Final

ENGINEERING EVALUATION/COST ANALYSIS KNOWN DISTANCE RANGE MUNITIONS RESPONSE SITE BERM AREA

MUNITIONS RESPONSE SERVICES
MILITARY MUNITIONS RESPONSE PROGRAM
CAMP DAWSON
KINGWOOD, WV

Contract No.: W912DR-09-D-0006

Delivery Order No.: 0008

JUNE 2014

Prepared For:

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT
Baltimore, MD 21203

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LIST OF ACRONYMS AND ABBREVIATIONS

%R	percent recovery
°F	Fahrenheit
µg/dL	micrograms per deciliter
AMEC	AMEC Earth and Environmental, Inc.
amsl	above mean sea level
ARAR	Applicable or Relevant and Appropriate Requirement
ARNG	Army National Guard Directorate
BLL	blood lead level
CDC	Centers for Disease Control and Prevention
CDCTC	Camp Dawson Collective Training Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CLU-IN	Clean-up Information Bulletin Board - EPA Technology Innovation Office
COC	contaminant of concern
CSF	cancer slope factor
CSR	Code of State Regulations
DENIX	Defense Environmental Network & Information Exchange
DoD	Department of Defense
DOT	United States Department of Transportation
DQI	data quality indicator
DQO	data quality objective
EDS	Environmental Data Services, LP
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FS	feasibility study
ft	foot
ft bgs	feet below ground surface
ft^2	square foot
GPS	global positioning system
HRR	Historical Records Review
ICP	inductively coupled plasma
IEUBK	Integrated Exposure Uptake Biokinetic Model
KD	Known Distance

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MMRP	Military Munitions Response Program
MRS	munitions response site
MS/MSD	matrix spike/matrix spike duplicate
MT2	MT2, LLC
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDNODS	Non-Department of Defense, Non-Operational Defense Site
NGYCP	National Guard Youth Challenge Program
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Services
NTCRA	non-time-critical removal action
NTIS	National Technology Information Service
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PA	preliminary assessment
PPE	personal protective equipment
QA	quality assurance
QC	quality control
QSM	Quality System Manual
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
RPD	relative percent difference
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	site inspection
SOP	standard operating practice
SRE	streamlined risk evaluation
TBC	to be considered

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

TCLP	toxicity characteristic leaching procedure
TCRA	time-critical removal action
TMV	toxicity, mobility, and volume
UCL	upper confidence limit
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
VISITT	Vendor Information System for Innovative Treatment Technologies
VRRR	Voluntary Remediation and Redevelopment Rule
WESTON®	Weston Solutions, Inc.
WVARNG	West Virginia Army National Guard
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Department of Natural Resources
WVU	West Virginia University
XRF	X-ray fluorescence
yd^3	cubic yard

1. INTRODUCTION, BACKGROUND, AND ENVIRONMENTAL SETTING

The Engineering Evaluation/Cost Analysis (EE/CA) was prepared to evaluate the response alternatives to address lead-contaminated soils at the former target and impact berms at the small arms range in the Known Distance (KD) Range Munitions Response Site (MRS), Camp Dawson, Kingwood, West Virginia. The EE/CA was conducted through Contract No. W912DR-09-D-0006, Delivery Order No. 0008. For the purposes of the EE/CA, the former target and impact berms at the small arms range will be referred to as the KD Range MRS Berm Area.

Delivery Order No. 0008 includes environmental services at two Military Munitions Response Program (MMRP) sites. The KD Range MRS, which is being tracked under Army Environmental Database Restoration number CPDW-002-R-001, is a 157.5-acre area located in the northeastern portion of Camp Dawson Cantonment. The EE/CA Approval Memorandum for Proposed Non-Time-Critical Removal Action (NTCRA), Camp Dawson Known Distance Range, Camp Dawson, West Virginia, was approved on April 23, 2013. The EE/CA Approval Memorandum provides supporting information for the following: lead-impacted soils were identified during the site inspection (SI) at the KD Range MRS Berm Area, and there is a substantial threat of ongoing and future releases into the environment that pose an imminent and substantial threat to the public health or welfare or the environment. The portion of the KD Range MRS that is the subject of the EE/CA Approval Memorandum is an area of approximately 2.4 acres associated with the former small arms range, specifically, the KD Range MRS Berm Area.

The EE/CA was approved because the four factors outlined in Section 300.415(b)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) are applicable:

(i) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants;

(ii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

(iii) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate; and

(iv) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.

Based on these factors, the conditions at the KD Range MRS Berm Area allow the exposure of nearby human populations to lead contamination.

A *Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP), Known Distance Range Munitions Response Site Engineering Evaluation/Cost Analysis Berm Soil Sampling Work Plan* was developed and approved by the West Virginia Department of Environmental Protection (WVDEP) on September 11, 2013, to provide additional site characterization and site conceptual model data. As stated in the approved UFP-QAPP, ecological receptors will be considered in the remedial investigation (RI) phase of the KD Range MRS project. The primary goal of the EE/CA for the KD Range MRS Berm Area is to evaluate removal actions to mitigate lead contamination that is a threat to the current and future human and ecological populations using the area. Further evaluation of potential risk to the environment will be assessed following the removal action and as part of the RI.

1.1 OBJECTIVES AND SCOPE OF THE EE/CA

1.1.1 Objectives

Soil sampling conducted during the SI (AMEC, 2012) at the KD Range MRS Berm Area shows the existence of significant levels of lead as a result of the historical use of the target and impact berms by the Army National Guard (ARNG) and the West Virginia Army National Guard (WVARNG) as a KD shooting range. The sampling results show concentrations of lead in the soils pose a potential risk to future human receptors at the KD Range MRS. The objectives of the KD Range MRS Berm Area EE/CA are to: (1) present the results of the October 2013 characterization/sampling event, (2) evaluate alternatives, and (3) recommend as a removal action alternative an NTCRA for soils at the KD Range MRS Berm Area. The thresholds of significance and the removal goals for lead in soils are presented in Section 3 of the EE/CA. The risk-based criteria were developed using both the current use and future use scenarios.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S.C. 9601) and the NCP (40 CFR 300.5) define removal actions as including "the cleanup or removal of released hazardous substances from the environment, such actions as may necessarily be taken in the event of the threat of release of hazardous substances into the environment, such actions as may be necessary to monitor, assess, and evaluate the release or

threat of release of hazardous substances, the disposal of removed material, or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release" (U.S. Environmental Protection Agency [EPA], 1993). EPA has classified removal actions into three types: emergency, time-critical, and non-time-critical, based on the type of situation, the urgency and threat of the release or potential release, and the subsequent time frame in which the action must be initiated.

The KD Range MRS Berm Area EE/CA was developed to support an NTCRA at the KD Range. An NTCRA is designed to be a response to releases requiring action, which can start later than 6 months after the determination that a response is necessary. Each response is unique and may require more expedited actions based on the threatened population, contaminants of concern (COCs), site characteristics, and other factors. The NCP Section 300.415(b)(2) factors were considered in determining the appropriateness of the removal action to abate, minimize, stabilize, mitigate, or eliminate the threat of a release from the KD Range MRS Berm Area.

1.1.2 Scope and Goals

The KD Range MRS Berm Area EE/CA was developed in accordance with *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, EPA 540-R-93-057, August 1993 (EPA, 1993). Chapter 2 of the EPA document provides guidance for conducting an EE/CA to analyze removal action alternatives for a site. An EE/CA, which is required for an NTCRA under the NCP, Section 300.415(b)(4)(i), provides a structure for the evaluation and recommendation of an appropriate removal action and a vehicle for public involvement. The EE/CA process includes a streamlined risk evaluation (SRE) as an intermediate process to evaluate risk. The streamlined risk evaluation used for the KD Range MRS Berm Area EE/CA is a screening level risk assessment.

The goals of an EE/CA are to identify the removal action objectives; to compare the cost, effectiveness, and implementability of various alternatives that may be used to satisfy these objectives; and to determine an appropriate removal action. The KD Range MRS Berm Area EE/CA and resulting NTCRA are being performed to achieve timely remediation of lead-contaminated soil at the KD Range MRS Berm Area.

The ARNG objective for the KD Range MRS Berm Area is to comply with CERCLA and applicable state risk-based standards and to make the property suitable for current and future use. The information from the KD Range MRS Berm Area EE/CA and the NTCRA will be incorporated into the Camp Dawson KD Range MRS and Stokes Mortar Range MRS RI and the feasibility study (FS).

1.1.3 Report Organization

KD Range MRS Berm Area EE/CA is organized into the following sections:

- The remainder of Section 1 provides information about the site background, including site description and history and the environmental setting information.
- Section 2 provides the results from the October 2013 EE/CA site characterization, including descriptions of the investigation techniques and analytical data.
- The SRE is presented in Section 3.
- Section 4 presents the identification of the removal action goal and objectives, and the schedule.
- The removal action alternatives are described and evaluated in Section 5.
- Comparative analyses of the removal action alternatives and the recommended alternative are presented in Sections 6 and 7, respectively.
- References are provided in Section 8.

Tables follow their first reference, and figures are presented at the end of each section. Supporting information from the field investigations, risk evaluation, and cost estimates is provided in the appendices to the KD Range MRS Berm Area EE/CA.

1.2 SITE BACKGROUND

1.2.1 Camp Dawson

Camp Dawson is a WVARNG facility located approximately 3 miles east of the City of Kingwood and extends across the Portland and Kingwood districts in Preston County, West Virginia (see **Figure 1-1**). The Camp Dawson Collective Training Center (CDCTC) consists of an approximately 4,125-acre training area that is divided into the following four main tracts: Camp Dawson Cantonment (also referred to as “Camp Dawson Proper”) (430 acres), Volkstone

(504 acres), Pringle Tract (2,134 acres), and Briery Mountain (1,057 acres). Camp Dawson Cantonment is bordered by the Preston Country Club and golf course, undeveloped wooded land, rural single-family homes, and the Cheat River.

Camp Dawson operated as a seasonal camp, with troop training occurring from its creation in May 1909 to the start of World War I. Training restarted in 1928 after World War I, and the facility was then used for training and as a camp for World War II prisoners. During World War II, ownership was transferred from the state to the federal government and back to the state in 1946. In 1985, the seasonal camp was turned into a permanent, year-round training facility. The change in mission from seasonal training to permanent training provided multi-purpose training opportunities. Camp Dawson is currently owned and operated by the State Armory Board, Department of Public Safety and Military Affairs, on behalf of the WVARNG.

Military units from West Virginia and several other states currently use Camp Dawson for various training and maneuver exercises, including small arms and nonmechanized tactical maneuver training and field exercise. In addition to the National Guard units, Army Reserve; Reserve Officers Training Corps; Active Army; and active and reserve units of the Navy, Air Force, and Marine Corps have trained at Camp Dawson. Non-Department of Defense (DoD) federal and state agencies also use Camp Dawson for training.

The KD Range MRS is a 157.5-acre area located in the northeastern portion of Camp Dawson Cantonment (see **Figure 1-2**) and includes the former KD small arms range, the suspected impact area for 3-inch Stokes mortar training, and the Stokes mortar target outfall area. The former KD small arms range consists of firing points and the target area/berm and impact berm. The section of the KD Range MRS that is the subject of the EE/CA is an area of approximately 2.4 acres associated with the former small arms range, specifically, the KD Range MRS Berm Area. The former KD range was used for small arms training from 1906 until 1997.

1.2.2 Previous Investigations

Several previous investigations and removal actions for munitions and explosives of concern (MEC) and munitions constituents (MC) have been conducted under the Camp Dawson MMRP, including a geophysical survey and anomaly assessment, a Preliminary Assessment (PA), a time-

critical removal action (TCRA), and a Historical Records Review (HRR)/SI. **Figure 1-3** presents exceedances of lead found in the berm area of the KD Range during the SI.

1.2.2.1 Geophysical Survey and Anomaly Assessment

The WVARNG conducted a geophysical survey and an anomaly assessment in 2009 after encountering a fuzed 3-inch Stokes mortar during construction of the Mountaineer Challenge Academy building, which is near the former small arms range within the KD Range MRS. The geophysical survey and anomaly assessment were performed to determine the potential for encountering MEC during military construction projects planned within the KD Range MRS. As reported in the final SI Report (AMEC, 2012), a total of 360 anomalies were identified as potential MEC and were investigated. Nine of the items were classified as MEC; however, no items were found within the KD Range MRS Berm Area.

1.2.2.2 Preliminary Assessment

A PA was conducted by the ARNG Directorate in 2009 to determine whether Camp Dawson Cantonment, specifically the KD Range MRS, was eligible for inclusion in the MMRP. The PA documented historical range use within the KD Range MRS, including the small arms training range and a former Stokes mortar range. The small arms range was active from approximately 1906 through 1997.

Information presented in the PA indicates Stokes mortar training occurred from approximately 1918 to World War II. The PA identified approximately 330 acres (of 430 acres) in Camp Dawson Cantonment as containing or suspected to contain munitions from previous use of the Stokes mortar range. Munitions density was identified as low. The predominant munitions type at Dawson Cantonment is the 3-inch Stokes mortar, which was suspected to have been fired from the southern banks of the Cheat River toward the hillside along the southern boundary of Camp Dawson Cantonment. Additional documented munitions include 81mm practice mortars and 75mm projectiles. In the PA report (ARNG, 2009), it was concluded that the KD Range MRS (and the Stokes Mortar Range MRS) met the MMRP eligibility requirements; therefore, these MRSs were recommended for further investigation under an SI phase. In addition, a TCRA was recommended for areas of the KD Range MRS where construction was planned.

1.2.2.3 Historical Records Review

An HRR was conducted in 2010 to identify potential MRSs where training and disposal activities might have occurred at Camp Dawson. Information resources used in the research included the following:

- Archival research was performed at the National Archives; the West Virginia State Archives; and other federal, state, and local agencies.
- Historical aerial photographs of Camp Dawson.
- Historical records, including the deed for Camp Dawson.
- Historical articles from local sources, including the WVARNG, historical societies, the *Preston County Journal*, and West Virginia University.
- Personnel interviews.

The results from archival research, historical records, and review of aerial photographs confirmed the use of Camp Dawson as a small arms and mortar training range from the early 1900s through the present. The information obtained during personnel interviews was used to identify potential MRSs at Camp Dawson where training and disposal activities may have occurred. The results of the personnel interviews indicated that two MRSs are present at Camp Dawson, the KD Range MRS and the Non-Department of Defense, Non-Operational Defense Site (NDNODS) Rocket Range MRS. The HRR is included in the SI Work Plan (AMEC, 2011). The KD Range MRS was subdivided into two MRSs during the SI: the KD Range MRS and the Stokes Mortar Range MRS.

1.2.2.4 Site Inspection

The SI field investigation was conducted from July 12, 2011, to July 14, 2011. The primary objectives of the SI were to collect the appropriate amount of information to support recommendations of No Further Action, immediate response, or further characterization concerning the presence of MEC and/or MC at each MRS. The following sections describe the SI field work, results, and conclusions for the impact berms in the KD Range MRS.

1.2.2.4.1 SI Results – KD Range MRS

An analog visual survey was conducted over the small arms range impact berm area. The survey was completed over nine transects spaced approximately 60 feet apart, totaling approximately 1,522 linear feet or 0.35 acre. The analog visual surveys were performed using a handheld

magnetometer with global positioning system (GPS) instrumentation to record transect pathways and anomaly locations. No intrusive work at anomaly locations was performed during the SI. No MEC or munitions debris (MD) was observed during the surveys.

Thirteen surface and subsurface soil samples, including QC samples, were collected at the small arms range target berm. The total lead screening criterion used in the SI was 400 milligrams per kilogram (mg/kg), which is the EPA Regional Screening Level for lead (EPA, 2013). Total lead exceeded the screening criterion in seven of the samples collected.

A summary of the SI recommendations for the KD Range MRS is provided in **Table 1-1**.

Table 1-1 Summary of SI Recommendations

MRS Name/ AEDB-R ID	Area (acres)	Recommendations		Basis for Recommendation	
		MEC	MC	MEC	MC
KD Range MRS/ CPDW-002-R-001	157.5	Conduct remedial investigation	Conduct remedial investigation	MEC and MD have been identified within the MRS boundary. Extent unknown.	Lead detected above screening criterion (400 mg/kg).

1.3 SOILS

The Natural Resources Conservation Service (NRCS) Soil Survey of Preston County, West Virginia, indicates that the impact berms area of the KD Range MRS consists of Philo silt loam, with fill material. The impact berms are manmade of primarily fill material. The source of the fill is unknown. Philo silt loam is described below.

Unit Name	Surface	Subsoil	Substratum	Drainage	Erosion Potential
Ph - Philo silt loam	Brown silt loam	Brown silt loam	Variegated gray and strong brown loam, underlain by stratified sand and gravel	Moderately well drained; very low potential for surface runoff	Moderate

1.4 GEOLOGY

Camp Dawson is located in the Cheat River Valley of the Appalachian Plateau physiographic province of north-central West Virginia. The geology consists of Quaternary aged alluvium from the Cheat River, underlain by the shale and sandstone of the Pennsylvanian aged Allegheny Formation. The terrain is relatively flat from the bank of the Cheat River for approximately 3,000 feet (ft) southeast, where the elevation increases sharply to the top of the Cheat River Valley. Camp Dawson Cantonment, including the KD Range MRS, is composed of overburden soils consisting of alluvial deposits from the Cheat River overlying fractured sedimentary bedrock, generally at a depth of approximately 30 ft. Bedrock underlying Camp Dawson Cantonment is typically mapped as shale, although sandstone is also encountered. Previous geotechnical investigations show the overburden lithology ranges from silty clays to gravel and sands with silty sands typically overlain by silty clays. Soils encountered in the October 2013 KD Range MRS Berm Area investigation were silt loam with some gravel and organics.

1.5 TOPOGRAPHY, SURFACE WATER DRAINAGE, AND HYDROGEOLOGY

1.5.1 Topography and Site Features

Camp Dawson Cantonment lies within a relatively flat area in the Cheat River Valley at an elevation of approximately 1,250 ft above mean sea level (amsl). The flat area constitutes the floodplain of the Cheat River. The topography of the Camp Dawson Cantonment ranges from approximately 1,240 to 1,740 ft amsl. The elevations of the target and impact berms at the KD Range MRS, which are the subject of the EE/CA, range from approximately 1,256 to 1,285 ft amsl, based on surveying performed as part of the October 2013 site characterization.

1.5.2 Hydrology

Camp Dawson is located in the Monongahela River basin. Surface waters include the Cheat River, ponds, and streams. The Cheat River is a major tributary of the Monongahela River with a 1,442-square mile drainage area. In the Camp Dawson Cantonment, surface drainage is collected by a network of ditches that empty into the Cheat River. Three streams drain into wetlands at the KD Range MRS, and one pond and three jurisdictional wetlands are located within the boundaries of the MRS. However, there are no streams, ponds, or wetlands located in the KD Range MRS Berm Area. The nearest wetland is approximately 120 ft southwest of the KD Range

MRS Berm Area. The wetland is a palustrine wetland of approximately 0.25 acre. The wetland formed as a result of inadequate drainage after the construction of Range Road. Surface water runoff from the KD Range MRS impact berms could reach this palustrine wetland. Surface water and sediment samples will be collected from the wetland during the RI for the KD Range and Stokes Mortar Range MRSs to determine whether lead has migrated from the KD Range MRS Berm Area to the wetland.

Camp Dawson Cantonment is located on the edge of the flood-prone region of the Cheat River. Low-lying areas within Camp Dawson Cantonment are located in the 100-year floodplain of the Cheat River. During a 500-year flood event that occurred on November 4, 1985, the Cheat River rose 16 ft above its normal level, resulting in damage to many buildings in the Camp Dawson Cantonment. Water levels reportedly reached 8 ft in the Armory. According to WVARNG (Rick Cheney) of Camp Dawson, the flood waters from the 1985 flood never reached the areas to be addressed by the KD Range Berm EE/CA. **Figure 1-4** depicts the 100-year floodplain as defined by the Federal Emergency Management Agency (FEMA).

1.5.3 Hydrogeology

The alluvial overburden and shallow fractured bedrock in the Camp Dawson Cantonment area together constitute an unconfined aquifer. Groundwater generally flows to the west-northwest from the flanking uplands toward the Cheat River. Groundwater ranges from 6 to 40 feet below ground surface (ft bgs). Depth to groundwater in the KD Range MRS is approximately 20 ft bgs. The aquifer receives recharge from infiltration of precipitation at the land surface and also lateral inflow from the fractured bedrock upland area to the south and east. The aquifer also discharges to the Cheat River.

1.6 SURROUNDING LAND USE, POPULATION, AND CLIMATE

The population of Preston County was estimated in 2010 to be 33,520 based on the 2000 US Census. The population density is 51.7 persons per square mile. Of the 11,946 households in Preston County, 21% include children under the age of 18. The average household size is 2.4 persons. Mean summer temperatures range from 57 degrees Fahrenheit (° F) to 80 °F in Preston County. Mean winter temperatures range from 16 °F to 35 °F. The mean annual average temperature in the region is 48 °F. The average annual precipitation is 46.6 inches, with the

highest precipitation occurring in June, measuring an average of 4.2 inches. The annual snowfall ranges from 50 to 130 inches.

1.7 ECOLOGICAL, CULTURAL, AND HISTORICAL RESOURCES

According to Camp Dawson personnel, there are no cultural or historical resources located in the KD Range MRS Berm Area.

Camp Dawson is located within the Central Appalachian Ecoregion, which consists of a high, dissected, rugged plateau composed of sandstone, shale, conglomerate, and coal. The following six ecological habitat types have been identified at Camp Dawson:

- Mature floodplain forest—Located along the shores of the Cheat River.
- Successional floodplain forest—Located on the floodplain of the Cheat River.
- Hemlock ravines—Located in small areas along creeks.
- Successional forests of low elevation plateaus—Located in small areas above the gorge slopes.
- River scour prairies—Located on scoured cobble zones along the Cheat River.
- Old fields—Located at abandoned farmland areas.

The KD Range MRS Berm Area consists of maintained grass and wooded areas. The target berm is a maintained grassy area, and the impact berm is unmaintained with some brush and small trees.

A baseline vegetation survey was conducted at Camp Dawson by the West Virginia Department of Natural Resources (WVDNR) Natural Heritage Program during the 2000 growing season, and was updated in summer 2005 and spring 2006. Approximately 43.4% of the Camp Dawson Cantonment tract consists of deciduous forest, some of which borders the impact berms at the KD Range MRS. A total of 603 species of plants were identified at Camp Dawson, including 7 potentially sensitive plant species (see **Table 1-2**). An area-specific evaluation for the impact berms at the KD Range MRS is not currently available. More than 15% of the vegetative species identified during the vegetation surveys were exotic or introduced species, with some invasive species present. Prevalent invasive species at Camp Dawson include Japanese knotweed, garlic mustard (*Alliaria petiolata*), Japanese stilt grass (*Microstegium vimineum*), and rambler rose.

