United States Environmental Protection Agency
Region 1

Decision Document

Small Arms Ranges Operable Unit

Camp Edwards
Joint Base Cape Cod
Cape Cod, Massachusetts

September 2015

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PART I: DECLARATION FOR THE SAFE DRINKING WATER ACT DECISION DOCUMENT

A. SITE NAME

The subject site is the Small Arms Ranges (also referred to as "the Site"), which is located at Camp Edwards at the Joint Base Cape Cod (JBCC) (formerly Massachusetts Military Reservation (MMR)).

B. STATEMENT OF BASIS AND PURPOSE

This Decision Document presents the selected decisions for the Small Arms Ranges. The selected decisions were chosen in accordance with Section 1431(a) of the Safe Drinking Water Act (SDWA), 42 USC § 300i(a), as amended, and the Administrative Order (AO) concerning response actions issued thereunder, U.S. Environmental Protection Agency Region 1 (EPA) Administrative Order No. SDWA-1-2000-0014 (AO3). The authority to select the necessary response action(s) has been delegated to EPA Region 1's Regional Administrator pursuant to EPA Delegation No. 9-17 (1200-TN-350) dated May 11, 1994, and further delegated to EPA Region 1's Director, Office of Site Remediation and Restoration, pursuant to a redelegation of authorities dated April 6, 2010.

This decision is based on the Administrative Record, which has been developed in accordance with AO3 and with a previous EPA Administrative Order, SDWA 1-97-1019 (AO1), including consideration of the substantive cleanup standards of the Massachusetts Contingency Plan (MCP) 310 CMR 40.0000. The Administrative Record is available for review by appointment at the Impact Area Groundwater Study Program (IAGWSP) office, PB0516 West Outer Road, Camp Edwards, MA.

C. ASSESSMENT OF THE SITE

On July 13, 1982, EPA determined that the Cape Cod Aquifer is the sole or principal source of drinking water for Cape Cod, Massachusetts, and that the Cape Cod Aquifer, if contaminated, would create a significant hazard to public health (47 Fed. Reg.30282). Contaminants from the Training Ranges and Impact Area at JBCC are present in and may enter and migrate in the aquifer. The decisions selected for the Small Arms Ranges in this Decision Document are necessary to protect the Cape Cod Aquifer, an underground source of drinking water on which the public relies. The Small Arms Ranges are also located within the Upper Cape Water Supply Reserve established pursuant to Chapter 47 of the Massachusetts Acts of 2002 and designated as conservation land under the care and control of the Massachusetts Division of Fisheries and Wildlife.

D. DESCRIPTION OF THE ACTIONS

This Decision Document sets forth the selected decisions for the Sites (Figure 1).

The overall results of groundwater sampling evaluations conducted indicate that the Small Arms Ranges are not currently a source of groundwater contamination above action levels. Soil investigation results reveal that elevated levels of a few propellant-related compounds and/or select metals exist in some surface soils at certain Small Arms Ranges. The mass of these contaminants has been greatly reduced at the Small Arms Ranges as a result of several soil removal actions and range maintenance activities. Therefore, the risk of future impacts to groundwater has been reduced.

The levels of lead and antimony observed in soil at the operational Small Arms Ranges are, in most cases, below the applicable action levels. For some of the ranges that are likely to remain non-operational in the future, additional investigation is recommended. Overall, given the toxicity of lead and antimony and some uncertainties in the total soil sorption capacity for lead and antimony, range design and/or maintenance programs to limit lead and antimony exposure at operational ranges remain prudent.

Additional action is needed to address residual soil contamination at the B, C, G, KD, N, Former B, Former C, Former D, Former N and Former M-2 Ranges since elevated levels of Small Arms related metals (including antimony, lead, and tungsten) exist in some surface soils. These surface soil contaminants pose a threat to groundwater. In some instances, they pose a human health risk for direct contact depending on future range use.

Based upon the absence of any groundwater contaminant plumes beneath the Small Arms Ranges, remediation of groundwater is not recommended at this time. However, certain Small Arms metals have been detected in groundwater and at elevated levels in pore water. Given these detections along with residual soil contamination, a long-term groundwater monitoring program with land use controls to protect monitoring wells and other environmental sampling equipment is required at the B, C, G, GA/GB, I, J, K, SE/SW, and T Ranges. If groundwater contamination is detected at any of these ranges, additional ranges may be added to the monitoring program.

A work plan (Project Note – *Sampling, Soil Removal, and Monitoring at Small Arms Ranges* – May 2014) describing the groundwater and soil sampling and additional investigations required as part of this Decision Document has been approved by EPA and MassDEP and will be implemented as part of the remedy (Appendix D). In addition, three

project note addendums have been prepared to address changes to the Massachusetts Contingency Plan Regulations, specifically related to the cleanup standard for lead (Appendices F, G and H)

The selected decision of long-term groundwater monitoring with land use controls to protect monitoring wells and other environmental sampling equipment, limited soil sampling, and soil removal at certain ranges is protective of human health and the environment (Table 2)

E. DETERMINATIONS

The selected decisions in this Decision Document will protect public health and are based on the investigations and removal actions which were conducted in the past and will be conducted in the future as part of the attached approved Project Notes

In this Decision Document, EPA is making no determination regarding any remaining public safety risk, ecological risk, dermal contact risk, and/or soil ingestion risk posed by any remaining contamination at the Sites

F SUPPORTING DATA

Detailed information on the Site is included in the Final Small Arms Range Investigation Report dated January 2014 An overview of the Site is included in the Decision Summary section of this document Additional information can be found in the Index of Key Supporting Documents, which is Appendix C to the Decision Document

G AUTHORIZING SIGNATURE

This Decision Document documents the selected decision for the Small Arms Ranges at the JBCC The response actions were selected by EPA under the authority of the SDWA The MassDEP concurs with this decision

U S Environmental Protection Agency

By _____ Date 09/30/15

Nancy Barmakian
Acting Director, Office of Site Remediation and Restoration
Region 1

PART II: THE DECISION SUMMARY

A. SITE DESCRIPTION

The Small Arms Ranges at Camp Edwards include 40 locations where small arms ammunition has been used since World War II (Figure 1). The ranges have been used for a variety of small arms, including pistols, rifles, shotguns, sub-machine guns, and machine guns. The types of ranges can be divided into three categories: operational and active (6), operational but inactive (14) and non-operational ranges (20). The Small Arms Ranges are located in a general circumference around the Impact Area at Camp Edwards (Figure 1). Most of the sites that are currently in use are relatively flat areas of cleared vegetation to accommodate easy acquisition of downrange targets. Many of the remaining sites are largely overgrown. A number of the former and current ranges have overlapped the same areas over time. According to the 2001 Archive Search Report conducted for the IAGWSP, all known ranges utilizing only small arms ammunition encompass approximately 1,399 acres.

The Small Arms Ranges have been classified into three categories:

- Operational Ranges (6 Active): These are ranges where firing is currently permitted and an Operations, Maintenance and Monitoring Plan (OMMP) is in place (J, K, SE/SW, T and I Ranges).

- Operational Ranges (14 Inactive): These are ranges that are not currently in use, but given their configuration and location, could be used again for small arms firing. They would need to go through an approval process to resume firing, including the development and implementation of an OMMP. Some of these ranges will require monitoring and maintenance in order to retain their Operational (Inactive) status (A, B, C, D, E, G, H, KD East, N, O, P, Former N, Q and Former R Ranges).

- Non-operational Ranges (20): These ranges have not been used for decades and many of them are situated in such a manner where development and activities which now exist within their firing fans would preclude their use. It is unlikely that these ranges will be used again for small arms firing (Former B, Former C, Former D, E-1, E-2, GA/GB, Former K, L-1 Range (L Range 1941-1950s), L Range (1950s-1980s), L-2, L-3, L-4, Former M-1, Former M-2, Former M-3, Former M-4, Skeet Range 1, Skeet Range 2, Succonsette Pond, and the 500-yard Rifle Range).

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

1. History of Site Activities

Records indicate that the earliest general usage for the Small Arms Ranges at JBCC was in the World War II period starting around 1940. A variety of small arms used at these ranges included pistols, rifles, shotguns, sub-machine guns and machine guns. Items used on the Small Arms Ranges included small arms ammunition ranging from 5.56 ball rounds to .50 caliber (cal) machine gun rounds. A number of the small arms ranges have undergone multiple uses since World War II, including conversion between use as pistol ranges and use as rifle and/or machine gun ranges. Except for a period from the 1980s to the present, historical information concerning the numbers of rounds of specific types of ammunition used at each range is largely unavailable.

Potential sources of Small Arms Range contaminants include propellant-related compounds deposited on the surface in the vicinity of firing lines and projectile-related compounds deposited on the surface at, and in the vicinity of, range backstops. Propellant-related compounds consist, in part, of a suite of semi-volatile organic compounds (SVOCs) produced by the combustion of small caliber ammunition propellants. SVOCs used as propellants include nitroglycerine and 2,4-DNT. These compounds are released to the environment and deposited as surface residue via airborne deposition.

At most rifle and pistol ranges, weapons are fired toward fixed or stationary targets placed in front of a backstop berm. This configuration often results in the formation of bullet pockets on the face of the berm. These pockets result from the impact of high-energy projectiles into the berm face. The bullet pocket areas are locations of more elevated small arms related metal concentrations within berm faces. By contrast, at shotgun ranges (O Range, Skeet Range 1, and Skeet Range 2), ammunition projectiles are typically more widely dispersed and generally fall to the ground with less impact energy than pistol or rifle bullets, resulting in less projectile fragmentation. However, they potentially impact a significant surface area due to the hundreds of lead pellets per shotgun shell.

In 1999, following a ban under EPA Administrative Order 1-97-1030 (AO2) on the use of lead-based ammunition, 5.56mm tungsten ammunition (also known as “green” or frangible ammunition) was fired at certain Small Arms Ranges. The tungsten projectiles consisted

of a high-density pressed tungsten powder core and steel penetrator surrounded by a copper-alloy jacket.

Tungsten ammunition was used at fourteen Small Arms Ranges (B, C, D, E, G, H, I, IBC, J, K, KD East, SE, SW and T Ranges) during the time period from 2000-2006. In February 2006, in response to concerns regarding migration of tungsten into groundwater, the use of tungsten ammunition was suspended. Subsequently, a berm maintenance program was implemented for focused removal of tungsten-contaminated soils at certain ranges. (Please note that IBC Range is being addressed as part of the Training Areas Operable Unit).

2. History of Investigations and Response Actions

History of Investigations

Since 1998 a series of investigations have been conducted at the Small Arms Ranges to characterize soil and groundwater conditions. Investigations included soil sampling at many of the ranges and installation and sampling of groundwater monitoring wells at many of the ranges.

Numerous groundwater and soil investigations have been implemented at the Small Arms Ranges and a detailed evaluation was undertaken to characterize and evaluate soil and groundwater. Investigations included soil sampling at most of the ranges and installation and sampling of groundwater monitoring wells at many of the ranges. From 2000 to 2004, a multi-range soil sampling effort was conducted as part of the Phase IIa and IIb Small Arms Range investigation programs. From 2006 to 2009, extensive soil sampling was conducted at six ranges (E, J, K, SE, SW and T Ranges) in preparation for their return to active use. From 2010 to 2012, soil, groundwater and pore water monitoring was conducted at the active J, K and T Ranges under the Small Arms Range Best Management Practices and Operations, Maintenance and Monitoring Plans. Investigations were also conducted at B, C, and I Ranges to evaluate the impacts of tungsten in soil, pore water, and groundwater. In 2013, soil sampling continued. Further, in order to assess the density, location, and condition of bullets remaining in the downrange area of GA/GB Range, a site reconnaissance was performed in 2014.

Reconnaissance results for the downrange portion of GA/GB Range indicate that most ammunition is copper jacketed .30 caliber bullets. These .30 caliber bullets are present below the ground surface, thus minimizing the likelihood for direct contact or ingestion risks. The copper jacket also restricts leaching potential of the lead core. (Appendix E, Project Note, Review of Site Conditions at GA/GB Range – August 2014).

No explosives were reported in any monitoring wells associated with these ranges (with the one exception being a well at G Range that intersects the Demo 1 plume). Trace levels of SVOC phthalate compounds (including bis(2-ethylhexyl)phthalate and di-n-butyl phthalate) were detected in certain samples, and were determined to be laboratory artifacts.

Low levels of metals, including barium, chromium, copper, lead, iron, and zinc, were detected in samples from wells. Tungsten was also reported in a few samples, primarily from B and G Range. The overall results of groundwater evaluations conducted to date indicate that the Small Arms Ranges are not currently a source of any significant groundwater contamination.

Investigation results indicate that some explosives and propellant-related compounds are present in surface soils at certain Small Arms Ranges. Propellant concentrations are generally low and studies indicate that propellants do not leach to groundwater because they are bound in nitrocellulose. Metals associated with small arms projectiles (antimony, copper, lead and tungsten) are present in soils and pore water at the target berm areas. In some instances, these surface soil contaminants may pose a human health risk for direct contact depending on future use.

Response Actions

The 1998 Berm Maintenance Program was implemented at 16 Small Arms Ranges (A, B, C, D, E, G, H, I, J, K, KD, N, O, P, SE, and SW) to remove lead bullets and to chemically fix leachable lead remaining in the soil, thus producing apatite (a lead phosphate mineral). At each range, soils containing leachable lead levels greater than 5.0 mg/L, as determined by Toxicity Characteristic Leaching Procedure (TCLP), were excavated and treated. During the initial phase of the Berm Maintenance Program, approximately 1,125 pre-excavation soil samples were collected to characterize total lead and leachable lead in the berms. Approximately 821 samples were analyzed on-site with the remainder submitted to an off-site laboratory. In addition, 160 soil samples were collected to characterize total copper, total iron, total nickel, and total antimony concentrations present in berm soils. Results indicated the highest leachable lead levels were generally within the first 2 feet of soil within the berm faces. Following characterization of lead distribution in the berm at each range, approximately 17,788 cubic yards of soil were excavated from the berm faces and transported to a central processing area south of Camp Edwards Range Control. Excavated soils were sifted to remove recyclable lead projectiles and the soil was treated to chemically fix the remaining lead in the soils. The process involves immobilizing leachable lead by chemically bonding the leachable lead fraction. The treated soil was returned to the berm faces.

In 2006, a Berm Maintenance Project was undertaken to address concerns and findings related to the use of tungsten-containing bullets at certain Small Arms Ranges at JBCC. Following an initial range evaluation and field screening program, soil excavation and removal actions were implemented at seven ranges (B, C, G, I, J, K, and T). A total of approximately 4,615 cubic yards of soil was excavated from the seven ranges identified above. In general, individual berms were excavated to depths of up to 2 feet across the toes of the berms, 3 feet across the middle of the berms, and 0.5 feet across the backs of the berms. During the soil excavation process, all soil excavated from B, C, and T Ranges was consolidated in the northern half of the range floor of C Range. All of the soil excavated from G, I, J, and K Ranges was consolidated on the range floor of the KD Range (West). Soil was ultimately disposed of off-site in compliance with local, state and federal environmental regulations.

In 2007, a soil excavation action was implemented at the firing line at T Range. Soils containing elevated nitroglycerin levels were excavated from Area 1 East, Area 1 Center, and Area 1 West. Post-excavation sampling confirmed low soil nitroglycerin levels (less than 5.0 mg/Kg) in all excavated areas.

In September 2008, soil removal actions were conducted at the J and K Ranges. Soil was excavated to depths of up to one foot. Nitroglycerin was not detected in any of the post-excavation multiple increment confirmatory soil samples. At K Range, soil was excavated to depths of up to one foot. Following excavation, post-excavation soil samples indicated residual nitroglycerin in some of the grids. J, K, and T ranges were rebuilt with new soil to prepare for use under the EPA and the JBCC Environmental Management Commission pilot test of the STAPP™ bullet trap systems. The excavated soil remains stockpiled on K Range. Since studies demonstrate that nitroglycerin is not a threat to groundwater, the soil is available to be used for Range Maintenance activities.

Between 2009 and 2011, surface soil removal actions were performed at several ranges to remove lead projectiles and elevated levels of lead in soil detected during previous range investigations. Excavation was focused on bullet fall-out areas and where soils had lead concentrations in excess of 300 mg/Kg. It was determined that soil excavation would be conducted at four areas at Former D Range, six areas at Former B Range, the berm face at Former M-2 Range, and the backsides of the berms at J Range and K Range. Following site preparation surface soils were excavated to prescribed depths based upon previous screening results. Excavated material from the ranges was stockpiled at Former D Range for subsequent mechanical screening to remove bullet fragments for recycling. Screened soil was transported to Current D Range. The soil is available for beneficial reuse off-site. Over 4,000 cubic yards of soil was excavated and screened under this program.

3. History of Relevant Federal and State Enforcement Activities

Federal Enforcement Activities

In February 1997, EPA Region 1 issued SDWA Administrative Order 1-97-1019 (AO1) requiring the investigation of the impact of contamination at or emanating from the Training Ranges and Impact Area upon the Sole Source Aquifer.

In May 1997, EPA issued Administrative Order 1-97-1030 (AO2), which prohibited all live firing of mortars and artillery, firing of lead from small arms, planned detonation of ordnance or explosives at or near the Training Ranges and Impact Area except for Unexploded Ordnance (UXO) activities, and certain other training-related activities.

In January 2000, EPA issued SDWA Administrative Order 1-2000-0014 (AO3), which required implementation of Rapid Response Actions (RRAs) and Remedial Actions (RAs) to address contamination from past and present activities and sources at and emanating from the training ranges and impact area. The RRAs specifically required by AO3 addressed elevated concentrations of contaminants in soil and have been completed. The comprehensive response action component of AO3 requires that a feasibility study, remedial design and response action be completed for several areas of concern.

C. COMMUNITY PARTICIPATION

Throughout the Site's history, the Impact Area Groundwater Study Program (IAGWSP), EPA and MassDEP have kept the community and other interested parties informed and involved with response activities at the Small Arms Range through informational meetings, fact sheets, press releases, public comment periods and public meetings.

The Impact Area Review Team (IART) was a citizen advisory committee established in 1997 under AO1. The IART served as a technical advisory resource, allowing the EPA, the National Guard Bureau, the Army, and MassDEP to hear the concerns and questions the public had related to the ongoing investigations and cleanup efforts at Camp Edwards. In 2007, the IART team merged with the Plume Cleanup Team, the citizens' advisory team for the Air Force Center for Engineering & Environment's Installation Restoration Program, and was renamed the MMR Cleanup Team (MMRCT, now the JBCCCT). The JBCCCT meets regularly throughout the year for program updates and to provide public comment.

Notices for all meetings related to the Site's investigation and response activities were published in the *Cape Cod Times* and the local edition of *The Enterprise* newspapers.

In October 2001, the IAGWSP, EPA and MassDEP released a Public Involvement Plan outlining activities to address community concerns and to keep citizens informed about and involved in response activities.

With respect to this Small Arms Ranges Decision Document, important updates include:

- On February 12, 2014, an informational meeting was held at Camp Edwards, MA, to present the Remedy Selection Plan for the Small Arms Ranges to the JBCCCT and the public. A fact sheet was developed for JBCCCT members and the public. At the meeting, the IAGWSP gave a presentation on the results of the investigations and the EPA provided a presentation on the proposed decision for the Site. The JBCCCT, local residents and officials, news media representatives, and members of the public were invited to attend the meeting. Representatives from EPA, MassDEP and IAGWSP were available to answer questions. The IAGWSP notified the public of the information session and associated public comment period in a display ad placed in the *Cape Cod Times* and *The Enterprise* newspapers on January 30 and 31, 2014 respectively. A news release regarding the meeting and the public comment period was issued to the local media on February 5, 2014.

- From February 5, through March 5, 2014, a 30 day public comment period was held on the Remedy Selection Plan. Copies of the Remedy Selection Plan Fact Sheet and other IAGWSP fact sheets and documents were placed in the IAGWSP's information repositories at the Bourne, Falmouth, and Sandwich, MA public libraries; on the IAGWSP Web site: www.jbcc-iagwsp.org; and, by appointment at the Administrative Record Office located at PB0516 West Outer Road, Camp Edwards, MA. This information was also placed on the EPA web site at www.epa.gov/region1/mmr, along with the Remedy Selection Plan.

Media releases on presentations and the public comment period for the Site were distributed to the *Cape Cod Times* and other area media including newspapers, radio and television media.

The IAGWSP, EPA, and MassDEP participated in general information sessions, such as open houses, information sessions, community meetings and annual updates to the local Town Managers, Boards of Selectmen, and Boards of Health on JBCC investigations and response activities.

D. SITE CHARACTERISTICS

Site Geology

The geology of Upper Cape Cod is comprised of glacial sediments deposited during the retreat of the Wisconsin stage of Holocene glaciations, approximately 15,000 years ago. Four sedimentary units characterize the regional geology: the Buzzards Bay and Sandwich Moraines, the Buzzards Bay Outwash, and the Mashpee Pitted Plain. The sedimentary units are underlain by crystalline bedrock. The majority of the Small Arms Ranges are located in the Mashpee Pitted Plain. The Buzzards Bay and Sandwich Moraines lie along the western and northern edges of Camp Edwards, converging in the vicinity of the Northwest Corner area of JBCC. Masterson et al. (1997) report that the Buzzards Bay Moraine resulted from the melt water deposition of sorted sediments within a stagnant ice margin overlying a basal till. The Mashpee Pitted Plain consists of fine-grained, glaciolacustrine sediments comprised of fine sand, silt, and clay. This laterally persistent facies can be encountered underlying the moraines. The Buzzards Bay Outwash can be found along the west JBCC boundary to the Cape Cod Canal and Buzzards Bay. Like the Mashpee Pitted Plain, the Buzzards Bay Outwash consists of coarse sand and gravel of deltaic origin with locally interbedded fine sand and silt. It should be noted that overlying all of these glacial deposits is a thin veneer of fine eolian silt, in some places 2 feet in thickness. This silt layer is normally located directly below topsoil at the Small Arms Ranges.

Site Hydrogeology

Surface water resources on JBCC are scarce. Surface water is not usually retained due to the well-drained, sandy soils of JBCC. As a result, approximately 60 percent of the annual rainfall on JBCC infiltrates the soil and contributes to the groundwater aquifer. The 31 wetlands located on the training sites comprise 55 acres of land. No large lakes, rivers, or streams exist on the property, only small marshy wetlands and ponds. Most of the wetlands and surface waters in the Sandwich and Buzzards Bay Moraines on JBCC are considered to be perched. However, Succonsette Pond, which lies immediately southwest of the Central Impact Area, intercepts the water table.

