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FINAL

FEASIBILITY STUDY REPORT

FOR

OPEN DETONATION GROUNDS MUNITIONS RESPONSE ACTION

SENECA ARMY DEPOT ACTIVITY
ROMULUS, SENECA COUNTY, NEW YORK

Prepared for:

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Contract Number W912DY-08-D-0003
Task Order No. 0013
EPA Site ID# NY0213820830
NY Site ID# 8-50-006

~~SEPTEMBER~~ APRIL 201~~5~~6

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LIST OF ACRONYMS

2,4-DNT	2,4-dinitrotoluene
AOI	Area of Interest
ARAR	Applicable or Relevant and Appropriate Requirements
Army	U.S. Army
AWQS	Ambient Water Quality Standards
BIP	Blow in Place
BRAC	Base Realignment and Closure
CD	Cultural Debris
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	Chemicals of Potential Concern
CWA	Clean Water Act
CY	Cubic Yards
DGM	Digital Geophysical Mapping
DMM	Discarded Military Munitions
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
ECL	Environmental Conservation Law
EE/CA	Engineering Evaluation and Cost Analysis
EM	Electromagnetic
EP	Extraction Procedure
EPA	Environmental Protection Agency
ESI	Expanded Site Investigation
ESQD	Explosive Safety Quantity-Distance
FS	Feasibility Study
GA	Classification: The best usage of Class GA waters is as a source of potable water supply. Class GA waters are fresh groundwaters.
GPR	Ground Penetrating Radar
HA	Hazard Assessment
HASP	Health and Safety Plan
HE	High Explosive
HEAT	High Explosive Anti-Tank
HFD	Hazardous Fragment Distance
HHRA	Human Health Risk Assessment
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
LORAN	Long-Range Navigation
LPS	Low Permeability Soil
LRA	Local Redevelopment Authority

LTM	Long Term Monitoring
LUC	Land Use Control
MCL	Maximum Contaminant Level
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
mg/kg	milligrams per kilogram
mg/L	milligrams per Liter
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Site
MSL	Mean sea level
mV	Millivolt
MW	Monitoring Well
N/A	Not Applicable
NCP	National Contingency Plan
NFA	No Further Action
NRC	Nuclear Regulatory Commission
NTU	Nephelometric Turbidity Unit
NYCRR	New York Code of Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and Maintenance
OB	Open Burning
OD	Open Detonation
OE	Ordnance Explosive
OSHA	Occupational Safety and Health Act
OSWER	Office of Solid Waste and Emergency Response
Parsons ES	Parsons Engineering Science, Inc.
PCB	Polychlorinated Biphenyl
ppm	parts per million
QC	Quality Control
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSL	Regional Screening Levels
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SCIDA	Seneca County Industrial Development Agency

SCO	Soil Cleanup Objective
SEAD	Seneca Army Depot (old name)
SEDA	Seneca Army Depot Activity
SPDES	State Pollutant Discharge Elimination System
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semivolatile Organic Compound
SW	Surface water
SWMU	Solid Waste Management Unit
TAGM	Technical and Administrative Guidance Memorandum
TAL	Total Analyte List
TBC	To Be Considered
TCL	Target Compound List
TCLP	Toxicity Characteristics Leaching Procedure
TP	Test Pit
TPV	Total Present Value
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
USACE	United States Army Corps of Engineers
USC	United States Code
UXO	Unexploded Ordnance
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compound
WP	White Phosphorus

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EXECUTIVE SUMMARY

Parsons, on behalf of the U.S. Army (Army), is submitting this Feasibility Study (FS) Report for the Open Detonation (OD) Grounds (SEAD-006-R-01) (formerly SEAD-45 and SEAD-115) located at the Seneca Army Depot Activity (SEDA) in Romulus, New York. This FS considers the nature and extent of impacts that have been characterized during previous investigations, including the Site Investigation, Ordnance Explosive Engineering Evaluation and Cost Analysis (OE EE/CA), Phase I and Phase II OE Removal and Supplemental Munitions Response. This report is part of the Remedial Investigation/Feasibility Study (RI/FS) process required for compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986. SEDA has officially been closed by the Department of Defense (DoD) and the Army since its historic mission was ceased in 2000. This document has been prepared for the US Army Corps of Engineers (USACE), Huntsville District, under Contract No. W912DY-08-D-0003, DO 0013, Task Order No. 0013.

Based on the previous site investigations, it was determined that the OD Grounds requires further action. This FS presents the remedial action alternatives that were developed in accordance with the Guidance for Conducting RI/FS under CERCLA (EPA/540/G-89/004, 1988). Three alternatives were developed and evaluated using the U.S. Environmental Protection Agency (EPA)'s nine evaluation criteria for the OD Grounds. These alternatives are:

- Alternative 1: No Further Action (NFA)
- Alternative 2: Geophysical mapping, intrusive investigation, capping, and land use controls (LUCs)
- Alternative 3: Geophysical mapping, intrusive investigation, excavation, off-site disposal, and LUCs

Alternative 1, NFA, is included for comparative purposes and is the baseline for the other alternatives; the detailed analysis of this alternative identified no reduction in current risk for Alternative 1. Alternatives 2 and 3 are similar, with the following difference: under Alternative 2, soils near the OD Hill would be capped and under Alternative 3 soils near the OD Hill would be excavated, processed, and disposed off-site. The munitions and explosives of concern (MEC) Hazard Assessment (HA), which was completed as part of this FS Report, demonstrates that both Alternatives 2 and 3 are similarly protective and limit the exposure pathway to possible material potentially presenting an explosive hazard (MPPEH). The human health risk assessment (HHRA) identified risk due to exposure to groundwater for multiple receptors, and exposure to soil for the residential receptor; both Alternatives 2 and 3 would effectively eliminate the pathway for future receptors to be exposed to potential munitions constituents (MC) and MPPEH in site media. Alternative 3 rates more favorably for permanence and volume reduction and Alternative 2 rates more favorably for implementability. The cost of Alternative 3 is substantially higher than the cost of Alternative 2. The capital cost of Alternative 2 is $8.0M, with a present worth value over 30 years of $8.9M. The capital cost of Alterative 3 is $27.6M, with a present worth value of $28.0M.

The implementation of Alternative 2 would include the following elements:

- Reacquire and intrusively investigate selected anomalies from previous digital geophysical mapping (DGM) efforts (generally located in areas greater than 500 ft from the OD Hill); all identified MPPEH will be handled and managed appropriately by trained personnel.
- Mag and dig operations with a handheld magnetometer, such as a Schonstedt, in areas that are not accessible for DGM surveys (predominantly areas located greater than 500 ft from the OD Hill).
- Impacted areas (close to the OD Hill) – Conduct an initial DGM survey in this area. For areas where the DGM and sampling data indicate that the soil is impacted, the surface soil will be excavated (exact depth to be determined, but assume 1.5 feet bgs or until impacts are no longer detected) and consolidated on the OD Hill. Subsequently, a DGM survey and confirmation sampling will be conducted over the area that was excavated to confirm that the impacts were removed. Based on results, additional areas may be excavated (if impacts persist) or point/polygon anomalies will be identified, reacquired and intrusively investigated.
- Design and construction of an engineered cap at least 18 inches thick to cover contaminated soils at the OD Hill area. Excavated soil will be placed on the OD Hill under the cap. The cap will comply with applicable requirements of New York State (NYS) Part 360 requirements for leaving waste in-place and the applicable screening criteria outlined in Part 375.6-7 (d)(1)(ii)(b).
- It is not anticipated that groundwater is a medium of concern, but the water quality will be evaluated following completion of the construction as part of the remedial action.
- LUCs will be placed on the Site to prohibit the use of groundwater, prohibit digging, and prevent the use of the Site for use as a daycare or a residential facility.
- Long-term monitoring (LTM) will be conducted to monitor and maintain the cap.
- A five-year review will be conducted.

Implementation of Alternative 2 would result in shrinking the size of the area of concern; under the alternative, the Army will have removed MPPEH and impacted soil from nearly the entire 385 acre OD Grounds, and installed a cap covering approximately 7 to 10 acres of the site.

Implementation of this alternative would be highly effective in achieving the Remedial Action Objectives (RAOs), long-term effectiveness, preventing exposure, and implementability. The costs for this alternative are moderate.

1.0 INTRODUCTION

1.1 PURPOSE AND ORGANIZATION OF REPORT

Parsons, on behalf of the Army, is submitting this FS Report for the OD Grounds located at the SEDA in Romulus, New York. This report is part of the RI/FS process required for compliance with CERCLA and SARA. The RI/FS at OD Grounds is being performed under the guidance of the EPA, EPA Region II, and the New York State Department of Environmental Conservation (NYSDEC). This document was prepared for the USACE, Huntsville District, under Contract No. W912DY-08-D-0003, DO 0013, Task Order No. 0013.

Several characterization efforts and investigations for MPPEH and impacted soils were conducted at the OD Grounds and were summarized in the following documents:

- Expanded Site Investigation (ESI) for Seven High Priority Solid Waste Management Units (SWMU) SEAD 1, 16, 17, 24, 25, 26, 45, Seneca Army Depot (Engineering Science, Inc, December 1995);
- Final Ordnance and Explosives Engineering Evaluation/Cost Analysis Report (OE EE/CA), Seneca Army Depot (Parsons ES, February 2004);
- Final Site Specific Project Report SEAD 45/115 Open Detonation Grounds Ordnance and Explosives Removal Phase I Geophysical Survey and Cost Estimate, Seneca Army Depot (Weston, March 2005);
- Draft Phase II Ordnance and Explosives Removal Report (Weston, March 2006); and
- Additional Munitions Response Site (MRS) Investigation Report, Seneca Army Depot (Parsons ES, May 2010).

These reports serve as the basis to characterize the nature and extent of operational impacts and to assess human health and environmental risks at the OD Grounds. A human health risk assessment (HHRA) and a MEC HA were both completed as part of the FS, and they are used to evaluate the existing and residual risk at this Site. This FS considers the nature and extent of impacts that were characterized in these documents, evaluates remedial action alternatives, and selects the most appropriate remedy for the OD grounds. This report is organized in accordance with the Guidance for Conducting RI/FIs under CERCLA (EPA, 1988).

Section 1 provides a brief overview of the characterization efforts, including background information, nature and extent of contamination, a summary of the HHRA, and a sum the MEC HA. **Section 2** presents the remedial action objectives (RAO) for each medium of concern and considers general response actions that meet the remedial objectives. **Section 3** evaluates the alternatives for each medium by preliminary screening to determine their relative merits for use in the remedial action. **Section 4** evaluates the remedial action alternatives in detail and provides the basis for selection of the remedy for the OD Grounds.

1.2 OD GROUNDS BACKGROUND

1.2.1 OD Grounds Description

The SEDA is located approximately 40 miles south of Lake Ontario, near Romulus, New York as shown in **Figure 1-1**. The facility is located in an uplands area, at an elevation of approximately 600 feet mean sea level (MSL), that forms a divide separating two of the New York Finger Lakes; Cayuga Lake on the east and Seneca Lake on the west. Sparsely populated farmland covers most of the surrounding area. NYS Highways 96 and 96A adjoin SEDA on the east and west boundaries, respectively.

The SEDA previously occupied approximately 10,600 acres of land located in the Towns of Varick and Romulus in Seneca County, New York. The former military facility was owned by the U.S. Government and operated by the Army between 1941 and approximately 2000, when the SEDA military mission ceased. The SEDA's historic military mission included receipt, storage, distribution, maintenance, and demilitarization of conventional ammunition, explosives, and special weapons. In 1995, the SEDA was designated for closure under the DoD's Base Realignment and Closure (BRAC) process. With the SEDA's inclusion on the BRAC list, the Army's emphasis expanded from expediting necessary investigations and remedial actions at prioritized SWMUs to including the release of non-affected portions of the Depot to the surrounding community so that the land can be reused for non-military purposes (i.e., industrial, municipal, and residential). Since the inclusion of the SEDA in the BRAC program, approximately 8,000 acres were released to the community. An additional 250 acres of land were transferred to the U.S. Coast Guard for continued operation of a long-range navigation (LORAN) station.

The OD Grounds Site is located in the northwestern corner of the Depot in Seneca County, New York and is also known as SEAD-006-R-01 (formerly SEAD-45 and SEAD-115). The Site, shown in **Figure 1-2**, is largely meadow with some wooded and heavily brushed areas. The OD Grounds consists of 385 acres and was used to perform open detonation and burning of munitions. This acreage includes the area surrounded by a 2,500-foot radius centered around the OD Hill. Note that the Open Burning (OB) Grounds (also known as SEAD-23) is a separate site that was previously addressed and is not included in the calculation of the OD Grounds acreage. For ease of discussion in this FS, two different portions of the OD Grounds Site were identified. They are referred to as the "Kickout Area" and the "OD Hill Area". The OD Hill Area is the location of demolition activities. The Kickout Area is the area in which blast fragments emanating from the OD Hill activity are expected to land. The boundaries of these areas are defined on **Figure 1-2**.

Access into the greater OD Grounds demolition area is possible via a paved road that enters the area from the southeast and roughly parallels the path of Reeder Creek along its western bank. The unnamed access road branches off North-South Baseline Road near Building 2104, which is located in the southeastern corner of the OD Grounds (**Figure 1-2**). Building 2104 was built in 1951 and is described as "Change House (OB/OD Grounds)". The building is not included in any lists of structures with potential unexploded ordnance (UXO) hazards or in which potentially hazardous materials were stored (Woodward-Clyde, 1997). A change house is a location for military personnel to change clothes and uniforms.

1.2.2 Future Land Uses

CERCLA guidance, Land Use in the CERCLA Remedy Selection Process, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-04, directs decision makers to achieve cleanup levels associated with the reasonably anticipated future land use over as much of the Site as possible. As part of the 1995 BRAC process, a Local Redevelopment Authority (LRA) comprised of representatives from the local community was established. DoD policy described in Responsibility for Additional Environmental Cleanup after Transfer of Real Property also states that "For BRAC properties, the LRA's redevelopment and land use plan, will be the basis for the land use assumptions DoD will consider during the remedy selection process." A Land Reuse Plan was prepared and approved by the LRA in 1996 which designated parcels of land within the Depot for reuse into eight categories: Planned Industrial/Office Development, Warehousing, Prison, Conservation/Recreation, Institutional, Housing, Airfield/Special Events, and Federal to Federal Transfer. The area that encompasses the OD Grounds was determined to be "Conservation/Recreation Area". In 2005, the Seneca County Industrial Development Agency (SCIDA) revised the planned future use of property within the former Depot and added Institutional Training, Residential/Resort, Green Energy, Development Reserve, Training Area, and Utility uses. Under this revised future use plan, the OD Grounds is located in the "Conservation/Recreation" parcel of the former Depot (**Figure 1-3**). The planned future use for OD Grounds is for conservation and passive recreational purposes where there is a limited potential for soil contact. Passive recreation refers to a use of the land where there is a limited potential for soil contact (e.g., does not include playgrounds or ballparks, but would include hiking or nature trails). In addition to the consideration of future land use during the remedy selection process, NYS regulations, New York Code of Rules and Regulations (NYCRR) Title 6, Chapter IV, Subchapter B, Part 375, Subpart 375-2.8 Remedial Program, requires evaluation of remedies that will restore the site conditions to "pre-disposal conditions to the extent feasible." (NYSDEC, 2013a)

1.2.3 Geological Setting

The Finger Lakes uplands area is underlain by a broad north-to-south trending series of rock terraces mantled by glacial till. As part of the Appalachian Plateau, the region is underlain by a tectonically undisturbed sequence of Paleozoic rocks consisting of shales, sandstones, conglomerates, limestones and dolostones. In the vicinity of SEDA, Devonian age (approximately 385 million years ago) rocks of the Hamilton Group are monoclinally folded and dip gently to the south. No evidence of faulting or folding is present. The Hamilton Group is a sequence of limestones, calcareous shales, siltstones, and sandstones.

SEDA geology is characterized by gray Devonian shale with a thin weathered zone where it contacts the overlying mantle of Pleistocene glacial till. This stratigraphy is consistent over the entire SEDA facility. The predominant surficial geologic unit present at the Site is dense glacial till. The till is distributed across the entire facility and ranges in thickness from less than 2 feet to as much as 15 feet although it is generally only a few feet thick. The till is generally characterized by brown to gray-brown silt, clay and fine sand with few fine-to-coarse gravel-sized inclusions of weathered shale. Larger diameter weathered shale clasts (as large as 6-inches in diameter) are more prevalent in basal portions of the till and are probably ripped-up clasts removed by the active glacier.

The bedrock underlying the Site is composed of the Ludlowville Formation of the Devonian age, Hamilton Group. Merin (1992) also cites three prominent vertical joint directions of northeast, north-northwest, and east-northeast in outcrops of the Genesee Formation 30 miles southeast of SEDA near Ithaca, New York. Three predominant joint directions, N60E, N30W, and N20E are present within this unit (Mozola, 1951). These joints are primarily vertical. The Hamilton Group is gray-black, calcareous shale that is fissile and exhibits parting (or separation) along bedding planes.