Table 1-2 Potentially Sensitive Plant Species Identified at Camp Dawson

Species (Common Name)	Scientific Name	State Status	Federal Status
Appalachian sedge	*Carex appalachica*	Imperiled	No listed status
Butternut	*Juglans cinera*	Vulnerable	No listed status
Emory's sedge	*Carex emoryi*	Imperiled	No listed status
Glomerate sedge	*Carex aggregate*	Historical (not observed within last 20 years)	No listed status
Red pine	*Pinus resinosa*	Critically imperiled	No listed status
Running buffalo clover	*Trifolium stoloniferum*	Imperiled	Endangered throughout range
Thicket sedge	*Carex abscondita*	Imperiled	No listed status

A comprehensive wildlife inventory was conducted at Camp Dawson by the West Virginia University (WVU) Wildlife and Fisheries Resources Program in 2000 and 2001 and again in 2006. The results of the surveys are summarized as follows:

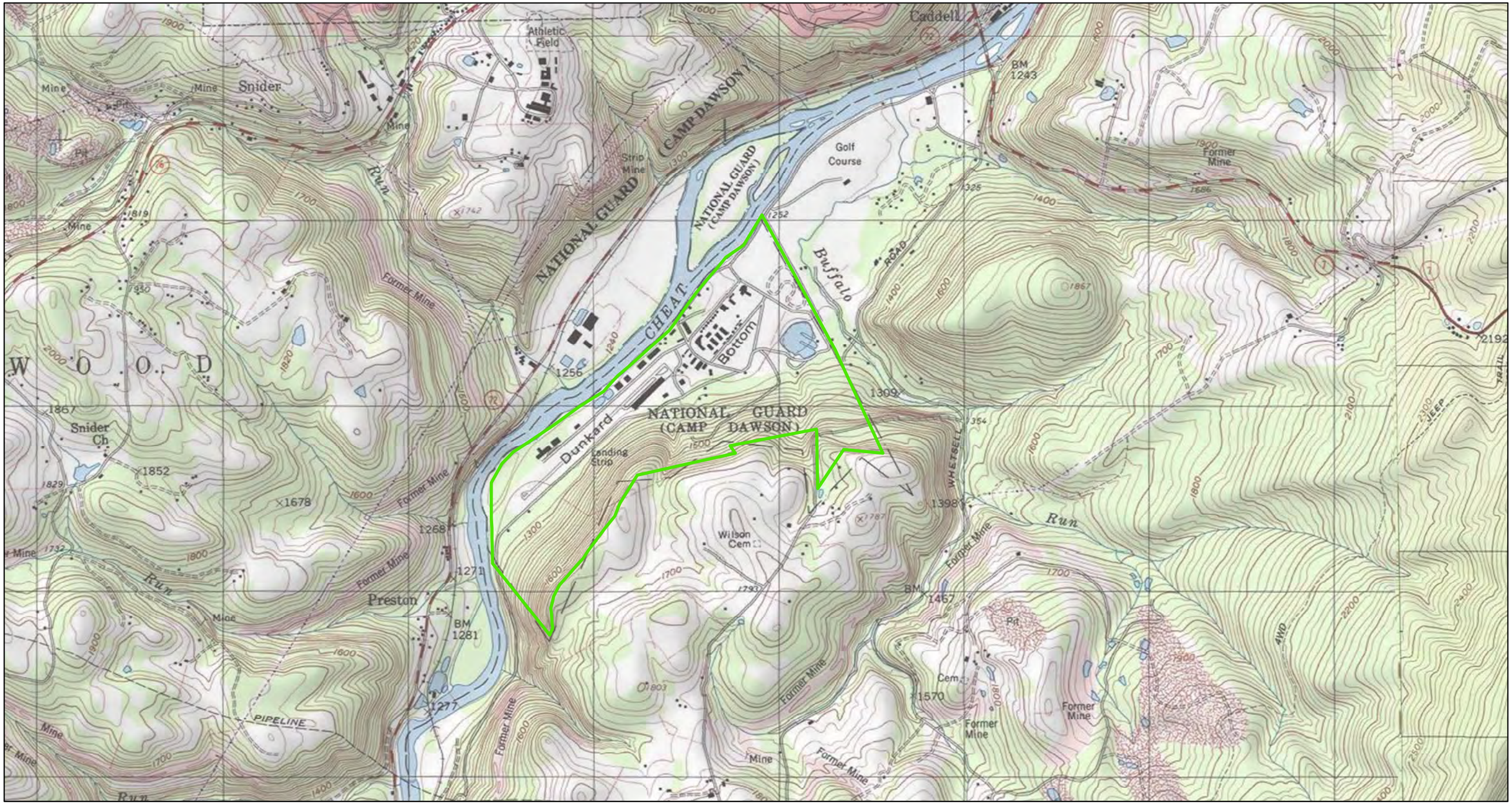
- A total of 39 mammals were identified, including 9 rare mammal species.
- A total of 106 bird species were identified, including 8 rare bird species.
- A total of 19 reptile and 19 amphibian species were identified, including one rare snake and one rare salamander.
- A total of 141 moth species were identified.
- A total of 24 fish and 8 benthic invertebrate species were identified within the Cheat River and selected tributaries.
- A total of 39 species of land snails were identified.

Potentially sensitive wildlife species, including state- and federally-listed protected species that have been identified at Camp Dawson are shown in **Table 1-3**. An area-specific evaluation of potentially sensitive wildlife species for the KD Range MRS Berm Area is not currently available. Amphibians and fish are not expected to be present at the KD Range MRS Berm Area because of the lack of water resources and therefore were not included in the table.

Table 1-3 Potentially Sensitive Wildlife Species Identified at Camp Dawson

Species (Common Name)	Scientific Name	State Status	Federal Status
Birds			
Alder flycatcher	*Empidonax alnorum*	Vulnerable breeding population; Vulnerable overall population	No listed status
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Vulnerable breeding population	No listed status
Cliff swallow	*Petrochelidon pyrrhonota*	Vulnerable breeding population; Vulnerable overall population	No listed status
Golden-winged warbler	*Vermivora chrysoptera*	Vulnerable breeding population; Vulnerable overall population	No listed status
Great-blue heron	*Ardea herodias*	Imperiled breeding population; Apparently secure overall population	No listed status
Sharp-shinned hawk	*Accipiter striatus*	Vulnerable breeding population; Vulnerable overall population	No listed status
Spotted sandpiper	*Actitis macularia*	Vulnerable breeding population	No listed status
Swainson's thrush	*Catharus ustulatus*	Critically imperiled breeding population	No listed status
Yellow-bellied sapsucker	*Sphyrapicus varius*	Critically imperiled breeding population; Vulnerable non-breeding population	No listed status
Reptiles			
Timber rattlesnake	*Crotalus horridus*	Critically imperiled	No listed status
Mammals			
Allegheny woodrat	*Neotoma magister*	Vulnerable	No listed status
Eastern small-footed bat	*Myotis leibii*	Critically imperiled	No listed status
Long-tailed shrew	*Sorex dispar*	Imperiled to vulnerable	No listed status
Meadow jumping mouse	*Zapus hudsonius*	Vulnerable	No listed status
Silver-haired bat	*Lasionycteris noctivagans*	Imperiled	No listed status
Southern bog lemming	*Synaptomys cooperi*	Imperiled	No listed status
Southern pygmy shrew	*Sorex hoyi winnemana*	Imperiled to vulnerable	No listed status
Southern rock vole	*Microtus chrotorrhinus carolinensis*	Imperiled	No listed status
Star-nosed mole	*Condylura cristata*	Imperiled	No listed status

SECTION 1
FIGURES



Camp Dawson Cantonment Boundary

Camp Dawson

Camp Dawson
Kingwood, WV

WESTON SOLUTIONS

FIGURE 1-1
Camp Dawson Cantonment
Site Location

N

0 1,000 2,000 3,000 Feet

0 375 750 1,125 Meters

NOTES:
Aerial Data Source: ESRI Bing
Topo Maps, 2011
Coordinate System:
UTM, Z17N, WGS84, Meter

5/8/2014
Revision: 0

Site_Location

Drawn: johna

PROJ: 03886.551.008

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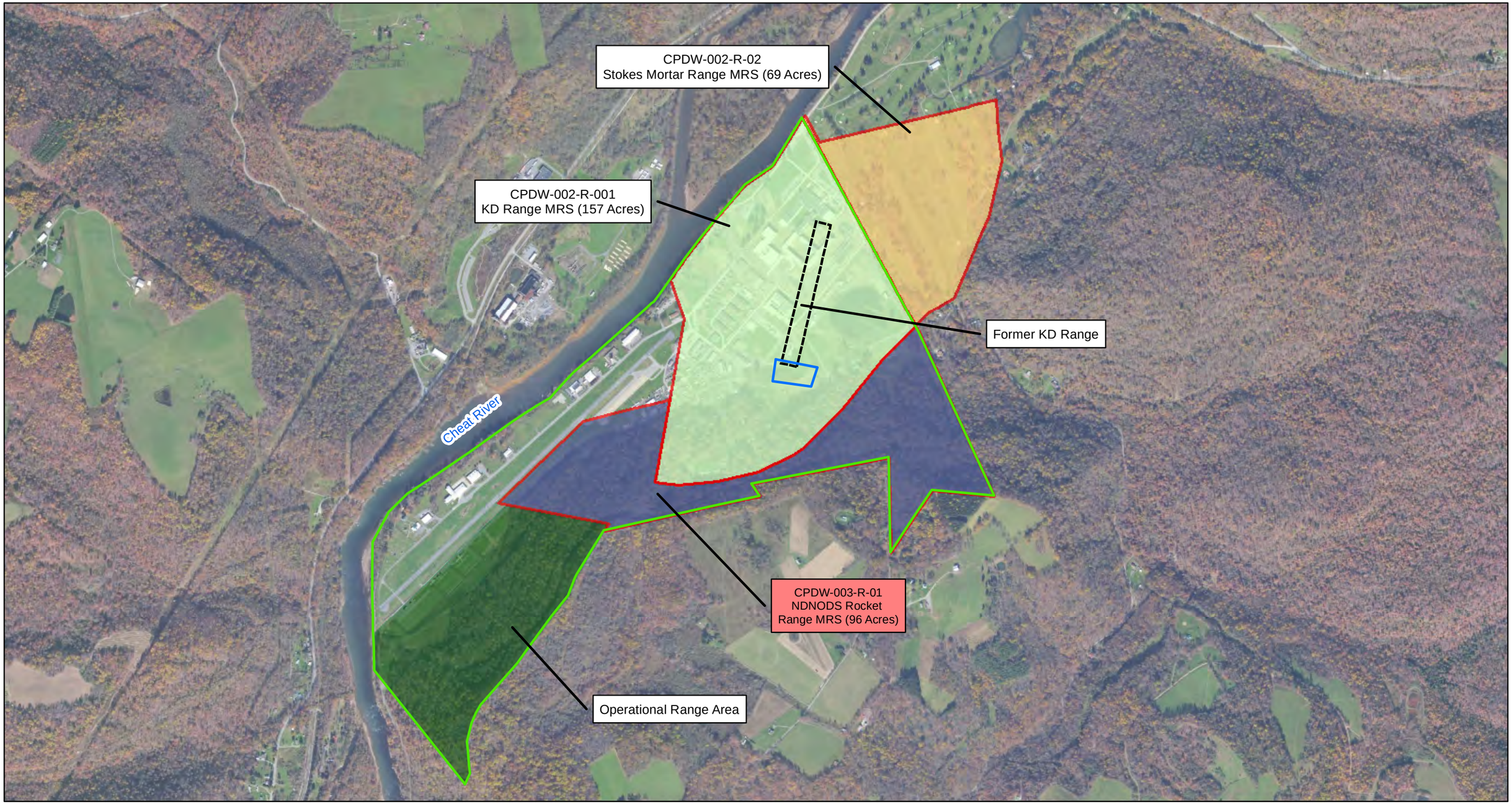
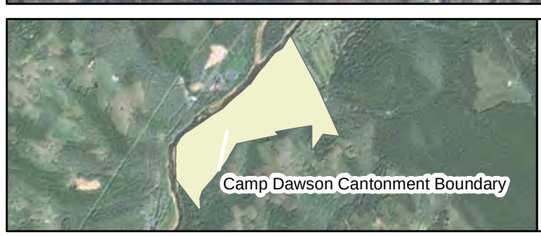




Camp Dawson Cantonment Boundary
Former KD Range
Operational Range Area
KD Range MRS Berm Area
CPDW-003-R-01 NDNODS Rocket Range MRS
CPDW-002-R-001 KD Range MRS
CPDW-002-R-02 Stokes Mortar Range MRS
CPDW-003-R-01 NDNODS Rocket Range MRS
MRS not included in the project

Camp Dawson

Camp Dawson
Kingwood, WV

N

0 630 1,260 1,890 Feet

0 230 460 690 Meters

NOTES:
Aerial Data Source: ESRI Bing Mapping Service, 2011

Coordinate System: UTM, Z17N, WGS84, Meter

FIGURE 1-2
MRS Location
Camp Dawson Cantonment

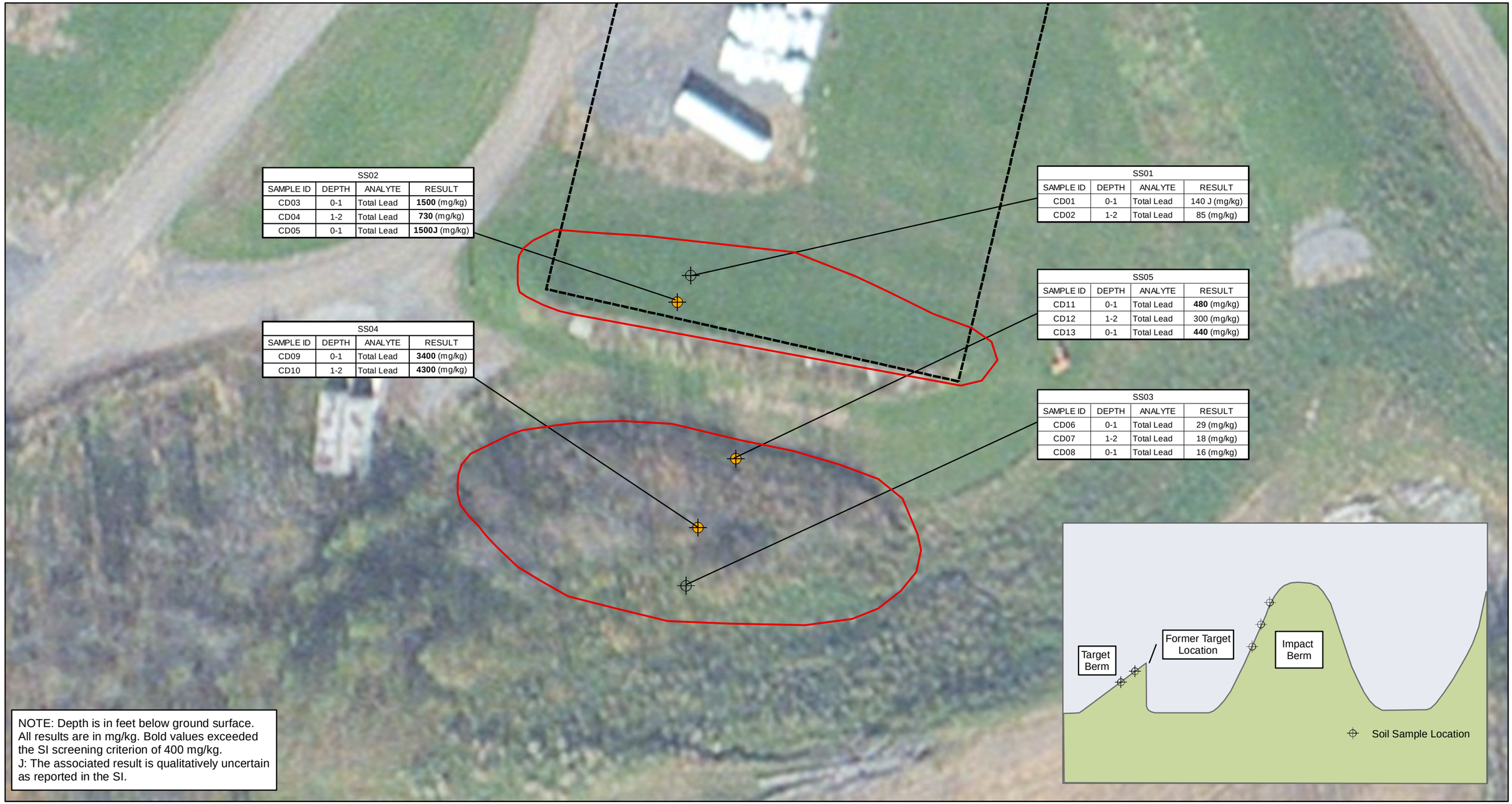
2/19/2014
Revision: 0

MRS_Range_Locations_Memo

Drawn: johna

PROJ: 03886.551.008

File: Y:\Camp_Dawson\Mxd\Approval Memo\MRS_Range_Locations_Memo.mxd, 2/19/2014 10:19:51 AM, johna



SS02			
SAMPLE ID	DEPTH	ANALYTE	RESULT
CD03	0-1	Total Lead	**1500** (mg/kg)
CD04	1-2	Total Lead	**730** (mg/kg)
CD05	0-1	Total Lead	**1500J** (mg/kg)

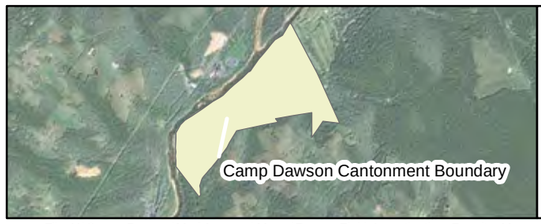
SS01			
SAMPLE ID	DEPTH	ANALYTE	RESULT
CD01	0-1	Total Lead	140 J (mg/kg)
CD02	1-2	Total Lead	85 (mg/kg)

SS05			
SAMPLE ID	DEPTH	ANALYTE	RESULT
CD11	0-1	Total Lead	**480** (mg/kg)
CD12	1-2	Total Lead	300 (mg/kg)
CD13	0-1	Total Lead	**440** (mg/kg)

SS04			
SAMPLE ID	DEPTH	ANALYTE	RESULT
CD09	0-1	Total Lead	**3400** (mg/kg)
CD10	1-2	Total Lead	**4300** (mg/kg)

SS03			
SAMPLE ID	DEPTH	ANALYTE	RESULT
CD06	0-1	Total Lead	29 (mg/kg)
CD07	1-2	Total Lead	18 (mg/kg)
CD08	0-1	Total Lead	16 (mg/kg)

NOTE: Depth is in feet below ground surface.
All results are in mg/kg. Bold values exceeded the SI screening criterion of 400 mg/kg.
J: The associated result is qualitatively uncertain as reported in the SI.



Soil Sample Location (Surface and Subsurface)

Soil Sample Locations with Lead Concentrations Greater than 400 (mg/kg)

Former KD Range

Berm Boundaries

Camp Dawson

Camp Dawson
Kingwood, WV

WESTON SOLUTIONS

FIGURE 1-3
KD Range MRS Berm
Area SI Results

N

0 20 40 60 Feet

0 9 18 27 Meters

NOTES:
Aerial Data Source: ESRI Bing Mapping Service, 2011

Coordinate System:
UTM, Z17N, WGS84, Meter

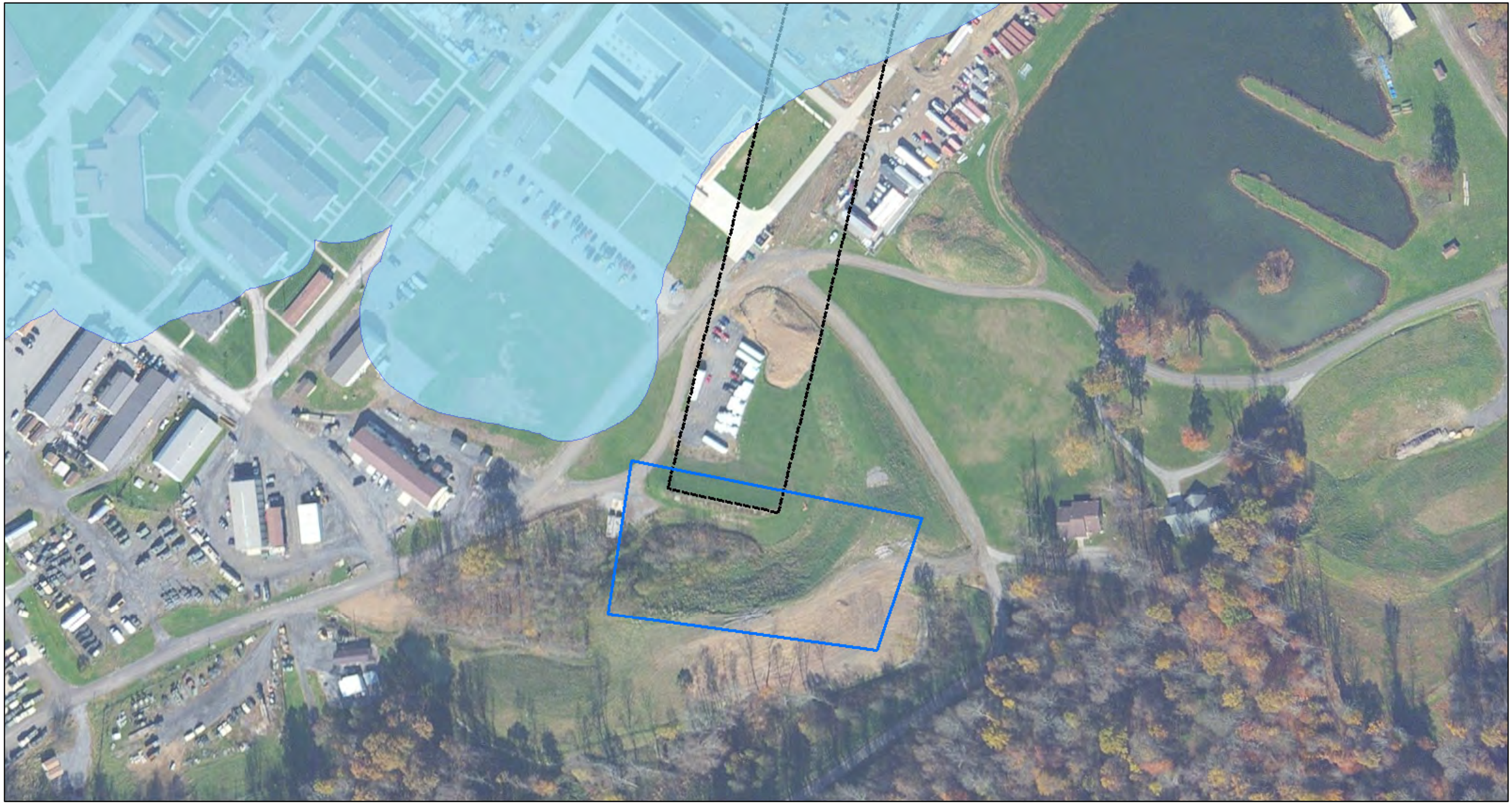
2/17/2014
Revision: 0

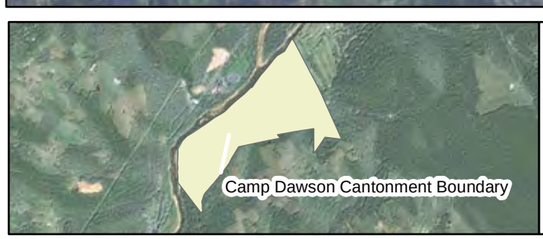
Range_Field_Investigation_Results_Memo

Drawn: johna

PROJ: 03886.551.008

File: Y:\Camp_Dawson\Mxd\Approval Memo\Range_Field_Investigation_Results_Memo.mxd, 2/17/2014 1:00:03 PM, johna





Former KD Range

KD Range MRS Berm Area

100-Year Floodplain

Camp Dawson

Camp Dawson
Kingwood, WV

N

0 140 280 Feet

0 30 60 90 Meters

NOTES:
Aerial Data Source: ESRI Bing Mapping Service, 2011

Coordinate System: UTM, Z17N, WGS84, Meter

FIGURE 1-4
Floodplain in the KD Range MRS

2/17/2014
Revision: 0

KD_Range_Floodplain

Drawn: johna

PROJ: 03886.551.008

File: Y:\Camp_Dawson\Mxd\KD_Range_Floodplain.mxd, 2/17/2014 1:05:58 PM, johna

2. SITE CHARACTERIZATION

To determine the environmental condition of the KD Range MRS Berm Area, surface soil and subsurface soil sampling and analysis were conducted during the KD Range MRS Berm Area investigation. Prior to these activities, investigations performed at the MRS included an SI. The SI consisted of the collection and analysis (for lead) of surface soil samples. The data from these investigations resulted in the identification of lead as a COC at the KD Range MRS Berm Area. The characterization, as defined in the KD Range MRS Berm UFP/QAPP, was to delineate the vertical and horizontal extent of lead-impacted soil at concentrations greater than 400 mg/kg.