The groundwater beneath JBCC is known as the Sagamore Lens, which is a part of the larger Cape Cod Aquifer. The Sagamore Lens is underlain by low permeability crystalline bedrock, which is not a productive source of water. The source of fresh water recharge to this groundwater system is rainfall and snowmelt. Approximately 27 inches of the average annual rainfall infiltrates the soil and recharges groundwater on an annual basis. The top of the groundwater mound of the Sagamore Lens is located within the area of the J-1, J-

2, and J-3 Ranges, which are southeast of the Impact Area located in the central portion of JBCC.

The height of the water table in and around JBCC can fluctuate up to 7 feet annually due to seasonal variations in groundwater recharge. Groundwater levels are highest in the spring when recharge rates are high; levels are lowest in the late summer/early autumn when rainfall is minimal.

The groundwater flow direction beneath most Small Arms Ranges in western and central portions of the site is predominantly to the west and northwest, and the hydraulic gradient steepens with increasing distance from the top of the regional potentiometric groundwater mound. Within the central portions of JBCC, groundwater elevations typically range between 65 and 70 feet NGVD, and depth to groundwater ranges from approximately 100 to 140 feet below ground surface (bgs).

For Small Arms Ranges located to the south of the groundwater mound, such as K Range, groundwater flow is to the southwest. The thickness of the saturated zone varies between 180 and 280 feet.

E. SUMMARY OF SITE RISKS

A Human Health Risk Screening was conducted for the 40 Small Arms Ranges. The objective of the risk screening was to identify any analytes that warranted further evaluation.

Soil data were available for explosives, perchlorate, PCNs, metals and inorganics, pesticides and herbicides, SVOCs, VOCs, and PCBs. 2,4-DNT and nitroglycerin were the most frequently detected explosives compounds identified. Both DNT and nitroglycerin are encapsulated in nitrocellulose and, consequently, are essentially immobile in the environment and neither compound has been detected in the groundwater associated with the ranges. Therefore, DNT and nitroglycerin residuals from small arms firing are not believed to pose a threat to groundwater. With a few possible exceptions such as antimony and tungsten, most metals detected in surface soil at the Small Arms Ranges are anticipated to have relatively low mobility and resist rapid migration through the vadose zone. Of the 19 metals detected in soil at concentrations exceeding at least one screening criterion, antimony, lead and tungsten are the most commonly associated with small arms ammunition.

Of the 187 soil analytes, 12 were detected at concentrations that exceeded both soil and groundwater screening criteria: perchlorate, antimony, arsenic, chromium, thallium, tungsten, zinc, MCPP, bis(2-ethylhexyl)phthalate, naphthalene, chloroform and PCE.

The maximum detection of perchlorate in soil at the Small Arms Ranges (0.101 mg/Kg at Succonsette Pond) was marginally above its MCP Method 1 S-1/GW-1 Standard (0.1 mg/Kg). In addition, perchlorate is not a typical component of small arms propellants. As such, and in consideration of the low frequency of detection of perchlorate in Small Arms Range soils, perchlorate in soil was determined to not warrant further evaluation.

Although there are exceedances of the MCP S-1/GW-1 Standard (20 mg/kg) for antimony in soil, antimony has rarely been detected in groundwater associated with the Small Arms Ranges. Antimony has been detected in 2 out of 262 groundwater samples analyzed for total antimony. Arsenic and thallium in the soil and groundwater at the Small Arms Ranges can be attributed to natural occurrence and do not warrant further evaluation. Elevated chromium in soil samples appear to be largely attributable to sample preparation methods that are no longer used.

Since the analytical method was refined and updated in 2006, the maximum detected filtered tungsten concentration exceeded the MassDEP Interim Drinking Water Guideline (20 µg/L) in one sample and the paired unfiltered result was below the Guideline, as were all subsequent groundwater samples for tungsten.

Zinc has been sporadically detected in 36 different wells, and the maximum detected concentration of zinc in groundwater was less than the MCP Method 1 GW-1 Standard (there is no MCL for zinc). The maximum detected concentration of zinc in soil was less than the MCP S-1/GW-1 Standard.

The MCPP exceedances have been associated with false positives obtained using an older analytical method. While bis(2-ethylhexyl)phthalate was detected in both soil and groundwater above screening levels, the single groundwater detection has been shown to be an anomalous result that was not reproduced in subsequent sampling. The maximum detected concentration of bis(2-ethylhexyl)phthalate in soil was less than the MCP S-1/GW-1 Standard. Naphthalene has been detected in groundwater in a single sample, but was not detected in subsequent sampling events. The maximum detected concentration of naphthalene in groundwater was less than the MCP Method 1 GW-1 Standard (there is no MCL for naphthalene) and the maximum detected concentration of naphthalene in soil was less than the MCP S-1/GW-1 Standard.

Although chloroform was detected in soil and groundwater at levels exceeding screening criteria, the widespread presence of chloroform on Cape Cod at these levels has been determined to be attributable to several sources unrelated to small arms range activities. As such, chloroform did not warrant further evaluation.

PCE was detected in a single soil sample collected from the GA/GB range. The concentration of PCE in soil is well below the MCP S-1/GW-1 Standard. All the groundwater detections of PCE were observed in samples collected from GA/GB Range monitoring wells in April 1999. The presence of the PCE was likely due to the Chemical Spill 10 groundwater contaminant plume that is being addressed by the Air Force cleanup program. Recent results from these wells were non-detect for PCE.

Eleven soil analytes were detected at maximum concentrations that exceeded MCP Method 1 or 2 S-1/GW-1 Standards: 2,4-DNT, nitroglycerin, perchlorate, antimony, arsenic, cadmium, chromium, lead, nickel, dieldrin, and benzo(a)pyrene. Tungsten was detected at maximum concentrations that exceeded the MassDEP Interim Risk-Based Soil Concentration. Heptachloronaphthalene was detected in one sample that exceeded the Relative Experimental Potency-adjusted MCP S-1/GW-1 Standard. 2,4-DNT, nitroglycerin, arsenic, and chromium have already been discussed. For other analytes, with the exception of lead, there are less than 10 samples that exceeded the MCP Method 1 S-1/GW-1 Standards. There are several sample locations at a number of the ranges (i.e. B Range, Former B Range, C Range, Former C Range, D Range, Former D Range, E Range, G Range, H Range, I Range, K Range, L-3 Range, Former M-2, N Range, Former N Range, SE Range, SW Range and T Range) where the lead concentration exceeded 200 mg/Kg. At some ranges, average soil concentrations are below this threshold. At Operational Ranges, a higher lead threshold applies (6000 mg/Kg). Additional work to address lead at the remaining Small Arms Ranges is described in Section F and Appendices D, F, G and H. Although lead has occasionally been detected in groundwater (3.8 percent of all unfiltered groundwater samples), the maximum detected concentration has been below the screening criterion. This finding is consistent with a recent study of the behavior of metallic lead in the environment which concluded (based on a literature search, a review of geochemical properties and existing Site data) that the soil conditions at JBCC retard the migration of lead to groundwater.

There were four Small Arms Ranges at JBCC that have not been sampled and did not have available analytical data for use in this risk screening. These were L Range (1950s to 1980s), L-1 Range (L Range 1941 to 1950s), L-4 Range, and Former M-3 Range. During the May 2013 Supplemental Investigation, a visual investigation and metal detector sweep were performed at L Range. No significant metal debris was detected and there was no visual evidence of past use of the area as a range. The Former M-3 Range was largely disturbed by construction of the Fuel Spill-12 treatment plant. However, a visual investigation and metal detector sweep were performed at the accessible portions of the range. No significant metal debris was detected and there was no visual evidence of past use of the area as a range. In order to qualitatively evaluate the Former M-3 Range, information regarding their operational history, time frame when it was used, size and

location was reviewed to identify whether there was a similar range that had sampling data that might provide an indication of the possible conditions at these ranges. The reference range for Former M-3 Range is Former M-1 Range. The soil concentrations at Former M-1 Range were found to either be below the detected constituents' screening criteria or were found to not present either a potential threat to groundwater.

As part of the operations and maintenance program, J, K, and T Ranges have been sampled annually to monitor the impacts of ongoing use of these ranges on soil, pore water, and groundwater. In addition, recent lysimeter sampling for tungsten and antimony at B and G Ranges indicates that although there may be some soil sorption and subsequent leaching of these metals, this phenomenon appears to be limited to the surface or near surface soil.

Groundwater sampling data from 54 monitoring wells associated with the Small Arms Ranges were available for explosives, perchlorate, metals and inorganics, pesticides and herbicides, SVOCs, VOCs, and PCBs. Of the 219 analytes reported for groundwater, 15 were detected at maximum concentrations that exceeded risk-based groundwater screening criteria: perchlorate, antimony, arsenic, chromium, nitrogen as nitrate-nitrite, thallium, tungsten, zinc, MCPP, bis(2-ethylhexyl)phthalate, naphthalene, chloroform, cis-1,3-dichloropropene, PCE and TCE. Of these, arsenic and chloroform have been previously associated with other sources, and their presence is not related to Small Arms Range activities. With antimony, thallium, bis(2-ethylhexyl)phthalate, naphthalene, cis-1,3-dichloropropene, PCE and TCE, typically, only the maximum detected concentrations of these analytes exceeded their most stringent screening criteria. More importantly, subsequent sampling results for the same wells were non-detect for these analytes. MCPP detections have been associated with false positives obtained using an older analytical method (AMEC 2002a). In addition, bis(2-ethylhexyl)phthalate is a common laboratory contaminant and its presence in these samples is believed to have been a laboratory artifact. Chromium has been sporadically detected in 24 different wells, typically only once or twice, and the maximum detected concentration of chromium was less than the MCL and the MCP Method 1 GW-1 Standard. The maximum tungsten concentration detected exceeded the MassDEP Interim Drinking Water Guideline (20 µg/L); however, an unfiltered result was below the Guideline as were all subsequent samples for tungsten. Zinc has been sporadically detected in 36 different wells, and the maximum detected concentration of zinc was less than the MCP Method 1 GW-1 Standard (there is no MCL for zinc). Nitrogen measured as nitrate-nitrite exceeded the MCL for nitrite, but not the MCL for nitrate. The maximum detected concentration also did not exceed the EPA Regional Screening Level for Tapwater for nitrate or the health advisory (HA) for nitrate plus nitrite. Finally, the one well (MW-344S) with a perchlorate detection above the screening criteria has been evaluated as part of the Northwest Corner Site as documented

in the *Final Northwest Corner Remedial Investigation/Feasibility Study* (Tetra Tech 2009). Therefore, no analytes detected to date in groundwater at the Small Arms Ranges were determined to warrant further evaluation in relation to potential risk.

F. THE SELECTED SITE DECISIONS

Based on the soil and groundwater data collected to date, the contaminants detected in soil at the Small Arms Ranges have not resulted in groundwater contamination above action levels, with the exception of tungsten. The mass of propellant and projectile related contaminants has been greatly reduced at the ranges as the result of several soil removal activities and range maintenance plans.

The risk of future impacts to groundwater has been reduced and active groundwater remediation is not recommended at this time. However, elevated levels of Small Arms related metals exist in some surface soils at certain Small Arms Ranges. These surface soil contaminants may pose a threat to groundwater. In some instances, they may also pose a human health risk for direct contact depending upon future range use. Therefore, additional action is required to address residual contamination at the B, C, G, KD, N, Former B, Former C, Former D, Former N and Former M-2 Ranges. Soil sampling and potential removal actions will be implemented at KD East, Former B, Former C, and Former D Ranges. Soil removal actions will also be implemented at B, C, G, N, Former M-2, and Former N Ranges.

Soil removal actions are currently planned at the ranges listed below. Contaminants of concern (COCs) are lead and tungsten. The target cleanup level for lead on operational ranges is the MCP Upper Concentration Limit (6,000 mg/Kg). The cleanup level for lead for unrestricted use is the MCP S-1/GW-1 soil cleanup standard (200 mg/Kg). The cleanup level for tungsten is a leaching based calculation developed by Rood and Hull (2007). This cleanup level varies based on the size of the contaminated area. Details of the soil removal actions are provided in the Project Notes in Appendices D, F, G and H.

OPERATIONAL RANGES

B Range
COCs: Lead (6,000 mg/Kg) and Tungsten (31 mg/Kg)
Extent of Removal: 0.46 acres; 479 cubic yards
Estimated Cost of Removal: $98,000

C Range
COCs: Lead (6,000 mg/Kg) and Tungsten (14 mg/Kg)
Extent of Removal: 0.87 acres; 705 cubic yards
Estimated Cost of Removal $144,000

G Range
COCs: Lead (6,000 mg/Kg) and Tungsten (26 mg/Kg)
Extent of Removal: 0.51 acres; 415 cubic yards
Estimated Cost of Removal: $84,000

N Range
COC: Lead (6,000 mg/Kg)
Extent of Removal: 0.93 acres; 751 cubic yards
Estimated Cost of Removal: $153,000

NON-OPERATIONAL RANGES

Former B Range
COC: Lead (200 mg/Kg)
Extent of Removal: 0.34 Acres; 453 cubic yards
Estimated Cost of Removal: $94,000

Former C Range
COC: Lead (200 mg/Kg)
Extent of Removal: 0.22 acres; 181 cubic yards
Estimated Cost of Removal: $ 72,000 plus $30,000 in road building costs

Former D Range
COC: Lead (200 mg/Kg)
Extent of Removal: 0.88 acres; 710 cubic yards
Estimated Cost of Removal: $145,000

Former M2 Range
COC: Lead (200 mg/Kg)
Extent of Removal: 0.56 acres; 448 cubic yards
Estimated Cost of Removal: $92,000

Former N Range
COC: Lead (200 mg/Kg)
Extent of Removal: 0.05 acres; 250 cubic yards
Estimated Cost of Removal: $51,000

Moreover, additional investigation is required at Former B Range (cleanup level 200 mg/Kg lead) to further delineate the extent of contamination. Soil removal is required if lead exceeds the cleanup level.

Additional soil removal will also be required at any of the ranges if post excavation confirmation samples exceed the cleanup levels.

The Appendices contains the following four project notes. These should be referred to for details on the sampling programs for each range.

1. Project Note: Sampling, Soil Removal and Monitoring at Small Arms Ranges; dated 12 May 2014
2. Project Note Addendum to the May 2014 Project Note for Sampling, Soil Removal, and Monitoring at Small Arms Ranges; dated 14 August 2014.
3. Project Note, Second Addendum to the May 2014 Project Note for Sampling, Soil Removal, and Monitoring at Small Arms Ranges; dated 18 December 2014.
4. Project Note, Third Addendum to the May 2014 Project Note for Sampling, Soil Removal, and Monitoring at Small Arms Ranges; dated 18 June 2015.

Certain Small Arms metals have been detected in groundwater and at elevated levels in pore water. Given these detections along with residual soil contamination, long-term groundwater monitoring will continue for the B, C, G, GA/GB, I, J, K, SE/SW, and T Ranges.

Land Use Controls

The Army is responsible for ensuring that land use controls are established, monitored, maintained, reported on, and enforced as part of the remedy to ensure the integrity of groundwater monitoring wells and other environmental sampling equipment at the Small Arms Ranges for the duration of the remedy selected in this Decision Document.

The Small Arms Ranges land use control program consists of three parts as follows:

1. On Camp Edwards, the Massachusetts Air National Guard is the entity tasked with managing infrastructure and requires approval for all projects involving construction or digging/subsurface soil disturbance. The Massachusetts Air National Guard requires completion and approval of a base digging permit prior to any construction, digging, or subsurface soil disturbance activity. All such permits are forwarded to the Massachusetts Army National Guard for concurrence. A copy of the permit is also sent to the Army's Impact Area Groundwater Study Program (IAGWSP) office. The base digging permit will not be processed without a Dig Safe permit number (see next paragraph).

2. The Dig Safe program implemented in Massachusetts provides an added layer of protection for monitoring wells and other environmental sampling equipment at the Small Arms Ranges. By law, anyone conducting digging activities must request clearance through the Dig Safe network. The IAGWSP is a member of Dig Safe. The Camp Edwards Training Range and Impact Area, including the Small Arms Ranges, have been identified by the IAGWSP as a notification region within the Dig Safe program. Dig Safe will electronically notify the IAGWSP at least 72 hours prior to any digging within this region. The Dig Safe notice will include the name of the party conducting the digging, the location of the work, and a brief description of the digging activity. Upon receiving Dig Safe notification of any proposed digging

activity on Camp Edwards, the IAGWSP will promptly review each notification. If the Dig Safe notification indicates proposed work near Small Arms Range monitoring wells or other environmental sampling equipment, the IAGWSP will mark its components to prevent damage due to excavation. The base digging permit and the Dig Safe permit must be in place prior to the start of any digging.

3. Finally, Camp Edwards Range Control has established safeguards and has a process in place to ensure that training units do not conduct digging activities outside of approved dig sites without authorization. To obtain authorization, a Non-Standard Training Request must be submitted to Range Control and reviewed by Camp Edwards and the Environmental Management Commission.

The extent of the Army's enforcement of these land use controls does not address parties failing to file a Dig Safe request or the improper processing of a notification. If incidents do occur, the Army is responsible for ensuring remedy integrity and, if necessary, repairing damage caused by third parties to the monitoring wells and other environmental sampling equipment.

In the event that the Massachusetts Air and/or Army National Guard fail to promptly enforce the first land use control or the Army fails to promptly enforce the second or third land use control, the Army will act in accordance with the paragraph below headed "Activities Inconsistent With Land Use Controls." Specifically, if the Army discovers that the party responsible for enforcing the identified land use control has failed to promptly enforce that land use control, then, as soon as practicable, but no later than 10 days after the Army becomes aware of this failure to promptly enforce the land use control, the Army will notify the EPA and MassDEP and initiate actions to address such failure. The Army will notify the EPA and MassDEP regarding how the Army has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach. For purposes of this paragraph, "promptly enforce" means if the violation or potential violation is imminent or on-going, enforce to prevent or terminate the violation within 10 days from the enforcing agency's (i.e., the Massachusetts Air and Army National Guards') discovery of the violation or potential violation; otherwise, enforce as soon as possible.

Land Use Controls Monitoring

Monitoring of the land use restrictions and controls will be conducted annually by the Army. The monitoring results will be provided annually in a separate report or as a section of another monitoring report, if appropriate, and provided to the EPA and MassDEP. The reports will be used in preparation of the Five-Year Review to evaluate the effectiveness of the final remedy.

The annual monitoring report, submitted to the regulatory agencies by the Army, will evaluate the status of the land use controls and how any land use controls deficiencies or

inconsistent uses have been addressed. The annual evaluation will address (1) whether the use restrictions and controls referenced above were put in place and effectively communicated, (2) whether the operator, owner, and state and local agencies were notified of the use restrictions and controls affecting the property, and (3) whether use of the property has conformed with such restrictions and controls and, in the event of any violations, summarize what actions have been taken to address the violations.

Operational Responsibilities and Liability

Upon approval by EPA, after consultation with MassDEP, the Army may transfer various operational responsibilities for land use controls (i.e., monitoring) to other parties, through agreements. However, the Army acknowledges its ultimate liability under the SDWA § 1431(a) for remedy integrity.

Activities Inconsistent With Land Use Controls

For any proposed land use change(s) that would be inconsistent with the land use control objectives or the final remedy, the Army will seek EPA review and concurrence at least 45 days prior to any proposed land-use change(s). In addition, if the Army discovers a proposed or ongoing activity that would be or is inconsistent with the land-use control objectives or use restrictions, or any other action (or failure to act) that may interfere with the effectiveness of the land use controls, it will address this activity or action as soon as practicable, but in no case will the process be initiated later than 10 days after the Army becomes aware of this breach. The Army will notify the EPA and MassDEP as soon as practicable, but no later than 10 days after the discovery of any activity that is inconsistent with the land use controls objectives or use restrictions, or any other action that may interfere with the effectiveness of the land use controls. The Army will notify the EPA and MassDEP regarding how the Army has addressed or will address the breach within 10 days of sending the EPA and MassDEP notification of the breach.

Ensuring Continued Maintenance of LUCs

The Army will provide notice to the EPA and MassDEP at least six months prior to relinquishing the lease to the Small Arms Ranges so the EPA and MassDEP can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective land use controls. If it is not possible for the Army to notify the EPA and MassDEP at least six months prior to any transfer or sale, then the Army will notify the EPA and MassDEP as soon as possible, but no later than 60 days prior to the transfer or sale of any property, subject to land-use controls.

The Army will not modify or terminate land use controls or implementation actions, or modify land use without approval by the EPA, in consultation with MassDEP. The Army, in coordination with other agencies using or controlling the Small Arms Ranges shall obtain prior approval before taking any anticipated action that may disrupt the

effectiveness of the land-use controls or any action that may alter or negate the need for land use controls. The Army will provide EPA and MassDEP 30 days' notice of any changes to the internal procedures for maintaining land use controls which may affect the site.

Five-Year Reviews

In addition to annual reports on groundwater monitoring and verification of land use controls, this decision for the Small Arms Ranges will be reviewed every five years. The purpose of the review is to revisit the appropriateness of the response in providing adequate protection of human health. The scope of the review will include, but is not limited to the following questions: is the response operating as designed (i.e., monitoring or land use controls); have any of the cleanup standards changed since finalization of this Decision Document; and is there any new information that would warrant updating the remedy. If appropriate, additional actions (including, if necessary, reopening this decision) may be required as a result of these reviews.

Modifications

Any significant changes to the selected decision described in this Decision Document will be documented in a technical memorandum in the Administrative Record. If the EPA, in consultation with MassDEP, believes that fundamental changes to the selected decisions are necessary, the EPA will issue a proposed revised Decision Document and accept public comment on it before issuing a final, revised Decision Document.

G. DETERMINATIONS

The selected action of long-term groundwater monitoring with land use controls to protect monitoring wells and additional action to address residual soil contamination at certain ranges is consistent with the SDWA §1431(a), 42 USC §300i(a), as amended and with AO3.

This decision is protective of human health. EPA's determination is related to unacceptable threats to the groundwater aquifer from the Site; however, by this Decision Document EPA is making no determination regarding public safety risk, ecological risk, dermal contact risk, and/or soil ingestion risk posed by remaining contamination at the Site.

