the appropriate ecological screening values to determine whether additional investigation should be recommended. The recommended ecological soil screening levels are based on EPA's EcoSSLs as shown on Table 3-2.

3.6 Stakeholder Coordination

Although a second TPP meeting was not conducted with the stakeholders, stakeholders were engaged in the SI Report process through several rounds of comments and comment responses. These comments and responses are presented as part of Appendix B. In an April 16, 2012, email, NASA concurred with the recommendation in the Draft Final SI Report to conduct further investigations (RI/FS) as appropriate. Additionally, time was set aside at the regular WFF Remedial Project Managers (RPM) meeting held on June 14, 2012, to discuss any remaining

concerns on the part of the stakeholders. The stakeholders present at the RPM meeting were T.J. Meyer of NASA and Paul Herman of VDEQ. The EPA representative was unable to attend the RPM Meeting; however, EPA did not provide comments on the Draft Final SI Report.

During the June 14, 2012, meeting, VDEQ's concern that the portion of the northeast-facing skeet range that is outside of the east-facing skeet range (as described in Section 2.2.1 and shown on Figures 2-1a and 2-1b), was proposed for inclusion in an existing separate MMRP project. VDEQ accepted this response but requested that further explanation be added to the Final SI Report explaining why the portion of the northeast-facing range outside of the east-facing skeet range will be included as part of a separate MMRP project. VDEQ requested that an additional reference be included in Appendix J, Conceptual Site Model – Skeet Range MRS, that supports the methodology the USACE uses to define exposure pathways. This reference has been added to Section 2.0, References, located in Appendix J, and to Section 7.0, References, in the main body of the SI Report.

Subsequent to the June 14, 2012, meeting, revised text was provided to the stakeholders on June 19, 2012, for review and comment. In a follow-up email dated June 20, 2012, NASA recommended that portions of the northeast-facing skeet range be included with the east-facing skeet range investigation rather than in a separate existing MMRP project. Further, NASA recommended a conference call to discuss the path forward with VDEQ and USACE.

On July 6, 2012, USACE proposed a revised approach that would include those portions of the northeast-facing skeet range that are outside of the east-facing skeet range boundary and not overlapped by the former Rifle Range and Aircraft Gun Testing Range/Machine-Gun/Pistol Range boundaries in the Skeet Range MRS. A conference call was held on July 12, 2012, with representatives from USACE, VDEQ, NASA, and EPA to discuss the revised approach. It was agreed during the conference call to include those portions of the northeast-facing skeet range that are outside of the east-facing skeet range boundaries and that are not overlapped with the Rifle Range and Aircraft Gun Testing Range/Machine Gun/Pistol Range as part of the Skeet Range MRS. As a result of the conference call, the text in Section 2.2.2 was revised in accordance with the conference call discussions. On July 18, 2012, stakeholder approval of the SI Report text revisions was received. This SI Report reflects those agreements reached with the stakeholders through the coordination described above.

3.7 Public Notice

A public notice was published in the *Chincoteague Beacon* and the *Eastern Shore News* (local newspapers) on October 28, 2010, and October 27, 2010, respectively. These notices solicit information from the general public about past activities at the former Main Base Ranges. To date, no responses have been received regarding the notices. The public notice affidavit is included in Appendix C.

4.0 Skeet Range MRS

4.1 History and Land Use

In 1944, the Bureau of Aeronautics constructed a Shotgun Range (also referred to as the Skeet Range) at CNAAS. The range was located in the Main Base Ranges' small arms complex immediately adjacent to and east of the Rifle Range. Installation development maps for CNAAS, dated June 1944 and June 1945, portray a northeasterly firing direction for the original skeet range and indicate the firing line and trap house.

An aerial photograph taken sometime in 1948 shows a repositioned skeet range with a new orientation. The June 1949 version of the installation map depicts three trap houses (Buildings A-37, A-26A, and A-26-B) arranged in a semicircle with an approximate 60-ft radius. This revised orientation at the skeet range is in an easterly direction. The June 1952 installation development map confirms that the skeet range direction of fire is due east. The northeasterly facing firing line and tower trap house are no longer displayed; only the three new trap houses are present in this area. Historical aerial photographs taken in 1948, 1949, and 1954 clearly depict the trap houses and the east-facing shooting arc.

The Skeet Range MRS is owned by NASA and contains NOAA satellite antennae and data acquisition operations. The majority of the MRS is located on open areas covered by grass and asphalt roads and pavement for NOAA's radar antennae stations. Approximately 2 acres of the MRS to the north are located within federally-designated wetlands along the Little Mosquito Creek. This area is densely covered with tree, shrub, and wetland vegetation. NASA's future land use plans at the former Main Base Range complex do not include residential reuse.

4.2 Previous Investigations

4.2.1 Tetra Tech, Site Investigation, October and November 2007

4.2.1.1 Soil Results

In October and November 2007, Tetra Tech performed a site investigation on behalf of NASA WFF under a CLEAN contract task order issued by NAVFAC (Tetra Tech, 2009a). The site investigation addressed soil and groundwater associated with the Main Base Firing Range Complex. A total of 84 surface soil samples were collected as part of the investigation: 57 of these samples were collected at the Skeet Range MRS (Figure 4-1). Each soil sample was collected from a 1-foot-square area using disposable plastic scoops or decontaminated stainless steel hand trowels from depths of 0 to 6 inches bgs and were sieved using a 2-mm sieve size (Tetra Tech, 2009a). The number of lead shots was recorded and a sample of soil was collected and analyzed for TAL metals and PAHs (Table 4-1). The concentrations of lead and PAH compounds were compared to screening criteria which included the human health screening level

for lead of 400 mg/kg. At the request of USACE NAB, the concentrations of lead were also compared to the human health screening level for industrial soil of 800 mg/kg.

Lead was detected in the surface soil throughout the Skeet Range at concentrations ranging from 6.9 mg/kg to 1,150 mg/kg (Table 4-2). The highest concentration was detected in surface soil sample SR-SS-0037-000.5 collected north of the asphalt road at sample location SR-SS-0037 (Figure 4-2). Areas where lead concentrations exceed the human health screening level are evident in the southern portion of the MRS and include samples SR-SS-024-000.5 (511 mg/kg), SR-SS-040-000.5 (756 mg/kg), SR-SS-041-000.5 and duplicate (398 and 407 mg/kg), SR-SS-042-000.5 (424 mg/kg), SR-SS-045-000.5 (405 mg/kg), and SR-SS051-000.5 (589 mg/kg). The number of lead shots found in these samples ranged from 45 to 165 per square foot (Figure 4-1) (Tetra Tech, 2009a). The lead shot count does not indicate a significant correlation but does suggest that the highest concentrations of lead in surface soil occurred at surface soil sample locations where lead shot was found at greater densities.

Surface soil samples collected during the 2007 investigation included PAH analysis (Table 4-1). In general, concentrations of PAHs greater than background and human health screening levels were found within approximately 225 ft of the former shooting arc; this corresponds with visual confirmation of clay pigeon fragments (Figures 4-1 and 4-3). The analytical results are consistent with the observation of clay pigeon target fragments and confirm the historical layout of the Skeet Range (Tetra Tech, 2009a).

The maximum detected concentration (MDC) of lead and PAH compounds at the Skeet Range MRS are compared to the background screening values and the human health and ecological screening values and summarized in the table below:

Site Inspection Analytes of Concern	Site Inspection Background Screening Values	EPA RSL Residential Soil (mg/kg)	EPA RSL Industrial Soil (mg/kg)	Ecological Screening Value (mg/kg)	MDC (mg/kg)
Lead	20.2	400	800	11	1,150
Acenaphthene	0.43	3400	33,000	1.1	0.67
Acenaphthylene	0.43	No value	No value	1.1	Not detected
Anthracene	0.43	17,000	170,000	1.1	2.8
Benz[a]anthracene	0.43	0.15	2.1	29	24
Benzo[a]pyrene	0.344	0.015	0.21	29	28
Benzo[b]fluoranthene	0.493	0.15	2.1	29	39
Benzo[k]fluoranthene	0.43	1.5	21	29	21
Benzo[g,h,i]perylene	0.43	No value	No value	29	24
Chrysene	0.487	15	210	29	24
Dibenz[a,h]anthracene	0.43	0.015	0.21	29	11
Fluoranthene	0.727	2300	22,000	1.1	36
Fluorene	0.43	2300	22,000	1.1	0.38
Indeno[1,2,3-cd]pyrene	0.43	0.15	2.1	29	27
Naphthalene	0.43	3.6	18	1.1	0.370
Phenanthrene	0.43	No value	No value	1.1	12
Pyrene	0.656	1700	17,000	29	30

The MDC of lead exceeds its background screening level and its human health (residential and industrial) and ecological screening levels. The MDC of 13 of the 16 PAH compounds analyzed exceed their respective background screening level; the MDC of 7 of the compounds exceed their respective residential human health screening levels (6 meet or exceed the industrial screening levels); and the MDC of 5 of the compounds exceed their respective ecological screening values.

Tetra Tech identified seven metals, in addition to lead, as potential COCs at the Skeet Range MRS (Tetra Tech, 2009a and 2009b). The MDC for each of these metals (except copper) resulted from samples collected from the drainage swale located north of the asphalt road (sample locations SR-SS-037, SR-SS-038, and/or SR-SS-039). The soil in this area is from the *Molena* soil series. Therefore, the background screening value shown below is representative of the background dataset determined in *Molena* surface soils (Tetra Tech, 2004). The MDC for copper resulted from a sample collected in the southwestern portion of the MRS (location SR-SS-054) from the *Bojac* soil series. Because a background screening value was not determined for copper in *Bojac* surface soils, the value shown below is taken from the background screening value for *Molena* surface soil (Tetra Tech, 2004). For human health risk-based comparison purposes, the EPA RSLs for residential soil are shown (EPA, 2012b).

Other Potential COCs (Tetra Tech, 2009)	Mean of all Data (Tetra Tech, 2009)	MDC (Tetra Tech, 2009)	Surface Soil Background Screening Value (Tetra Tech, 2004)	EPA RSL Residential Soil (EPA, 2012)
Aluminum	11,500	23,000	21,800	77,000
Arsenic	6.95	23.4 J	30.9	0.39
Chromium, Total	12.4	24	23.3	NV
Copper	22.6	842	82.8	3100
Iron	8550	30,200 J	16,300	55,000
Manganese	190	1190	1060	1800
Vanadium	17.6	34.5	39.6	390

Notes:
All values shown are mg/kg.
J = estimated concentration

Of the seven metals, arsenic and vanadium did not exceed their respective background screening values. Aluminum, chromium, copper, iron, and manganese each exceeded their respective background screening values in only one sample. None of the concentrations exceeding the background screening value also exceed the EPA RSL for residential surface soil. For these reasons, the seven metals do not appear to be potential COCs at the MRS.

4.2.1.2 Soil Lead Exposure Risk Assessment

As part of the site investigation for the Skeet Range, Tetra Tech conducted a soil lead evaluation and exposure risk assessment (Tetra Tech, 2009a). The following summarizes the findings of this evaluation as it relates to exposure to lead in soil for residential (including child) and industrial receptors. The modeling results summarized below include all of the surface soil data collected during the 2007 site investigation; the 2009 follow-up sampling results were not included because the Tetra Tech Site Investigation Report was issued in February 2009, prior to the follow-up sampling performed later that year in November.

The MDC of each chemical of potential concern (COPC) was adopted as the exposure point concentration (EPC). The EPC is defined as the constant chemical concentration to which a receptor is continuously exposed while in contact with an environmental medium. Lead was selected as a COPC for the Skeet Range soil. Child blood lead concentrations were predicted assuming reasonable maximum exposure (RME) conditions applied to a population of children exposed to soil containing the MDC of lead. The Integrated Exposure and Uptake Biokinetic (IEUBK) Model predicted that 53.5 percent of an exposed population of children would exhibit blood lead levels above 10 micrograms per deciliter (µg/dL). This percentage exceeds EPA's protective level cutoff of 5 percent and indicates that adverse effects from lead exposure to residential children under these conditions cannot be ruled out. A second model run assumed central tendency exposure (CTE) conditions, with children exposed to the mean concentration of lead in soil. These modeling results predicted that 0.6 percent of an exposed population of children would exhibit blood lead levels above 10 µg/dL. This percentage does not exceed EPA's protective level cutoff of 5 percent (Tetra Tech, 2009a).

Blood lead modeling of adult workers exposed to the MDC of lead in Skeet Range soil predicted that 11.9 percent of a population of exposed pregnant workers would exhibit fetal blood lead levels above 10 µg/dL. A CTE prediction of worker blood lead concentrations assumed exposure to the mean soil lead concentration and predicted that 4.6 percent of workers would have fetal blood lead levels above 10 µg/dL. Modeled results exceeded EPA's protective level cutoff of 5 percent only for exposure to the maximum soil lead concentration (Tetra Tech, 2009a).

4.2.1.3 Groundwater Results

Tetra Tech installed four temporary monitoring wells and one background comparison well in 2007 within the vicinity of the Main Base Ranges complex using direct-push technology. Two of the wells (RR-MW-02 and RR-MW-03) were located within the Skeet Range MRS boundaries. The temporary monitoring well (RR-MW-01) used for background comparison purposes was installed to the west of the former Rifle Range (Figure 4-1). The groundwater samples were collected using peristaltic pumps and low-flow sampling techniques. The samples were analyzed for TAL metals and PAHs (Table 4-3). Lead was detected at concentrations (1.2 and 1.1 micrograms per liter [µg/L]) below the concentration of the background sample (2.2 µg/L). No PAH compounds were detected in groundwater from the temporary monitoring wells (RR-MW-02 or RR-MW-03) located at the MRS. Perchlorate was also sampled for but was not detected from the wells at the MRS. The Tetra Tech report concluded that groundwater has not been "significantly impacted" by the Main Base Ranges complex (Tetra Tech, 2009a).

The MDC of lead in groundwater at the Skeet Range MRS is compared to the background threshold level and the human health screening values and summarized in the table below:

Site Inspection Analyte of Concern	Site Inspection Background Threshold Value (µg/L)	EPA Tapwater RSLs (µg/L)	Virginia Water Quality Criteria (Public Water Supply) (µg/L)	Maximum Detected Concentration (µg/L)
Lead	6.6	15 (MCL)	15	1.2

Notes:
µg/L = micrograms per liter
MCL = Maximum Contaminant Level
RSL = Regional Screening Level

The MDC of lead does not exceed its background threshold value, the EPA Tapwater RSLs, or the Virginia Water Quality Criteria for Public Water Supplies. PAH compounds were not detected in groundwater at the MRS above the laboratory's practical quantitation limit (PQL) of 0.2 µg/L. Seven of the 16 PAH compounds not detected (Benz[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Dibenz[a,h]anthracene, Indeno[1,2,3-cd]pyrene, and Naphthalene) have human health screening values less than the PQL. Therefore, for these PAH compounds, measurement quality objectives were not met.

4.2.1.4 Summary

The following conclusions summarize the Tetra Tech site investigation findings with respect to MEC and MC for the Skeet Range MRS (Tetra Tech, 2009a).

- No evidence of MEC was found at the Skeet Range MRS during the investigation. Evidence of lead shot pellets was found during the investigation.
- Clay pigeon target fragments were observed within approximately 250 ft of the firing line. The greatest density of fragments was encountered in the open ground to the northeast, east, and southeast of the skeet range shooting arc.
- Higher concentrations of lead shot were found to the southeast of the firing line.
- The concentrations of lead at eight sample locations exceed the residential human health screening level (400 mg/kg). The results occurred at seven sample locations from the southeastern portion of the MRS and at one sample location from the drainage swale located north of the road. Concentrations in these samples ranged from 405 to 1,150 mg/kg.
- Ecological risk screening performed as part of the Tetra Tech evaluation determined that soil lead concentrations and lead shot pellet density in the southeastern portion of the Skeet Range present a potential risk to birds.
- The concentrations of 7 PAH compounds out of 16 analyzed exceed their respective EPA residential soil screening levels.
- PAHs present the greatest risk to the human receptor primarily from the area nearest to the shooting arc (i.e., northeast, east, and southeast). Clay pigeon target fragments were observed on the ground surface in these areas.

The Tetra Tech report recommended that further actions be taken at the Skeet Range MRS to address elevated levels of lead and selected PAHs in soil near the former Skeet Range shooting arc to the north, east, and southeast. Figures 4-2 and 4-3 depict the "approximate area requiring further investigation," as determined by Tetra Tech (Tetra Tech, 2009a).

4.2.2 Tetra Tech, Follow-Up Sampling, July 2009

Additional surface soil sampling was performed by Tetra Tech in July 2009 in the drainage swale located north of the access road (Tetra Tech, 2009b). The purpose of this sampling event was to confirm the elevated lead in soil results identified in the 2007 sampling event. The sample collected at sampling location SR-SS-037 in the July 2009 follow-up sampling event (1,190 mg/kg) confirmed the 2007 concentration (1,150 mg/kg). A duplicate sample was also collected in July 2009 at this location; the concentration of lead in this sample was 1,400 mg/kg. Seven of the nine samples collected for lead analysis (included one duplicate sample) from the drainage swale located north of the road, had concentrations of lead greater than 400 mg/kg (Tetra Tech, 2009b).