2.1 SOIL CHARACTERIZATION—SAMPLING AND RESULTS

Soil characterization at the KD Range MRS Berm Area included collection and analysis of surface and subsurface soil sampling during one mobilization, which took place the week of October 7, 2013. Surface soil was collected using a trowel, and subsurface soil was collected using a soil recovery probe. Surface soil samples and additional subsurface samples were collected to provide additional data for the site delineation (i.e., refinement of the estimates of volume and cost). These samples were analyzed for total lead. Some samples were analyzed using the toxicity characteristic leaching procedure (TCLP) for total lead to determine the leaching potential of lead from the soils at the KD Range MRS Berm Area. On-site analytical capabilities and an off-site fixed-based laboratory were used for lead analyses.

The scope of the sampling consisted of the following: 50 surface soil samples, 12 subsurface soil samples, 8 laboratory confirmation samples (including one duplicate), 4 QC samples (consisting of matrix spike/matrix spike duplicate (MS/MSD), field rinsate blanks, and field duplicate), and 4 TCLP samples, all of which were analyzed for total lead.

Sample Type	Samples Collected
Soil for lead X-ray fluorescence (XRF) analysis	62
Laboratory lead confirmation samples (including one duplicate)	8
Quality control (QC) samples (lead only)	4
Toxicity Characteristic Leaching Procedure (TCLP) samples (lead only)	4

Figure 2-1 shows the sampling locations at the KD Range MRS Berm Area. A discussion of the analytical results of these samples is presented in Section 2.1.3.

2.1.1 Sampling Procedures, Analytical Methods, and Data Validation

Sampling procedures (including sample handling, documentation, and decontamination) at the KD Range MRS Berm Area were in accordance with the KD Range MRS Berm Sampling UFP-QAPP. Daily reports are included in **Appendix A**.

Prior to collecting any samples, a grid of potential sample locations was laid out. All the locations sampled were laid out by a WV-licensed surveyor. The actual sample location coordinate information was gathered with a GPS instrument after sampling using the procedures outlined in the KD Range MRS Berm Sampling UFP-QAPP.

Initial soil samples were collected from a known area of lead-impacted soils identified by the data collected during the SI and site history. Based on the X-ray fluorescence (XRF) results of each soil sample, a decision was made whether to move to the next grid node/sample location and whether a deeper sample was required. For horizontal delineation, the decision to move to another grid node was based on the concentration of lead in the soil sample. If lead concentrations were above 1,500 mg/kg, the decision was made to sample two grid nodes away (50 feet). If soils were above 400 mg/kg but below 1,500 mg/kg, the decision was made to sample at the next grid node (25 feet). If the sample was below 400 mg/kg, no further horizontal sampling was needed. The process was followed until soil samples were found to be below 400 mg/kg. Vertical delineation was achieved by collecting surface soils and subsurface soils concurrently. Subsurface soils were analyzed based on the results of the surface soil samples. Subsurface soils were analyzed until the soil samples were found to be below 400 mg/kg. The limits of lead-impacted soils were delineated both vertically and horizontally by using the prescribed method.

Samples were collected and stored in plastic bags for analysis. Each sample location was labeled with a sample ID number. The sample numbers were recorded in the site logbook, the chain-of-custody, and the shipment documents in accordance with relevant SOPs.

Sample ID

[_ _ _]	[_ _]	[_ _ _ _]	[_ _]	[_ _]
1	2	3	4	5

The sample ID is composed of five components:

Component 1 – Defines the site location using a predetermined identifier:

CDW = Camp Dawson

Component 2 – Defines the MRS area location using a predetermined identifier:

KD = KD Range

Component 3 – Chronological sample number:

01 = First sample location coordinated with map location

Component 4 – Defines the sample matrix and sample number:

SS01 = surface soil sample (0 to 6 inch depth)

SS02 = subsurface soil sample (6 to 12 inch depth)

SS03 = subsurface soil sample (12 to 18 inch depth)

SS04 = subsurface soil sample (18 to 24 inch depth)

Component 5 – Defines the QA sample type:

XX = XRF Sample

00 = Normal Sample

01 = Duplicate Sample

02 = Equipment blank sample

03 = Trip blank

04 = Ambient blank

05 = Matrix spike/matrix spike duplicate

06 = Correlation sample

An example of typical sample ID nomenclature is CDW-KD-43-SS03-XX. The “CDW” indicates a sample collected from Camp Dawson. The “KD” indicates a sample collected from the KD Range. The “43” indicates the sample at location number 43. The “SSO3” indicates that the sample was collected at 12 to 18 inches bgs. The “XX” identifies the sample as an XRF reading.

The samples were analyzed by XRF on-site by the subcontractor firm MT2, LLC (MT2). The samples were analyzed as described in the KD Range MRS Berm Sampling UFP-QAPP by using EPA Method 6000.

Laboratory confirmation samples, duplicates, and blanks were analyzed by CT Laboratories LLC, in Baraboo, WI, using EPA method SW-846 6010C as specified in the KD Range MRS Berm Sampling UFP-QAPP. Field and laboratory quality assurance (QA) procedures were conducted in accordance with the KD Range MRS Berm Sampling UFP-QAPP.

MT2 collected additional samples for physical parameters (grain size, Atterberg limits, percent moisture, and pH) using the analytical procedures specified in the KD Range MRS Berm Sampling UFP-QAPP. The physical parameter data were collected to assist in developing an appropriate treatment method, and the results are provided and discussed in the MT2 Treatability Report in **Appendix B** of the EE/CA.

Laboratory data from the KD Range MRS Berm investigation were independently evaluated by Environmental Data Services, LP (EDS) for data quality and usability prior to performing the SRE. Independent validation of the analytical data was based on the *USEPA Region III Modifications to the National Functional Guidelines for Inorganic Data Review* (EPA, 1994a), and the quality assurance/quality control (QA/QC) requirements for the analytical methods used for the analyses. These guidelines ensure that the data meet uniform requirements for accuracy. Some data collected by MT2, including physical parameters, TCLP results, and total lead data from XRF analysis, were used solely for refinement of volume and cost estimates. These data were not subject to full data validation and were not used in the SRE. The parameters included in the data validation were the following:

- Data completeness.
- Holding time.
- Calibrations.
- Laboratory and field blanks analyses.
- Surrogate recoveries.
- Matrix spike/matrix spike duplicate (MS/MSD) analyses.
- Laboratory control sample (LCS) and LCS duplicate (LCSD).
- Laboratory and field duplicates.
- Internal standards.
- Sample cleanup.

- Compound/analyte identification.
- Compound/analyte quantitation.
- Serial dilution results (inorganic only).
- Inductively coupled plasma (ICP) interference check sample results (inorganic only).

If these parameters for the site-specific analyses did not meet the EPA criteria, a discussion of the implications regarding the guidelines appears in the data validation report narrative (**Appendix C**). Parameters outside guidelines do not necessarily indicate that the result is invalid. The decision about validity is made by the professional validator based on the EPA guidelines.

Definitions of validation qualifiers assigned by the professional validator are as follows:

U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

R = The data are unusable. The sample results are rejected as a result of serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.

J+ = The result is an estimated quantity, but the result may be biased high.

J- = The result is an estimated quantity, but the result may be biased low.

As a result of the independent validation process, some data were assigned the qualifiers "UJ" and "J." A J-flag refers to estimated values. Data values flagged with J, with the exception of UJ, which refers to a nondetect, were used as positive detections. The data validation process is summarized in Section 2.1.3.5.

2.1.2 TCLP Analyses

Based on the concentrations of lead found above screening levels at the KD Range MRS Berm Area, four samples were identified for TCLP lead analyses. These analyses provide an indication of the potential leachability of lead from soils and assist in determining whether soil from a site will be considered a Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste when exceeding the regulatory toxicity limit of 5 milligrams per liter (mg/L) of lead (hereafter referred to as RCRA characteristic waste limit) in the event removal activities are implemented. TCLP analytical results are discussed with other analytical results in Section 2.1.3.

2.1.3 Analytical Results

A total of 75 samples (70 lead analyses, 4 TCLP, and 1 rinsate blank) were collected as part of the investigative activities at the KD Range MRS Berm Area. This total includes field XRF results, laboratory results, and laboratory QA/QC samples such as duplicate environmental samples and rinsate blanks.

The results of the soil sampling for lead conducted at the KD Range MRS Berm Area are summarized in the following sections. A summary of the laboratory QA/QC sample results follows the discussions of the soil sample results. A complete summary of the soil analytical results for the KD Range MRS Berm investigation area is provided in **Appendix D**. These results consist of a table of "raw" XRF data from the electronic database and hard copies of data summaries from laboratory reports for the unvalidated data. The validated data package is included in **Appendix C**.

2.1.3.1 Soil Sampling Results

For the discussion that follows, routine field and field duplicate soil samples were considered as one sample. Results from the TCLP surface soil samples are discussed in Section 2.1.3.3.

Surface soil samples, which were analyzed for lead only, showed concentrations ranging from 17 to 3,768 mg/kg. In general, lead concentrations were higher in surface sampling intervals than in subsurface sampling intervals. Lead was found in seven surface soil samples above the screening level of 400 mg/kg. The seven surface sample locations that exceeded the screening level were 3, 4, 7, 12, 21, 23, and 26. **Table 2-1** presents the lead results for the KD Range MRS Berm investigation. **Table 2-1** lists the samples and their corresponding XRF and laboratory analysis results. Sample IDs ending in "XX" were analyzed by XRF, and sample IDs ending in a digit were laboratory analyzed. All laboratory samples were qualified with a "J"; a J-flag refers to estimated values. **Figure 2-2** and **Figure 2-3** present the locations of lead concentrations in the surface (0 to 0.5 ft bgs) and the subsurface (0.5 to 2.0 ft bgs) soil sampling intervals, respectively.

Table 2-1
Soil Analytical Results - Lead
Camp Dawson - KD Range EE/CA

Sample Number	Sampling Location	EPA Residential Action Level	Units	Date Sampled	Date Analyzed	Result	Flag	Variation (Pb+/-)	Difference (%)	MDL
CDW-KD-01-SS01-XX	1	400	mg/kg	7-Oct-13	7-Oct-13	31		3		
CDW-KD-02-SS01-XX	2	400	mg/kg	7-Oct-13	7-Oct-13	45		3		
CDW-KD-03-SS01-XX	3	400	mg/kg	7-Oct-13	7-Oct-13	2,077		21		
CDW-KD-03-SS01-00	3	400	mg/kg	7-Oct-13	22-Oct-13	2,550	J		19%	0.054
CDW-KD-03-SS02-XX	3	400	mg/kg	7-Oct-13	7-Oct-13	1,359		16		
CDW-KD-03-SS03-XX	3	400	mg/kg	7-Oct-13	7-Oct-13	858		12		
CDW-KD-03-SS04-XX	3	400	mg/kg	7-Oct-13	7-Oct-13	175		5		
CDW-KD-04-SS01-XX	4	400	mg/kg	7-Oct-13	7-Oct-13	3,768		36		
CDW-KD-04-SS02-XX	4	400	mg/kg	7-Oct-13	7-Oct-13	1,895		19		
CDW-KD-04-SS03-XX	4	400	mg/kg	7-Oct-13	7-Oct-13	99		4		
CDW-KD-05-SS01-XX	5	400	mg/kg	7-Oct-13	7-Oct-13	218		5		
CDW-KD-06-SS01-XX	6	400	mg/kg	7-Oct-13	7-Oct-13	19		2		
CDW-KD-07-SS01-XX	7	400	mg/kg	8-Oct-13	8-Oct-13	844		11		
CDW-KD-07-SS02-XX	7	400	mg/kg	8-Oct-13	8-Oct-13	67		3		
CDW-KD-08-SS01-XX	8	400	mg/kg	8-Oct-13	8-Oct-13	19		3		
CDW-KD-09-SS01-XX	9	400	mg/kg	8-Oct-13	8-Oct-13	17		3		
CDW-KD-10-SS01-XX	10	400	mg/kg	8-Oct-13	8-Oct-13	20		3		
CDW-KD-11-SS01-XX	11	400	mg/kg	8-Oct-13	8-Oct-13	22		3		
CDW-KD-12-SS01-XX	12	400	mg/kg	8-Oct-13	8-Oct-13	3,418		33		
CDW-KD-12-SS02-XX	12	400	mg/kg	8-Oct-13	8-Oct-13	1,002		13		
CDW-KD-12-SS03-XX	12	400	mg/kg	8-Oct-13	8-Oct-13	37		3		
CDW-KD-13-SS01-XX	13	400	mg/kg	8-Oct-13	8-Oct-13	324		7		
CDW-KD-13-SS01-05	13	400	mg/kg	8-Oct-13	22-Oct-13	302	J		7%	0.058
CDW-KD-14-SS01-XX	14	400	mg/kg	8-Oct-13	8-Oct-13	17		2		
CDW-KD-15-SS01-XX	15	400	mg/kg	8-Oct-13	8-Oct-13	21		3		
CDW-KD-16-SS01-XX	16	400	mg/kg	8-Oct-13	8-Oct-13	137		4		
CDW-KD-16-SS01-00	16	400	mg/kg	9-Oct-13	22-Oct-13	127	J		8%	0.057
CDW-KD-17-SS01-XX	17	400	mg/kg	8-Oct-13	8-Oct-13	29		3		
CDW-KD-18-SS01-XX	18	400	mg/kg	8-Oct-13	8-Oct-13	31		3		
CDW-KD-19-SS01-XX	18	400	mg/kg	8-Oct-13	8-Oct-13	26		3		
CDW-KD-20-SS01-XX	20	400	mg/kg	8-Oct-13	8-Oct-13	78		4		
CDW-KD-21-SS01-XX	21	400	mg/kg	8-Oct-13	8-Oct-13	654		10		
CDW-KD-21-SS02-XX	21	400	mg/kg	8-Oct-13	8-Oct-13	215		6		
CDW-KD-22-SS01-XX	22	400	mg/kg	8-Oct-13	8-Oct-13	70		4		
CDW-KD-23-SS01-XX	23	400	mg/kg	8-Oct-13	8-Oct-13	2,940		29		
CDW-KD-23-SS01-00	23	400	mg/kg	8-Oct-13	22-Oct-13	2,310	J		27%	0.05
CDW-KD-23-SS02-XX	23	400	mg/kg	8-Oct-13	8-Oct-13	1,582		18		

Table 2-1
Soil Analytical Results - Lead
Camp Dawson - KD Range EE/CA (Continued)

Sample Number	Sampling Location	EPA Residential Action Level	Units	Date Sampled	Date Analyzed	Result	Flag	Variation (Pb+/-)	Difference (%)	MDL
CDW-KD-23-SS03-XX	23	400	mg/kg	8-Oct-13	8-Oct-13	191		5		
CDW-KD-24-SS01-XX	24	400	mg/kg	8-Oct-13	8-Oct-13	283		6		
CDW-KD-25-SS01-XX	25	400	mg/kg	8-Oct-13	8-Oct-13	31		3		
CDW-KD-26-SS01-XX	26	400	mg/kg	9-Oct-13	9-Oct-13	713		10		
CDW-KD-26-SS02-XX	26	400	mg/kg	9-Oct-13	9-Oct-13	200		5		
CDW-KD-27-SS01-XX	27	400	mg/kg	9-Oct-13	9-Oct-13	60		3		
CDW-KD-28-SS01-XX	28	400	mg/kg	9-Oct-13	9-Oct-13	41		3		
CDW-KD-29-SS01-XX	29	400	mg/kg	9-Oct-13	9-Oct-13	35		3		
CDW-KD-30-SS01-XX	30	400	mg/kg	9-Oct-13	9-Oct-13	47		3		
CDW-KD-31-SS01-XX	31	400	mg/kg	9-Oct-13	9-Oct-13	109		4		
CDW-KD-32-SS01-XX	32	400	mg/kg	9-Oct-13	9-Oct-13	73		4		
CDW-KD-33-SS01-XX	33	400	mg/kg	9-Oct-13	9-Oct-13	42		3		
CDW-KD-34-SS01-XX	34	400	mg/kg	9-Oct-13	9-Oct-13	63		3		
CDW-KD-35-SS01-XX	35	400	mg/kg	9-Oct-13	9-Oct-13	69		4		
CDW-KD-35-SS01-00	35	400	mg/kg	10-Oct-13	22-Oct-13	195	J		65%	0.052
CDW-KD-36-SS01-XX	36	400	mg/kg	9-Oct-13	9-Oct-13	77		4		
CDW-KD-37-SS01-XX	37	400	mg/kg	9-Oct-13	9-Oct-13	65		4		
CDW-KD-38-SS01-XX	38	400	mg/kg	9-Oct-13	9-Oct-13	70		3		
CDW-KD-39-SS01-XX	39	400	mg/kg	9-Oct-13	9-Oct-13	92		4		
CDW-KD-39-SS01-00	39	400	mg/kg	9-Oct-13	22-Oct-13	67.6	J		36%	0.049
CDW-KD-39-SS01-01	39	400	mg/kg	9-Oct-13	22-Oct-13	64.1	J		44%	0.048
CDW-KD-40-SS01-XX	40	400	mg/kg	9-Oct-13	9-Oct-13	25		3		
CDW-KD-41-SS01-XX	41	400	mg/kg	9-Oct-13	9-Oct-13	26		3		
CDW-KD-42-SS01-XX	42	400	mg/kg	9-Oct-13	9-Oct-13	158		5		
CDW-KD-43-SS01-XX	43	400	mg/kg	9-Oct-13	9-Oct-13	63		4		
CDW-KD-44-SS01-XX	44	400	mg/kg	9-Oct-13	9-Oct-13	21		3		
CDW-KD-45-SS01-XX	45	400	mg/kg	10-Oct-13	10-Oct-13	91		4		
CDW-KD-46-SS01-XX	46	401	mg/kg	10-Oct-13	10-Oct-13	60		4		
CDW-KD-47-SS01-XX	47	402	mg/kg	10-Oct-13	10-Oct-13	70		4		
CDW-KD-48-SS01-XX	48	403	mg/kg	10-Oct-13	10-Oct-13	47		3		
CDW-KD-49-SS01-XX	49	400	mg/kg	10-Oct-13	10-Oct-13	85		4		
CDW-KD-49-SS01-00	49	400	mg/kg	10-Oct-13	22-Oct-13	78.5	J		8%	0.054
CDW-KD-50-SS01-XX	50	400	mg/kg	10-Oct-13	10-Oct-13	92		4		

Yellow shading indicates an exceedance of the EPA RSL of 400 mg/kg for lead.
mg/kg = parts per million
MDL = Minimum Detection Limit
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
SS01 = Collected from 0-0.5 ft bgs
SS02 = Collected from 0.5-1 ft bgs
SS03 = Collected from 1-1.5 ft bgs
SS04 = Collected from 1.5-2 ft bgs

Lead was detected in all the correlation samples analyzed by the fixed-based laboratory. Lead concentrations for the split samples ranged from 64.1 to 2,550 mg/kg. The comparison of the XRF survey results to the corresponding laboratory analytical results is discussed in more detail in Section 2.1.3.2.

2.1.3.2 Field XRF Method Discussion

The XRF instrumentation as a tool to delineate lead concentrations in soil over 400 mg/kg was useful during the characterization. A graph of the XRF sample results versus the laboratory results is provided as **Figure 2-4**. There was very little variability in the samples. **Table 2-1** lists the percent difference between the XRF result and the laboratory result. The slight variability between these results is likely due to the heterogeneity of the soil and the nature of the field preparation method. Variability is often encountered with field screening methods because they are not designed to achieve the same level of accuracy and precision as the fixed-based laboratory methods.