H. DOCUMENTATION OF NO SIGNIFICANT CHANGES

EPA presented the Remedy Selection Plan for the Small Arms Ranges on Wednesday, February 12, 2014. The proposed decisions are long-term groundwater monitoring with land use controls to protect monitoring wells and other environmental sampling equipment

at the B, C, G, GA/GB, I J, K, SE/SW, and T Ranges and additional action to address residual soil contamination at the B, C, G, KD, N, Former B, Former C, Former D, Former N and Former M-2 Ranges since elevated levels of small arms related metals exist in some surface soils. No written or verbal comments were submitted during the public comment period. It was determined that no significant changes to the actions, as originally identified in the Decision Document Fact Sheet, were necessary.

I. STATE ROLE

The MassDEP has reviewed the various alternatives in the Remedy Selection Plan for the Small Arms Ranges and has concurred with the selected decisions. Please refer to Appendix A.

PART III: THE RESPONSIVENESS SUMMARY

On February 5, 2014, EPA published the Remedy Selection Plan fact sheet for the Small Arms Ranges which included the proposed decision for the Sites and announced the public comment period on the proposed decision. The EPA proposed long-term groundwater monitoring at the B, C, G, GA/GB, I J, K, SE/SW, and T Ranges and additional action to address residual soil contamination at the B, C, G, KD, N, Former B, Former C, Former D, Former N and Former M-2 Ranges since elevated levels of Small Arms related metals exist in some surface soils.

The Army notified the public of the February 12, 2014 public meeting and announced the public comment period in display advertisements placed in the January 30 and 31 editions of the *Cape Cod Times* and *Enterprise* newspapers.

The Army placed copies of the Remedy Selection Plan for the Small Arms Ranges in the Army's information repositories at the Bourne, Falmouth, and Sandwich, MA public libraries. The repository contains documents on the investigations and findings supporting selection of the response actions including the investigation report for the site and other relevant documents upon which EPA relied in selecting the proposed remedies. The fact sheet also was made available on the Army web site, which also contains the supporting documents and which offered a means of submitting public comments on the decision document fact sheet.

At the February 12, 2014 public meeting of the JBCCCT, held at Camp Edwards, MA, the EPA gave a presentation on the Remedy Selection Plan and answered questions from the team. Local residents, officials, and news media representatives interested in site activities and cleanup decisions were invited to attend the meeting. Representatives from MassDEP and Army were present. No official comments were received from the public.

FIGURES

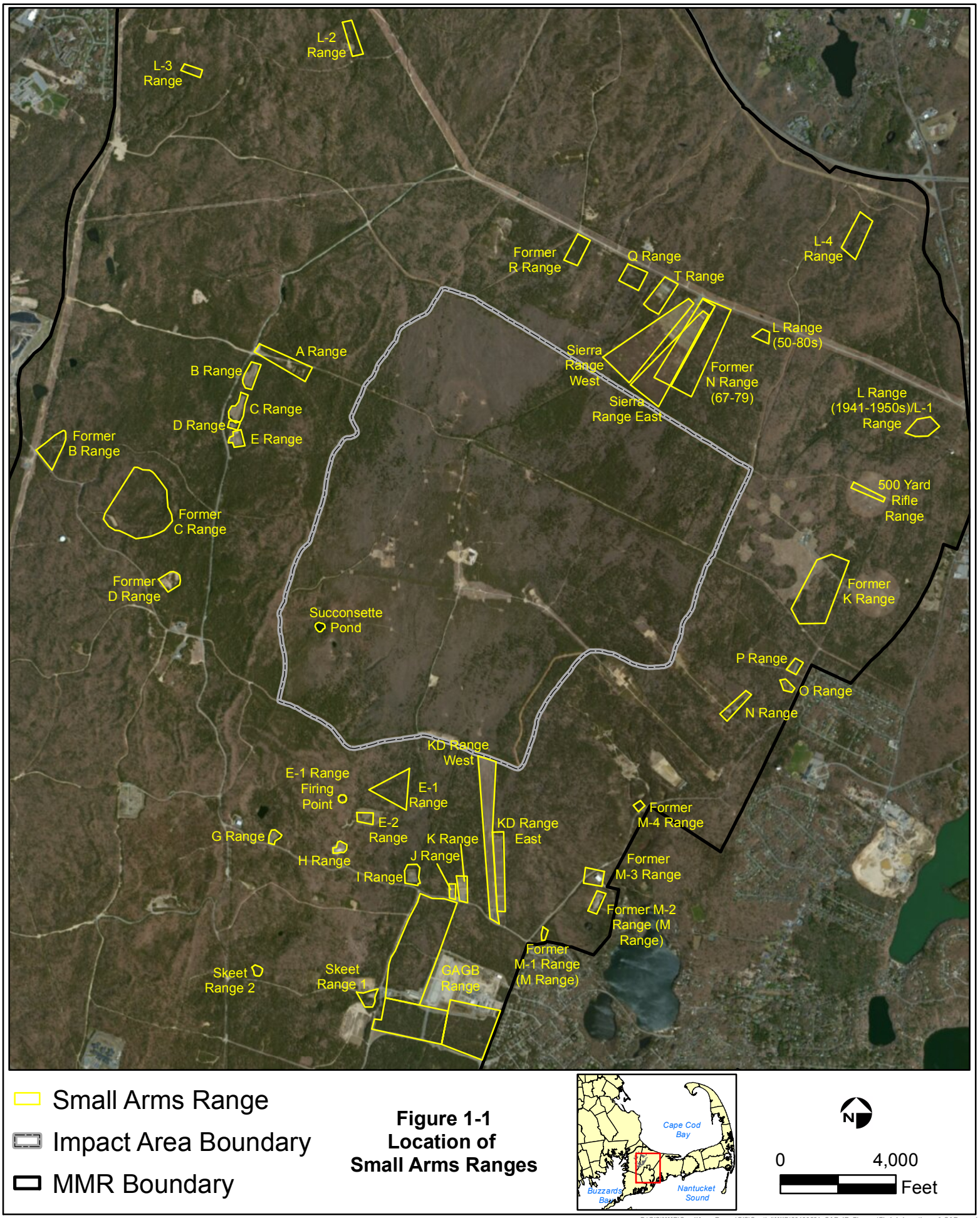

Figure 1-1
Location of
Small Arms Ranges

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Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Pre-Excavation Soil Sample Location Not Evaluated
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

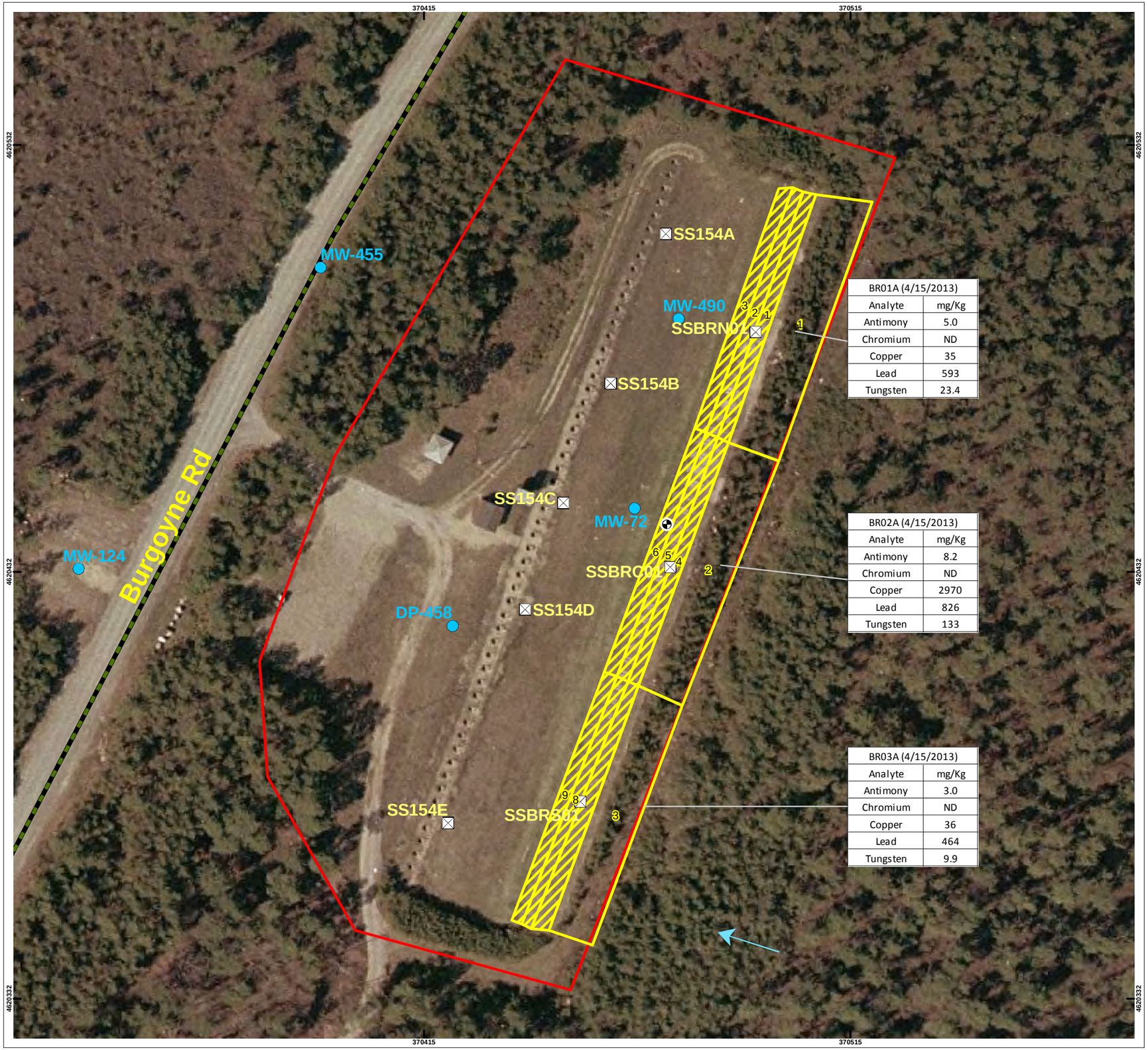
75 0 75 150 Feet

TITLE

T Range
Operational (Active)

N

FIGURE
2



Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Lysimeter Location
- Sampling Area
- XRF Sampling Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

40 0 40 80 Feet

TITLE

B Range Operational(Inactive) 2013 Sampling

N

FIGURE **3**

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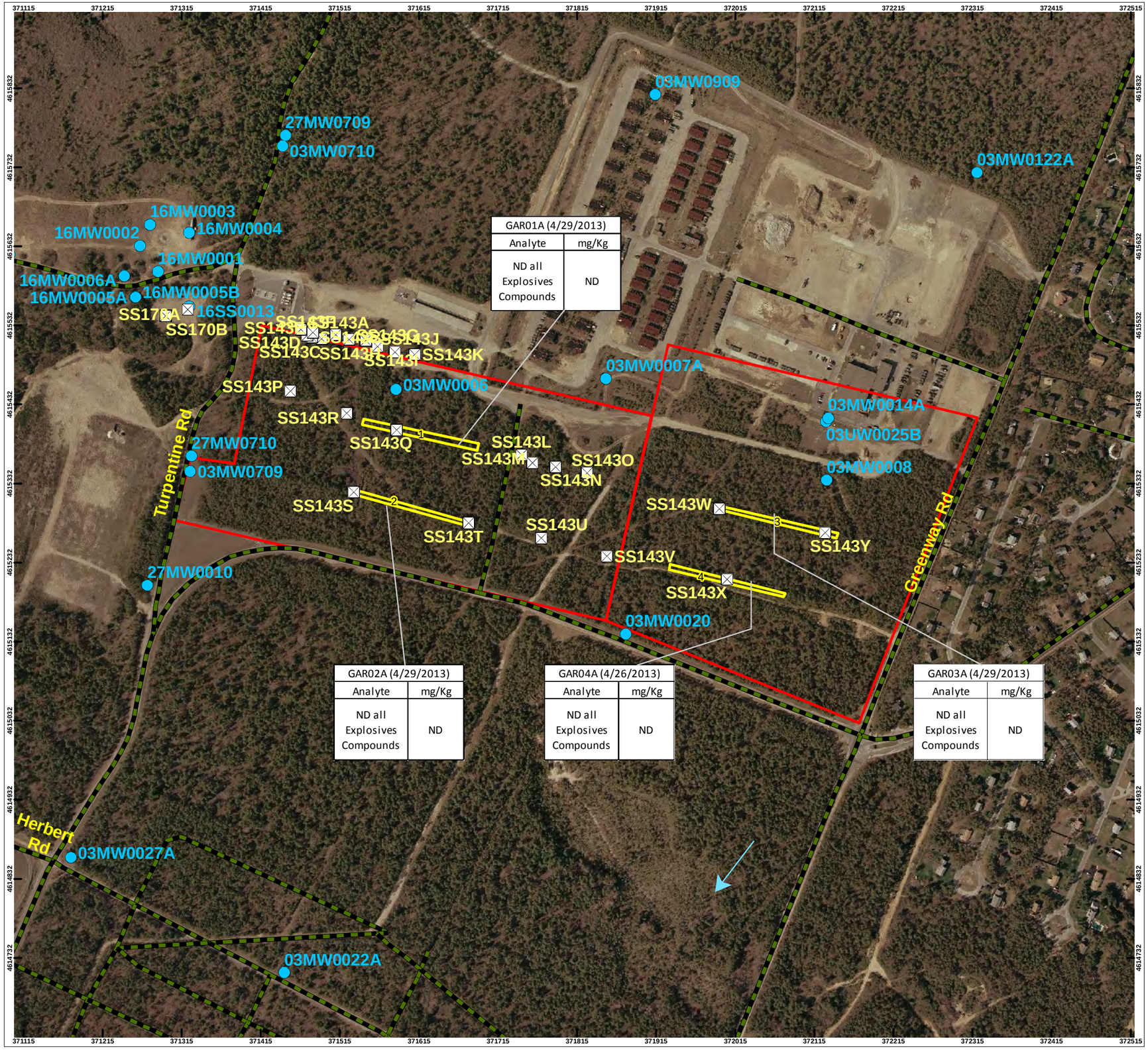

Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Sampling Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

200 0 200 400 Feet

TITLE

GA/GB Range
Non-operational
2013 Sampling

N

FIGURE
4

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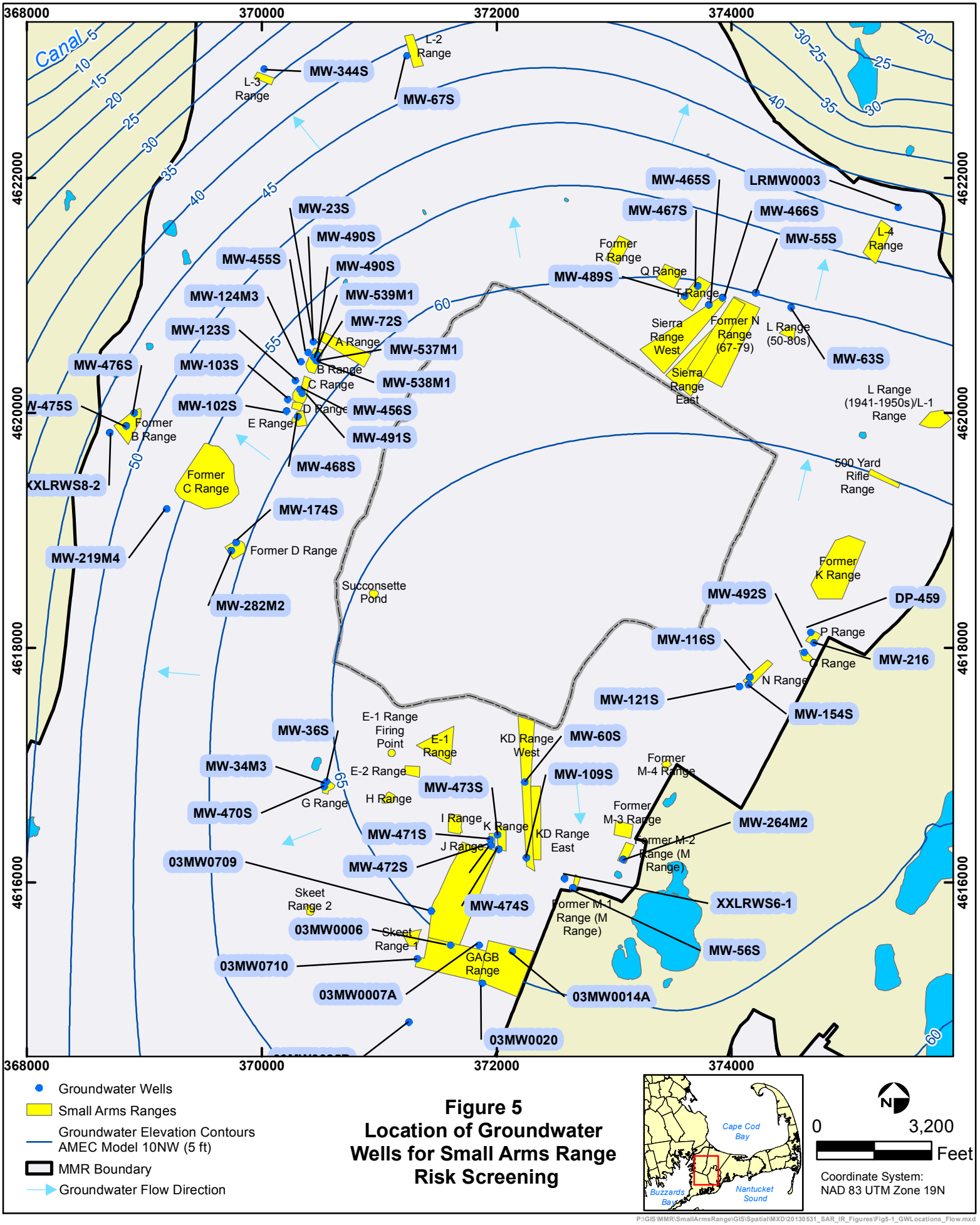

Figure 5
Location of Groundwater Wells for Small Arms Range Risk Screening

P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20130531_SAR_IR_Figures\Fig5-1_GWLocations_Flow.mxd

TABLES

TABLE 1
Small Arms Ranges
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
Federal/Chemical Specific	SDWA MCLs, 40 CFR 141.61 – 141.63	The EPA has promulgated SDWA MCLs (40 CFR 141-143) that are enforceable standards for public drinking water supplies. The standards protect drinking water quality by limiting the levels of specific contaminants that can adversely affect public health.
State/Chemical Specific	MA Drinking Water Regulations, 310 CMR 22.00	These standards establish Massachusetts MCLs (MMCLs) for public drinking water systems (310 CMR 22.00 et seq.).
Federal/Action Specific	SDWA 47 FR 30282 Sole Source Aquifer	Pursuant to Section 1424(e) of the Safe Drinking Water Act, the EPA has determined that the Cape Cod aquifer is the sole or principal source of drinking water for Cape Cod, Massachusetts, and that the Cape Cod aquifer, if contaminated, would create a significant hazard to public health.
Federal/Chemical Specific	Drinking Water Health Advisories, published at http://www.epa.gov/ waterscience/criteria/drinking/	These are exposure concentrations protective of adverse non-cancer effects for a given exposure period. The 1-day and 10-day HA are designed to protect a child; the lifetime HA is designed to protect an adult.
Federal/Chemical Specific	Drinking Water Equivalent Levels (DWELs), published at http://www.epa.gov/ waterscience/criteria/drinking/	DWELs set forth lifetime exposure concentration values protective of adverse, non-cancer health effects, assuming that all of the exposure to a contaminant is from drinking water.
Federal/Chemical Specific	Human Health Reference Doses (RfDs), Reference Concentrations (RfCs), Cancer Slope Factors (CSFs), and 10^{-6} excess lifetime cancer risk level	These risk-based concentrations are considered together with site-specific exposure information to develop concentrations of residual contamination that will not endanger human health.

TABLE 1
Small Arms Ranges
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
State/Chemical Specific	Massachusetts Contingency Plan, Method 1, GW-1 Groundwater Standards, 310 CMR 40.0974(2) Table 1	These cleanup standards were developed by MassDEP considering a defined set of exposures considered to be a conservative estimate of the potential exposures at most sites. Groundwater at MMR is classified as GW-1.
State/Chemical Specific	Massachusetts Drinking Water Guidelines, in Standards and Guidelines for Chemicals in Massachusetts Drinking Waters (Spring 2009), available at http://www.mass.gov/dep/water/dwstand.pdf.	This document lists both promulgated Massachusetts MCLs and also MassDEP Office of Research and Standards guidelines for chemicals that do not have Massachusetts MCLs. Standards promulgated by EPA but not yet effective may be included on the Guidelines list. These values are derived based on a review and evaluation of all available data for the chemical of interest.
State/Action Specific	Massachusetts Surface Water Quality Standards, 314 CMR 4.00	These MassDEP standards prescribe the minimum water quality criteria required to sustain the designated uses of Massachusetts waters. The levels are designed to prevent all adverse health effects from ingestion, inhalation or dermal contact.
Federal/Action Specific	Subtitle C Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 40 CFR Part 264	These requirements establish minimum national standards that define the acceptable management of hazardous waste.

TABLE 1
Small Arms Ranges
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
State/Action Specific	MA Hazardous Waste Management Regulations (310 CMR 30.0000)	These requirements specify how a generator of solid waste must determine whether that waste is hazardous. If waste is determined to be hazardous, it must be managed in accordance with these requirements.
Federal/Action Specific	EPA Guidance on "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (9200.4-17P) (Apr. 21, 1999)	This guidance describes EPA's policy regarding the use of monitored natural attenuation (MNA) for the cleanup of contaminated soil and groundwater. It provides guidance regarding necessary site-specific characterization data and analysis, a methodology for determining a reasonable timeframe for remediation, a preference for remediation of sources, appropriate performance monitoring and evaluation, and a preference for contingency remedies.
Federal/Action Specific	Resource Conservation and Recovery Act (RCRA) [40 CFR 261-262]	These regulations govern the identification and listing of hazardous waste under RCRA, and the requirements on generators of hazardous waste.
Federal/Action Specific	RCRA Land Disposal Restrictions [40 CFR 268]	These regulations restrict the disposal of any treatment wastes classified as hazardous waste.
State/Action Specific	Solid Waste Management Regulations (RCRA Subtitle D), 310 CMR 19.000 et seq.	If a waste is determined to be a solid waste, it must be managed in accordance with the state regulations at 310 CMR 19.000 et seq.
Federal/Action Specific	Hazardous Waste Operations and Emergency Response, 29 CFR 1910.120	These regulations describe training, monitoring, planning, and other activities to protect the health of workers performing hazardous waste operations.