1.2.4 Hydrogeology

Regionally, four distinct hydrologic units have been identified within Seneca County (Mozola, 1951). These include two distinct shale formations, a series of limestone units, and unconsolidated beds of Pleistocene glacial drift. Overall, the groundwater in the county is very hard, and therefore, the quality is minimally acceptable for use as potable water.

Regionally, the water table aquifer of the unconsolidated surficial glacial deposits of the region would be expected to flow in a direction consistent with the ground surface elevations. Geologic cross-sections from Seneca Lake and Cayuga Lake can be found in Mozola (1951) and Crain (1974). The geologic cross-sections suggest that a groundwater divide exists approximately half way between the two Finger Lakes. SEDA is located on the western slope of this divide and therefore regional groundwater flow is expected to be primarily westward towards Seneca Lake. Except for local variations in the hydrogeology, the Site hydrogeology is overall consistent with the regional hydrogeology.

Surface drainage from SEDA flows to five primary creeks. In the southern portion of the Depot, the surface drainage flows through man-made drainage ditches and streams into Indian and Silver Creeks. These creeks then merge and flow into Seneca Lake just south of the SEDA airfield. The central part and administration area of the SEDA drain into Kendaia Creek. Kendaia Creek flows in a predominant westerly direction, and discharges into Seneca Lake at a location north of Pontius Point and the SEDA's former Lake Shore Housing Area. The majority of the northwestern and north-central portion of the SEDA drains into Reeder Creek. Reeder Creek flows predominantly northwesterly and leaves the Depot at a point that is north of the Open Detonation Area (i.e., SEAD-45) and west of the former Weapons Storage Area or the "Q" (i.e., SEAD-12) before it turns to the west and flows into Seneca Lake. The northeastern portion of the Depot, which includes a marshy area called the Duck Pond, drains into Kendig Creek and then flows north into the Cayuga-Seneca Canal and to Cayuga Lake. Other minor creeks are also present and drain portions of the Depot.

Surface water flow from precipitation events at OD Grounds is controlled by local topography which slopes gently to the east-northeast, as there is little relief on-site other than the demolition mound. In general, surface water flows east making its way into a network of drainage swales throughout the Site that eventually lead into Reeder Creek, a sustained surface water body. Reeder Creek flows to the north-northwest along the eastern border of the OD Hill.

The groundwater flow direction in the till/weathered shale aquifer on the Site is to the east-northeast based on the groundwater elevations measured in nine monitoring wells (MW) on April 4, 1994. Note that the wells at the OD Grounds have not been sampled or gauged since the 1995 ESI was conducted. The distribution of groundwater in the till aquifer is characterized by moist soil with coarse-grained lenses of water-saturated soil and in most instances the deeper weathered shale horizons were saturated. The recharge of water to the wells during sampling in 1994 was generally poor. Groundwater elevations collected within the Open Burning Grounds between 2007 and 2012 show a general groundwater flow to the northeast (**Figure 1-4**). Comparison between the 1994 data and the recent groundwater elevations suggests an approximately NNW-SSE trending groundwater divide through the western portion of the Open Burning Grounds (approximately at the large C-shaped berm visible in **Figure 1-4**) (Parsons, 2013). Groundwater east of the divide flows to the northeast while groundwater west of the divide flows to the southwest. Groundwater elevations measured during the ESI suggest a northeasterly direction of groundwater flow in the in the OD Grounds (**Figure 1-4**) (Parsons, 1995).

1.2.5 SWMU History

The OD Grounds was used to destroy munitions. Operations at the OD Grounds began circa 1941 when the Depot was first constructed and continued at regular intervals until circa 2000 when the military mission of the Depot ceased. This facility operated under Interim Status as a Subpart X Miscellaneous Unit for open burning and open detonation of explosives, propellants and pyrotechnics and other unserviceable ammunition under 40 Code of Federal Regulations (CFR) Part 265 and NYCRR 373-1. Due to the closure of the Site, the RCRA permit was not finalized as Final Status. RCRA Closure requirements and RCRA Corrective Action requirements were deferred to the CERCLA program by the NYSDEC. Under this deferment, the Army was permitted to open burn and open detonate all MPPEH to safely dispose and demilitarize the materials in association with any remedial activities. Final Closure of the open burning tray will occur at the end of these activities.

During operations, munitions were placed in a hole created in the hill with additional demolition material, covered with a minimum of 8 feet of soil, and detonated remotely. After demolition was completed, explosively displaced portions of the mound were reconstructed by bulldozing displaced and native soils back into the central earthen mound.

The historic operations resulted in MEC, MPPEH, munitions constituents (MC), and munitions debris (MD) being expelled from the OD Hill to the surrounding area. The investigations revealed that the area encompassing 1,000 feet to 2,000 feet from the OD Hill received "kickouts" from the demolition operation (**Figure 1-2**).

1.2.6 Previous Investigations and Activities

1.2.6.1 1995 Expanded Site Investigation for Seven High Priority SWMUs

Parsons Engineering Science, Inc. (Parsons ES) completed an ESI at the OD Grounds. During the ESI, surface and subsurface soil samples, groundwater and surface water samples, sediment samples were collected. The nature and extent of the impacts from the sample results is discussed in Section 1.3. In addition, ground penetrating radar (GPR) and Geonics Electromagnetic (EM) terrain conductivity meter (EM-31) surveys were performed in addition to anomaly removal. Five detailed GPR grids were conducted to further characterize several anomalies identified by the EM-31 survey. Ten test pits were excavated to identify the sources of various EM-31 anomalies.

Based on the ESI EM-31 surveys anomalies in test pits TP45-3, TP45-4, TP45-5, TP45-6 and TP45-10 were attributed to pipes, blasting wires, and conduit wires. The other test pits encountered a variety of material, including munitions fragments, wood, ash, wire, nails, etc., all of which may have contributed to the observed EM-31 anomalies. Parsons collected 14 soil samples and submitted them for laboratory analysis for volatile organic compounds (VOC), semivolatile organic compounds (SVOCs), Pesticides/Polychlorinated Biphenyl (PCB), metals, cyanide, explosives, herbicides, and nitrates. The results of the soil investigations are summarized in the Nature and Extent discussion in Section 1.3.1 below.

1.2.6.2 2000 Ordnance and Explosives Engineering Evaluation and Cost Analysis

Parsons ES completed the field work for the EE/CA in 2000 and prepared the final report in 2004 (Parsons, 2004). The purpose of the EE/CA was to characterize the nature and extent of Ordnance and Explosives (OE), now referred to as MEC, identify potential safety problems associated with MEC, and study risk management alternatives at the various Areas of Interest (AOI). This objective was accomplished by characterizing MEC presence and developing and analyzing risk management alternatives.

The EE/CA fieldwork used geophysical survey techniques and intrusive investigations to estimate the density of the ordnance in different areas, which was then compared with the current and future activities and anticipated users. Data collected from this characterization project were also used to develop alternatives designed to reduce the risk of possible exposure to ~~UXO~~MPPEH within the AOIs, which included the OD Grounds. These alternatives were then evaluated to determine their effectiveness, implementability, and cost.

As part of the OE EE/CA, fifty-seven (57) 100-foot by 100-foot grids were surveyed at the OD Grounds using the EM61-MK2 (EM-61). Six grids in heavily wooded areas were also investigated by "mag and flag" surveys. In the majority of the grids surveyed with the EM61, a high density of buried metal was detected. Of the 1,337 anomalies identified in the EM61 surveyed grids, 86% were intrusively investigated. Two of the "mag and flag" surveyed grids were also intrusively investigated, although no statistics are available for these grids.

Approximately 3.5 acres of meandering path data were collected in the OD Grounds using the EM61. This data was all collected to the west and north of the grids surveyed in the OD Grounds. Due to extremely thick brush and forest to the east of the gridded area of the OD Grounds no meandering path data were collected in this direction. The meandering path data that was collected represented 2% of the 174-acre area outside of the 60-acre area investigated by the grid surveys. Of the 970 anomalies selected from the meandering path data, 72% were intrusively investigated. Of these, 19 (2.7%) were "false positives" as no discernible metallic debris was located.

Ordnance-related items were recovered from 666 of the 701 anomalies investigated (95%), and 21 of these were ~~UXO items, now referred to as~~ MEC/MPPEH items. Density determinations were made ~~using USACE's UXO Calculator,~~ and the OD Grounds meandering path AOI was defined as 'high density' for having a density greater than 10 anomalies/acre.

Occasionally, anomalies identified on the Anomaly Dig Sheet could not be reacquired with the instrument that performed the survey. In such instances, the anomaly was flagged at the coordinate location and the inability to reacquire the anomaly was documented on the reacquisition team dig sheet. The intrusive teams would again geophysically search the immediate area around the flag using both Schonstedt® and Foerster® metal-detectors. If again no anomaly was identified, the location was assumed to be a "false positive"; however, 10% of the "false positives" were excavated to 18 inches and re-checked using the Schonstedt® and Foerster for quality control (QC) purposes. No OE was ever found in locations where "false-positive" digs were performed.

1.2.6.3 2003 Phase I Geophysical Investigation

The Phase I Geophysical Investigation of the OD Hill was conducted between June 2, 2003 and August 27, 2003. An EM61 towed-array system was used to perform a geophysical survey in all accessible areas between 1,000 ft. and 2,500 ft. from the OD Hill (213 acres), and a "mag and flag" approach using hand-held magnetometers was used in a portion of the wooded/transect areas (9.65 acres). Results of the geophysical survey revealed that approximately 599 targets per acre exist in non-wooded areas between 1,000 ft. and 1,500 ft. of the OD Hill, approximately 139 targets per acre exist in non-wooded areas between 1,500 ft. and 2,500 ft. of the OD Hill, and approximately 208 targets per acre exist in wooded (transect) areas.

To verify the accuracy of results obtained both digitally and manually, Weston and EOTI UXO Technicians removed a total of 512 items from anomaly target locations within the non-wooded/open areas, and a total of 736 items from anomaly target locations within the transects. Of the 512 target anomalies excavated from the non-wooded/open areas, approximately 97% of the items were found at a maximum depth of 12 inches bgs. No items were identified at depths exceeding 20 inches bgs.

This investigation identified approximately 14,700 anomalies that are to be investigated in the open areas between 1,000 ft. and 1,500 ft. from the OD Hill under an area munitions response action. The anomalies identified within the 1,000 to 1,500 ft radius will be addressed as part of Alternatives 2 or 3 proposed in this FS.

1.2.6.4 2006 Phase II Ordnance and Explosives Removal Activities

The primary objective of Phase II was to reacquire, remove, and dispose of approximately 8,500 ~~MEC UXO~~MPPEH[1] items and ordnance related scrap now referred to as MD located in non-wooded areas, between the 1,500 ft. and 2,500 ft. radius from the OD Hill to a depth of 4 ft. In addition, ~~potential MEC UXO~~MPPEH and MD items located within 220 transects through wooded areas of the OD Grounds also required reacquisition, removal, and disposal.

Between September 2003 and March 2005, Weston removed 7,940 out of the 8,500 identified anomalies within the open area of the OD Grounds. In the wooded area, Weston investigated and removed and cleared 169 of the 220 transects.

In the open area, a total of 9,497 individual items were removed between the 1,500-ft and 2,500-ft. radius. Weston removed 6,663 individual items from the wooded areas. The percent of items recovered in both Phase I and Phase II investigations that were classified as OE (MEC or MPPEH) was 7%. Approximately 58% of the items recovered were classified as MD and 28% were classified as cultural debris (CD) (i.e., non-munitions related debris such as barbed wire, horseshoes, and consumer hardware). Six percent (6%) of the items recovered were no-contacts.

[1] ~~The Phase II report, and other older reports, use the term UXO to describe unexploded ordnance. UXO items were reclassified and included in the broader category of MEC. In this paragraph, both terms were used for clarity.~~

1.2.6.5 2010 Supplemental Work

The focused site investigation was conducted by Parsons ES in 2010 and included topographic and geophysical surveys of specific areas within the OD Grounds and the collection and analysis of soil samples from TP and surface soil locations. The objectives of the site investigation included determining MC concentrations in sub-surface and surface soils in or adjacent to the OD Hill; depth of soil and debris in saturated areas for geophysical mapping to identify individual anomalies; determine the volume of soil in the OD Hill; and estimation of the bedrock surface at the OD Grounds. The results of the MC sampling indicated that metal concentrations are generally greatest in soils closest to the OD Hill and decrease with distance from OD Hill. With one exception, concentrations of metals detected at a distance greater than 1,000 ft from the OD Hill were below the relevant criteria levels. The topographic investigation concluded that bedrock underlying the area of the OD Hill mound is estimated to vary from 10 to 20 ft. bgs. Based on the topographic survey, the estimated volume of the earthen mound above ground surface is 38,000 cubic yards (cy). The estimated volume of soil in the OD Hill above bedrock surface is 75,000 cy (Parsons, 2010).

The Army selected five test plots in order to provide a preliminary assessment of the vertical deposition of MPPEH, MD, MC, and CD located at different distances and in different directions from the OD Hill. As part of this investigation, if the initial geophysical survey at a test plot location continued to show high levels of geophysical anomalies, additional one-foot excavations and repeat EM surveys were conducted as directed by the Army.

Review of the data gathered indicates that anomaly densities generally decrease with depth of excavation, especially at distances greater than 100 to 200 feet from the OD Hill mound. The overall assessment of the data suggest that there may be a directional component to the vertical deposition of anomalies, as is evidenced by the absence of anomalies to the southeast of the OD Hill and the presence of anomalies to the northeast and northwest at roughly comparable distances from the detonation site. Additionally, the results suggest that areas in close proximity to the OD Hill may have more subsurface anomalies due to the extensive amount of soil rework that was done at this Site during its operational period.

1.3 NATURE AND EXTENT OF IMPACTS

1.3.1 Soil

As part of the development of this FS, analytical data are compared to November 2012 EPA Regional Screening Levels (RSL) for industrial soil and the NYSDEC approved Remedial Program Soil Cleanup Objectives (EPA, 2012; NYSDEC, 2013a). 6 NYCRR Subpart 375-6, effective December 2006, includes the soil cleanup objective (SCO) tables developed for unrestricted use and restricted use scenarios (NYSDEC, 2013b). The OD Grounds is located in the future Conservation/Recreation area (**Figure 1-3**); however, the Site should not be used in cases where contact with the soil is likely (e.g., playgrounds and ball parks). Hiking trails and scenic walking paths are considered acceptable. Because the OD Grounds is a former MRS, any remedy will include LUCs implemented at this area that will prohibit digging, prevent use of/access to groundwater, and prohibit the area for use as a residential/child care facility. As a result, the NYSDEC restricted use SCOs for the commercial use scenario are considered to be appropriate criteria for the OD Grounds. Note that the SCOs in 6 NYCRR Subpart 375-6 had not been developed at the time of previous investigations and therefore were not considered in the 1995 ESI. The ESI report summarized that heavy metals are contaminants of concern.

Soil sampling was performed at the OD Grounds during several previous investigations. All data gathered were used to determine the nature and extent of impact on soil due to previous site activities. **Figure 1-5A** and **Figure 1-5B** show the approximate locations of the soil samples collected at the OD Grounds. A summary of surface and subsurface soil exceedances data are presented in **Table 1-1**. The full dataset is provided in **Appendix A-1**.

White phosphorus was a component of some munitions processed at the OD Grounds. Phosphorus has been discussed as a potential COC. However, levels significantly in excess of benchmark total and soluble phosphorus have not been found downgradient in Reeder Creek based on independent sampling. Additionally, degradation products of white phosphorus cannot be speciated from naturally occurring and anthropogenic phosphorus. The runoff areas, including Reeder Creek, have not shown any adverse ecological impacts from the destruction of rounds with white phosphorus.

1.3.1.1 Surface Soil

Within the OD Hill and Kickout Areas, a total of 80 surface soil samples were collected and analyzed. All 80 samples were analyzed for inorganic metals. Fifty-five samples were collected within the 500 foot OD Hill radius. The remaining 25 samples were collected between 500 and 2,000 feet (Kickout Area) from the OD Hill to delineate the extent of any impacts to the surface soil within the Kickout Area. Forty-five of the surface soil samples were collected and analyzed for explosives and 33 samples were analyzed for SVOCs, herbicides, pesticides, and PCBs. Fourteen samples were analyzed for VOCs. None of the VOC, herbicide, or explosive results exceeded their respective screening criteria [November 2012, EPA Regional Screening Levels (RSL) for industrial soil and the NYSDEC approved Remedial Program Restricted Use Soil Cleanup Objectives for Commercial Use Sites] (EPA, 2012; NYSDEC, 2013b).

The concentration of one PCB, Aroclor-1254, exceeded both its Commercial SCO and Industrial RSL screening criteria in one sample. The elevated concentration of Aroclor-1254 appears to be an isolated occurrence. Aroclor-1254 was detected at two soil sample locations. The maximum concentration (2,000 μg/kg) of Aroclor-1254 was detected in the surface soil sample S45-ODH-4-01 located on the eastern side of the OD Hill. This concentration is above the NYS Commercial SCO value of 1,000 μg/kg. The second detection of Aroclor-1254 in the surface soil was observed in the sample duplicate collected at SS45-10 at an estimated concentration of 110 J μg/kg, below the commercial SCO; Aroclor-1254 was not detected in the duplicate's associated sample. Aroclor-1254 was not detected in the subsurface soil or in groundwater. Based on the fact that the PCB was not detected in any other samples on or surrounding the OD Hill, and groundwater sampling has confirmed that the PCB has not migrated to groundwater, Aroclor-1254 is not considered a constituent of concern.