The MDC of lead at the MRS from the 2009 follow-up sampling is compared to the background screening values and the human health and ecological screening values and summarized in the

table below:

Site Inspection Metal of Concern	Site Inspection Background Screening Value	Human Health Residential Soil Screening Level (mg/kg)	Ecological Screening Value (mg/kg)	MDC (mg/kg)
Lead	20.2	400	11	1400

The MDC of lead exceeds the background, human health, and ecological screening values.

4.3 MEC Evaluation

4.3.1 Preliminary Conceptual Site Model Summary for MEC

The preliminary CSM developed for the Skeet Range MRS identified only small arms ammunition (shotguns with lead shot) at the MRS. Surface soil was identified as a potential pathway for human exposure to MEC. NASA-WFF and NOAA employees and construction workers were identified as potential human receptors, with the potential route of human exposure identified as direct contact. A revised CSM is presented in Appendix J.

4.3.2 Field Observations and Historical Evidence of MEC

The discovery of MEC or MD (other than that associated with normal skeet range use) has never been reported for the MRS. As part of their field observations, Tetra Tech observed the presence of clay pigeon target fragments and lead shot at the Skeet Range MRS. The TPP stakeholders also observed clay pigeon target fragments during the site walk conducted as part of the TPP meeting held in September 2010.

4.3.3 MEC Risk Assessment

The following section presents a qualitative assessment of the risk associated with potential MEC at the Skeet Range MRS. This assessment is based on historical documentation, Tetra Tech's site investigation, and the TPP meeting site visit. A MEC assessment is provided to convey relative risk on a scale from low to high and is not intended to be a thorough risk assessment as would be conducted for an RI/FS.

Former ranges used exclusively for live fire of small arms ammunition present no significant or unique explosive hazard (Department of the Army, 2009). Based on historical information, the Skeet Range MRS is a former small arms range where known munitions activity was limited to the use of small arms ammunition. Significant MEC risk for the MRS is not anticipated based on the following:

- Historical evidence indicates that only small arms ammunition was used at the MRS.
- Small arms ammunition does not pose a significant or unique explosive hazard.
- Evidence of MEC or MD (other than that associated with normal skeet range use) associated with former military munitions activity was not observed during the site investigation performed by Tetra Tech in 2007 and 2009.

4.4 Munitions Constituents Evaluation

4.4.1 Preliminary Conceptual Site Model Summary for Munitions Constituents

The preliminary CSM for the Skeet Range MRS identified lead as the MC of concern. Although PAHs from the pitch-based targets at the Skeet Range are not MC, they are addressed under the MMRP as constituents potentially associated with former range use. Both lead and PAH compounds have been identified as constituents of concern associated with the former skeet range.

The highest concentrations of MC at the Skeet Range MRS are predicted to be present in the fall zones typical of a skeet range (ITRC, 2003). Identified primary potential human receptors at the MRS include NASA-WFF and NOAA employees and construction workers. Other potential human receptors could include any future residents. Ecological receptors are also present, including certain birds that may forage in the southeastern portion of the lead fall zone (where lead shot density was demonstrated to be high), and other potential ecological receptors located downslope of the drainage swale in the marshlands along the Little Mosquito Creek.

4.4.2 Soil Exposure Pathway

Soil pathway receptors may be exposed to MC if soil contains MC from the firing of small arms ammunition. Surface soil samples were collected as part of the Tetra Tech investigation to evaluate soil exposure to lead from lead shot and to PAHs from clay pigeon target fragments. Surface soil was the primary medium of concern because of the presence of MC (lead) and target fragments (PAH compounds) in the soil from range activities. Potential human receptors of MC are NASA-WFF and NOAA employees and construction workers who might be exposed to contaminated soil from dermal contact, ingestion, and inhalation of soil particles during intrusive work. Although residential uses are not planned, other potential human receptors would include any future residents (adult or child).

Soil samples were collected from the upper 6 inches bgs. The samples were analyzed using EPA SW-846 methodology for the following:

- TAL metals by EPA Method 6010B and
- PAHs by EPA Method 8270C.

Table 4-1 show the concentrations of lead and PAH compounds in soil compared to the established screening values. Table 4-2 shows the concentrations of lead in soil compared to the established screening values. Figures 4-2 and 4-3 depict the sample results for lead and PAH compounds, respectively.

4.4.2.1 Comparison to Background Data

Fifty-six samples (including duplicates) collected during the site investigations exceeded the background screening value for lead in soil of 20.2 mg/kg (Figure 4-2). These concentrations ranged in value from 25.9 mg/kg to 1,400 mg/kg. The highest concentration of lead was

detected in sample SR-SS-100-000.5-D (at location SS-SR-037), which was collected north of the NOAA access road in the drainage swale.

PAH compounds were identified above background screening levels in 22 samples (Figure 4-3 and Table 4-1). Sample SR-SS-008-000.5, located just east of the shooting arc, exhibited the highest concentrations of benz(a)anthracene (24 mg/kg), benzo(a)pyrene (28 mg/kg), benzo(b)flouranthene (21 mg/kg), chrysene (24 mg/kg), dibenz(a,h)anthracene (11 mg/kg), indeno(1,2,3-cd)pyrene (27 mg/kg), and pyrene (30 mg/kg). Sample SR-SS-033-000.5, located 60 ft northwest of SR-SS-008, exhibited the highest concentrations of acenaphthene (0.67 mg/kg), anthracene (2.8 mg/kg), flouranthene (36 mg/kg), fluorene (0.38 mg/kg), napthalene (0.37 mg/kg), and phenanthrene (12 mg/kg).

4.4.2.2 Comparison to Human Health Screening Values

Soil analytical results were compared to human health screening values only if background screening levels were exceeded (Tables 4-1 and 4-2). A total of 15 surface soil samples (including two duplicates) exceed the human health screening value for lead of 400 mg/kg (Figure 4-2). Twenty-two of the samples (including two duplicates) collected during the investigation exceeded both background screening levels and human health screening values for PAHs (Figure 4-3).

4.4.2.3 Comparison to Ecological Screening Values

Chemical concentrations in surface soil that exceeded background screening levels were compared to ecological screening values (Tables 4-1 and 4-2). A total of 56 surface soil samples (including two duplicates) exceeded the background screening level for lead (20.2 mg/kg) and also exceeded the ecological screening value (11 mg/kg). Concentrations of PAHs exceeded the ecological screening values in 17 surface soil samples (including one duplicate) at the MRS.

4.4.3 Surface Water Pathway

The Skeet Range MRS does not have any perennial or intermittent surface water features. A wet weather conveyance provides drainage for the MRS and surrounding areas. The drainage feature or swale originates in the central portion of the Skeet Range MRS and continues northeasterly via a concrete culvert beneath the asphalt roadway (Figure 2-8). The drainage pathway is a wet weather conveyance only and does not carry natural stream flow. Surface water runoff flowing in the swale empties into the marshlands of Little Mosquito Creek located approximately 400 ft to the north of the northern tip of the MRS. MC derived from spent small arms ammunition has been deposited on surface soil within the lead shot fall zone (Figure 4-2).

Surface water and sediment samples were not collected as part of the Tetra Tech site investigation. However, soil samples were collected from the drainage swale and analyzed for lead. Concentrations of lead, in the 12 surface soil samples collected within the drainage pathway north of the road, ranged from 104 mg/kg to 1,400 mg/kg. Lead was detected in sample

SR-SS-101-000.5 at 1,400 mg/kg (this sample confirmed the concentration of lead in sample SR-SS-0037-000.5, which was 1,150 mg/kg). Grain size analysis for soil from sample location SR-SS-0037 indicated an elevated percentage of silt in the sample (51 percent) when compared to other surface soil samples from the MRS. Lead results from the two northernmost samples located further downslope of SS-SR-037 (SR-SS-038-000.5 and SR-SS-039-000.5) were 235 mg/kg and 104 mg/kg, respectively. The decrease in the concentration of lead in the surface soil samples collected further downslope of SR-SS-0037 indicates that the MC is not moving appreciably. The elevated occurrence in the immediate vicinity of SR-SS-037 may be a result of drainage patterns in the area that allowed the finer silt particles to settle in this portion of the drainage pathway.

4.4.4 Groundwater Pathway

Groundwater from the Main Base Firing Range Complex area wells was sampled on October 22, 2007, by Tetra Tech via low-flow sampling techniques using Teflon-lined polyethylene tubing and a peristaltic pump. An in-line, flow-through meter was utilized during sampling to collect field readings of pH, conductivity, temperature, turbidity, dissolved oxygen, oxidation reduction potential, and salinity. The samples were analyzed using EPA SW-846 methodology for the following:

- TAL metals by EPA Method 6020 and
- PAHs by EPA Method 8270C.

Table 4-3 shows the concentrations of lead and PAHs in groundwater compared to the established background threshold levels and the human health screening levels. Figures 4-2 and 4-3 depict the sample results for lead and PAHs, respectively.

4.4.4.1 Comparison to Background

Groundwater samples were collected at the MRS: RRMW-02-2001023, RRMW-03-20071023 and RRMW-03-20071023-D (duplicate sample). One groundwater sample was collected from a temporary monitoring well (RRMW-01) located outside of the MRS to the west of the former Rifle Range (Figure 4-1). This groundwater sample served as a background sample (Tetra Tech, 2009a).

The concentration of lead detected in the background well was 2.2 µg/L. The concentrations of detected lead in RRMW-02-2001023 and RRMW-03-20071023 (0.97 µg/L and 1.2 µg/L, respectively) are below the background screening level (Table 4-3 and Figure 4-2). PAH compounds were not detected in groundwater above any of the laboratory method detection limits (Table 4-3 and Figure 4-3).

4.4.4.2 Comparison to Human Health Screening Values

The concentration of lead detected in groundwater at the MRS was below both background screening levels and human health screening levels (Table 4-3 and Figure 4-2). PAH compounds

were not detected in groundwater above any of the laboratory method detection limits (Table 4-3 and Figure 4-3).

4.4.5 Air Pathway

Inhalation of MC in vapor form is not a pathway of concern for non-volatile MC under normal environmental conditions. Potential inhalation of soil and sediment in the form of airborne dust is considered in the development of health-based screening values in soil.

4.5 Draft MRSPP Rating

The MRSPP was published as a rule in 2005 for the DoD to assign a relative priority for munitions responses to each location in the DoD's inventory of defense sites known or suspected of containing UXO, DMM, or MC. Provisions of the Rule require that the Department assign a relative priority to each defense site in the inventory for response activities that are based on the overall conditions at each MRS. Priority 1 indicates the highest potential hazard and Priority 8 the lowest potential hazard. Under the MRSPP, only MRSs with CWM can be assigned to Priority 1 and no MRS with CWM can be assigned to Priority 8.

Therefore, a draft MRSPP rating was created for the Skeet Range MRS. Existing site information, primarily the results of the site investigation performed at the Main Base Range Complex by Tetra Tech in 2007 and 2009, form the basis of the information used to complete the draft MRSPP ratings. The MRSPP includes three hazard evaluation modules for the Skeet Range MRS: the Explosive Hazard Evaluation (EHE), the CWM Hazard Evaluation (CHE), and the Health Hazard Evaluation (HHE). Explosives hazards are evaluated using the EHE module; CWM-related hazards are evaluated using the CHE module; and health and environmental hazards posed by MC are evaluated using the HHE module. Appendix K contains the ratings for each module and the draft MRS Priority for the Skeet Range MRS. The draft MRSPP for the Skeet Range MRS is presently rated Priority 5.

5.0 Summary and Conclusions

The WFF Main Base Ranges included the Aircraft Gun Testing Range/Pistol Range, the Rifle Range, and the Skeet Range. The Skeet Range is the only MRS being investigated for this SI.

Based on historical evidence (installation maps and aerial photographs), the MRS is a former small arms firing range used for skeet and trap shooting with shotguns. Evidence of former military munitions activity at the Skeet Range MRS was observed by the Tetra Tech site investigation field team in 2007 in the form of lead shot and clay pigeon target fragments. The TPP stakeholders observed clay pigeon target fragments during the site walk conducted in September 2010. Historical information and observations indicate that only small arms were used at the range, and small arms present no unique or significant explosive hazard.

Fifty-seven surface soil samples (including three duplicate samples) were collected in October and November of 2007 by Tetra Tech as part of the site investigation of the Main Base Firing Range Complex (Tetra Tech, 2009a). The surface soil samples were analyzed for TAL metals and PAHs.

Fifty-six samples (including two duplicates) collected during the site investigation exceeded the background screening value for lead in soil of 20.2 mg/kg (Figure 4-2 and Tables 4-1 and 4-2). These concentrations ranged from 25.9 mg/kg to 1,400 mg/kg. The highest concentration of lead was detected in sample SR-SS-100-000.5-D (at location SS-SR-037), which was collected north of the NOAA access road in the drainage swale. A total of 15 surface soil samples (including two duplicates) exceed the human health screening value for lead of 400 mg/kg. A total of 56 surface soil samples (including two duplicates) exceeded the background screening level for lead (20.2 mg/kg) and also exceeded the ecological screening value (11 mg/kg). The number of lead shots found in the samples collected in the southeastern portion of the MRS ranged up to a maximum of 165 per square foot. Correspondingly, the concentrations of lead in the samples collected in this area ranged up to a maximum of 756 mg/kg.

PAH compounds were identified above background screening levels in 22 samples (including one duplicate) (Figure 4-3 and Table 4-1). Twenty-two of the samples (including two duplicates) collected during the investigation exceeded both background screening levels and human health screening values for PAHs. Concentrations of PAHs exceeded the ecological screening values in 17 surface soil samples (including one duplicate) at the MRS. The PAH concentration pattern is consistent with the observation of clay pigeon target fragments and the CSM, as shown on Figure 4-3.

Previous surface soil sampling performed at the Skeet Range MRS confirmed that the soil medium provides an exposure route for lead and PAHs to human receptors at the MRS. The predicted distribution of lead in surface soil is based on the distribution of lead shot within the

lead shot fall zones, and the predicted distribution of PAHs is based on the target fall zones. Presently, MC contamination in surface soil appears to have moved within the source area through the culvert downslope along the drainage pathway, but it is not moving appreciably.

The MRS qualifies as an IEP and a sensitive environment. A small 2-acre portion of the approximately 30.2-acre MRS is located within wetlands along the Little Mosquito Creek. Although the wetland portion of the MRS is not expected to receive direct impacts from skeet range activities, it most likely receives surface runoff from the range as it flows through a centralized drainage swale into a concrete culvert constructed beneath the road. Previous surface soil sampling performed at the Skeet Range MRS confirmed that concentrations of lead downslope of the drainage swale exceed screening criteria. This indicates a potential exposure route to ecological receptors located in the wetlands further downslope.

Groundwater samples were collected from two temporary monitoring wells installed within the MRS and analyzed for metals and PAHs (Figures 4-2 and 4-3 and Table 4-3). The concentrations of lead from these wells were below the concentration of lead from the background screening well (and below the human health screening level). PAHs were not detected in groundwater at the MRS.

6.0 Recommendations

Results of the SI provide the basis for conclusions and/or recommendations for further actions at the MRS.

Based on historical evidence, NASA-WFF site knowledge, and the results from the site investigation performed in 2007 and 2009, evidence of MEC (other than small arms use) is not present at the MRS. Therefore, further investigation or removal action is not required regarding the presence of MEC at the Skeet Range MRS.

Based on the analytical results from the site investigation performed by Tetra Tech in 2007 and 2009, concentrations of lead and PAHs exceed background, human health, and ecological screening values at the Skeet Range MRS. Therefore, an RI/FS is recommended regarding the presence of lead and PAHs at the Skeet Range MRS.

Results of the SI provide the basis for identifying MRSs and for scoring an MRS using MRSPP (Appendix K). The Skeet Range MRS, part of the Main Base Ranges, was identified at the WFF FUDS. Shaw has verified that the location and size (approximately 30.2 acres) of the Skeet Range MRS are correct.

The site investigation performed by Tetra Tech largely defined the horizontal extent of lead and PAH contamination in the surface soil (0 to 6 inches bgs) located south of the paved road at the east-facing skeet range. Any future remedial investigation scoping planned for the MRS should address the determination of the vertical extent of contamination in the shallow subsurface soil in this area. Further, remedial investigation scoping should include the drainage pathway located north of the paved road. An evaluation of sediment and surface water media is required because the pathway is considered to be potentially complete (to ecological receptors that may be located in the wetlands associated with Little Mosquito Creek). Remedial investigation scoping should also include an evaluation of those portions of the original northeast-facing skeet range that are not overlapped by the adjacent Rifle Range and the Aircraft Gun Testing/Machine-Gun/Pistol Range.

It is further recommended that the acreage of the Skeet Range MRS be revised in the MRS Inventory. The current MRS Inventory indicates that the Skeet Range occupies 31.6 acres. The revised areal extent of the Skeet Range MRS boundaries is approximately 30.2 acres based on the inclusion of those portions of the northeast-facing skeet range that are outside of the east-facing Skeet Range, the adjacent Rifle Range, and the Aircraft Gun Testing/Machine-Gun/Pistol Range and the exclusion of that portion of the Rifle Range that overlaps the east-facing skeet range.

7.0 References

32 CFR 179.3 (Code of Federal Regulation Title 32, Part 179). 2007. *Munitions Response Site Prioritization Protocol (MRSPP).* Website: http://www.gpoaccess.gov/cfr/index.html. Washington, D.C. August 22, 2007.

