FINAL

SITE INSPECTION REPORT

FORT PIERCE U.S. NAVAL AMPHIBIOUS TRAINING BASE
INDIAN RIVER AND SAINT LUCIE COUNTIES, FLORIDA

FUDS PROPERTY NO. I04FL0698

September 2015

Contract No.: W912DY-10-D-0025
Task Order No.: 0020

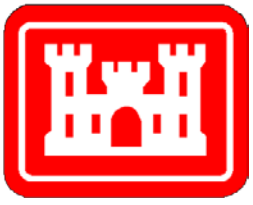
Prepared For:

U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE
4820 University Square
Huntsville, Alabama 35816

U.S. ARMY CORPS OF ENGINEERS JACKSONVILLE DISTRICT
701 San Marco Boulevard
Jacksonville, Florida 32207

Prepared By:

PIKA-PIRNIE JV
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477



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The PIKA-Pirnie JV has completed this Site Inspection Report for the former Fort Pierce U.S. Naval Amphibious Training Base, Projects 02, 03, 04, 06, and 07. I have reviewed this document and certify that it contains accurate content and that it complies with established policy principles and procedures, utilizing justified and valid assumptions.

JV Program Manager
Bobby Templin, PE, BCEE, PMP

18 September 2015
Date

JV Corporate Quality Manager
Al Larkins

18 September 2015
Date

JV Project Manager
Susan Burtnett, PE (Florida), BCEE

SUSAN R. BURTNETT, P.E. LICENSE No. 70380 STATE OF FLORIDA PROFESSIONAL ENGINEER

18 September 2015
Date

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LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Restoration, Compensation and Liability Act
CESAJ	United States Army Corps of Engineers, Jacksonville District
CFR	Code of Federal Regulations
COPC	Constituent of Potential Concern
COPEC	Constituent of Potential Ecological Concern
CSEM	Conceptual Site Exposure Model, or Conceptual Site Model (CSM)
Cu	Copper
DA	Department of the Army
DERP	Defense Environmental Restoration Program
DID	Data Item Description
DNT	Dinitrotoluene
DoD	Department of Defense
Eco-SSL	Ecological Soil Screening Level
EE/CA	Engineering Evaluation / Cost Analysis
ELAP	Environmental Laboratory Accreditation Program
EM	Engineer Manual
EP	Engineer Pamphlet
ER	Engineer Regulation
ERAGS	Ecological Risk Assessment Guidance for Superfund
ESRI	Environmental Systems Research Institute
^{o}F	degrees Fahrenheit
FDEP	Florida Department of Environmental Protection
FL	Florida
FUDS	Formerly Used Defense Site
GIS	Geographic Information System
GPS	Global Positioning System
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
Inc.	Incorporated

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

JV	PIKA-Pirnie Joint Venture, LLC
MC	Munitions Constituents
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
mg/kg	Milligrams per kilogram
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
	Plan
NDAI	No DoD Action Indicated
Pb	Lead
PE	Professional Engineer
ProUCL	ProUCL® v.5.0.00
PWS	Performance Work Statement
QA	Quality Assurance
RI/FS	Remedial Investigation / Feasibility Study
Sb	Antimony
SCTL	Soil Cleanup Target Level
SI	Site Inspection
SLERA	Screening Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SQL	Sample Quantitation Limit
TIFF	Tagged Image File Format
TO	Task Order
TOC	Total Organic Carbon
TPP	Technical Project Planning
TRV	Toxicity Reference Value
UCL	Upper Confidence Limit
UFP-QAPP	Uniform Federal Policy Quality Assurance Project Plan
U.S.	United States

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

USACE	United States Army Corps of Engineers
USAESCH	United States Army Engineering and Support Center, Huntsville
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WERS	Worldwide Environmental Remediation Services
Zn	Zinc

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GLOSSARY OF TERMS

Accuracy. The degree to which a measurement reflects the true value of a variable.

Analytes. The chemicals for which a sample is analyzed.

Bioaccumulation. General term describing a process by which chemicals are taken up by an organism either directly from exposure to a contaminated medium or by consumption of food containing the chemical.

Bioavailability. The degree to which a material in environmental media can be assimilated by an organism.

Chemicals of Potential Concern. Chemicals that are potentially site-related and whose data are of sufficient quality for use in a quantitative risk assessment.

Concentration. The relative amount of a substance in an environmental medium, expressed by relative mass (e.g., mg/kg), volume (ml/L), or number of units (e.g., parts per million).

Conceptual Site Model. Describes a series of working hypotheses of how the stressor might affect ecological components. Describes ecosystem or ecosystem components potentially at risk, and the relationships between measurement and assessment endpoints and exposure scenarios.

Contaminant of Potential Ecological Concern. A substance detected at a hazardous waste site that has the potential to affect ecological receptors adversely due to its concentration, distribution, and mode of toxicity.

Correlation. An estimate of the degree to which two sets of variables vary together, with no distinction between dependent and independent variables.

Degradation. Conversion of an organic compound to one containing a smaller number of carbon atoms.

Detection Limit (DL). The lowest amount that can be distinguished from the normal "noise" of an analytical instrument or method.

Data Quality Objectives (DQOs). Qualitative and quantitative statements to ensure that data of known and documented quality are obtained to support an Agency decision.

Duplicate. A sample taken from and representative of the same population as another sample. Both samples are carried through the steps of sampling, storage, and analysis in an identical manner.

GLOSSARY OF TERMS (CONTINUED)

Ecological Risk Assessment. The process that evaluates the likelihood that adverse ecological effects may occur or are occurring as a result of exposure to one or more stressors.

Ecosystem. The biotic community and abiotic environment within a specified location and time, including the chemical, physical, and biological relationships among the biotic and abiotic components.

Exposure. Contact of an organism with a chemical or physical agent. Exposure is quantified as the amount of the agent available at the exchange boundaries of the organism (e.g., skin, lungs, gut) and available for absorption.

Exposure Assessment. The determination or estimation (qualitative or quantitative) of the magnitude, frequency, duration, and route of exposure.

Exposure Pathway. The course a chemical or physical agent takes from a source to an exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a site. Each exposure pathway includes a source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source, a transport/exposure medium (e.g., air) or media (in cases of intermedia transfer) also is included.

Exposure Route. The way a chemical or physical agent comes in contact with an organism (e.g., by ingestion, inhalation, dermal contact).

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 Department of Defense. Some FUDS properties include areas formerly used as military ranges.

Hazard. The likelihood that a substance will cause an injury or adverse effect under specified conditions.

Hazard Quotient. The ratio of a single substance exposure level over a specified time period (e.g., subchronic) to a reference dose for that substance derived from a similar exposure period.

Ingestion Rate. The rate at which an organism consumes food, water, or other materials (e.g., soil, sediment). Ingestion rate usually is expressed in terms of unit of mass or volume per unit of time (e.g., kg/day, L/day).

Media. Specific environmental compartments—air, water, soil—which are the subject of regulatory concern and activities.

GLOSSARY OF TERMS (CONTINUED)

Military Munitions. Military munitions means all 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 Department of Defense, the Coast Guard, the 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 ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.

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 U.S.C. 2011 et seq.) have been completed. (10 U.S.C. 101(e)(4)

Munitions Constituents (MC). Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710 (e)(4))

Non-detects (NDs). Chemicals that are not detected in a particular sample above a certain limit, usually the quantitation limit for the chemical in that sample. Non-detects may be indicated by a "U" data qualifier.

Population. An aggregate of individuals of a species within a specified location in space and time.

Positive Data. Analytical results for which measurable concentrations (i.e., above a quantitation limit) are reported. May have data qualifiers attached (except a U, which indicates a non-detect).

Precision. A measure of the closeness of agreement among individual measurements.

Quantitation Limit (QL). The lowest level at which a chemical can be accurately and reproducibly quantitated. Usually equal to the instrument detection limit multiplied by a factor of three to five, but varies for different chemicals and different samples.

Range. The term 'range,' when used in a geographic sense, means a designated land or water area that is set aside, managed, and used for range activities of the Department of Defense. Such term includes the following:

GLOSSARY OF TERMS (CONTINUED)

(B) Airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration. (10 U.S.C. 101(e)(3)

Replicate. Duplicate analysis of an individual sample. Replicate analyses are used for quality control.

Representative Samples. Serving as a typical or characteristic sample; should provide analytical results that correspond with actual environmental quality or the condition experienced by the contaminant receptor.

Risk. The expected frequency or probability of undesirable effects resulting from exposure to known or expected stressors.

Statistic. A computed or estimated statistical quantity such as the mean, the standard deviation, or the correlation coefficient.

Toxicity Value. A numerical expression of a substance's exposure-response relationship that is used in risk assessments.

Uptake. A process by which materials are transferred into or onto an organism.

Uncertainty. Imperfect knowledge concerning the present or future state of the system under consideration; a component of risk resulting from imperfect knowledge of the degree of hazard or of its spatial and temporal distribution.

1.0 EXECUTIVE SUMMARY

The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) under the Defense Environmental Response Program to address DoD sites containing or suspected of containing munitions and explosives of concern (MEC) or munitions constituents (MC). Under the MMRP, the United States Army Corps of Engineers (USACE) conducts the Formerly Used Defense Sites (FUDS) program for the Army on behalf of the DoD. The PIKA-Pirnie Joint Venture (the JV) was contracted (Contract No. W912DY-10-D-0025, Task Order No 0020 under the Worldwide Environmental Remediation Services [WERS] contract) by the United States Army Engineering and Support Center, Huntsville (USAESCH) and the USACE Jacksonville District to perform a Site Inspection (SI) at the former Fort Pierce United States Naval Amphibious Training Base (USNATB).

1.1 SI OBJECTIVES AND SCOPE

The overall goal of this SI was to gather sufficient information to determine the presence or absence of MEC and MC from past DoD use at Projects 02, 03, 04, 06 and 07. This was accomplished by completing an SI based on historical data for Projects 02 and 03 (no field activities were conducted) and by conducting an instrument-assisted visual survey and surficial soil sampling at Projects 04, 06, and 07. The SI for the former Fort Pierce USNATB, as identified in the Performance Work Statement (PWS), was also completed to assess the potential risk and hazards to human health, safety, and the environment; to make recommendations for future actions as appropriate, such as Remedial Investigation/Feasibility Study (RI/FS) or No DoD Action Indicated (NDAI), and to collect necessary information to complete the Munitions Response Site Prioritization Protocol (MRSPP). The PWS for this project is included in **Appendix A** of this document. The data quality objectives and plan for obtaining the SI data were developed through the Technical Planning Process (TPP) and are documented in the Final SI Work Plan. The TPP Memorandum is included in **Appendix B** for reference.

1.2 FORT PIERCE USNATB

1.2.1 This report describes the methods and findings of a SI conducted at the Fort Pierce USNATB, located in Indian River and St. Lucie Counties, Florida. The FUDS property number is I04FL0698. The site was used as a joint U.S. Army and Navy training facility.