Among the metals, cadmium, copper and mercury were the only metals to exceed their respective Commercial SCOs. Arsenic, cadmium, and lead exceeded their respective Industrial RSLs. Cadmium and lead had one exceedance each over the RSL. Analytical soil data demonstrate that concentrations of metals are higher closer to the OD Hill, and concentrations decrease as the distance increases from the OD Hill and into the Kickout area of the OD Grounds. This is illustrated in Figures 1-6A and 1-6B. There were no exceedances of NYSDEC Commercial SCOs in the Kickout area. The OD Hill area will be addressed by one of the remedial alternatives proposed in the FS, and any elevated concentrations in the soil would be addressed at that time.

Figures 1-6A and **1-6B** illustrate that the concentrations of the metals in the soil are higher close to the OD Hill and the concentrations decrease as the distance increases into the Kickout area of the OD Grounds. The figures highlight that there were no exceedances of NYSDEC Commercial SCOs in the Kickout area. Samples collected for metals analysis were also sent for synthetic precipitation leaching procedure (SPLP) analysis during the 2010 Supplemental Work. The discussion of these results and samples are included in Section 1.4.1.

1.3.1.2 Subsurface Soil

A total of 21 subsurface soil samples were collected within the 500 foot OD Hill radius. No subsurface soil samples were collected within the Kickout Area. All of the subsurface soil samples were analyzed for inorganic metals. In addition to metals, six of the subsurface samples were analyzed for explosives, VOCs, SVOCs, herbicides, pesticides, and PCBs. None of the VOC, herbicide, pesticide, or explosive results exceeded their respective screening criteria (November 2012, EPA Regional Screening Levels [RSL] for industrial soil and the NYSDEC approved Remedial Program Restricted Use Soil Cleanup Objectives for Commercial Use Sites) (EPA, 2012; NYSDEC, 2013b).

The SVOC concentrations were all below the Commercial SCOs; however, one result from the SVOC analysis was an explosive, 2,4-dinitrotoluene (2,4-DNT), with a concentration (14,000 μg/kg) that exceeded its respective industrial RSL (5,500 μg/kg) (a corresponding SCO value is not available) in one sample. This sample (TP45-2) was collected at a location on top of OD Hill. However, using the appropriate analytical method for explosive analysis (SW8330), the same sample resulted in a concentration of 190 μg/kg. Also, this was the only exceedance of the Industrial RSL for 2,4-DNT in the SVOC results. The maximum concentration of 2,4-DNT detected using the explosive analytical method was 1,100 μg/kg (S45-ODH-18-01). This value is below both the Industrial RSL (7,400 μg/kg) and the Residential RSL (1,600 μg/kg). Other nearby detections of 2,4-DNT were well below applicable screening criteria; therefore, the Army does not believe that the Site was impacted by 2,4-DNT and it is not considered a contaminant of concern.

Metals in subsurface soil that exceeded their respective NYSDEC Commercial SCO include: cadmium, copper, and mercury. Only arsenic exceeded an EPA Industrial RSL.

1.3.2 Ditch Soil

Four ditch soil samples were collected during the ESI. Three of the samples were collected from the drainage ditches located downgradient of the OD Hill and the fourth sample was collected from a low-lying area northwest of the OD Hill. The material at the base of the drainage swales is Site soil. The ditch soil samples collected during the ESI are located approximately 500 ft to 600 ft from the OD Hill, or within or close to the "OD Hill area". These samples were analyzed for VOCs, SVOCs, metals, PCBs, pesticides, herbicides and nitrate/nitrite nitrogen (**Appendix A-4**).

VOCs and herbicides were not detected in the samples. Several SVOCs, nitroaromatics, pesticides, and PCBs were detected at low concentrations.

A summary of the ditch soil analytical results from the ESI and a comparison to the Commercial SCOs is presented in **Table 1-2**. The results show that arsenic, cadmium, copper, and mercury were detected at concentrations above their respective Commercial SCOs. Arsenic exceeded its commercial SCO once with a concentration (16.1 mg/kg), similar to the SCO value (16 mg/kg). Cadmium, copper, and mercury each exceeded their Commercial SCOs twice at locations downgradient of the OD Hill. Compared to EPA Industrial RSLs, only arsenic (16.1 mg/kg) was found to exceed its EPA Industrial RSL (1.6 mg/kg) in four of four samples (EPA, 2012). The ditch soils ~~results~~ are grouped with ~~the~~ surface soil results because extensive RI data for the OB Grounds showed that all drainage ditches and Reeder Creek sediment (at the time) were consistent with levels of metals in all the soil data, including background levels. Therefore there is no distinction between ditch soils and surface soils. ~~collected from the OD Hill area due to the similar characteristics of the matrix.~~

1.3.3 Groundwater

Groundwater results discussed below were sampled over an approximately 20 year time period from both the OD and OB Grounds (**Appendix A-2**). Water quality screening criteria used for comparison in this FS report includes the lower of the values from either NYS Ambient Water Quality Standards (AWQS) for Class GA groundwater or EPA National Primary Drinking Water Regulations Maximum Contaminant Level (MCL) (EPA, 2012; NYSDEC, 2004). A consolidated summary of groundwater exceedances from these reports is presented in **Table 1-3**.

Groundwater sample results from the 1995 ESI suggest no gross contamination of the groundwater within the OD Grounds. There were no VOC exceedances and no pesticides or herbicides were found in the groundwater samples collected. Two explosives were detected in the groundwater one time each. One of the explosives (1,3-Dinitrobenzene) was detected below its respective groundwater criteria. NYS AWQS and EPA MCL screening criteria for the other explosive (HMX) do not exist; however, the detected value (0.5 ug/L), for comparison, is far less than the EPA's tap water RSL of 780 ug/L.

One SVOC [Bis(2-Ethylhexyl)phthalate] was detected in four groundwater samples at concentrations above the criteria value. Ten metals (antimony, beryllium, chromium, iron, lead, manganese, mercury, nickel, sodium, and thallium) were found in one or more the groundwater samples at concentrations above the criteria value. The groundwater sampling methodology used during the 1995 ESI resulted in high turbidity in the samples. The elevated metals concentrations are likely due to the turbidity levels [e.g., values as high as 9860 nephelometric turbidity units (NTU)] and are associated with suspended particles rather than representative of actual conditions in the groundwater aquifer. Thallium was detected in one sample and only slightly exceeded its screening criterion (**Table 1-3**). The results of the 1995 ESI suggest that the groundwater at the OD Grounds is not impacted by historic site activities.

Adjacent to the OD Hill, the groundwater within the OB Grounds Site was sampled prior to the 1994 OB Grounds RI and six wells from this Site currently are part of a long-term monitoring (LTM) program (Parsons, 1994, 2013). Groundwater monitoring for explosives, metals, total organic carbon, total organic halides, pH, pesticides, and nitrates between 1981 through 1987 indicated no exceedances of then current NYS AWQS except for iron and manganese. In 1989, sampling was conducted on ten additional installed wells and six of the seven previous wells. This round of sampling examined Extraction Procedure (EP) Toxicity metals and explosives. No metals or explosives exceeded applicable screening criteria.

Results from Phase I and II groundwater sampling were compiled in the 1994 OB Grounds RI Report (Parsons, 1994). Analytes examined during these sampling events included volatile organic analysis (VOA), target compound list (TCL) for semi-volatiles, pesticides, and PCBs, total analyte list (TAL) metals, and explosives. Groundwater was found to be minimally impacted by metals and explosives. Based on these results, the 1996 OB Grounds FS Report determined that groundwater was not a medium of concern (Parsons, 1996).

Based on the 1998 Record of Decision (ROD) for the OB Grounds, lead and copper were the contaminants and media of concern proposed for the remedy in the Site soils and sediments adjacent to Reeder Creek (Parsons, 1998). Between 2007 and 2012, LTM of wells within the OB Grounds for copper and lead has shown no evidence of lead or copper in the groundwater above the cleanup goals subsequent to the completion of the remedial action for the Site. These findings are consistent with the groundwater analytical results obtained during the RI stage (1990s) of work at the Site, indicating that there is no evidence of groundwater quality deterioration over approximately 20 years.

Although the OB Grounds are not immediately downgradient from the OD Grounds, the results from previous investigations at the OB Grounds Site can be used as an analogue for the potential groundwater contamination expected in the adjacent OD Grounds. OB Grounds and OD Grounds are adjacent to each other. Similar historic operations took place on the two sites, which would suggest similar distribution of contaminants, fate and transport, and exposure scenarios. Based on the similar detections, the geography, and the historic use, it is appropriate to use the groundwater data from OB as an analog of the groundwater at OD Grounds. As such, groundwater is not expected to be a medium of concern within the OD Grounds; however, potential examination of the groundwater may be appropriate subsequent to the remedial alternative evaluation in this FS.

1.3.4 Surface Water

During the ESI, the NYSDEC AWQS for Class C surface water were used to evaluate the OD Grounds surface water conditions (**Appendix A-3**) (NYSDEC, 2004). A summary of surface water data from the ESI is presented in **Table 1-4**. Four surface water samples were collected as part of the OD Grounds investigation. Three of the surface water samples were collected from drainage ditches located downgradient of the OD Hill, and the fourth sample was collected from a low-lying area northwest of the OD Hill. No VOC, SVOC, pesticide, PCB, herbicide compounds were found in the samples collected. Seven metals aluminum, cadmium, copper, iron, lead, mercury, and zinc were found in three of the four surface water samples at concentrations above the associated criteria value. In addition, nitroaromatic compounds were found in two of the surface water sample collected. The surface water samples were collected from drainage swales that were typically dry and the water sampled likely represented surface runoff from a recent precipitation event, rather than Site surface water. The four surface water samples collected were from ephemeral drainage ditches and a low-lying swale. These on-site surface water pools are not classified by NYSDEC as surface water bodies and therefore NY Ambient Water Quality Concentrations (AWQC) do not apply. Surface water is not considered a media of concern.

During the 1994 OB Grounds RI, surface water sampling was conducted within Reeder Creek (**Figure 1-4**) (Parsons, 1994). Reeder Creek is a recognized surface water body and therefore AWQCs would apply to human and ecological receptors. Surface water samples were collected from Reeder Creek up- and down-gradient of the OB Grounds (**Appendix A-3**). Reeder Creek serves as drainage for much of the OD Grounds; therefore, these samples were downgradient of various portions of the OD Grounds. Results from Reeder Creek were compared to recent NYS AWQC values. Table A-3 compares all surface water data to the Class D standard because at the time the OB RI was conducted the NYSDEC had classified the reach of Reeder Creek adjacent to the OB Grounds as Class D. At the time of the OB RI, the NYSDEC reclassified all of Reeder Creek as a Class C water body. The surface water concentrations of aluminum and iron in Reeder Creek exceeded the NYS AWQCS for a Class C water body. Only iron exceeded the Class D standard in Reeder Creek. The maximum concentration of aluminum in Reeder Creek was 300 ug/L, which is above the NYSDEC Class C standard of 100 ug/L. There is no aluminum standard for a Class D water body. Vanadium was detected at a maximum concentration of 39 ug/L in Reeder Creek, which is above the NYS AWQS of 14 ug/L for a Class C water body, but is not above the Class D criteria of 190 ug/L. No significant impacts to the surface water were found and the OB RI concluded that surface water was not a medium of concern; therefore, surface water is not considered a medium of concern at the OD Grounds.

1.3.5 Sediment

In conjunction with surface water samples, collocated sediment samples were collected from within Reeder Creek (**Figure 1-4**) (Parsons, 1994). Arsenic, copper, lead, manganese, mercury, nickel and zinc exceeded NY Sediment Criteria values. These exceedances were for a "to be considered" (TBC), therefore sediment was retained as a media of interest in the 1996 OB Grounds FS. As part of the OB Grounds remedial action, impacted sediment was excavated and removed from the creek. Since the removal of sediment, the inspections of Reeder Creek have found minimal sediment in various sections. Recent inspections of Reeder Creek noted that the streambed was observed to contain exposed bedrock and fractured shale pieces and thin organic/sediment layers which appear to be from decomposition of fallen leaves and the migration of tree material stockpiles by beavers in previous seasons and not the result of active erosion of the Site soil and soil transport (Parsons, 2014). Evidence for excessive erosion into the creek was not found. Current monitoring at OB Grounds suggests no visual impacts to Reeder Creek.

1.3.6 Geophysics

All geophysics efforts conducted during previous investigations were followed by investigation of a select number of anomalies and target areas. The OD Grounds area was included in various geophysical investigations in the past. The results of the geophysical investigation and the following investigation of anomalies and targets are discussed in detail in Section 1.2 – Previous Investigation.

1.4 FATE AND TRANSPORT

This section presents an overview of the fate and transport characteristics for the Site contaminants identified as constituents that have an impact on the applicable matrix at the OD Grounds. Contaminants of concern may be selected because of their intrinsic toxicological properties, because they are present in large quantities, or because they are presently in or potentially may move into critical exposure pathways (e.g., drinking water supply) (EPA, 1988).

Sediment and surface water collected on-site and downgradient of the Site do not show gross contamination of Site media indicative of an observed release. Conditions observed within Reeder Creek were addressed during the OB Grounds and are no longer representative of current Site conditions (Parsons, 1994). Current conditions in the creek exhibit little to no sediment in the creek bottom and there is no evidence of migration or erosion of nearby soils into the creek (Parsons, 2013). There was no evidence of a release to groundwater from either on-site samples or samples collected from an adjacent site. Constituents of concern for this Site are MC (metals) in soil and potential MPPEH items.

Understanding the fate of the various MEC and MC contaminants potentially present in or released to the environment is important to evaluate the potential hazards or risks posed by those contaminants to human health and/or the environment. For example, MEC may be found on the ground surface or be below grade; however, it is possible for natural processes to result in the movement, relocation, or unearthing of the MEC, thereby increasing the chance of its subsequent exposure to human receptors. Furthermore, MC may remain inside intact munitions or chemicals that may have been released to the environment during operational activities.

Analytical results from environmental samples and observations from previous geophysical and anomaly investigations indicate the presence of MEC/MD, metals, nitrates and explosives at the OD Grounds. The following paragraphs discuss potential migration processes for, the persistence of, and the potential migration routes of MEC/MD and of the Chemicals of Potential Concern (COPCs) present at the Site.

Many different environmental processes act upon MC, which may influence or alter their availability to interact with receptors. These processes depend on the media in which the source (MEC or MD) exists and the exposure of MC to the processes. These processes work through the different media: air, soil, surface water, groundwater, or biota. The following are short descriptions of these processes as described in Hewitt, et al. (2003).

- **Advection** – the passive movement of a solute with flowing water.
- **Dispersion** – the observed spreading of a solute plume, generally attributed to hydrodynamic dispersion and molecular diffusion.
- **Adsorption/desorption** – the process by which dissolved, chemical species accumulate (adsorption) at an interface or are released from the interface (desorption) into solution.
- **Diffusion** – the migration of solute molecules from regions of higher concentration to regions of lower concentration.
- **Biotic transformation** – the modification of a chemical substance in the environment by a biological mechanism.
- **Oxidation/reduction** – reactions in which electron(s) are transferred between reactants.

- **Covalent binding** – the formation of chemical bonds with specific functional groups in soil organic solids.
- **Polymerization** – the process by which the molecules of a discrete compound combine to form larger molecules with a molecular weight greater than that of the original compound, resulting in a molecule with repeated structural units.
- **Photolysis** – the chemical alteration of a compound due to the direct or indirect effects of light energy.
- **Infiltration** – the process by which water enters the soil at the ground surface and moves into deeper horizons.
- **Evapotranspiration** – the collective processes of evaporation of water from water bodies, soil and plant surfaces, and the transport of water through plants to the atmosphere.
- **Plant root uptake** – the transport of chemicals into plants through the roots.
- **Sedimentation** – The removal from the water column of suspended particles by gravitational settling.

1.4.1 Metals

The analytical results from the soil samples collected during the 2010 OD Grounds Supplemental work indicate that metal concentrations are highest in samples collected in close proximity to the OD Hill, and generally decrease in the Kickout area as distance from the OD Hill increases.

Once all total metal concentration results were received and evaluated, eight samples were selected for leachability determinations using the SPLP (EPA SW-846 Method 1312) in combination with EPA SW-846 Method 6010 and 7471, as appropriate for the RCRA eight metals (i.e., arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) and other metals of interest (e.g., antimony, cobalt, copper, vanadium, and zinc). The SPLP method was implemented in an effort to determine the ability of a material in the soil to potentially impact the groundwater or surface water, and, therefore, is relevant to the discussion of fate and transport. These samples were representative of the conditions within 500 feet distance from the center of the OD Hill. The results of these analyses are presented in **Appendix A-5**. Total metal analysis results presented were compared to EPA's RSLs for residential soils and NYSDEC Commercial SCO values, while the SPLP results are compared to NYSDEC GA Groundwater Effluent values. A detailed evaluation of the data is provided in the Completion Report for Additional MRS Investigation at Seneca Army Depot (Parsons, 2010).