40 CFR 300 (Code of Federal Regulation Title 40, Part 300). 2006. *National Oil and Hazardous Substances Pollution Contingency Plan.* Website: http://www.gpoaccess.gov/cfr/index.html. Washington, D.C. October 4, 2006.

40 CFR 312 (Code of Federal Regulation Title 40, Part 312). 2006. *Innocent Landowners, Standards for Conducting All Appropriate Inquiries*. Website: http://www.access.gpo.gov/nara/cfr/waisidx_06/40cfr312_06.html. July 1, 2006.

70 FR 58016 (Federal Register Vol. 70, No. 192, page 58016). 2005. *Rules and Regulations - Munitions Response Site Prioritization Protocol, Preamble*. Codified 32 CFR Part 179. October 5, 2005.

70 FR 58028 (Federal Register Vol. 70, No. 192, page 58028). 2005. *Munitions Response Site Prioritization Protocol, Final Rule***.** Codified 32 CFR Part 179. October 5, 2005.

10 USC 2701 et seq. (U.S. Code Title 10, Part 2701). 2004. *Chapter 160 – Environmental Restoration, Sec. 2701 Environmental Restoration Program*. U.S. Government Printing Office. Website: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=browse_usc&docid=Cite:+10USC2701. January 20, 2004.

42 USC 9601 (U.S. Code Title 42, Part 9601). 2003. *Hazardous Substances Releases, Liability, and Compensation*. U.S. Government Printing Office. Website: http://frwebgate5.access.gpo.gov/cgi-bin/waisgate.cgi?WAISdocID=209840153119+0+0+0&WAISaction=retrieve. January 7, 2003.

Army Air Forces (AAF). 1945. Gunnery and Bombardment Ranges. AAF Manual 85-0-1. Published by Headquarters, Army Air Forces. Declassified. June 1945.

ASTM International (ASTM). 2007. ASTM E 1527-05, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*.

Center for Conservation Biology. 2010. Virginia Bald Eagle Nest Survey. Website: http://www.ccb-wm.org/virginiaeagles/. Queried June 2011.

Department of the Army. 2009. *Army Policy for Application of the Military Munitions Response Site Prioritization Protocol (MRSPP).* Tad Davis, Deputy Assistant Secretary of the Army. February 20, 2009.

Department of Defense (DoD). 2001. *Management Guidance for the Defense Environmental Restoration Program*. Office of the Deputy Under Secretary of Defense (Installations and Environment). September 2001.

Department of Defense (DoD). 2010. *Defense Environmental Programs Annual Report to Congress Fiscal Year 2010, MRS Inventory*. Website: http://deparc.xservices.com/deparc/do/home.

Environmental Data Resources, Inc. (EDR). 2010. *EDR Radius Map Report™ with GeoCheck®, WFF Main Base Ranges*. July 22, 2010.

ESRI. 2006. StreetMap 2006 database distributed with ArcGIS software. ESRI, 380 New York Street, Redlands, California. Website: http://www.esri.com/.

Executive Order 12580. 1987. *Superfund Implementation*. 52 FR 2923. January 23, 1987. Website: http://www.archives.gov/federal-register/codification/executive-order/12580.html.

Executive Order 13016. 1996. *Amendment to Executive Order No. 12580.* 61 FR 45871. August 28, 1996. Website: http://www.archives.gov/federal-register/executive-orders/1996.html.

Interstate Technical and Regulatory Council (ITRC). 2003. *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges.* Technical Regulatory Guidelines. 2003.

National Oceanic and Atmospheric Administration (NOAA). 2005. Ocean and Coastal Resource Management. Coastal Zone Management Act of 1972, as amended through Pub. L. No. 109-58, the Energy Policy Act of 2005. Website: http://coastalmanagement.noaa.gov/czm/czm_act.html.

National Oceanic and Atmospheric Administration (NOAA). 2009. Climate of Virginia. National Climatic Data Center. Website: http://www.ncdc.noaa.gov/oa/ncdc.html. Queried September 2010.

Richardson, D.L. 1992. Hydrogeology and Analysis of the Ground-Water Flow System of the Eastern Shore, Virginia. U.S. Geological Survey (USGS) Open-File Report 91-490, 118 pp.

Shaw Environmental, Inc. (Shaw). 2011. *Final Technical Project Planning Memorandum, Wallops Flight Facility Main Base Ranges (Skeet Range),* FUDS Property No. C03VA0301, Accomack County, Virginia. Prepared for the U.S. Army Corps of Engineers. February 2011.

Tetra Tech NUS, Inc. (Tetra Tech). 2004. *Background Soil and Groundwater Investigation Report for the Main Base, NASA Wallops Flight Facility, Wallops Island, Virginia*. May 2004

Tetra Tech NUS, Inc. (Tetra Tech). 2009a. *Site Investigation Report, Revision 1 for the Main Base Firing Range Complex, NASA Wallops Flight Facility, Wallops Island, Virginia*. February 2009.

Tetra Tech NUS, Inc. (Tetra Tech). 2009b. *Follow-Up Sampling, Skeet Range – Drainage Area, Main Base Firing Range Complex, NASA Wallops Flight Facility, Wallops Island, Virginia*. July 2009.

URS Group, Inc. (URS). 2005. *Final Site-Wide Environmental Assessment, Wallops Flight Facility, Virginia*. Prepared for NASA, Goddard Space Flight Center. Prepared by URS Group, Inc. and EG&G Technical Services. January 2005.

URS Group, Inc. (URS). 2011. *2011 Annual Drinking Water Quality Report for 2010 data,* Goddard Space Flight Center, Wallops Flight Facility, Main Base Waterworks. Prepared for NASA, Goddard Space Flight Center. Prepared by URS. 2011.

U.S. Army Corps of Engineers (USACE). 1948-1957. Aerial photographs dated 1948, 1949, 1954, and 1957.

U.S. Army Corps of Engineers (USACE). 1998. Technical Project Planning (TPP) Process. EM 200-1-2. August 31, 1998.

U.S. Army Corps of Engineers (USACE). 2003. *Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Waste (HTRW) Projects*. EM 1110-1-1200. February 3, 2003.

U.S. Army Corps of Engineers (USACE). 2004. *Defense Environmental Restoration Program (DERP) Formerly Used Defense Sites (FUDS) Program Policy*. Engineer Regulation (ER) 200-3-1. May 10, 2004.

U.S. Army Corps of Engineers (USACE). 2005. *Formerly Used Defense Sites (FUDS) Military Munitions Response Program (MMRP) Site Inspections. Program Management Plan*. February 2005.

U.S. Army Corps of Engineers (USACE). 2006. *Screening-Level Ecological Risk Assessments for FUDS MMRP Site Inspections*. Prepared by USACE HTRW CX. August 11, 2006.

U.S. Army Corps of Engineers (USACE). 2007. *FUDS MMRP Site Inspection Program Supplemental Execution Guidance, Military Munitions Center of Expertise Interim Guidance Document (IGD) 07-04.* Prepared by CEHNC-OE-CX. July 16, 2007.

U.S. Army Corps of Engineers (USACE). 2009. *Project Summary Sheet for DERP-FUDS MMRP Project No. C03VA030109, Wallops Flight Facility, Main Base Ranges, Accomack County, Virginia.* July 2009.

U.S. Army Corps of Engineers (USACE). 2010. *Draft Final Defense Environmental Restoration Program for Formerly Used Defense Sites Preliminary Assessment, Wallops Flight Facility, Accomack County, Virginia*. March 2010.

1378 U.S. Army Corps of Engineers (USACE). 2011. *Wallops Flight Facility, MMRP Realignment*
1379 *FUDSMIS Data Summary*. March 2011.

1380 U.S. Census. 2010. Website: http://www.census.gov/. Queried September 2010.

1381 U.S. Department of Agriculture (USDA). 1999. Topographic maps: Accomack, Somerset and
1382 Worcester Counties, Virginia. USDA Service Center Agencies.

1383 U.S. Department of Agriculture (USDA). 2008. *Natural Resources Conservation Service, Web*
1384 *Soil Survey of the National Cooperative Soil Survey*. Interactive online database. Website:
1385 http://websoilsurvey.nrcs.usda.gov/app/. Queried September 2010.

1386 U.S. Department of Agriculture (USDA). 2011. Aerial photograph, Accomack County. USDA
1387 Farm Service Agency, Aerial Photography Field Office National Agriculture Imagery Program
1388 Server (available in ArcGIS at http://gis.apfo.usda.gov/arcgis/services).

1389 U.S. Environmental Protection Agency (EPA). 1990. *Appendix A to Part 300 – The Hazard*
1390 *Ranking System*, Title 40 CFR Part 300, 55 FR 51624. December 14, 1990.

1391 U.S. Environmental Protection Agency (EPA). 1997. *Ecological Risk Assessment Guidance for*
1392 *Superfund: Process for Designing and Conducting Ecologic I Risk Assessments* (ERAGS).
1393 USEPA/540/R-97/006, OSWER Directive # 9285.7-25. June 1997.

1394 U.S. Environmental Protection Agency (EPA). 2010. *Safe Drinking Water Information System*.
1395 Website: http://www.epa.gov/enviro/html/sdwis/sdwis_query.html#geography. Queried
1396 October 2010.

1397 U.S. Environmental Protection Agency (EPA). 2011. *Guidance for Developing Ecological Soil*
1398 *Screening Levels (Eco-SSLs)*. OSWER Directive 9285.7-55. Office of Solid Waste and
1399 Emergency Response. November 2005. Website: http://www.epa.gov/ecotox/ecossl. Last
1400 updated June 2011.

1401 U.S. Environmental Protection Agency (EPA). 2012a. CERCLA Overview. Website:
1402 http://www.epa.gov/superfund/policy/cercla.htm. Queried April 2012.

1403 U.S. Environmental Protection Agency (EPA). 2012b. Region 3 Regional Screening Levels
1404 Summary Table. Website: http://www.epa.gov/reg3hwmd/risk/human/index.htm. May 2012.

1405 U.S. Fish and Wildlife Service (USFWS). 2006. NWIDBA.CONUS_wet_poly: Classification
1406 of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish
1407 and Wildlife Service, FWS/OBS-79/31. Branch of Habitat Assessment, Washington, D.C. May
1408 2006.

1409 U.S Geological Survey (USGS). 2004. *A Tapestry of Time and Terrain, The Union of Two*
1410 *Maps – Geology and Topography*. Website: http://tapestry.usgs.gov/. Queried September 2010.

Town of Chincoteague. 2009. *Annual Drinking Water Quality Report* (for calendar year 2009). Public Works Department. Website: http://www.chincoteague-va.gov/government/public-works/water-facts. Queried March 2012.

Virginia Department of Conservation and Recreation (VaDCR). 2010. Letter from Ms. Alli Baird (VaDCR) to Gregg McGraw (Shaw Environmental, Inc.). August 24, 2010.

Virginia Department of Fish and Wildlife Information Service (VaFWIS), Game and Inland Fisheries. 2012. Website: http://vafwis.org/fwis/. Queried July 25, 2012.

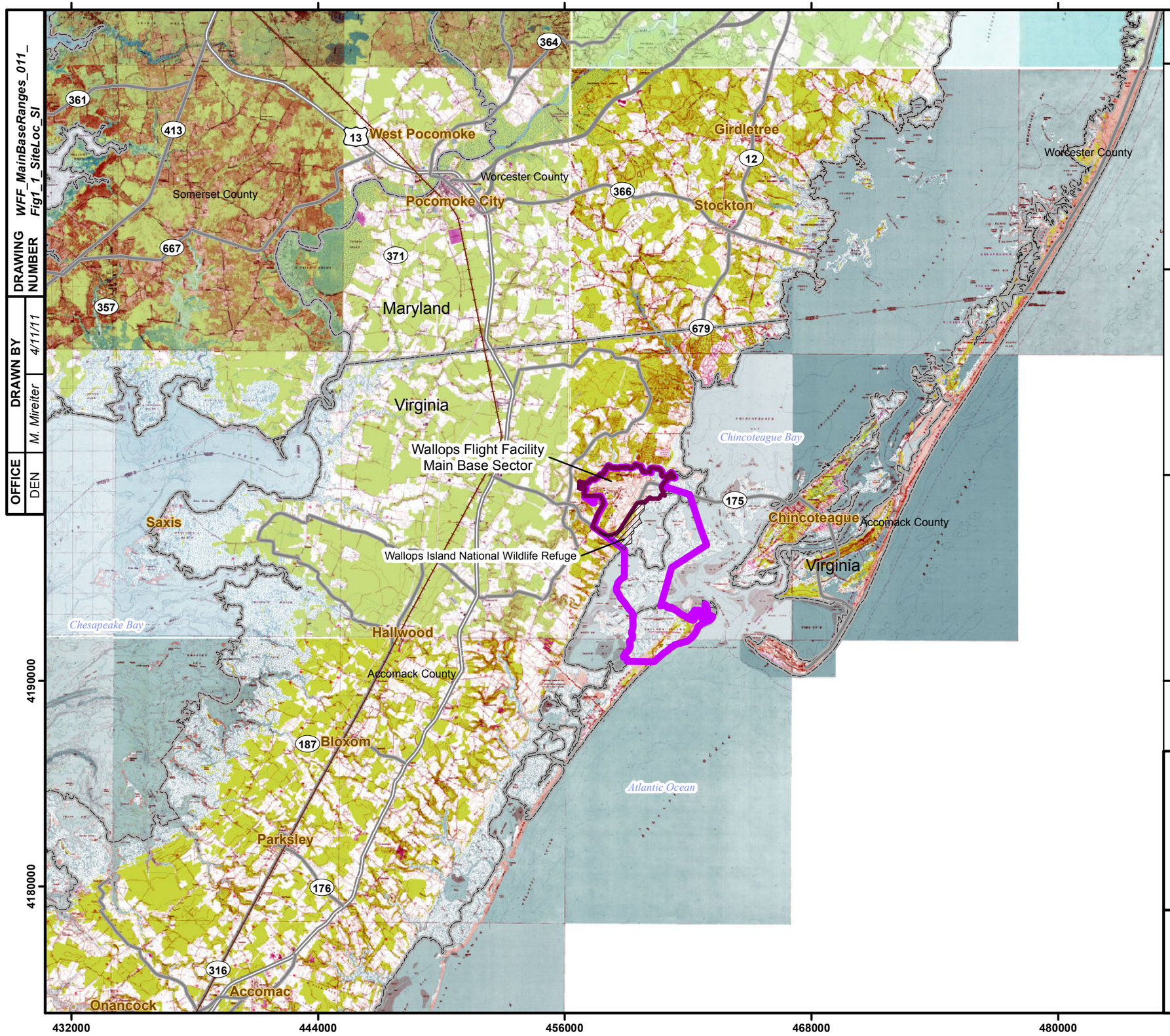
Virginia State Regulations. 2011. Virginia Water Quality Criteria, Title 9, Agency 25, Chapter 260, Section 140. January 2011.

Figures

DRAWING NUMBER: WFF_MainBaseRanges_011_Fig1_1_SiteLoc_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN



Legend

- Wallops Flight Facility FUDS Boundary
- Wallops Flight Facility Main Base Sector
- Wallops Island National Wildlife Refuge

NOTES:
1) Property boundary was obtained from the USACE.
2) Topographic maps (Accomack, Worcester, and Somerset Counties) were obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.

N

0 1.5 3 6 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 1-1

SITE LOCATION

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_024_Fig2_1a_1948Aerial_SI

DRAWN BY: M. Mireiter 4/11/11

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459150 459320 459490 459660 459830

4200250 4200100 4199950 4199800 4199650

High Tower Range

Aircraft Gun Testing/ Machine-Gun/ Pistol Range Butt

Rifle Range

High Tower Trap House

Rifle Range

Firing Line

Trap House

Skeet Range Shooting Arc

Control House

Trap House

0 25 50 Feet

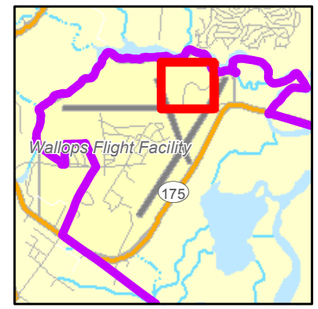
Legend

- East Facing Skeet Range Boundary
- Rifle Range Boundary
- 1944 Drawing Site Features
- Estimated Safety Fan for High Tower Range (Northeast Facing Skeet Range)
- Skeet Range MRS

NOTES:

1) Property boundary was obtained from the USACE. Range location was derived based on evidence of firing point arc visible on 1948, 1949, and 1954 aerial photographs.
2) Aerial photograph was obtained from the USACE and is dated October 13, 1948.

N



0 125 250 500 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-1a

1948 AERIAL PHOTOGRAPH

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

459150 459320 459490 459660 459830

4200250
4200100
4199950
4199800
4199650

High Tower Range
Aircraft Gun Testing/ Machine-Gun/ Pistol Range Butt
Rifle Range
High Tower Trap House
Rifle Range
Firing Line
Trap House
Skeet Range Shooting Arc
Control House
Trap House
0 25 50 Feet

DRAWING NUMBER: WFF_MainBaseRanges_025_Fig2_1b_1949Aerial_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

Legend

- East Facing Skeet Range Boundary
- Rifle Range Boundary
- 1944 Drawing Site Features
- Estimated Safety Fan for High Tower Range (Northeast Facing Skeet Range)
- Skeet Range MRS

NOTES:
1) Property boundary was obtained from the USACE. Range location was derived based on evidence of firing point arc visible on 1948, 1949, and 1954 aerial photographs.
2) Aerial photograph was obtained from the USACE and is dated 1949.