1.2.2 Fort Pierce USNATB was constructed on the beaches of North and South Hutchinson Islands and the causeway linking Fort Pierce to South Hutchinson Island. Between 27 July 1942 and 6 July 1945, the U.S. acquired land holdings (mostly leased) totaling 19,280.48 acres, including 9,936.09 acres in submerged lands. The installation was a training site used during World War II to prepare for the invasion of Europe and the Pacific. It included submerged obstacle training areas, mine removal training areas, beach landing sites and anti-aircraft gunnery training areas. Up to 40,000 personnel were trained at the installation over the short period of time it was operational. Many of the facilities were temporary, including many semi-tent

structures (hutments). Most of the facilities were removed when the installation was decommissioned in 1946, and the property was returned to the owners. Subsequently, much of the beach property has been extensively subdivided and heavily developed, with the exception of land belonging to the Fort Pierce Inlet State Recreation Area on North Hutchinson Island.

1.2.3 This SI includes the following five Projects within the former Fort Pierce USNATB:

- Project 02 – Engineer Board Area
- Project 03 – Naval Demolition Research Area
- Project 04 – Naval Combat Demolition Unit Area
- Project 06 – South Island Bombing Range
- Project 07 – Anti-Aircraft Gunnery Range

1.3 TECHNICAL PROJECT PLANNING

The approach for this SI was developed by the PIKA-Pirnie Joint Venture, LLC (JV) in conjunction with project stakeholders. A TPP meeting was conducted in November 2013. The TPP meeting was attended by representatives from USACE, Florida Department of Environmental Protection (FDEP), St. Lucie County, Indian River County, the City of Vero Beach, and the JV. A Work Plan describing the methods for the instrument-assisted visual reconnaissance and soil sampling was prepared. Explosives and select metals from small arms (antimony, lead, copper and zinc) were the primary MC of interest, depending on the Project. The TPP attendees agreed upon the SI technical approach, including instrument-assisted visual reconnaissance and collection of surface soil samples (refer to the TPP Memorandum in **Appendix B**).

1.4 SI FIELD ACTIVITIES

On 10 November 2014, the JV mobilized to the project area. Instrument-assisted visual reconnaissance and soil sampling was conducted at Projects 04, 06, and 07 between 11 November and 15 November 2014. Twenty soil samples were submitted to GEL Laboratories, Charleston, South Carolina, a DoD Environmental Laboratory Accreditation Program (ELAP)-certified analytical laboratory. Two soil samples (splits of samples submitted to GEL) were submitted to Accutest Laboratories Orlando, Inc. (Accutest), Orlando, Florida, a DoD ELAP-certified analytical laboratory, for quality assurance.

1.5 SI FINDINGS AND RECOMMENDATIONS

1.5.1 Projects 04, 06 and 07

1.5.1.1 Based on the comparison of maximum detected constituent concentrations to human health risk-based screening levels, no MC [also referred to as constituents of potential concern (COPCs) in the SI report] were identified in soil. Therefore, potential human exposure to detected MC is not expected to result in adverse health effects at Projects 04, 06, and 07. Further assessment on the basis of the potential for human health risk is not warranted.

1.5.1.2 Based on the comparison of maximum detected constituent concentrations to ecological risk-based screening levels, antimony, lead, and zinc were identified as constituents of potential ecological concern (COPECs) in surface soil at Project 04 and antimony was identified as a COPEC in surface soil at Project 07. The initial screening-level risk calculations indicated there may be a potential for risk from exposure to maximum concentrations of lead at Project 04 and of antimony at Project 07. However, in the screening-level risk calculation, the arithmetic average concentration of 10 milligrams per kilogram (mg/kg) for lead resulted in a hazard quotient (HQ) of 1; indicating adverse ecological health effects from exposure to lead are unlikely. Lead is a naturally-occurring element in soils and is often present in concentrations generally ranging from 1 to 10 mg/kg or greater in Florida (Ma, et al, 1999). Also, antimony was infrequently detected (1/5) in soil at Project 07 and, when detected, was within the range of background values for eastern United States (U.S.) soils. The United States Environmental Protection Agency (USEPA) acknowledges that the ecological soil screening level (Eco-SSL) for antimony of 0.27 mg/kg, which is the value protective of exposure to mammals, is below the range reported in typical U.S. soils (USEPA, 2005). Therefore, the maximum concentration (0.722 mg/kg) is not representative of exposure to antimony in soil across Project 07 at the former Fort Pierce USNATB and likely represents background conditions. The HQs for antimony and zinc based on the maximum concentrations at Project 04 were not greater than 1. Based on the results of the screening level ecological risk assessment (SLERA), no further assessment of antimony, lead, or zinc in soil is warranted at either Project 04 or Project 07.

1.5.1.3 Results from the instrument-assisted visual survey and evaluation of the analytical data indicate no unacceptable risk to human and ecological receptors were identified at Projects 04, 06 and 07. NDAI is recommended.

1.5.2 Project 02 and 03

Clearance and removal actions have occurred within Projects 02 and 03 in the past. While these areas have been extensively developed, MEC and munitions debris (MD) may potentially be found during excavation activities, as well as through oceanic disturbances and following storms, such as hurricanes and tropical storms, that tend to erode and redeposit sediment and beach sands. Therefore, it is recommended that Project 02 and 03 proceed to the RI/FS phase.

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2.0 INTRODUCTION

The PIKA-Pirnie Joint Venture (the JV) was established by PIKA International, Inc. and ARCADIS (formerly Malcolm Pirnie, Inc.). The JV has prepared this Site Inspection (SI) Report on behalf of the United States Army Corps of Engineers (USACE) to document the SI for five projects (Project 02, Project 03, Project 04, Project 06, and Project 07) associated with the former Fort Pierce United States Naval Amphibious Training Base (USNATB) located in Indian River and Saint (St.) Lucie Counties, Florida (FL). A map showing the general site location is included as **Figure L-1** in **Appendix L**. The USACE is responsible for implementing SIs at FUDS. The former Fort Pierce USNATB is a FUDS with designated FUDS Property Number I04FL0698. The individual projects have unique FUDS Project Numbers as follows:

- Project 02 – I04FL069802
- Project 03 – I04FL069803
- Project 04 – I04FL069804
- Project 06 – I04FL069806
- Project 07 – I04FL069807

2.1 PROJECT AUTHORIZATION

The JV was directed to perform this SI under the United States Army Engineering and Support Center, Huntsville (USAESCH) Worldwide Environmental Remediation Services (WERS) Contract No. W912DY-10-D-0025, Task Order No. 0020. This task order was issued on 24 July 2013 and is being administered by USAESCH. The USACE, Jacksonville District (CESAJ) is responsible for overall project management, stakeholder coordination, as well as regional support.

2.2 PURPOSE AND SCOPE

2.2.1 The overall goal of this SI is to gather sufficient information to determine the presence or absence of MEC and MC from past DoD use at Fort Pierce USNATB Projects 02, 03, 04, 06 and 07. A SI was performed, based on historical data (*i.e.*, no field activities) for Projects 02 and 03. For Projects 04, 06, and 07, an instrument-assisted visual survey and surficial soil sampling were conducted. The SI for the former Fort Pierce USNATB, as identified in the PWS, also includes an assessment for potential risk and hazards to human health, safety, and the environment; recommendations for future actions as appropriate, such as RI/FS or NDAI; and incorporates SI information to complete the MRSPP.

2.2.2 The primary objective of the MMRP SI is to determine whether a FUDS project warrants further response action under the Comprehensive Environmental Restoration, Compensation and Liability Act (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 time critical removal action, (ii) collects or develops additional data, as appropriate, for Hazard Ranking System (HRS) scoring by the United States Environmental Protection Agency (USEPA) if applicable; and (iii) collects data, as appropriate, to characterize the release, if identified, for

effective and rapid initiation of the RI/FS. Additional objectives of the MMRP SI are to collect the additional data necessary to complete the MRSPP (included in **Appendix K**).

2.2.3 While not all MC constitute CERCLA hazardous substances, pollutants or contaminants, the Defense Environmental Restoration Program (DERP) Statute (10 USC 2701) provides DoD the authority to respond to releases of MC and DoD policy states that such responses shall be conducted in accordance with CERCLA and the National Contingency Plan.

2.3 PROPERTY DESCRIPTION AND PROBLEM IDENTIFICATION

2.3.1 Project Location

The former Fort Pierce USNATB was located in Indian River and St. Lucie Counties in FL. The property extended from near Jensen Beach north to approximately five miles south of Vero Beach, FL (**Figure L-1**, **Appendix L**). The area where the former Fort Pierce USNATB was located has been extensively subdivided and heavily developed for residential and commercial use, and includes public recreational areas.

2.3.2 Site Description

The following sections provide site description, environmental, and climatic information for the Fort Pierce USNATB. The SI focuses on the former military munitions activities that took place during World War II (WWII).

2.3.3 Topography

The site is located on the Floridian Plateau, which lies within the Atlantic Coastal Lowlands province. The Atlantic Coastal Lowlands extend inland from the coast for approximately 20 miles. The Lowlands are characterized by flat, low elevations (< 25 feet above sea level), that are swampy and poorly drained. The lowlands represent the shallow, flat bottoms of ancient seas.

2.3.4 Geology

2.3.4.1 Thick sequences of sedimentary rocks of marine origin overlie the crystalline basement rocks in this part of the Floridian Plateau. Sediments exposed at the surface range from Miocene age (26 to 12 million years ago) through Pleistocene age (three to two million years ago) to recent age. Miocene sediments are those associated with the Hawthorn formation and consist of sands and clayey sands. Pleistocene sediments are those associated with the Caloosahatchee, Fort Thompson, and Anastasia formations, which consist mainly of shell beds (colloquially called marls), clays, and clayey sands that crop out in the shallow ditches and streams and along the Atlantic coast. Recent sediments are the deposits of peat, lake deposits, dune sands, and alluvial deposits of streams.

2.3.4.2 Almost all of Indian River and Saint Lucie County is covered by a veneer of Pleistocene sand. These sediments were laid down by marine processes. During the last two million years of Pleistocene time, sea level rose more than 100 feet above present sea level and fell more than 200 feet below present sea level. These sea level fluctuations occurred several times, alternately covering and exposing parts of the Floridian Plateau. Each significant change in sea level created a

different environment of deposition for any given location across the relatively flat Plateau. These sea level changes resulted in a very complex interbedding and interfingering of heterogeneous lithologies in the subsurface stratigraphy. The present coastal beaches, offshore barrier islands, and back-bay deposits have been designated as shell lithology because of their shell, silt, and clay content. Quite often, these shell beds have been changed to a coquina, which is a limestone composed of shells, corals, organic debris, sand and minerals that have been cemented together. Fragments of these coquina units are commonly found in spoil piles along the many canals. Exposed sections in canals and borrow pits show evidence that the shell beds originally were thicker. Over time, the calcareous shells and debris have been leached away leaving quartz sand and other insoluble minerals as residuum. Interfingered and interbedded among the various shell, clay and sand units are thin, discontinuous lenses and stringers of sandy, phosphatic limestones and dolomites (Lane, et.al., 1980).