TABLE 1
Small Arms Ranges
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
Federal/Action Specific	Underground Injection Control Program [40 CFR 114, 144, 146, 147, 148, 1000]	Underground Injection Control Program regulations outline minimum program and performance standards for underground injection wells and prohibit any injection that may cause a violation of any primary drinking water regulation in the aquifer. Infiltration galleries and wells fall within the broad definition of Class V wells. These regulations are administered by the State.
State/Action Specific	MassDEP Stormwater Management Program Policy (Nov. 18, 1996)	Provides policies and guidance on complying with the state's stormwater discharge requirements.
Federal/Action Specific	National Environmental Policy Act, 42 U.S.C. 4321-4370f	"EPA believes that NGB is not required to follow NEPA procedures, as long as the NGB's actions are conducted in accordance with the administrative order, because of the provision in the CEQ regulations exempting enforcement actions from NEPA." (USEPA, 1 March 01)
Federal/Action Specific	CWA NDPES Stormwater Discharge Requirements, 40 CFR 122.26	Establishes requirements for stormwater discharges associated with construction activities that result in a land disturbance of equal to or greater than one acre of land. The requirements include good construction management techniques; phasing of construction projects; minimal clearing; and sediment, erosion, structural, and vegetative controls to mitigate stormwater run-on and runoff.
State/Action Specific	Stormwater Discharge Requirements, 314 CMR 3.04 and 314 CMR 3.19	Requires that stormwater discharges associated with construction activities be managed in accordance with the general permit conditions of 314 CMR 3.19 so as not to cause a violation of Massachusetts surface water quality standards in the receiving surface water body (including wetlands).

TABLE 1
Small Arms Ranges
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
State/Chemical Specific	Massachusetts Air Pollution Control Regulations [310 CMR 6.00 – 7.00]	Construction activities could trigger Massachusetts Air Pollution Control Regulations (310 CMR 6.00 – 7.00). These regulations set emission limits necessary to attain ambient air quality standards for fugitive emissions, dust and particulates.
State/Action Specific, Chemical Specific	310 CMR 40.0040 Construction and operation of a groundwater treatment plant	Regulations establish management procedures for remedial wastewater as well as the construction, installation, change, operation and maintenance of treatment works for Remedial Wastewater. Treatment works shall be inspected and the inspections documented. Treatment works shall be protected from vandalism and measures shall be taken to prevent system failure, contaminant pass through, interference, by-pass, upset, and other events likely to result in a discharge of oil and/or hazardous material to the environment.
State/Action Specific, Chemical Specific	Discharge of Groundwater 310 CMR 40.0045	Regulations restrict remedial wastewater discharge to the ground surface or subsurface and/or groundwater. Such a discharge should not erode or impair the functioning of the surficial and subsurface soils, infiltrate underground utilities, building interiors or subsurface structures, result in groundwater mounding within two feet of the ground surface, or result in flooding or breakout to the ground surface. The concentrations of all pollutants discharged must be below the Massachusetts Groundwater Quality Standards established by 314 CMR 6.0. The concentrations must also be below the applicable Reportable Concentrations established by 310 CMR 40.0300 and 40.1600.
State/Action Specific	Discharge of Groundwater 310 CMR 40.0300 and 310 CMR 40.1600	The MCP contains special provisions for the discharge of groundwater containing very low levels of oil or hazardous material. Groundwater containing oil and/or hazardous material in concentrations less than the applicable release notification threshold established by 310 CMR 40.0300 and 40.1600, can be discharged to the ground subsurface and/or groundwater only when following appropriate guidelines.

TABLE 1
Small Arms Ranges
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
State/Action Specific	Groundwater Discharge Regulations [314 CMR 5.00]	Recharge of effluent from some treatment works requires a permit under Groundwater Discharge Regulations at 314 CMR 5.00 unless the exemption allowing for actions taken in compliance with MGL C. 21E and regulations at 40 CMR 40.00 applies. The effluent discharged must not exceed any Massachusetts Groundwater Quality Standards and effluent limitations in 314 CMR 5.10(3). For previous projects on MMR, the MassDEP has determined that effluent from any constructed treatment system is “conditionally exempt” from obtaining the permit provided that the applicable or relevant provisions of the MCP 310 CMR 40.0000 are complied with.
State/Action Specific	MassDEP Drinking Water Program, Private Well Guidelines (2008), available at http://www.mass.gov/dep/water/laws/prwellgd.pdf	These are guidelines concerning private well location, design, construction, development, water quality testing, operation, maintenance, and decommissioning.
State/Action Specific	Underground Injection Control [310 CMR 27.00]	These regulations prohibit injection of fluid containing any pollutant into underground sources of drinking water where such pollutant will, or is likely to, cause a violation of any state drinking water standard or adversely affect the health of persons.
State/Action Specific	STATE - MA Erosion and Sediment Control Guidelines for Urban and Suburban Areas (May 2003), available at http://www.mass.gov/dep/water/essec1.pdf	Provides guidance and best management practices regarding erosion and sediment control.

TABLE 1
Small Arms Ranges
Summary of Regulatory Considerations*

AUTHORITY/TYPE	PROVISION	SYNOPSIS
Federal/Action Specific	Archaeological Resources Protection Act, 16 U.S.C. §§ 470aa-ll, 43 CFR Part 7; Native American Graves Protection and Repatriation Act, 25 U.S.C. §§ 3001-3013, 43 CFR Part 10, National Historic Preservation Act, 16 U.S.C. §§ 470 et seq., 36 CFR Part 800; Massachusetts Historic Preservation Act, MGL ch. 9 §§ 26-27C; MGL ch. 7, § 38A; MGL ch. 38, §§ 6B-6C; 950 CMR 70-71.	These statutes and regulations provide for the protection of historical, archaeological, and Native American burial sites, artifacts, and objects that might be lost as a result of a federal construction project.
State/Action Specific	Massachusetts Endangered Species Act.	The Massachusetts Endangered Species Act provides that impacts to state-listed endangered or threatened species, or species of special concern or their habitats from actions are to be avoided, minimized, and/or mitigated.

*Regulations that EPA will either consider or require, as appropriate, in selecting and defining the remedial action as specified in the final decision document.

TABLE 2

SMALL ARMS RANGES SUMMARY – CAMP EDWARDS ARMY NATIONAL GUARD TRAINING SITE, JOINT BASE CAPE COD			
RANGE NAME	**RESPONSE ACTIONS**	**CURRENT STATUS**	**DECISION**
Operational Ranges (Active) – Ranges where firing is permitted and an Operations, Maintenance and Monitoring Plan (OMMP) is in place			
J Range	1998 Berm maintenance program, 2006 tungsten, 2008 range floor and berm face and 2009 lead soil removal projects.	OMMP in place and STAPP™ system in use.	Continue Long-term monitoring
K Range	1998 Berm maintenance program, 2006 tungsten, 2008 range floor and berm face and 2009 lead soil removal projects.	OMMP in place and STAPP™ system in use.	Continue Long-term monitoring
SE/SW Range	1998 Berm maintenance program.	OMMP in place	Continue Long-term monitoring
T Range	2006 tungsten soil removal project.	OMMP in place and STAPP™ system in use.	Continue Long-term monitoring
I Range	1998 Berm maintenance program, 2006 and 2012 tungsten soil removal projects.	OMMP in place.	Continue Long-term monitoring
Operational Ranges (Inactive) – Ranges not currently in use but could be used again. Would need to go through approval process and develop OMMPs			
A Range	1998 Berm maintenance program.	No exceedances of action levels	No further action
B Range	1998 Berm maintenance program, 2006 tungsten soil removal project.	Detections exceed action levels	Soil removal and long-term monitoring
C Range	1998 Berm maintenance program, 2006 tungsten soil removal project.	Detections exceed action levels	Soil removal and long-term monitoring
D Range	1998 Berm maintenance program.	No exceedances of action levels	No further action*
E Range	1998 Berm maintenance program.	No exceedances of action levels	No further action*
G Range	1998 Berm maintenance program, 2006 tungsten soil removal project.	Detections exceed action level	Soil removal and long-term monitoring
H Range	1998 Berm maintenance program.	No exceedances of action levels	No further action*
KD East	1998 Berm maintenance program.	Detections exceed action levels	Confirmatory soil sampling
N Range	1998 Berm maintenance program.	Detections exceed action levels	Soil removal
O Range	1998 Berm maintenance program.	No exceedances of action levels	No further action
P Range	1998 Berm maintenance program.	No exceedances of action levels	No further action
Former N Range	No response actions conducted.	Detections exceed action level	Soil removal
Q Range	No response actions conducted.	No exceedances of action levels	No further action
Former R Range	No response actions conducted.	No exceedances of action levels	No further action
Non-operational Ranges – Ranges that have not been used for decades and will not be used for small arms firing in the future			
Former B Range	2009 lead soil removal project.	Detections above action levels	Confirmatory soil sampling and soil removal
Former C Range	No response actions conducted.	Detections above action levels	Confirmatory soil sampling and soil removal
Former D Range	2009 lead soil removal project.	Detections above action levels	Confirmatory soil sampling and soil removal
E-1 Range (North of Demo 1)	Investigated as part of Phase IIb	To be investigated	Will be evaluated under the Training Areas Operable Unit
E-2 Range (at Demo 1)	Investigated as part of Demolition Area 1	Evaluated under the Demolition Area 1 Operable Unit	No further action
GA/GB Range	No response actions conducted.	No exceedances of action levels	Long-term monitoring
Former K Range (MMRP)	No response actions conducted.	To be investigated	Will be evaluated under the Military Munitions Response Program (MMRP)
L-1 Range (L Range 41-50s)	No response actions conducted.	No exceedances of action levels	No further action
L Range (1950s-1980s)	No response actions conducted.	Range not found – probably never existed	No further action
L-2, L-3 and L-4 Ranges	No response actions conducted.	No exceedances of action levels	No further action
Former M-1 Range	No response actions conducted.	No exceedances of action levels	No further action
Former M-2 (M-Range)	2009 lead soil removal project.	Detections above action levels	Soil removal
Former M-3 and M-4 Ranges	No response actions conducted.	No exceedances of action levels	No further action
Skeet Range 1	No response actions conducted.	No exceedances of action levels	No further action
Skeet Range 2	No response actions conducted.	No exceedances of action levels	No further action
Succonsette Pond	No response actions conducted.	No exceedances of action levels	No further action
500-Yard Rifle Range	No response actions conducted.	No exceedances of action levels	No further action

Ranges associated with the Otis Fish and Game Club and a Small Arms Range in the southern portion of the base have not been included in this document since these ranges are being evaluated under a separate remediation program. Certain multi-use ranges (particularly the IBC and U Ranges) have also not been included in this report, as these ranges are part of the Training Ranges Operable Unit.

Ranges shaded in blue indicate additional actions will be taken

**Assuming future use is as a Small Arms Range*

APPENDIX A
MASSDEP LETTER OF CONCURRENCE

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection
Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

September 29, 2015

Ms. Nancy Barmakian, Acting Director
Office of Site Remediation and Restoration
U.S. Environmental Protection Agency, Region I
5 Post Office Square Suite 100
Boston, MA 02109-3912

RE: **BOURNE**
Release Tracking Number: 4-0015031
Joint Base Cape Cod (JBCC)
Decision Document, Small Arms Ranges Operable Unit, Concurrence

Dear Ms. Barmakian:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the document entitled "**Decision Document Small Arms Ranges Operable Unit** (the Decision Document) dated September, 2015. The Decision Document presents the selected response actions necessary for forty (40) active, inactive and non-operational Small Arms Ranges (SARs) located on Camp Edwards at the Joint Base Cape Cod (JBCC), in Bourne Massachusetts. The response actions were selected by the U.S. Environmental Protection Agency Region 1 (EPA) in accordance with Section 1431(a) of the Safe Drinking Water Act (SDWA), 42 USC §300i(a), as amended and EPA Administrative Order No. SDWA-1-2000-0014 (AO3), which includes consideration of the substantive cleanup standards set forth under Massachusetts General Law c. 21E and 310 CMR 40.0000, the Massachusetts Contingency Plan (MCP). The U.S. Army (Army) and the National Guard Bureau (NGB) are Respondents under AO3.

The Decision Document sets forth the following response actions:

- Additional action, such as soil confirmation sampling and/or soil removal, is necessary at B, C, G, KD, N, Former B, Former C, Former D, Former N and Former M-2 Ranges since elevated levels of small arms related metals (tungsten, antimony, and lead) exist above MCP cleanup standards in some surface soils. These metals may pose a human health risk for direct contact depending on future use;

- Propellants and metals detected in soil at the Small Arms Ranges have not resulted in groundwater impacts above standards. Therefore, remediation of groundwater is not recommended at this time. However, certain small arms metals have been detected in pore

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water near the ground surface and in groundwater. Given these detections along with residual propellants and metals detected in soil, a long-term groundwater monitoring program with land use controls to protect the monitoring wells has been proposed at the B, C, G, GA/GB, I, J, K, SE/SW, and T Ranges; and

- E-1 Range will be evaluated under the Training Areas Operable Unit, Former K Range will be evaluated under the Military Munitions Response Program, and no further action is necessary for the remaining 21 Small Arms Ranges (A, D, E, H, O, P, Q, Former R, E-2, L, L-1, L-2, L-3, L-4, Former M-1, Former M-3, Former M-4, Skeet 1, Skeet 2, Succonsette Pond, and 500-Yard Rifle range).

The Small Arms Ranges at Camp Edwards include 40 locations where small arms ammunition has been used for military training since World War II. The ranges have been used for a variety of small arms, including pistols, rifles, shotguns, sub-machine guns, and machine guns. The types of ranges can be divided into three categories: operational and active (6), operational but inactive (14) and non-operational ranges (20). Each of the Small Arms Ranges typically includes one or more firing lines, a range floor, target arrays, and an impact berm. The impact berms usually include an earthen berm face frequently containing bullet pockets and an earthen trough at the base of the berm. A number of the older small arms ranges at Camp Edwards do not include the typical range features or a formal impact berm. For several of these ranges, natural terrain hillsides were used as backstops in conjunction with or in place of man-made berms. Small Arms Ranges have undergone multiple uses over time including conversion between use as pistol, rifle, shot gun, sub-machine gun, and/or machine gun ranges. The types of small arms ammunition historically utilized at the ranges included 5.56 mm ball, 9 mm, .30 caliber, .45 caliber, .50 caliber, 7.62 mm ball and tracer rounds.

Potential sources of Small Arms Range impacts to soil and groundwater include propellant-related chemicals, including lead, antimony, nitroglycerine and 2,4-dinitrotoluene (2,4-DNT) deposited on the ground surface at the firing points, and metals associated with projectiles including lead, copper, tungsten and antimony deposited at and behind the range impact berms. Several response actions have been undertaken at the Small Arms Ranges to reduce propellant and metals impacts to soil and to limit the mobility of the contaminants. A berm maintenance program was implemented in 1998 to remove lead projectiles and to chemically fix leachable lead remaining in soil. In 2006, a berm maintenance project was undertaken to address concerns related to the use of tungsten-containing bullets at certain Small Arms Ranges. Soil removal actions have been conducted in 2006, 2007, 2008, and 2009 to eliminate or reduce small arms related propellants and metals. In 2013, additional soil investigation was performed at the Small Arms Ranges. Hundreds of soil samples were taken from backstop berms and at firing lines at 28 ranges. Samples were analyzed for small arms range metals and propellants. Analytical results indicate that antimony, lead, and tungsten exist in soil above MCP standards at certain ranges and additional action in these areas is necessary.

Groundwater samples from fifty four (54) monitoring wells across Small Arms Ranges were analyzed for small arms related propellants and metals to determine whether the groundwater has been impacted. Propellants and metals detected in soil at the Small Arms Ranges have not resulted in groundwater impacts above MCP standards. The mass of propellant and projectile related impacts to soil has been greatly reduced at the ranges as the result of soil removal and range maintenance activities. The risk of future impacts to groundwater has been reduced and therefore groundwater remediation is not recommended at this time.

Determination

MassDEP concurs with the remedies proposed in the Decision Document for the Small Arms Ranges Operable Unit. The selected remedies will ensure a sufficient and protective level of control for groundwater such that none of the contamination associated with the Small Arms Ranges will present a significant risk of harm to health, safety, public welfare or the environment during a foreseeable period of time.

There may be areas within the Small Arms Ranges Operable Unit which pose a public safety risk, ecological risk, dermal contact risk and/or soil ingestion risk. These potential risks are not specifically addressed by this Decision Document, which was issued by the USEPA pursuant to Administrative Order No. SDWA-1-2000-0014 and Section 1431(a) of the SDWA, and which focuses on potential endangerment to the health of persons deriving from contaminants present in or likely to enter the underground source of drinking water. The USEPA is making no determination in this Decision Document regarding any potential public safety risk, ecological risk, dermal contact risk and/or soil ingestion risk posed by the Small Arms Ranges Operable Unit. MassDEP's concurrence is limited to the Decision Document and MassDEP makes no determination regarding any potential public health, safety, welfare or environmental risk posed by any remaining contamination at the Small Arms Ranges Operable Unit.

It is MassDEP's understanding that the Massachusetts Army National Guard (MANG) will develop Operations, Maintenance and Monitoring Plans (OMMPs) detailing measures to be implemented at Camp Edwards to mitigate any remaining public safety risk, ecological risk, dermal contact risk and/or soil ingestion risk posed by the Small Arms Ranges Operable Unit. MassDEP will continue to work with the MANG, the Environmental Management Commission (EMC) and the Department of Fish and Game (DFG) to develop OMMPs for the Small Arms Ranges Operable Unit.

MassDEP's concurrence with the remedy selected by the USEPA set forth in the Decision Document is based upon representations made to MassDEP by the Army/National Guard Bureau (NGB) and assumes that all information provided is substantially complete and accurate. Without limitation, if MassDEP determines that any material omissions or misstatements exist, if new information becomes available, if Land Use Controls (LUCs) are not properly implemented, monitored and/or maintained or if conditions within the Small Arms Ranges Operable Unit changes, resulting in potential or actual human exposure or threats to the environment, MassDEP reserves its authority under M.G.L. c. 21E, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the MCP, the National Contingency Plan (NCP) and any other applicable law or regulation to require further response actions including, without limitation, additional investigation, remedial measures, and the implementation of LUCs. MassDEP will review relevant information as it becomes available, including, without limitation, new regulatory requirements or changes in the environmental conditions, to determine if additional investigative and/or remedial measures are necessary at the Small Arms Ranges Operable Unit for the protection of public health, safety, welfare or the environment.

Please incorporate this letter into the Administrative Record for the Camp Edwards Small Arms Ranges. If you have any questions regarding this matter, please contact Leonard J. Pinaud, Chief, State & Federal Sites Management Section in the MassDEP's Southeast Regional Office at (508) 946-2871.

Sincerely,

Paul W. Locke
Acting Assistant Commissioner
Bureau of Waste Site Cleanup

PL/LP/EJ/lg

Ec: Gary Moran, Deputy Commissioner - Operations
Millie Garcia-Serrano, Acting Regional Director
Gerard Martin, Acting Deputy Regional Director, BWSC-SERO
Leonard J. Pinaud, Chief, State & Federal Site Management
Dawn Stolfi Stalenhoef, Chief Regional Counsel
Richard Lehan, Department of Fish and Game
LTC Brian Saunders, Camp Edwards Impact Area Groundwater Study Program
COL William J. O'Brien, Post Commander, HQ Camp Edwards
JBCC Cleanup Team
Upper Cape Boards of Selectmen
Upper Cape Boards of Health
Lara Goodine [RAONR DEPMOU]

APPENDIX B
GLOSSARY OF TERMS AND ACRONYMS

AFCEC	U.S. Air Force Civil Engineer Center
Antimony	A metal used in some small arms ammunition
AO	Administrative Order
Cal	caliber
DD	Decision Document
EPA	United States Environmental Protection Agency
HA	Health Advisory; EPA guidelines that represent the concentration of a chemical in drinking water that, given a lifetime of exposure, is not expected to cause adverse, non-cancerous, effects.
IAGWSP	Impact Area Groundwater Study Program
IART	Impact Area Review Team
JBCC	Joint Base Cape Cod
JBCCCT	Joint Base Cape Cod Cleanup Team
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level (Federally-promulgated)
MCP	Massachusetts Contingency Plan
mg/Kg	Milligrams per Kilogram
MMRCT	Massachusetts Military Reservation Cleanup Team
MMR	Massachusetts Military Reservation
OMMP	Operations, Maintenance and Monitoring Plan
perchlorate	A water-soluble salt used as an oxidizer
RISDWA	Safe Drinking Water Act
SVOC	semi-volatile organic compound
STAPP™	Bullet catching system used on some Small Arms Ranges.
Tungsten	A metal historically used in some small arms ammunition.
UXO	Unexploded Ordnance
VOC	volatile organic compound

APPENDIX C
INDEX OF KEY SUPPORTING DOCUMENTS

APPENDIX C
INDEX OF KEY SUPPORTING DOCUMENTS

Phase IIb Field Sampling Plan for Unbermed Small Arms Ranges 11/16/2000

Final Completion of Work Report for MMR Small Arms Berm Maintenance, Removal of Metallic Lead and Fixation of Leachable Lead 12/9/2002

Final TM 02-2 Small Arms Ranges Report 3/17/2003

Draft Technical Memorandum – Tungsten Impacted Soil Screening 2006

Environmental Assessment of Lead at Camp Edwards, Massachusetts Small Arms Ranges 5/4/2007

Final T Range Soil and Groundwater Investigation Report 7/30/2007

Project Note, Proposed Field Delineation at Former B and Former D Ranges 4/16/2008

Project Note, Juliet and Kilo Range Soil Sampling and Soil Removal of Range Floor and Juliet Range Berm Face 2008

Final Juliet Range Investigation Report 10/2/2008

Final Kilo Range Investigation Report 10/3/2008

Sierra Range Soil Investigation – Lead and Tungsten 1/24/2012

India Range Soil Investigation – Lead and Tungsten 5/11/2012

India Range Tungsten Investigation and Soil Removal 5/14/2012

Final Former B, Former D and M-2 Ranges Soil Removal Project Summary Report 1/24/2013

Project Note, Small Arms Ranges Supplemental Investigation Sampling 5/17/2013

Project Note, Additional Sampling to be Conducted in Support of Small Arms Ranges Supplemental Investigations 6/2013

Final Small Arms Ranges Remedy Selection Plan 1/28/2014

Final Small Arms Ranges Investigation Report 1/31/2014

APPENDIX D PROJECT NOTE
Sampling, Soil Removal and Monitoring at
Small Arms Ranges
May 2014

Project Note – Sampling, Soil Removal and Monitoring at Small Arms Ranges

Impact Area Groundwater Study Program
Camp Edwards, MA

Date: May 12, 2014

1.0 PURPOSE

This Project Note defines soil excavation, soil sampling, groundwater monitoring, and other activities that are planned for several Small Arms Ranges (SARs) at Camp Edwards. The SAR Decision Document (SAR DD) issued by the EPA in 2014 requires these actions to complete work required under the Safe Drinking Water Act Administrative Orders at the SARs. Figure 1-1 shows the locations of the SARs at Camp Edwards. Orange circles highlight the locations where actions are planned in this Project Note. All other SARs were found to need no further action during the development of the Small Arms Ranges Investigation Report and Remedy Selection Plan.