N

Wallops Flight Facility
175

0 125 250 500 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-1b

1949 AERIAL PHOTOGRAPH

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

459150 459320 459490 459660 459830

4200250 4200100 4199950 4199800 4199650

Target Berm
Aircraft Gun Testing/ Machine-Gun/ Pistol Range Butt
100-Yd Firing Line
200-Yd Firing Line
Rifle Range
300-Yd Firing Line
Skeet Range MRS

100-Yd Firing Line
Rifle Range
Skeet Range MRS
Trap House
Skeet Range Shooting Arc
Control House
Trap House
0 25 50 Feet

Legend

- Skeet Range MRS
- Rifle Range Boundary
- 1944 Drawing Site Features

NOTES:
1) Property boundary was obtained from the USACE.
2) Aerial photograph was obtained from the USACE and is dated 1954.

N

Wallops Flight Facility
175

0 125 250 500 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-1c

1954 AERIAL PHOTOGRAPH

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

OFFICE	DRAWN BY		DRAWING NUMBER
DEN	M. Mireiter	4/11/11	WFF_MainBaseRanges_012_Fig2_1c_1954Aerial_SI

DRAWING NUMBER: WFF_MainBaseRanges_026_Fig2_1d_1957Aerial_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

459150 459320 459490 459660 459830

4200250 4200100 4199950 4199800 4199650

Target Berm

Aircraft Gun Testing/ Machine-Gun/ Pistol Range Butt

100-Yd Firing Line

200-Yd Firing Line

Rifle Range

300-Yd Firing Line

Skeet Range MRS

100-Yd Firing Line

Rifle Range

Skeet Range MRS

Trap House

Skeet Range Shooting Arc

Control House

Trap House

0 25 50 Feet

Legend

- Skeet Range MRS
- Rifle Range Boundary
- 1944 Drawing Site Features

NOTES:
1) Property boundary was obtained from the USACE.
2) Aerial photograph was obtained from the USACE and is dated 1957.

N

0 125 250 500 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-1d

1957 AERIAL PHOTOGRAPH

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_013_Fig2_2_2011Aerial_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

456600 458400 460200 462000 463800

4200000 4198400 4196800 4195200 4193600

Limpet Dr
Mosquito Creek
Rifle Range
Rehor Rd
Harpold St
Bond St
Bliss St
Kline St
Opelly St
Anderson St
Wormhoudt St
Mill Dam Rd
Fulton St
Stubbs Blvd
175
Blades Cir
Mifflin Rd
Salver Dr
Dogwood Ln
Holly Cir
Holly Ln
Maple Ln
Atlantic Rd
Watts Bay Dr
Wallops Neck Rd
Wallops Island National Wildlife Refuge
Cedar Creek
Little Simoneaston Creek
Wright Rd
Waterfield Ln
Nocks Landing Rd
Channel Rd

Estimated Lead Shot Fall Zone
Estimated Target Fragments Fall Zone
Estimated Target Fragments and Lead Shot Fall Zone
Rifle Range
Skeet Range MRS
Site 8
Site 5
0 125 250 Feet
APFO

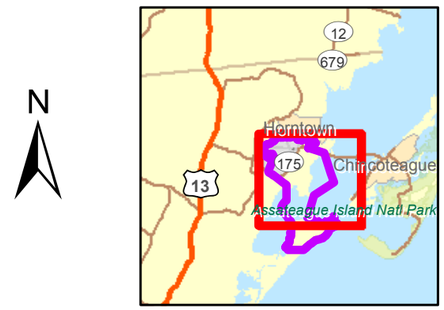
Legend

- Wallops Flight Facility FUDS Boundary
- Skeet Range MRS
- Rifle Range Boundary
- Wallops Island National Wildlife Refuge
- Extent of Tree Removal
- Proposed Soil Grading/Disturbance Area
- Proposed NOAA Radar Site
- Proposed Asphalt Paved Area

Skeet Range Estimated Shotfall Zones[2]

- Estimated Lead Shot Fall Zone
- Estimated Target Fragments Fall Zone
- Estimated Target Fragments and Lead Shot Fall Zone

NOTES:
1) Property boundary was obtained from the USACE.
2) Shotfall zone boundaries are based on previous skeet range investigations (adapted from the ITRC *Characterization and Remediation of Soils at Closed Small Arms Ranges*, ITRC, 2003).
3) 2011 aerial photograph was obtained from the U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office National Agriculture Imagery Program Server (available in ArcGIS at http://gis.apfo.usda.gov/arcgis/services).



REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-2

2011 AERIAL PHOTOGRAPH

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

OFFICE	DRAWN BY		DRAWING NUMBER
DEN	M. Mireiter	4/11/11	WFF_MainBaseRanges_014_Fig2_3_Topo_SI

456800 458200 459600 461000 462400

4196900 4195600

Rifle Range

Wallops Island National Wildlife Refuge

Mosquito Creek

Little Mosquito Creek

Cedar Creek

Big Simonecston Creek

Watts Bay

Chincoteague Pumping Station

WALLOPS NECK

Mill Dam Rd

Wright Rd

Wallops Neck Rd

Watts Bay Dr

Stubbs Blvd

Fulton St

Harpold St

Reiser Rd

Bliss St

Kline St

Orelly St

Anderson St

Wormhoudt St

Waterfield Ln

Atlantic Rd

Maple Ln

Holly Ln

Holly Cir

Dogwood Ln

Sallyet Dr

Blades Cir

Odum Cir

Limpet Dr

Chester

Mosquito Point

Tiger Flat

Sandpits

Sandpit

Cem

BM 40

175

679

Rifle Range

Skeet Range MRS

FACILITY

0 150 300 Feet

4196900 4195600

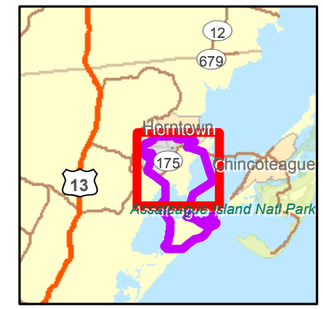
456800 458200 459600 461000 462400

Legend

- Wallops Flight Facility FUDS Boundary
- Skeet Range MRS
- Rifle Range
- Wallops Island National Wildlife Refuge

NOTES:
1) Property boundary was obtained from the USACE.
2) Topographic map (Accomack County) was obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.

N



0 1,000 2,000 4,000 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-3

TOPOGRAPHIC MAP

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_015_Fig2_4_Census_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

2000 CENSUS DATA			
Population		Housing Units	Households
Within Range Boundary	0	0	0
Range + 1/4 Mile	0	0	0
Range + 1/2 Mile	0	0	0
Range + 1 Mile	27	17	9
Range + 2 Miles	4,400	1,659	1,562
Range + 3 Miles	5,090	1,988	1,848
Range + 4 Miles	6,266	2,633	2,359

Highest Census Block Group Density Per Square Mile Within 2 Miles of the Skeet Range
203.6

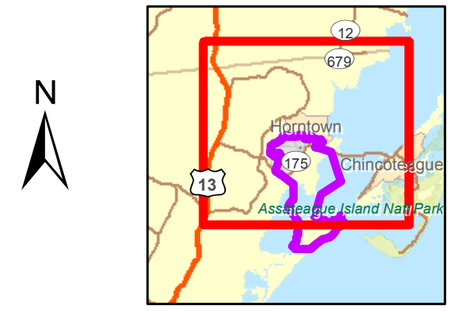
Legend

- Wallops Flight Facility FUDS Boundary
- Skeet Range MRS
- Wallops Island National Wildlife Refuge

2005 Census Block Group Population

- 0 - 2000
- 2001 - 4000
- 4001 - 6000
- Census Block Centroid Unit
- 203.6 — Number of People Per Square Mile Within Census Block Group

NOTES:
1) Property boundary was obtained from the USACE.
2) Census data were obtained from StreetMap (ESRI, 2006).
3) The 2005 population of Accomack County was 90 people per square mile.
4) The Census Block Centroid Units represent centroids of the smallest entities for which the Census Bureau tabulates census information, bounded on all sides by visible features such as streets, streams, and railroad tracks, and/or invisible boundaries such as city, town, and county limits. The population assigned to a centroid unit may be a positive integer or zero. The centroid populations were summed within defined distances from the FUDS boundary to generate population totals presented on the inset table.
5) 2011 aerial photograph was obtained from the U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office National Agriculture Imagery Program Server (available in ArcGIS at http://gis.apfo.usda.gov/arcgis/services).



0 2,500 5,000 10,000 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-4

CENSUS DATA WITHIN A 4-MILE RADIUS

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_016_Fig2_5_SensRec_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

453000 456000 459000 462000 465000

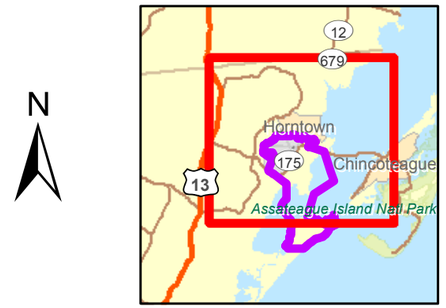
4206000 4203200 4200400 4197600 4194800

Coldkall Creek
Swans Gut Creek
Powell Creek
Chincoteague Bay
Tunnels Mill Branch
Little Mosquito Creek
Cedar Creek
Skeet Range MRS
Wallops Island National Wildlife Refuge
Chincoteague
Chincoteague National Wildlife Refuge

Legend

- Wallops Flight Facility FUDS Boundary
- Skeet Range MRS
- 4-Mile Radius from Skeet Range
- Wallops Island National Wildlife Refuge
- Wetlands Area
- Active Bald Eagle Nest
- Inactive Bald Eagle Nest
- Airport
- Church
- Park

NOTES:
1) Property boundary was obtained from the USACE.
2) Wetlands data was obtained from the U.S. Fish and Wildlife Service, May 2006, NWIDBA.CONUS_wet_poly: Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31., U.S. Fish and Wildlife Service, Branch of Habitat Assessment, Washington, D.C.
3) Endangered species data was obtained from the Final Site-Wide EA (URS, 2005).
4) Topographic map (Accomack County) was obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



N

0 2,250 4,500 9,000
Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-5

SENSITIVE RECEPTOR LOCATIONS WITHIN A 4-MILE RADIUS

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_017_Fig2_6_GWWells_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

457000 458100 459200 460300 461400

4200100

4199200

4198300

4197400

4196500

Skeet Range MRS

WALLOPS FLIGHT FACILITY (NASA-GSFC)

Wallops Island National Wildlife Refuge

Mosquito Creek

Little Simoneaston Creek

Big Simoneaston Creek

Cedar Creek

Chincoteague Pumping Station

WALLOPS NECK

Simoneaston Bay

COCKLE CREEK

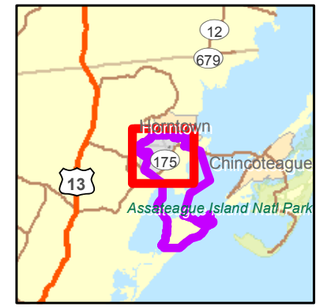
Legend

- Wallops Flight Facility FUDS Boundary
- Skeet Range MRS
- Wallops Island National Wildlife Refuge

Groundwater Well Type

- Monitoring Well
- Observation Well
- Piezometer
- Potable Water Supply

NOTES:
1) Property boundary was obtained from the USACE.
2) Groundwater well data was obtained from the USACE.
3) Topographic map (Accomack County) was obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.



N

0 750 1,500 3,000 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-6

GROUNDWATER WELL LOCATIONS

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_018_Fig2_7_RegSW_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

Fairmount
West Pocomoke
Pocomoke City
Snow Hill
Girdletree
Stockton
Saxis
Chincoteague
Wallops Island
National Wildlife Refuge
Hallwood
Bloxom
Parksley
Accomac
Onancock
Onley
Chesapeake Bay
Atlantic Ocean
Chincoteague Bay
Little Mosquito Creek
Mosquito
WALLOPS FLIGHT FACILITY
(NASA-GSFC)
Skeet Range MRS

Legend

- Wallops Flight Facility FUDS Boundary
- Skeet Range MRS
- 15-Mile Radius from Skeet Range
- Wallops Island National Wildlife Refuge
- Intermittent Stream
- Perennial Stream

NOTES:
1) Property boundary was obtained from the USACE.
2) Topographic maps (Accomack, Worcester, and Somerset Counties) were obtained from the U.S. Department of Agriculture, Service Center Agencies, 1999.

N

0 1.75 3.5 7 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-7

REGIONAL SURFACE WATER DRAINAGE WITHIN A 15-MILE RADIUS

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: *WFF_MainBaseRanges_019_Fig2_8_CulturalRes_SI*

DRAWN BY: *M. Mireiter* *4/11/11*

OFFICE: DEN

458400 458670 458940 459210 459480

4200660 4200440 4200220 4200000 4199780 4199560

Little Mosquito Creek

Building A-131

Asphalt Road

Culvert

Surface Water Flow Direction

Skeet Range MRS

APFO

Legend

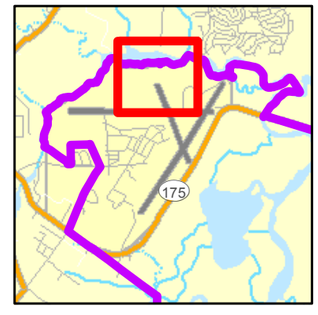
- Wallops Flight Facility FUDS Boundary
- Skeet Range MRS
- High Archaeological Sensitivity
- Moderate Archaeological Sensitivity

Wetland Type

- Estuarine Wetland
- Palustrine Forested/Shrub Wetland
- Palustrine Pond
- Bald Eagle Nest Buffer
- Active Bald Eagle Nest

NOTES:

1) Property boundary was obtained from the USACE.
2) Wetlands data was obtained from the U.S. Fish and Wildlife Service, May 2006, NWIDBA.CONUS_wet_poly: Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC. FWS/OBS-79/31., U.S. Fish and Wildlife Service, Branch of Habitat Assessment, Washington, D.C.
3) Archaeological sensitivity areas were obtained from the Final Site-Wide EA (URS, 2005).
4) 2011 aerial photograph was obtained from the U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office National Agriculture Imagery Program Server (available in ArcGIS at http://gis.apfo.usda.gov/arcgis/services).



N

0 200 400 800

Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 2-8

SENSITIVE RECEPTORS WITHIN IMMEDIATE VICINITY OF MRS

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_020 Fig4_1_PrevSampleLocs_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

459100 459200 459300 459400 459500

4200100

4200010

4199920

4199830

4199740

RRMW-04
Groundwater Flow Direction
Rifle Range
RRMW-05
RRMW-01
RRMW-02
RRMW-03
Site 8
Site 5
Skeet Range MRS
SR-SS-039 0
SR-SS-005
SR-SS-006 0
SR-SS-038 0
SR-SS-004
SR-SS-108
SR-SS-107
SR-SS-035
SR-SS-103
SR-SS-037
SR-SS-003
SR-SS-105
SR-SS-104
SR-SS-102
SR-SS-034
SR-SS-002
SR-SS-106
SR-SS-033
SR-SS-011
SR-SS-012
SR-SS-008
SR-SS-009
SR-SS-001
SR-SS-036
SR-SS-007
SR-SS-010
SR-SS-013
SR-SS-014
SR-SS-019
SR-SS-016
SR-SS-025
SR-SS-015
SR-SS-020
SR-SS-017
SR-SS-018
SR-SS-026
SR-SS-021
SR-SS-027
SR-SS-022
SR-SS-044
SR-SS-031
SR-SS-023
SR-SS-041
SR-SS-032
SR-SS-043
SR-SS-028
SR-SS-024
SR-SS-042
SR-SS-052
SR-SS-029
SR-SS-040
SR-SS-050
SR-SS-054
SR-SS-045
SR-SS-051
SR-SS-047
SR-SS-053
SR-SS-049
SR-SS-030
SR-SS-055
SR-SS-056

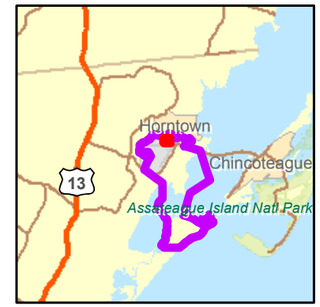
Legend

- Skeet Range MRS
- Rifle Range Boundary

Historical Sample Locations

- Soil
- Groundwater
- Clay Pigeon Fragments
- XX Lead Shot Per Square Foot
- Extent of Tree Removal
- Proposed NOAA Radar Site
- Proposed Soil Grading/Disturbance Area
- Proposed Asphalt Paved Area

NOTES:
1) Property boundary was obtained from the USACE.
2) Previous sample locations were obtained from the USACE.
3) Lead shot per square foot data, clay shot fragment data, and groundwater flow direction were derived from figures in the Site Investigation Report for the Main Base Firing Range Complex (Tetra Tech NUS Inc., 2007-2009).
4) 2011 aerial photograph was obtained from the U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office National Agriculture Imagery Program Server (available in ArcGIS at http://gis.apfo.usda.gov/arcgis/services).