2.3.5 Climate

The climatic data collected at Fort Pierce, Indian River and Saint Lucie County, FL shows the average annual precipitation at approximately 52 inches. Approximately 70 percent of this precipitation occurs in May through October. The climate in the study area is subtropical, characterized by mild moderate dry winters and warm, humid summers. The average annual temperature for the area is 73 degrees Fahrenheit. The extremes in temperature vary from 22 to 99 degrees Fahrenheit.

2.3.6 Hydrology

The surface water of the study area drains west into the Indian River, east into the Atlantic Ocean, or infiltrates into the sand. The site is periodically flooded by tropical storm and hurricane-induced storm surges. Project 07 lies adjacent to Blind Creek.

2.3.7 Vegetation

The surrounding terrain is level, and consists of sandy beaches and dense coastal vegetation. Morning glory (*Ipomoea sagittata Poir.*), sea oats (*Uniola paniculata*), sea purslane (*Sesuvium sp.*), and beach elder (*Iva imbricate*) typically dominate the dune areas. Palm trees and sea grape (*Coccoloba uvifera*) are also present along and inland from the dunes. Mangroves dominate the near-shore areas along the Indian River.

2.3.8 Utilities

The former Fort Pierce USNATB is currently utilized for residential, commercial and recreational land uses. Overhead and buried electrical, potable water, sanitary sewer, stormwater and telecommunications/fiber optic lines were identified.

2.3.9 Significant Structures

Significant structures at the former Fort Pierce USNATB include the following:

- Project 02 includes single and multi-family residential, recreational, and commercial development. Several single family homes and condominium complexes were observed, as well as businesses.
- Project 03 includes single and multi-family residential, recreational, and commercial development. Several single family homes and condominium complexes were observed, as well as businesses.
- Project 04 includes single and multi-family residential development. Several single family homes and condominium complexes were observed.
- Project 06 encompasses single and multi-family residential, commercial, and recreational developments. Observed structures included single homes, condominium complexes, public restrooms and picnic pavilions.
- Project 07 includes primarily undeveloped and recreational land. Observed structures included facilities associated with public parks.

2.3.10 Population

The former Fort Pierce USNATB is located within Indian River and St. Lucie Counties, FL. Based on estimated census data for year 2013, the population of Indian River County, FL is 141,994, which corresponds to 282.4 persons per square mile. The population of St. Lucie County, FL is 286,832, which corresponds to 501.5 persons per square mile.

2.3.11 Security

The former Fort Pierce USNATB is currently utilized for residential, commercial and recreational land uses. Instrument-assisted visual reconnaissance was conducted only in areas where rights of entry were obtained from property owners. The JV made all reasonable attempts to control access into work areas and limit access to only those personnel necessary to accomplish the specific operations or who have a specific purpose and authorization to be on the site. This was accomplished by coordinating with property owners several days ahead of the field activities to limit unauthorized people from entering the site during the field work.

2.3.12 Cultural Sites

No known historical, archeological or cultural sites are located within the project areas.

2.4 FORT PIERCE USNATB BACKGROUND

2.4.1 Fort Pierce USNATB Background Information

The former Fort Pierce USNATB is located near Fort Pierce, in Indian River and St. Lucie Counties, FL. The site was used as a joint U.S. Army and Navy training facility. Fort Pierce USNATB was constructed on the beaches of North and South Hutchinson Islands and the causeway linking Fort Pierce to South Hutchinson Island. Between 27 July 1942 and 6 July 1945, the U.S. acquired land holdings (mostly leased) totaling 19,280.48 acres, including 9,936.09 acres in submerged lands. The installation was a training site used during World War II to prepare for the invasion of Europe and the Pacific. It included submerged obstacle training areas, mine removal training areas, beach landing sites and anti-aircraft gunnery training areas.

Up to 40,000 personnel were trained at the installation over the short period of time it was operational. Many of the facilities were temporary, including many semi-tent structures (hutments). Most of the facilities were removed when the installation was decommissioned in 1946, and the property was returned to the owners. Subsequently, much of the beach property has been extensively subdivided and heavily developed, with the exception of land belonging to the Fort Pierce Inlet State Recreation Area on North Hutchinson Island. This SI includes the following five Projects within the former Fort Pierce USNATB.

- Project 02 – Engineer Board Area
- Project 03 – Naval Demolition Research Area
- Project 04 – Naval Combat Demolition Unit Area
- Project 06 – South Island Bombing Range
- Project 07 – Anti-Aircraft Gunnery Range

2.4.2 Projects 02, 03, 04, 06 and 07 Background Information

2.4.2.1 Project 02 – Engineer Board Area

This 2,013-acre site is located on North Hutchinson Island in Indian River County, FL (**Figure L-2, Appendix L**). The site is situated south of Vero Beach, centered adjacent to Little Starvation Cove. Virtually every acre of Project 02 is developed for residential, commercial, or recreational use. Historically, the Engineer Board Area activities included support facilities for constructing and emplacing obstacles along the beach and just off-shore. There is no evidence of ordnance storage associated with the munitions response site (MRS); however, ordnance-related operations were conducted along the eastern boundary between 1943 and 1945. Beach fortifications were constructed intermittently along the coastline for destruction by various air and water-borne methods. As part of these beach fortifications, practice anti-tank land mines were placed among the rows of barbed-wire and concrete structures. Attacks with bulk explosives, rockets, and aerial bombs were used to test their effectiveness in removing the obstacles and the mines. There were no identified targets positioned within the interior of the MRS. However, MEC items have been found in various locations within the interior of the MRS. Historical munitions identified and associated clearance activities include:

- Review of historical aerials from the 1940s identified bombing that took place near Porpoise Point.
- In 1949, local residents reported finding mines along the North Island beach.
- In March 1957, an AN-MK 17 M-l depth bomb was found and detonated in place.
- A 350-pound bomb and 50 sticks of dynamite were found at the MRS in 1957.
- Additionally, it is reported that incendiary bombs were discovered during the development of the Seagrove Subdivision in the 1970's.

According to the INPR, although clearance and removal actions have occurred, as well as extensive development, MEC and MD may potentially be found periodically during excavation activities, as well as through oceanic disturbances and following storms, such as hurricanes and tropical storms (*e.g.*, beach erosion during storms).

2.4.2.2 Project 03 – Naval Demolition Research Area

This 1,712-acre site is located on North Hutchinson Island in Indian River and St. Lucie Counties, FL (**Figure L-3, Appendix L**). The site is south of Vero Beach, centered approximately on Big Starvation Cove. Nearly every acre of the MRS is developed residentially, commercially, or recreationally. While there is little documented evidence of munitions storage, use, or disposal in the Naval Demolition Research Unit Area, the mission of this unit is not clearly delineated in historical documentation and its designation indicates that ordnance use is likely. Munitions and MD have been discovered in this area since the period of military operations. Surface inspections were conducted in this area and a letter and Certificates of Clearance were issued on 16 January 1946 and, again, on 19 October 1946. Since that time, high explosive munition items have been found in the area. These items have primarily been exposed via beach erosion. Beginning in 1952, operations were undertaken to identify and remove military obstacles and debris from along the shoreline of the Naval Demolition Research Area. Historical munitions identified and associated clearance activities include:

- Five horned scullies were removed from the surf in April 1952. Ten others were located but not removed until July 1952. As part of the latter operation, portions of the beach were scraped with a bulldozer at the water's edge to check for additional debris, but none was encountered.
- In the 1960's a dragline operator was killed by impacting an unexploded device at Avalon State Park.
- In 1994, during a property visit in support of the ASR, the team found (what is presumed now to be) a 7.2" Inert Rocket Warhead. During a follow-up visit, the team learned of a number of munitions canisters being recovered near the area of the rocket warhead. In addition, reportedly a bomb 2.5 feet in length with three fins was found submerged near one of the horned scullies.
- In 1998, a Beach Barrier Removal Project was conducted on portions of this MRS. During the removal project from Martin Cove to the Fort Pierce Inlet, approximately nine pounds of high explosives (C-2) were found within scullie-related debris along the shoreline.

According to the INPR, although clearance and removal actions have occurred, as well as extensive development, MEC and MD may potentially be found periodically during excavation activities, as well as through oceanic disturbances and following storms, such as hurricanes and tropical storms (*e.g.*, beach erosion during storms).

2.4.2.3 Project 04 – Naval Combat Demolition Unit Area

This 800-acre site is located on North Hutchinson Island in St. Lucie County FL, centered approximately 2.5 miles north of the Fort Pierce Inlet (**Figure L-4, Appendix L**). The Naval Combat Demolition Unit (NCDU) was headquarters for the underwater demolition teams. This area was one of several identified on North Hutchinson Island where considerable quantities of conventional munitions were stored and used for training. Beach areas along North Hutchinson

Island were subjected to numerous explosive attacks from the land, the sea, and the air. Much of the beach from south of the city of Vero Beach to the Fort Pierce Inlet was used in some fashion for the obstacle removal exercises. The NCDU also included an ammunition storage bunker and a suspected burial site reported near the New Sands Condominiums. Personnel responsible for base closeout activities stated that munitions from the bunker were removed at that time. There is no indication that the bunker still exists. The suspected burial site was assessed during the Engineering Evaluation / Cost Analysis (EE/CA) field investigation in 1996; no evidence of the burial site was found. Speculation is that an area approximately one mile to the north (i.e., north of the New Sands Condominiums) may have been the actual burial site noted historically. Reportedly, approximately 200 inert landmines were found during the construction of a condominium complex at that location. Records indicate that surface inspections were conducted at Project 04 in 1946. A letter and Certificate of Clearance were issued on 16 January 1946 and, again on 19 October 1946.

2.4.2.4 Project 06 – South Bombing Range

This 649-acre site is located on South Hutchinson Island in St. Lucie County, FL. It is centered immediately east of Nettles Island (**Figure L-5, Appendix L**). The site was identified as a possible bombing range based on general historical documentation and interpretation of pock marks present in historical aerial imagery. There is no substantiated evidence of this range, and no recorded incident relating to MEC or MD. The land area associated with the MRS is extensively developed with high-rise condominiums, private residences, and commercial businesses. There was no evidence of previous military activities in the area. For multiple reasons, the MRS was excluded from the field investigation conducted in support of the 1996 EE/CA. Although MEC may be present in this area, it was determined at that time that further investigation was not warranted, considering the probability of public exposure to MEC and the difficulty of conducting investigations under current land use conditions.