A review of the data indicates that all of the metals detected show some potential to leach to groundwater. Two metals, mercury and lead, show the highest number of samples affected (i.e., six) at levels of potential concern, while cadmium and copper are also observed to be of potential concern when total soil concentrations move up to and above the Commercial SCOs.

While metals can be described by a range of mobilities, their transport abilities can generally be characterized by the same underlying principles. The mobility of metals within a soil system is primarily associated with the movement of water through that system. This mobility is affected by the solubility of the metal and its compounds, as well as chemical parameters affecting the oxidation state of the metal in solution. Metals associated with the aqueous phase of soil are subject to movement with soil, water, and may be transported through the vadose zone to groundwater. However, the rate of migration of the metal usually does not equal the rate of water movement through the soil due to fixation and adsorption reactions (Dragun, 1988). Metals, unlike organic compounds, cannot be degraded (McLean and Bledsoe, 1992). Metals become immobile due to mechanisms of adsorption and precipitation. Metal-soil interactions are such that when metals are introduced at the soil surface, downward transportation does not occur to any great extent unless the metal retention capacity of the soil is overloaded, or metal interaction with the associated waste matrix enhances mobility.

1.4.2 MPPEH/MEC/MD

There are two primary natural processes that can result in the migration or exposure of MPPEH/MEC items that might be present at a Site: erosion and frost heave. Natural erosion of soil over time by the wind or by water (surface water or precipitation) can result in the exposure of MEC below grade by the removal of the overlying soil. In some cases, if soil is unstable and the erosive force is sufficient to act on items(s) the size of the MEC present, this process can result in the movement of MEC from its original position to another location (typically somewhere downstream of the wash). This is not anticipated to be the case at the OD Grounds as there has been no visual indication of this occurring on-site.

In addition to erosion, below grade objects have been known to move or migrate toward the surface during freezing and thawing cycles. This occurs when cold temperatures penetrate into the ground and water below the buried objects freezes and expands, gradually pushing the items upwards. This phenomenon is often referred to as "frost heave" and is most likely to affect items buried above the frost line. Soil type influences the occurrence of frost heave: gravel, sand, and clay are not typically susceptible to the process, whereas silty soil is susceptible.

The 2010 Supplemental Work conducted at the OD Grounds concluded that the geophysical anomalies, which were indicative of potential presence of MPPEH showed a general decrease in density from saturated levels (i.e., 600 anomalies per acre) at surface elevations to lower densities at depth at each test plot; this is especially true for the test plots that are further from the initial point of detonation. The study also concluded that directional and point-of-detonation distance variations may be related to the vertical distribution of geophysical anomalies in the soil surrounding the detonation site.

1.5 HUMAN HEALTH RISK ASSESSMENT

A HHRA was conducted for the OD Grounds and is presented as an appendix to this FS in **Appendix B**. The objectives of the risk assessment were to:

- Assess the OD Grounds conditions for protectiveness of human health and the environment;
- Determine whether additional response actions are necessary at OD Grounds;
- Identify constituents of potential concern (COPCs) and provide a basis for determining levels of COPCs that are adequately protective of human health and the environment; and

- Provide a basis for comparing potential health impacts of various remedial alternatives, and evaluate selection of the No-Action remedial alternative, where appropriate.

To meet these objectives, the risk assessment generally follows EPA guidance [the Risk Assessment Guidance for Superfund (RAGS) series of guidance documents] and incorporates exposure scenarios and assumptions that are appropriate for current and anticipated future land use at this Site (EPA, 1989). The HHRA provides an evaluation of the potential risks to human health posed by constituents detected in surface soil, combined surface and subsurface soil, groundwater and surface water associated with the OD Grounds at SEDA.

This risk assessment divides the OD Grounds into two areas for assessment purposes based on differing potential risk observed during previous investigations. The density of potential MEC is highest at the center of the OD Grounds, in the vicinity of the OD Hill where the demolition activities took place and areas in the immediate vicinity that received most of the "kick-outs" from those activities. This area is referred to as the "OD Hill Area" in this risk assessment. The second area includes areas further away from the OD Hill that received kick-outs, but in lower densities. This second assessment area is referred to as the "Kickout Area".

1.5.1 Baseline Human Health Risk Assessment

A conceptual site model (CSM) is used to qualitatively define the type of potential exposures to contaminants at or migrating from a site (i.e., to systematically evaluate the effect of chemicals in relevant media on potential receptors). The CSM is used to summarize existing site characterization data, including assumptions about land and groundwater use, and to complete the qualitative exposure pathway assessment. An exposure pathway evaluation describes how a receptor could be exposed to COPCs at, or migrating from, a site. The site-specific CSM for potential human exposures is depicted in **Figure 1-7A** (OD Hill Area) and **Figure 1-7B** (Kickout Area). In accordance with the site-specific CSM, risk was quantitatively or qualitatively evaluated for the following potential human exposure scenarios to contaminants found within the OD Hill Area and Kickout Area:

- Exposure of hypothetical future residents;
- Exposure of hypothetical future excavation / construction workers;
- Exposure of future park workers; and
- Exposure of current and future recreational users.

Exposure scenarios selected for evaluation are anticipated to account for the range of reasonably anticipated exposures under current and future conditions at SEDA. The exposure assumptions used for estimating constituent intake are presented in **Appendix B**, Table 2.6 (soil), Table 2.7 (groundwater), and Table 2.8 (surface water). There are no complete exposure pathways for sediment.

The exposure areas evaluated in this risk assessment were defined considering the results of the source area investigation and activity patterns of the potential receptors being evaluated in the HHRA. For evaluation of soil, the OD Hill Area and the Kickout Area were evaluated as separate exposure areas. All groundwater wells were located within the OD Hill Area or the OB Area. Groundwater evaluation was conducted on a combined data set, including data from all wells, as well as data from each well individually. For surface water, three exposure areas were evaluated, the on-site drainage ditches in the OD Hill Area, the portion of Reeder Creek upstream of the Kickout Area, and the portion of Reeder Creek that passes through the Kickout Area and all downstream locations. Once Reeder Creek enters the Kickout Area, all locations downstream from that point are potentially affected by munitions activities at the OD Grounds and considered together.

Exposure point concentrations are the concentrations of chemicals in a given medium to which a receptor may be exposed at a specific location known as the 'exposure point'. Each groundwater sampling location was considered an exposure point. Therefore, a groundwater exposure point concentration (EPC) was identified as the maximum detected concentration of each COPC in each well. Surface water EPCs were the maximum detected concentration of each COPC. Risk for each surface water exposure area was estimated using the maximum detected concentration from each area. For receptors potentially exposed to soil, an EPC was calculated for soil intervals 0 - < 2 feet bgs and 0 – ≤ 15 feet bgs. EPCs were calculated for each soil COPC using the USEPA's statistical program ProUCL, version 5.0.00 (USEPA, 2013).

Cumulative carcinogenic risks and noncarcinogenic hazards estimated for the four receptor groups at the site are shown in **Exhibit 1.5-1**. The cumulative risk/hazard estimates described below include chromium(III). The cumulative risk/hazard estimates that include chromium(VI) show similar patterns (**Exhibit 1.5-2**). Chromium(VI) is not expected to be present at the Site based on past munitions-related activities and is not summarized below.

Exhibit 1.5-1
Human Health Quantitative Cumulative Risk Summary for all Media
Seneca Army Depot Activity

All COPCs including chromium(III)

Receptor and Medium	Exposure Pathways	Total Carcinogenic Risk (1)	Carcinogenic Risk Drivers (4)	Total Hazard Index - Child (1)	Non-Carcinogenic Risk Drivers (Child) (4)	Total Hazard Index - Adult (1)	Non-Carcinogenic Risk Drivers (Adult) (4)
Receptor: Hypothetical Future Resident							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill Area	Ingestion, Dermal Contact, Inhalation	2.8E-05	--	**5.8**	**Aroclor-1254 31% Cadmium 30%**	0.60	--
Combined Surface and Subsurface Soil (0 - ≤ 15 feet bgs)	Ingestion, Dermal Contact, Inhalation	5.8E-05	--	**5.3**	**Aroclor-1254 33% Cadmium 25%**	0.55	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	**1.8E-04**	**Arsenic 100%**	**51**	**Cobalt 31% Manganese 21% Thallium 33%**	**30**	**Cobalt 31% Manganese 22% Thallium 33%**
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	6.7E-07	--	**3.0**	**MCPA 10% Cobalt 63%**	0.32	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	4.6E-07	--	0.63	--	0.22	--
Receptor: Hypothetical Future Excavation/ Construction Worker							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill Area	Ingestion, Dermal Contact, Inhalation	8.2E-08	--	--	--	0.14	--
Combined Surface and Subsurface Soil (0 - ≤ 15 feet bgs)	Ingestion, Dermal Contact, Inhalation	6.3E-08	--	--	--	0.046	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	1.9E-08	--	--	--	0.13	--
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	1.6E-08	--	--	--	0.025	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	1.5E-09	--	--	--	0.032	--
Receptor: Future Park Worker							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill Area	Ingestion, Dermal Contact, Inhalation	5.6E-06	--	--	--	0.37	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	9.8E-05	--	--	--	**19**	**Cobalt 32% Manganese 20% Thallium 34%**
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	2.9E-06	--	--	--	0.19	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	1.0E-07	--	--	--	0.026	--
Receptor: Current and Future Recreational User							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill Area	Ingestion, Dermal Contact, Inhalation	1.8E-06	--	0.39	--	0.039	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	1.3E-05	--	**3.4**	**Cobalt 32% Manganese 20% Thallium 35%**	**2.0**	**Cobalt 32% Manganese 20% Thallium 34%**
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	1.0E-06	--	0.000017	--	0.0000016	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	6.3E-08	--	0.086	--	0.030	--

Exhibit 1.5-2
Human Health Quantitative Cumulative Risk Summary for all Media
Seneca Army Depot Activity

All COPCs including chromium(VI)

Receptor and Medium	Exposure Pathways	Total Carcinogenic Risk [1]	Carcinogenic Risk Drivers [4]	Total Hazard Index - Child [1]	Non-Carcinogenic Risk Drivers (Child) [4]	Total Hazard Index - Adult [1]	Non-Carcinogenic Risk Drivers (Adult) [4]
Receptor: Hypothetical Future Resident							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill Area	Ingestion, Dermal Contact, Inhalation	6.5E-05	--	**6.0**	**Aroclor-1254 29% Cadmium 29%**	0.62	--
Combined Surface and Subsurface Soil (0 - ≤ 15 feet bgs)	Ingestion, Dermal Contact, Inhalation	9.1E-05	--	**5.5**	**Aroclor-1254 32% Cadmium 24%**	0.57	--
Groundwater - MW 45-4 [2]	Ingestion, Dermal Contact	**1.2E-03**	**Arsenic 16%**	**54**	**Cobalt 30% Manganese 20% Thallium 32%**	**32**	**Cobalt 30% Manganese 21% Thallium 32%**
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	2.2E-05	--	**3.1**	**MCPA 10% Cobalt 57% Manganese 12%**	0.33	--
Surface Water - On site drainage ditches [3]	Ingestion, Dermal Contact	7.5E-05	--	0.87	--	0.32	--
Receptor: Hypothetical Future Excavation/ Construction Worker							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill Area	Ingestion, Dermal Contact, Inhalation	2.1E-07	--	--	--	0.15	--
Combined Surface and Subsurface Soil (0 - ≤ 15 feet bgs)	Ingestion, Dermal Contact, Inhalation	9.7E-08	--	--	--	0.048	--
Groundwater - MW 45-4 [2]	Ingestion, Dermal Contact	5.1E-07	--	--	--	0.15	--
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	4E-08	--	--	--	0.026	--
Surface Water - On site drainage ditches [3]	Ingestion, Dermal Contact	2.6E-07	--	--	--	0.043	--
Receptor: Future Park Worker							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill Area	Ingestion, Dermal Contact, Inhalation	1.3E-05	--	--	--	0.39	--
Groundwater - MW 45-4 [2]	Ingestion, Dermal Contact	**5.0E-04**	**Arsenic 20%**	--	--	**20**	**Cobalt 31% Manganese 19% Thallium 33%**
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	7.0E-06	--	--	--	0.20	--
Surface Water - On site drainage ditches [3]	Ingestion, Dermal Contact	1.6E-06	--	--	--	0.0289	--
Receptor: Current and Future Recreational User							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill Area	Ingestion, Dermal Contact, Inhalation	4.4E-06	--	0.41	--	0.041	--
Groundwater - MW 45-4 [2]	Ingestion, Dermal Contact	6.3E-05	--	**3.6**	**Cobalt 31% Manganese 19% Thallium 34%**	**2.1**	**Cobalt 31% Manganese 19% Thallium 33%**
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	2.5E-06	--	0.0083	--	0.00080	--
Surface Water - On site drainage ditches [3]	Ingestion, Dermal Contact	1.0E-05	--	0.120	--	0.0437	--

(1) Cancer Risks and Hazard Indices were calculated by summing across exposure routes for each receptor.
(2) The greatest risk associated with groundwater is from MW 45-4. For a summary of risk associated with individual wells, see Table 2.59.
(3) The surface water most likely to be encountered at the site is from the drainage ditches onsite. For a summary of risk associated with other surface water bodies, see Table 2.79.
(4) Percent contribution was calculated by dividing the cancer risk or hazard index of each COPC by the total risk or total HI. COPCs with less than 10% contribution are not shown.
-- = Cumulative Hazard not calculated for a child for this receptor.

A summary of the risks are as follows:

Hypothetical future resident exposed to surface soil, combined surface and subsurface soil, groundwater as potable water, and surface water:

- Cumulative carcinogenic risks range from 2 x 10^{-4} (groundwater in MW45-4) to 7 x 10^{-7} (surface soil in Kickout Area). The highest cumulative carcinogenic risk, which is outside USEPA's acceptable carcinogenic risk range of 1 x 10^{-4} to 1 x 10^{-6}, is due to exposure to groundwater as potable water in the center of the OD Hill Area.
- Cumulative noncarcinogenic hazards for a child range from 0.6 (surface water) to 51 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill Area.
- Cumulative noncarcinogenic hazards for an adult range from 0.2 (surface water) to 30 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill Area.

Hypothetical construction workers exposed to surface soil, combined surface and subsurface soil, groundwater as potable water, and surface water:

- Cumulative carcinogenic risks range from 2 x 10^{-8} (surface soil in Kickout Area) to 2 x 10^{-9} (surface water onsite). All carcinogenic risks are less than USEPA's acceptable carcinogenic risk range of 1 x 10^{-4} to 1 x 10^{-6}.
- Cumulative noncarcinogenic hazards for an adult range from 0.03 (surface soil in Kickout Area) to 0.1 (surface soil in OD Hill Area). All noncarcinogenic hazard HIs are less than 1.

Future park workers exposed to surface soil, groundwater as potable water, and surface water:

- Cumulative carcinogenic risks range from 1 x 10^{-4} (groundwater in MW45-4) to 1 x 10^{-7} (surface water onsite). All carcinogenic risks are within or less than USEPA's acceptable carcinogenic risk range of 1 x 10^{-4} to 1 x 10^{-6}.
- The cumulative noncarcinogenic hazards for an adult range from 0.03 (surface water onsite) to 19 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill Area.

Current and future recreational users exposed to surface soil, groundwater as potable water, and surface water:

- Cumulative carcinogenic risks range from 1 x 10^{-5} (groundwater in MW45-4) to 6 x 10^{-8} (surface water onsite). All carcinogenic risks are within or less than USEPA's acceptable carcinogenic risk range of 1 x 10^{-4} to 1 x 10^{-6}.
- Cumulative noncarcinogenic hazards for a child range from 0.09 (surface water onsite) to 3 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill Area.

- Cumulative noncarcinogenic hazards for an adult range from 0.03 (surface water) to 2 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill Area.

Uncertainties may result in overestimated current risks/hazards. Most notably, onsite groundwater is not currently used as a potable drinking water source so the risk/hazard estimates herein may be overestimated. The estimated risks/hazards associated with potable groundwater would apply only if a well were installed for potable water. Further, there are no buildings currently onsite and there are no plans for development of the Site in the future. Therefore, near- and long-term residential scenarios are hypothetical and conservative since there are no residential properties onsite currently and it is unlikely the Site will be developed as residential property. Therefore, based on the exposure scenarios evaluated in this risk assessment, there are no unacceptable risks/hazards expected for any receptor as a result of exposure to soil, groundwater, or surface water based on current, or reasonably anticipated future land use.

1.6 BASELINE ECOLOGICAL RISK ASSESSMENT

A BERA was completed during the RI at the OB Grounds. The OB Grounds is adjacent to, and surrounded by, the OD Grounds. There is no significant difference in the environmental setting and natural communities hosted by each site. The COPCs at each site are similar and the concentrations of these COPCs are not notably different. Copper and lead were found to be drivers of ecological risks at the OB Grounds. Based on a comparison of EPCs and maximum values from each site, the ecological risks are expected to be similar at the OD Grounds.