0 75 150 300 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 4-1

SAMPLE LOCATIONS (TETRA TECH NUS, INC., 2007-2009)

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_021 Fig4_2_MetalsResults_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

459100 459200 459300 459400 459500

4199920 4199830 4199740

RRMW-04 Rifle Range RRMW-05 RRMW-01 RRMW-02-20071023 RRMW-03-20071023 RRMW-03-20071023-D

SR-SS-039-000.5 SR-SS-006-000.5 SR-SS-038-000.5 SR-SS-005-000.5 SR-SS-108-000.5 SR-SS-004-000.5 SR-SS-037-000.5 SR-SS-107-000.5 SR-SS-100-000.5 SR-SS-035-000.5 SR-SS-103-000.5 SR-SS-100-000.5-D SR-SS-003-000.5 SR-SS-104-000.5 SR-SS-105-000.5 SR-SS-002-000.5 SR-SS-010-000.5 SR-SS-102-000.5 SR-SS-034-000.5 SR-SS-011-000.5 SR-SS-106-000.5 SR-SS-033-000.5 SR-SS-012-000.5 SR-SS-001-000.5 SR-SS-036-000.5 SR-SS-007-000.5-D SR-SS-007-000.5 SR-SS-009-000.5 SR-SS-013-000.5 SR-SS-008-000.5 SR-SS-019-000.5 SR-SS-016-000.5 SR-SS-025-000.5 SR-SS-015-000.5 SR-SS-020-000.5 SR-SS-014-000.5 SR-SS-020-000.5-D SR-SS-021-000.5 SR-SS-017-000.5 SR-SS-026-000.5 SR-SS-022-000.5 SR-SS-027-000.5 SR-SS-023-000.5 SR-SS-031-000.5 SR-SS-043-000.5 SR-SS-032-000.5 SR-SS-041-000.5 SR-SS-028-000.5 SR-SS-041-000.5-D SR-SS-029-000.5 SR-SS-042-000.5 SR-SS-024-000.5 SR-SS-054-000.5 SR-SS-040-000.5 SR-SS-053-000.5 SR-SS-051-000.5 SR-SS-030-000.5 SR-SS-055-000.5 SR-SS-056-000.5 SR-SS-049-000.5 SR-SS-047-000.5 SR-SS-045-000.5 SR-SS-050-000.5 SR-SS-052-000.5 SR-SS-018-000.5 SR-SS-044-000.5 Site 8 Site 5

Skeet Range MRS

APFO

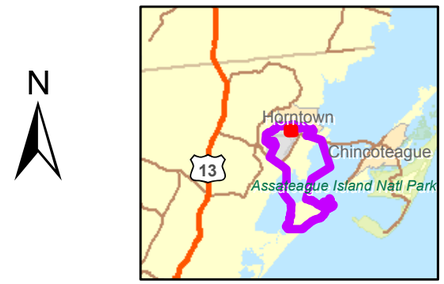
Legend

- Skeet Range MRS
- Rifle Range Boundary
- Approximate Area Recommended for Further Investigation (Tetra Tech NUS, 2009)
- Extent of Tree Removal
- Proposed Soil Grading/Disturbance Area
- Proposed NOAA Radar Site
- Proposed Asphalt Paved Area

Skeet Range Estimated Shotfall Zones[2]

- Estimated Lead Shot Fall Zone
- Estimated Target Fragments Fall Zone
- Estimated Target Fragments and Lead Shot Fall Zone
- Soil Sample Results Greater than Background, Ecological, and Human Health Screening Values
- Soil Sample Results Greater than Background and Ecological But Less Than Human Health Screening Values
- Soil Sample Results Less than Background Screening Levels
- Groundwater Sample Results Less than Background Screening Levels
- Background Groundwater Sample Location

NOTES:
1) Property boundary was obtained from the USACE.
2) Shotfall zone boundaries are based on previous skeet range investigations (adapted from the ITRC *Characterization and Remediation of Soils at Closed Small Arms Ranges*, ITRC, 2003).
3) Previous sample locations were obtained from the USACE.
4) Approximate area recommended for further investigation was obtained from Figure 12 of the Wallops Flight Facility Main Base Ranges SI Report (Tetra Tech NUS, Inc., 2007-2009).
5) 2011 aerial photograph was obtained from the U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office National Agriculture Imagery Program Server (available in ArcGIS at http://gis.apfo.usda.gov/arcgis/services).



0 75 150 300 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 4-2

LEAD RESULTS (TETRA TECH NUS, INC., 2007-2009)

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

DRAWING NUMBER: WFF_MainBaseRanges_022 Fig4_3_PAHResults_SI

DRAWN BY: M. Mireiter 4/11/11

OFFICE: DEN

459100 459200 459300 459400 459500

4199920 4199830 4199740

RRMW-04
Rifle Range
RRMW-05
RRMW-01
SR-SS-039-000.5
SR-SS-006-000.5
SR-SS-038-000.5
SR-SS-005-000.5
SR-SS-004-000.5
SR-SS-035-000.5
SR-SS-037-000.5
SR-SS-003-000.5
SR-SS-002-000.5
SR-SS-010-000.5
SR-SS-034-000.5
SR-SS-011-000.5
SR-SS-012-000.5
SR-SS-033-000.5
SR-SS-001-000.5
SR-SS-036-000.5
SR-SS-007-000.5-D
RRMW-03-20071023
SR-SS-007-000.5
SR-SS-009-000.5
RRMW-03-20071023-D
SR-SS-013-000.5
SR-SS-008-000.5
SR-SS-019-000.5
SR-SS-016-000.5
SR-SS-025-000.5
Site 8
RRMW-02-20071023
SR-SS-015-000.5
SR-SS-018-000.5
SR-SS-020-000.5
SR-SS-014-000.5
SR-SS-020-000.5-D
SR-SS-021-000.5
SR-SS-017-000.5
SR-SS-026-000.5
SR-SS-022-000.5
SR-SS-044-000.5
SR-SS-027-000.5
SR-SS-023-000.5
Site 5
SR-SS-031-000.5
SR-SS-043-000.5
SR-SS-032-000.5
SR-SS-041-000.5
SR-SS-028-000.5
SR-SS-041-000.5-D
SR-SS-052-000.5
SR-SS-042-000.5
SR-SS-029-000.5
SR-SS-050-000.5
SR-SS-024-000.5
SR-SS-045-000.5
SR-SS-054-000.5
SR-SS-040-000.5
SR-SS-047-000.5
SR-SS-053-000.5
SR-SS-049-000.5
SR-SS-051-000.5
SR-SS-030-000.5
SR-SS-055-000.5
SR-SS-056-000.5
Skeet Range MRS
APFO

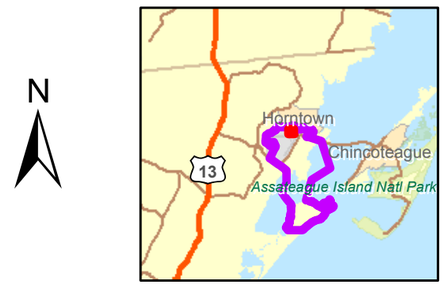
Legend

- Skeet Range MRS
- Rifle Range Boundary
- Approximate Area Recommended for Further Investigation (Tetra Tech NUS, 2009)
- Extent of Tree Removal
- Proposed Soil Grading/Disturbance Area
- Proposed NOAA Radar Site
- Proposed Asphalt Paved Area

Skeet Range Estimated Shotfall Zones[2]

- Estimated Lead Shot Fall Zone
- Estimated Target Fragments Fall Zone
- Estimated Target Fragments and Lead Shot Fall Zone
- Soil Sample Results Greater than Background, Ecological, and Human Health Screening Values
- Soil Sample Results Greater than Background and Human Health But Less Than Ecological Screening Values
- Soil Sample Results Greater than Background and Ecological But Less Than Human Health Screening Values
- Soil Sample Results Less than Background Screening Levels
- Groundwater Sample Results Less than Background Screening Levels
- Background Groundwater Sample Location

NOTES:
1) Property boundary was obtained from the USACE.
2) Shotfall zone boundaries are based on previous skeet range investigations (adapted from the ITRC *Characterization and Remediation of Soils at Closed Small Arms Ranges*, ITRC, 2003).
3) Previous sample locations were obtained from the USACE.
4) Approximate area recommended for further investigation was obtained from Figure 12 of the Wallops Flight Facility Main Base Ranges SI Report (Tetra Tech NUS, Inc., 2007-2009).
5) 2011 aerial photograph was obtained from the U.S. Department of Agriculture, Farm Service Agency, Aerial Photography Field Office National Agriculture Imagery Program Server (available in ArcGIS at http://gis.apfo.usda.gov/arcgis/services).



0 75 150 300 Feet

REFERENCE/PROJECTION: NAD 83 UTM Zone 18N

FIGURE 4-3

PAH RESULTS (TETRA TECH NUS, INC., 2007)

MAIN BASE RANGES (SKEET RANGE)
WALLOPS FLIGHT FACILITY MAIN BASE SECTOR
PROJECT NUMBER CO3VA030109

US Army Corps of Engineers®

Shaw®

Tables

Table 2-1
Munitions Information
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Small Arms Munitions/ MMRP-Related Items	Component	Constituents	Site Inspection Analytes
12-gauge shotgun was standard. Other gauges that may have been used: .410, 16, or 20 gauges.	Projectile	Lead shot	Lead
	Propellant	Smokeless powder, nitrocellulose, diphenylamine, graphite, dinitrotoluene	None[a]
	Cartridge or shell casing with firing cap	Cardboard or brass	None
Clay pigeon targets		Petroleum pitch-based binder containing PAHs	PAHs[b]

Notes:

MC = munitions constituents
MMRP = military munitions response program
MRS = munitions response site
PAHs = polycyclic aromatic hydrocarbons

The basis for excluding MC is summarized in the footnotes provided below:

[a] Propellant is largely dispersed in the air upon firing and involves limited potential quantities.

[b] PAHs from the pitch-based clay pigeon targets used at the MRS are not MC; however, they are addressed under the MMRP as constituents associated with former range use.

Table 2-2
Army Checklist for Important Ecological Places[a]
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

		Yes / No	Comments
1	Locally important ecological place identified by the Integrated Natural Resource Management Plan, BRAC Cleanup Plan or Redevelopment Plan, or other official land management plans	☐ / ☒	
2	Critical habitat for Federal designated endangered or threatened species	☐ / ☒	
3	Marine Sanctuary	☐ / ☒	
4	National Park	☐ / ☒	
5	Designated Federal Wilderness Area	☐ / ☒	
6	Areas identified under the Coastal Zone Management Act	☒ / ☐	The entire coastline of Wallops Flight Facility is located within the Virginia Coastal Zone Management (CZM) Area. The Virginia CZM Program is part of a national coastal zone management program; a voluntary partnership between the National Oceanic and Atmospheric Administration, the National Ocean Service Office of Ocean and Coastal Resource Management, and U.S. coastal states and territories authorized by the federal CZM Act.
7	Sensitive Areas identified under the National Estuary Program or Near Coastal Waters Program	☐ / ☒	
8	Critical areas identified under the Clean Lakes Program	☐ / ☒	
9	National Monument	☐ / ☒	
10	National Seashore Recreational Area	☐ / ☒	
11	National Lakeshore Recreational Area	☐ / ☒	
12	Habitat known to be used by Federal designated or proposed endangered or threatened species	☐ / ☒	
13	National preserve	☐ / ☒	
14	National or State Wildlife Refuge	☐ / ☒	
15	Unit of Coastal Barrier Resources System	☐ / ☒	
16	Coastal Barrier (undeveloped)	☐ / ☒	
17	Federal land designated for protection of natural ecosystems	☐ / ☒	
18	Administratively Proposed Federal Wilderness Area	☐ / ☒	
19	Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters	☐ / ☒	

Table 2-2 (Cont.)
Army Checklist for Important Ecological Places[a]
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

		Yes / No	Comments
20	Migratory pathways and feeding areas critical for maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which fish spend extended periods of time	☐ / ☒	
21	Terrestrial areas utilized for breeding by large or dense aggregations of animals	☐ / ☒	
22	National river reach designated as Recreational	☐ / ☒	
23	Habitat known to be used by state designated endangered or threatened species	☐ / ☒	
24	Habitat known to be used by species under review as to its Federal endangered or threatened status	☐ / ☒	
25	Coastal Barrier (partially developed)	☐ / ☒	
26	Federally designated Scenic or Wild River	☐ / ☒	
27	State land designated for wildlife or game management	☐ / ☒	
28	State-designated Scenic or Wild River	☐ / ☒	
29	State-designated Natural Areas	☐ / ☒	
30	Particular areas, relatively small in size, important to maintenance of unique biotic communities	☐ / ☒	
31	State-designated areas for protection or maintenance of aquatic life	☐ / ☒	
32	Wetlands	☒ / ☐	Approximately 2 acres of the northern tip of the munitions response site are located within palustrine and estuarine wetlands along Little Mosquito Creek. Storm event runoff flows downslope to the Tidal Oligohaline Marsh along Little Mosquito Creek.
33	Fragile landscapes, land sensitive to degradation if vegetative habitat or cover diminishes	☒ / ☐	According to the Virginia Department of Conservation and Recreation, Division of Natural Heritage, the wetland portion of the munitions response site is located within the Little Mosquito Creek Conservation Site. This conservation site has a biodiversity significance ranking of "B3" which represents a site of high importance.

a – Based on EPA, 1990, 55 FR 51624, Table 4-23 – Sensitive Environments Rating Values, Dec. 14, 1990; EPA, 1997, ERAGS, Exhibit 1-1 List of Sensitive Environments.

Table 3-1
Background and Human Health Screening Levels
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Analyte	Groundwater				Soil		
	Background Value	Site Inspection Background Screening Values	EPA Tapwater RSLs [c]	Virginia Water Quality Criteria (Public Water Supply) [d]	Site Inspection Background Screening Values	EPA Industrial Soil RSLs [g]	EPA Residential Soil RSLs [h]
MC of Concern	(µg/L)				(mg/kg)		
Lead	2.2 [a]	6.6 [a]	15 [e]	15	20.2 [f]	800	400
Related Constituents (PAHs)							
Acenaphthene	0.2 [b]	0.2 [b]	400	670	0.43[b]	33,000	3400
Acenaphthylene	0.2 [b]	0.2 [b]	N/V	N/V	0.43[b]	N/V	N/V
Anthracene	0.2 [b]	0.2 [b]	1300	8300	0.43[b]	170,000	17,000
Benz[a]anthracene	0.2 [b]	0.2 [b]	0.029	0.038	0.43[b]	2.1	0.15
Benzo[a]pyrene	0.2 [b]	0.2 [b]	0.0029	0.038	0.34	0.21	0.015
Benzo[b]fluoranthene	0.2 [b]	0.2 [b]	0.029	0.038	0.49	2.1	0.15
Benzo[k]fluoranthene	0.2 [b]	0.2 [b]	0.29	0.038	0.43[b]	21	1.5
Benzo[g,h,i]perylene	0.2 [b]	0.2 [b]	N/V	N/V	0.43[b]	N/V	N/V
Chrysene	0.2 [b]	0.2 [b]	2.9	0.038	0.49	210	15
Dibenz[a,h]anthracene	0.2 [b]	0.2 [b]	0.0029	0.038	0.43[b]	0.21	0.015
Fluoranthene	0.2 [b]	0.2 [b]	630	130	0.73	22,000	2300
Fluorene	0.2 [b]	0.2 [b]	220	1100	0.43[b]	22,000	2300
Indeno[1,2,3-cd]pyrene	0.2 [b]	0.2 [b]	0.029	0.038	0.43[b]	2.1	0.15
Naphthalene	0.2 [b]	0.2 [b]	0.14	N/V	0.43[b]	18	3.6
Phenanthrene	0.2 [b]	0.2 [b]	N/V	N/V	0.43[b]	N/V	N/V
Pyrene	0.2 [b]	0.2 [b]	87	830	0.66	17,000	1700

Notes:
EPA = U.S. Environmental Protection Agency
µg/L = micrograms per liter
MC = munitions constituents
mg/kg = milligrams per kilogram
N/V = no value available
PAH = polycyclic aromatic hydrocarbon
RSL = Regional Screening Level
Tetra Tech = Tetra Tech NUS, Inc.

Table 3-1 (Cont.)
Background and Human Health Screening Levels
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

[a] An observed release is established when a site groundwater sample concentration is three times or more above the background concentration (2.2 µg/L), in accordance with Hazard Ranking System criteria (40 CFR Appendix A to Part 300).

[b] The PQLs were used as background thresholds (Tetra Tech, 2004).

[c] EPA Tapwater Regional Screening Levels for Chemical Contaminants at Superfund Sites (May 2012).

[d] Virginia Water Quality Criteria, Virginia State Regulations, Title 9, Agency 25, Chapter 260, Section 140 (January 2011).

[e] EPA Screening Level for lead is based on the Maximum Contaminant Level (MCL) (May 2012).

[f] Background screening values/thresholds (Tetra Tech, 2004).

[g] EPA Regional Screening Levels for Industrial Soil (May 2012).

[h] EPA Regional Screening Levels for Residential Soil (May 2012).