2.4.2.5 Project 07 – Anti-Aircraft Gunnery Range

This 25,357-acre site is located on South Hutchinson Island in St. Lucie County, FL, approximately 1.5 miles up the coast (north) from the St. Lucie Power Plant (**Figure L-6, Appendix L**). The site is identified in historical documents as a multiple use range with small arms up to and including .50 caliber, and anti-aircraft artillery up to 3-inch. The portion of the MRS on land encompasses approximately 192 acres, which includes the firing lines and points, ready lines, ammunition issue area, safety/buffer areas, and the administrative area. All firing, to include ground target ranges (*i.e.*, pistol and rifle) and anti-aircraft guns were established along the coastline with their direction of fire seaward. Impact areas for anti-aircraft weapons are expected to be thousands of yards off shore. Maximum ranges for these bullets and projectiles (.30 caliber to 3-inch) are approximately 3,450 to 15,300 yards. During low tide, the concrete anti-aircraft gun emplacements have been observed. The St. Lucie County Park (Blind Creek Oceanside Park) completely encompasses the land portion of the site. Residential homes and the St. Lucie Power Plant border the park, to the north and south, and both are within 0.5 miles of site boundary. Available evidence indicates a very low probability of encountering MEC in this

area. There is one reference to MD identified in the ASR from an interview with a local resident who said that, as a young boy (in the 1950s), he remembers camping on South Island in the area of the firing ranges and finding empty ammunition storage boxes and spent casings. After the 2005 hurricanes, expended shell casing were identified at Blind Creek in the vicinity of the munitions storage area. For several reasons, the site was excluded from the field investigation conducted in support of the 1996 EE/CA.

2.5 CURRENT AND FUTURE LAND USE

Existing uses of all five project areas include residential, commercial and recreational uses. Surrounding areas are residential, commercial, and recreational. There is one school located within Project 02. Residential homes are located within Project 02, 03, 04, and 06. Future land use is expected to remain the same as current use.

2.6 MUNITIONS CONSTITUENTS

The primary MC associated with the munitions used historically at the Fort Pierce USNATB are explosives and metals. Metals (lead, antimony, copper, zinc) are primarily associated with small arms munitions; however, the only MRS where small arms munitions were fired is the Anti-Aircraft Gunnery Range (Project 07). This range's target area, where the munitions would be found, is off-shore and the munitions, if any, are underwater. Larger munitions (*e.g.*, bombs) are typically constructed of steel or iron casings filled with explosives fillers. Therefore, the primary MC associated with MEC are explosives, primarily trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), cyclotrimethylenetrinitramine (RDX), 2,4-dinitrotoluene (DNT), 2,6-DNT, nitroglycerin (NG), and pentaerythritoltetranitrate (PETN).

2.7 PREVIOUS AND CURRENT INVESTIGATIONS

The previous and current studies, in addition to this SI, conducted at the former Fort Pierce USNATB are listed below:

- 1996 *Final Engineering Evaluation / Cost Analysis, Former Fort Pierce United States Naval Amphibious Training Base, Fort Pierce, Florida* prepared by Environmental Science and Engineering
- 1998 *Multi-Sensor Towed Array Detection System Mapping and Ordnance Investigation Report*
- 1998 *Completion Report for Beach Barrier Removal Project*
- 2007 *Archive Search Report, Fort Pierce Naval Amphibious Training Base Fort Pierce, Fort Pierce, Florida, Saint Lucie, Indian River, and Martin Counties, Site No. I04FL069800* prepared by USACE, Saint Louis District.
- 2012 *Final Remedial Investigation Report, Former Chemical Warfare Agent Test Area, Fort Pierce United States Navy Amphibious Training Base, Fort Pierce, Saint Lucie County, Florida* prepared by the PIKA/Pirnie JV

- 2012 Revised Inventory Project Report prepared by USACE, Jacksonville District
- On-going *Building Demolition and Debris Removal Project*, which includes the near-shore areas of the former Engineer Board Facility Area, Engineer Board Operations Areas 1-6, the Naval Demolition Research Unit Operation Area, and the Naval Combat Demolition Unit Operation Area, being prepared by USA Environmental, Inc.
- On-going *Time Critical Removal Action* at Fort Pierce Project 05, to locate, confirm identification and condition of, and dispose of MEC, MPPEH, and explosive hazards found as part of the Building Demolition and Debris Removal project, being prepared by the JV.

A summary of pertinent information used in this SI is discussed below.

2.7.1 Final Engineering Evaluation / Cost Analysis, 1996

For the Final EE/CA, three areas were selected for field investigations. The areas selected were believed to have the highest probability of posing a risk of public exposure to MEC considering historical military use of the sites, current, and probable future land uses. These areas were designated as Areas A, B, and C, as shown on **Figure L-7 in Appendix L**. Areas A (in the Engineer Board Area) and B (in the Naval Combat Demolition Unit Area) included undeveloped property with the potential for future residential development (Area A has subsequently been developed). Aerial photographs taken in 1944 indicated that these areas contained beach fortifications that were bombarded. Area C (in the Naval Combat Demolition Unit Area) was reported to be a possible disposal area for military materiel. Two types of magnetometer surveys were performed, and hand excavation was used to intrusively investigate magnetic anomalies. Excavation was performed only in Area B, considering the proximity of residential structures, and the need for evacuation and traffic rerouting in Areas A and C. A total of 0.84 acres of land was surveyed for Area A. The surveyed area consisted of two non-adjacent undeveloped residential lots. Non-munitions related military debris was encountered during surface clearance of both lots. For Area B, two adjacent grids, each 0.5-acres, were surveyed. All (134) magnetic anomalies were exposed and identified. No munitions-related or military debris were identified. The EE/CA also mentions that Area B is located on a portion of North Hutchinson Island determined to be accreting (*i.e.*, where the land is expanding) as a result of sand deposition, and that this area was likely below the mean high water level during World War II. Area C consisted of three grids totaling 0.55-acre. Two types of magnetometers were used to locate a suspected burial site east of the Sands on the Ocean condominium complex. The investigation at Area C yielded no evidence of buried material. The conclusion from the EE/CA was that, although unexploded ordnance (UXO) used at the former Fort Pierce USNATB may remain at the site, the number of UXO items per acre is apparently low. Further, UXO items, if present, are likely to be below land or water surfaces. The EE/CA recommended risk reduction alternative was implementation of a community awareness program.

2.7.2 Multi-Sensor Towed Array Detection System Mapping and Ordnance Investigation Report, March 1998

A Multi-Sensor Towed Array Detection System (MTADS) was deployed at areas of the former Fort Pierce USNATB from 19 January to 3 February 1998. Approximately 150 acres of beach, between the shoreline and vegetation lines were surveyed, including over 15 miles of beachfront, primarily on North Hutchinson Island (**Figure L-7, Appendix L**). Data was pre-processed on site to verify data integrity and determine the density and extent of buried munitions-related contamination. Based upon required exclusion zone distances, only items predicted to be smaller than or equivalent to an M6 anti-tank (AT) mine were intrusively investigated. No ordnance items were found during this stage of intrusive anomaly investigation. After investigating the smaller items, target recovery switched to prosecution of targets considered to be too large to be discrete ordnance. These items were considered as likely beach access obstacles, such as the horned scully previously recovered at this site, particularly off-shore. The MTADS survey concluded that, based upon recovered targets, it is unlikely that significant ordnance contamination exists from Round Island Park to beyond the Avalon Park entrances by P.V. Martin's restaurant. Historical documentation indicates that this stretch of beach was used as an underwater demolition team (UDT) training area primarily involving beach obstacles, such as horned scullies. The larger targets recovered in the area were primarily railroad rails associated with the construction of beach obstacles. The MTADS report mentions that north of Round Island, parts of the beach are eroding. It is in this area that recent ordnance discoveries have been made. The five miles of beach south of Round Island are either similar to how they existed during World War II or have accreted up to one to two feet of sand. Further to the south, approaching the Fort Pierce Inlet, much more sand has accreted. Approximately two miles of beach on South Hutchinson Island were surveyed using the MTADS. In total, 262 targets were analyzed in three distinct survey areas. The authors concluded that there was no evidence of large target concentrations in any of the surveys that would be indicative of a bombing target. Approximately six targets (*i.e.*, anomalies) large enough to be 250-pound (or larger) bombs were identified, and they were widely dispersed. The target sizes and distributions were similar in all three surveys.

2.7.3 Revised Inventory Project Report, 2012

The revised Inventory Project Report (INPR), prepared by USACE in 2012, identified Fort Pierce USNATB as a training site for preparation for the invasion of Europe during World War II. The site included submerged obstacle training areas, mine removal training areas, beach landing sites, and anti-aircraft gunnery training areas. Up to 40,000 personnel trained at the facility. Fort Pierce USNATB closed in 1946, was returned to its former owners, and has since been heavily developed for residential and commercial uses. As part of the INPR, the preliminary site visit was performed by USACE and contractor personnel in May 1993, and several subsequent property visits were noted. Site visit personnel performed site inspections and conducted interviews with local officials and residents regarding past activities at Fort Pierce

USNATB. The revised INPR identified eight areas comprising the former Fort Pierce USNATB that required further investigation for ordnance and explosive waste. Project 00 was not included in the INPR. For the remaining projects (01 through 07), the INPR describes the historical operations and provides a list of available documentation. Projects 01 and 05 are not part of this SI. The INPR found no evidence of chemical weapons use at Fort Pierce USNATB.

2.8 SITE INSPECTION REPORT ORGANIZATION

2.8.1 The sections of this SI Report have been organized following guidance provided in Engineer Pamphlet (EP) 1110-1-18.

- Chapter 1 – Executive Summary
- Chapter 2 – Introduction
- Chapter 3 – Field Investigation and Methodology
- Chapter 4 – Results
- Chapter 5 – Geospatial Information and Electronic Submittals
- Chapter 6 – Screening Level Risk Analysis
- Chapter 7 – Summary and Conclusion
- Chapter 8 – References

2.8.2 The following appendices are included as part of this SI Report:

- Appendix A – Performance Work Statement (PWS)
- Appendix B – Technical Project Planning (TPP) Memorandum
- Appendix C – Field Notes and Field Forms
- Appendix D – Laboratory Reports [including Electronic Data Deliverables [EDDs)]
- Appendix E – Data Tables
- Appendix F – Data Validation Reports (including EDDs)
- Appendix G – Photodocumentation Log
- Appendix H – Geographic Information System Data Deliverable
- Appendix I – Screening Level Risk Assessment (Ecological Risk Assessment Tables)
- Appendix J – Conceptual Site Model
- Appendix K – Munitions Response Site Prioritization Protocol (Tables)
- Appendix L – Figures

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3.0 FIELD INVESTIGATION ACTIVITIES

3.1 FIELD INVESTIGATION OVERVIEW

3.1.1 The SI at the former Fort Pierce USNATB included an instrument-aided visual reconnaissance and surface soil sample collection and analysis at Projects 04, 06 and 07 to determine the presence or absence of MEC and MC. The field activities, including the reconnaissance and sampling activities, were conducted from 11 November 2014 through 15 November 2014. The activities were documented using field notes and field forms, which are included in **Appendix C**. Field observations were also photo-documented and the photograph log is included in **Appendix G**. No field activities were conducted at Projects 02 and 03 since existing historical data and observations were sufficient to determine the likely presence of MEC at these sites.