At the conclusion of the XRF sampling, seven correlation samples were selected for concurrence to ensure that the XRF sampling met the data quality objectives (DQOs) for the project. After mixing and drying, soil from the XRF sample bags was transferred to the appropriate sample jars and sent to an off-site laboratory for analysis. All sample handling, preparation, and shipment was performed in accordance with the UFP-QAPP and as described in Section 2.1.1. **Table 2-1** lists the samples and their corresponding XRF and the laboratory analysis results. Sample IDs ending in "XX" were analyzed by XRF, and sample IDs ending in a digit were laboratory analyzed. The XRF field results and laboratory data were evaluated using a least squares linear regression analysis. The results of the linear regression analysis for Camp Dawson KD Range MRS Berm investigation yielded a coefficient of determination (r^2) of 0.92 and a correlation coefficient (r) of 0.96. In Method 6200, EPA defines that if r is 0.9 or greater, the confirmatory data are statistically equivalent to laboratory data at a 99% confidence level and the data meet definitive level data criteria. The data collected at Camp Dawson are acceptable as definitive level data. The linear regression results are presented in **Figure 2-5**.

2.1.3.3 TCLP Results

Four soil samples were analyzed by CT Laboratories LLC for TCLP. The TCLP samples were chosen based on the XRF results, locations, and depths. The four TCLP samples collected were

CDW-KD-07-SS01, CDW-KD-12-SS02, CDW-KD-23-SS01, and CDW-KD-23-SS02. The samples were selected based on the locations of elevated concentrations of lead (greater than 800 mg/kg) measured by the XRF analysis and the varying depths of the samples. **Table 2-2** presents TCLP data collected for the KD Range MRS Berm Area investigation.

Table 2-2 Soil Analytical Results – TCLP Lead

Sample Number:	Sampling Location	RCRA Toxicity Characteristic	Units	Date Sampled	Date Analyzed	Result	Flag	MDL
CDW-KD-07-SS01-00	7	5	mg/L	8-Oct-13	23-Oct-13	2.7		0.0014
CDW-KD-12-SS02-00	12	5	mg/L	8-Oct-13	23-Oct-13	0.71		0.0014
CDW-KD-23-SS01-00	23	5	mg/L	8-Oct-13	23-Oct-13	11	J	0.0014
CDW-KD-23-SS02-00	23	5	mg/L	8-Oct-13	23-Oct-13	0.03		0.0014

Only one location exceeded the RCRA characteristic waste limit for lead of 5 mg/L. The sample CDW-KD-23-SS01 had a concentration of 11 mg/L. The XRF result associated with CDW-KD-23-SS01-XX had a lead concentration of 2,940 mg/kg. This concentration suggests that the levels of lead in the soil at this sample location are potentially leachable to an extent exceeding the RCRA characteristic waste limit.

2.1.3.4 Quality Control Samples

Field QC samples specified in the KD Range MRS Berm Sampling UFP-QAPP include rinsate, field blanks, and field duplicates. Field duplicates, which consist of one soil sample split into two parts with each aliquot analyzed by the laboratory for the identical parameters, are collected to estimate sampling and laboratory analysis precision, including sample homogeneity. Precision is measured using the routine and duplicate sampling results and is expressed as a relative percent difference (RPD). Calculation of the RPD is described in the KD Range MRS Berm Sampling UFP-QAPP.

MS/MSD samples are created by the introduction of a known concentration of a compound into a sample to provide information about the effect of the sample matrix on the extraction and/or measurement methodology. MS/MSDs are reviewed as part of the data validation process and are discussed in the data validation narrative (see **Appendix C**) and in Section 2.1.3.5.

QC samples collected at the KD Range included two rinsate blanks and one field duplicate as well as two MS/MSDs performed for laboratory QC. Equipment blank CDW-KD-35-SS01-02 contained no detected concentrations of lead.

As discussed in Section 2.1.1, the data results were validated by an independent third party, EDS, LP, in accordance with the KD Range MRS Berm Sampling UFP-QAPP. In addition, the field QC samples were collected and analyzed to assess the quality of the data resulting from the field sampling program, as specified in the KD Range MRS Berm Sampling UFP-QAPP.

2.1.3.5 Field QC Samples and Sampling Quality Control

Field duplicates were collected for the KD Range MRS Berm investigation and represent field QC.

High-quality data were collected for the KD Range MRS Berm investigation as evidenced by the following parameters:

- Precision is represented as the RPD between measurements of an analyte in duplicate samples. Sample CDW-KD-SS01-01 was collected as a field duplicate of sample CDW-KD-SS01-00 to provide another set of measurements for analysis. The RPD for lead for the field duplicate was 5%, as noted in the validation narrative included in **Appendix C**. The UFP-QAPP required that precision be below 20%, and that objective was met.

- Accuracy was ensured by selecting appropriate data collection instruments, having instructions clearly delineated for their correct use, and following the sampling plan discussed in the KD Range MRS Berm Sampling UFP-QAPP. One rinsate blank and one ambient blank were obtained during the soil investigation. New, clean, dedicated disposable equipment (i.e., scoops, aluminum pans, and sterile gloves) was used. Only the soil recovery probe was reused. The soil recovery probe had acetate liners for each sample location, and only the drive point of the soil recovery probe was exposed. The soil recovery probe was decontaminated according to the KD Range MRS Berm Sampling UFP-QAPP between each location. A rinsate blank was collected prior to Sampling Location 35. Lead was not detected in the rinsate sample, CDW-KD-35-SS01-02.

- Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population. The field duplicate results show that the data are representative of the population because the 5% RPD indicates that there are low parameter variations at the sampling point. This low RPD supports that the sample data are accurate and precise in representing the lead concentration of the soil in the KD Range Berm MRS. Sampling was done in accordance with the sampling procedures discussed in the Final UFP-QAPP. No deviations were identified (see **Appendix A**, Daily Reports).

- Completeness is a measure of the amount of adequate data obtained from the actual performance of measurement procedures compared to the amount expected to be obtained from error-free performance of the same measurement procedures under normal conditions. Completeness measures the extent to which the database resulting from a measurement effort fulfills objectives for the amount of data required. Completeness is defined as the valid data percentage of the total tests requested. Complete project data involve both satisfactory performance and documentation of field and laboratory procedures. Valid analyses are defined as those where the sample arrives at the laboratory intact, properly preserved, in sufficient quantity to perform the requested analyses, and accompanied by a completed chain-of-custody. Furthermore, the sample must be analyzed within the specified holding time and in such a manner that analytical QC acceptance criteria are met, with the following exception: data qualified as estimated as a result of data validation are considered valid and are counted towards completeness if still suitable for the intended use of the data. 100% completeness was achieved for the KD Range MRS Berm Area sampling. All designated samples were analyzed, no samples were lost, damaged, or not able to be analyzed. No data were rejected by the data validator and all data points met the project DQOs.

- Comparability is the degree to which one data set can be compared to another data set measuring the same property. Comparability of data sets generated for the project was obtained through the implementation of the standard sampling procedures discussed in the KD Range MRS Berm Sampling UFP-QAPP. No deviations to the sampling procedures discussed in the UFP-QAPP were documented (see **Appendix A**, Daily Reports). The XRF field data correlated well with the laboratory data, with a laboratory data coefficient of determination (r^2) of 0.92 and a correlation coefficient (r) of 0.96. Daily instrument blanks, method blanks, and calibration verification procedures were used to maintain the data quality of the XRF. Documentation of the XRF daily instrument blanks, method blanks, and calibration verification procedures are recorded in the XRF raw data files in **Appendix D**.

Based on the previously listed parameters and discussion, field data meet the data quality objectives of the UFP-QAPP. These data are sufficient to support the SRE and the evaluation of alternatives.

2.1.3.6 Data Validation Results

The data validation guidelines are listed in Section 2.1.1. The data validation package for the KD Range MRS Berm Area laboratory data, including validation report narratives for the analytical results and a glossary of QA/QC terms and data qualifier codes, is provided in **Appendix C**. The data validation guidelines ensure that all data meet uniform requirements for accuracy and determine the validity and usability of the data for their intended use. If the data quality parameters for the KD Range MRS-specific analyses did not meet the criteria of the EPA and DoD Quality Systems Manual (QSM) Version 5.0 (July 2013) or the laboratory standard

operating procedure (SOP), a discussion of the implications regarding the guidelines is included in the data validation narrative.

Based on the results presented in the data validation report (**Appendix C**), no major issues were identified during data validation. There were no rejections of data. Overall, the data were acceptable for the intended purposes. Results qualified (U) because of blank contamination may then be qualified (J) as a result of another action. The results may be qualified as UJ because of the combination of the U as a result of the blank contamination and J as a result of actions from other exceedances of QC criteria.

The MS/MSD samples exhibited acceptable percent recovery (%R) values except the following: Samples 2 and 5, lead spike recoveries, were 0%/28% and 0%/0%, respectively. This result affected all soil and TCLP samples. The spike recovery limits do not apply when the sample concentration is more than 4 times the spike added. Sample spikes for soils were 8 times lower than the sample concentration. TCLP spikes were 55 times lower than the sample concentration. No qualifications were required. The post-digestion spike recovery was 0% for Sample No. 2 and 70% for Sample No. 5. To comply with the UFP–QAPP, the laboratory reanalyzed the MS/MSD with the appropriate amount of matrix spike. The reanalysis of the MS/MSD with the appropriate amount of spike had spike recoveries of 87% and 89%. This reanalysis of the MS/MSD had no effect on the data supplied in the original data package.

Overall, the data validation showed that the data received from the laboratory were valid and usable for assessing the environmental conditions. Sufficient usable data were available to allow the objectives of the KD Range MRS Berm Sampling UFP-QAPP to be met and the KD Range MRS Berm Area EE/CA to be completed.

The XRF QA/QC procedures described in the SOP in the UFP-QAPP were completed every day of analysis. The XRF data were reviewed by a project scientist with XRF analyses experience, but who did not run the analyses for the KD Range MRS Berm Area samples. As discussed in Section 2.1.3.2, the XRF field data correlated well with the laboratory data, with a laboratory data coefficient of determination (r^2) of 0.92 and a correlation coefficient (r) of 0.96. Based on the verification of method implementation and quality control, the results observed and the high correlation coefficient for the data set, the results are considered high-quality data that are valid

and usable for assessing the environmental conditions. Daily instrument blanks, method blanks, and calibration verification procedures were used to maintain the data quality of the XRF. Documentation of the XRF daily instrument blanks, method blanks, and calibration verification procedures are recorded in the XRF raw data files in **Appendix D**.

Determining data usability goes beyond validation because it involves evaluating the achievement of the DQOs based on the comparison of the project data quality indicators (DQIs) and individual MRS-specific work plans (which in this case is the EE/CA UFP-QAPP), with the obtained results. The process for evaluating the sampling, analyses, and data from the EE/CA investigation was performed in accordance with the guidelines in the UFP-QAPP and the procedures described in appropriate EPA guidance documents, particularly *Guidance for Data Useability in Risk Assessment* (Publication No. 9285.7-05FS, September 1992).

2.1.3.6.1 Sampling and Analysis Activities Evaluation

All sampling and analysis activities were completed according to the project-specific DQIs and the EE/CA UFP-QAPP. Laboratory data results flagged with a J/UJ were validated and met the requirements of the UFP-QAPP and are acceptable.

2.1.3.6.2 Achievement of DQOs

The data set has been assessed to be of known quality, the data limitations have been documented, and the overall applicability and usability of the data for the intended purposes have been determined. Based on the following determinations, the DQOs have been met.

- The data collected during the October 2013 sampling event are adequate to determine the extent to which hazardous substances have migrated from potential hazardous source areas.
- The data collected during the October 2013 sampling event adequately characterize the nature and extent of potential hazardous substance source areas at the MRS.
- The sample set collected during the October 2013 sampling event is sufficient to develop the site-specific removal and disposal treatment methodologies.

SECTION 2
FIGURES

25 KD Range GPS Sample Locations

Surveyor Grid Nodes

Camp Dawson Cantonment Boundary

Camp Dawson

Camp Dawson
Kingwood, WV

WESTON SOLUTIONS

FIGURE 2-1
KD Range MRS
Berm Sample Locations

N

0 50 Feet

0 10 20 30 Meters

NOTES:
Aerial Data Source: ESRI Bing Mapping Service, 2011

Coordinate System:
UTM, Z17N, WGS84, Meter

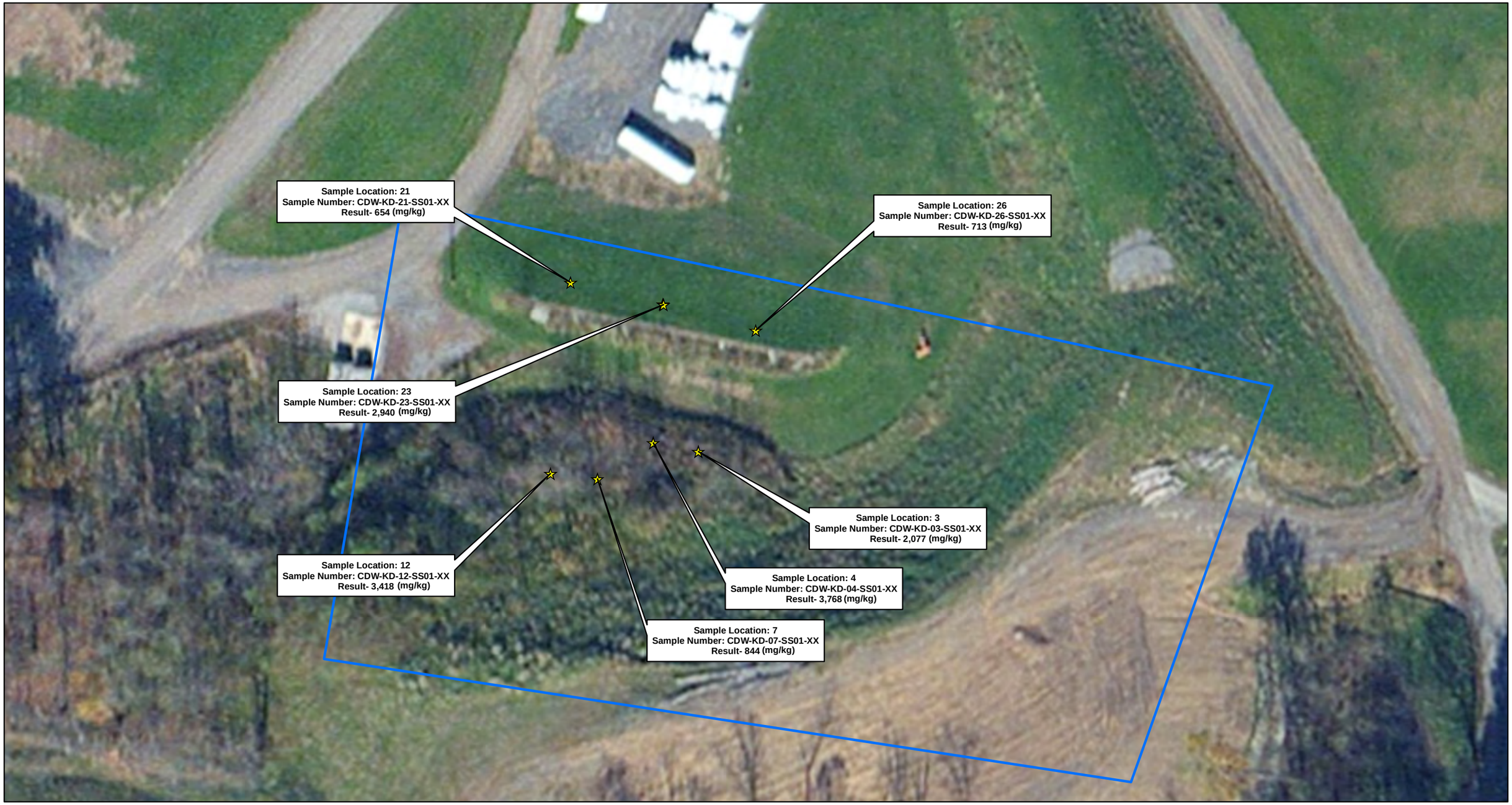
12/18/2013
Revision: 0

GPS_Locations

Drawn: johna

PROJ: 03886.551.008

File: Y:\Camp_Dawson\Mxd\GPS_Locations.mxd, 12/18/2013 3:29:54 PM, johna



KD Range GPS Sample Surface Results

Camp Dawson Cantonment Boundary

KD Range MRS Berm Area

Camp Dawson

Camp Dawson
Kingwood, WV

WESTON SOLUTIONS

N

0 50 Feet

0 10 20 30 Meters

NOTES:
Aerial Data Source: ESRI Bing Mapping Service, 2011

Coordinate System: UTM, Z17N, WGS84, Meter

FIGURE 2-2
Surface Sample Locations with XRF Results Exceeding Lead Screening Criterion

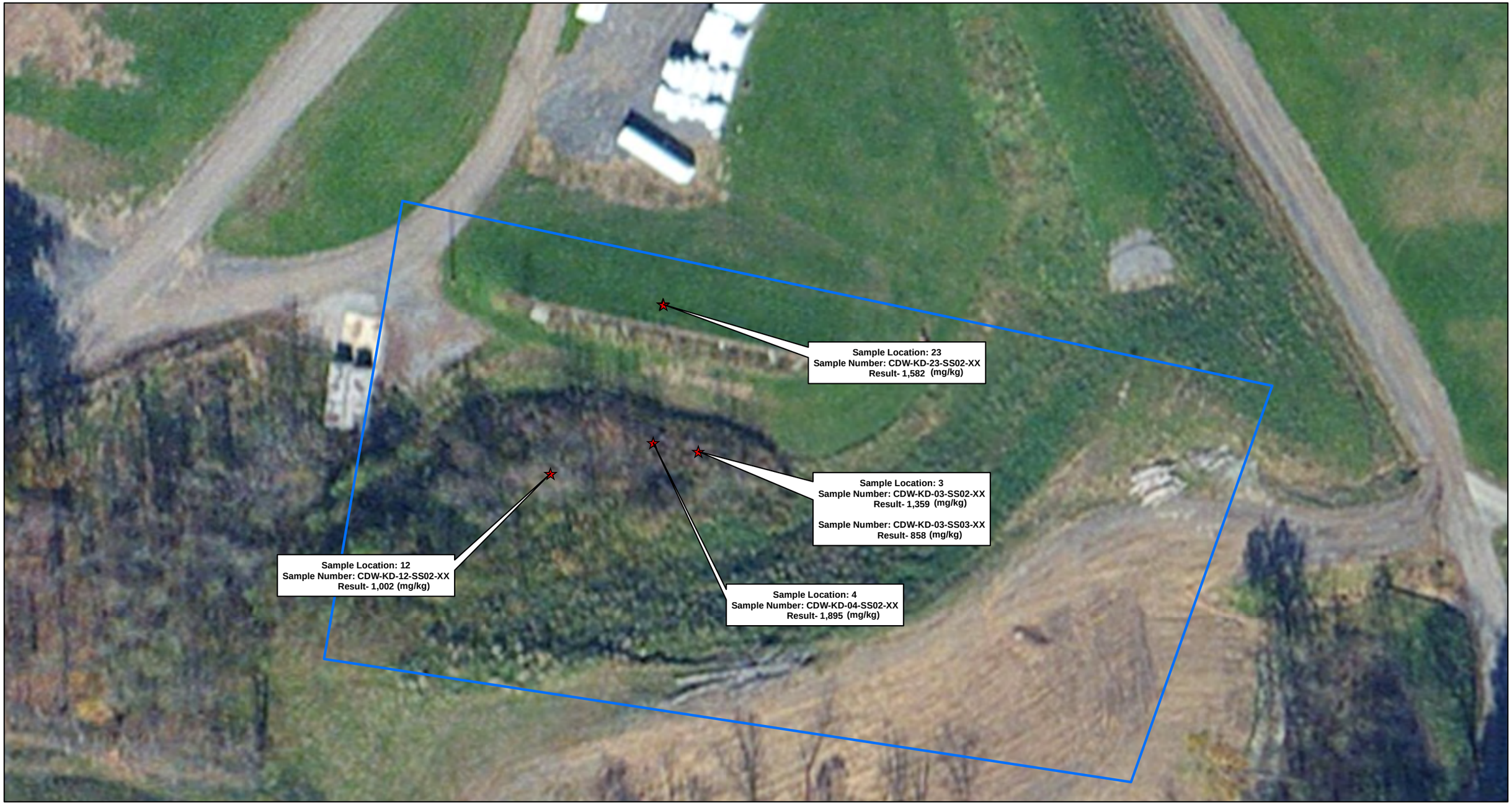
2/17/2014
Revision: 0

Samp_Locations_Surface_Results

Drawn: johna

PROJ: 03886.551.008

File: Y:\Camp_Dawson\Mxd\Samp_Locations_Surface_Results.mxd, 2/17/2014 1:12:00 PM, johna



KD Range GPS Sample Subsurface Results

Camp Dawson Cantonment Boundary

KD Range MRS Berm Area

Camp Dawson

Camp Dawson
Kingwood, WV

N

0 50 Feet

0 10 20 30 Meters

NOTES:
Aerial Data Source: ESRI Bing Mapping Service, 2011

Coordinate System: UTM, Z17N, WGS84, Meter

FIGURE 2-3
Subsurface Sample Locations with XRF Results Exceeding Lead Screening Criterion