The basis for these actions and the data used to determine the need for further action are presented in the Final Small Arms Range Investigation Report (the SAR IR) which was completed in January 2014. That report includes the results of extensive sampling of soil and groundwater on most of the SARs. As a result of that investigation, several areas were identified where lead and/or tungsten concentrations exceed applicable thresholds. The SAR DD requires that response actions be completed to address these areas. This Project Note defines the specific actions to be taken.

2.0 SCOPE OF WORK

This section describes the sampling and soil removal activities at the SARs. All soil samples will be ground according to EPA Method 8330B. All excavated soil will be transported off-site to an appropriate landfill. All post-excavation sampling will be coordinated with the regulators prior to collecting the samples.

2.1 B RANGE

The area behind the berm at B Range was investigated for metals concentrations in three sections in 2013. The findings indicate elevated tungsten concentrations in the center section (Area BR02A on Figure 2-1). This area will be cleared of vegetation then excavated to a depth of 6 inches. Excavation of this area will generate approximately 100 cubic yards of soil. A post-excavation 100-point multiple-increment sample will be collected from the excavated area to determine any remaining concentrations of lead, antimony and tungsten and the need for any further soil removal.

Sampling in Area BR01A and Area BR03A showed that the lateral extent of high tungsten concentrations was limited to Area BR02A, but no sampling was conducted further downrange. Before soil excavation commences, a soil sample will be taken from this downrange area and analyzed for tungsten, antimony and lead. The area (shown on Figure 2-1) will measure approximately 200 feet by 50 feet downrange. A 100-point multiple-increment sample and two replicates (three samples total) will be collected from the surface to 3 inches deep. If tungsten, antimony or lead concentrations in this sample area exceed the actionable levels (Rood calculated value for tungsten, MassDEP upper concentration limits [UCL] for lead and antimony), this area will also be cleared of vegetation and excavated.

Sampling of the berm in 2013 detected an elevated level of tungsten in Area 6 (Figure 2-1) which is located at the base of the target berm and measures approximately 200 feet by 15 feet. This is also the area where a pan lysimeter is located which has shown elevated tungsten concentrations in recent sampling events. Area B6 will be excavated to a depth of 2 feet below the surface. In addition, a small stockpile of tungsten contaminated soil (approximately 20 cubic yards) which originally came from I Range is located in this area. This soil will be removed and added to the B Range stockpile. Excavation of this area will generate approximately 130 cubic yards of soil. The existing lysimeter will be removed as part of this action and will not be replaced. A post-excavation 50-point multiple-increment sample will be collected from the surface to 3 inches deep to determine any remaining concentrations of lead, antimony, and tungsten and the need for any further soil removal.

2.2 FORMER B RANGE

The soil excavation project to remove bullets from Former B Range in 2009 did not include the location of sample SS140L which, in 2002, had a lead concentration of 2,410 mg/Kg at a depth of 0-0.5 feet and 477 mg/Kg at a depth of 1.5-2 feet. Those samples were discrete samples.

A soil sample grid measuring 40 feet by 80 feet will be laid out over sample location SS140L and a 100-point multiple-increment sample and two replicates (three samples total) will be collected from the surface to 3 inches (Figure 2-2). A 30-point multiple-increment sample will be collected from 1.75-2 feet. These samples will be analyzed for lead and antimony.

In addition, a second multiple-increment sample grid will be sampled directly east of the excavation area (Figure 2-2). The grid will measure approximately 20 feet by 50 feet to include former grab sample locations SS140Q and SS140R where lead was detected above the MCP S-1/GW-1 standard. A 50-point multiple-increment sample will be collected from the surface to 3 inches and analyzed for lead and antimony. If the lead or antimony concentrations are found to be above the actionable level (MCP S-1/GW-1), the sample area will be excavated to the depth of the contamination. If required, excavation of these areas could generate up to 250 cubic yards of soil. A 100-point post-excavation multiple-increment sample will be collected from the excavated areas and analyzed for lead and antimony. The need to continue the excavation deeper will be assessed based on the post-excavation sample results.

2.3 C RANGE

The area behind the berm at C Range was investigated for metals concentrations in four sections in 2013. The findings indicate elevated tungsten concentrations in areas CR01A and CR02A (Figure 2-3). These areas will be cleared of vegetation then excavated to a depth of 6 inches. Excavation of this area will generate approximately 200 cubic yards of soil. A post-excavation 100-point multiple-increment sample will be collected from each of the excavated areas to determine any remaining concentrations of lead and tungsten and the need for additional soil removal.

Sampling in Area CR03A showed that the lateral extent of elevated tungsten concentrations was limited but no sampling was conducted further downrange. Before soil excavation commences, a soil sample will be collected downrange of area CR02A and south of CR04A to determine the extent of elevated tungsten concentrations. The area (Figure 2-3) will measure approximately 100 feet by 100 feet. A 100-point multiple-increment sample and two replicates (three samples total) will be collected from the surface to 3 inches.

In addition, sample Area CR04A had a reported tungsten concentration just above the action level. To better characterize the distribution of tungsten, this area will be divided into two separate sample areas with a dividing line running east to west. Each of the two new areas will be approximately 50 feet by 100 feet in size. A 100-point multiple-increment sample will be collected from the surface to 3 inches deep in each area and analyzed for tungsten and lead.

Two replicates (three samples total) will be collected from one of the sample areas. If tungsten or lead concentrations in either of these sampling areas exceed the actionable levels (Rood or UCL), the area with the exceedance will be cleared of vegetation and excavated. A 100-point post-excavation multiple-increment sample will be collected from any areas where excavation is required.

XRF screening of the berm face identified two sampling areas with tungsten concentrations that are elevated in comparison with the surrounding screening results. Sample areas 5 and 6 will be excavated to a depth of 6 inches. Combined, these two areas are approximately 20 feet by 150 feet. Excavation of this area will result in the generation of approximately 60 cubic yards of soil. A 50-point post-excavation multiple-increment sample will be collected and analyzed for tungsten and lead.

2.4 FORMER D RANGE

The soil excavation project to remove bullets from Former D Range in 2009 did not extend to the location of samples SS135G and SS135T which, in 2002, had lead concentrations of 2,900 mg/Kg and 501 mg/Kg respectively at a depth of 0-0.5 feet. Those samples were discrete samples. An XRF screening location in this area (HS-29) had a reported reading of 312 mg/Kg. In addition, SS135U had a reported lead concentration of 604 mg/Kg for this 2002 grab sample location.

A soil sample grid will be laid out over sample location SS135G and 135T to include the area between the previous excavations as shown on Figure 2-4. This area measures approximately 85 feet by 100 feet with an area of 9,000 square feet. A 100-point multiple-increment sample and two replicates (three samples total) will be collected from the surface to 3 inches deep in this area. In addition, a 30 foot by 30 foot sample grid will be laid out at sample location SS135U (approximately 900 square feet). A 50-point multiple-increment sample will be collected from this area from the surface to 3 inches deep. All of these samples will be analyzed for lead and antimony. If the lead or antimony concentrations are found to be above the actionable level (MCP S-1/GW-1), these areas will be excavated to the depth of 6 inches. Excavation of these areas, if needed, will generate approximately 185 cubic yards of soil. A post-excavation multiple-increment sample will be collected from each excavated area and analyzed for lead and antimony. The need to continue the excavation deeper will be assessed based on that sample results.

2.5 G RANGE

The area behind the berm at G Range was investigated for metals concentrations in 2013. The multiple-increment sample results indicate elevated lead and tungsten concentrations in area GR01A (see Figure 2-5). This area will be cleared of vegetation then excavated to a depth of 6 inches. Excavation of this area will generate approximately 100 cubic yards of soil. A post-excavation 100-point multiple-increment sample will be collected from surface to 3 inches deep in the excavated area to determine any remaining concentrations of lead, tungsten and antimony and the need for additional excavation.

No sampling was conducted further downrange. Therefore, before soil excavation commences, a soil sample will be taken from this downrange area (approximately 160 feet by 50 feet) and analyzed for tungsten, lead and antimony (Figure 2-5). A 100-point multiple-increment sample and two replicates (three samples total) will be collected from the surface to 3 inches deep. If metals concentrations exceed the actionable levels (Rood or UCL), this area will also be cleared of vegetation, excavated and post excavation samples will be collected.

2.6 KD RANGE EAST

Soil sampling in 1999 detected an elevated concentration of chromium in one location adjacent to the KD Range parking area, sample SS44A (see Figure 2-6). This area will be resampled to determine the chromium concentration. A 20 foot by 20 foot sample area will be centered on former sampling location SS44A and a 50 point multiple-increment sample and two replicates (three samples total) will be collected from the surface to 3 inches. The sample will be ground in a non-metallic puck mill so that chromium is not introduced to the sample during grinding. This sample will be analyzed for total chromium and hexavalent chromium.

Based on the result of this analysis, it will be determined whether further action, such as soil removal, is needed by comparing the result to the MCP S-1/GW-1 standards.

2.7 N RANGE

The area behind the berm at N Range was investigated for metals concentrations in two sections in 2013. The findings indicate elevated lead concentrations in both areas (Areas NR01A and NR02A on Figure 2-7). These areas will be cleared of vegetation then excavated to a depth of 6 inches. Excavation of this area will generate approximately 200 cubic yards of soil. A post-excavation 100-point multiple-increment sample will be collected from each area to determine any remaining concentrations of lead, tungsten and antimony and the need for any additional excavation.

No sampling has been conducted further downrange from these two areas to determine whether or not the elevated lead concentrations continue. Before soil excavation commences, soil samples will be taken from this downrange area and analyzed for tungsten, lead and antimony. Sample areas measuring approximately 175 feet by 50 feet will be laid out directly to the west of sample areas NR01A and NR02A. A 100-point multiple-increment sample will be collected from the surface to 3 inches in each area. Two replicates (three samples total) will be collected from one of the two sample areas. If tungsten, lead or antimony concentrations in these sample areas exceed the actionable levels (Rood or MCP S-1/GW-1), these areas will also be cleared of vegetation and excavated. A post-excavation 100-point multiple-increment sample will be collected from each excavation area to determine any remaining concentrations of lead, tungsten and antimony and the need for any additional excavation.

2.8 FORMER N RANGE

Site reconnaissance on this range in 2013 indicated the presence of several target mounds. (Figure 2-8) Sampling of one of these mounds detected elevated levels of lead. Historic aerial photography (1977) and a range map indicate that this range was used as an individual reaction course which included a total of six or seven target mounds. Two of the target mounds were removed when Sierra East range was constructed. Another more thorough site reconnaissance will be conducted on this range to locate and delineate each of the target mounds.

Vegetation will be cleared to access the target mounds. Metal detectors and XRF soil screening instruments will be used to estimate the initial extent of soil removal around each mound. The mounds will then be removed to grade as well as any surrounding soils that appear to be impacted with bullets.

The area surrounding the initial extent of soil removal around each mound will also be sampled in order to determine whether or not elevated lead concentrations extend to a wider area. Samples will also be analyzed for antimony. In general, a 25-foot perimeter will be established around each initial excavation area and the soils within that perimeter will be sampled and analyzed for lead and antimony. The perimeters will be divided into as many sample areas as needed so that the sample areas will not exceed 10,000 square feet. A multiple-increment sample will be collected from the surface to 3 inches deep in each of these areas. Two

replicates (three samples total) will be collected for at least 25% of the multiple-increment sample areas. Any sample areas within the perimeter that are found to have a lead or antimony concentrations exceeding the MCP S-1/GW-1 standard will be excavated to a depth of 6 inches.

Upon completion of the removal of the mounds and any surrounding areas, the excavated areas will be sampled so that the remaining lead or antimony concentrations can be determined. A multiple-increment sample, either 50 or 100 point, depending on the size of the excavated area, will be collected from each area. The number of increments and area to be sampled will be coordinated with the regulators prior to sample collection. If lead or antimony concentrations in any area still exceed the S-1/GW-1 standard, those areas will be excavated to a depth of 6 inches and resampled. Two replicates (three samples total) will be collected for at least 25% of the multiple-increment sample areas.

Along with the excavation activities, three multiple-increment soil grids will be laid out on the range floor to characterize the portions of the range where there are no target mounds. Each sample will measure approximately 10,000 square feet and include 100 increments. The samples will be analyzed for lead and antimony. The results of these will be used to determine if lead or antimony concentrations on the range floor are above or below actionable thresholds. Two replicates (three samples total) will be collected at one of the multiple-increment sample areas.

2.9 FORMER M-2 RANGE (AKA M-RANGE)

Sampling downrange of the berm in 2013 detected elevated lead concentrations in 4 of 6 sample areas (Areas FMRM202A, FMRM203A, FMRM204A, and FMRM205A on Figure 2-9). Each of these areas will be cleared of vegetation and excavated to a depth of 6 inches. This will generate approximately 150 cubic yards of soil for reuse or disposal.

Before soil excavation commences, sample areas will be laid out to characterize the area further downrange of the elevated lead detections. These sample areas will be approximately the same size as FMRM202A, FMRM203A, FMRM204A, and FMRM205A (Approximately 50 feet by 100 feet as shown on Figure 2-9). A 100-point multiple-increment sample will be collected from each area and analyzed for lead and antimony. Two replicates (three samples total) will be collected from one of the sample areas. If lead or antimony concentrations in any of these areas exceed the actionable levels (MCP S-1/GW-1), those areas will also be cleared of vegetation and excavated to a depth of 6 inches.

Upon completion of the soil removal, the excavated areas will be sampled so that the remaining lead concentrations can be determined. One 100-point multiple-increment sample will be collected from each 10,000 square foot area excavated and analyzed for lead and antimony. If lead or antimony concentrations in any area still exceed the MCP S-1/GW-1 standards, those areas will be excavated to a depth of 6 inches and resampled. Two replicates (three samples total) will be collected for at least 25% of the multiple-increment sample areas.

3.0 GROUNDWATER MONITORING AT I RANGE

A groundwater monitoring well will be installed at I Range as part of this investigation. I Range underwent soil sampling and removal actions throughout the course of the SAR work. The range is currently active for small arms training using the 5.56mm copper ammunition. Recent lysimeter sampling has identified elevated concentrations of antimony and lead. A well is proposed to monitor for potential impacts from metals historically used on the range.

The monitoring well will be installed within the footprint of the range, near the western edge, in a location appropriate to determine if historic use of the berm has had an impact to groundwater (Figure 3-1). An 8-inch borehole will be drilled to a depth of approximately 30 feet below the water table, which is estimated to be at a depth of approximately 80 feet below ground surface

at this location, for a total depth of the boring at approximately 110 feet below ground surface. A single well screen will be installed so that it intersects the groundwater table. The well will be developed and the location and elevation will be surveyed.

After the well is developed, samples will be collected from the newly installed well screen. Groundwater samples will be analyzed at an off-site laboratory for lead, tungsten and antimony.

4.0 REPORTING

The results of the multiple-increment sampling and excavation work will be reviewed with the regulatory agencies to determine whether or not any additional sampling or excavation is required. Upon completion of this scope of work and any additional actions, a completion of work report will be prepared to document the work performed and the resulting site conditions. This report will include plans showing the extent of the various excavations. Tables summarizing post-excavation laboratory results will also be included.

5.0 SIGNATURES

The signatures below represent concurrence with the above sampling project note.

12 MAY 2014
EPA Representative

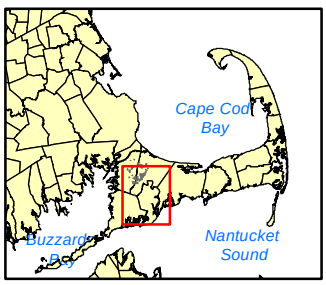
12 May 2014
MassDEP Representative

13 MAY 2014
Impact Area Groundwater Study Program

FIGURES

Location of Proposed Work
Small Arms Range
Impact Area Boundary
MMR Boundary

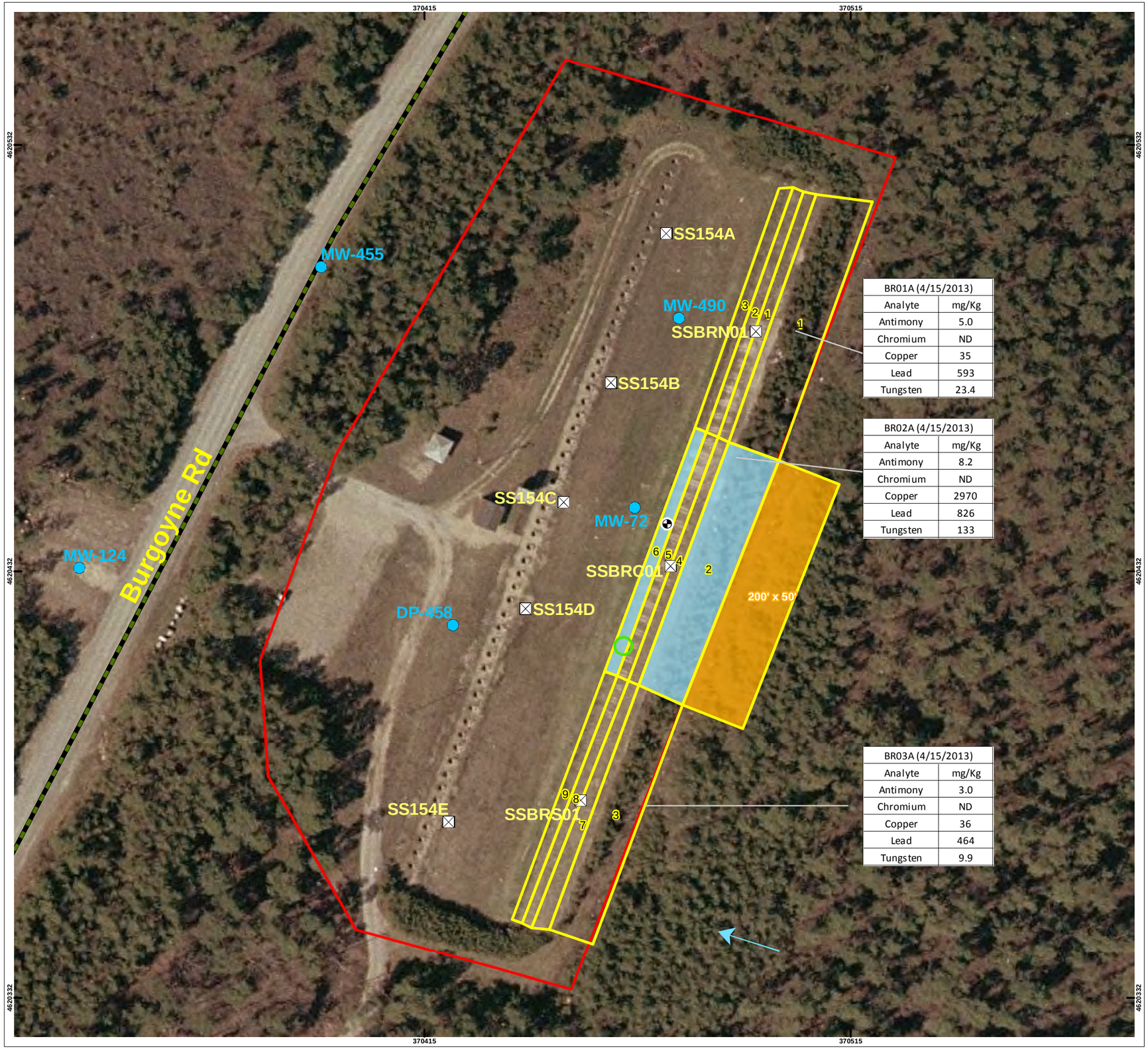
Figure 1-1
Location of Small Arms Ranges



N

0 4,000 Feet

P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig1-1_Location_of_SARs.mxd



BR01A (4/15/2013)	
Analyte	mg/Kg
Antimony	5.0
Chromium	ND
Copper	35
Lead	593
Tungsten	23.4

BR02A (4/15/2013)	
Analyte	mg/Kg
Antimony	8.2
Chromium	ND
Copper	2970
Lead	826
Tungsten	133

BR03A (4/15/2013)	
Analyte	mg/Kg
Antimony	3.0
Chromium	ND
Copper	36
Lead	464
Tungsten	9.9

Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Lysimeter Location
- I Range Soil Stockpile
- Sampling Area
- MIS Sample Area
- Excavation Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

40 0 40 80 Feet

TITLE

B Range
Sampling and
Excavation Areas

N

FIGURE
2-1

P:\GIS\MMR\SmallArmsRange\GIS\SpatialMXD\20140321_SAR_ProjectNote\Fig2-1_BRange_Sampling_Excavation.mxd

Impact Area Groundwater Study Program

LEGEND

- Surface Sample
- Surface Sample > 300 mg/Kg Lead
- Gun and Mortar Location
- Excavation
- Vegetative Clearing Area
- Monitoring Well
- MIS Sample

AMEC Sample

Tetra Tech Sample

Tetra Tech Sample July 2008

[#] - mg/Kg Lead

Sample ID Suffix Key:

CS - Compost Site
EX - Depression Area Location
HS - Hillside
FL - Firing Line
RF - Range Floor
TL - Target Line
BB - Berm
SB - South of Berm

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83, UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