3.1.2 Following approval of the Final SI Work Plan, rights of entry from property owners of parcels, where field activities were planned, were obtained by the USACE. The rights of entry were completed prior to initializing field activities, with copies in-hand prior to mobilizing to the site. The parcels where rights of entry were obtained, and where the field activities were focused, are shown on **Figures L-8, L-9** and **L-10** in **Appendix L**. In some cases, verbal consent for right of entry was provided by a property owner for an adjacent parcel where field activities were conducted. As such, the field team had permission to enter and conduct field activities on all parcels where the field work took place.

3.2 INSTRUMENT-AIDED VISUAL RECONNAISSANCE

3.2.1 The JV conducted an instrument-aided visual reconnaissance focused on documenting current site conditions. The team walked along meandering paths through accessible areas at Projects 04, 06 and 07, including the:

- Former ammunition bunker location at Project 04
- Areas correlating to the pock mark areas noted on the historical aerial at Project 06
- Former ordnance storage bunker area at Project 07

3.2.2 A SubSurface Instruments (SSI) ML3 handheld magnetometer was operated by the UXO escort (UXO Technician Level II or higher) and was used to identify metallic objects on the ground surface or in the shallow subsurface. The survey team visually inspected all instrument detections (ring-offs) related to objects at the surface.

3.2.3 A Trimble® GeoXH™ Global Positioning System (GPS) handheld receiver was also used to record the path traversed by the visual reconnaissance team. Following data collection, the GPS data from the visual survey was post-processed in reference to two local GPS broadcast beacons. The reconnaissance paths at each site are shown graphically as mapped features on the **Figures L-11, L-12** and **L-13** in **Appendix L**. No intrusive work was conducted as part of the visual reconnaissance. Instruments and equipment used to gather and generate data were tested daily for accuracy and reproducibility of results to be consistent with manufacturers'

specifications. The equipment tests, as well as observations made, were documented and are included in the field notes and field forms in **Appendix C**.

3.3 SOIL SAMPLING AND ANALYSIS

3.3.1 Discrete, surface soil samples (0 to 0.5 feet below ground surface) were collected from 20 locations biased to where munitions-related activities took place or where they were suspected based on historical documentation regarding the sites. Refer to **Table 3-1** below for a summary, by project site, of the number of soil samples collected and the associated analytical parameters. Sample location data (*i.e.*, corresponding longitude and latitude positions for each sample location), which was recorded during the field effort using the handheld GPS receiving unit and post-processed, is tabulated and included in **Table E-2** in **Appendix E**. Proposed and actual sampling locations are shown on **Figures L-11, L-12** and **L-13** in **Appendix L**.

Table 3-1: Soil Sampling and Analytical Parameters

Project	Number/Location of Surface Soil Samples (0 to 0.5 feet below ground surface)	Analytical Parameters
Project 04	5 samples in the immediate vicinity of the former ammunition storage bunker (see **Figure L-11** in **Appendix L**)	Explosives; Metals (lead, antimony, copper, and zinc)
Project 06	10 samples from the approximate locations of the pock marks shown in the historical aerial photograph (see **Figure L-12** in **Appendix L**)	Explosives
Project 07	5 samples in the immediate vicinity of the former ordnance storage bunker (see **Figure L-13** in **Appendix L**)	Metals (lead, antimony, copper, and zinc)

3.3.2 The soil samples were analyzed for the MC associated with the former munitions-related use. Metals (lead, antimony, copper, and zinc) are primarily associated with small arms munitions; larger munitions (*e.g.*, bombs) are typically constructed of steel or iron casings filled with explosives fillers. The primary MC associated with high explosive bombs and other munitions are explosives, primarily trinitrotoluene (TNT), cyclotetramethylenetetranitramine (HMX), cyclotrimethylenetrinitramine (RDX), 2,4-dinitrotoluene (DNT), 2,6-DNT, nitroglycerin (NG), and pentaerythritoltetranitrate (PETN). The former ammunition storage bunker at Project 04 could have been used to store small arms ammunition in addition to larger munitions. Therefore, the five samples collected at Project 04 were analyzed for explosives and metals. The ten samples collected at Project 06 were analyzed for explosives only since the site was potentially used as a bombing target. The five samples collected at Project 07 were analyzed for metals only since only small arms munitions were stored in the former ordnance storage bunker based on historical documentation and site use.

3.3.3. All of the 20 planned surface soil samples were collected from Projects 04, 06 and 07 on 12 November 2014 through 15 November 2014 in accordance with FDEP Standard Operating Procedures (SOP-001/01-FS-3000) per the Final SI Work Plan. The proposed and actual sample locations are shown on **Figures L-11, L-12** and **L-13** in **Appendix L**. The samples were collected as previously planned from the 0 to 0.5 foot interval (below ground surface) using dedicated, one-time use sampling equipment. The soil samples were collected into new, laboratory-supplied containers and placed into a cooler with ice following collection. The sample containers were labeled with the sample identification (soil number and depth), date and time of collection, and the sampler's initials. The samples collected for laboratory analysis were shipped in sealed coolers with ice to the laboratory. A chain of custody form was completed and accompanied the samples throughout sample collection and transport to the laboratory.

3.3.4 Six soil samples were also collected for Total Organic Carbon (TOC) analysis using USEPA SW-846 Method 9060. The TOC samples and resulting analytical data were obtained to normalize explosives data, if explosives were detected in the samples.

3.3.5 The samples were submitted to GEL Analytical Laboratories, Inc. (GEL), Charleston, South Carolina, a DoD ELAP-certified analytical laboratory for analysis of explosives by USEPA SW-846 Method 8330B and select metals (antimony, copper, lead and zinc) by USEPA Method 3050B/6010C. Additionally, two split samples were collected and submitted to the quality assurance (QA) laboratory (Accutest, Orlando, Florida), a DoD ELAP-certified analytical laboratory) for analysis of explosives by USEPA SW-846 Method 8330B and select metals (antimony, copper, lead and zinc) by USEPA Method 3050B/6010C. The analytical data was also third-parted validated. Laboratory analytical methods and data validation procedures were selected to meet the data quality objectives identified in the UFP-QAPP (presented as Appendix E in the Final SI Work Plan).

3.4 DEVIATIONS FROM THE PLANNING DOCUMENTS

3.4.1 For the TOC samples, at least one soil sample, per soil type, within Projects 04 and 06 was planned. However, due to observations made in the field regarding soil characteristics, two samples were collected from Project 04 and four samples were collected from Project 06. These samples were analyzed for TOC by USEPA SW-846 Method 9060 as planned.

3.4.2 In some cases, the planned sampling location was shifted slightly based on field observations and accessibility at the sample location. For a number of locations, dense vegetation prevented access to the location planned. However, in these cases, a nearby, equally representative location that was accessible was sampled. As such, all planned samples were collected and data usability was not affected by inaccessible areas at a site. The planned and actual sample locations are shown on **Figures L-11, L-12** and **L-13** in **Appendix L** for Projects 04, 06 and 07, respectively.

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4.0 FIELD INVESTIGATION FINDINGS

4.1 INSTRUMENT-AIDED VISUAL RECONNAISSANCE RESULTS

No munitions or evidence of munitions use were observed during the instrument-aided visual survey. Only one subsurface anomaly was noted during the visual survey. The subsurface anomaly was detected in Project 04 at a vacant parcel that appeared to have been filled (*i.e.*, the parcel was approximately two to four feet higher in elevation than the surrounding area) and developed in the past (*i.e.*, visual observations indicated that structures may have been present, but demolished and removed). Based on these observations, the anomaly is most likely related to the site's previous use and the subsequent demolition or filling activities rather than a munitions-related item. Additionally, the area where the anomaly was noted is not near the former ammunition bunker location. The anomaly location is shown on **Figure L-11**.

4.2 SOIL ANALYTICAL RESULTS

4.2.1 A total of 20 surface soil samples were collected from Project 04 (5 samples), Project 06 (10 samples), and Project 07 (5 samples). Samples were collected and analyzed in accordance with the Final SI Work Plan, and FDEP SOPs. The soil samples were analyzed for explosives and select metals (lead, copper, antimony, and zinc) by DoD-certified analytical laboratories. The validated soil analytical results are summarized in **Table E-1** in **Appendix E**. The laboratory reports and EDDs containing the soil analytical data are included in **Appendix D**. All sample analysis was performed within laboratory holding times. The laboratory analytical data were found to be of acceptable quality by the third-party validator and met the data quality objectives identified in the UFP-QAPP. The data collected were determined to be meaningful and usable for the SIs at Projects 04, 06 and 07.

4.2.2 Six soil samples were also collected for TOC analysis using USEPA SW-846 Method 9060. The TOC results were intended to be used to normalize the explosives data, if explosives were detected in the samples. However, because there were no detections of explosives constituents in any of the samples, the TOC data was not used. As such, it is not included in the validated analytical data table, but it is provided in the laboratory analytical data package for reference.

4.2.3 There were no detections of explosives in any of samples. All detections of metals were below their respective human health screening levels. Based on the comparison of maximum constituent concentrations to human health risk-based screening levels, no COPCs were identified in soil. Therefore, there is no source of human exposure to MC originating at Projects 04, 06 and 07, and the soil exposure pathways are incomplete. Based on the comparison of maximum detected constituent concentrations to ecological risk-based screening levels, antimony, lead, and zinc were identified as COPECs in surface soil at Project 04 and antimony was identified as a COPEC in surface soil at Project 07. However, further review of these detections as part of the screening-level ecological risk assessment discussed in Section 6.2 determined that there is no source of ecological exposure to MC originating at Project 06 and no

source of ecological exposure to MC presenting an unacceptable risk at Projects 04 and 07. As such, the soil exposure pathways are incomplete.

4.3 COMPARISON OF PRIMARY AND QA LABORATORY SOIL RESULTS

Replicate soil samples from two locations were also submitted to Accutest for explosives and select metals (lead, antimony, copper and zinc) analysis as part of the QA procedures. The laboratory report from Accutest is included in **Appendix D**. Due to the non-detect results, the relative percent difference was not calculated.

4.4 DATA VALIDATION

The laboratory analytical data were submitted to a third party validator (Laboratory Data Consultants) for review. The validated analytical reports and EDDs are included in **Appendix F**. Measurement performance criteria evaluated during validation included precision, accuracy, representativeness, comparability, detection limit verification, and completeness. As shown on the validation reports, the laboratory data are of acceptable quality, subject to the data validator's qualifying marks, and were found to be meaning and useful for the purposes of the SI. In addition, the data quality objectives for the SIs at Projects 04, 06 and 07 were met based on the quantity, quality, and usability of the data collected during the SI, to include both visual reconnaissance and analytical data. This data was found to be complete and acceptable for its intended use in determining the presence or absence of MEC and MC at Projects 04, 06 and 07, as well as making recommendations for follow-on actions, if needed.

4.5 HISTORICAL FILE REVIEW

4.5.1 Project 02 – Engineer Board Area

For the SI, a review of historical documentation was performed for Project 02. Based on this review, there is no evidence of ordnance storage. However, ordnance-related operations were conducted along the eastern boundary between 1943 and 1945. Land mines and bombs have historically been identified within Project 02, as well. According to the INPR, although clearance and removal actions have occurred, as well as extensive development, MEC and MD and liable to be found periodically during excavation activities, as well as through oceanic disturbances and following storms, such as hurricanes and tropical storms (*e.g.*, beach erosion during storms).