2/17/2014
Revision: 0

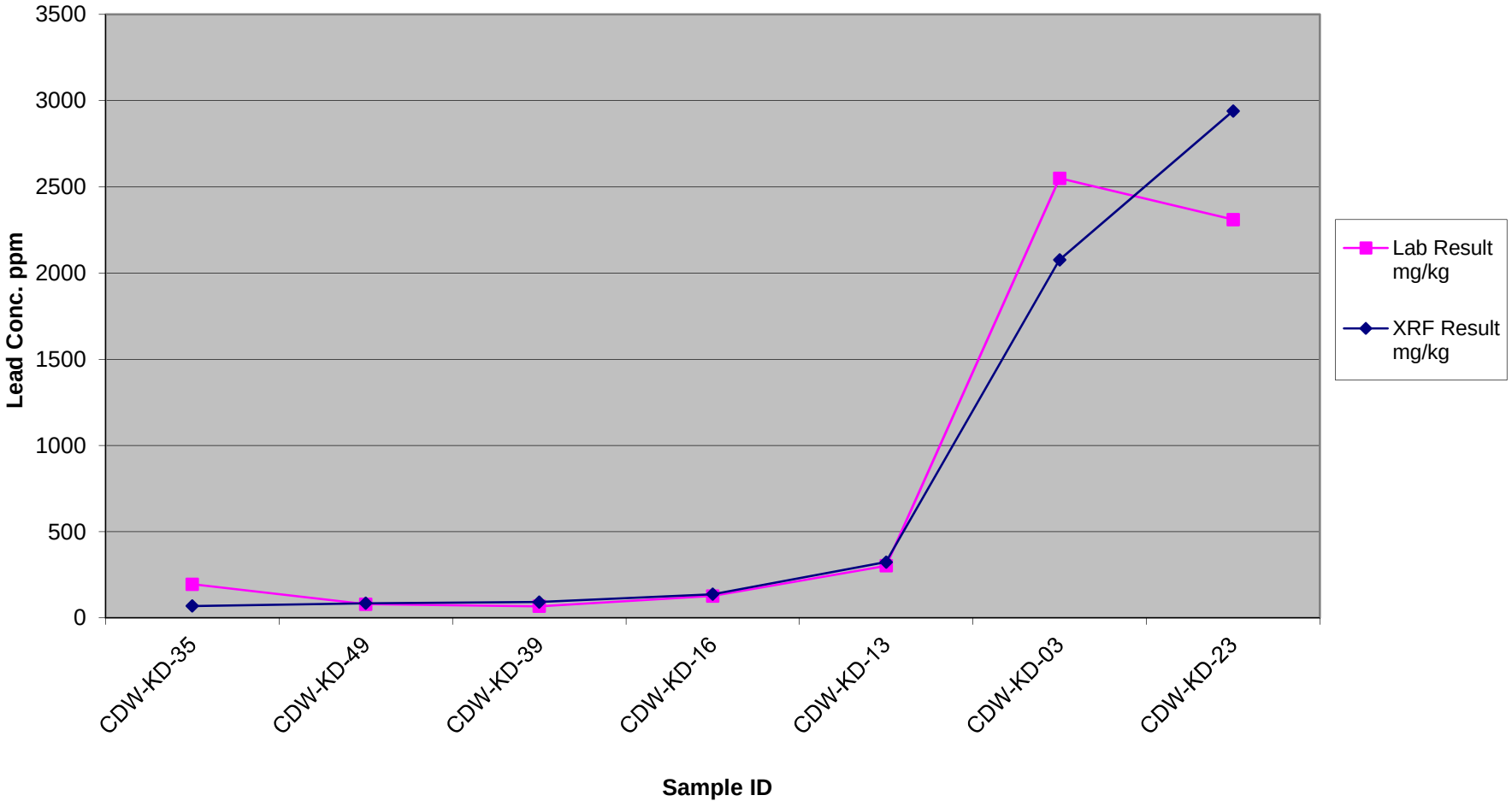
Samp_Locations_SubSurface_Results

Drawn: johna

PROJ: 03886.551.008

File: Y:\Camp_Dawson\Mxd\Samp_Locations_SubSurface_Results.mxd, 2/17/2014 1:19:32 PM, johna

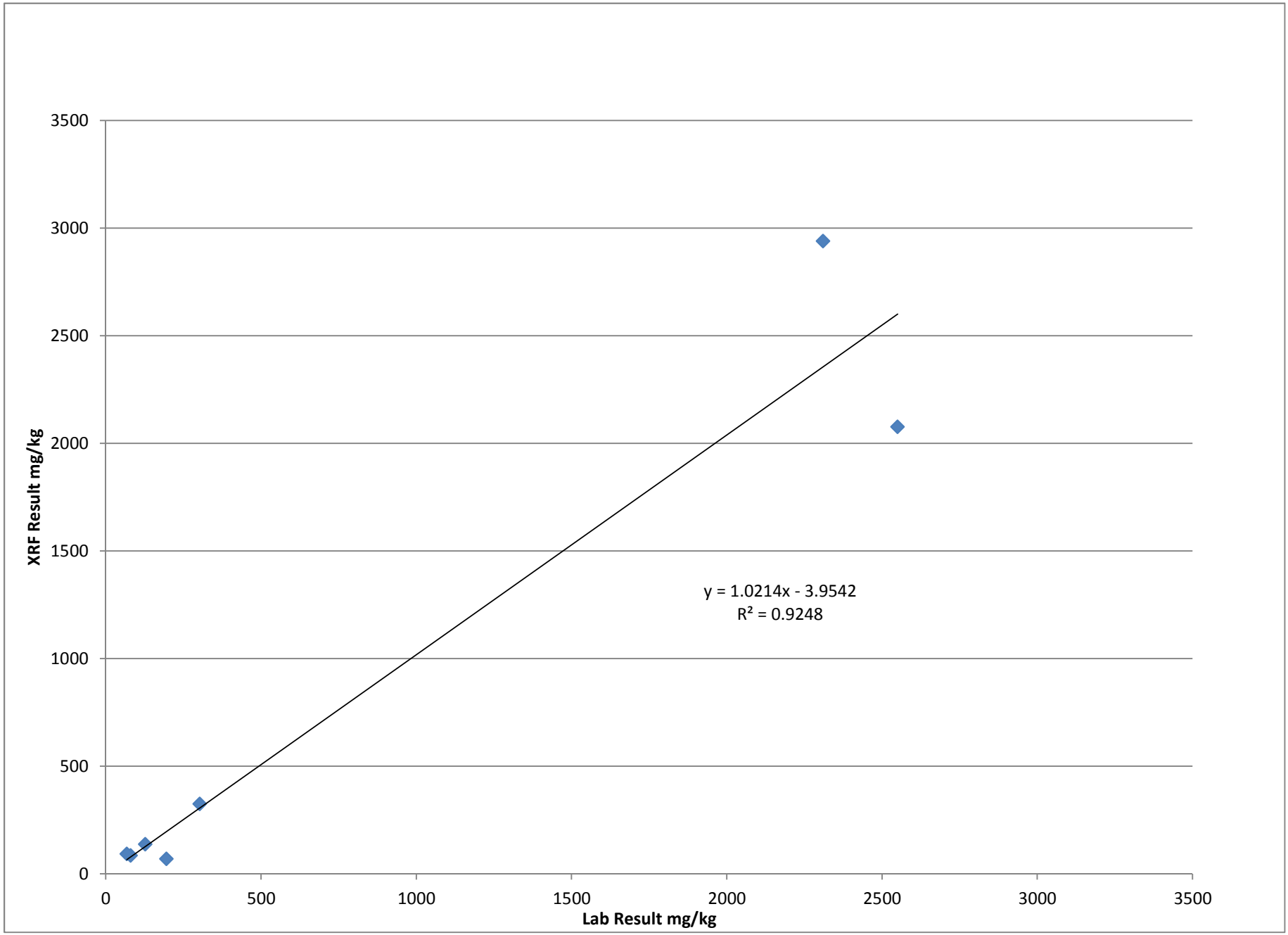
Figure 2-4
KD Range MRS Berm Area Field XRF versus Analytical Laboratory Results for Lead Concentrations



Notes:
1. Average value used for replicate samples.

2/19/2014

Figure 2-5 KD Range MRS Berm Area Field XRF versus Analytical Laboratory Results Linear Regression for Lead Concentrations



3. STREAMLINED RISK EVALUATION

3.1 INTRODUCTION AND OBJECTIVES

An SRE was performed for the KD Range MRS Berm Area investigation to determine whether the human health risk was within an acceptable range for unrestricted use. If the human health risks were found to be outside the acceptable range, the SRE process would be used to develop a risk-based removal action goal. This approach is consistent with EPA policy concerning land use presented in the *CERCLA Remedy Selection Process* (Office of Solid Waste and Emergency Response [OSWER] Directive No. 9355.7-04, May 25, 1995) (EPA, 1995), and the *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA* (EPA, 1993).

The objectives of the SRE for the KD Range MRS Berm Area EE/CA were to evaluate the potential risk of health problems if no cleanup action or removal action were to occur and to provide supporting data for the EE/CA.

The following subsections include the methodology, results, and conclusions of the human health SRE performed for the KD Range MRS Berm Area.

3.2 SRE METHODOLOGY

The site characterization approach included collection of sufficient data to perform the SRE for the impact berms in the KD Range MRS. The data set consists of both XRF and laboratory data. The XRF data were used to provide a more comprehensive and representative data set.

Field XRF data were compared with validated laboratory-determined lead concentration data. Ordinary least squares linear regression of the XRF concentrations against laboratory concentrations showed excellent agreement between analytical methods with a best fit equation of $Pb_{xrf} = 1.02Pb_{lab} - 3.95$ with a coefficient of determination (r^2) of 0.92 and a correlation coefficient (r) of 0.96. The frequently asked questions provided by EPA regarding XRF recent advances in technology and instrumentation now permit the use of XRF to yield results that are fully comparable with contract laboratory program (CLP) methods for soil (http://epa.gov/superfund/lead/products/xrffaqs.pdf).

The correlation coefficient for the XRF and laboratory confirmation data for the KD Range MRS Berm Area is greater than 0.9 and exceeds a primary criterion in EPA Method 6200 for use as definitive level data. The seven laboratory confirmation samples for the KD Range MRS Berm Area collected at a frequency of 1 to 10 XRF samples were sufficient for evaluating XRF accuracy. However, there were not sufficient laboratory data alone to perform distribution goodness-of-fit testing and subsequent calculation of the reliable upper confidence limit (UCL) estimates for an SRE. As noted in an August 2008 XRF training module provided by EPA (Module 2: Basic XRF Concepts), an approach using a larger data set containing both the laboratory confirmation samples and the XRF results would provide a better understanding of variability and contaminant distribution, and consequently a better average in instances where the XRF was properly calibrated for the element of interest. Therefore, the larger data set of laboratory and XRF data was used for the SRE.

The data used in the SRE were validated or were subject to quality review and verification. **Table 2-1** presents the XRF and analytical results for the Camp Dawson KD Range MRS.

3.2.1 Data Evaluation

Duplicate samples from the same sampling location were considered as one data point in summarizing the analytical results. The values reported for a duplicate sample were treated according to the following rules:

- For duplicates in which both the sample values were detected concentrations, the values were averaged unless the relative difference between the two samples, based on the magnitude of the lower of the two values, was equal to or greater than 50% for soil.
- In the latter cases, the maximum value of the duplicate set was used as the sample concentration.
- If a duplicate set consisted of nondetected and detected values, the detected value was used as the sample concentration in subsequent calculations. Both duplicate samples were included in the summary table with respect to the range of detected concentrations.

3.2.2 Selection as a Contaminant of Potential Concern

The EPA Office of Solid Waste has released a detailed directive on risk assessment and cleanup of lead in residential soil. The directive recommends that soil lead levels less than 400 mg/kg are generally safe for residential use and soil levels less than 800 mg/kg are generally safe for industrial use (EPA, 2013).

The average concentration for the 68 lead samples was 448 mg/kg (laboratory duplicates were not included in the calculation of the average concentration). At this step in the SRE process, lead is considered a contaminant of potential concern because it exceeds the screening level for residential soils (400 mg/kg).

Table 3-1 provides a summary of the lead results.

Table 3-1 Lead Soil Summary

Chemical	Range of Detected Concentrations (mg/kg)	Arithmetic Mean (mg/kg)	Residential Soil Screening Level (mg/kg)	Number of Samples Exceeding Residential Screening Level
Lead	17 – 3,768	448	400	14 of 68

Frequency of detection was 100%.
Number of samples = 68 routine samples.

3.3 EXPOSURE ASSESSMENT

Although the future commercial/industrial worker is the current primary receptor at the Camp Dawson KD Range MRS, the MRS is being evaluated for unrestricted use via the Integrated Exposure Uptake Biokinetic (IEUBK) model to predict the blood lead levels (BLLs) in young children. The basis for the evaluation is the use of the area by youths attending the Mountaineer Challenge Academy and the likely future use of the MRS for residential housing. Currently, residents at the KD Range MRS include Mountaineer Challenge Academy faculty/staff, cadets enrolled at the Academy, and other installation personnel who live within the KD Range MRS year-round. The Mountaineer Challenge Academy trains and mentors selected at-risk youth (ages 16-18) to become contributing members of society in a quasi-military environment during

a 22-week residential and 1-year post-residential follow-up program (National Guard Youth Challenge Program [NGYCP], 2013).

3.3.1 Evaluation of Lead

Young children (under the age of 6 years) are considered the most at risk from lead exposures because of their rapidly developing bodies and brains. EPA has developed the IEUBK model (EPA, 1994b and 2010a) to indirectly characterize lead risk based on the environmental exposure to lead-contaminated media. Thus, the IEUBK model was used to assess the potential impact of exposures to lead in the soil by future child residents. The level of risk associated with lead exposure that is considered protective of child residents would also be protective of adult residents.

The IEUBK model is premised on the protection of young children or the fetus from chronic lead toxicity. The model is used to predict BLLs in children based on studies of real-time human exposures and measurements of BLLs correlated with behavioral toxicity information in children. According to EPA, the model is predicated on the assumption of a 95% probability that the BLL in a child or a fetus should not exceed 10 micrograms per deciliter (μg/dL) in order to be protective against neurotoxic potential. Concentrations of lead in the blood reflect exposure to environmental lead through a number of contact routes, including soil ingestion, dust inhalation, dermal contact with soil, and lead received from maternal blood during gestation. The IEUBK model predicts child BLLs from media concentrations and exposure parameters supplied by the user in combination with the pharmacokinetic constants modeled from scientific data and the empirical human data. The default concentrations and the exposure input values recommended for the IEUBK model are based on experimental data as presented in **Table 3-2**.

Table 3-2 IEUBK Model Inputs

Media Concentrations for Input		
Soil	Site-specific data required	Lead average = 448 mg/kg
Dust	Site-specific date required or input value can be derived from soil concentration using multiple source analysis.	Used lead soil average (448 mg/kg), using multiple source analysis.
Air	Default. Ratio of indoor to outdoor air lead concentration is 30%	0.1 microgram per cubic meter
Drinking Water	Default	4 micrograms/liter

3.4 TOXICITY ASSESSMENT

The toxicity assessment involves weighing the available evidence and estimating the potential for the occurrence of adverse health effects. Although classified as a B2 carcinogen (probable human carcinogen), EPA has not assigned verified or provisional toxicity values (i.e., cancer slope factors [CSFs] and reference doses [RfDs]) to lead because the toxicity data available to date are inadequate for evaluation by EPA's current methodology. Therefore, lead risk was not evaluated using the conventional risk assessment approach.

In 2012, the Centers for Disease Control and Prevention (CDC) lowered the blood lead concentration level from 10 µg/dL to 5 µg/dL as the level of concern above which significant health risks occur. However, EPA has not lowered its recommended BLL (http://www.epa.gov/superfund/lead/ieubkfaq.htm#input). Therefore, the IEUBK model will be based on the BLL of 10 µg/dL.

3.5 RISK CHARACTERIZATION

Risk characterization is the key step in the risk assessment process because it serves as the bridge between risk assessment and the information needs of risk management. Risk characterization involves evaluating a combination of the information gathered as part of the data evaluation, selection of contaminants of potential concern, and toxicity and exposure assessments. Risk characterization can include the development of risk-based removal action goals.

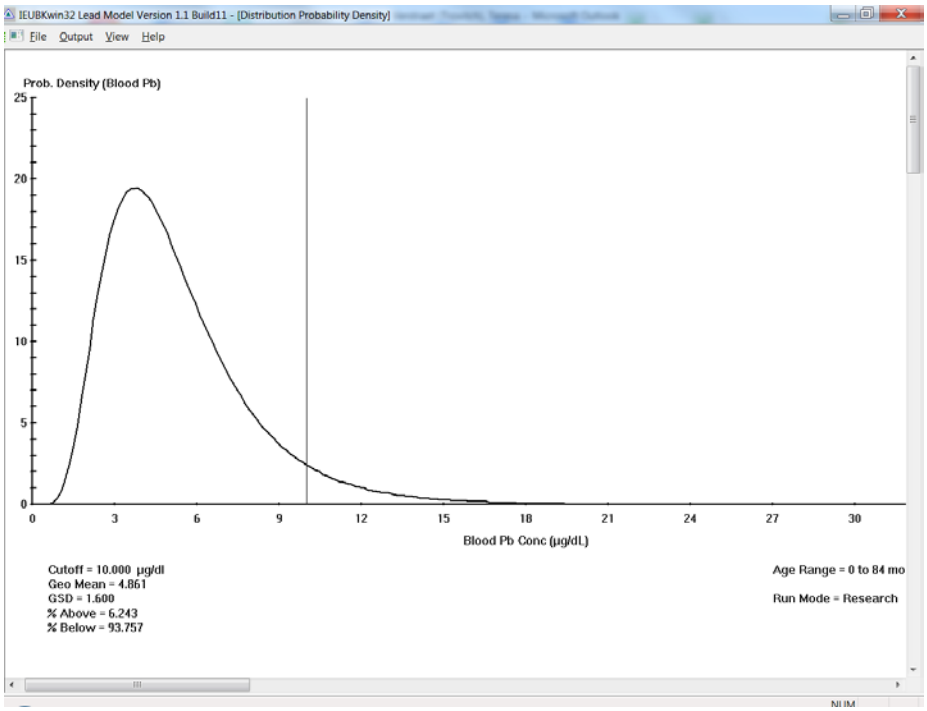
It is important to identify and understand all the assumptions and uncertainties associated with the risk assessment in order to place the conclusions in the proper perspective. Moreover, uncertainty analysis may identify areas at a site where additional data collection could aid in the selection of a more suitable remedy, especially for model parameters that are very sensitive to site-specific input (e.g., bioavailability). When conducting a risk assessment, it is more important to identify the key site-related variables and assumptions that contribute most to the uncertainty than to precisely quantify the degree of uncertainty in the entire risk assessment.

3.5.1 IEUBK Model Results

Blood lead levels were estimated for the hypothetical future child resident scenario using the IEUBK model (EPA, 2010a). The average lead concentration in aggregate soil (448 mg/kg) was used in the IEUBK evaluation. This concentration was used for both the indoor and outdoor dust lead levels. The child's age was assumed to be 0 to 84 months, and all other default model assumptions were used. Based on the input parameters and assumptions, the geometric mean BLL for the hypothetical child resident was 4.86 µg/dL with 93.8% of the population having a BLL less than 10 µg/dL (**Figure 3-1**). This percentage is slightly lower than the desired result of 95% of the population having BLL below 10 µg/dL, which indicates that there is an unacceptable level of risk based on residential use.

The IEUBK model was used as the primary tool to generate a risk-based removal action goal based on an unrestricted (residential) scenario. EPA's risk reduction policy is for no child to have greater than a 5% probability of having a BLL of 10 µg/dL or greater. In terms of a risk-based removal action goal, **Figure 3-2** and **Figure 3-3** demonstrate that an average lead concentration of 418 mg/kg will result in 95% of the population having a BLL less than 10 µg/dL.

Standard defaults, as presented in **Table 3-2** and in the IEUBK model, yield a residential risk-based removal action goal of 418 mg/kg.



Note: IEUBK model run using average lead concentration of 448 mg/kg yields 6.2% above the 10 µg/dL BLL (EPA, 1994b and 2010a).

Figure 3-1 IEUBK Model Run Using Average Lead Concentration

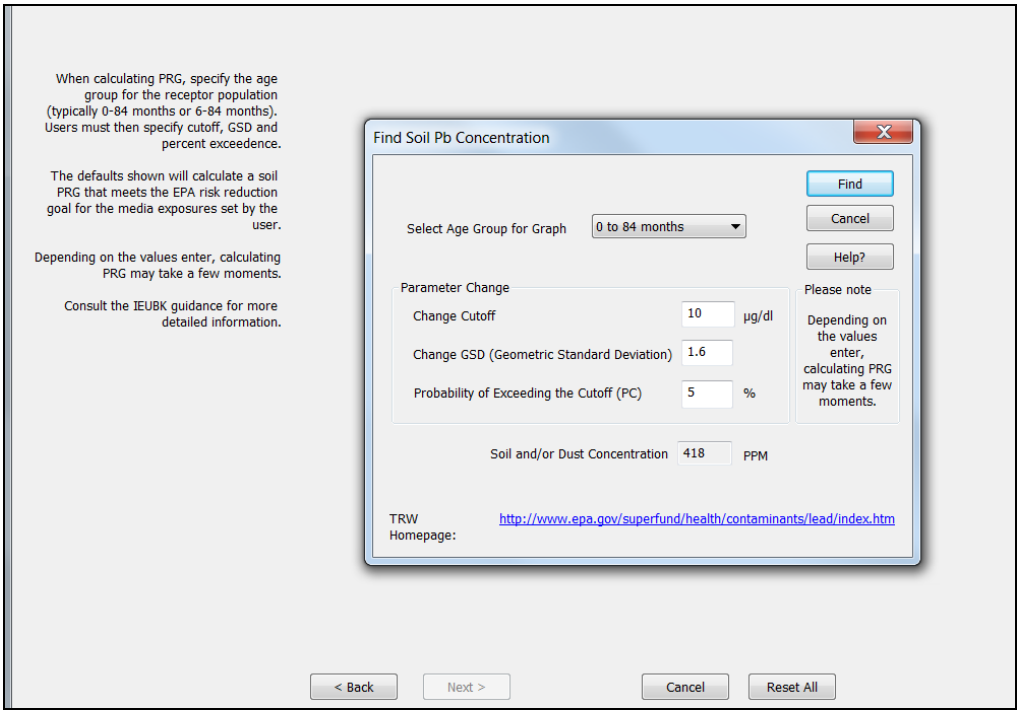
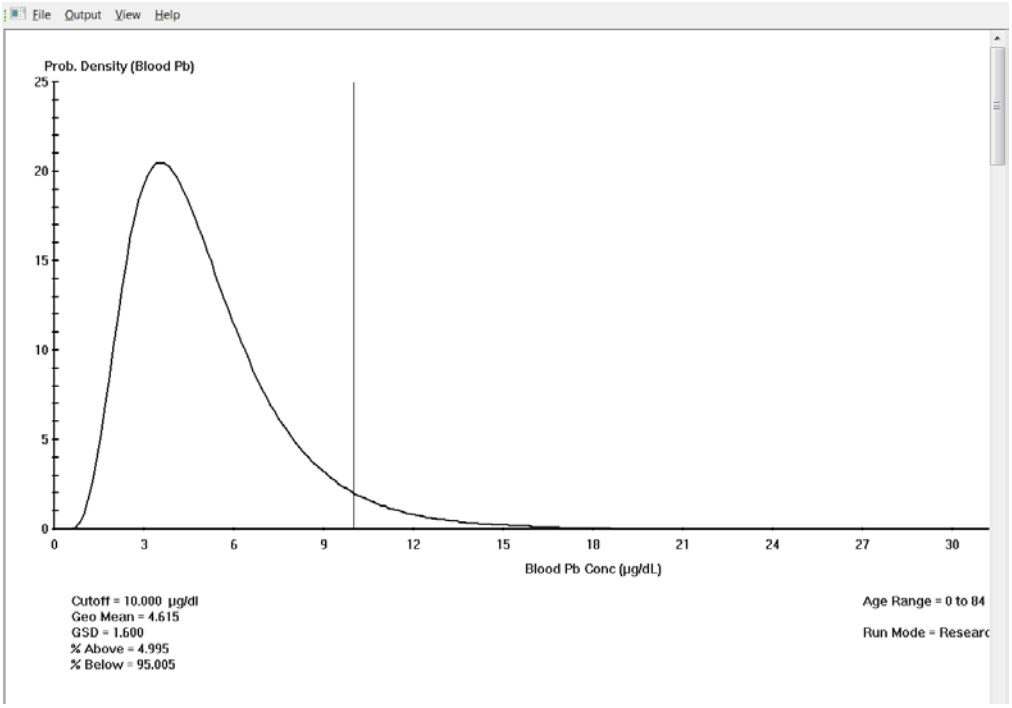


Figure 3-2 Residential Lead Risk-Based Removal Action Goal Using IEUBK Model



Note: IEUBK model run using lead risk-based removal action goal of 418 mg/kg demonstrated 5.0% above the 10 µg/dL BLL and 95% below the BLL (EPA 1994b and 2010a).