20 0 20 40 Feet

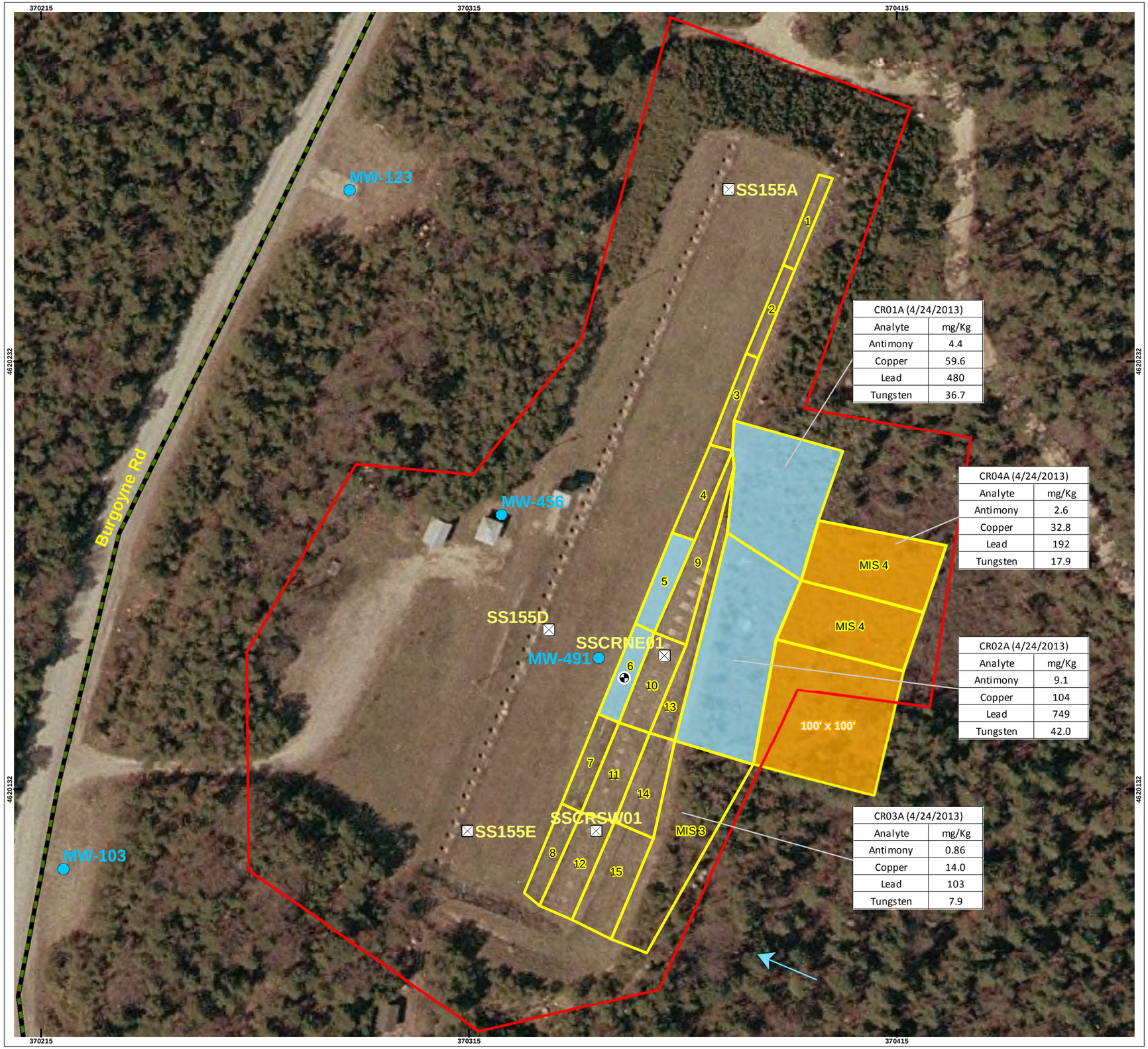
TITLE

Former B Range Sampling Areas

N

FIGURE 2-2

P:\GIS\MMR\SmallArmsRange\GIS\SpatialMXD\20140321_SAR_ProjectNote\Fig2-2_FormerB_SamplingAreas.mxd



Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Lysimeter Location
- Sampling Area
- MIS Sample Area
- Excavation Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for anyanalyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

40 0 40 80 Feet

TITLE

C Range Sampling and Excavation Areas

N

FIGURE
2-3

P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig2-3_CRange_Sampling_Excavation.mxd

Impact Area Groundwater Study Program

LEGEND

- Surface Sample
- Surface Sample > 300 mg/Kg Lead
- Proposed Excavation Area
- Area of Excavation
- Laydown Area (Materials/Equipment/Soil Stockpiles)
- Vegetative Clearing Area
- MIS Sample Area

AMEC Sample
Tetra Tech Sample
Tetra Tech Sample July 2008
Tetra Tech Sample August 2009

[#] - mg/Kg Lead

Sample ID Suffix Key:
HS - Hillside
FL - Firing Line
RF - Range Floor
BB - Berm

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83, UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

20 0 20 40 Feet

TITLE

Former D Range Sampling Areas

N

FIGURE
2-4

P:\GIS\MMR\SmallArmsRange\GIS\SpatialMXD\20140321_SAR_ProjectNote\Fig2-4_FormerD_SamplingAreas.mxd

Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Lysimeter Location
- Sampling Area
- MIS Sample Area
- Excavation Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

40 0 40 80 Feet

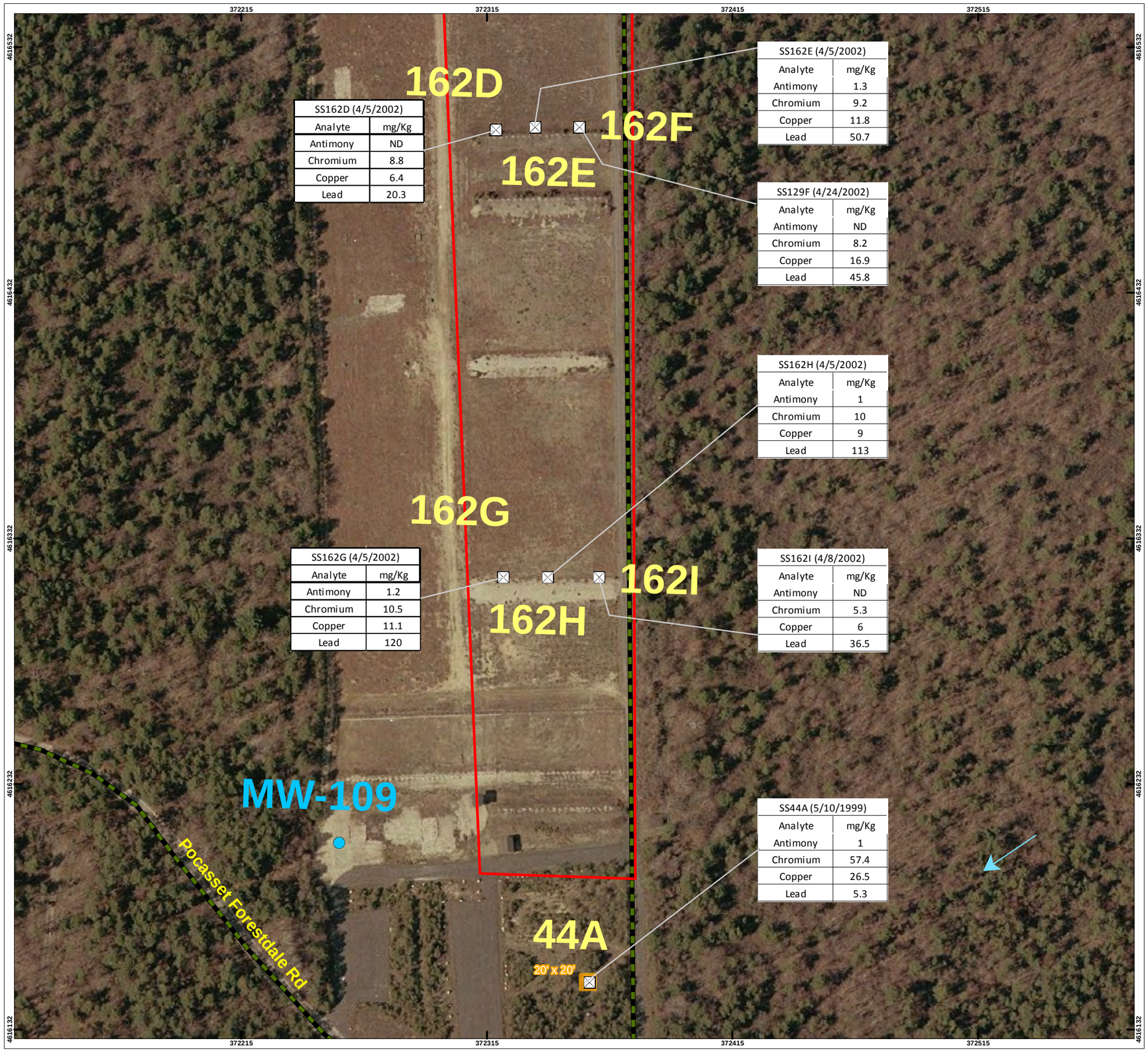
TITLE

G Range Sampling and Excavation Areas

N

FIGURE
2-5

P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig2-5_GRange_Sampling_Excavation.mxd



Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- MIS Sample Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

90 0 90 180 Feet

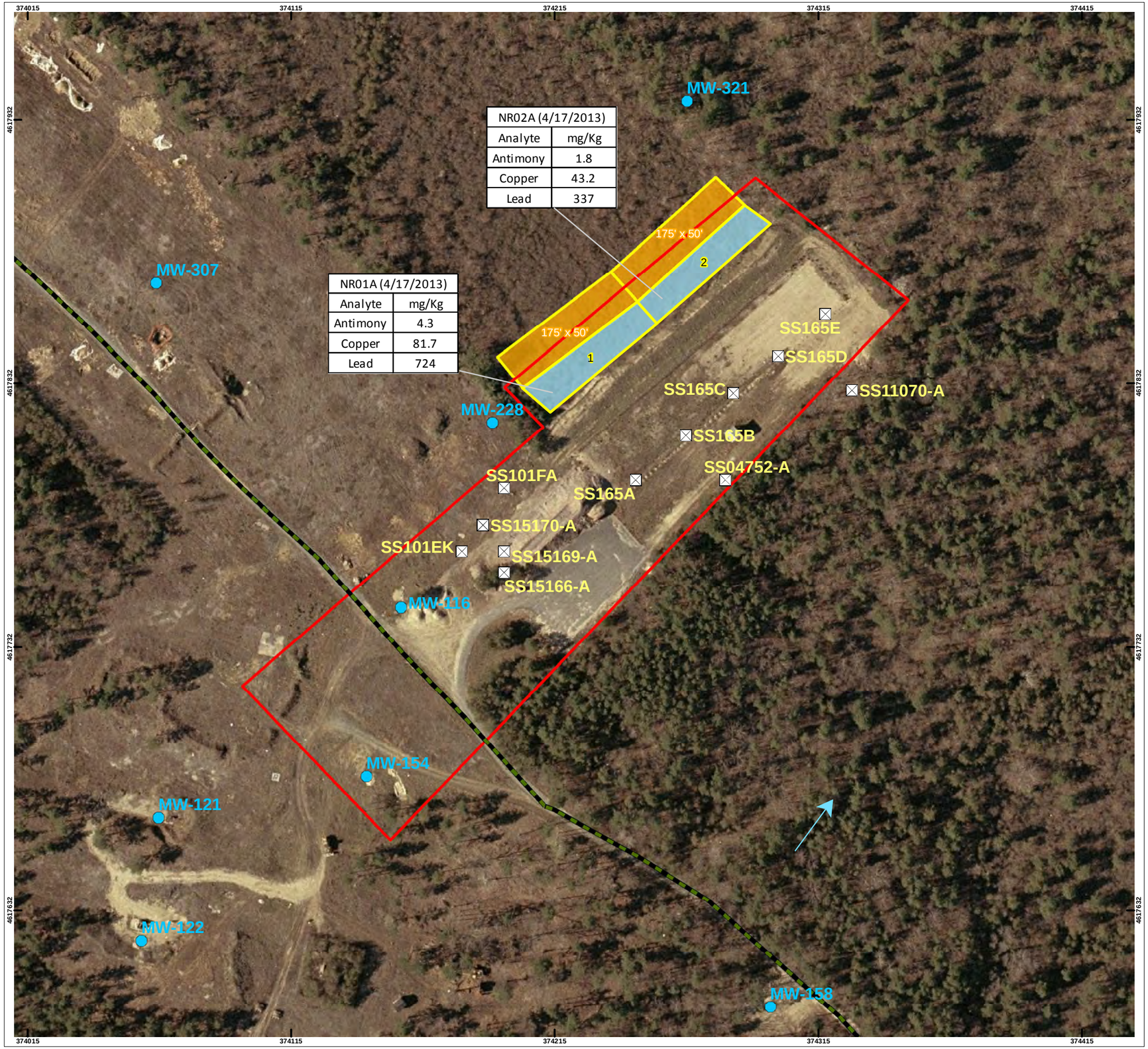
TITLE

KD Range East Sampling Area

N

FIGURE
2-6

Document Path: P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig2-6_KDRange_East_SamplingAreas.mxd



Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Sampling Area
- MIS Sample Area
- Excavation Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

50 0 50 100 Feet

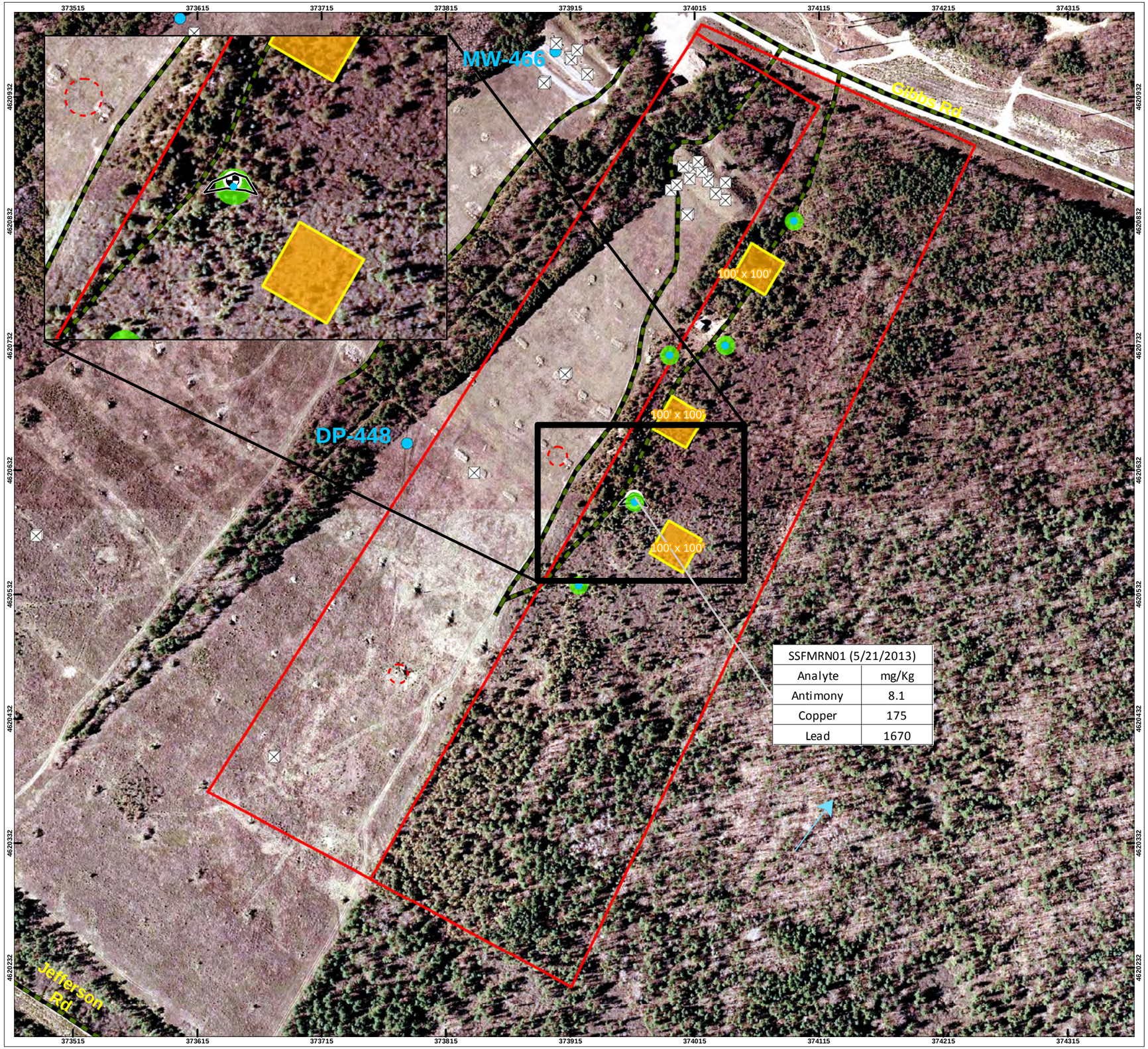
TITLE

N Range Sampling and Excavation Areas

N

FIGURE
2-7

P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig2-7_NRange_Sampling_Excavation.mxd



Impact Area Groundwater Study Program

LEGEND

- Possible Target Berm Excavation Area
- Target Berm
- Soil Sample Location
- Existing Monitoring Well
- Target Berm (Removed)
- Possible Target Berm Sample Area
- Sample Area MIS & XRF
- Area of Interest
- MIS Sample Area
- Road
- Groundwater Flow Direction

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

190 0 190 380 Feet

TITLE

Former N Range Sampling and Excavation Areas

N

FIGURE
2-8

P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig2-8_FormerNRange_Sampling_Excavation.mxd

Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Sampling Area
- MIS Sample Area
- Excavation Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

60 0 60 120 Feet

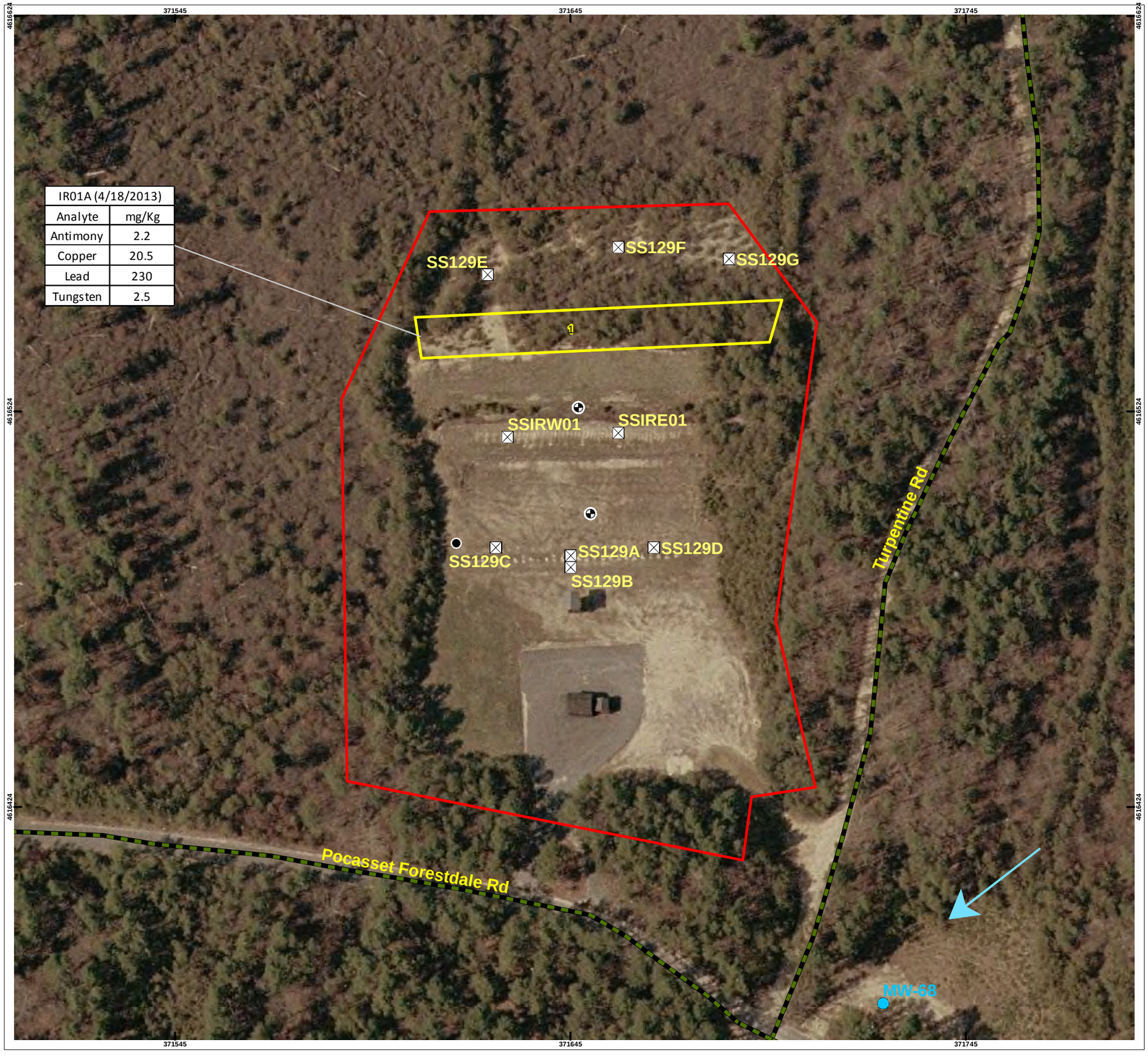
TITLE

Former M-2 Range Sampling and Excavation Areas

N

FIGURE
2-9

Document Path: P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig2-9_M2Range_Sampling_Excavation.mxd



Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Proposed Monitoring Well
- Lysimeter Location
- Soil Sample Location
- Sampling Area
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

40 0 40 80 Feet

TITLE

I Range
Proposed Monitoring Well Location

N

FIGURE
3-1

P:\GIS\MMR\SmallArmsRange\GIS\SpatialMXD\20140321_SAR_ProjectNote\Fig3-1_IRange_ProposedMWLocation.mxd

APPENDIX E PROJECT NOTE
Review of Site Conditions at GA/GB Range
August 2014

Final Project Note

Review of Site Conditions at GA/GB Range

Impact Area Groundwater Study Program (IAGWSP)
Camp Edwards, MA

Date: August 14, 2014

1.0 PURPOSE

During the course of the Small Arms Ranges (SARs) investigation, concerns were raised regarding the presence of bullets in soil in a down-range area of the GA/GB Range, a former WWII era .30 caliber rifle range. The GA/GB Range had been investigated as part of the SAR operable unit including soil and groundwater sampling and was found to meet MCP S-1/GW-1 standards for the contaminants of concern. In April 2014, a two day site reconnaissance was conducted to help quantify the density, location and condition of bullets in soil in the down-range area. This Project Note provides background information and a summary of the reconnaissance activities. In addition, the Project Note proposes a path forward to establish use restrictions and groundwater monitoring as a permanent solution for the 110+ acre area downrange of GA/GB Range

2.0 BACKGROUND INFORMATION – GA/GB RANGE

The GA/GB Ranges are non-operational ranges that were constructed sometime between 1935 and 1941 north of Dolan Road. Subsequent modifications were made in the early 1940s, expanding the existing 20 targets to 150 targets at the 200-yard GA Range, and 70 targets at the 300-yard GB Range. Figure 1 is an aerial photograph from 1955 showing the layout of the range. GA was the western half of the range and GB was the eastern half. Two to three firing lines are located to the south of the photograph with two target lines located downrange. At the target lines, wooden timbers (railroad ties) were used in the construction of east-west trending butt wall backstops for both the GA/GB Ranges. Construction specifications for these backstops indicate that the walls were fortified with crib walls built of railroad ties and backfilled with earth. Targets were manually raised and lowered in front of the butt wall. An earthen parapet was constructed uprange of the target areas to protect target operators from rifle fire. The remnants of these features for GA Range were noted in the field during reconnaissance in 2002. Construction of the Camp Edwards UTES facility and fueling point has eliminated evidence of many of these features in the former GA/GB Range as shown in Figure 2.