4.5.2 Project 03 – Naval Demolition Research Area

Historical documentation was also reviewed during the SI for Project 03. While there is little documented evidence of munitions storage, use, or disposal, and the mission of this unit is not clearly delineated in historical documentation, its designation indicates that ordnance use is likely. Munitions and MD have been discovered in this area since the period of military operations during WWII. High explosive munition items have been found in the area and in 1952 military obstacles and debris were removed. A dragline operator was killed in the 1960s by impacting an unexploded device at Avalon State Park. In the 1990s, a rocket warhead, 2.5-foot

long bomb, and nine pounds of high explosives were found. According to the INPR, although clearance and removal actions have occurred as well as extensive development, MEC and MD may potentially be found periodically during excavation activities, as well as through oceanic disturbances and following storms, such as hurricanes and tropical storms (*e.g.*, beach erosion during storms).

4.6 REVISED CONCEPTUAL SITE MODEL AND EXPOSURE PATHWAYS

4.6.1 Groundwater Receptors

There is no use of local groundwater as a potable water source on either North or South Hutchinson Island and there are no known municipal water wells near the project site. A potentially complete pathway for residents, recreational users, and visitors (including contractors and County/City personnel) has been assumed for Projects 02 and 03 until verification that limited or no source of MC exists and the potential for migration to groundwater can be ruled out (*i.e.*, an incomplete pathway confirmed). Based on the SI findings, MC source areas in soil were not identified at Project 04, Project 06 and Project 07 at the Fort Pierce USNATB and due to the lack of MC source areas, the groundwater pathway is considered incomplete.

4.6.2 Surface Water Receptors

The former Fort Pierce USNATB was situated on two barrier islands, subject to coastal flooding and erosion. These islands are surrounded by the Atlantic Ocean to the east, the Indian River (a shallow tidal lagoon) to the west, and tidal inlets to the north and south that are maintained by jetties and dredging. Surface water is a potentially complete pathway for residents, recreational users, visitors (including contractors and County personnel) and biota at Projects 02 and 03. Based on the SI findings, MC source areas in soil were not identified at Project 04, Project 06 and Project 07 at the Fort Pierce USNATB and due to the lack of MC source areas, the surface water pathway is considered incomplete.

4.6.3 Soil Exposure Receptors

4.6.3.1 There is unrestricted access to much of the former Fort Pierce USNATB, which is used for residential, commercial and recreational purposes. The five projects can be accessed by residents, recreational users, County personnel, visitors and contractors. These can all be considered to be potential receptors for direct contact with the soil. Many wildlife species are found within the former Fort Pierce USNATB, including several state-designated threatened and endangered species. **Table 4-1** below provides a complete list of threatened and endangered species that may be present at the former Fort Pierce USNATB.

Table 4-1: Federal and State Listed Threatened and Endangered Species

Common Name	Scientific Name	Federal and State Status
Birds		
Wood stork	*Mycteria Americana*	FE
Florida Scrub Jay	*Aphelocoma coerulescens*	FT
Bald Eagle	*Haliaeetus leucocephalus*	FM
Reptiles		
Loggerhead Turtle	*Caretta caretta*	FT
Green Turtle	*Chelonia mydas*	FE
Leatherback Turtle	*Dermochelys coriacea*	FE
Gopher Tortoise	*Gopherus Polyphemus*	CCA/ST
Mammals		
West Indian Manatee	*Trichechus manatus*	FE
Southern Beach Mouse	*Peromyscus polionotus niveiventris*	FT

Notes:

FE = Federal Endangered
FT = Federal Threatened
FM = Federal Managed
CCA = Federal Conservation Coordination Agreement
SE = State Endangered
ST = State Threatened
SSC = State Species of Concern

4.6.3.2 Based on the SI findings, MC source areas in soil were not identified at Project 04, Project 06 and Project 07 at the Fort Pierce USNATB and due to the lack of MC source areas, the soil pathway is considered incomplete. There were no detections of explosives in any of samples. All detections of metals were below their respective human health screening levels and, at Project 06, below their respective ecological screening levels. Although antimony, lead, and zinc were detected above ecological screening values in a few surface soil samples at Project 04 and Project 07 (antimony only), further review of these detections as part of the screening-level ecological risk assessment, discussed in Section 6.2, determined that there is no source of ecological exposure to MC presenting an unacceptable risk at Projects 04 and 07. As such, all soil exposure pathways are incomplete for Projects 04, 06 and 07.

5.0 GEOSPATIAL INFORMATION AND ELECTRONIC SUBMITTALS

5.1 GPS AND GIS DATA DELIVERABLES

5.1.1 During field activities, the Trimble® GeoXH™ was utilized in conjunction with a Trimble® GeoBeacon™ to collect GPS positions during the instrument-aided visual survey and for each sample location. Coordinates were collected utilizing the GPS handheld receiver through triangulation from the transmitter satellite network. Following data collection, the GPS positions were post-processed in reference to two local GPS broadcast beacons. The corresponding longitude and latitude position for each sample location is presented in **Table E-2** in **Appendix E**. Geographic Information System (GIS) data created for this project is provided in in accordance with Data Item Description (DID) WERS-007.01 in **Appendix H**. GIS data were delivered in Environmental Systems Research Institute (ESRI) Shapefile format. A "READ.ME" file was included with delivered data, which will contain basic information about each Shapefile. All final GIS data generated from this project conform to the Spatial Data Standards for Facilities, Infrastructure and Environment.

5.1.2 The GIS database, which is maintained by the JV's GIS Manager, was used to store preliminary and final, or published, versions of project GIS data. It is the official project repository of GIS data, including unprocessed feature and attribute data sources that may be used outside the GIS. The office-based database is the main location for processing data sources into draft and final GIS products, as well as for production work.

5.1.3 Maps were plotted at an appropriate scale and have a revision block, title block, sheet layout, legend, grid lines, scale bar, and a true north arrow. In general, the direction of north runs from the bottom of the figure to the top, with no skew. The location, identification, and coordinates for the visual survey reconnaissance path walked and for each soil sample location are provided on the figures in **Appendix L**.

5.2 ELECTRONIC DOCUMENT AND OTHER FILES

All document files were delivered in Microsoft Office compatible formats. The drawing and plot data were provided in the Universal Transverse Mercator Coordinate System, North American Datum 83, and units in meters. GIS data were submitted in ESRI Arc Map-compatible format. Raster data, such as United States Geological Survey (USGS) Topographic Quadrangles or Orthophotography were provided in either Tagged Image File Format (TIFF) or MrSID format. All ArcGIS project files (.mxd) were provided to USACE with the final report. In addition to GIS data and project files, maps were delivered in portable document format for viewing without modification.

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6.0 SCREENING-LEVEL RISK ASSESSMENTS

This screening-level risk assessment presents a conservative evaluation of MC detected in soil samples collected from areas associated with the past DoD use at Projects 04, 06 and 07 within the former Fort Pierce USNATB. The assessment is based on the comparison of detected MC concentrations to screening levels considered protective of adverse human and ecological health effects and follows USEPA risk assessment guidelines. The assessment also describes the potential for exposure of human and ecological populations (termed receptors) to MC originating at the five project sites within the former Fort Pierce USNATB, through updated human health and ecological conceptual site exposure models (CSEMs, also referred to as CSMs) that illustrate constituent source areas, MC release/migration mechanisms, and potential exposure pathways and exposure routes. Concurrent evaluation of the environmental sample data and the potential for human and ecological exposure allows for an informed decision as to the potential for risk and whether further assessment is warranted. Sources of uncertainty in the screening-level risk assessment and the extent to which the potential for risk may be over- or under-stated are also discussed. All supporting tables for the screening-level risk assessment are presented in **Appendix I**. While a general lack of MC sources was determined based on the concurrence of information gathered during the SI, a screening-level risk assessment for human and ecological receptors was conducted as an additional line of evidence supporting that conclusion.

6.1 SCREENING LEVEL HUMAN HEALTH RISK ASSESSMENT

The screening-level human health risk assessment (HHRA) is consistent with *USACE Risk Assessment Handbook Vol. I: Human Health Evaluation* (EM 200-1-4). As such, the screening-level HHRA consists of data evaluation, exposure assessment, and risk screening. For the purposes of this SI, the data evaluation and risk screening steps were combined to allow for an upfront determination of COPCs in soil. These COPCs are the constituents that are detected at concentrations greater than risk-based screening levels and, therefore, may result in adverse health effects, if human exposure occurs. The exposure assessment describes the potential for human exposure to COPCs originating at the former Fort Pierce USNATB and culminates in the updated human health CSEM.

6.1.1 Data Evaluation and Risk Screening

6.1.1.1. This screening-level risk assessment is based on the analytical results of soil samples collected during the SI in November 2014. Fieldwork and environmental sampling were conducted in accordance with the final SI Work Plan (PIKA- Pirnie JV, 2014). Soil samples were analyzed for explosives and a limited list of MC (*i.e.,* antimony, copper, lead, and zinc) typically associated with small arms ammunition, which were used primarily at the Anti-Aircraft Gunnery Range (Project 07).

6.1.1.2. Laboratory analytical methods and data validation procedures were selected to meet the data quality objectives identified in the UFP-QAPP (presented as Appendix E in the final SI Work Plan). Measurement performance criteria evaluated during validation include precision, accuracy,

representativeness, comparability, detection limit verification, and completeness. As shown on the validation reports, overall the data are of acceptable quality, subject to the data validator's qualifying marks. Data assigned other qualifiers (*e.g.*, indicating the numerical value is an estimated quantity) were treated the same as data without such qualifiers.

6.1.2 COPCs in Soil

Soil data are available from surface samples (*i.e.*, 0-0.5 feet below ground surface) collected from Projects 04, 06, and 07. Soil sample locations are shown on **Figures L-11**, **L-12** and **L-13** in **Appendix L**. A total of 20 surface soil samples, plus three duplicate samples, were submitted for laboratory analysis to the primary analytical laboratory. Fifteen samples (plus two duplicate samples) were analyzed for explosives. Ten samples (plus two duplicate samples) were analyzed for metals. Soil samples from Project 06 were only analyzed for explosives, which were not detected. Therefore, the potential for risk to human receptors from exposure to MC in soil at Project 06 is unlikely. **Table I-1** in **Appendix I** presents a surface soil data summary for detected MC across Projects 04 and 07, including frequency of detection and the range of detected MC concentrations. In summarizing the soil data, duplicate sample results were averaged with those of the corresponding parent sample. A risk-based screen of detected MC concentrations was implemented, using the FDEP Soil Cleanup Target Levels (SCTLs) for Residential Direct Exposure (Chapter 62-777, F.A.C.). Chemicals with maximum detected concentrations greater than risk-based screening levels were selected as COPCs. Based on this approach, no MCs were identified as COPCs in soil.