Figure 3-3 IEUBK Model Run for Establishing Residential Risk-Based Removal Action Goal

3.6 CONCLUSIONS

The frequency of detection for lead at Camp Dawson KD Range MRS Berm Area was 100% (n = 68). The maximum detected soil chemical concentration for lead in validated samples was 3,768 mg/kg. The mean value for lead is 448 mg/kg, which represents an unacceptable risk for unrestricted use (i.e., residents), based on the IUEBK model calculations.

In conclusion, a lead risk-based removal action goal for Camp Dawson KD Range MRS Berm Area soils was developed using the IEUBK model. The results indicate that lead concentrations at the MRS would pose an unacceptable risk to residents, including young children (0 to 84 months). The calculated risk-based removal action goal of 418 mg/kg was developed to be protective for residential land use. This risk-based removal action goal was used to support the development of the EE/CA removal action goal for the Camp Dawson KD Range MRS Berm Area.

4. IDENTIFICATION OF REMOVAL ACTION GOAL, OBJECTIVES, AND SCHEDULES

Prior to identifying the removal action objectives, it is necessary to consider other relevant information leading to the removal action objectives. The applicable or relevant and appropriate requirements (ARARs) and the removal action goal are discussed in Sections 4.1 and 4.2, the extent of contamination is discussed in Section 4.3, the removal action objectives are presented in Section 4.4, and the removal action schedule is discussed in Section 4.5.

4.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Pursuant to Section 300.400(g)(3) and 300.415(j) of the NCP, a list of ARARs and other advisories, criteria, and guidance to be considered (TBC) is developed for a site or sites to identify requirements that may apply to SIs, remedial response actions, and risk assessments. EPA policy, as reflected in CERCLA (as amended by the Superfund Amendments and Reauthorization Act of 1986 [SARA]) and the NCP, provides that the development and evaluation of removal actions under CERCLA must include removal alternatives (for EE/CAs) or remedial alternatives (for FSs) to meet ARARs and to ensure protection of public health and the environment.

ARARs are defined as follows:

- Applicable requirements—Those cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.
- Relevant and appropriate requirements—Those cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site.

Applicable requirements and relevant and appropriate requirements are considered to have the same weight with respect to requiring compliance at CERCLA site cleanups.

SARA also identifies the TBC category, which includes non-promulgated federal and state criteria, strategies, advisories, and guidance documents. TBCs do not have the same status as

ARARs; however, if no ARAR exists for a substance or particular situation, TBCs may be used to ensure that a remedy is protective.

ARARs and TBCs are divided into three general categories: chemical-specific, location-specific, and action-specific. Definitions of each of these categories and specific ARARs/TBCs for the KD Range MRS Berm Area are presented in the following sections.

4.1.1 Chemical-Specific ARARs

Chemical-specific requirements are health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants, or contaminants. These limits may take the form of cleanup levels or discharge levels.

At the KD Range MRS Berm Area, the only COC is lead. There are no promulgated federal chemical-specific ARARs for total lead in soil. At the state level, WVDEP promulgated WV Code, Title 60, Series 3, entitled the Voluntary Remediation and Redevelopment Rule (VRRR), which initially became effective on July 1, 1997, with a residential remediation standard for lead of 400 mg/kg. The EPA regional screening table developed by Oak Ridge National Laboratory under an Interagency Agreement with EPA in November 2013 and adopted by EPA Region 3, defines the lead criteria as 400 mg/kg for residential soil and 800 mg/kg for industrial soil (EPA, 2013). The WVDEP VRRR residential remediation standard of 400 mg/kg is applicable to the removal action and is considered a chemical-specific ARAR for the KD Range MRS Berm Area.

According to 40 CFR Section 261.3 (a)(2), a solid waste is hazardous if it exhibits any characteristics of hazardous waste. In accordance with 40 CFR 261.24, the RCRA characteristic waste limit for lead is based on a TCLP result exceeding 5 mg/L, and concentrations of lead in leachate samples exceeding 5 mg/L from lead-contaminated soil indicate that the soil is a characteristic hazardous waste. The RCRA characteristic waste limit of 5 mg/L is applicable for the soil excavated from the KD Range MRS Berm Area as part of the removal action.

4.1.2 Location-Specific ARARs

Location-specific requirements are restrictions on activities that are based on the characteristics of a site or its immediate environment. The KD Range MRS Berm Area does not have any areas

that require location-specific ARARs. There are no wetlands or ecologically sensitive areas within the areas identified for removal as part of the KD Range MRS Berm Area EE/CA.

4.1.3 Action-Specific ARARs and TBCs

Action-specific requirements are controls or restrictions on particular types of activities in related areas such as hazardous waste management or wastewater treatment. The action-specific ARARs associated with the KD Range are presented in **Table 4-1**. No federal or state solid waste handling regulations, other than hazardous waste regulations, were identified that would be applicable or relevant and appropriate for the removal action at the KD Range MRS Berm Area.

Evaluation of hazardous waste management regulations indicated that no state or federal requirements were identified that would be applicable or relevant and appropriate for the on-site treatment of the RCRA characteristic waste lead-contaminated soils. The treatment would be a temporary activity and would not involve a permanent treatment facility. The information in 40 CFR 264.1(g)(8)(I)(B) and in the EE/CA Memorandum about an imminent and substantial threat to the public health or welfare or the environment supports an exemption for a removal action at the KD Range MRS Berm Area. The EE/CA supports imminent threat and 40 CFR 264.1 (g) lists exemptions. ARARs identified for shipment and disposal of hazardous waste are provided in **Table 4-1**, including hazardous waste manifests and land disposal restrictions.

The West Virginia Code "Hazardous Waste Management Act," WV Code §22-18-23 is not an ARAR because the regulation is not more stringent than federal regulations. However, the regulation states that the West Virginia guidance requires the work to follow RCRA Subtitle C. RCRA Subtitle C regulations are included in the Code of Federal Regulations, 40 CFR, Parts 260 through 299. Not all of these parts apply to the EE/CA. The only parts of 40 CFR (and RCRA Subtitle C) that apply to the EE/CA are explained in **Table 4-1**.

Table 4-1 Preliminary Identification of Potential Applicable or Relevant and Appropriate Requirements and To-Be-Considered Information

Standard, Requirement, Criteria, or Limitation	Citation Potentially Germane to Removal Action at Camp Dawson KD Range MRS Berm Area	Description of Requirement	Comment
Chemical-Specific			
West Virginia Voluntary Remediation and Redevelopment Rule	WV Title 60 Legislative Rule, Department of Environmental Protection, Secretary's Office. Series 3, §60-3-3. Eligibility, §60-3-9.2 Remediation Standards. Table 60-3B	Legislative rule establishes the eligibility, procedures, standards, and legal documents required for environmental cleanups in the state of West Virginia.	*Applicable* States eligibility requirements and remediation standards that are applicable because they are more stringent than EPA regulations because there are no EPA promulgated standards for lead in soil. Establishes contaminant levels that do not present a substantial risk to human health. If, on the basis of the site assessment, these standards are met, no remedial action or further characterization is required.
Definition of Hazardous Waste: Toxicity Characteristic	40 CFR 261: 261.1(a) 261.10(a)(1)(i) 261.11(a)(1) 261.11(a)(2) 261.24 Table 1	Regulation defines the criterion that indicates which solid wastes are subject to regulation as hazardous waste. Hazardous waste characteristics are defined in 261.10 and 261.11. 40 CFR 261.24, Table 1 lists the maximum concentration of contaminants for toxicity characteristics.	*Applicable* The main contaminant in the soil is lead, which is a metal compound that can result in undesirable and irreversible health effects in young children. Thus lead-contaminated soil at certain concentrations fits the characteristic of a hazardous waste in 261.10(a)(1)(i) and 261.11(a)(1)&(2). Lead is one of the toxicity characteristic waste compounds listed in 261.24, Table 1, with a Toxicity Characteristic Regulatory Level of 5 mg/L. Applicable to determining whether soil is a characteristic hazardous waste after excavation. Some soil samples that exceed the regulatory level were collected during the EE/CA field work.
Action-Specific			
Hazardous Waste Manifest System and Related Standards For Generators	40 CFR 262: 262.11 262.21-.27 262.30-.34	General Facility Standards provide for hazardous waste determination (262.11), waste manifest generation (262.21 - 262.27) and handling (262.30 - 262.34), during the planned removal action event.	*Applicable* for both removal alternatives because it lists the requirements for handling and transporting hazardous waste. Waste manifest applies only for off-site transport (Alternative 3) because for Alternative 2, the lead-contaminated soil will no longer be hazardous waste after treatment, and the soil is being repurposed on Camp Dawson property.

Table 4-1 Preliminary Identification of Potential Applicable or Relevant and Appropriate Requirements and To-Be-Considered Information (Continued)

Standard, Requirement, Criteria, or Limitation	Citation Potentially Germane to Removal Action at Camp Dawson KD Range MRS Berm Area	Description of Requirement	Comment
Hazardous Waste Manifest System and Related Standards For Transporters	40 CFR 263: 263.10(a) & (b) 263.20 263.22(a) 263.30(a) – (c) 263.31	These regulations establish the standards that apply to persons transporting hazardous waste off-site within the United States as the transportation requires a manifest under 40 CFR 262 (263.10(a)&(b)). A manifest system will follow the guidelines specified in 263.20 and 263.22. Any spills that occur during transport will be cleaned up by the transport, per 263.30 and 263.11.	*Applicable* Transportation manifests would keep track of the volume of soil transported off-site for Alternative 3, and would provide documentation of a removal action occurring. Only construction trucks would be used to transport the contaminated or treated soil.
Land Disposal Restrictions and Treatment Standards	40 CFR 268.40	In order for site waste to be disposed of on land, the table "Treatment Standards for Hazardous Wastes" sets the maximum standard required for treatment prior to disposal.	*Applicable* For lead, the treatment standard is that the TCLP sample needs a lead concentration less than 0.75 mg/L. Applies to off-site disposal of lead-contaminated soil at permitted hazardous waste disposal facility (Alternative 3).
West Virginia Groundwater Protection Regulations	WV 47 CSR 58: 58-4.3.2 58-4.4	Establishes requirements for groundwater protection for new storage/disposal areas (58-4.3.2) and loading areas (58-4.4) during site work.	*Relevant and Appropriate* Proper spill prevention and control techniques are to be implemented in order to control any kind of releases that could impact the groundwater, particularly in areas of loading or off-loading vehicles. No groundwater monitoring wells would need to be installed for the removal action because the potential for groundwater contamination does not exist. Any accidental release or spill would be reported, in accordance with the regulation 46 CSR 3.
Erosion and Sedimentation Controls	West Virginia Erosion and Sediment Control Best Management Practice Manual 2006	Addresses erosion and sediment control for earth disturbing activities associated with construction.	*TBC* For excavation of soil at the KD Range MRS Berm Area as part of Alternative 1 or 2, the use of best management practices is to-be-considered to provide protection of surface waters from soil runoff during excavation activities. It is not a regulatory requirement.

CFR = Code of Federal Regulations
CSR = Code of State Regulations
EE/CA = Engineering Evaluation/Cost Analysis
EPA = United States Environmental Protection Agency
KD = Known Distance
MRS = Munitions Response Site
TBC = to be considered
TCLP = toxicity characteristic leaching procedure
WV = West Virginia

The WV National Pollutant Discharge Elimination System (NPDES) Stormwater Program requires operators of construction sites that disturb one (1) acre or greater, including smaller sites that are part of a larger common plan of development, to obtain authorization to discharge stormwater under an NPDES Construction Stormwater General Permit. Soil removal activities at the KD Range MRS involve an area less than 1 acre; therefore, an NPDES permit is not required for soil excavation activities. Preston County does not have a county-specific stormwater ordinance. However, erosion and sedimentation controls should be used during the excavation activities to prevent soil runoff from the excavation area. The *West Virginia Erosion and Sediment Control Best Management Practice Manual* (WVDEP, Division of Water and Waste Management, 2006) addresses erosion and sediment control for earth-disturbing activities associated with construction and is considered a TBC for the removal action at the KD Range MRS Berm Area. The manual is designed to assist construction site developers, engineers, designers, and contractors in identifying and implementing the most appropriate best management practices for construction activities. However, the use of other best management practices manuals may also be acceptable. The use of the Best Management Practice Manual is not a regulatory requirement.

4.2 PRELIMINARY REMOVAL ACTION GOAL

The removal action goal for a contaminant is the most protective chemical-specific ARAR/TBC or risk-based removal goal for that contaminant. Lead is the only COC at the KD Range MRS Berm Area. A site-specific risk-based removal action goal for the KD Range MRS Berm Area was determined based on the IEUBK. The IEUBK model was used to assess the potential impact of exposures to lead in the soil by future child residents. The level of risk associated with lead exposures that is considered protective of child residents would also be protective of adult residents. The results indicate that lead concentrations at the KD Range MRS Berm Area would pose an unacceptable risk to residents, including young children (0 to 84 months). The calculated risk-based removal action goal of 418 mg/kg was developed to be protective for residential land use (see Section 3.4.1). Although the risk-based model allows a lead level of 418 mg/kg, the West Virginia VRRR residential remediation standard of 400 mg/kg (see Section 4.1.1) was selected as the removal action goal for the KD Range MRS Berm Area because it is considered an ARAR.

4.3 EXTENT OF CONTAMINATION

A plan view of the KD Range MRS Berm Area showing the extent of contamination is depicted in **Figure 4-1**. There are two distinct areas, one on the target berm and one on the impact berm. Approximate dimensions of the contaminated areas are 150 ft by 25 ft and 125 ft by 60 ft. These areas were delineated by extrapolating between sample locations with lead detections greater than 400 mg/kg and the surrounding surface soil sample locations with lead detections less than 400 mg/kg (see **Figure 4-1**). The analytical results of the soil samples collected from within the contaminated areas indicate that the soil from ground surface to 0.5 ft bgs is contaminated with lead above the removal action goal of 400 mg/kg. Vertical delineation in the 150 ft by 25 ft area and 125 ft by 60 ft area was achieved by sampling the soil from each grid node in 6-inch intervals. Lead results, with the exception of one location (CDW-KD-3), were below 400 mg/kg at 1 to 1.5 ft bgs. CDW-KD-3 exceeded the removal action goal in the subsurface soil sampling interval of 1.0 to 1.5 ft bgs. Sample results for lead at 1.5 to 2 ft bgs at CDW-KD-3 did not exceed 400 mg/kg.

The two separate areas contaminated with lead above the removal action goal are relatively small. For the purpose of developing a conservative estimated excavation volume and to ensure that all contaminated material would be removed, the proposed minimum excavation depth in both areas was assumed to be 1 ft. The total estimated volume of the proposed removal at the KD Range MRS Berm Area is approximately 460 cubic yards (yd^3).

In addition to the proposed removal area, **Figure 4-1** presents an estimated boundary for the area of soils that could potentially be classified as characteristic hazardous waste following excavation, based on the TCLP results for lead discussed in Section 2.2. This area, shown as the blue cross-hatched area, has a surface area of approximately 500 square feet (ft^2). The area was delineated by extrapolating between sample locations with TCLP results for lead greater than 5 mg/L and the surrounding sample locations with TCLP results for lead less than 5 mg/L. For the purpose of developing a conservative estimated excavation volume and to ensure that all contaminated material would be removed, the proposed minimum excavation depth for the area was assumed to be 2 ft bgs. The total estimated volume of potentially hazardous soil is approximately 40 yd^3, which is included in the 460 yd^3 total estimated volume of soil to be removed from the KD Range MRS Berm Area.

4.4 REMOVAL ACTION SCOPE AND OBJECTIVES

The scope of the removal action is to remove and treat/dispose the lead-contaminated soils above the removal action cleanup goal (referred to hereafter as the removal action goal) from the KD Range MRS Berm Area. Although the action is being performed as a "removal action" as defined by CERCLA (i.e., NTCRA), the WVARNG intends for it to be a final action (i.e., remedial action). The goal of the removal action at the KD Range MRS Berm Area is to prevent direct contact, ingestion, and inhalation of lead contamination in soil, which poses an unacceptable risk to current and future residents and to industrial/commercial and construction workers, by eliminating exposure to levels that are above the removal action goal. Specific components of the removal action objectives for the KD Range MRS Berm Area are summarized as follows:

- Remove lead-contaminated soils exceeding the removal action goal of 400 mg/kg from the KD Range MRS Berm Area, thereby reducing the potential health-based risks to humans to acceptable levels. The removal action will be performed to abate, prevent, minimize, stabilize, or eliminate potential risks to current and future residents entering the area and being exposed to the soils.
- Treat soils exceeding the RCRA characteristic waste limit of 5 mg/L or dispose in a permitted off-site disposal facility.
- Complete removal action/verification sampling by the year 2015.
- Conduct removal action in compliance with ARARs.
- Properly dispose of any waste streams generated from the removal action.
- Stabilize KD Range MRS Berm Area upon completion of removal action.

4.5 REMOVAL ACTION SCHEDULE

The schedule for the NTCRA at the KD Range MRS Berm Area will depend on the recommended alternative selected. WVARNG intends to have the KD Range MRS Berm Area administratively closed out by 2015. A proposed schedule for the implementation of the recommended removal action alternative is provided in Section 7. This schedule is based on the assumed agency approval periods/dates for the EE/CA and other supporting documentation as shown on the schedule. A public review and comment period of 30 days is also included.

SECTION 4
FIGURE

25 KD Range GPS Sample Locations

Camp Dawson Cantonment Boundary

KD Range MRS Berm Area

Lead Impacted Soils (to be excavated to a minimum depth of 1 ft bgs)

Soil potentially exceeding 5 mg/L TCLP (to be excavated to a depth of 2 ft bgs)

Camp Dawson

Camp Dawson
Kingwood, WV

N

0 50 Feet

0 10 20 30 Meters

NOTES:
Aerial Data Source: ESRI Imagery Mapping Service, 2011

Coordinate System: UTM, Z17N, WGS84, Meter

FIGURE 4-1
KD Range MRS Berm Area
Extent of Contamination

5/6/2014
Revision: 0

Extent_of_Contamination

Drawn: johna

PROJ: 03886.551.008

File: Y:\Camp_Dawson\Mxd\Extent_of_Contamination.mxd, 5/6/2014 4:05:31 PM, johna

5. IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

5.1 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

The objective of this section is to identify and analyze a range of removal action alternatives for implementing an NTCRA at the KD Range MRS Berm Area. These alternatives are designed to provide various degrees of protection to human health and the environment in achieving removal action objectives. The removal action objectives for the KD Range MRS Berm Area are presented in Section 4. In accordance with CERCLA, the identified removal action alternatives are evaluated in sufficient detail to allow an administrative decision to be made based on the relevant criteria.

Based on the results of the SI and the October 2013 soil characterization reported in the EE/CA, lead is the only COC in the KD Range MRS Berm Area. The removal action goal for the KD Range MRS Berm Area soil is 400 mg/kg for lead. Approximately 460 yd^3 of soil exceed the removal action goal.

Based on the removal action objectives and the nature and extent of the lead contamination in soils at the KD Range MRS Berm Area, a limited number of alternatives have been identified for evaluation of applicability to the berm area. Because the action is being performed as an NTCRA, the screening included only alternatives based on proven, effective, and easily implementable (given the MRS condition) technologies for mitigation of lead. Less-proven technologies were not considered during the identification process because they lacked substantiated effectiveness.

The following factors were considered when developing the removal action alternatives:

- The alternatives often include an alternative that is used as a baseline. For the KD Range MRS Berm Area EE/CA, other alternatives were compared against the no action alternative (Alternative 1) during the analysis.
- The alternatives must provide a range of protectiveness to human health and the environment in achieving removal action objectives.

- The alternatives must be able to be implemented in a timely manner. The removal action at the KD Range MRS Berm Area is being performed as an NTCRA. The KD Range MRS Berm Area final remedial action, including the removal action, must be completed by 2015.

- The alternatives must include technologies that can effectively treat heavy metals in soil, specifically, lead.

The information about the technologies was extracted from current EPA and DoD guidance documents and databases (e.g., the Clean-up Information Bulletin Board under the EPA Technology Innovation Office [CLU-IN]; the National Technology Information Service [NTIS] database; the Vendor Information System for Innovative Treatment Technologies [VISITT] database; and the Defense Environmental Network & Information Exchange [DENIX]). Based on this information, the following removal action alternatives were identified for the KD Range MRS Berm Area:

- Alternative 1: No Action.
- Alternative 2: Excavation, Treatment, and Repurpose.
- Alternative 3: Excavation and Off-Site Disposal.

As mentioned earlier, the no action alternative was included as a baseline alternative against which other alternatives are compared. The second alternative, treatment and repurpose, includes an innovative technology, which has proven effective in stabilizing lead in soil and is easily implementable. The second alternative also consists of the excavation of lead-contaminated soil and repurpose at a controlled active range at Camp Dawson. The third alternative, excavation and off-site disposal, does not entail treatment of soil within the KD Range MRS Berm Area.