The target areas were accessed by three north-south trending tunnels that traversed the length of the 200-yard GA Range and a downrange portion of GB Range. Some tunnel entrances and collapse features in the tunnel ceilings are observable at the surface in GA Range.

Firing lines consisted of 20-foot-wide raised east-west trending embankments that sloped backward (uprange) from a height of approximately 2 feet above the surrounding terrain to form a gentle ramp from which trainees would fire rifles. These ramps were constructed of materials excavated from the target area during butt wall construction. Two separate firing lines, one at 100 yards and another at 200 yards, were constructed at GA Range. GB Range had a third firing line at 300 yards. Based on historical records, expected ammunition use was limited to .30 cal ball rounds. Use of GA/GB Ranges ended in the 1950s.

A review of the 1955 historic aerial photograph (Figure 1) shows impacts to vegetation in the downrange area. GA/GB was an unbermed range, and it appears that these vegetation impacts were the result of bullets traveling downrange beyond the target lines. The vegetation impacts

are evident in the photograph as far downrange as Pocasset-Forestdale Road approximately 3,500 feet from the firing line.

GA/GB Range Investigations

Groundwater

Data from 54 monitoring wells were evaluated to determine whether any chemical constituents at the SARs might be impacting groundwater as part of the SAR investigation. These wells were selected based on their proximity to the various SARs, their well screen depth, groundwater flow direction, and the current understanding of water chemistry in these areas. There are several monitoring wells located at the GA/GB Range downgradient of the downrange area. Figures 5-1 and 5-13A from the SAR Investigation Report (2014) show the locations of the monitoring wells. The maximum concentration of antimony (2.9 µg/L) was reported in an unfiltered sample from 03MW0006. This result is below the MCP GW-1 standard. The primary constituents of the bullets fired at GA/GB (copper and lead) have not been detected in unfiltered samples collected from GA/GB range wells. Bullets containing tungsten were not used at this range. RDX and/or nitroglycerin have not been detected in samples collected from these wells and there is no evidence that high explosives were ever used at this range. Perchlorate was not a target analyte for the GA/GB Range and is not expected to be present given the range use history. Table 5-4 from the SAR Investigation Report provides a summary of groundwater results from the Small Arms Ranges, including GA/GB.

Soil

Soil sampling and analyses were conducted at the GA/GB Ranges (Figure 5-13A) as part of the Phase I and Phase IIb investigations for the Impact Area Groundwater Study Program. Soil samples were collected at the soil berm, a drainage ditch, a coal ash deposit, and firing line locations. This sampling was conducted between the firing lines and target line and did not include the downrange area.

Downrange of GA/GB Ranges

The downrange area considered in the 2013 SAR investigation is located west of the UTES facility and north of GA Range. As part of the field investigation, a visual site inspection and three metal detector sweeps were conducted across the downrange area. Scattered detections of metal were found throughout the areas traversed during the metal detector sweeps with no particular pattern or areas of high accumulation of metals (Figure 5-13C).

Visual inspections included emphasis on the north end of the downrange area to inspect a location where bullets had previously been identified in the root ball of a fallen pine tree. Approximately twelve .30 cal bullets were found in an area that measures approximately one square foot just south of Pocasset-Forestdale Road. A brief inspection of several overturned trees in the immediate area indicated additional .30 cal projectiles.

Based upon site inspection and review, a 100-point multiple increment sample (SSGARNGO5) was collected from a 100 by 100-foot area downrange of GA/GB Ranges where photos from the post WWII time frame indicate stressed vegetation. Surface leaf litter and loose organic material were removed at each incremental location prior to sample collection. Soil sample increments were then collected with a 3/4-inch diameter core sampler from the surface to a depth of three inches. The composite sample was analyzed for selected metals found in small arms projectiles (antimony, copper and lead). Results for antimony (0.9 mg/Kg) and lead (94.1 mg/Kg) were below their respective MassDEP S-1/GW-1 standards (antimony - 20 mg/Kg; lead - 300 mg/Kg). Copper was detected at a concentration of 14.6 mg/Kg. There is no S-1/GW-1 standard for copper.

A second 100-point multiple increment sample (SSGARNGO6) was collected from a 100 by 100-foot location at the north end of the downrange area, just south of Pocasset-Forestdale Road. The sample area was centered on the tree described above where several bullets were found. The sample was analyzed for selected metals (antimony, copper and lead). Results for antimony (0.4 mg/Kg) and lead (34.1 mg/Kg) were below their respective MassDEP S-1/GW-1 standards. Copper was detected at a concentration of 12.1 mg/Kg. Individual bullets were not seen in any of the soil samples. This was probably because of the small diameter of the sampling device relative to the bullet size and bullet density across the range. Individual bullets are unlikely to be collected by the sample core device.

Based upon an overall review of the investigation results, the fact that the ranges are non-operational and there are no S-1/GW-1 exceedances, no further action was recommended at these ranges in the SAR Investigation Report.

3.0 APRIL 2014 FIELD RECONNAISSANCE

After completion of the SAR Investigation Report and Remedy Selection Plan, questions remained regarding the density and potential impacts from the bullets in soil noted in the downrange area at GA/GB. It was decided that a closer inspection of the area was required to learn more about the bullet density and depths at the range and to inspect the condition of the area and the vegetation types. On April 10 and 14, 2014, representatives from the Environmental Protection Agency, Massachusetts Department of Environmental Protection, Environmental Management Commission, U.S. Army Corps of Engineers, Camp Edwards and the Army National Guard Impact Area Groundwater Study Program conducted the field reconnaissance. The scope was to follow a series of transects across the area and select specific locations to dig in search of bullets. The search was aided by a White all-metals detector and Garrett Pro Pointer metal detector. The metal detectors were used at each dig location to find bullets using their electromagnetic signal.

This part of Camp Edwards is heavily vegetated with scrub oaks and pitch pines. Winter storms in 2012 had caused a number of the pines to be uprooted. This allowed for a visual inspection of the subsurface soil near the tree roots.

The bullets were typically found beneath the leaf litter within the root mass. Photos 1 – 5 show the search for bullets and the orientation of the bullets as discovered in place.

In general, bullets were identified at depths between 1 to 6 inches below ground surface. Photo 6 shows the condition of some of the bullets as found in the field. All bullets found were .30 caliber and most were approximately 1.1 inches in length (bullet shown to the left in Photo 7). These bullets were probably fired by the M1 Garand rifle. Some .30 caliber bullets were shorter at approximately 0.7 inches in length (bullet shown second from left). These bullets were probably from the M1 Carbine. Most bullets were intact with minimal evidence of deformation or corrosion seen. However some had been deformed by impacts with hard objects (third bullet from left) and some showed signs of corrosion of the lead filler at the base of the projectile (bullet at right side of photo).

According to the Army databases, the .30 caliber bullet (M1 Garand) contains has a total mass of approximately 11.2 grams. The slug is approximately 7.4 grams (94% lead and 6% antimony). The bullet is jacketed in copper with the lead slug exposed at the base of the projectile. The jacket is 3.8 grams (90% copper and 9.9% zinc).

Figure 6 shows the number of bullets that were found at each location. Additional information obtained during the field reconnaissance is provided in Table 1. A density of approximately 4 bullets per square foot was found to be the approximate average across the range. An area of higher bullet density was seen at points 31, 32 and 40 in the center of the downrange area where 14, 16 and 10 bullets, respectively, were found. As shown in the figure, density dropped

off at the edge of the range to the east and west. Bullets were still found at the northernmost sample point (location 43) although the density was lower than the south-central portion of the range (locations 31 and 32). Bullet density is fairly uniform across the range, with no particular "hot spots" of concentrated bullets found.

4.0 DISCUSSION AND RECOMMENDATIONS

Discussion

GA/GB Range was a rifle training range that was used primarily during WWII and the Korean War. Use of the range was discontinued in the mid 1950s. GA/GB did not have a soil backstop berm. This allowed most of the bullets fired to travel downrange and drop to the ground when they ran out of energy.

The bullets found on the range during the April 2014 site reconnaissance were, for the most part, undeformed with minimal corrosion. Soil sampling conducted in 2013 as part of the SAR Investigation shows that the use of the range has not resulted in levels in soil above cleanup standards, indicating that the metals associated with small arms projectiles (lead, antimony and copper) are still part of the intact bullets after almost 75 years in the soil. No impacts to groundwater have been found downgradient of the range. This finding is consistent with other SARs at Camp Edwards.

Because of the layout of the range with no soil berm to trap bullets, no "hot spot" of concentrated bullets has been found, nor would any be expected. The bullets found this April were relatively uniformly distributed across over 110+ acres with a concentration of approximately 4 bullets per square foot. The downrange area of GA/GB is now heavily vegetated with scrub oak and pitch pines and the bullets, while at a relatively shallow depth (1 to 6 inches), are within the root mass of the oaks, pines and other underbrush.

The only potentially feasible approach to remove the bullets would be to clear-cut the vegetation and bulldoze, stockpile, screen and sift the soil. Removing the bullets from the soil and root mass would be extremely difficult. In addition, it would take decades or longer for the scrub oak/pitch pine habitat to be restored to its current condition.

Access to the bullets at GA/GB Range is unlikely under the current and reasonable foreseeable use of the area. Digging is required to come in contact with the bullets. Contact with the lead within the bullets is further restricted by the copper jacket. This minimizes the likelihood for direct contact or ingestion risks. The copper jacket also restricts the leaching potential of the lead core of the .30 cal bullets.

Recommendations

Given the costs and environmental impacts, removal of the bullets at the downrange portion of GA/GB does not appear feasible with currently available technologies. Therefore, it is recommended that the bullets be allowed to remain in place and that the location of the former range be recorded so that, if excavation or other significant development of this training area were to occur in the future, steps could be taken to properly manage the excavated soil. The current use as a bivouac/maneuver area does not pose any significant risk of contact with the bullets in the subsurface soil so these training activities can continue. This range should be subject to the ongoing 5-year Reviews conducted under the IAGWSP so that changes in the range can be documented and the applicability of any new innovative bullet recovery technologies can be assessed. In addition, groundwater monitoring should be conducted annually at selected wells down gradient of the GA/GB range to evaluate groundwater quality. This activity will be conducted as part of the SAR groundwater monitoring program.

5.0 SIGNATURES

The signatures below represent concurrence with this Project Note.