6.1.3 Exposure Assessment

6.1.3.1. The objective of the screening-level exposure assessment is to establish the assumptions regarding the potential for human exposure to MC originating at Projects 04, 06, and 07. As described previously, Projects 02 and 03 were not included in the screening level risk assessment since no field investigation was conducted for these Projects and, while MEC and MD are unlikely to be found, a RI/FS will be recommended for both. The potential for exposure is described by the human health CSEM (**Figures J-1** through **J-4** in **Appendix J**), which illustrates constituent source areas, the source medium and potential exposure media, release and transport mechanisms, and exposure routes for potential human receptor populations (described in more detail below). For an exposure pathway to be complete, all of the following elements must be present: a source and mechanism of constituent release, a retention and/or transport medium, a point of contact with the exposure medium, and an exposure route at the contact point. If any one of these elements is missing, the pathway is considered incomplete.

6.1.3.2. The human health CSEM is based on the current and most likely future land uses at Projects 04, 06, and 07 at the former Fort Pierce USNATB. There is unrestricted access to much of the former Fort Pierce USNATB, which is used for residential, commercial, and recreational purposes. The three Projects can be accessed by residents, recreational users, County personnel, visitors and contractors. These can all be considered to be potential receptors for direct contact with the soil.

6.1.3.3. The historical munitions-related use of Projects 04, 06, and 07 were as follows:

- Project 04 – Headquarters for underwater demolition units; included an ammunition storage bunker. The SI focused on investigation of the area where the former ammunition storage bunker was located.
- Project 06 – Possible bombing range with interpreted pock marks on historical aerial imagery. Investigation focused on areas correlating to historical pock marks.
- Project 07 – Multiple use range, including small arms and anti-aircraft artillery. Investigation focused on the former location of the ordnance storage bunker.

6.1.3.4. The primary exposure medium is surface soil associated with the focus areas at each Project. Primary release mechanisms constitute soil disturbance that may cause redistribution of MC in soil. The current degree of soil disturbance is low. Release mechanisms from soil currently and in the future include surface runoff, infiltration/percolation of precipitation through soil, leaching from soil to groundwater, and uptake of MC into plants and invertebrates in direct contact with soil.

6.1.3.5. Based on the current and most likely future land uses at Projects 04, 06, and 07 at the former Fort Pierce USNATB, the following potential human receptor populations and exposure pathways were identified:

- Current/Future Recreationists (adults and children) - who may access the Project areas sampled while hiking through the area or otherwise recreating. Potential exposure pathways and routes of exposure include incidental ingestion of and dermal contact with constituents in surface soil, as well as inhalation of wind-generated respirable particulates emitted from surface soil to outdoor air.

- Current/Future Outdoor Site Workers (adults) - including County personnel or contractors who may access the Project areas for maintenance purposes, biological surveys, or for future development. Potential exposure pathways and routes of exposure include incidental ingestion of and dermal contact with COPCs in surface soil, as well as inhalation of wind- or mechanical-generated respirable particulates emitted from surface soil to outdoor air.

- Future Residents (adults and children) - who may be exposed to constituents originating at the Projects through contact with surface soil and shallow groundwater drawn from off-site wells used for irrigation. Under a future residential development scenario, potential exposure pathways and routes of exposure for surface soil include incidental ingestion of and dermal contact with COPCs in surface soil, as well as inhalation of wind-generated respirable particulates emitted from surface soil to outdoor air. Although the groundwater pathway is really considered incomplete since there is no use of local groundwater as a potable water source on either North or South Hutchinson Island and there are no known municipal water wells near the project site, this pathway was evaluated in relation to the FL SCTLs for leachability as a verification and to rule out this pathway.

6.1.3.6. The former Fort Pierce USNATB was situated on two barrier islands, subject to coastal flooding and erosion. These islands are surrounded by the Atlantic Ocean to the east, the Indian River (a shallow tidal lagoon) to the west, and tidal inlets to the north and south that are maintained by jetties and dredging. Human contact with surface water and sediment is a potentially complete pathway for residents, recreational users, visitors (including contractors and County personnel) and biota. Although surface water and sediment were not investigated during the SI, further investigation of these media is not warranted based on the results of the SI.

6.1.4 Risk Characterization

Based on the comparison of maximum detected constituent concentrations to human health risk-based screening levels, no COPCs were identified in soil. Therefore, potential human exposure to detected MC is not expected to result in adverse health effects at Projects 04, 06, and 07. Further assessment on the basis of the potential for human health risk is not warranted.

6.2 SCREENING-LEVEL ECOLOGICAL RISK ASSESSMENT

The SLERA is consistent with Steps 1 and 2 of the USEPA's *Ecological Risk Assessment Guidance for Superfund* (ERAGS) (USEPA, 1997) and also with the *USACE Risk Assessment Handbook Vol. II: Environmental Evaluation* (EM 200-1-4). The SLERA consists of problem formulation and screening-level exposure estimate and risk calculation. Problem formulation establishes the environmental setting, identifies COPEC in soil and shallow groundwater, and describes the potential for exposure of ecological receptors to COPECs originating at Projects 04, 06, and 07 at the former Fort Pierce USNATB based on the CSEM presented in **Figures J-3** and **J-4** in **Appendix J**. The screening-level exposure estimate and risk calculation evaluates the potential for ecological risk in terms of a HQ, which is the ratio of a conservative exposure estimate to a constituent-specific toxicity reference value (TRV). HQs greater than 1 indicate a potential for ecological risk.

6.2.1 Problem Formulation

Problem formulation serves to establish the goals, breadth, and focus of the SLERA (USEPA, 1997). It is based on the current understanding of the Project areas and immediately surrounding areas, as well as information collected during the SI.

6.2.1.1 Environmental Setting

6.2.1.1.1. The former Fort Pierce USNATB was situated on two barrier islands, North and South Hutchinson Islands. Barrier islands are unstable landforms subject to coastal flooding and erosion. These islands are surrounded by the Atlantic Ocean to the east, the Indian River (a shallow tidal lagoon) to the west, and tidal inlets north and south that are maintained by jetties and dredging.

6.2.1.1.2. The surrounding terrain is level, and consists of sandy beaches and dense coastal vegetation. Surface water runoff within the former Fort Pierce USNATB drains either west into the Indian River, east into the Atlantic Ocean, or infiltrates into the sand. The site is periodically

flooded by tropical storm and hurricane-induced storm surges. Project 07 lies adjacent to Blind Creek.

6.2.1.1.3. Potential ecological habitat within Projects 04, 06, and 07, and in the general vicinity of the former Fort Pierce USNATB, is a mix of tidal wetlands, interspersed with upland beach and dune communities. Mangroves dominate the near-shore areas along the Indian River.

6.2.1.1.4. Flora at the former Fort Pierce USNATB include morning glory (*Ipomoea sagittata Poir.*), sea oats (*Uniola paniculata*), sea purslane (*Sesuvium* sp.), and beach elder (*Iva imbricate*), all of which typically dominate the dune areas. Palm trees and sea grape (*Coccoloba uvifera*) are also present along and inland from the dunes.

6.2.1.1.5 Many wildlife species are found within the former Fort Pierce USNATB, including several State-designated threatened and endangered species. Listed bird species for which potential habitats are present include the Florida scrub jay (*Aphelocoma coerulescens*), bald eagle (*Haliaeetus leucocephalus*), and wood stork (*Mycteria Americana*). Mammal species listed and potentially present include the aquatic West Indian Manatee (*Trichechus manatus*) and the southeastern beach mouse (*Peromyscus polionotus niveiventris*). A variety of reptiles occur in the area, with the principal concern being for marine turtles, such as the Loggerhead (*Caretta caretta*), Green Turtle (*Chelonia mydas*), and Leatherback Turtle (*Dermochelys coriacea*), which would be present in nearby waters and would use the beach and beach dune communities for nesting. There is also potential habitat present for the gopher tortoise (*Gopherus polyphemus*). Other ecological receptors include mammals, reptiles, amphibians, birds and insects that naturally occur on or traverse the sites.

6.2.1.2 COPECs in Soil

COPECs in soil were identified by evaluating the surface soil data set described above for the screening-level HHRA. Soil samples from Project 06 were only analyzed for explosives, which were not detected. Therefore, the potential for adverse health effects in ecological receptors associated with exposure to MC in soil at Project 06 is unlikely. A risk-based screen of detected MC concentrations at Projects 04 and 07 was implemented, using the lowest of available constituent-specific Eco-SSLs (USEPA, 2013) as ecological risk-based screening levels. Chemicals with maximum detected concentrations greater than risk-based screening levels were selected as COPECs. As shown in **Table I-2** in **Appendix I**, based on this approach, antimony, lead, and zinc were identified as COPECs in soil at Project 04. As shown in **Table I-3** in **Appendix I**, based on this approach, antimony was the only identified COPEC in soil at Project 07.

6.2.2 Screening-Level Exposure Estimate and Risk Calculation

The potential for adverse ecological effects from exposure to COPECs in soil (*i.e.,* antimony, copper, and lead) was evaluated by calculating the ratio (termed the HQ) of the COPEC exposure estimate to a constituent-specific TRV. As the ecological risk-based screening levels used to identify COPECs represent conservative thresholds for adverse ecological effects (USEPA, 1997), including bioaccumulative potential, they were also used as corresponding TRVs. An HQ

greater than 1 indicates that exposure to the COPEC may cause adverse effects, while an HQ of 1 or less indicates that the COPEC is unlikely to pose ecological risk.

6.2.2.1 Exposure Estimate

6.2.2.1.1. For the purposes of this SI, conservative estimates of exposure were used. These are the maximum detected MC concentrations. Where the HQ calculated using the maximum concentration was greater than 1, an alternate exposure estimate was calculated as the 95% upper confidence limit (UCL) on the arithmetic average concentration. The 95% UCL concentration provides reasonable confidence that the true average will not be under-estimated.

6.2.2.1.2. The ProUCL® v.5.0.00 (ProUCL) program developed by USEPA's Technology Support Center for Monitoring and Site Characterization was used to test the distribution of each data set and calculate 95% UCL concentrations. When entering data into ProUCL, if a COPEC was not detected in a sample, the sample quantitation limit (SQL) was entered as a proxy concentration and the sample result was coded as non-detect. ProUCL contains rigorous parametric and nonparametric statistical methods that can be used on full or uncensored data sets and on data sets with below detection limit observations (also called left-censored data sets). Depending on the distribution and 95% UCL estimation method, ProUCL will use only detected data or will incorporate detection limits (USEPA, 2013). ProUCL output is presented in **Appendix I**.