Table 3-2
Ecological Screening Values for Lead and PAHs in Soil
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Analyte	Background Screening Values (Tetra Tech, 2004)	Laboratory MDL	Laboratory PQL	EPA Ecological Soil Screening Level (EcoSSL) [a]
MC Metals	**(mg/kg)**			
Lead	20.2 [b]	0.09	0.91	11
PAHs	**(mg/kg)**			
Acenaphthene	0.43 [c]	0.000160	0.005	1.1
Acenaphthylene	0.43 [c]	0.000170	0.005	1.1
Anthracene	0.43 [c]	0.000133	0.005	1.1
Benz[a]anthracene	0.43 [c]	0.000146	0.005	29
Benzo[a]pyrene	0.344 [d]	0.000143	0.005	29
Benzo[b]fluoranthene	0.493	0.000145	0.005	29
Benzo[k]fluoranthene	0.43 [c]	0.000130	0.005	29
Benzo[g,h,i]perylene	0.43 [c]	0.000199	0.005	29
Chrysene	0.487 [d]	0.000192	0.005	29
Dibenz[a,h]anthracene	0.43 [c]	0.000243	0.005	29
Fluoranthene	0.727 [d]	0.000209	0.005	1.1
Fluorene	0.43 [c]	0.000227	0.005	1.1
Indeno[1,2,3-cd]pyrene	0.43 [c]	0.000244	0.005	29
Naphthalene	0.43 [c]	0.000546	0.005	1.1
Phenanthrene	0.43 [c]	0.000312	0.005	1.1
Pyrene	0.656 [d]	0.000231	0.005	29

Notes:
EPA = U.S. Environmental Protection Agency
MC = munitions constituents
MDL = method detection limit
mg/kg = milligrams per kilogram
PAHs = polycyclic aromatic hydrocarbons
PQL = practical quantitation limit.

[a] From EPA Ecological Soil Screening Levels. Website: http://www.epa.gov/ecotox/ecossl/. June 2011.
[b] Background threshold determined by Shaw using Tetra Tech background data set (Tetra Tech, 2004).
[c] The PQLs were used as background thresholds (Tetra Tech, 2004).
[d] Background screening values (Tetra Tech, 2004).

Table 4-1
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-001				SR-SS-002				SR-SS-003			
Sample Number							SR-SS-001-000.5				SR-SS-002-000.5				SR-SS-003-000.5			
Sample Date							19-Oct-07				19-Oct-07				19-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***59.3***	0.42	0.08		9.6	0.45	0.09		***30.1***	0.47	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.2	0.021	0.0015		0.018	0.02	0.0015	J	0.012	0.021	0.0016	J
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0014	0.021	0.0014	U	< .0014	0.02	0.0014	U	< .0014	0.021	0.0014	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	**0.69**	2.1	0.26	J	0.088	0.02	0.0026		0.071	0.021	0.0027	
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	**9.5**	2.1	0.26		**0.89**	0.2	0.026		**0.8**	0.11	0.014	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	**14**	2.1	0.21		**0.99**	0.2	0.021		**0.78**	0.11	0.011	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	**21**	2.1	0.23		**1.5**	0.2	0.022		**1.1**	0.11	0.012	
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	**10**	2.1	0.34		**0.76**	0.2	0.034		**0.53**	0.11	0.018	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	**9**	2.1	0.19	J	**0.74**	0.2	0.019	J	**0.56**	0.11	0.01	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	**10**	2.1	0.27		**0.91**	0.2	0.027		**0.71**	0.11	0.014	
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	**4.7**	2.1	0.39		0.27	0.02	0.0038		0.25	0.021	0.004	
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	***10***	2.1	0.41		***1.4***	0.2	0.041		**1.1**	0.11	0.021	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.086	0.021	0.0017		0.012	0.02	0.0017	J	0.0079	0.021	0.0018	J
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	**11**	2.1	0.45	J	**0.83**	0.2	0.044	J	**0.67**	0.11	0.023	
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.12	0.021	0.0018		0.0085	0.02	0.0018	J	0.006	0.021	0.0019	J
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	***2.9***	2.1	0.44		**0.55**	0.2	0.044		0.42	0.11	0.023	
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	**8**	2.1	0.71	J	**1.3**	0.2	0.07	J	**1.1**	0.11	0.037	J

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

U - Value is a non-detected result as reported by the laboratory.
J - Value is considered estimated due to exceedance of technical quality control criteria.
UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-004				SR-SS-005				SR-SS-006			
Sample Number							SR-SS-004-000.5				SR-SS-005-000.5				SR-SS-006-000.5			
Sample Date							22-Oct-07				18-Oct-07				19-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	***50.1***	0.41	0.08		***71.6***	0.41	0.08		***317***	0.44	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	< .0016	0.022	0.0016	U	< .0015	0.02	0.0015	U	< .0016	0.021	0.0016	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0015	0.022	0.0015	U	< .0014	0.02	0.0014	U	< .0014	0.021	0.0014	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	< .0029	0.022	0.0029	U	0.0036	0.02	0.0026	J	< .0027	0.021	0.0027	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.015	0.022	0.0028	J	0.022	0.02	0.0026	J	0.0037	0.021	0.0027	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.015	0.022	0.0023	J	0.02	0.02	0.0021	J	0.0044	0.021	0.0022	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.02	0.022	0.0025	J	0.02	0.02	0.0022	J	0.0065	0.021	0.0023	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.012	0.022	0.0037	J	0.014	0.02	0.0034	J	0.0045	0.021	0.0035	J
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.012	0.022	0.0021	J	0.013	0.02	0.0019	J	0.0037	0.021	0.002	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.015	0.022	0.003	J	0.02	0.02	0.0027	J	0.0047	0.021	0.0028	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.012	0.022	0.0042	J	< .0038	0.02	0.0038	U	< .004	0.021	0.004	U
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.015	0.022	0.0045	J	0.031	0.02	0.0041		0.0074	0.021	0.0043	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0018	0.022	0.0018	U	< .0017	0.02	0.0017	U	< .0017	0.021	0.0017	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.014	0.022	0.0049	J	0.016	0.02	0.0044	J	0.005	0.021	0.0046	J
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .002	0.022	0.002	U	< .0018	0.02	0.0018	U	< .0019	0.021	0.0019	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	0.0058	0.022	0.0048	J	0.013	0.02	0.0044	J	< .0046	0.021	0.0046	U
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	0.0096	0.022	0.0078	J	0.021	0.02	0.007		< .0073	0.021	0.0073	U

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-007				SR-SS-007				SR-SS-008			
Sample Number							SR-SS-007-000.5				SR-SS-007-000.5-D				SR-SS-008-000.5			
Sample Date							22-Oct-07				22-Oct-07				22-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				FD				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***93.9***	0.48	0.09		***97.5***	0.53	0.1		***84.3***	0.36	0.07	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.16	0.022	0.0016		0.16	0.022	0.0016		**0.63**	3.4	0.24	J
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0015	0.022	0.0015	U	< .0015	0.022	0.0015	U	< .0015	0.022	0.0015	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	**1**	1.1	0.14	J	**1**	1.1	0.14	J	***2.7***	3.4	0.43	J
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	**8.8**	1.1	0.14	J	**8.9**	1.1	0.14	J	**24**	3.4	0.42	
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	**8.7**	1.1	0.12		**9.2**	1.1	0.12		**28**	3.4	0.35	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	**11**	1.1	0.12		**13**	1.1	0.12		***39***	3.4	0.37	
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	**6.6**	1.1	0.19		**5.8**	1.1	0.19		**24**	3.4	0.56	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	**5.3**	1.1	0.1	J	**6.4**	1.1	0.1	J	**21**	3.4	0.31	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	**7.7**	1.1	0.15		**7.9**	1.1	0.15		**24**	3.4	0.44	
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	**3.8**	1.1	0.21	J	**3.3**	1.1	0.21	J	**11**	3.4	0.63	
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	***9.8***	1.1	0.22	J	***11***	1.1	0.22	J	***32***	3.4	0.67	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.08	0.022	0.0018		0.085	0.022	0.0018		0.31	0.022	0.0018	
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	**8.5**	1.1	0.24		**7.5**	1.1	0.24		**27**	3.4	0.73	J
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.083	0.022	0.002		0.081	0.022	0.002		0.34	0.022	0.002	
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	***4***	1.1	0.24		***4***	1.1	0.24		***11***	3.4	0.72	
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	**12**	1.1	0.39	J	**11**	1.1	0.39	J	***30***	3.4	1.2	J

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-009				SR-SS-010				SR-SS-011			
Sample Number							SR-SS-009-000.5				SR-SS-010-000.5				SR-SS-011-000.5			
Sample Date							22-Oct-07				22-Oct-07				18-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	***64.9***	0.45	0.09		***25.9***	0.45	0.09		***38.6***	0.34	0.07	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.36	0.022	0.0016		< .0016	0.021	0.0016	U	< .0015	0.021	0.0015	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0015	0.022	0.0015	U	< .0014	0.021	0.0014	U	< .0014	0.021	0.0014	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	***2.5***	2.2	0.28		< .0027	0.021	0.0027	U	< .0027	0.021	0.0027	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	**19**	2.2	0.28	J	0.022	0.021	0.0027	J	0.0065	0.021	0.0026	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	**17**	2.2	0.23		0.023	0.021	0.0022		0.0072	0.021	0.0022	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	**22**	2.2	0.24		0.034	0.021	0.0024		0.0083	0.021	0.0023	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	**11**	2.2	0.37		0.02	0.021	0.0036	J	0.006	0.021	0.0035	J
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	**12**	2.2	0.21	J	0.018	0.021	0.002	J	0.005	0.021	0.002	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	**16**	2.2	0.29		0.022	0.021	0.0028		0.0071	0.021	0.0028	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	**6.4**	2.2	0.42	J	0.014	0.021	0.004	J	< .0039	0.021	0.0039	U
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	***26***	2.2	0.45	J	0.029	0.021	0.0043	J	0.0082	0.021	0.0042	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.21	0.022	0.0018		< .0018	0.021	0.0018	U	< .0017	0.021	0.0017	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	**14**	2.2	0.48		0.025	0.021	0.0046		0.0058	0.021	0.0045	J
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.18	0.022	0.002		< .0019	0.021	0.0019	U	< .0019	0.021	0.0019	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	***10***	2.2	0.48		0.011	0.021	0.0046	J	< .0045	0.021	0.0045	U
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	**27**	2.2	0.77	J	0.021	0.021	0.0073	J	< .0072	0.021	0.0072	U

Notes:

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[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-012				SR-SS-013				SR-SS-014			
Sample Number							SR-SS-012-000.5				SR-SS-013-000.5				SR-SS-014-000.5			
Sample Date							18-Oct-07				22-Oct-07				22-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***104***	0.43	0.08		***42.3***	0.48	0.09		***39.7***	0.42	0.08	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	< .0015	0.021	0.0015	U	0.016	0.023	0.0017	J	0.069	0.022	0.0016	
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0014	0.021	0.0014	U	< .0015	0.023	0.0015	U	< .0014	0.022	0.0014	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	< .0026	0.021	0.0026	U	0.052	0.023	0.0029		0.31	0.022	0.0028	
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.011	0.021	0.0026	J	**1.2**	0.23	0.029	J	**1.6**	0.54	0.068	
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.012	0.021	0.0022	J	**1.4**	0.23	0.024		**1.9**	0.54	0.056	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.013	0.021	0.0023	J	**1.9**	0.23	0.025		**3**	0.54	0.06	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.0097	0.021	0.0035	J	**1.1**	0.23	0.038		**1.3**	0.54	0.09	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.008	0.021	0.0019	J	**0.92**	0.23	0.021	J	**1.4**	0.54	0.051	
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.012	0.021	0.0028	J	**1.2**	0.23	0.03		**1.7**	0.54	0.072	
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	< .0039	0.021	0.0039	U	**0.57**	0.23	0.043	J	**0.74**	0.54	0.1	
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.012	0.021	0.0042	J	**1.1**	0.23	0.046	J	***2.5***	0.54	0.11	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0017	0.021	0.0017	U	0.006	0.023	0.0019	J	0.041	0.022	0.0018	
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.0097	0.021	0.0045	J	**1.3**	0.23	0.049		**1.4**	0.54	0.12	
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .0019	0.021	0.0019	U	0.0081	0.023	0.002	J	0.033	0.022	0.0019	
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0045	0.021	0.0045	U	0.25	0.023	0.0049		**0.79**	0.54	0.12	
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	< .0072	0.021	0.0072	U	**1.2**	0.23	0.078	J	**1.6**	0.54	0.19	

Notes:

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[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
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MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-015				SR-SS-016				SR-SS-017			
Sample Number							SR-SS-015-000.5				SR-SS-016-000.5				SR-SS-017-000.5			
Sample Date							22-Oct-07				22-Oct-07				22-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	*16.8*	0.46	0.09		***68.3***	0.43	0.08		***171***	0.43	0.08	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.0021	0.021	0.0015	J	0.034	0.023	0.0016		< .0016	0.021	0.0016	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0014	0.021	0.0014	U	< .0015	0.023	0.0015	U	< .0014	0.021	0.0014	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	0.01	0.021	0.0027	J	0.25	0.023	0.0029		< .0027	0.021	0.0027	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.096	0.021	0.0026		**1.5**	0.45	0.057		0.0063	0.021	0.0027	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.11	0.021	0.0022		**1.5**	0.45	0.047		0.008	0.021	0.0022	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.16	0.021	0.0023	J	**1.2**	0.45	0.05		0.0099	0.021	0.0024	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.079	0.021	0.0035		**1**	0.45	0.075	J	0.008	0.021	0.0035	J
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.074	0.021	0.002		**1.6**	0.45	0.042		0.0054	0.021	0.002	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.093	0.021	0.0028		**1.8**	0.45	0.06		0.0066	0.021	0.0028	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.046	0.021	0.0039		0.35	0.023	0.0042		0.0086	0.021	0.004	J
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.12	0.021	0.0042		***3.7***	0.45	0.09		0.0099	0.021	0.0043	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0017	0.021	0.0017	U	0.034	0.023	0.0018		< .0018	0.021	0.0018	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.095	0.021	0.0046		**0.95**	0.45	0.098	J	0.009	0.021	0.0046	J
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .0019	0.021	0.0019	U	0.02	0.023	0.002	J	< .0019	0.021	0.0019	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	0.043	0.021	0.0045		***1.5***	0.45	0.097		< .0046	0.021	0.0046	U
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	0.11	0.021	0.0072		**2.5**	0.45	0.16		< .0073	0.021	0.0073	U

Notes:

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bgs - below ground surface
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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-018				SR-SS-019				SR-SS-020			
Sample Number							SR-SS-018-000.5				SR-SS-019-000.5				SR-SS-020-000.5			
Sample Date							25-Oct-07				24-Oct-07				24-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	***101***	0.47	0.09		***64.4***	0.44	0.09		*16.6*	0.4	0.08	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	< .0017	0.023	0.0017	U	0.018	0.023	0.0016	J	0.23	0.021	0.0015	
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0015	0.023	0.0015	U	< .0015	0.023	0.0015	U	< .0014	0.021	0.0014	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	< .0029	0.023	0.0029	U	0.054	0.023	0.0029		***2.3***	2.1	0.27	
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.0043	0.023	0.0029	J	**0.98**	0.34	0.043		**9.8**	2.1	0.26	
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.005	0.023	0.0024	J	**1.3**	0.34	0.035		**11**	2.1	0.22	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.0081	0.023	0.0025	J	**2.2**	0.34	0.037		**9**	2.1	0.23	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	< .0038	0.023	0.0038	U	**0.89**	0.34	0.056		**7.2**	2.1	0.35	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	< .0021	0.023	0.0021	U	0.33	0.023	0.0021	J	**8.1**	2.1	0.2	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	< .003	0.023	0.003	U	**1.1**	0.34	0.045	J	**11**	2.1	0.28	
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	< .0043	0.023	0.0043	U	0.094	0.023	0.0043		**3.5**	2.1	0.39	J
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.007	0.023	0.0046	J	**1**	0.34	0.068		***18***	2.1	0.42	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0019	0.023	0.0019	U	0.0082	0.023	0.0018	J	0.13	0.021	0.0017	
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	< .005	0.023	0.005	U	**0.81**	0.34	0.074	J	**7.3**	2.1	0.45	
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .002	0.023	0.002	U	0.01	0.023	0.002	J	0.12	0.021	0.0019	
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0049	0.023	0.0049	U	0.21	0.023	0.0049		***6.2***	2.1	0.45	
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	< .0079	0.023	0.0079	U	**1.2**	0.34	0.12	J	**12**	2.1	0.72	

Notes:

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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-020				SR-SS-021				SR-SS-022			
Sample Number							SR-SS-020-000.5-D				SR-SS-021-000.5				SR-SS-022-000.5			
Sample Date							24-Oct-07				25-Oct-07				25-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							FD				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	*18.6*	0.44	0.09		*14.6*	0.52	0.1		***26***	0.48	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.21	0.021	0.0015		0.052	0.024	0.0018		< .0018	0.024	0.0018	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0014	0.021	0.0014	U	< .0016	0.024	0.0016	U	< .0016	0.024	0.0016	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	***1.5***	2.1	0.27	J	0.19	0.024	0.0031		< .0031	0.024	0.0031	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	**9.6**	2.1	0.26		**2.6**	0.24	0.031	J	0.037	0.024	0.0031	
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	**9.5**	2.1	0.22		**2.4**	0.24	0.025		0.035	0.024	0.0025	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	**15**	2.1	0.23		**2.6**	0.24	0.027		0.059	0.024	0.0027	
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	**6.4**	2.1	0.35		**1.7**	0.24	0.04		0.089	0.024	0.0041	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	**6.4**	2.1	0.2	J	**1.4**	0.24	0.023	J	0.018	0.024	0.0023	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	**11**	2.1	0.28	J	**2.2**	0.24	0.032		0.042	0.024	0.0032	
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	**1.4**	2.1	0.39	J	**1.1**	0.24	0.046		0.017	0.024	0.0046	J
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	***15***	2.1	0.42		***3.9***	0.24	0.049		0.051	0.024	0.0049	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.13	0.021	0.0017		0.029	0.024	0.002		< .002	0.024	0.002	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	**5.4**	2.1	0.45		**1.9**	0.24	0.053		0.067	0.024	0.0053	
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.11	0.021	0.0019		0.027	0.024	0.0022		< .0022	0.024	0.0022	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	***5.7***	2.1	0.45		***1.2***	0.24	0.052		0.024	0.024	0.0053	J
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	**13**	2.1	0.72	J	**2.2**	0.24	0.084		0.084	0.024	0.0084	

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

U - Value is a non-detected result as reported by the laboratory.
J - Value is considered estimated due to exceedance of technical quality control criteria.
UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-023				SR-SS-024				SR-SS-025			
Sample Number							SR-SS-023-000.5				SR-SS-024-000.5				SR-SS-025-000.5			
Sample Date							25-Oct-07				25-Oct-07				24-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***91.5***	0.4	0.08		***511***	0.41	0.08		***56.9***	0.46	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	< .0016	0.022	0.0016	U	< .0017	0.023	0.0017	U	0.053	0.023	0.0017	
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0015	0.022	0.0015	U	< .0015	0.023	0.0015	U	< .0015	0.023	0.0015	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	< .0029	0.022	0.0029	U	< .003	0.023	0.003	U	0.1	0.023	0.0029	
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.0049	0.022	0.0028	J	0.0047	0.023	0.0029	J	**2.4**	0.91	0.12	
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.0046	0.022	0.0023	J	0.0047	0.023	0.0024	J	**3.5**	0.91	0.094	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	< .0025	0.022	0.0025	U	< .0026	0.023	0.0026	U	**5.2**	0.91	0.1	
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	< .0037	0.022	0.0037	U	< .0038	0.023	0.0038	U	**2.6**	0.91	0.15	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	< .0021	0.022	0.0021	U	< .0022	0.023	0.0022	U	**1.7**	0.91	0.085	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	< .003	0.022	0.003	U	< .0031	0.023	0.0031	U	**2.8**	0.91	0.12	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	< .0042	0.022	0.0042	U	< .0044	0.023	0.0044	U	0.34	0.023	0.0043	
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.0084	0.022	0.0045	J	0.0078	0.023	0.0046	J	***2***	0.91	0.18	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0018	0.022	0.0018	U	< .0019	0.023	0.0019	U	0.019	0.023	0.0019	J
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	< .0049	0.022	0.0049	U	< .005	0.023	0.005	U	**2.3**	0.91	0.2	J
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .002	0.022	0.002	U	< .0021	0.023	0.0021	U	0.03	0.023	0.002	
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0048	0.022	0.0048	U	< .005	0.023	0.005	U	**0.6**	0.91	0.2	J
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	< .0078	0.022	0.0078	U	< .008	0.023	0.008	U	0.24	0.023	0.0078	J

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

U - Value is a non-detected result as reported by the laboratory.
J - Value is considered estimated due to exceedance of technical quality control criteria.
UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-026				SR-SS-027				SR-SS-028			
Sample Number							SR-SS-026-000.5				SR-SS-027-000.5				SR-SS-028-000.5			
Sample Date							24-Oct-07				24-Oct-07				24-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	***27.1***	0.53	0.1		*16.6*	0.51	0.1		***47.1***	0.47	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.24	0.022	0.0016		0.021	0.023	0.0017	J	< .0017	0.024	0.0017	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0015	0.022	0.0015	U	< .0016	0.023	0.0016	U	< .0016	0.024	0.0016	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	***1.3***	2.2	0.28	J	0.11	0.023	0.003		< .003	0.024	0.003	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	**10**	2.2	0.28		**0.95**	0.23	0.029		0.018	0.024	0.003	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	**12**	2.2	0.23		**0.81**	0.23	0.024		0.018	0.024	0.0025	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	**19**	2.2	0.24		**1.3**	0.23	0.026		0.02	0.024	0.0026	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	**8.3**	2.2	0.37		**0.65**	0.23	0.039		0.014	0.024	0.004	J
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	**5.7**	2.2	0.21	J	**0.54**	0.23	0.022	J	0.016	0.024	0.0022	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	**10**	2.2	0.29	J	**1.1**	0.23	0.031	J	0.014	0.024	0.0032	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	**2**	2.2	0.42	J	0.32	0.023	0.0044		0.0085	0.024	0.0045	J
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	***11***	2.2	0.45		***1.5***	0.23	0.047		0.029	0.024	0.0048	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.091	0.022	0.0018	J	0.012	0.023	0.0019	J	< .002	0.024	0.002	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	**7.2**	2.2	0.48	J	**0.49**	0.23	0.051		0.016	0.024	0.0052	J
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.1	0.022	0.002		0.01	0.023	0.0021	J	< .0021	0.024	0.0021	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	***3.9***	2.2	0.48		**0.56**	0.23	0.05		0.0086	0.024	0.0051	J
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	< .0077	0.022	0.0077	U	**1.3**	0.23	0.08	J	0.019	0.024	0.0082	J

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

U - Value is a non-detected result as reported by the laboratory.
J - Value is considered estimated due to exceedance of technical quality control criteria.
UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-029				SR-SS-030				SR-SS-031			
Sample Number							SR-SS-029-000.5				SR-SS-030-000.5				SR-SS-031-000.5			
Sample Date							24-Oct-07				24-Oct-07				24-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	***328***	0.51	0.1		***289***	0.46	0.09		6.9	0.44	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.11	0.024	0.0017		< .0017	0.023	0.0017	U	0.011	0.021	0.0016	J
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0016	0.024	0.0016	U	< .0015	0.023	0.0015	U	< .0014	0.021	0.0014	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	0.31	0.024	0.003		< .0029	0.023	0.0029	U	0.083	0.021	0.0027	
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	**3.6**	0.59	0.075		0.005	0.023	0.0029	J	**0.44**	0.043	0.0054	
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	**3.5**	0.59	0.061		< .0024	0.023	0.0024	U	0.29	0.043	0.0044	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	**3**	0.59	0.065	J	0.0068	0.023	0.0025	J	0.46	0.043	0.0047	
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	**2.2**	0.59	0.098		< .0038	0.023	0.0038	U	0.25	0.021	0.0035	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	**2.7**	0.59	0.056	J	0.0045	0.023	0.0021	J	0.28	0.021	0.002	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	**3.6**	0.59	0.078	J	< .003	0.023	0.003	U	0.42	0.043	0.0056	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.32	0.024	0.0045	J	< .0043	0.023	0.0043	U	0.15	0.021	0.004	
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	***6.5***	0.59	0.12		0.0094	0.023	0.0046	J	0.59	0.043	0.0085	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.046	0.024	0.0019		< .0019	0.023	0.0019	U	0.011	0.021	0.0018	J
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	**2.2**	0.59	0.13		< .005	0.023	0.005	U	0.27	0.021	0.0046	
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.041	0.024	0.0021		< .002	0.023	0.002	U	0.0071	0.021	0.0019	J
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	***1.8***	0.59	0.13		< .0049	0.023	0.0049	U	0.31	0.043	0.0092	
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	**4.2**	0.59	0.2	J	< .0078	0.023	0.0078	U	0.53	0.043	0.015	J

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
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Validation Qualifier Definitions

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J - Value is considered estimated due to exceedance of technical quality control criteria.
UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-032				SR-SS-033				SR-SS-034			
Sample Number							SR-SS-032-000.5				SR-SS-033-000.5				SR-SS-034-000.5			
Sample Date							24-Oct-07				25-Oct-07				24-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	*15.5*	0.36	0.07		***26.3***	0.46	0.09		9.8	0.46	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.0083	0.021	0.0015	J	**0.67**	0.22	0.016		0.024	0.021	0.0015	
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0014	0.021	0.0014	U	< .015	0.22	0.015	U	< .0014	0.021	0.0014	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	0.036	0.021	0.0027		***2.8***	0.22	0.028		0.11	0.021	0.0027	
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.36	0.042	0.0053		**24**	4.5	0.56	J	**1.2**	0.21	0.027	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.33	0.021	0.0022		**22**	4.5	0.46		**1.2**	0.21	0.022	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.33	0.021	0.0023	J	**19**	4.5	0.49		**1.2**	0.21	0.023	
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.17	0.021	0.0035		**13**	4.5	0.74		**0.74**	0.21	0.035	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.24	0.021	0.002	J	**14**	4.5	0.42	J	**0.76**	0.21	0.02	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.33	0.021	0.0028	J	**20**	4.5	0.59	J	**1.1**	0.21	0.028	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.11	0.021	0.004		**9.5**	4.5	0.84		0.16	0.021	0.004	J
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.43	0.042	0.0085		***36***	4.5	0.9		***2.1***	0.21	0.042	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.0029	0.021	0.0017	J	0.38	0.22	0.018		0.013	0.021	0.0017	J
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.2	0.021	0.0046		**16**	4.5	0.97		**0.8**	0.21	0.046	
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.0042	0.021	0.0019	J	0.37	0.22	0.02		0.0088	0.021	0.0019	J
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	0.17	0.021	0.0045		***12***	4.5	0.96		**0.66**	0.21	0.045	
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	0.34	0.021	0.0073	J	**22**	4.5	1.5	J	**1.3**	0.21	0.073	J

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

U - Value is a non-detected result as reported by the laboratory.
J - Value is considered estimated due to exceedance of technical quality control criteria.
UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-035				SR-SS-036				SR-SS-037			
Sample Number							SR-SS-035-000.5				SR-SS-036-000.5				SR-SS-037-000.5			
Sample Date							25-Oct-07				18-Oct-07				19-Oct-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	*20*	0.44	0.09		***99.6***	0.47	0.09		***1150***	0.52	0.1	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	< .0016	0.022	0.0016	U	< .0016	0.021	0.0016	U	< .0017	0.023	0.0017	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0015	0.022	0.0015	U	< .0014	0.021	0.0014	U	< .0016	0.023	0.0016	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	0.0029	0.022	0.0029	J	< .0027	0.021	0.0027	U	< .003	0.023	0.003	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.06	0.022	0.0028		0.0094	0.021	0.0027	J	0.01	0.023	0.0029	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.065	0.022	0.0023	J	0.0086	0.021	0.0022	J	0.013	0.023	0.0024	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.12	0.022	0.0025	J	0.0099	0.021	0.0023	J	0.017	0.023	0.0026	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.061	0.022	0.0037	J	0.0067	0.021	0.0035	J	0.011	0.023	0.0039	J
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.047	0.022	0.0021	J	0.006	0.021	0.002	J	0.0083	0.023	0.0022	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.083	0.022	0.003	J	0.0088	0.021	0.0028	J	0.011	0.023	0.0031	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.013	0.022	0.0042	J	< .004	0.021	0.004	U	< .0044	0.023	0.0044	U
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.088	0.022	0.0045		0.011	0.021	0.0042	J	0.014	0.023	0.0047	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0018	0.022	0.0018	U	< .0017	0.021	0.0017	U	< .0019	0.023	0.0019	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.044	0.022	0.0049	J	0.0069	0.021	0.0046	J	0.011	0.023	0.0051	J
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .002	0.022	0.002	U	< .0019	0.021	0.0019	U	< .0021	0.023	0.0021	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	0.032	0.022	0.0048		< .0046	0.021	0.0046	U	0.0057	0.023	0.005	J
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	0.12	0.022	0.0077	J	< .0073	0.021	0.0073	U	< .008	0.023	0.008	U

Notes:

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[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
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[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

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ft - feet
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mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-038				SR-SS-039				SR-SS-040			
Sample Number							SR-SS-038-000.5				SR-SS-039-000.5				SR-SS-040-000.5			
Sample Date							19-Oct-07				19-Oct-07				6-Nov-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	***235***	0.43	0.08		***104***	2.1	0.4	J	***<u>756</u>***	0.46	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	< .0017	0.023	0.0017	U	< .0074	0.1	0.0074	UJ	< .0017	0.024	0.0017	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0016	0.023	0.0016	U	< .0067	0.1	0.0067	UJ	< .0016	0.024	0.0016	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	< .003	0.023	0.003	U	< .013	0.1	0.013	UJ	< .003	0.024	0.003	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.013	0.023	0.0029	J	0.014	0.1	0.013	J	0.0042	0.024	0.003	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.013	0.023	0.0024	J	< .01	0.1	0.01	UJ	0.0048	0.024	0.0025	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.022	0.023	0.0026	J	< .011	0.1	0.011	UJ	0.0074	0.024	0.0026	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.0084	0.023	0.0039	J	< .017	0.1	0.017	UJ	0.0042	0.024	0.0039	J
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.011	0.023	0.0022	J	< .0094	0.1	0.0094	UJ	0.0042	0.024	0.0022	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.014	0.023	0.0031	J	0.018	0.1	0.013	J	0.0045	0.024	0.0031	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.0094	0.023	0.0044	J	< .019	0.1	0.019	UJ	< .0045	0.024	0.0045	U
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.013	0.023	0.0047	J	0.025	0.1	0.02	J	0.0066	0.024	0.0048	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0019	0.023	0.0019	U	< .0083	0.1	0.0083	UJ	< .0019	0.024	0.0019	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.011	0.023	0.0051	J	< .022	0.1	0.022	UJ	< .0052	0.024	0.0052	U
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .0021	0.023	0.0021	U	< .009	0.1	0.009	UJ	< .0021	0.024	0.0021	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .005	0.023	0.005	U	< .022	0.1	0.022	UJ	< .0051	0.024	0.0051	U
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	< .008	0.023	0.008	U	< .035	0.1	0.035	UJ	< .0082	0.024	0.0082	U

<u>Notes:</u>

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**<u>Underlined</u>**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-041				SR-SS-041				SR-SS-042			
Sample Number							SR-SS-041-000.5				SR-SS-041-000.5-D				SR-SS-042-000.5			
Sample Date							6-Nov-07				6-Nov-07				6-Nov-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				FD				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***398***	0.53	0.1		***407***	0.49	0.1		***424***	0.45	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	< .0017	0.024	0.0017	U	< .0017	0.024	0.0017	U	< .0018	0.024	0.0018	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0016	0.024	0.0016	U	< .0016	0.024	0.0016	U	< .0016	0.024	0.0016	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	< .003	0.024	0.003	U	< .003	0.024	0.003	U	< .0031	0.024	0.0031	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.0087	0.024	0.003	J	0.014	0.024	0.003	J	0.0035	0.024	0.0031	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.0097	0.024	0.0024	J	0.012	0.024	0.0025	J	0.0044	0.024	0.0025	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.013	0.024	0.0026	J	0.019	0.024	0.0026	J	< .0027	0.024	0.0027	U
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.0073	0.024	0.0039	J	0.01	0.024	0.004	J	< .0041	0.024	0.0041	U
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.0075	0.024	0.0022	J	0.011	0.024	0.0022	J	< .0023	0.024	0.0023	U
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.0093	0.024	0.0031	J	0.014	0.024	0.0031	J	0.0043	0.024	0.0032	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	< .0044	0.024	0.0044	U	< .0045	0.024	0.0045	U	< .0046	0.024	0.0046	U
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.013	0.024	0.0047	J	0.022	0.024	0.0048	J	0.0054	0.024	0.0049	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0019	0.024	0.0019	U	< .002	0.024	0.002	U	< .002	0.024	0.002	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.0086	0.024	0.0051	J	0.012	0.024	0.0052	J	< .0053	0.024	0.0053	U
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .0021	0.024	0.0021	U	< .0021	0.024	0.0021	U	< .0022	0.024	0.0022	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	0.0061	0.024	0.0051	J	0.0076	0.024	0.0051	J	< .0053	0.024	0.0053	U
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	< .0081	0.024	0.0081	U	0.01	0.024	0.0082	J	< .0084	0.024	0.0084	U

Notes:

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[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