1.76 HAZARD ASSESSMENT

A MEC HA was prepared to qualitatively assess the potential explosive hazards to human receptors associated with complete MEC exposure pathways at the OD Grounds. The results of the MEC HA show that implementation of a remedy would reduce the MEC hazard potential. A detailed description of the MEC HA conducted for the OD Grounds, including the information and assumptions used for this assessment, is included as **Appendix C** of this FS.

This MEC HA divides the OD Grounds in the same manner described for the HHRA based on differing anticipated explosive hazard characteristics. Previous investigations indicate the density of potential MEC is highest at the center of the OD Grounds, in the vicinity of the OD Hill where the demolition activities took place and areas in the immediate vicinity that received most of the "kickouts" from those activities. This area is referred to as the "OD Hill Area" in this MEC HA. The second assessment area includes areas further away from the OD Hill that received kickouts, but in lower densities. This second assessment area is referred to as the "Kickout area" in this MEC HA. The locations of these two assessment areas are shown on **Figure 1-3**.

The MEC HA method focuses on hazards to human receptors and does not directly address environmental or ecological concerns that might be associated with MEC. The process for conducting the MEC HA is described in the MEC HA interim guidance document (USEPA, 2008) and uses input data based on historical documentation, field observations, and the results of previous studies and removal actions. The MEC HA interim guidance was developed by the Technical Working Group for Hazard Assessment, which included representatives from the DoD, the U.S. Department of the Interior, the USEPA, and various states and tribes. NYSDEC is not a party to the MEC HA guidance. The DoD has encouraged use of this method on a trial basis (DoD, 2009).

A qualitative baseline evaluation of the potential MEC hazards posed was conducted by reviewing each of the MEC HA input factors for the OD Hill and Kickout areas. Having generated baseline MEC HA scores for each assessment area, different remedial alternatives were further evaluated using the MEC HA method to compare how they might reduce the explosive hazards in each area. The remedial alternatives evaluated were (1) geophysical mapping, intrusive investigation, and installation of an 18-inch thick cap, followed by implementation of LUCs and (2) geophysical mapping, intrusive investigation, excavation, off-site soil disposal, followed by implementation of LUCs. These are referred to in this FS as Remedial Alternatives 2 and 3, respectively. Remedial Alternative 1 represents the no action alternative, which is the baseline scenario for this MEC HA.

Under the MEC HA method, the potential MEC hazards are evaluated qualitatively for each area by evaluating Site conditions and assigning related "input factors" that generate a total MEC HA score between 125 and 1,000, with the upper limit representing the maximum level of explosive hazard. The MEC HA method identified the associated hazard levels for these scores, which range from 1 to 4. A Hazard Level of 1 indicates the highest potential explosive hazard conditions and a hazard level of 4 indicates low potential explosive hazard conditions. The basis for these hazard levels is detailed in the MEC HA interim guidance document (USEPA, 2008).

For the OD Hill area, the baseline score (the no action alternative) results in a MEC HA score of 865. Remedial Alternative 2 (geophysical mapping, intrusive investigation, and installation of an 18-inch thick cap, followed by implementation of LUCs) results in a MEC HA score of 470. Remedial Alternative 3 (geophysical mapping, intrusive investigation, excavation, off-site disposal, and implementation of LUCs) was also evaluated for the OD Hill area, and resulted in a MEC HA score of 470, the same as Alternative 2. The reduction in MEC HA score from 865 to 470 reduces the corresponding Hazard Level rating from 1 ('highest potential explosive hazard conditions') to 4 ('low potential explosive hazard conditions'). Based on these results, there is no significant difference between these remedial alternatives with respect to reduction of explosive hazards at the OD Hill area.

For the Kickout area, the baseline score (the no action alternative) results in a MEC HA score of 715. Remedial Alternatives 2 and 3 both result in a MEC HA score of 445. This reduction in MEC HA score reduces the corresponding Hazard Level rating from 3 ('moderate potential explosive hazard conditions') to 4 ('low potential explosive hazard conditions'). Based on these results, there is no significant difference between these remedial alternatives with respect to reduction of explosive hazards at the Kickout area.

In addition to providing a technique to evaluate baseline MEC hazards, the MEC HA method establishes a process to qualitatively evaluate the hazard mitigation that would be achieved by remedial actions. This process is based on assumptions made regarding the effects of a given remedial response (e.g., LUCs, surface cleanup, subsurface cleanup), coupled with modified scores for MEC HA input factors, to evaluate how the MEC HA score might be reduced following implementation of the response. The primary purpose of this process is to support the evaluation of response alternatives conducted during an FS; i.e., this evaluation should not be used as the sole basis upon which to recommend a remedial response. As with the baseline score, these total MEC HA scores and the associated hazard levels are *qualitative references only* and should not be interpreted as quantitative measures of explosive hazard.

Accounting for score modifications resulting from either Remedial Alternative 2 or 3, the total Hazard Level rating is reduced to a 4, 'low potential explosive hazard conditions" from a Hazard Level rating of 1 ('highest potential explosive hazard conditions'). Based on the scores, the evaluation indicates that implementation of Alternatives 2 or 3 would result in equivalent reduction of hazards.

Since this initial MEC HA was completed, the DoD has issued a letter to USEPA (dated November 10, 2014) stating that the MEC HA has been evaluated and at this time is not recognized as a "suitable tool for assessing explosives hazards associated with MEC known or suspected to be present at a Munitions Response Site (MRS)". As such, the Army acknowledges limitations in the application of the information provided in this MEC HA. At this time, there is no valid CERCLA criteria for risk assessment for MPPEH.

2.0 REMEDIAL ACTION OBJECTIVES

The purpose of this section is to develop RAOs and general response actions for each medium of interest identified at the OD Grounds. Based on the RAO and the general response actions, potential remedial technologies are identified and screened in **Sections 2** and **3**, and a detailed analysis of remedial action alternatives is provided in **Section 4**. This process follows the USEPA and NYSDEC method of identifying and screening technologies/processes and consists of the following six steps:

- Develop RAOs that specify media of interest, chemical constituents of concern, exposure pathways, and preliminary remediation goals that permit a range of treatment and containment alternatives to be developed. The preliminary remediation goals will be based on chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and the results of the HHRA and the MEC Hazard Assessment (**Section 2**);
- Develop general response actions for each medium of interest that will satisfy each remedial action objective for the OD Grounds (**Section 2**);
- Identify estimates of volumes or areas, to the extent practical, of media to which general response actions might be applied (**Section 2**);
- Identify remediation technologies/processes associated with each general response action. Screen and eliminate technologies/processes based on technical implementability (**Section 2**);
- Evaluate technologies/processes and retain processes that are representative of each technology (**Section 2**); and
- Assemble and further screen the retained technologies/processes into a range of alternatives as appropriate (**Sections 3** and **4**).

2.1 GENERAL REMEDIAL ACTION OBJECTIVES

As discussed in **Section 1**, the ESI, OE EE/CA, the munition response actions, and the 2010 supplemental work conclude that further actions are warranted for the OD Grounds. Based on the previous investigations and the proposed future site use, soil was identified as a medium of interest. RAOs address the goals for reducing the potential MPPEH and/or soil contamination hazards to ensure protection of human health, safety and the environment (USEPA, 1988). The RAOs are intended to be as specific as possible, but not so specific that the range of alternatives that can be developed is unduly limited. The intent of this FS is to select RAOs that are protective of human health and the environment for evaluation and that achieve an acceptable minimum level of risk at the OD Grounds. The future use for the OD Grounds is passive recreation/conservation for walking and hiking activities. There will be no intrusive soil activities such as digging, camping, camp fires, tent staking, trail construction, playgrounds, etc.

The overall objective of any remedial response is to protect human health and the environment. RAOs have been developed to meet this overall objective. The objectives are then used as a basis for developing remedial alternatives.

CERCLA, as amended by SARA of 1986, requires that a CERCLA remedial action:

- At minimum, attain federal or more stringent state ARARs on completion of the remedial action for on-site remedial actions (unless an ARAR waiver becomes necessary).
- Use remedial alternatives that permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances;
- Select remedial actions that protect human health and the environment, are cost effective, and involve permanent solutions, alternative solutions, and resource recovery technologies to the maximum extent possible;
- Avoid off-site transport and disposal of untreated hazardous substances or contaminated materials where practical technologies exist to treat these materials on-site.

The National Contingency Plan (NCP) regulations, which implement CERCLA, generally require ARAR compliance during remedial actions as well as at completion [40 CFR 300.435(b)(2)]. However, a no-action decision does not require compliance with ARARs.

The RAOs for the OD Grounds consist of media specific objectives designed to be protective of human health and the environment. Where applicable, consideration was given to the NCP preference for permanent solutions. The general RAOs for the OD Grounds are as follows:

- Prevent public or other persons from direct contact with MEC or MPPEH, direct contact with soil, or inhalation of MC that may present a health risk due to potential contamination. NYSDEC Commercial SCOs were determined to be an appropriate and acceptable contaminant level for protection of human health and the environment.
- Restore the area to a condition that would comply with the SEDA LRA determination in which the future use of the OD Grounds would be for passive recreation/conservation where contact with the soil is not likely (i.e., would not include playgrounds, ballparks, camping).

The investigation and remediation of the OD Grounds is subject to pertinent requirements of both federal environmental statutes or regulations (generally administered by EPA Region II for SEDA) and the State of New York environmental statutes and regulations (generally administered by the NYSDEC), determined in accordance with the CERCLA ARAR process. ARARs are promulgated standards that may be applicable to the site cleanup process after a remedial action has been selected for implementation.

Any standard, requirement, criterion, or limitation under any federal environmental or state environmental or facility siting law may be either applicable or relevant and appropriate to a specific action. The only state laws that may become ARARs are those promulgated, and identified timely by the state, such that they are legally enforceable and generally applicable and equivalent to or more stringent than federal laws. A determination of applicability is made for the requirements as a whole, whereas a determination of relevance and appropriateness may be made for only specific portions of a requirement. An action must comply with relevant and appropriate requirements to the same extent as an applicable requirement with regard to substantive conditions, but need not comply with the administrative conditions of the requirement.

Three categories of potentially applicable state and federal requirements were reviewed: (1) chemical-specific, (2) location-specific, and (3) action-specific. Chemical-specific ARARs address certain contaminants or class of contaminants and relate to the level of contamination allowed for a specific pollutant in various environmental media. Location-specific ARARs are based on the specific setting and nature of the site. Action-specific ARARs relate to specific actions proposed for implementation at a site. Both location-specific and action-specific ARARs are independent of the media. In addition to ARARs, advisories, criteria, or guidance may be evaluated as TBC. The NCP provides that the TBC category may include advisories, criteria, or guidance that were developed by EPA, other federal agencies, or states that may be useful in devising CERCLA remedies. These advisories, criteria, and guidance are not promulgated and, therefore, are not legally enforceable standards such as ARARs.

2.2 POTENTIAL CHEMICAL-SPECIFIC ARARS AND TBCS

Chemical-specific ARARs are usually health-based or risk-based numerical values or methodologies, established by promulgated standards, that are required to be used to determine acceptable concentrations of chemicals that may be found in or discharged to the environment. Chemical-specific TBCs can serve to indicate contaminant levels that may merit concern.

Potential federal and state chemical-specific ARARs and TBCs considered in connection with the FS at the OD Grounds are described in the following sections.

2.2.1 Soil

Cleanup levels for hazardous constituents in soil have been proposed by NYS surface and subsurface soil chemical exceedances of NYSDEC Subparts 375-1 through 375-4 and Subpart 375-6 under 6 NYCRR Part 375 - Environmental Remediation Programs. 6 NYCRR Subpart 375-6, effective December 2006, includes the SCO tables developed for five categories of future land use (i.e., unrestricted use, residential, restricted-residential, commercial, and industrial). As the OD Grounds is located in the future recreational area, the NYSDEC SCOs for commercial use scenario are considered to be relevant and appropriate criteria for the Site.

USEPA RSLs for soil are considered TBCs for this FS.

2.3 POTENTIAL LOCATION-SPECIFIC ARARS

Location-specific ARARs may serve to limit contaminant concentrations, or even to restrict or to require some forms of remedial action in environmentally or historically sensitive areas at a site, such as natural features (including wetlands, flood-plains, and sensitive ecosystems) and manmade features (including landfills, disposal areas, and places of historic or archaeological significance). These ARARs generally restrict the concentration of hazardous substances or the conduct of activities based solely on the particular characteristics or location of the site.

Potential federal and state location-specific ARARs considered in connection with this response action include the following:

Federal:

- Executive Orders 11593, Floodplain Management (May 24, 1977), and 11990, Protection of Wetlands (May 24, 1977).

- Clean Water Act (CWA), Section 404, and Rivers and Harbor Act, Section 10 (requirements for Dredge and Fill Activities) and the associated regulations (i.e. 40 CFR part 230).
- Wetlands Construction and Management Procedures (40 CFR part 6, Appendix A).

Based on the OD Grounds conditions and the land use determination, further consideration of these location-specific ARARs does not appear warranted at this time.

2.4 ACTION-SPECIFIC ARARS

Action-specific ARARs are usually technology or activity-based requirements or limitations that control actions involving specific substances. Action-specific ARARs generally set performance or design standards, controls, or restrictions on particular types of activities. To develop technically feasible alternatives, applicable performance or design standards must be considered during the development of all response action alternatives. Note that regulations that are not related to environmental law or do not govern activities that take place at the CERCLA site are not considered ARARs.

No action-specific regulations were identified in connection with this response action. Based on the OD Grounds conditions, further consideration of these action-specific ARARs does not appear warranted at this time.

2.5 SITE-SPECIFIC CLEANUP GOALS

Remedial action at the OD Grounds is guided by the cleanup goal of preventing direct contact by receptors with MEC and with MC. These cleanup goals will have the effect of protecting human health and the environment, complying with ARARs, and meeting all other RAOs.

Table 2-1
OD Grounds Remedial Action Objectives

Media	Contaminant of Concern	Receptor	Exposure Route	Remedial Action Objective	Applicable ARAR/TBCs[1]
Soil	MC	Human (Current and Future Site Visitors, Recreational Users)	Incidental ingestion, dermal contact, inhalation	Prevent direct contact with soil, or inhalation of MC by receptors.	NYSDEC Commercial SCOs
Soil	MEC	Human (Current and Future Site Visitors, Recreational Users)	Physical Access to Site	Prevent direct contact with MEC by receptors	Removal of MEC to the extent practicable.
Not Applicable (N/A)	N/A	Human (Current and Future Site Visitors, Recreational Users)	N/A	Restore the area to a condition that would comply with the SEDA LRA determination that the future use of the OD Grounds would be for recreation/conservation.	N/A

(1) ARARs and TBCs are described in Subchapter 2.1 of this report.

2.6 GENERAL RESPONSE ACTIONS

General response actions are selected to satisfy the RAOs for each medium of concern at the project site. Identification of the general response actions also includes identification of ARARs. General response actions are those actions that will achieve the identified RAOs and may include treatment, containment, excavation, extraction, disposal, LUCs, or some combination of any or all of these. This subchapter describes the general response actions applicable to the OD Grounds. The general response actions identified include the following:

- No Action
- Hazard Management – LUCs (e.g., access restrictions [fencing and signage], activity restrictions, education, or deed notification)
- Remedial Action (Mapping, excavation, disposal, engineering controls, restoration) – MEC removal through geophysical mapping and excavation, soil excavation, MEC disposal, soil capping, site restoration

With the exception of the No Action alternative, the general response actions identified above may be combined in developing remedial action alternatives for the project site. Some areas may exhibit a higher MEC density and a correspondingly greater potential for MEC hazards so it may be appropriate to apply a different response action or combination of response actions in different parts of the Site.

The No Action alternative refers to a site remedy where no active remediation or enforceable LUCs are implemented. Under CERCLA, evaluation of a No Action alternative is required, pursuant to the NCP (42 CFR 300.430 et seq.), to provide a baseline for comparison with other remedial technologies and alternatives.

Hazard management technologies include enforceable administrative institutional controls and/or physical measures (engineering controls) to prevent or limit exposure of receptors to MEC or MC. A deed notice/environmental easement is an example of an institutional control. Physical barriers and access restrictions (e.g., fencing, locked gates, and warning signs) or activity restrictions (prohibiting intrusive activities) are examples of engineering controls. LUCs can be cost-effective, reliable, and immediately effective, and can be implemented either alone or in conjunction with other remedial components. Inspections and monitoring typically are required to document long-term effectiveness of LUCs. The administrative feasibility of and cost to implement LUCs depend on site-specific circumstances (e.g., whether or not a site is under the direct operational control of the DoD, or has been transferred to non-federal ownership).

A remedial action alternative may employ technologies to reduce the toxicity, mobility, or volume (TMV) of contaminants in the subsurface, thereby preventing or minimizing exposure of receptors to MEC or chemical contamination that could pose an unacceptable MEC hazard or HTW risk. Physical extraction methods are typically used to remove surface and subsurface MEC for disposal. The feasibility and cost to implement MEC excavation options can vary widely based on site-specific conditions and circumstances. Examples of remedial action approaches include removal of soil and/or MEC by hand, implementation of an engineered cover, or excavation and off-site disposal.

2.7 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Remedial action technologies and processes were identified for consideration as possible remedial options at the OD Grounds. The list of technologies and processes presented was developed from several sources including standard engineering handbooks, vendor information, and best engineering estimates.