6.2.2.2 Risk Calculation

6.2.2.2.1. **Table I-4** in **Appendix I** presents the ecological risk calculation for soil at Project 04. As shown, the HQs based on the maximum detected antimony, lead, and zinc concentrations are 1, 3, and 1. A 95% UCL concentration was not calculated for antimony or zinc, as the HQs calculated using the maximum detected concentration were not greater than 1, indicating adverse ecological health effects from exposure to antimony and zinc are unlikely. The 95% UCL concentration for lead is 21 mg/kg, compared to the maximum concentration of 30.4 mg/kg. In the screening-level risk calculation, the alternate exposure concentration of 21 mg/kg for lead results in an HQ of 2. However, there are only five values with which to calculate a 95% UCL and the data are skewed high due to the isolated lead detection above screening criteria, creating significant uncertainty in calculating a representative exposure point concentration. The arithmetic average concentration of 10 mg/kg for lead results in an HQ of 1; indicating adverse ecological health effects from exposure to lead are unlikely. In addition, lead is a naturally-occurring element in soils in concentrations generally ranging from 1 to 10 mg/kg in FL. However; there are areas in the state where natural lead concentrations are identified above 10 mg/kg (Ma, et al, 1999). It is likely that additional sampling of surface soil at Project 04 would indicate the concentration of 30.4 mg/kg represents the high end of variability in a data set representative of background. Additionally, the area of interest at Project 04 was the former location of an ammunition storage bunker. The isolated, low-level lead detection is not likely the result of any military activities as no small arms were deployed at the sample location and lead, in any significant quantity, would not have been a component of the munitions typically stored.

6.2.2.2.2 **Table I-5** in **Appendix I** presents the ecological risk calculation for soil at Project 07. As shown, the HQ based on the maximum detected antimony concentration is 3. A 95% UCL concentration was not calculated for antimony, as antimony was only detected in one of the five samples at Project 07. In addition to being detected infrequently, antimony was also detected within the range of background for eastern U.S. soils as shown in **Table I-5**. The USEPA acknowledges that the Eco-SSL for antimony of 0.27 mg/kg is below the range of background values reported in typical U.S. soils (USEPA, 2005). Therefore, the maximum concentration (0.722 mg/kg) is not representative of exposure to antimony in soil across Project 07 and likely represents background conditions.

6.2.2.2.3 Based on the results of the SLERA, no further assessment of antimony, lead, or zinc in soil is warranted at Projects 04 or 07.

6.3 CHARACTERIZATION OF UNCERTAINTY

6.3.1. A basic assumption underlying this screening-level risk assessment is that the soil data adequately characterize environmental conditions and the potential for constituents to be present. However, there are always some uncertainties associated with environmental sampling and analysis. Uncertainty associated with environmental sampling is generally related to limitations in terms of the number and distribution of samples, while uncertainty associated with the analysis of samples is generally due to systematic or random errors (*i.e.*, false positive or negative results). Efforts to minimize uncertainty were made by collecting and analyzing soil and groundwater samples in accordance with the UFP-QAPP and by independently validating the analytical data. Due to the nature of the Projects and the sampling design, only a few samples were collected at Projects 04, 06, and 07. Based on these small data sets, there is uncertainty in calculating a representative 95% UCL and also in characterizing data relative to published regional background values for metals.

6.3.2. For the purposes of identifying COPCs/COPECs, this screening-level risk assessment conservatively assumes human and ecological exposure is to maximum detected MC concentrations in surface soil. This approach likely over-states the potential for exposure, as MC are not likely present at maximum concentrations throughout the areas of Projects 04, 06, and 07 at the former Fort Pierce USNATB. In calculating ecological HQs for lead, both maximum and 95% UCL concentrations were used as estimates of exposure. The 95% UCL concentration is an arithmetic average concentration and is likely to be overly conservative and not representative of overall site conditions.

6.3.3. Lastly, toxicity values used to derive the risk-based screening levels can result in the potential for human and ecological risk being over- or under-stated to an unknown degree. Human health toxicity values are generally derived by extrapolating from laboratory animal data to humans. Uncertainty factors are typically applied to avoid under-estimating the potential for adverse health effects. The Eco-SSLs were intentionally derived to be conservative in order to provide a level of protection to terrestrial ecosystems and wildlife, balanced with reasonableness,

under which unacceptable adverse effects are unlikely to occur. In order to make the Eco-SSLs for avian and mammalian wildlife protective of local populations, they were derived to represent the conservative end of the exposure distribution (*e.g.,* high-end food ingestion rates). Other conservative assumptions in the derivation of the Eco-SSLs for wildlife, which lend to the potential for risk being over-stated, include: surrogate species reside and forage exclusively at the contaminated site, bioavailability of the chemical in soil or food was assumed to equal the bioavailability in the laboratory study upon which the Eco-SSL was based, and each wildlife species consumes only one food source.

6.3.4. While reptiles and amphibians are identified as potential ecological receptors, the potential for adverse effects on reptile and amphibian populations was not evaluated quantitatively due to the general lack of readily available ecological screening values (due to the lack of information on metabolism and toxicity in these potential receptors). Amphibians are known to be sensitive indicator species for stressors in the environment. The potential for adverse effects to these receptors at the former Fort Pierce USNATB is unknown. However, given the relatively low levels of metals detected and their limited distribution across the site, as described previously, an MC source is not present at Projects 04, 06, and 07. Therefore, it is unlikely that reptiles and amphibians would be adversely impacted by historical munitions use at the Project areas.

6.4 CONCLUSIONS AND RECOMMENDATIONS

6.4.1. Based on the comparison of maximum detected constituent concentrations to human health risk-based screening levels, no COPCs were identified in surface soil at Project 04, 06, and 07. Therefore, potential human exposure to detected MC is not expected to result in adverse health effects. Further assessment on the basis of the potential for human health risk is not warranted.

6.4.2. Based on the comparison of maximum detected constituent concentrations to ecological risk-based screening levels, no COPECs were identified in surface soil at Project 06. Antimony, lead, and zinc were identified as COPECs in surface soil at Project 04 and antimony was identified as a COPEC in surface soil at Project 07. The initial screening-level risk calculations indicate there may be a potential for risk from exposure to maximum concentrations of lead at Project 04 and of antimony at Project 07. However, in the screening-level risk calculation, the arithmetic average concentration of 10 mg/kg for lead results in an HQ of 1, indicating adverse ecological health effects from exposure to lead are unlikely. Lead is a naturally-occurring element in soils and is often present in concentrations generally ranging from 1 to 10 mg/kg or greater in FL (Ma, et al, 1999). Also, antimony was infrequently detected (1/5) in soil at Project 07 and was also detected within the range of background for eastern U.S. soils. The USEPA acknowledges that the Eco-SSL for antimony of 0.27 mg/kg, which is the value protective of exposure to mammals, is below the range reported in typical U.S. soils (USEPA, 2005). Therefore, the maximum concentration (0.722 mg/kg) is not representative of exposure to antimony in soil across Project 07 at the former Fort Pierce USNATB and likely represents background conditions. The HQs for antimony and zinc based on the maximum concentrations

at Project 04 were not greater than 1. Based on the results of the SLERA, no further assessment of antimony, lead, or zinc in soil is warranted at either Project 04 or Project 07.

6.4.3 No MEC or MD was discovered during the visual survey. No evidence of military activity was observed. Since no MEC or MD was observed at the Project areas, no MC source was identified and this further supports the screening-level risk assessment findings.

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7.0 SUMMARY AND CONCLUSIONS

7.1 PROJECT 04, PROJECT 06, AND PROJECT 07

7.1.1. Observations made during the instrument-assisted visual reconnaissance did not identify any MEC or MD at Projects 04, 06 and 07. As such, there is no evidence of munitions-related activities remaining at these Project areas. The former bunkers have been demolished and removed and there is no evidence of munitions use, storage, or disposal.

7.1.2. A total of 20 surface soil samples were collected from Project 04 (5 samples), Project 06 (10 samples), and Project 07 (5 samples). Three duplicate samples and two split samples were also collected. The samples were collected and analyzed in accordance with the Final SI Work Plan and FDEP SOPs. The soil samples were analyzed for explosives and select metals (lead, copper, antimony, and zinc) by DoD-certified analytical laboratories.

7.1.3. The laboratory analytical data was found to be of acceptable quality by the third-party validator and met the data quality objectives identified in the UFP-QAPP. The data collected were determined to be meaningful and usable for the SIs at Projects 04, 06 and 07.

7.1.4 There were no detections of explosives in any of the samples. All detections of metals were below their respective human health screening levels. Based on the comparison of maximum constituent concentrations to human health risk-based screening levels, no COPCs were identified in soil. Therefore, there is no source of human exposure to MC originating at Projects 04, 06 and 07, and the soil exposure pathways are incomplete. Further assessment on the basis of the potential for human health risk is not warranted.

7.1.5 Based on the comparison of maximum detected constituent concentrations to ecological risk-based screening levels, antimony, lead, and zinc were identified as COPECs in surface soil at Project 04 and antimony was identified as a COPEC in surface soil at Project 07. However, further review of these detections as part of the screening-level ecological risk assessment, discussed in Section 6.2, determined that there is no source of ecological exposure to MC originating at Project 06 and no source of ecological exposure to MC presenting an unacceptable risk at Projects 04 and 07. As such, the soil exposure pathways are incomplete. Further assessment on the basis of the potential for ecological risk is not warranted.

7.1.6 Based on the SI findings from the instrument-assisted visual reconnaissance and the soil sample analytical data, there is no unacceptable risk to human and ecological receptors at Projects 04, 06 and 07 and NDAI is recommended for these three sites.

7.2 PROJECT 02

The findings for the SI for Project 02 are based on evidence of MEC presence in historical documents. While there is no evidence of ordnance storage, ordnance-related operations were conducted along the eastern boundary of the site between 1943 and 1945. Land mines and bombs have historically been identified within Project 02. According to the INPR, although clearance and removal actions have occurred, as well as extensive development, MEC and MD

could be found during excavation activities, as well as through oceanic disturbances and following storms, such as hurricanes and tropical storms (*e.g.*, beach erosion during storms). Therefore, it is recommended that Project 02 proceed to the RI/FS phase.

7.3 PROJECT 03

As with Project 02, the findings for the SI for Project 03 are based on historically documented MEC presence. While there is little documented evidence of munitions storage, use, or disposal, and the mission of this unit is not clearly delineated in historical documentation, its designation indicates that ordnance use was likely. Munitions and MD have been discovered in this area since WWII. High explosive munition items have been found in the area and, in 1952, military obstacles and debris were removed. A dragline operator was killed in the 1960s by impacting an unexploded device at Avalon State Park. In the 1990s, a rocket warhead, 2.5-foot long bomb, and nine pounds of high explosives were found and removed. According to the INPR, although clearance and removal actions have occurred, as well as extensive development, MEC and MD may potentially be found periodically during excavation activities, as well as through oceanic disturbances and following storms, such as hurricanes and tropical storms (*e.g.*, beach erosion during storms). Therefore, it is recommended that Project 03 proceed to the RI/FS phase.

8.0 REFERENCES

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29 CFR 1910.120, Occupational Safety and Health Standards, Hazardous Materials, "Hazardous Waste Operations and Emergency Response."

40 CFR 300.415, "National Oil and Hazardous Substances Pollution Contingency Plan (NCP)."

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