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bgs - below ground surface
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PAHs - polycyclic aromatic hydrocarbons
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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-043				SR-SS-044				SR-SS-045			
Sample Number							SR-SS-043-000.5				SR-SS-044-000.5				SR-SS-045-000.5			
Sample Date							6-Nov-07				6-Nov-07				6-Nov-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	***152***	0.48	0.09		***74.3***	0.42	0.08		***405***	0.39	0.08	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	< .0017	0.023	0.0017	U	< .0018	0.024	0.0018	U	< .0018	0.025	0.0018	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0016	0.023	0.0016	U	< .0016	0.024	0.0016	U	< .0017	0.025	0.0017	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	< .003	0.023	0.003	U	0.0057	0.024	0.0031	J	< .0032	0.025	0.0032	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.0052	0.023	0.0029	J	0.066	0.024	0.0031	J	0.0096	0.025	0.0032	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.0066	0.023	0.0024	J	0.097	0.024	0.0025		0.014	0.025	0.0026	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.01	0.023	0.0026	J	0.13	0.024	0.0027		0.014	0.025	0.0028	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.0064	0.023	0.0039	J	0.089	0.024	0.004	J	0.009	0.025	0.0042	J
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.0054	0.023	0.0022	J	0.069	0.024	0.0023	J	0.0096	0.025	0.0024	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.006	0.023	0.0031	J	0.07	0.024	0.0032		0.011	0.025	0.0034	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	< .0044	0.023	0.0044	U	0.054	0.024	0.0046	J	< .0048	0.025	0.0048	U
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.0079	0.023	0.0047	J	0.12	0.024	0.0048		0.016	0.025	0.0051	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0019	0.023	0.0019	U	< .002	0.024	0.002	U	< .0021	0.025	0.0021	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.006	0.023	0.0051	J	0.11	0.024	0.0053		0.012	0.025	0.0055	J
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .0021	0.023	0.0021	U	< .0022	0.024	0.0022	U	< .0023	0.025	0.0023	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .005	0.023	0.005	U	0.059	0.024	0.0052		0.0077	0.025	0.0054	J
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	< .008	0.023	0.008	U	0.1	0.024	0.0083	J	< .0087	0.025	0.0087	U

Notes:

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[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
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Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-047				SR-SS-049				SR-SS-050			
Sample Number							SR-SS-047-000.5				SR-SS-049-000.5				SR-SS-050-000.5			
Sample Date							6-Nov-07				6-Nov-07				7-Nov-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***117***	0.41	0.08		***90.1***	0.47	0.09		***98.1***	0.44	0.09	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.0026	0.023	0.0017	J	< .0018	0.025	0.0018	U	0.002	0.024	0.0017	J
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0015	0.023	0.0015	U	< .0016	0.025	0.0016	U	< .0016	0.024	0.0016	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	0.01	0.023	0.0029	J	< .0031	0.025	0.0031	U	0.0082	0.024	0.003	J
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.046	0.023	0.0029	J	0.013	0.025	0.0031	J	0.035	0.024	0.003	
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.04	0.023	0.0024		0.013	0.025	0.0026	J	0.031	0.024	0.0024	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.049	0.023	0.0025		0.014	0.025	0.0027	J	0.028	0.024	0.0026	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.024	0.023	0.0038	J	0.0073	0.025	0.0041	J	0.02	0.024	0.0039	J
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.027	0.023	0.0021	J	0.0093	0.025	0.0023	J	0.02	0.024	0.0022	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.039	0.023	0.003		0.012	0.025	0.0032	J	0.024	0.024	0.0031	J
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.019	0.023	0.0043	J	< .0046	0.025	0.0046	U	0.017	0.024	0.0044	J
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.076	0.023	0.0046		0.019	0.025	0.0049	J	0.059	0.024	0.0047	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	< .0019	0.023	0.0019	U	< .002	0.025	0.002	U	< .0019	0.024	0.0019	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.033	0.023	0.005		0.0096	0.025	0.0054	J	0.028	0.024	0.0051	
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	< .002	0.023	0.002	U	< .0022	0.025	0.0022	U	< .0021	0.024	0.0021	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	0.037	0.023	0.0049		0.0097	0.025	0.0053	J	0.023	0.024	0.0051	J
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	0.043	0.023	0.0079	J	< .0085	0.025	0.0085	U	0.029	0.024	0.0081	

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

U - Value is a non-detected result as reported by the laboratory.
J - Value is considered estimated due to exceedance of technical quality control criteria.
UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-051				SR-SS-052				SR-SS-053			
Sample Number							SR-SS-051-000.5				SR-SS-052-000.5				SR-SS-053-000.5			
Sample Date							7-Nov-07				7-Nov-07				7-Nov-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***589***	0.59	0.2		***150***	0.52	0.1		***152***	0.53	0.1	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.0073	0.024	0.0018	J	< .0017	0.024	0.0017	U	< .0017	0.024	0.0017	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0016	0.024	0.0016	U	< .0016	0.024	0.0016	U	< .0016	0.024	0.0016	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	0.065	0.024	0.0031		< .003	0.024	0.003	U	0.0095	0.024	0.003	J
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	0.31	0.024	0.0031	J	0.014	0.024	0.003	J	0.054	0.024	0.003	
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	0.24	0.024	0.0025		0.013	0.024	0.0025	J	0.046	0.024	0.0024	
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.23	0.024	0.0027	J	0.015	0.024	0.0026	J	0.045	0.024	0.0026	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.13	0.024	0.004		0.012	0.024	0.0039	J	0.028	0.024	0.0039	
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.16	0.024	0.0023	J	0.0096	0.024	0.0022	J	0.033	0.024	0.0022	
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.24	0.024	0.0032		0.0095	0.024	0.0031	J	0.041	0.024	0.0031	
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.098	0.024	0.0046		0.0084	0.024	0.0045	J	0.02	0.024	0.0045	J
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	0.56	0.073	0.015		0.025	0.024	0.0048		0.093	0.024	0.0047	
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.0071	0.024	0.002	J	< .002	0.024	0.002	U	< .0019	0.024	0.0019	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.17	0.024	0.0053		0.015	0.024	0.0052	J	0.037	0.024	0.0052	
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.0041	0.024	0.0022	J	< .0021	0.024	0.0021	U	< .0021	0.024	0.0021	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	0.27	0.024	0.0052		0.0078	0.024	0.0051	J	0.036	0.024	0.0051	
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	0.31	0.024	0.0084		0.011	0.024	0.0082	J	0.051	0.024	0.0082	

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

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J - Value is considered estimated due to exceedance of technical quality control criteria.
UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-1 (Cont.)
2007 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-054				SR-SS-055				SR-SS-056			
Sample Number							SR-SS-054-000.5				SR-SS-055-000.5				SR-SS-056-000.5			
Sample Date							7-Nov-07				7-Nov-07				7-Nov-07			
Sample Depth (ft bgs)							0.5 to 0.5				0.5 to 0.5				0.5 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	Parameter	Units	Site Inspection Background Screening Value	Ecological Screening Value	Human Health EPA Regional Screening Level - Residential Soil	Human Health EPA Regional Screening Level - Industrial Soil	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ	Result	PQL	MDL	VQ
Metals	Lead	mg/kg	20.2	11	400	800	***587***	0.58	0.2		***115***	0.49	0.1		***58.7***	0.53	0.1	
PAHs	Acenaphthene	mg/kg	0.430 [a]	1.1	3400	33000	0.013	0.026	0.0019	J	< .0017	0.023	0.0017	U	< .0017	0.024	0.0017	U
PAHs	Acenaphthylene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	< .0017	0.026	0.0017	U	< .0016	0.023	0.0016	U	< .0016	0.024	0.0016	U
PAHs	Anthracene	mg/kg	0.430 [a]	1.1	17000	170000	0.078	0.026	0.0033		< .003	0.023	0.003	U	< .003	0.024	0.003	U
PAHs	Benzo(a)anthracene	mg/kg	0.430 [a]	29	0.15	2.1	**0.54**	0.13	0.016		0.0048	0.023	0.0029	J	0.0031	0.024	0.003	J
PAHs	Benzo(a)pyrene	mg/kg	0.344	29	0.015	0.21	**0.45**	0.13	0.013		0.0061	0.023	0.0024	J	0.0037	0.024	0.0025	J
PAHs	Benzo(b)fluoranthene	mg/kg	0.493	29	0.15	2.1	0.41	0.13	0.014	J	0.0058	0.023	0.0026	J	0.0049	0.024	0.0026	J
PAHs	Benzo(ghi)perylene	mg/kg	0.430 [a]	29	No criteria	No criteria	0.24	0.026	0.0043		0.0061	0.023	0.0039	J	< .004	0.024	0.004	U
PAHs	Benzo(k)fluoranthene	mg/kg	0.430 [a]	29	1.5	21	0.3	0.026	0.0024	J	0.0051	0.023	0.0022	J	0.0036	0.024	0.0022	J
PAHs	Chrysene	mg/kg	0.487	29	15	210	0.43	0.026	0.0034		< .0031	0.023	0.0031	U	< .0032	0.024	0.0032	U
PAHs	Dibenzo(a,h)anthracene	mg/kg	0.430 [a]	29	0.015	0.21	0.18	0.026	0.0049		< .0044	0.023	0.0044	U	< .0045	0.024	0.0045	U
PAHs	Fluoranthene	mg/kg	0.727	1.1	2300	22000	**0.89**	0.13	0.026		0.0079	0.023	0.0047	J	0.006	0.024	0.0048	J
PAHs	Fluorene	mg/kg	0.430 [a]	1.1	2300	22000	0.0095	0.026	0.0021	J	< .0019	0.023	0.0019	U	< .002	0.024	0.002	U
PAHs	Indeno(1,2,3-cd)pyrene	mg/kg	0.430 [a]	29	0.15	2.1	0.31	0.026	0.0056		0.0083	0.023	0.0051	J	< .0052	0.024	0.0052	U
PAHs	Naphthalene	mg/kg	0.430 [a]	1.1	3.6	18	0.0067	0.026	0.0023	J	< .0021	0.023	0.0021	U	< .0021	0.024	0.0021	U
PAHs	Phenanthrene	mg/kg	0.430 [a]	1.1	No criteria	No criteria	0.36	0.026	0.0056		< .005	0.023	0.005	U	< .0051	0.024	0.0051	U
PAHs	Pyrene	mg/kg	0.656	29	1700	17000	**0.68**	0.13	0.044		< .008	0.023	0.008	U	< .0082	0.024	0.0082	U

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[**Shaded**] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

[a] - Background screening value is established at the laboratory's POL

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions

U - Value is a non-detected result as reported by the laboratory.
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UJ - Value is considered estimated non-detect due to exceedance of techical quality control criteria and the reported result is less than the Contract Required Quantitation Limit.

Table 4-2
2009 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-037				SR-SS-037				SR-SS-102			
Sample Number							SR-SS-100-000.5				SR-SS-100-000.5-D				SR-SS-102-000.5			
Sample Date							20-Jul-09				20-Jul-09				20-Jul-09			
Sample Depth (ft bgs)							0 to 0.5				0 to 0.5				0 to 0.5			
Sample Purpose							REG				FD				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***1190***	0.57	0.16	*E	***1400***	0.55	0.15	*E	***701***	0.53	0.15	*E

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[Shaded] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PQL - practical quantitation limit
QC - quality control
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions
*E - A serial dilution analysis exceeded QC criteria indicating the presence of a matrix interference.

Table 4-2 (Cont.)
2009 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-103				SR-SS-104				SR-SS-105			
Sample Number							SR-SS-103-000.5				SR-SS-104-000.5				SR-SS-105-000.5			
Sample Date							20-Jul-09				20-Jul-09				20-Jul-09			
Sample Depth (ft bgs)							0 to 0.5				0 to 0.5				0 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***1330***	0.55	0.15	*E	***354***	0.62	0.17	*E	***564***	0.55	0.15	*E

Notes:

[**Bold Face**] Result exceeds Site Inspection Background Screening Value
[*Italicized*] - Result exceeds Site Inspection Ecological Screening Level
[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[Shaded] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PQL - practical quantitation limit
QC - quality control
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions
*E - A serial dilution analysis exceeded QC criteria indicating the presence of a matrix interference.

Table 4-2 (Cont.)
2009 Surface Soil Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							SR-SS-106				SR-SS-107				SR-SS-108			
Sample Number							SR-SS-106-000.5				SR-SS-107-000.5				SR-SS-108-000.5			
Sample Date							20-Jul-09				20-Jul-09				20-Jul-09			
Sample Depth (ft bgs)							0 to 0.5				0 to 0.5				0 to 0.5			
Sample Purpose							REG				REG				REG			
Fraction	**Parameter**	**Units**	**Site Inspection Background Screening Value**	**Ecological Screening Value**	**Human Health EPA Regional Screening Level - Residential Soil**	**Human Health EPA Regional Screening Level - Industrial Soil**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	mg/kg	20.2	11	400	800	***728***	0.57	0.16	*E	***325***	0.54	0.15	*E	***1050***	0.59	0.16	*E

Notes:

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[**Underlined**] - Result exceeds Site Inspection Human Health Screening Level for Residential Soil
[Shaded] - Result exceeds Site Inspection Human Health Screening Level for Industrial Soil

bgs - below ground surface
FD - field duplicate sample
ft - feet
MDL - method detection limit
mg/kg - milligrams per kilogram
MRS - Munitions Response Site
PQL - practical quantitation limit
QC - quality control
REG - regular field sample
VQ - validation qualifier

Validation Qualifier Definitions
*E - A serial dilution analysis exceeded QC criteria indicating the presence of a matrix interference.

Table 4-3
2007 Groundwater Results Comparison
Main Base Ranges Skeet Range MRS
Wallops Flight Facility, Virginia

Location							RR-MW-02				RR-MW-03				RR-MW-03			
Sample Number							RRMW-02-20071023				RRMW-03-20071023				RRMW-03-20071023-D			
Sample Date							23-Oct-07				23-Oct-07				23-Oct-07			
Sample Purpose							REG				REG				FD			
Fraction	**Parameter**	**Filtered**	**Units**	**Background Screening Value**	**EPA RSL - Tapwater**	**Virginia Water Quality Criteria- Public Water Supply**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**	**Result**	**PQL**	**MDL**	**VQ**
Metals	Lead	N	µg/L	6.6	15	15	0.97	5	0.0008		1.2	5	0.0008		1.1	5	0.0008	
PAHs	Acenaphthene	N	µg/L	0.20 [a]	400	670	< 0.027	0.2	0.027	U	< 0.027	0.2	0.027	U	< 0.027	0.2	0.027	U
PAHs	Acenaphthylene	N	µg/L	0.20 [a]	No criteria	No criteria	< 0.017	0.2	0.017	U	< 0.017	0.2	0.017	U	< 0.017	0.2	0.017	U
PAHs	Anthracene	N	µg/L	0.20 [a]	1300	8300	< 0.033	0.2	0.033	U	< 0.033	0.2	0.033	U	< 0.033	0.2	0.033	U
PAHs	Benzo(a)anthracene	N	µg/L	0.20 [a]	0.029	0.038	< 0.041	0.2	0.041	U	< 0.04	0.2	0.04	U	< 0.04	0.2	0.04	U
PAHs	Benzo(a)pyrene	N	µg/L	0.20 [a]	0.0029	0.038	< 0.076	0.2	0.076	U	< 0.075	0.2	0.075	U	< 0.075	0.2	0.075	U
PAHs	Benzo(b)fluoranthene	N	µg/L	0.20 [a]	0.029	0.038	< 0.075	0.2	0.075	U	< 0.074	0.2	0.074	U	< 0.074	0.2	0.074	U
PAHs	Benzo(ghi)perylene	N	µg/L	0.20 [a]	No criteria	No criteria	< 0.068	0.2	0.068	U	< 0.067	0.2	0.067	U	< 0.067	0.2	0.067	U
PAHs	Benzo(k)fluoranthene	N	µg/L	0.20 [a]	0.29	0.038	< 0.048	0.2	0.048	U	< 0.048	0.2	0.048	U	< 0.048	0.2	0.048	U
PAHs	Chrysene	N	µg/L	0.20 [a]	2.9	0.038	< 0.088	0.2	0.088	U	< 0.087	0.2	0.087	U	< 0.087	0.2	0.087	U
PAHs	Dibenzo(a,h)anthracene	N	µg/L	0.20 [a]	0.0029	0.038	< 0.1	0.2	0.1	U	< 0.099	0.2	0.099	U	< 0.099	0.2	0.099	U
PAHs	Fluoranthene	N	µg/L	0.20 [a]	630	130	< 0.068	0.2	0.068	U	< 0.067	0.2	0.067	U	< 0.067	0.2	0.067	U
PAHs	Fluorene	N	µg/L	0.20 [a]	220	1100	< 0.031	0.2	0.031	U	< 0.031	0.2	0.031	U	< 0.031	0.2	0.031	U
PAHs	Indeno(1,2,3-cd)pyrene	N	µg/L	0.20 [a]	0.029	0.038	< 0.081	0.2	0.081	U	< 0.08	0.2	0.08	U	< 0.08	0.2	0.08	U
PAHs	Naphthalene	N	µg/L	0.20 [a]	0.14	No criteria	< 0.047	0.2	0.047	U	< 0.047	0.2	0.047	U	< 0.047	0.2	0.047	U
PAHs	Phenanthrene	N	µg/L	0.20 [a]	No criteria	No criteria	< 0.036	0.2	0.036	U	< 0.036	0.2	0.036	U	< 0.036	0.2	0.036	U
PAHs	Pyrene	N	µg/L	0.20 [a]	87	830	< 0.1	0.2	0.1	U	< 0.1	0.2	0.1	U	< 0.1	0.2	0.1	U

Notes:
[**Bold Face**] - Result exceeds Background Level
[*Italicized*] - Result exceeds EPA RSL for tapwater
[Underlined] - Result exceeds Virginia Water Quality Criteria for Public Water Supply
[a] - Background screening value is established at the laboratory's PQL

µg/L - micrograms per liter
EPA - Environmental Protection Agency
FD - field duplicate sample
MDL - method detection limit
MRS - Munitions Response Site
PAHs - polycyclic aromatic hydrocarbons
PQL - practical quantitation limit
REG - regular field sample
RSL - Regional Screening Level
VQ - validation qualifier

Validation Qualifier Definitions
U - Value is a non-detected result as reported by the laboratory.