These alternatives were also selected based on the CERCLA process preference for treatment over the conventional containment or land disposal approaches to address the principal threat at the KD Range MRS Berm Area. The NCP (40 CFR 300.415) requires that alternatives be developed in sufficient detail to support the technical decision in the administrative record. The information presented herein meets these criteria. Each of the technologies/alternatives was evaluated against predetermined criteria to retain only those technologies that are feasible and have a high potential to achieve the removal action objectives. Each of the alternatives was evaluated using the following three main criteria, in consideration of the likelihood that the use of the alternative will enable the removal action objectives to be met:

- **Effectiveness—**The effectiveness of the technology relative to other alternatives within the same technology type. The effectiveness evaluation focuses on performance and the reliability of the technology considering its stage of development (i.e., well-established, proven technologies are considered more reliable than those still in the experimental stages). This evaluation also includes protectiveness (public health, community, residents, and workers during implementation); short- and long-term effectiveness; level of treatment expected (reduction of toxicity, mobility, and volume [TMV]); compliance with ARARs; and residual effect concerns.

- **Implementability—**Implementability includes both the technical and administrative feasibility of implementing a process option. The implementability evaluation primarily considers the level of difficulty in overcoming technical and institutional concerns associated with a given technology. This evaluation includes construction/operational considerations; time for implementation; availability of equipment, personnel, and services; state and community acceptance; and permits/approvals required.

- **Cost—**Cost is a limited factor in the evaluation process. In lieu of detailed cost estimates, relative costs for capital purchases and operations and maintenance (O&M) are used to compare alternatives. Cost estimates developed for the KD Range MRS Berm Area EE/CA are order-of-magnitude costs that may vary as additional information is obtained for the MRS. As required under CERCLA guidance, the accuracy of the estimated costs should be between +50% and –30%. General categories of costs (high, medium, or low) are used to compare alternatives against one another.

A detailed evaluation of the three alternatives against each of these evaluation criteria is presented in Sections 5.2 through 5.4.

5.2 ALTERNATIVE 1 – NO ACTION

Alternative 1 was evaluated as a baseline scenario against which other alternatives may be compared. Under the no action alternative, no remedial measures would be implemented. Potential risks due to lead contamination would continue to exist.

5.2.1 Effectiveness—Protectiveness and Ability to Achieve Removal Action Objectives

Alternative 1 would not be effective in achieving the removal action objectives, and it would not be protective of human health (users of the KD Range MRS Berm Area). The potential risks to users of the KD Range MRS Berm Area would continue to exist as a result of the presence of lead above the removal action goal. In the absence of remedial actions, the KD Range MRS Berm Area would be left undisturbed and untreated; therefore, there would be a continued risk to

the current site users. If no action were taken, the removal action objective would not be met. There are no location-specific or action-specific ARARs associated with Alternative 1.

5.2.2 Implementability—Technical Feasibility, Availability, and Administrative Feasibility

Alternative 1 can be easily implemented. There are no technical or administrative difficulties involved with the implementation because there would be no activities or permitting associated with this alternative. Alternative 1 could be implemented within the time period desired for an NTCRA.

5.2.3 Cost

There are no costs associated with Alternative 1 other than the existing maintenance costs for the KD Range MRS Berm Area by ARNG. The maintenance cost would be a factor whether or not a removal action is implemented at the MRS, and would remain consistent with respect to the alternatives considered. Therefore, the maintenance cost is not listed in the KD Range MRS Berm Area EE/CA for any alternative.

5.3 ALTERNATIVE 2 – EXCAVATION, TREATMENT, AND REPURPOSE

Alternative 2 would include the excavation, treatment, and repurpose of the contaminated soils that exceed the removal action goal. Alternative 2 consists of removing from the KD Range MRS Berm Area the soil with lead concentrations exceeding the removal action goal of 400 mg/kg (approximately 460 yd^3), which includes an estimated 40 yd^3 of soil predicted to be a RCRA characteristic waste (with a lead TCLP concentration exceeding 5 mg/L). Alternative 2 also consists of treating the soil (approximately 460 yd^3) with a chemical stabilizing agent, and repurposing the treated soil in a controlled active range at Camp Dawson.

The soil with lead concentrations exceeding the removal action goal of 400 mg/kg (approximately 460 yd^3), which includes an estimated 40 yd^3 of soil predicted to be a RCRA characteristic waste (with a lead TCLP concentration exceeding 5 mg/L), would be treated with a chemical metal-stabilizing agent called ECOBOND®. ECOBOND® will stabilize the lead in the soil prior to the soil being repurposed at a controlled active range within Camp Dawson. After treatment, the soil with a TCLP greater than 5 mg/L lead would no longer be classified as a characteristic hazardous waste. The treatment of the excavated soil also provides stabilization to

prevent leaching and migration of lead at the active range where the soil would be placed. ECOBOND® has been successfully used at several sites to treat and stabilize lead in contaminated soil by converting the lead into a non-leachable and insoluble form, bringing the potential leachate value to well below 5 mg/L for lead. The overall weight of the treated soil would increase slightly due to the addition of the ECOBOND®.

Confirmation soil samples will be collected at the base of the excavated area and analyzed for lead to ensure that the removal action goal is met. Backfill might not be needed because Camp Dawson would likely regrade the area after the removal action.

5.3.1 Effectiveness—Protectiveness and Ability to Achieve Removal Action Objectives

The primary factors that determine the effectiveness of the treatment process for the soil that exceeds 5 mg/L of lead in leachate and the soil that exceeds 400 mg/kg lead are the initial concentrations of lead and the volume of the amendment needed to stabilize the lead in soil. The Treatability Report (**Appendix B**), prepared by MT2, finds that the lead-impacted soils can successfully be treated to reduce the lead in leachate from the soil by adding the appropriate amount of ECOBOND to the potentially hazardous soil. The report includes a calculation of the amount of ECOBOND® needed to stabilize the lead-contaminated soil predicted to be hazardous (40 yd^3) at the KD Range MRS Berm Area. In the report, it was concluded that a minimum ratio of 1 gram of ECOBOND® for every 100 grams of contaminated soil was needed to stabilize the lead in soil and to reduce the leachate sample concentration to below 5 mg/L. To ensure effectiveness, samples would be collected from the treated soil and analyzed for lead in the leachate to confirm that the leachate concentrations are below 5 mg/L.

Upon completion, Alternative 2 would effectively reduce the TMV by treating the RCRA characteristic hazardous soil and stabilizing it, reducing the levels of leachable lead well below 5 mg/L. In addition, lead would be stabilized in all the excavated soil with concentrations greater than the removal action goal. The treated soil would be permanently removed from the KD Range MRS Berm Area using proven excavation techniques and confirmation sampling to ensure that the removal is effective.

The treated soil would then be transferred to a controlled active range on the Camp Dawson property. The removal action is anticipated to be the final action to address the soils at the KD Range MRS Berm Area. Alternative 2 would be successful in meeting the removal action objectives by reducing the leachable lead concentrations in soil to levels below the RCRA characteristic waste limit for lead and removing soils that have lead concentrations greater that the removal action goal of 400 mg/kg and moving them to a more restricted area. Alternative 2 would be protective of users of the KD Range MRS Berm Area because the lead-contaminated soils would be treated to render them nonhazardous and to prevent lead from leaching and migrating. Then the soils would be placed in a controlled active range area at Camp Dawson with little or no opportunity for human exposure. Because the material is being repurposed at Camp Dawson, the treated soil would not have to be transported to off-site landfills, thus reducing the potential risk to the general public and the environment along the transportation routes.

Exposure to contaminants during the implementation of Alternative 2 would be minimal because the material handling would be conducted using appropriate equipment and following the proper health and safety procedures. Dust suppression measures would minimize respiratory exposure. To reduce the potential for runoff from the active excavation, erosion control measures would be used to protect the residents, workers, and the environment at Camp Dawson during implementation of Alternative 2.

Alternative 2 would be protective of human health (personnel using or visiting the KD Range MRS Berm Area) because soil exceeding the removal action goal would be treated and removed from the KD Range MRS Berm Area. In addition, Alternative 2 would be protective of personnel along the transportation route within Camp Dawson and the environment because the lead in soil would be stabilized prior to being transported. In addition, the treated soil would be transported from the KD Range MRS Berm Area for repurposing as fill on Camp Dawson. Soil that originally did not meet the RCRA characteristic waste limit for lead would be treated such that the soil would no longer meet the characteristics of a hazardous waste and the lead would be stabilized. Thus, the potential risk of human exposure to the soil during transport would be reduced. The treated soil would be repurposed at Camp Dawson at a controlled active range, where there is restricted access to both the general public and on-base personnel.

Alternative 2 provides sustainable aspects consistent with EPA's *Superfund Green Remediation Strategy* (EPA, 2010b), which outlines methods to reduce the demand placed on the environment during cleanup actions and to conserve natural resources. Two of the green remediation methods listed in the EPA document are as follows: "pursue ways to reduce the use of natural resources and energy during remedial actions and when developing cleanup alternatives; and identify additional on-site or off-site uses of materials or energy otherwise considered waste." Alternative 2 supports these two green methods by minimizing the natural resources that would be used and by utilizing the treated soil on a controlled active range on-site.

The chemical-specific ARARs would be met under Alternative 2. Personal protective equipment (PPE) and other safety procedures required under Occupational Safety and Health Administration (OSHA) 29 CFR 1910 and 1926, and the United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual (USACE, 2008) would be necessary for protection of workers treating and transporting soil to the controlled active range. Proper runoff control measures would be used to prevent the off-site migration of contaminants. Other potentially applicable action-specific ARARs/TBCs as specified in Section 4.1.3, such as the West Virginia Groundwater Protection Regulations WV 47 CSR 58 and the *West Virginia Erosion and Sediment Control Best Management Practice Manual* (WVDEP, 2006), would be met using Alternative 2. There are no location-specific ARARs associated with Alternative 2.

A stormwater discharge permit would not be required because the earthmoving activity would involve less than 1 acre. However, the best management practices presented in the *West Virginia Erosion and Sediment Control Best Management Practice Manual* will be implemented as needed for erosion and sedimentation control measures.

5.3.2 Implementability—Technical Feasibility, Availability, and Administrative Feasibility

It is anticipated that Alternative 2 would be relatively easy to implement. The heavy earthmoving equipment needed to complete the project is readily available. WESTON and its subcontractor MT2 would provide all necessary equipment and make the appropriate arrangements with Camp Dawson to complete this project. Camp Dawson has ongoing construction projects that utilize heavy earthmoving equipment and dump trucks. Therefore, the infrastructure at Camp Dawson is sufficient to support the equipment slated to complete this project.

The soil treatment technology is commercially available through MT2. Because treatment with ECOBOND® is a relatively simple technology, technical difficulties are not anticipated. The ECOBOND® product is applied to the soil and mechanically mixed in situ. The application and mixing requires no specialized equipment and can be completed with readily accessible earthmoving equipment. Backfill might not be needed because Camp Dawson would likely regrade the area after the removal action.

WVDEP acceptance of Alternative 2 would be anticipated for several reasons. First, treatment with ECOBOND® is an established technology accepted by EPA and other state agencies for treatment of soils affected by lead. This technology and the ECOBOND® application has been approved in Work Plans for over 600 projects nationwide by DoD, EPA, and numerous states, as well as other state and federal regulatory agencies. WESTON has successfully used ECOBOND® at Wheeler Army Airfield and Schofield Barracks in Honolulu, HI. MT2 has successfully used ECOBOND® at many military installations, including F.E. Warren AFB, WY; Joint Base Lewis McChord, WA; and Aberdeen Proving Ground, MD. ECOBOND® is a proprietary phosphate-based, nonhazardous, dry, granular product that chemically converts lead into a nonleachable form without changing the physical properties of the soil. ECOBOND® will be delivered to the site in bulk by trucks, off-loaded, and staged in a central location near the treatment piles. ECOBOND® will be premeasured and applied using a front-end loader or an equivalent piece of equipment. The loader will be used to evenly spread ECOBOND® over the surface and then the loader and excavator will be used to thoroughly mix ECOBOND® with the soils. Soils once treated will be excavated and loaded into trucks for transport to an active range. Furthermore, using ECOBOND® for the lead concentrations found at the KD Range MRS has been proven to be an excellent means for stabilizing lead to soil. Treatment and placement of the treated soils is expected to be completed in a few weeks' time, which would minimize impacts to Camp Dawson operations. During placement of soils, NGYCP activities in the immediate area would be postponed. However, the NGYCP can easily move to other areas of Camp Dawson to conduct training without impacting the program.

5.3.3 Cost

The costs associated with Alternative 2 include the following:

- Development of the work plans.
- Site preparation work.
- Work associated with treatment and repurpose, including excavating, mixing, hauling and placement of excavated soils (e.g., soils above 400 mg/kg and treated soils) at an active training range at Camp Dawson.
- Confirmation sampling and analysis.
- Site restoration.
- Preparation of the site closure report.

The approximate cost associated with Alternative 2 is $481,780. A summary of the estimated costs for this alternative is provided in **Table 5-1.**

Table 5-1

Cost Estimate for Alternative 2 - Excavation, Treatment, and Repurpose

Item	Item/Task	Quantity	Unit	Unit Cost	Total Cost	Comments/Assumptions
1	**Work Plans**	1	LS	$125,000	**$125,000**	Work Plan, Specifications, and H&S Plan (includes preparation and incorporating comments)
2	**Site Preparation and Construction of On-Site Facilities**					
	Mobilization and Demobilization	1	LS	$40,000	$40,000	Staff, construction and other equipment.
	Rental of Site Trailer, Equip., Temp Toilets, per diem, etc.	1	LS	$16,000	$16,000	
	Decon Station	1	LS	$2,500	$2,500	
	Silt Fencing	860	LF	$5	$4,300	
	Silt Fencing Equipment	1	DAY	$200	$200	
	Surveying	2	EACH	$3,000	$6,000	
	Clearing and Grubbing	1	LS	$10,000	$10,000	Removal of trees and material
	Miscellaneous	1	LS	$2,000	$2,000	Includes decon pad, storage pad, PPE
	Subtotal for Item 2				**$81,000**	
3	**Excavation, Transportation, and Treatment of Lead-Contaminated Soil**					
	Excavation of Lead-Contaminated Soil	460	CY	$30	$13,800	
	Confirmation Sampling and Analysis (Lead)	30	EA	$300	$9,000	Excavated bottom and side walls.
	Treatment of Soil with ECOBOND	460	CY	$45	$20,700	
	Haul, & Emplace Soils to “On-Installation” Range	460	CY	$10	$4,600	
	Subtotal for Item 3				**$48,100**	
4	**Backfilling/Site Restoration**					
	Place and Regrade Area	100	CY	$15	$1,500	
	Site Restoration	1	LS	$10,000	$10,000	
	Subtotal for Item 4				**$11,500**	
5	**Site Closure Report**	1	LS	$105,000	**$105,000**	Includes preparation and incorporating comments
	Subtotal				$370,600	
	Administrative, Overhead, and Contingency 30%				111,180	
	Total Present Worth Cost				**$481,780**	

5.4 ALTERNATIVE 3 – EXCAVATION AND OFF-SITE DISPOSAL

Alternative 3 involves excavation and off-site disposal of lead-contaminated soil. Excavation, haul, and disposal is a common and successful alternative used nationwide. An estimated 460 yd^3 of lead-impacted soil would be expected to be removed from the KD Range MRS Berm Area. The majority of the soil would be shipped to a state-permitted industrial waste landfill. Approximately 10% of the removed soil would be shipped to a secure landfill permitted to accept the lead-contaminated soil that is a RCRA characteristic hazardous waste.

The proposed area of excavation is depicted in **Figure 4-1**. The rationale for selecting this area and the estimated quantities of excavation are discussed in Section 4.3. The estimated total area of excavation would be 11,250 ft^2 (0.25 acre). The proposed excavation depth is 1 ft bgs for the majority of the KD Range MRS Berm Area and 2 ft bgs for an approximately 500 ft^2-area on the target berm. The estimated total volume of excavation would be approximately 460 yd^3 (including soil classified as hazardous waste). The estimated volume of soils that potentially could be classified by the TCLP results as characteristic hazardous waste is 40 yd^3.

Confirmation soil samples would be collected at the base of the excavated area and analyzed for lead to ensure that the removal action goal is met. Backfill might not be needed because Camp Dawson would likely regrade the area after the removal action. The area of the berm removal would be graded to match the surrounding grade.

5.4.1 Effectiveness—Protectiveness and Ability to Achieve Removal Action Objectives

Alternative 3 would be effective in meeting the removal action objectives and reducing the TMV from the lead-contaminated soil at the KD Range MRS Berm Area. Alternative 3 would not, however, satisfy the preference for alternatives involving treatment under CERCLA. The removal action is anticipated to be the final remedial action to address the soils at the KD Range MRS Berm Area. Alternative 3 would result in a permanent long-term remediation because the lead-contaminated soils would be completely removed, thereby removing the source of risk and reducing the overall risk. After Alternative 3 has been implemented, the KD Range MRS Berm Area would meet the lead removal action goal, and the resulting conditions would be protective of human health for residential use.

Alternative 3 would be protective of human health (users of the KD Range MRS Berm Area) in the long term because the contaminated soil would be removed and properly disposed at secure, state-permitted industrial and hazardous waste landfills located off-site and permitted to accept the type of waste. Transporting the soil off-site creates additional potential risks that must be evaluated. Transporting soils off-site would involve potential exposure to the general public along transportation routes between Camp Dawson and the landfills during transport. Alternative 3 involves hauling the material to off-site landfills, which would require approximately 36 trips in tri-axle dump trucks. The non-hazardous waste would need to be shipped a minimum of 40 miles to the closest industrial landfill and the hazardous waste a minimum of 75 miles to the closest RCRA Subtitle C permitted landfill. If the contaminated soil is not properly contained and secured in the trucks, there could be potential releases of contaminated soil during transport, which could result in exposure to the general public and the environment along the transportation routes. Trucks traveling off-site would create additional traffic and wear to local roadways and infrastructure. In addition, contaminated soil disposed at a landfill not under WVARNG control or ownership would be a long-term liability to WVARNG if there were a release to the environment at the landfill.

Exposure to contaminants during implementation of Alternative 3 would be minimal because the material handling would be conducted using appropriate equipment and following proper health and safety procedures. Dust suppression measures would minimize respiratory exposure to both removal action workers and the general public during disposal transportation. Erosion control measures might also be needed to protect residents, workers, the community, and the environment during implementation of Alternative 3.

Chemical-specific ARARs would be met under Alternative 3. PPE and other safety procedures required under OSHA 29 CFR 1910 and 1926 and the USACE Safety and Health Requirements Manual (USACE, 2008) would be followed to protect workers during excavation and handling activities. Other potentially applicable action-specific ARARs and TBCs, such as the West Virginia Groundwater Protection Regulations WV 47 CSR 58 and the *West Virginia Erosion and Sediment Control Best Management Practice Manual* (WVDEP, 2006), as specified in Section 4.1.3, would be met by Alternative 3. There are no location-specific ARARs associated with Alternative 3.

A stormwater discharge permit would not be required because the earthmoving activity would involve less than 1 acre. However, the best management practices presented in the *West Virginia Erosion and Sediment Control Best Management Practice Manual* would be implemented as needed for erosion and sedimentation control measures.

5.4.2 Implementability—Technical Feasibility, Availability, and Administrative Feasibility

The steps involved in implementing the technology in Alternative 3 are reliable, readily available, and can be easily implemented. Equipment and services, such as excavation equipment and landfill capacity, are readily available. WESTON would provide all necessary equipment and make the appropriate arrangements with Camp Dawson to complete this project. Camp Dawson has ongoing construction projects that utilize heavy earthmoving equipment and dump trucks. Therefore, the infrastructure at Camp Dawson is sufficient to support the equipment slated to complete this project. No administrative barriers are foreseen in the implementation of Alternative 3 because excavation and off-site disposal is an established technology accepted by EPA and other state agencies. The excavated soils from the KD Range MRS would be disposed at secure state-permitted industrial and hazardous waste landfills; therefore, state acceptance of this alternative would be anticipated. Alternative 3 is expected to take approximately 3 to 4 weeks to complete, and is not expected to impact Camp Dawson operations.

5.4.3 Cost

The costs for Alternative 3 include the following:

- Preparation of work plans.
- Site preparation activities.
- Excavation and off-site disposal.
- Confirmation sampling and analysis.
- Backfilling/site restoration.
- Preparation of the site closure report.

The total cost associated with Alternative 3 is approximately $622,180. This cost estimate includes the assumption that approximately 90% of the excavated soil would meet the criteria for industrial waste under West Virginia state regulations and approximately 10% would require disposal as a hazardous waste. A summary of the estimated costs for Alternative 3 is provided in **Table 5-2**.

Table 5-2

Cost Estimate for Alternative 3 - Excavation and Off-Site Disposal

Item	Item/Task	Quantity	Unit	Unit Cost	Total Cost	Comments/Assumptions
1	**Work Plans**	1	LS	$125,000	**$125,000**	Work Plan, Specifications, and H&S Plan (includes preparation and incorporating comments)
2	**Site Preparation and Construction of On-Site Facilities**					
	Mobilization and Demobilization	1	LS	$40,000	$40,000	Staff, construction and other equipment.
	Rental of Site Trailer, Equip., Temp Toilets, per diem, etc.	1	LS	$16,000	$16,000	
	Decon Station	1	LS	$2,500	$2,500	
	Silt Fencing	860	LF	$5	$4,300	
	Silt Fencing Equipment	1	DAY	$200	$200	
	Surveying	2	EACH	$3,000	$6,000	
	Clearing and Grubbing	1	LS	$10,000	$10,000	Removal of trees and material
	Miscellaneous	1	LS	$2,000	$2,000	Includes decon pad, storage pad, PPE
	Subtotal for Item 2				**$81,000**	
3	**Excavation, Transportation, and Disposal of Lead-Contaminated Soil**					
	Residual Waste					
	Excavation of Lead-Contaminated Soil	420	CY	$30	$12,600	
	Confirmation Sampling and Analysis (Lead)	30	EA	$300	$9,000	Excavated bottom and side walls.
	Transportation and Disposal of Excavated Soil at an Industrial Waste Landfill	714	TON	$150	$107,100	1 CY = 1.7 Tons. Disposal at industrial waste landfill = $150 per ton.
	Hazardous Waste					
	Excavation of Lead-Contaminated Soil	40	CY	$30	$1,200	
	Confirmation Sampling and Analysis (Lead) and Disposal Sampling	8	EA	$300	$2,400	Excavated bottom and side walls.
	Transportation and Disposal of Excavated Soil at a Hazardous Waste Landfill	68	TON	$350	$23,800	1 CY = 1.7 Tons. Transport and disposal at a hazardous waste landfill: $350 per ton.
	Subtotal for Item 3				**$156,100**	
4	**Backfilling/Site Restoration**					
	Place and Regrade Area	100	CY	$15	$1,500	
	Site Restoration	1	LS	$10,000	$10,000	
	Subtotal for Item 4				**$11,500**	
5	**Site Closure Report**	1	LS	$105,000	**$105,000**	Includes preparation and incorporating comments
	Subtotal				$478,600	
	Administrative, Overhead, and Contingency 30%				143,580	
	Total Present Worth Cost				**$622,180**	

6. COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

A comparative analysis of the alternatives is provided in **Table 6-1**. Each alternative is evaluated using the following evaluation criteria: effectiveness, implementability, compliance with ARARs and other criteria, long-term effectiveness and permanence, reduction of TMV, and short-term effectiveness.