2.7.1 MEC/MPPEH

2.7.1.1 Detection Technologies for MEC/MPPEH

The selection of the best technology depends on the properties of the MEC to be located, including whether the ordnance is found on the surface or below the surface, and the characteristics of the area where the MEC is located, such as soil type, topography, vegetation, and geology.

Detection technologies have two basic forms. One form, visual searching, has been successfully used on a number of sites where MEC is located on the ground surface. When performing a visual search of a site, the area to be searched is divided into five-foot lanes, which are then systematically inspected for MEC. A metal detector is sometimes used to supplement the visual search in areas where ground vegetation may conceal MEC. Typically, any MEC found during these searches is flagged or marked on a grid sheet for later removal.

The other form of MEC detection, geophysics, includes a family of detection instruments designed to locate MEC. This family of instruments includes magnetic instruments, electromagnetic instruments, and ground penetrating radar. Each piece of equipment has its own inherent advantages and disadvantages based on its operating characteristics, making the selection of the type of geophysical instrument paramount to the survey success. Nevertheless, geophysics is the most cost-effective method of conducting subsurface MEC surveys. The equipment designed for MEC geophysical surveys is lightweight, easily maintained, and very effective. However, there are limitations to geophysics.

MEC can be readily detected at the site using geophysical techniques. The handheld flux-gate magnetometers (i.e., Schonstedt GA-52CX) have been successfully used to "mag and dig" around buildings and structures where the EM61 suffers more from interference. Use of the handheld magnetometers can also be indicated by terrain where the ground surface (e.g., sloped or wooded terrain) may not be conducive to use of an EM61. A high degree of confidence should be expected for successful detection with these methods. However, it should be noted that there are limitations to their detection capabilities such as the depth of detection and interference from utilities, structures, and other metal in the vicinity. Time-domain electromagnetic induction metal detectors (i.e., Geonics EM61–MK2) can also be successfully used for digital geophysical mapping (DGM) at areas of the site. Although these geophysical instruments can be successful in finding MEC, only a percentage of the anomalies identified result in actual MEC.

Geophysical equipment cannot usually distinguish MEC items from other metallic objects located below the surface. "Cultural interference," such as underground utility lines, construction debris, or metal bearing rock, can produce a signature to the equipment similar to MEC. Therefore, it is necessary for the geophysical survey team to carefully document any known cultural interference prior to beginning the survey. Another limitation to the equipment is that metallic objects have to be larger when at greater depths so that the geophysical equipment can obtain a reading. The use of geophysical equipment and surveys has proven to be one of the most cost effective methods currently available to detect subsurface MEC. At the OD Grounds, it will be most effective to use handheld flux-gate magnetometers in wooded or inaccessible terrain and to use an EM61 for DGM in the open areas that require the detection of potential MPPEH.

2.7.1.2 Removal Technologies for MEC/MPPEH

Once a site has been surveyed by either visual or geophysical means, the recovery of MEC/MPPEH can begin. MEC recovery operations can take the form of a surface-only clearance, an intrusive (subsurface) clearance, or a combination of the two methods. The decision on the appropriate level of clearance operation is based on the nature and extent of the MEC contamination as well as the intended future use of the site. Removal technologies include hand excavation and mass excavation (using heavy mechanical equipment). Hand excavation is considered the industry standard for MEC recovery and can be done very thoroughly. Hand excavation was conducted during previous investigations at the OD Grounds. Construction support would include UXO personnel to provide sweeps to detect MEC prior to any planned construction.

During a surface clearance operation exposed MPPEH items are identified during the detection phase. The MEC items are then inspected, collected (if possible), and transported to a designated area for cataloging and eventual disposal. If it is determined during the MPPEH inspection that the item cannot be safely moved it may be necessary to destroy the MPPEH item in place.

During a subsurface clearance operation subsurface MPPEH identified by the geophysical survey or other detection methods require excavation for removal. The excavation of the MPPEH item then takes place with either hand tools or mechanical equipment depending on the suspected depth of the object. Once the item has been exposed, it is then inspected, collected (if possible), and transported to a designated area for cataloging and disposal. If it is determined during the inspection that the item cannot be safely moved, it will be destroyed in place.

Evacuations are sometimes necessary when conducting intrusive investigations to minimize the risk of the operation. An evacuation area is calculated by USACE based on the potential explosive force that could be encountered during an excavation. An evacuation distance is then calculated to ensure that all non-essential personnel are outside of that distance during the excavation process. Engineering controls can be developed to reduce this evacuation distance; however, evacuations may be required if excavations take place close to any inhabited areas and engineering controls cannot be developed to reduce the exclusion zone to preclude the need to evacuate. Every possible option will be explored to minimize potential evacuations with the exception of compromising public safety. Due to the remoteness of SEDA, it is unlikely that evacuations will be necessary during MEC clearance activities.

At the OD Grounds it is anticipated that hand digging will be used to remove MPPEH in areas at most of the Site (i.e., Kickout area – 1,000 to 2,500 foot radius). In areas of the Site close to the OD Hill, it may be more efficient to use mechanical excavation equipment and consolidate impacted soil.

2.7.1.3 Disposal Technologies for MEC

Disposal technologies include blow in place (BIP) and 'consolidate and blow.' For BIP, each munition is individually destroyed; whereas, the consolidated shot can be used for munitions that are "acceptable to move." The decision regarding which of these techniques to use is based on the risk involved in employing the disposal option, as determined by the specific area's characteristics and the nature of the MEC items recovered.

A countercharge can be used to destroy the MEC item or the MEC item can be thermally treated as a means of destruction. Engineering controls, such as sandbag mounds and sandbag walls over and around the MEC item, are often used to minimize the blast and fragmentation effects when an MEC item is destroyed in this manner.

In some instances it is determined that an MPPEH item must be destroyed in-place. This technique is typically employed when the item cannot be safely moved to a remote location. This procedure utilizes techniques similar to those described above that will detonate the MEC item or apply sufficient pressure and heat to neutralize the hazard. When this technique is employed, engineering controls such as sandbag mounds and sandbag walls over and around the MEC item are often used to minimize the blast effects.

2.7.1.4 Engineering Controls for MEC

Engineering controls for MEC would include such measures as installing an impermeable earth cover over the contaminated area to prevent contact with MEC. Such a cover would typically be installed after a surface clearance had been conducted, and LUCs (e.g., access and activity restrictions) would be implemented in conjunction the cover.

2.7.2 Technologies for Soil Remediation

Table 2-2 shows the remedial action processes arranged according to categories for general response actions for soil/debris at the OD Grounds and provides the basis for screening out of the various technologies/processes. This table indicates which technologies/processes were retained for further evaluation in **Section 3**.

2.7.2.1 Excavation: Earthmoving/Excavation

Removal of soils can be accomplished using standard mechanical technologies. Armored and unarmored heavy equipment such as backhoes, excavators, front-end loaders, scrapers, bulldozers, and draglines are commonly used for the mechanical excavation of soils. Because the soil at the OD Grounds is readily accessible and can be easily removed using standard mechanical excavation techniques, this technology was retained for further consideration. In the Kickout area, hand digging (activity associated with the MPPEH/MD removal) may be sufficient to remove the potential MEC. After the excavation, the MEC/MPPEH will be disposed of in a designated demolition area and soil may be backfilled (as necessary) to the excavated areas. Similarly, the removal of impacted soil through the use of standard mechanical excavation techniques was retained as a potential soil remediation technology.

Off-site disposal involves the certification that the material is free of MPPEH, consolidation of Material Documented as Safe (MDAS) and the affected soils into separate containers, and transportation off-site. This technology decreases continued on-site exposure to potential MPPEH and MC by receptors. MDAS would be recycled or melted off-site. Off-site disposal of contaminated soils is preferable when on-site disposal is precluded or limited by site characteristics, when unimpaired future use of the site is a high priority, and when the volume for disposal is too small to warrant construction of a landfill. In past projects at SEDA, the Ontario County Landfill in Stanley, NY was used as the permitted, off-site RCRA Subtitle D facility. This landfill has the capacity and capability to handle the disposal material and is approximately 20 miles from SEDA.

2.7.2.2 Capping and Containment Technologies

Capping involves placing a barrier over the impacted area to prevent contact (i.e. exposure to subsurface soil via direct contact and dust inhalation) with human and ecological receptors, and surface water runoff. Two single component cap options that are available to unlined landfill facilities consists of either a low permeability soil (LPS) cap or a geomembrane cap. The soil layer below the geomembrane will be free of sharp rocks and stones, to prevent damage to the overlying geomembrane to the possible extent. This remedial method may include 12-inches of sand above the geomembrane to promote drainage off of the cap, while also providing cap protection. A layer of sand could potentially be substituted by a geocomposite drainage layer and with 18 inches of select subsoil used. Six inches of topsoil would complete the protective layer to a total thickness of 18 inches. A non-woven geotextile fabric may be installed between the top soil and sand drainage layer if required. As required, surface and subsurface drainage will be controlled by swales or cap drains, respectively. These aspects are variable, depending on the relative geotechnical properties of each soil type used for the drainage layer and the top soil. Approximately 10 acres of the OD Hill area would be expected to be capped, covering approximately 75,000 cy of material. This capping/containment method would be effective in reducing the potential exposure to potential metallic debris and metals contaminated soil, and therefore has been retained for further consideration.

Table 2-2
OD Grounds Feasibility Study – Technology Screening

General Response Action	Primary Remedial Technology	Process Options	Screening: Technically Implementable?	Evaluation: Effectiveness	Implementability	Cost	Retained for Consideration?
No Action	None	None	N/A[1]	Effectiveness at achieving RAOs would not be demonstrated. Utilized as baseline for alternative comparison.	Readily implementable	No Cost	Yes
Hazard Management	Land Use Controls / Institutional Controls	Access Restrictions (fencing, signage)	Yes	Potentially effective in meeting RAOs.	Readily implementable.	Negligible cost. (Low capital, low maintenance.)	Yes
		Activity Restrictions (e.g., no intrusive activities allowed)	Yes	Potentially effective in meeting RAOs.	Readily implementable.	Negligible cost. (Low capital, low maintenance.)	Yes
		Deed Notice	Yes	Potentially effective in meeting RAOs.	Readily implementable.	Negligible cost. (Low capital, low maintenance.)	Yes
Remedial Action	MEC or Soil Removal	Hand Excavation	Yes	Potentially effective in meeting RAOs.	Readily implementable in most areas of Site	Moderate capital, no O&M.	Yes
	MEC or Soil Removal	Heavy Equipment Excavation	Yes	Potentially effective in meeting RAOs.	Reasonably implementable with coordination	Moderate capital, no O&M.	Yes
	Engineering Controls	Install soil cap[2]	Yes	Potentially effective in meeting RAOs.	Readily implementable	Moderate capital, low O&M.	Yes
	MEC or Soil Disposal	Soil disposal off-site (after MEC risks removed)	Yes	Potentially effective in meeting RAOs.	Readily implementable in most areas of Site	High capital, no O&M.	Yes

(1) Evaluation of the No-Action alternative is required to provide a baseline for comparison with other remedial technologies and alternatives; the No Action alternative is retained for further consideration throughout the FS.
(2) Engineering controls such as installation of an impermeable cover would need to be implemented in conjunction with LUCs (e.g., access and activity restrictions).

2.7.3 Land Use Controls (LUCs)

Risk and hazard management technologies include enforceable administrative institutional controls and/or physical measures (engineering controls) to prevent or limit exposure of receptors to MEC or MC. Deed notices, zoning ordinances, special use permits, and restrictions on excavation are examples of institutional controls. Physical barriers and access restrictions (e.g., fencing, locked gates, and warning signs) or activity restrictions (prohibiting intrusive activities) are examples of engineering controls. LUCs can be cost-effective, reliable, and immediately effective, and can be implemented either alone or in conjunction with other remedial components. Inspections and monitoring typically are required to document long-term effectiveness of LUCs. The administrative feasibility of and cost to implement LUCs depend on site-specific circumstances (e.g., whether or not a site is under the direct operational control of the DoD, or has been transferred to non-federal ownership).

2.7.4 Evaluation of Technologies

In the CERCLA process, the alternatives described above must be analyzed and screened against the three general categories of effectiveness, implementability, and cost to ensure that they meet the minimum standards of the criteria within each category. This screening will be performed for the alternatives chosen as possibilities at the OD Grounds. The three general categories are described below along with the specific evaluation criteria contained within each of the categories.

The effectiveness of an alternative refers to its ability to meet the clean-up objective within the scope of the response action. The effectiveness category is divided into four evaluation criteria. These include Overall Protection of Public Safety and the Human Environment; Compliance with ARARs; Long-Term Effectiveness; and Short-Term Effectiveness.

The implementability category includes the technical and administrative feasibility of implementing an alternative, the availability of various services and materials required during its implementation, and the acceptance local residents and agencies have expressed towards the various alternatives. The implementability category is divided into six evaluation criteria including: Technical Feasibility; Administrative Feasibility; Availability of Services and Materials; Property Owner Acceptance; Local Agency Acceptance; and Community Acceptance.

Finally, each alternative is evaluated to determine its projected overall implementation cost. Each of the evaluation criteria introduced above will be discussed in greater detail in **Section 3**.

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

3.1 INTRODUCTION

This section summarizes the remedial action alternatives that were developed from the technologies screened in **Section 2**. Prior to the development of alternatives, an evaluation of general response actions and a technology screening was performed for inclusion into proposed remedial action alternatives for the OD Grounds. Technologies were combined into alternatives considering potential waste-limiting and site-limiting factors unique to the OD Grounds and the level of technical development for each technology. This information was used to differentiate alternatives with respect to effectiveness and implementability. This FS focuses on identifying and evaluating alternatives for the OD Grounds.

3.2 DESCRIPTION OF ALTERNATIVES

The following remedial action alternatives were developed for the OD Grounds:

- Alternative 1: NFA
- Alternative 2: Geophysical mapping, intrusive investigation, capping, LUCs; and
- Alternative 3: Geophysical mapping, intrusive investigation, excavation, off-site disposal, and LUCs.

Technologies and processes associated with these actions were assembled into remedial action alternatives.

3.2.1 Alternative 1, No-Further Action

Alternative 1 is the no further action alternative. CERCLA and NYSDEC guidance for conducting feasibility studies recommends that the no-action alternative be considered against all other alternatives.

The no further action alternative would leave the OD Grounds undisturbed with the continuation of existing site security measures, such as locked gates, to prevent civilian access and direct contact with contaminated soil and possible exposure to potential MPPEH.

3.2.2 Alternative 2, Geophysical Mapping/Intrusive Investigation/Capping/LUCs

This alternative would complete the MPPEH clearance in areas that were not previously cleared by previous investigations (generally located in areas greater than 500 ft from the OD Hill). In the open and accessible areas, previously identified anomalies will be reacquired and removed. In areas that are wooded or inaccessible and were not previously cleared, mag and dig operations will be completed using a handheld magnetometer, such as a Schonstedt. In accessible areas that were not previously mapped (0 – 1,000 foot radius), DGM surveys will be conducted using EM61s over approximately 60 acres in the area surrounding the OD Hill.

It is anticipated that impacted soil will be encountered in areas located closer to the OD Hill (0 – 500 foot radius). At locations where the DGM survey and sampling data indicates that there is impacted soil, the surface soil will be excavated (exact depth to be determined, but assume 1.5 feet bgs or until impacts are no longer detected). The impacted soil will be consolidated and incorporated under the Site cap. The excavated area will then be resurveyed, and the results of the DGM survey will be used to demonstrate that any impacted soil is contained under the cap. For less impacted soil, the anomalies from the DGM surveys will be reacquired and intrusively investigated by a geophysicist and UXO dig team, in the same manner as the previous intrusive investigation in the Kickout area. A two-person UXO technician / demolition team will perform any required MPPEH demolition procedures. The demolition team will dispose of any MPPEH suspected of containing explosives/spotting charges or inaccessible voids by detonation. All MD will be certified and disposed of as MDAS in accordance with current regulations.

The non-impacted excavated soil will be placed on the OD Hill and the resulting surface will be compacted and graded. An engineered cap, covering approximately 7 acres in aerial extent and approximately 75,000 cy (+/- 35%) of material, will be installed over the OD Hill and the surrounding area. The cap will comply with NYS Part 360-2.13 requirements. A geomembrane layer will be installed and the total thickness of the cap will be at least 18 inches. Any identified soil with contaminant levels exceeding the Commercial SCOs would be incorporated under the cap. Soil outside the cap will be tested for compliance with Commercial SCOs. A design work plan will be prepared and the exact limits of the cap (and volume incorporated under the cap) will be determined during the design phase of the project.

LTM would include maintenance of the cap and LUC inspections. LUCs will be placed on the Site to prohibit the use of groundwater, prohibit digging, and prevent the use of the Site as a daycare or for residential activities. Access to and use of the groundwater will be restricted at the OD Grounds under the terms of the future ROD. The groundwater is not being used, and will not be used, as a potable water source. Currently, a non-groundwater sourced municipal water supply is available for SEDA. Subsequent to the remedial action, a groundwater sampling event will be conducted to confirm that the groundwater was not negatively impacted as a result of the remedial action.