Alternative 1 (no action) can be easily implemented. There are no technical or administrative difficulties involved with the implementation because there would be no activities or permitting associated with this alternative. Alternative 1 could be implemented within the time period desired for an NTCRA. Alternative 1 would not be effective in reducing the risk of lead exposure to the Camp Dawson community. For the no action alternative, there would be no activities to implement. Alternative 1 would not be in compliance with ARARs. No action at the KD Range MRS Berm Area would have no long-term effectiveness and permanence, no reduction of TMV, and no short-term effectiveness.

The comparative analysis shows that Alternative 2 (excavation, treatment, and repurpose) presents the most favorable overall characteristics of the three alternatives evaluated in achieving the removal action objectives. Alternative 2 is technically and administratively feasible, and can be easily implemented. Alternative 2 meets the removal action goal for lead, thereby reducing the potential risks posed by the contaminated soil. The excavation, treatment, and on-site repurpose alternative can be completed within a short time frame. The contaminated soil would be treated prior to leaving the KD Range MRS Berm Area for repurposing on-site within a restricted access area on a controlled active range. The lead in the soil placed at the active range would be stabilized to prevent migration and leaching of lead. Thus, the human health exposure risks would be reduced for users of Camp Dawson and the KD Range MRS Berm Area during transport of the soil and after the removal action is complete.

Alternative 2 would satisfy the preference for actions that employ treatment as a principal element. The TMV would be reduced through treatment of the contaminated soil. The excavated soil would be treated and stabilized then transported to a controlled active range at Camp Dawson. In Alternative 3, the TMV would not be reduced through removal of the contaminated

soil, merely transferred to another location. The excavated soil would be transported off-site and disposed in secure state-permitted industrial and hazardous waste landfills. During Alternative 3 transportation, there would be a potential risk to the public along the route and a risk to the environment if there were a release.

Compared to Alternative 2, Alternative 3 is equally technically and administratively feasible, implementable, meets the removal action goal for lead, and can be completed in an equivalent time frame.

Alternative 3 has a potentially higher risk to the environment because there could be potential releases of hazardous waste (lead-contaminated soil) during transport to the off-site landfill. On the other hand, for Alternative 2, the lead-contaminated soil exceeding the hazardous waste characteristic criterion for lead of 5 mg/L would be treated prior to transport to levels no longer exhibiting a hazardous waste toxicity characteristic.

For Alternative 2, there is less potential of exposure to the general public that are along the transportation routes because the soil is being repurposed at Camp Dawson. Thus, it will not be necessary to ship the nonhazardous waste a minimum of 40 miles to the closest industrial landfill and the hazardous waste a minimum of 75 miles to the closest RCRA Subtitle C permitted landfill. Alternative 2 provides a green and more sustainable solution compared to Alternative 3. Because Alternative 2 involves treating and repurposing the soil at Camp Dawson, less fossil fuel would be used and lower carbon emissions would be released compared to off-site disposal of the soil.

The total cost of Alternative 2 (excavation, treatment, and repurpose) is $481,780, which is approximately 23% lower than the cost of Alternative 3 (excavation and off-site disposal).

Table 6-1
Comparative Analysis of
Removal Action Alternatives
KD Range MRS Berm Area

Alternative Number	Description	Cost	Effectiveness: Protectiveness, Ability to Achieve Removal Objectives	Effectiveness: Compliance with ARARs and Other Criteria, Advisories, and Guidance	Effectiveness: Long-Term and Permanence	Effectiveness: Short-Term	Effectiveness: Reduction of Toxicity, Mobility, and Volume through Treatment	Implementability: Technical Feasibility, Availability, Administrative Feasibility	Implementability: Timeframe
1	No action	$0	This alternative would not achieve the removal action objectives. It would not be protective of human health or the environment; potential risks to human health and the environment would continue to exist.	This alternative would not comply with chemical-specific ARARs. There are no action- or location-specific ARARs associated with this alternative.	The magnitude of residual risk would not be reduced over the long term.	There would be no short-term risks to workers, the community, or the environment because no removal actions are associated with this alternative.	There would be no reduction in TMV.	Technically feasible. WVDEP may oppose the no action alternative because the KD Range MRS Berm Area would not be suitable for future use without addressing the contamination problem. WVDEP may oppose the no action alternative because potential risks to human health and the environment would continue to exist at the KD Range MRS Berm Area.	0 weeks
2	Excavation, treatment with ECOBOND®, and repurpose	$481,780	This alternative would achieve the removal action objectives because the lead-impacted soils would be treated with ECOBOND®, binding the lead and not allowing it to leach. The treated soil would be moved to a controlled active range, reducing the risk of exposure to residents of Camp Dawson. This alternative would be protective of human health (users of the KD Range MRS Berm Area and human receptors along the transportation route). The soil would be stabilized, reducing the leachability of the lead (also rendering waste nonhazardous). The treated soil would be placed in a controlled active range at Camp Dawson with limited opportunities for access by personnel and residents.	This alternative would meet applicable chemical-specific ARARs, and action-specific ARARs and TBCs. There are no location-specific ARARs associated with the alternative.	Magnitude of residual risk would be reduced to acceptable levels upon the completion of work. The lead-contaminated soil would be treated to stabilize lead, and the soil would be repurposed at a controlled active range at Camp Dawson. The alternative would be more green and sustainable because the soil would be repurposed at Camp Dawson. In addition, the alternative would involve the use of fewer natural resources (fossil fuel) than shipping the non-hazardous waste a minimum of 40 miles to the closest industrial landfill and the hazardous waste a minimum of 75 miles to the closest RCRA Subtitle C permitted landfill.	Potential risks posed to workers during excavation, transportation, and backfilling activities would be reduced by wearing proper PPE and following health and safety procedures. Dust and erosion control measures would minimize impacts on the community and the environment.	This alternative would satisfy the preference for actions that employ treatment as a principal element. The TMV would be reduced through removal and treatment of the contaminated soil. The excavated soil would be stabilized and transported to a controlled active range at Camp Dawson.	Technically and administratively feasible. Excavation/backfilling equipment and space at the active range are readily available. The components needed for ECOBOND® are available and the technology has been proven at other lead-contaminated sites. The treatability study for the KD Range MRS Berm Area showed ECOBOND® would be effective.	3 to 4 weeks

Alternative Number	Description	Cost	Effectiveness: Protectiveness, Ability to Achieve Removal Objectives	Effectiveness: Compliance with ARARs and Other Criteria, Advisories, and Guidance	Effectiveness: Long-Term and Permanence	Effectiveness: Short-Term	Effectiveness: Reduction of Toxicity, Mobility, and Volume through Treatment	Implementability: Technical Feasibility, Availability, Administrative Feasibility	Implementability: Timeframe
3	Excavation and off-site disposal	$622,180	This alternative would achieve the removal action objectives and provide protection to human health and the environment by permanently removing the entire layer of contaminated soil. However, there would be a potential risk to the public along the transportation route and a risk to the environment if there were a release during shipping.	This alternative would meet applicable chemical-specific ARARs, and action-specific ARARs and TBCs. There are no location-specific ARARs associated with the alternative.	Soils with lead concentrations above the removal action goal would be removed from Camp Dawson. The magnitude of residual risk would be reduced to acceptable levels upon completion of work. There would be a potential long-term liability to WVARNG due to disposing hazardous waste at an off-site facility.	Potential risks posed to workers during excavation, transportation, and backfilling activities would be reduced by wearing proper PPE and following health and safety procedures. Dust and erosion control measures would minimize impacts on the community and the environment.	This alternative would not satisfy the preference for actions that employ treatment as a principal element. The TMV would be reduced through the permanent removal of contaminated soil. The excavated soil would be transported off-site and disposed in secure state-permitted industrial and hazardous waste landfills. During transportation, there would be a potential risk to the public along the route and a risk to the environment if there were a release.	Technically and administratively feasible. Excavation/backfilling equipment and industrial waste landfill space are readily available. This technology has been successfully implemented at numerous lead-impacted sites across the country.	3 to 4 weeks

PPE = Personal protective equipment.
TBC = To be considered.
TMV = Toxicity, mobility, and volume.

7. RECOMMENDED ALTERNATIVE

Based on the detailed analysis of the removal action alternatives presented in Section 5, and the comparative analysis discussed in Section 6, Alternative 2 (excavation, treatment, and repurpose) is recommended as the selected remedy. Specific components of Alternative 2 are as follows:

- Excavation of lead-contaminated soil above the removal action goal of 400 mg/kg.
- Confirmation soil sampling and analysis.
- On-site treatment of soils exceeding the TCLP criterion for lead and 400 mg/kg lead.
- Transportation and placement of the treated soil at a Camp Dawson controlled active range.
- Site restoration by grading.

The proposed excavation area totals 11,250 ft^2 (approximately 0.25 acre). The volume to be excavated is approximately 460 yd^3. For the purpose of the KD Range MRS Berm Area EE/CA, it is assumed that the excavated soil would need to be treated and could be repurposed on-site. Upon completion of the berm removals, the area would be re-graded and seeded with grass.

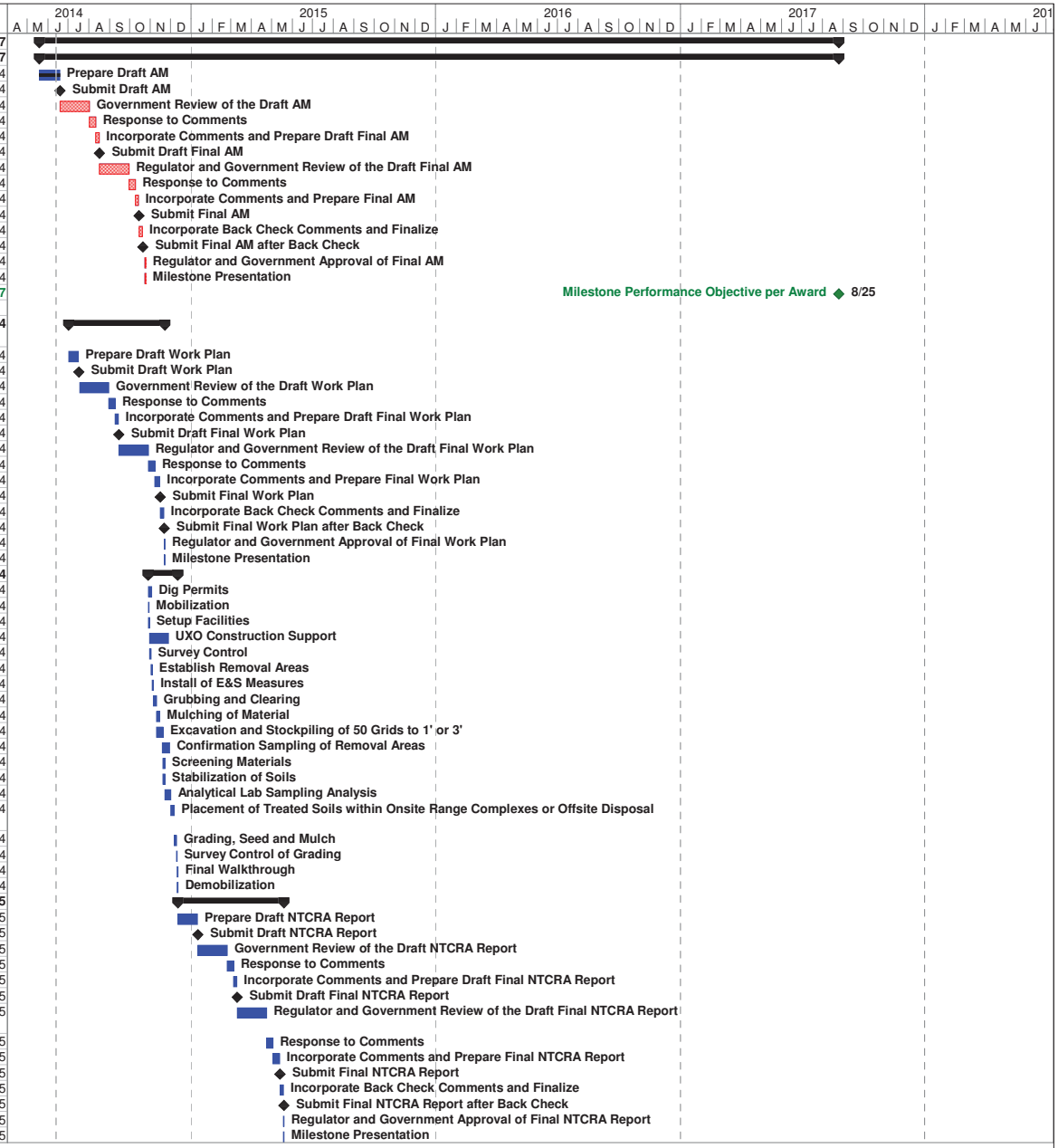
Alternative 2 can be easily implemented. Technical or administrative difficulties are not expected. The equipment necessary for the implementation of this alternative is readily available. Administrative difficulties are not anticipated because Alternative 2 would meet the removal action objectives, permanently remove the contaminated material from the KD Range MRS Berm Area, and provide adequate protection to human health and the environment. The lead-contaminated hazardous soil would be treated so that it would no longer be a RCRA characteristic waste and it would be repurposed at Camp Dawson. Thus, Alternative 2 entails reduced liability for the Army compared to off-site disposal.

In addition, Alternative 2 provides a more sustainable and green alternative that repurposes the soil. Alternative 2 also involves reduced fossil fuel usage and reduced carbon emissions compared to Alternative 3 because the soil would not be shipped off-site.

The total estimated cost for Alternative 2 is $481,780. As shown in **Table 6-1**, Alternative 2 could be completed within 3 to 4 weeks. A schedule for the implementation of the selected alternative is provided in **Figure 7-1**.

SECTION 7
FIGURE

ID	Task Name	Duration	Start	Finish
1	**Known Distance - Range (CPDW-002-R-001)**	**1237 days**	**5/19/2014**	**8/25/2017**
2	**Action Memorandum (AM)**	**1237 days**	**5/19/2014**	**8/25/2017**
3	Prepare Draft AM	31 days	5/19/2014	6/17/2014
4	Submit Draft AM	1 day	6/18/2014	6/18/2014
5	Government Review of the Draft AM	45 days	6/19/2014	8/1/2014
6	Response to Comments	10 days	8/1/2014	8/10/2014
7	Incorporate Comments and Prepare Draft Final AM	5 days	8/11/2014	8/15/2014
8	Submit Draft Final AM	1 day	8/16/2014	8/16/2014
9	Regulator and Government Review of the Draft Final AM	45 days	8/16/2014	9/29/2014
10	Response to Comments	10 days	9/29/2014	10/8/2014
11	Incorporate Comments and Prepare Final AM	5 days	10/9/2014	10/13/2014
12	Submit Final AM	1 day	10/13/2014	10/14/2014
13	Incorporate Back Check Comments and Finalize	5 days	10/14/2014	10/19/2014
14	Submit Final AM after Back Check	1 day	10/19/2014	10/20/2014
15	Regulator and Government Approval of Final AM	1 day	10/23/2014	10/24/2014
16	Milestone Presentation	1 day	10/23/2014	10/24/2014
17	**Milestone Performance Objective per Award**	**1 day**	**8/24/2017**	**8/25/2017**
18				
19	**Non Time Critical Removal Action (NTCRA) - Work Plan for KD-Range (FSP, UFP-QAPP, APP/SSHP)**	**149 days**	**7/1/2014**	**11/22/2014**
20	Prepare Draft Work Plan	15 days	7/1/2014	7/15/2014
21	Submit Draft Work Plan	1 day	7/16/2014	7/16/2014
22	Government Review of the Draft Work Plan	45 days	7/18/2014	8/30/2014
23	Response to Comments	10 days	8/30/2014	9/8/2014
24	Incorporate Comments and Prepare Draft Final Work Plan	5 days	9/9/2014	9/13/2014
25	Submit Draft Final Work Plan	1 day	9/13/2014	9/14/2014
26	Regulator and Government Review of the Draft Final Work Plan	45 days	9/14/2014	10/28/2014
27	Response to Comments	10 days	10/28/2014	11/6/2014
28	Incorporate Comments and Prepare Final Work Plan	8 days	11/7/2014	11/14/2014
29	Submit Final Work Plan	1 day	11/14/2014	11/15/2014
30	Incorporate Back Check Comments and Finalize	5 days	11/15/2014	11/20/2014
31	Submit Final Work Plan after Back Check	1 day	11/20/2014	11/21/2014
32	Regulator and Government Approval of Final Work Plan	1 day	11/21/2014	11/22/2014
33	Milestone Presentation	1 day	11/21/2014	11/22/2014
34	**KD - Range NTCRA - Field Work**	**46 days**	**10/28/2014**	**12/11/2014**
35	Dig Permits	5 days	10/28/2014	11/2/2014
36	Mobilization	1 day	10/28/2014	10/29/2014
37	Setup Facilities	2 days	10/28/2014	10/30/2014
38	UXO Construction Support	29 days	10/30/2014	11/27/2014
39	Survey Control	2 days	10/30/2014	11/1/2014
40	Establish Removal Areas	2 days	11/1/2014	11/2/2014
41	Install of E&S Measures	2 days	11/3/2014	11/4/2014
42	Grubbing and Clearing	5 days	11/5/2014	11/9/2014
43	Mulching of Material	5 days	11/9/2014	11/14/2014
44	Excavation and Stockpiling of 50 Grids to 1' or 3'	10 days	11/9/2014	11/19/2014
45	Confirmation Sampling of Removal Areas	11 days	11/18/2014	11/29/2014
46	Screening Materials	3 days	11/19/2014	11/22/2014
47	Stabilization of Soils	3 days	11/19/2014	11/22/2014
48	Analytical Lab Sampling Analysis	9 days	11/22/2014	11/30/2014
49	Placement of Treated Soils within Onsite Range Complexes or Offsite Disposal	5 days	12/1/2014	12/5/2014
50	Grading, Seed and Mulch	4 days	12/6/2014	12/9/2014
51	Survey Control of Grading	1 day	12/9/2014	12/10/2014
52	Final Walkthrough	1 day	12/10/2014	12/11/2014
53	Demobilization	1 day	12/10/2014	12/11/2014
54	**Non Time Critical Removal Action (NTCRA) - Report**	**164 days**	**12/12/2014**	**5/19/2015**
55	Prepare Draft NTCRA Report	30 days	12/12/2014	1/9/2015
56	Submit Draft NTCRA Report	1 day	1/10/2015	1/10/2015
57	Government Review of the Draft NTCRA Report	45 days	1/10/2015	2/23/2015
58	Response to Comments	10 days	2/23/2015	3/4/2015
59	Incorporate Comments and Prepare Draft Final NTCRA Report	5 days	3/5/2015	3/9/2015
60	Submit Draft Final NTCRA Report	1 day	3/9/2015	3/10/2015
61	Regulator and Government Review of the Draft Final NTCRA Report	45 days	3/10/2015	4/23/2015
62	Response to Comments	10 days	4/23/2015	5/2/2015
63	Incorporate Comments and Prepare Final NTCRA Report	10 days	5/2/2015	5/12/2015
64	Submit Final NTCRA Report	1 day	5/12/2015	5/13/2015
65	Incorporate Back Check Comments and Finalize	5 days	5/13/2015	5/18/2015
66	Submit Final NTCRA Report after Back Check	1 day	5/18/2015	5/19/2015
67	Regulator and Government Approval of Final NTCRA Report	1 day	5/18/2015	5/19/2015
68	Milestone Presentation	1 day	5/18/2015	5/19/2015



Task | Milestone | Summary | Performance Milestone | Critical Path | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | External Tasks | External Milestone | Progress

Military Munitions Response Program - Munitions Response Services
Camp Dawson, Kingwood, WV

Note: Duration is based on Calendar days.

Figure 7-1 Schedule

8. REFERENCES

AMEC (AMEC Earth and Environmental, Inc.). 2011. *Site Inspection Work Plan*.

AMEC (AMEC Earth and Environmental, Inc.). 2012. *Final Site Inspection Report*.

ARNG (Army National Guard). 2009. *Preliminary Assessment, Known Distance Range Munitions Response Site, Camp Dawson.* December 2009.

EPA (U.S. Environmental Protection Agency). 1992. *Guidance for Data Useability in Risk Assessment.* Publication No. 9285.7-05FS. September 1992.

EPA (U.S. Environmental Protection Agency). 1993. *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*. EPA 540-R-93-057. August 1993.

EPA (U.S. Environmental Protection Agency). 1994a. *USEPA Region III Modifications to the National Functional Guidelines for Inorganic Data Review*.

EPA (U.S. Environmental Protection Agency). 1994b. Integrated Exposure Uptake Biokinetic (IEUBK) Model.

EPA (U.S. Environmental Protection Agency). 1995. *CERCLA Remedy Selection Process* OSWER Directive No. 9355.7-04, 25. May 1995.

EPA (U.S. Environmental Protection Agency). 2010a. *Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows® version (IEUBKwin v1.1 build 11)* 32-bit version. February 2010. EPA (U.S. Environmental Protection Agency). 2010b. *Superfund Green Remediation Strategy*. Office of Solid Waste and Emergency Response, Office of Superfund Remediation and Technology Innovation. September 2010. http://www.epa.gov/superfund/greenremediation.

EPA (U.S. Environmental Protection Agency). 2013. *EPA Regional Screening Level Table, User's Guide* (November 2013). Available at: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm

NGYCP (National Guard Youth Challenge Program). 2013. Mountaineer Challenge Academy. Website accessed 29 October 2013 via http://www.ngycp.org/site/state/wv/node/2262.

USACE (U.S. Army Corps of Engineers). 2008. *EM 385-1-1, Safety and Health Requirements Manual*. September 15, 2008.

WVDEP (West Virginia Department of Environmental Protection), Division of Water and Waste Management. 2006. *West Virginia Erosion and Sediment Control Best Management Practice Manual*.