Implementation of this alternative would be highly effective in achieving the RAOs, long-term effectiveness, preventing exposure, and implementability. The costs for this alternative are moderate.

3.2.3 Alternative 3, Geophysical Mapping/Intrusive Investigation/Excavation/Off-Site Disposal/LUCs

The geophysical mapping and intrusive investigation components of Alternative 3 are similar to Alternative 2, but this alternative would involve the excavation and off-site disposal of all soil containing MPPEH or contaminant concentrations that exceed cleanup goals in lieu of capping these soils. Similar to Alternative 2, reacquisition would be completed in the Kickout area. In areas outside of the OD Hill that are wooded or inaccessible and were not previously surveyed, mag and dig operations will be completed using a handheld magnetometer, such as a Schonstedt. In accessible areas that were not previously mapped (0 – 1,000 foot radius), DGM surveys will be conducted using EM61s over approximately 60 acres in the area surrounding the OD Hill. Areas with impacted soil delineated by the DGM will be excavated to native material (estimate 15,000 cubic yards). The soil will be mechanically processed to remove MPPEH and the overburden will be staged on-site for potential reuse and/or reincorporation to bring the excavated surface back to its original grade. A post-excavation confirmatory DGM survey will be conducted over the excavated area to confirm that all MPPEH is removed. In the event that the geophysical data suggests that the soil is still impacted, an additional 1-foot lift of soil would be excavated. The specific decision criteria regarding over-excavation will be detailed in the Work Plan. All MD will be certified and disposed of as MDAS in accordance with current regulations.

In Alternative 3, the OD Hill and the potentially impacted soil immediately surrounding it will be addressed by excavation and off-site disposal. An excavator would excavate the soils, which would then be processed using a screening table (or similar) to ensure the removal of all MPPEH. Prior to disposal, excavated soils will be sampled for RCRA hazardous waste characteristics to include a full Toxicity Characteristics Leaching Procedure (TCLP) analysis (TCLP VOCs, TCLP SVOCs, TCLP pesticides and herbicides, TCLP metals plus ignitability, corrosivity, and reactivity). Soils deemed free from MPPEH and meeting site cleanup standards will be left for potential re-use on-site. Post-excavation confirmatory (in-situ) soil will be sampled for metals by EPA method SW846 6010C. A sampling strategy for the soil within the 0 to 1,000-foot radius, including sample locations and the number of samples, will be detailed in a follow-on document subsequent to MEC clearance activities. Soil remaining on-site outside the cap will be tested for compliance with SCOs.

Upon completion of excavation and confirmatory sampling, the excavated areas would be graded and re-vegetated to promote positive drainage. The disturbed areas would be restored to the natural grade. Soils not appropriate for reuse at the Site (e.g., soils intermixed with debris or above the cleanup standards) will be disposed of at an approved Subtitle D landfill (e.g., Ontario County Landfill, Stanley, NY). Trucks will be staged to haul the excavated soil off-site to an approved landfill. Identified MPPEH will be demolished appropriately, as described in Alternative 2.

As in Alternative 2, part of Alternative 3 will include LUCs placed on the Site to prohibit the use of groundwater, to prohibit digging, and to prevent the use of the Site as a day care or for residential activities. Following the remedial action, a groundwater sampling event will be conducted to confirm that the groundwater was not negatively impacted by the remedial action.

Implementation of this alternative using excavation and off-site disposal would be effective in reducing the on-site toxicity, mobility, and volume of MPPEH and MC at the OD Grounds, and transfer the impact of the overall toxicity and volume to a controlled environment. The associated costs for excavation and off-site disposal are extremely high.

3.3 SCREENING CRITERIA

The alternatives assembled above will be screened for effectiveness, implementability, and cost. This screening process is used to select the most favorable alternatives for a detailed analysis. Although this is a qualitative screening, care has been taken to ensure that screening criteria are applied consistently to each alternative and that comparisons have been made on an equal basis, at approximately the same level of detail. The screening criteria include the following:

- **Effectiveness** – the degree to which an alternative reduces the toxicity, mobility, or volume through treatment; minimizes residual risks; and affords long-term protection.
- **Implementability** – the technical and administrative feasibility of implementing the alternative.
- **Cost** – the costs of construction and any long-term costs to operate and maintain.

- **Reduction of Toxicity, Mobility, or Volume through Treatment** – the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element.

The detailed analysis and evaluation in **Section 4** compare additional criteria for each of the alternatives. **Section 4** identifies the most practicable permanent solution as determined by the criteria specified in the NCP (40 CFR 300.430).

No Further Action (Alternative 1) does not implement any remedy to reduce the potential risk; therefore the Alternative does not provide long-term protection of either human health or the environment. Implementation of this alternative does not meet the effectiveness screening criteria. The feasibility and the cost both screen well. Although this alternative does not meet the effectiveness requirements, it is retained for further evaluation for comparative purposes.

Geophysical Mapping/Intrusive Investigation/Capping/LUCs (Alternative 2) would meet the effectiveness criteria for MEC, MPPEH, and soil. The Alternative will minimize exposure to any potential MPPEH by the completion of the intrusive investigation and the installation of the cap. The alternative is effective at reducing the exposure to MPPEH by removing any MPPEH from the Site, excavating contaminated soil, and installing a protective cap over soil potentially impacted by metals near the OD Hill. In the case that MEC is identified at the Site, the volume and/or mobility of the MEC would be reduced through intrusive investigation and removal. The implementation of LUCs would be effective at limiting public exposure to any potential contaminants remaining at the Site below the surface. Implementation is administratively and technically feasible, and the skilled labor (e.g., UXO technicians) is readily available to perform this work. The costs to complete this alternative, which are presented in **Section 4**, are moderate.

Geophysical Mapping/Intrusive Investigation/Excavation/Off-Site Disposal/LUCs (Alternative 3) would meet the effectiveness criteria for MPPEH and soil. This alternative is similar to Alternative 2, with the addition of excavation and off-site disposal of soil from the OD Hill instead of placement beneath a cap. The alternative will minimize exposure to any MPPEH by the completion of intrusive investigation of anomalies outside of the OD Hill and the excavation of soil at the OD Hill. The alternative is effective at reducing the exposure to MPPEH by permanently removing any MPPEH and contaminated soil at the Site. In the case that MEC is identified at the Site, the volume of the MEC would be reduced through intrusive investigation and excavation/off-site disposal. The implementation of LUCs would further be effective at limiting public exposure to any potential subsurface soil contamination remaining at the Site. Implementation is administratively and technically feasible, and the skilled labor (e.g., UXO technicians) is readily available to perform this work. The costs to complete this alternative, which are presented in **Section 4**, are high due to the excavation, screening, and off-site disposal costs.

4.0 DETAILED ANALYSIS OF RETAINED ALTERNATIVES

4.1 INTRODUCTION

The purpose of the detailed analysis is to evaluate and compare the identified alternatives and present a proposed plan to the regulatory agencies and for public review. The alternatives identified for the detailed analysis include the following:

- Alternative 1: No Further Action;
- Alternative 2: Geophysical mapping, intrusive investigation, capping, LUCs; and
- Alternative 3: Geophysical mapping, intrusive investigation, excavation, off-site disposal, and LUCs.

The alternatives are compared and evaluated with respect to seven evaluation criteria developed to address the statutory requirements and preferences of CERCLA. The seven criteria are as follows:

1. Overall protection of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume
5. Short-term effectiveness
6. Technical and administrative implementability
7. Cost

Two additional criteria, state and community acceptance of the remedy, can play a role in weighing the balance between remedies that are cost effective and meet other criteria. Public involvement activities help provide an understanding of these factors even though the Proposed Plan has not yet been issued.

The state and community acceptance criteria are based on the degree of assumed acceptance from the local public and from state agencies regarding the implementation of alternatives. These criteria cannot be fully evaluated and assessed until comments on the FS and the Proposed Plan are received.

Each of the three alternatives are analyzed individually against each criterion and then compared against one another to determine their respective strengths and weaknesses and to identify the key trade-offs. The alternative(s) identified as the most practicable solution in reducing the potential MPPEH and soil contamination exposure hazard is selected with respect to each evaluation criteria. The following sections describe each of the evaluation criteria and the evaluation process used for performing the analysis.

4.2 EVALUATION CRITERIA

Alternatives are compared and evaluated with the NCP criteria, including threshold factors, balancing factors, and modifying factors. The following sections describe the factors and each of the criteria.

4.2.1 Threshold Factors

Threshold factors (i.e., protectiveness, compliance with ARARs) are requirements that each alternative must meet or have specifically waived to be eligible for selection.

4.2.1.1 Overall Protection of Human Health and the Environment

The selected alternative must adequately protect human health and the environment from unacceptable risks posed by potential MPPEH. A human health risk assessment was conducted (**Appendix B**) and identified potential risks from exposure to groundwater and risks to potential future residents from soil and groundwater. The selected alternative must prevent exposure to the risks identified in the HHRA. The overall protectiveness to human health and the environment from the threat of MPPEH/MEC was evaluated by completing a MEC HA (**Appendix C**) based on the impact each alternative has on the exposure hazard (MPPEH) and on the environment. Although the potential for human receptors to come into contact with potential MPPEH at the OD Grounds is currently limited, the protectiveness criterion was evaluated in terms of possible human interaction by commercial/industrial workers (e.g., SEDA employees), and/or passive recreational users (e.g., hunters) based on the current and anticipated future land uses at the Site. Exposure involves three components: the MPPEH source characteristics, the receptor, and interaction between them. All three components are required for a safety threat from MEC/MPPEH to exist. The protectiveness factor also considers the environmental impact that implementation of an alternative has on the existing environmental/ecological factors at the OD Grounds. **Appendix C** discusses this in more detail.

4.2.1.2 Compliance with ARARs

The NCP requires that all project sites meet ARARs (or that an ARAR waiver be obtained). The ARARs are identified in **Section 2** of this FS Report. Chemical-specific, location-specific, and action-specific were evaluated. Compliance with the NYS SCOs was identified as a chemical-specific ARAR. The evaluation in **Section 2** indicates that further evaluation of location-specific and action-specific ARARs is not warranted.

4.2.2 Balancing Factors

Primary balancing criteria (i.e., long-term effectiveness, reduction, short-term effectiveness, implementability, cost) are those that form the basis for comparison among alternatives that meet the threshold criteria. CERCLA requires that alternatives be developed for treating principal threats at the project site through reductions in toxicity, mobility, or volume. In addition, remedies are required to be permanent (e.g., removal of MPPEH or soil contamination) to the maximum extent practicable, and to be cost effective. The five balancing factors described below are weighed against each other to determine which remedies are cost effective and are "permanent" to the maximum extent practicable. The NCP explains that in general, preferential weight is given to alternatives that offer advantages in terms of the reduction of toxicity, mobility, or volume through treatment, and that achieve long-term effectiveness and permanence. However, the NCP also recognizes that some contamination problems will not be suitable for treatment and permanent remedies. The balancing process takes that preference into account, and weighs the proportionality of costs to effectiveness to select one or more remedies that are cost effective. The final risk management decision in the Decision Document is one that determines which cost-effective remedy offers the best balance of all factors to achieve permanence to the maximum extent practicable.

4.2.2.1 Long-term Effectiveness and Permanence

The permanence criterion evaluates the degree to which an alternative permanently reduces or eliminates the potential for MPPEH or soil contamination exposure hazard. This criterion also evaluates the magnitude of residual risk with the alternative in place, and the effectiveness of controls to manage the residual risk.

4.2.2.2 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion addresses the statutory preference for selecting remedies that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. This preference is satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

4.2.2.3 Short-term Effectiveness

The short-term effectiveness criterion addresses the potential consequences and risks of an alternative during the implementation phase. Alternatives were evaluated for their effects on human health and the environment prior to the remedy being completed. Short-term risks address adverse impacts to the workers and community during the construction and implementation phases of the remedy.

4.2.2.4 Technical and Administrative Implementability

The technical and administrative implementability criterion evaluates the difficulty of implementing a specific cleanup action alternative. The evaluation includes consideration of whether the alternative is technically possible; availability of necessary on-site and off-site facilities, services, and materials; administrative and regulatory requirements; and monitoring requirements.

4.2.2.5 Cost

The cost criterion evaluates the financial cost to implement the alternative. This includes direct, indirect, and long-term operation and maintenance (O&M) costs (30-year duration). Direct costs are those costs associated with the implementation of the alternative. Indirect costs are those costs associated with administration, oversight, and contingencies. Cost estimates presented are order-of-magnitude level estimates. Based on a variety of information, including productivity estimates (based on site conditions), cost estimating guides, and prior experience at SEDA. The actual costs will depend on true labor rates, actual weather conditions, final project scope, and other variable factors. A present value analysis is used to evaluate costs (capital and operations/maintenance) which occur over different time periods. The total present value (TPV) is the amount needed to be set aside at the initial point in time (base year) to assure that funds will be available in the future as they are needed. A discount rate of 2% was used to estimate TPV per a 2014 update to the Office of Management and Budget (OMB) Circular A-94 for benefit-cost analyses of proposed federal programs, policies, and regulations (OMB, 1992).

4.2.3 Modifying Factors

Community and state acceptance of the remedy can play a role in weighing the balance between remedies that are cost effective and meet other criteria. Public involvement helps to provide an understanding of these factors even though the Proposed Plan has not yet been issued. The community and state acceptance criteria are based on the degree of assumed acceptance from the local public and from state agencies regarding the implementation of alternatives. These criteria cannot be fully evaluated and assessed until comments on the FS and the Proposed Plan are received.

4.3 INDIVIDUAL ANALYSIS OF ALTERNATIVES

4.3.1 Alternative 1 – No Further Action

4.3.1.1 Description

The no further-action alternative would leave the OD Grounds undisturbed with the continuation of existing site security measures, such as locked gates, to prevent civilian access and direct contact with, or possible exposure to, potential MPPEH and soil contamination. Because no remedial activities would be implemented with the NFA alternative, long-term human health and environmental risks for the site essentially would be the same as those represented in the baseline MEC HA (**Appendix C**). Future receptors will be exposed to risks from the pathways described in the HHRA (**Appendix B**).

4.3.1.2 Assessment

Threshold Factors

This alternative does not provide any protectiveness. The ARARs would not be met for the OD Grounds.

Balancing Factors

The no-action alternative includes no controls for exposure and no long-term management measures. All current and potential future risks would continue under this alternative.

This alternative provides no reduction in toxicity, mobility, or volume of MPPEH through treatment.

There would be no additional risks posed to workers or the environment as a result of this alternative being implemented.

There are no implementability concerns posed by this remedy, since no action would be taken.

The present worth cost and capital cost of Alternative 1 are estimated to be $0, since there would be no action.

Summary – Alternative 1

Alternative 1 does not reduce the potential exposure hazards. Alternative 1 does not provide overall protection to human health or the environment, as it does not implement a remedy to reduce potential MPPEH or contaminated soil exposure. In addition, there is no reduction in toxicity, mobility, or volume. No costs are associated with this alternative.

4.3.2 Alternative 2 – Geophysical Mapping, Intrusive Investigation, Capping, and LUCs

4.3.2.1 Description

This alternative includes a combination of activities to achieve a reduction in the MEC hazard.

1. Reacquire and intrusively investigate selected anomalies from previous DGM efforts (generally located in areas greater than 500 ft from the OD Hill). In the open and accessible areas, previously identified anomalies with a response greater than 50 millivolts (mV) will be reacquired and removed. In areas that are wooded or inaccessible and were not previously cleared, mag and dig operations will be completed using a handheld magnetometer, such as a Schonstedt.
2. Impacted areas (close to the OD Hill) – Conduct an initial DGM survey in areas that were not previously mapped. DGM surveys will be conducted using EM61s over approximately 60 acres in the area surrounding the OD Hill. At locations where the DGM survey and sampling data indicates that there is impacted soil, the soil will be excavated (exact depth to be determined, but assume 1.5 feet bgs or until impacts are no longer detected), consolidated, and incorporated under the Site cap. Subsequently, a DGM survey and confirmation sampling will be conducted over the area that was excavated to confirm that the impacts were removed. Based on results, additional areas may be excavated (if impacts persist) or point/polygon anomalies will be identified, reacquired and intrusively investigated. For the other areas, the anomalies on the generated dig list will be reacquired and intrusively investigated by a geophysicist and UXO dig team, and a mag and dig survey will be completed in areas near the OD Hill that are overgrown or sloped (e.g., where a DGM survey was not completed).

A two-person UXO technician/demolition team will perform any required MPPEH demolition procedures. The demolition team will dispose of any MPPEH suspected of containing explosives/spotting charges or inaccessible voids by detonation. All MD will be certified and disposed of as MDAS in accordance with current regulations. The excavated soil will be placed on the OD Hill and the resulting surface will be compacted and graded. An engineered cap at least 18-inches thick will be installed over the OD Hill and the surrounding area. The exact extent of the cap will be defined during the remedial design based on geophysical data and soil results. The estimated duration of the construction is 20 months.

LTM would include monitoring of the cap. It is not anticipated that groundwater is a medium of concern, but the water quality may be evaluated following completion of the construction. As such, LTM of existing and new groundwater wells would be assumed to be part of the alternative.

LUCs would be implemented at the Site to prohibit the use of groundwater, prohibit digging and prevent the use of the Site as a daycare or for residential activities.

4.3.2.2 Assessment

Threshold Factors

There is a high level of overall protectiveness of human health and the environment with the implementation of this remedy. Potential MPPEH would be removed from the Site and a cap would be installed to prevent contact with any metals-contaminated soil at the OD Hill. This is a long-term solution that would be highly protective with the LTM of the cap and the LUCs. During remedial actions, the community is shielded from construction activities by security measures already in place at the Site. The protection of Site workers will be ensured by using trained UXO personnel and by providing other personnel with UXO Technician escorts. The implementation of this alternative would result in decreased human receptor interaction and reduced exposure to potential MPPEH. As a result of access controls which reduce exposure to MPPEH, Alternative 2 is protective of human health; however, Alternative 2 cannot completely control behavior or restrict access to residual soil contamination. Additionally, although access to potentially contaminated soils will be prevented by the cap, Alternative 2 will allow residual contamination above NYS Commercial SCOs to remain at the Site therefore the Site is not suitable for residential activities. Alternative 2 prevents exposure to soil with concentrations above the SCO specified in the ARARs by preventing access to soils above the SCO through the use of a cap and LUCs.

Balancing Factors

It is possible that not all MPPEH contamination would be removed; therefore, risk would be managed not by source removal but through controls to limit an exposure pathway (i.e., interaction). Controls for exposure would include a NYS Part 360 cap, long-term management of the cap conditions, and LUC measures such as prohibition of digging or use for residential or daycare facilities. Long term management/monitoring would include inspections, maintenance of the cap and the LUCs, and performing five-year reviews. The LUCs would be maintained through the deed restriction/ environmental easement, and the implementation of the controls would be confirmed through LUC reviews and the 5-year review. Though impacted soil will remain on-site under the cap, there is no residual risk for human exposure while the LUCs are in place.

This alternative does not employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances.

There would be a potential short term impact during the demolition of any MEC items. A health and safety plan (HASP) would be prepared and all work would be conducted in accordance with the HASP and USACE UXO requirements. Mitigations strategies will be implemented during the demolition such that any potential risk to public health would be minimized.

The long-term effectiveness for the alternative is high since the intrusive investigations, surface excavations, cap, and LUC would be effective at limiting exposure pathways.

There are no implementability concerns posed by this alternative, and Alternative 2 is readily implementable from a technical perspective. Hand digging anomalies is a common and proven technique to address MPPEH.

The total capital cost for this alternative is $8.0M. The TPV (30-year present worth) cost of this alternative is estimated to be $8.9M. The capital costs include document preparation, implementation of the field work for the remedial action, design, etc. The total costs include $31,500 per year for LUC inspections and cap maintenance, plus $40,300 per five-year review over the 30 year period. If the Site cannot be used for unrestricted use, five-year reviews will continue beyond the 30-year cost period.

Summary – Alternative 2

The RAOs are achieved through implementation of this alternative through decreased human exposure to MPPEH; this alternative provides significant reduction in toxicity, mobility, or volume of MPPEH. This alternative provides for good long-term effectiveness and permanence and is easily implemented. The cost associated with implementing this alternative is moderate. There are minimal long-term maintenance costs.

4.3.3 Alternative 3 – Geophysical Mapping/Intrusive Investigation/Excavation/Off-Site Disposal/LUCs

4.3.3.1 Description

This alternative is similar to Alternative 2, although it includes excavation of the soil at the OD Hill followed by off-site disposal instead of placement below a cap.

The DGM, reacquisition, mag and dig surveys, and intrusive investigations steps described in Alternative 2 are included in Alternative 3 as well. An area surrounding the OD Hill will be delineated based on the DGM survey results. Soils will be excavated to native material. Excavated soils would be processed using a screening table (or similar) to identify and remove any potential debris or MPPEH. Excavated soils will be sampled, and soils deemed free from MPPEH and meeting site cleanup standards will be staged on-site for potential re-use. The excavated area will be graded and re-vegetated to promote positive drainage and to match the natural ground contour. Soils not appropriate for reuse at the Site (e.g., soils intermixed with debris or above the cleanup standards) will be disposed of at an approved Subtitle D landfill. Identified MPPEH will be demolished appropriately, as described in Alternative 2. The estimated duration of the construction is 30 months.

It is not anticipated that groundwater is a medium of concern, but the water quality may be evaluated following completion of the construction. As such, to evaluate the impacts of the remedial action on the groundwater, a post-remedial action groundwater sampling event of existing and potential new groundwater wells would be assumed to be part of the alternative.

LUCs will be placed on the Site to prohibit the use of groundwater, prohibit digging, and prevent the use of the Site as a day care or for residential activities.

Implementation of this alternative with excavation would be highly effective in reducing the toxicity, mobility, and volume of potential MPPEH and soil contamination. However, costs would for excavation and off-site disposal would be considered extremely high.

4.3.3.2 Assessment

Threshold Factors

There is a high level of overall protectiveness of human health and the environment with the implementation of this remedy. MPPEH and soil contamination would be removed from the Site through intrusive investigation and excavation. This is a long-term solution as both the MEC source and any soil identified outside of appropriate screening criteria would be removed. During remedial actions, the community is shielded from construction activities by security measures already in place at the Site. The protection of Site workers will be ensured by using trained UXO personnel and by providing other personnel with UXO

Technician escorts. The environment would be protected during excavation activities by using the proper construction best management practices. The implementation of this alternative would eliminate any potential exposure to MPPEH by permanently removing the soil and the MPPEH and minimizing concern of residual MPPEH. Alternative 3 will comply with the chemical-specific ARARs identified for the Site by the client subsequent to selection of an alternative remedy detailed in this FS. Chemical-specific ARARs will be addressed by achieving the Commercial SCOs for soil remaining on-site.

Balancing Factors

Alternative 3 would meet the long-term effectiveness and permanence criteria through the removal and proper disposition of MPPEH and off-site disposal of soil contamination. There would be significant reduction of toxicity, mobility, or volume at the Site through removal of MPPEH and contaminated soil. Though it is noted that no treatment will be employed.

This alternative would have moderate implementability rating given the permitting and logistics requirements for the off-site disposal of the excavated material.

There would be a potential short term impact during the demolition of any MEC items. A HASP would be prepared and all work would be conducted in accordance with the HASP and USACE UXO requirements. Mitigations strategies will be implemented such that any potential risk to public health would be minimized.

The long-term effectiveness for the alternative is high since the intrusive investigations, excavation, off-site disposal, and LUCs would be effective at limiting exposure pathways. The risk of exposure to MC or MPPEH would be removed from the Site.

There is a high cost for this alternative, with a total capital cost of $27.6M. The TPV (30-year present worth) cost of this alternative is estimated to be $28.0M. The capital costs include document preparation, implementation of the field work for the remedial action, design, excavation. The total costs include $10,800 per year for LUC inspections, plus $40,300 per five-year review over the 30 year period. If the Site cannot be used for unrestricted use, five-year reviews will continue beyond the 30-year cost period. If the Site is approved for unlimited use/unrestricted exposure, the five-year reviews may be terminated.

The MPPEH contamination would be removed; therefore, long-term management and permanence would be achieved by source removal.

Summary – Alternative 3

The RAOs are achieved through implementation of this alternative through decreased human exposure to potential MPPEH; this alternative provides good reduction in toxicity, mobility, or volume of MPPEH. This alternative provides for good long-term effectiveness and permanence. The alternative will require some permitting to be implemented. The cost associated with implementing this alternative is very high.

4.4 COMPARATIVE ANALYSIS OF ALTERNATIVES

In the following analysis, the alternatives are evaluated in relation to one another for each of the evaluation criteria to identify the relative advantages and disadvantages of each alternative in terms of the threshold and balancing criteria. **Table 4-1** ranks the alternatives, and **Table 4-2** summarizes the costs for these alternatives. Details regarding the comparative analysis are provided in the following sections.

4.4.1 Overall Protection of Human Health and the Environment

The protectiveness criterion was evaluated in terms of possible human and ecological interaction with potential MPPEH or soil contamination. Each alternative was evaluated in terms of whether it would reduce or remove the amount of MPPEH and/or soil contamination at the OD Grounds. Alternatives 2 and 3 are ranked equally favorably. Alternatives 2 and 3 both provide good protection of both human health and the environment by limiting exposure to MPPEH or soil contamination. The limitation of Alternative 2 with regards to environmental protection is the potential for soil contamination remaining under the soil cap above screening criteria; however, the implementation of LUC would make Alternative 2 equally protective of human health. Alternative 3 has a high level of permanence since soil and MPPEH would be removed off-site and analytical sampling would confirm that remaining in-situ soils were below the selected screening criteria. With both Alternatives 2 and 3, there continues to be the possibility that all MPPEH may not have been identified and there is a residual risk that some MPPEH may remain on-site. The LUCs component of the remedies proposed in Alternatives 2 and 3 makes each alternative equally protective of limiting exposure.

Alternative 1 provides the least overall protection of human health and the environment because it does not remove or restrict access to potential MPPEH or reduce the in-situ toxicity, mobility, and volume of soil contamination.

4.4.2 Compliance with ARARs and Issues To Be Considered

Alternatives 2 and 3 are equally ranked as both comply with the chemical-specific ARAR identified for the OD Grounds and each of these alternatives provides a mechanism for either removing or controlling exposure to contaminated soil. However, Alternative 1 does not provide a mechanism for removing or controlling exposure to MPPEH contamination and does not comply with the ARAR.

4.4.3 Long-term Effectiveness and Permanence

The permanence criterion evaluates the degree to which an alternative permanently reduces or eliminates the potential for MPPEH or contaminated soil exposure hazards. Alternative 3 provides a higher degree of long-term effectiveness and permanence based on the permanence of removing metals contaminated soil from the OD Hill Site. Alternative 2 was determined to provide good effectiveness by reducing possible receptor interaction with MPPEH or contaminated soil. Alternative 1 offers no long-term effectiveness and permanence.

4.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 2 and 3 offer a reduction in toxicity and mobility by completing the intrusive investigations and either capping or excavating the impacted soil. Alternative 1 offers no reduction in toxicity, mobility, or volume of contaminants and was assigned the lowest ranking. Alternative 3 offers the strongest approach to the removal of all toxicity from the Site since any contamination would be removed from the Site rather than managed. Alternative 3 offers volume reduction on-site by disposal of soil off-site; although the toxicity is reduced at the Site this alternative does not include any treatment of the removed soil.

4.4.5 Short-term Effectiveness

No additional risk to the community, Site workers, or the environment is provided by Alternative 1; however, Alternative 1 is determined to have the greatest risk and least short-term effectiveness due to no actions taken to remove the MPPEH and contaminated soil risk therefore a continued impact for existing conditions will persist.

Locally, during implementation of Alternatives 2 and 3, a temporary increase in dust may be associated with cap installation and/or excavation; however, the local community is generally buffered from these activities due to the location of the Site within SEDA. Both Alternative 2 and 3 would require UXO personnel who would be exposed to explosive hazards. Alternative 2 requires less excavation than Alternative 3; however, both require the installation of a soil cap; therefore, protection would be required against dermal contact and dust inhalation during construction activities.

Both Alternative 2 and 3 would provide similar short-term effectiveness in a similar amount of time (i.e., months). Alternatives 2 and 3 include demolition of recovered MPPEH thus quickly reducing the explosive hazard at the Site. Alternative 3, which includes off-site transportation and disposal, has a short-term negative impact of hauling materials on public roads outside of the Depot, which can impact the surrounding community. Alternative 2 is the most favorable for short-term effectiveness as it eliminates exposure to human health and the environment by the active remediation steps and the implementation of the LUCs.

4.4.6 Implementability

Alternative 1 is the easiest to implement since it requires no action. Alternatives 2 and 3 are both technically and administratively feasible. The DGM and intrusive investigations use standard techniques common to munitions work. Both alternatives will require LTM of the LUCs. Alternative 3 has the additional burden of satisfying local, state, and federal permitting require meetings for transportation and disposal; therefore, Alternative 2 is the more feasible option.

4.4.7 Cost

The cost criterion evaluates the financial cost to implement the alternative. The cost criterion includes direct, indirect, and long-term maintenance (O&M) costs. Direct costs are those costs associated with the implementation of the alternative. Indirect costs are those costs associated with administration, oversight, and contingencies. These costs were adapted from costs associated with similar activities at the Depot. These costs presented do not include costs for SEDA to administer and provide oversight for the respective activities.

The actual costs will depend on true labor rates, actual Site conditions, final project scope, and other variable factors. The alternative with the lowest cost to implement would be Alternative 1, which requires no action; therefore, no costs are incurred. Alternative 2 requires moderate costs compared to Alternative 3 which is the most costly to implement. Alternative 3 is an order of magnitude higher than the cost of Alternative 2.

Costs range from $0 (Alternative 1) to approximately $28.0M (Alternative 3). Alternative 3 has the highest cost because of the costs incurred for the excavation, transportation, and off-site disposal. **Table 4-2** summarizes costs for all alternatives, and **Appendix D** provides additional cost information.

4.4.8 State Acceptance

State acceptance cannot be fully evaluated and assessed until comments on the FS and the proposed plan are received. Modifying criteria (i.e., state and community acceptance), however, are considered in remedy selection. It is anticipated that Alternative 1 would not be acceptable to the state due to its lack of long-term effectiveness.

4.4.9 Community Acceptance

Community acceptance cannot be fully evaluated and assessed until comments on the proposed plan are received.

4.4.10 MEC Hazard Assessment Results

Based on the MEC HA conducted for each assessment area (provided in **Appendix C**), with regards to the reduction of potential MEC hazards, Alternative 2 and Alternative 3 provide identical levels of reduction of MEC hazards compared to the baseline condition. The MEC HA is summarized in Section 1.5 and presented in full in **Appendix C**. Implementation of Alternative 2 or 3 would decrease the hazard level rating to a "4", "low potential explosive hazard conditions". Note that these total MEC HA scores and the associated hazard levels are *qualitative references only* and should <u>not</u> be interpreted as quantitative measures of explosive hazard.

4.4.11 Summary of Comparative Analysis

The three alternatives were evaluated in terms of seven criteria. **Table 4-1** summarizes the alternatives and identifies the most practicable solution for reducing the potential MPPEH exposure hazard at the OD Grounds. In some cases, more than one alternative was identified within the same evaluation category, indicating that those alternatives have similar compliance with the criterion.

Alternative 1 must be ruled out because it is ineffective in long-term permanence and does not achieve the RAOs. Overall, Alternatives 2 and 3 have similar levels of protectiveness, permanence, long-term effectiveness, and short-term effectiveness. They will both limit exposure to potential MPPEH or contaminated soil. Alternative 3 ranks higher for the reduction of toxicity, mobility, or volume due to the volume reduction of off-site disposal. Alternative 2 rates more favorably for implementability. Alternative 2 ranks better in terms of cost.

Based on a comparison of the criteria, the highest ranked remedy for the OD Grounds is Alternative 2, DGM Mapping, intrusive investigation, cap, and LUCs. Alternative 2 limits human exposure to potential MPPEH or soil contamination, is implementable using known techniques, and is cost effective. The capital cost for the alternative is $8.0M. The TPV is $8.9M. The total costs include $31,500 per year for LUC inspections and cap maintenance, plus $40,300 per five-year review over the 30 year period.

Table 4-1
Ranking of Alternatives

Alternative No.	Description	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction through Treatment	Short-Term Effectiveness	Implementability	Cost	Total Score	Overall Ranking
1	**No Further Action**	1	1	1	1	3	3	3	13	# 3
2	**Geophysical Mapping/Intrusive Investigation / Capping/LUCs**	3	3	2	2	2	2	2	16	# 1
3	**Geophysical Mapping/Intrusive Investigation / Excavation/Off-Site Disposal/LUCs**	3	3	3	3	1	1	1	15	# 2

Notes:

1) Alternatives were scored 1 to 3 for each screening criterion. A score of 1 represents the least favorable score and a score of 3 represents the most favorable score.

2) The alternative with the highest total score represents the most favorable alternative. Within each screening criterion, alternatives were scored from one to three for each subcategory.

3) The total score of all subcategories is the basis for the scoring for the screening criterion.

Table 4-2
Remedial Alternatives Cost Summary

Alternative	Description	Capital Cost	Annual LTM Cost	Five-Year Review Cost (per event)	TPV at 2% Discount Rate
1	No Further Action	$0	--	--	--
2	Geophysical Mapping/Intrusive Investigation/Capping/LUCs	$7,977,000	$31,500	$40,300	$8,856,000
3	Geophysical Mapping/Intrusive Investigation/Excavation/Off-Site Disposal/LUCs	$27,552,000	$10,800	$40,300	$27,967,000

Notes:

1) Discount rate of 2% per OMB (2014) and USEPA (2000) guidance was used to estimate TPV.

2) TPV includes six five- year review events and the long-term monitoring.

FIGURES

APPENDICES

APPENDIX A

OD GROUNDS ANALYTICAL DATA

APPENDIX B

HUMAN HEALTH RISK ASSESSMENT

APPENDIX C

MEC HAZARD ASSESSMENT

APPENDIX D

DETAILED COST ESTIMATE

APPENDIX E

RESPONSE TO COMMENTS