14 August 2014
EPA Representative

8/14/2014
MassDEP Representative

14 August 2014
IAGWSP Representative

FIGURES,

TABLES

And

PHOTOS

1955

Figure 1 GA/GB 1955 Aerial

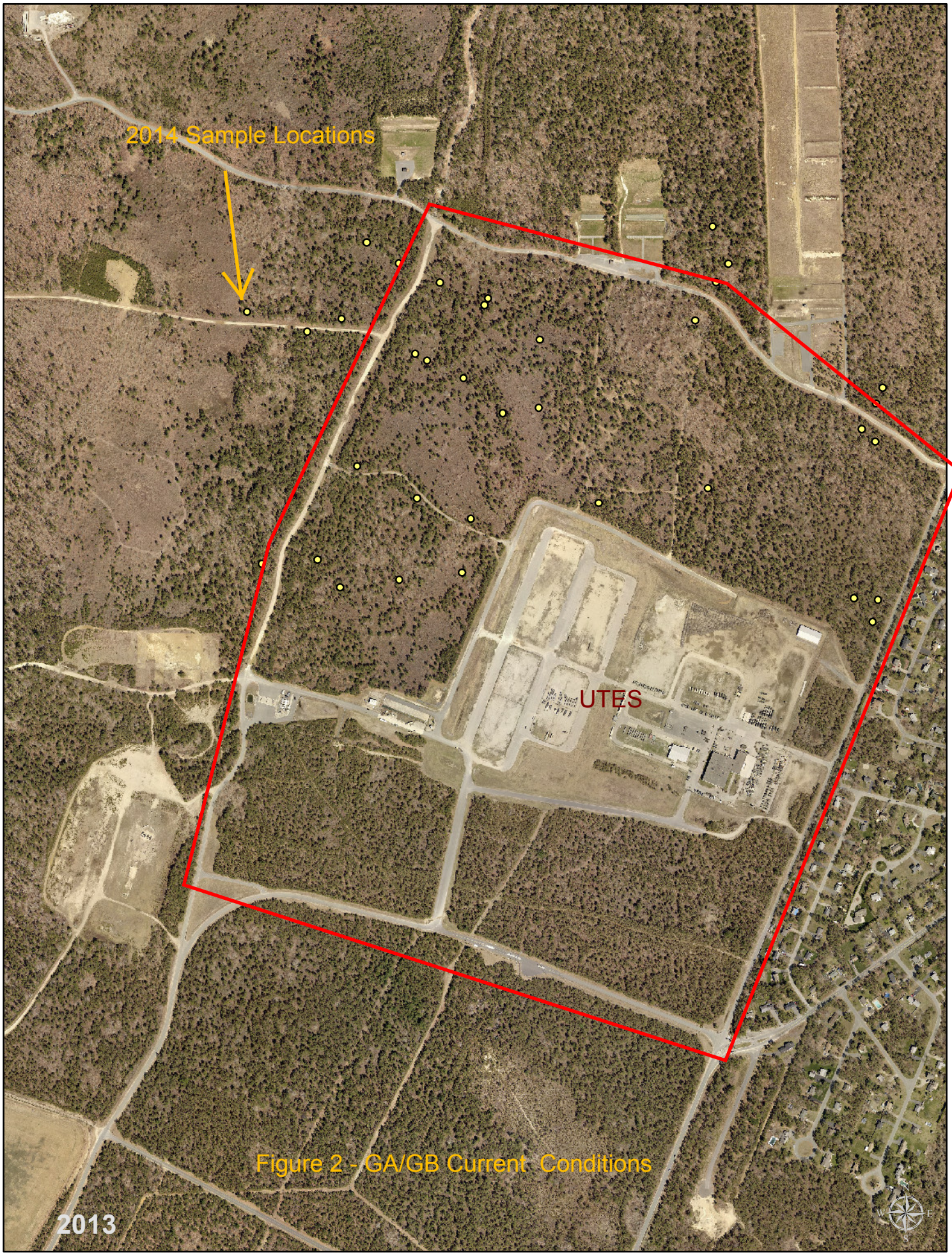


Figure 2 - GA/GB Current Conditions

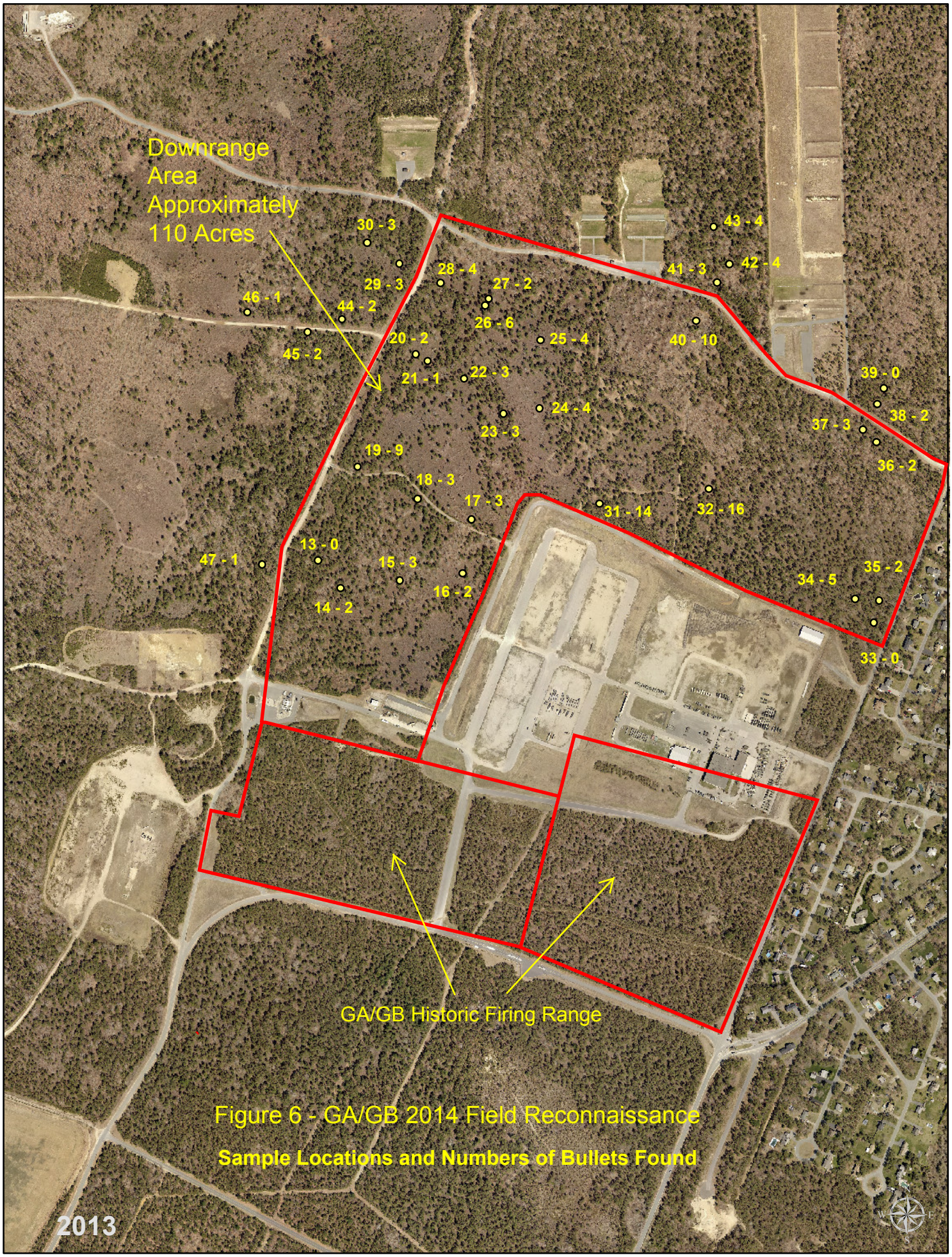


Figure 6 - GA/GB 2014 Field Reconnaissance

Sample Locations and Numbers of Bullets Found

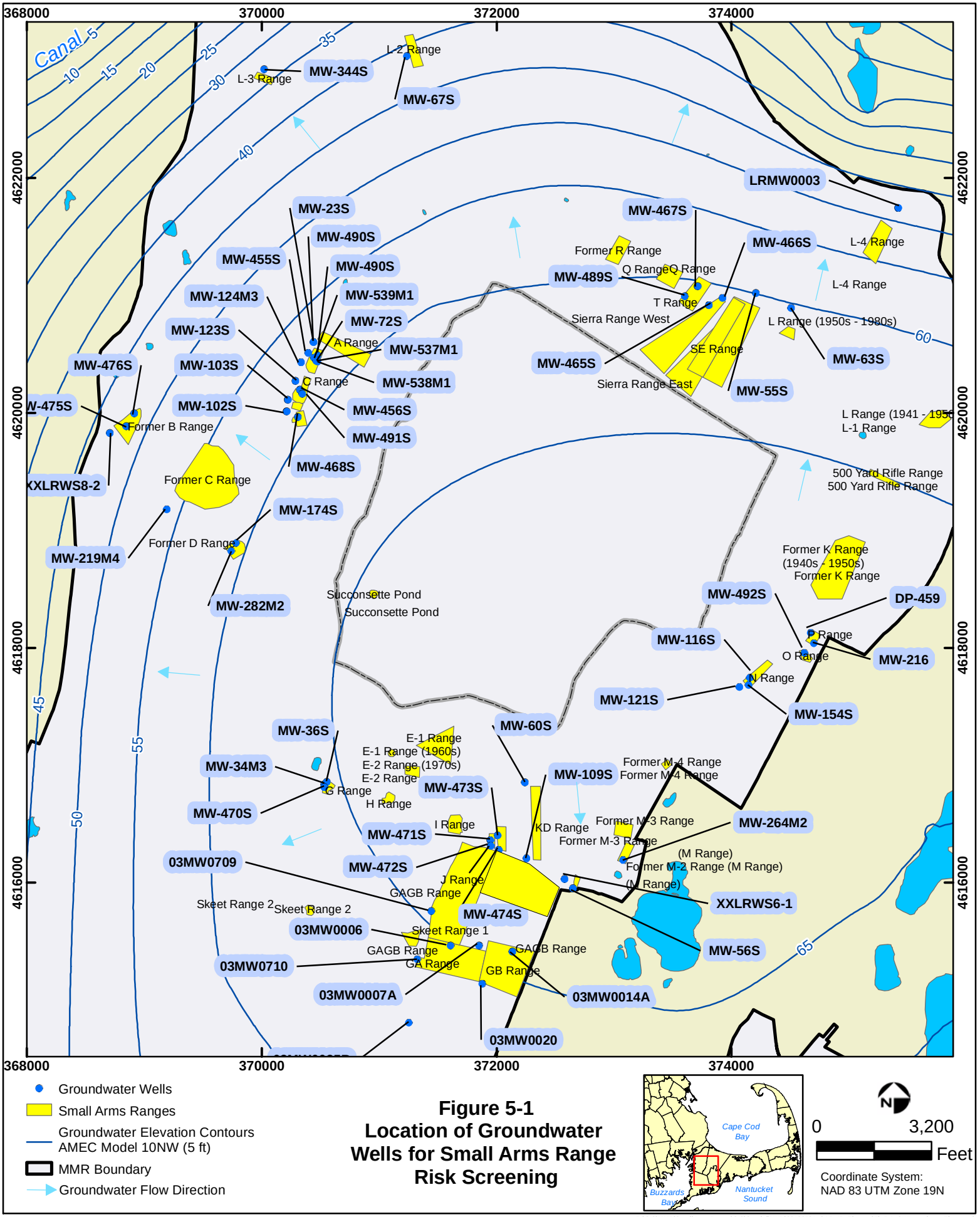
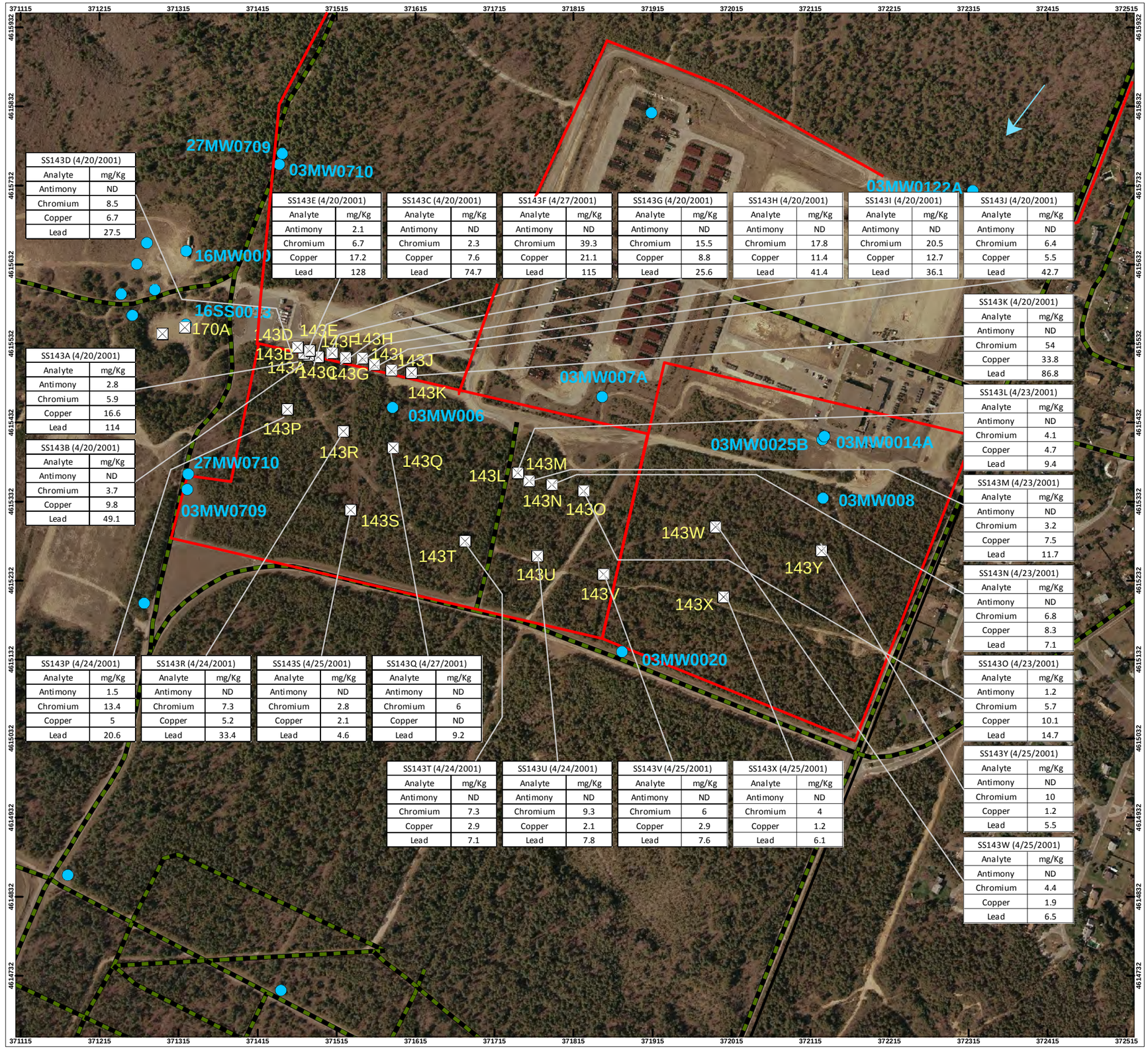


Figure 5-1
Location of Groundwater Wells for Small Arms Range Risk Screening



SS143D (4/20/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	8.5
Copper	6.7
Lead	27.5

SS143E (4/20/2001)	
Analyte	mg/Kg
Antimony	2.1
Chromium	6.7
Copper	17.2
Lead	128

SS143C (4/20/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	2.3
Copper	7.6
Lead	74.7

SS143F (4/27/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	39.3
Copper	21.1
Lead	115

SS143G (4/20/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	15.5
Copper	8.8
Lead	25.6

SS143H (4/20/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	17.8
Copper	11.4
Lead	41.4

SS143I (4/20/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	20.5
Copper	12.7
Lead	36.1

SS143J (4/20/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	6.4
Copper	5.5
Lead	42.7

SS143K (4/20/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	54
Copper	33.8
Lead	86.8

SS143A (4/20/2001)	
Analyte	mg/Kg
Antimony	2.8
Chromium	5.9
Copper	16.6
Lead	114

SS143B (4/20/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	3.7
Copper	9.8
Lead	49.1

SS143L (4/23/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	4.1
Copper	4.7
Lead	9.4

SS143M (4/23/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	3.2
Copper	7.5
Lead	11.7

SS143N (4/23/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	6.8
Copper	8.3
Lead	7.1

SS143O (4/23/2001)	
Analyte	mg/Kg
Antimony	1.2
Chromium	5.7
Copper	10.1
Lead	14.7

SS143P (4/24/2001)	
Analyte	mg/Kg
Antimony	1.5
Chromium	13.4
Copper	5
Lead	20.6

SS143R (4/24/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	7.3
Copper	5.2
Lead	33.4

SS143S (4/25/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	2.8
Copper	2.1
Lead	4.6

SS143Q (4/27/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	6
Copper	ND
Lead	9.2

SS143T (4/24/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	7.3
Copper	2.9
Lead	7.1

SS143U (4/24/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	9.3
Copper	2.1
Lead	7.8

SS143V (4/25/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	6
Copper	2.9
Lead	7.6

SS143X (4/25/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	4
Copper	1.2
Lead	6.1

SS143Y (4/25/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	10
Copper	1.2
Lead	5.5

SS143W (4/25/2001)	
Analyte	mg/Kg
Antimony	ND
Chromium	4.4
Copper	1.9
Lead	6.5

Impact Area Groundwater Study Program

LEGEND

- Area of Interest
- Existing Monitoring Well
- Soil Sample Location
- Roads
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

300 0 300 600 Feet

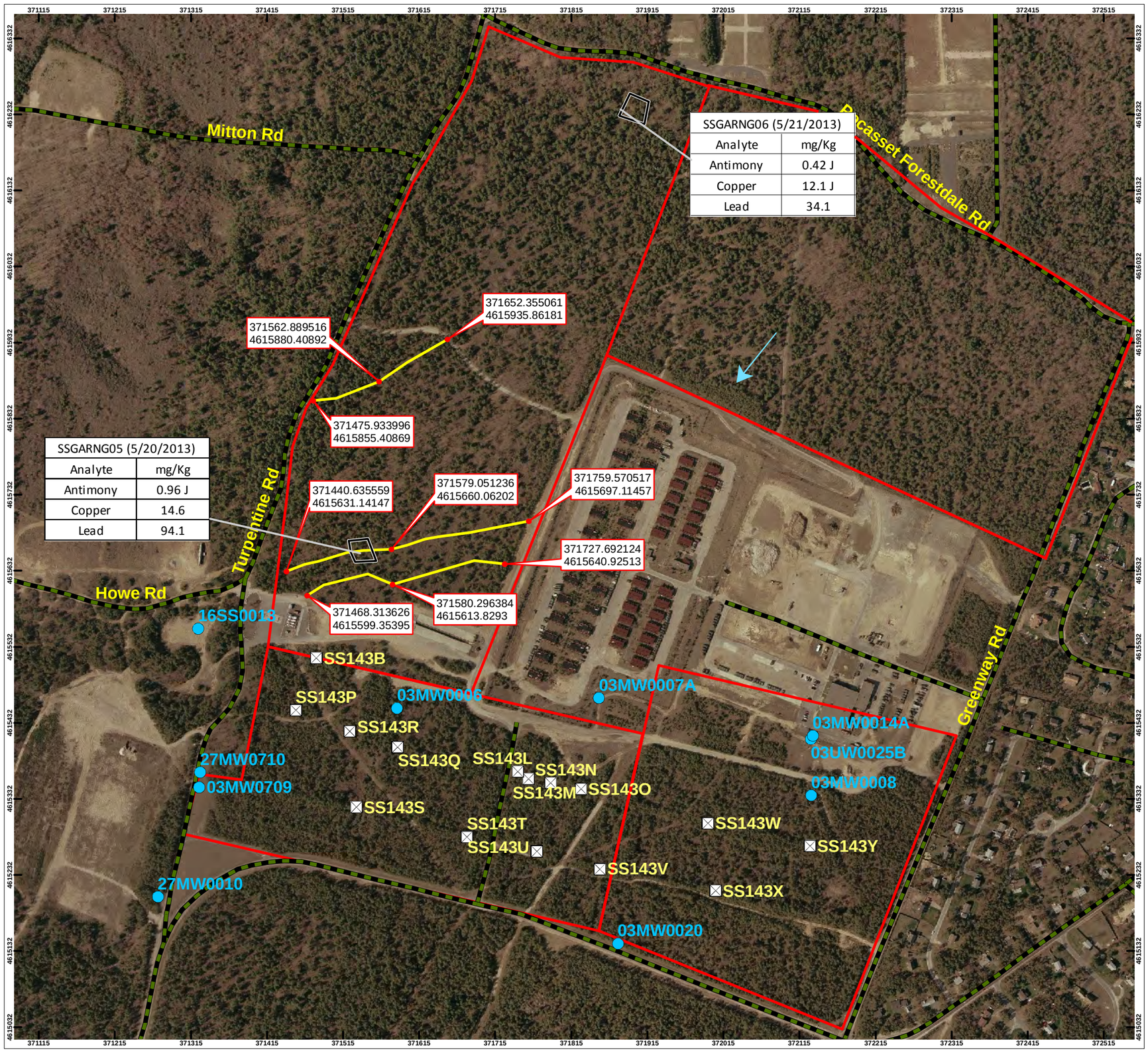
TITLE

GA/GB Range

N

FIGURE
5-13A

Document Path: P:\GIS\MMR\SmallArmsRange\GIS\SpatialMXD\20130531_SAR_IR_Figures\Fig5-13A_GAGBRange.mxd



Impact Area Groundwater Study Program

LEGEND

- Sample Area MIS & XRF
- Soil Sample Location
- Sweep Line Point
- Sweep Line
- Existing Monitoring Well
- Road
- Area of Interest
- Groundwater Flow Direction

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

250 0 250 500 Feet

TITLE

Down Range of
GA/GB
2013 Investigation

N

FIGURE
5-13C

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Table 5-4
Range-Specific Groundwater Data Summary

RANGE	WELL ID	Depth to water (ft)	Date Recorded	TOP OF SCREEN	BOTTOM OF SCREEN	2,4-DINITROTOLUENE 8330	2,4-DINITROTOLUENE 8270	RDX 8330	NITROGLYCERIN 8330	N-NITROSODI-PHENYLAMINE 8270	PERCHLORATE E314.0,6850,6860	ANTIMONY TOTAL	ANTIMONY FILTERED	COPPER TOTAL	COPPER FILTERED	LEAD TOTAL	LEAD FILTERED	TUNGSTEN TOTAL	TUNGSTEN FILTERED
A RANGE	MW-23S	129.37	Jun-00	122.5	132.5	ND	ND	ND	ND	ND	--	ND	ND	5.2 J	ND	4.6	ND	--	--
B RANGE	MW-124M3	135.65	Dec-04	160	170	ND	--	ND	ND	--	ND	ND	--	--	--	--	--	--	--
	MW-455S	120.66	Jun-13	118	128	ND	ND	ND	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	0.21 J
	MW-490S	110.77	Jun-12	108	118	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	ND	ND
	MW-537M1	110.64	Jun-13	106	116	--	--	--	--	--	--	ND	ND	ND	ND	ND	--	0.5 J	ND
	MW-538M1	109.68	Mar-12	107	117	--	--	--	--	--	--	ND	10.8	6.2 J	ND	23.8	2.3 J	14.3	10.4
	MW-539M1	115.41	Jun-13	113	123	--	--	--	--	--	--	ND	ND	13.3 J	ND	ND	ND	ND	ND
	MW-72S	110.03	Jun-13	106	116	ND	ND	ND	ND	ND	ND	ND	--	2.3 J	ND	0.37 J	ND	3.7	3.3
FORMER B RANGE	MW-475S	53.78	Jun-13	50	60	ND	ND	ND	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	ND
	MW-476S	61.95	Jun-13	60	70	ND	ND	ND	ND	ND	--	ND	ND	ND	4.9 J	ND	ND	ND	ND
	XXLRWS8-2	56.79	Jan-99	90.05	105.05	ND	ND	ND	--	ND	--	ND	ND	ND	ND	ND	ND	--	--
C RANGE	MW-103S	145	Jan-01	143	153	ND	--	ND	ND	--	--	ND	3.1 J	--	--	--	--	--	--
	MW-123S	138.94	Oct-12	139	149	ND	--	ND	ND	--	--	ND	--	--	--	ND	ND	ND	ND
	MW-456S	153.2	Jun-13	150.3	160.3	ND	ND	ND	ND	ND	--	ND	ND	ND	ND	ND	ND	ND	0.45 J
	MW-491S	149.3	Jun-13	146.5	156.5	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	0.9	0.33 J
FORMER C RANGE	MW-219M4	174.39	Oct-12	225	235	ND	--	ND	ND		ND	--	--	--	--	--	--	--	--
D RANGE	MW-102S	144.4	Jan-06	145	155	ND	--	ND	ND	--	ND	6.7 J	--	--	--	--	--	--	--
FORMER D RANGE	MW-174S	191.83	Jun-13	190	200	ND	ND	ND	ND	ND	ND	ND	ND	3.6 J	ND	7.3 J	ND	0.32	0.38 J
	MW-282M2	182.76	Oct-11	206	216	ND	--	ND	ND		0.043 J	--	--	--	--	--	--	--	--
E RANGE	MW-468S	173.62	Jun-13	170	180	ND	ND	ND	ND	ND	--	ND	ND	6.3 J	ND	ND	ND	ND	0.39 J
G RANGE	MW-34M3	78.72	Mar-13	111	121	ND	ND	0.37	ND	ND	1.12	ND	--	ND		ND	--	--	--
	MW-36S	76.9	Mar-13	73	83	ND	ND	ND	ND	ND	ND	--	--	4.3 J		ND	--	--	--
	MW-470S	78.71	Mar-13	76	86	ND	ND	ND	ND	ND	--	--	ND	ND	ND	7.7 J	ND	0.23	0.81 J
GA/GB RANGE	03MW0006	86.63	Aug-03	81	91	ND	ND	ND	ND	ND	--	2.9 J	--	ND	--	ND	--	--	--
	03MW0007A	88.47	Jan-00	104	109	ND	ND	ND	ND	ND	--	ND	--	ND	--	ND	--	--	--
	03MW0014A	86.35	Jan-00	119	124	ND	ND	ND	ND	ND	--	ND	--	ND	--	ND	--	--	--
	03MW0020	84.25	Jan-00	114	124	ND	ND	ND	ND	ND	--	ND	--	ND	--	ND	--	--	--
	03MW0709	86.2	Jan-00	76	86	ND	ND	ND	ND	ND	--	ND	--	ND	--	ND	--	--	--
	03MW0710	82.6	Jan-00	82	87	--	--	--	--	--	--	ND	--	ND	--	ND	--	--	--
KD SAR	MW-109S	86.79	Mar-12	89	99	ND	ND	ND	ND	ND	ND	ND	--	3 J	--	0.96 J	ND	ND	ND
	MW-60S	95.25	Aug-03	90.7	100.7	ND	ND	ND	ND	ND	ND	ND	--	2.2 J	--	ND	--	--	--
J RANGE	MW-471S	87.71	Sep-12	85	95	ND	ND	ND	ND	ND	--	ND	ND	3.6 J	7.3 J	ND	ND	ND	0.33 J
	MW-472S	88.49	Sep-12	85	95	ND	ND	ND	ND	ND	--	ND	ND	1.4 J	1.9 J	ND	ND	ND	ND
K RANGE	MW-473S	86.95	Sep-12	83	93	ND	ND	ND	ND	ND	--	ND	ND	1.2 J	8.3 J	0.18 J	ND	ND	ND
	MW-474S	89.46	Sep-12	86	96	ND	ND	ND	ND	ND	--	ND	ND	0.82 J	1.7 J	0.042 J	ND	ND	ND
L2 RANGE	MW-67S	155.99	Oct-12	161	171	ND	ND	ND	ND	ND	0.043 J	ND	--	103	--	ND		ND	ND
L3 RANGE	MW-344S	114.33	May-13	115.5	125.5	ND	--	ND	ND		2.2	--	--	--	--	--	--	--	--
L4 RANGE	LRMW0003	24.39	Jun-05	95	105	ND	ND	ND	ND	ND	ND	ND	ND	1.1 J	ND	ND	ND	--	--
FORMER M1 RANGE	MW-56S	77.36	Sep-05	76	86	ND	ND	ND	ND	ND	ND	ND	--	ND	--	ND	--	--	--
	XXLRWS6-1	56.43	Jan-99	111.56	126.56	ND	ND	ND	ND	ND	--	ND	ND	ND	ND	ND	ND	--	--
FORMER M2 RANGE	MW-264M2	28.59	Dec-12	136	146	ND	ND	ND	ND	ND	ND	--	--	--	--	--	--	--	--
N RANGE	MW-116S	100.28	Aug-13	102	112	--	--	--	--	--	0.64 J	ND	--	5.8 J	--	ND	--	--	--
	MW-121S	93.26	Aug-02	87.95	97.95	ND	ND	ND	ND	ND	ND	ND	--	5.7 J	--	ND	--	--	--
	MW-154S	96.64	Sep-05	98	108	ND	ND	ND	ND	ND	ND	ND	--	2.6	--	ND	--	--	--
	MW-63S	156.88	Jul-05	153	163	ND	ND	ND	ND	ND	ND	ND	ND	3.4 J	ND	ND	ND	--	--
O RANGE	MW-492S	82.4	Jun-13	79.5	89.5	--	--	--	--	--	--	ND	ND	1.8 J	ND	0.43 J	ND	ND	--
P RANGE	DP-459	not recorde	DP drilled 20	107.5	112.5	ND	--	ND	ND	--	ND	--	--	--	--	--	--	--	--
	MW-215S	102.22	Feb-09	104	114	--	--	--	--	--	1.4 J	ND	--	ND	--	ND	--	--	--
SE/SW RANGE	MW-465S	141.02	Jun-13	136	146	ND	ND	ND	ND	ND	--	ND	ND	3.2 J	ND	ND	ND	0.49	1.3 J
	MW-466S	137.8	Jun-13	133	143	ND	ND	ND	ND	ND	--	ND	ND	0.32 J	ND	ND	ND	1.2	0.88 J
	MW-55S	139.33	Aug-03	133	143	ND	ND	ND	ND	ND	ND	ND	--	2.3 J	--	ND	--	--	--
T RANGE	MW-467S	128.26	Sep-12	125	135	ND	ND	ND	ND	ND	--	ND	ND	2.5 J	2.2 J	7.1 J	ND	0.7	0.59 J
	MW-489S	125.08	Oct-11	124	134	--	--	ND	--	--	--	ND	ND	3.6 J	0.88 J	ND	--	ND	ND

Note:
Maximum detected concentrations for all wells through Fall 2012; for the yellow highlighted wells the maximum is up through May 2013.

Sample ID	Sample Location		Collection Date and Time	Number	Notes
	latitude	longitude		of Bullets	
13	41.68364762	-70.54389736	10-APR-14 10:49:12AM	0	
14	41.68324395	-70.54343518	10-APR-14 10:59:52AM	2	2 to 3 inches deep
15	41.68337345	-70.54225677	10-APR-14 11:20:20AM	3	2 to 3 inches deep
16	41.68349415	-70.5410175	10-APR-14 11:35:39AM	2	2 to 6 inches deep
17	41.68429948	-70.54085716	10-APR-14 11:51:15AM	3	2 inches deep
18	41.68458916	-70.54193758	10-APR-14 11:58:20AM	3	2 to 5 inches deep
19	41.68505008	-70.54314173	10-APR-14 12:07:15PM	9	1 inch deep
20	41.68674247	-70.54202316	10-APR-14 12:27:44PM	2	3 inches deep - bullets co-located
21	41.68664642	-70.54178378	10-APR-14 12:37:12PM	1	3 inches deep - downed tree root ball
22	41.68638968	-70.5410538	10-APR-14 2:15:14PM	3	3 inches deep
23	41.6858819	-70.5402638	10-APR-14 2:25:51PM	3	3 inches deep - approx. 1 bullet per sq ft
24	41.68597352	-70.53954405	10-APR-14 2:38:36PM	4	
25	41.68698295	-70.53955553	10-APR-14 2:53:02PM	4	5 inches deep - approx. 4 bullets per sq ft
26	41.68758812	-70.54059732	10-APR-14 3:05:07PM	6	5 inches deep
27	41.6874893	-70.54066873	10-APR-14 3:21:25PM	2	5 inches deep
28	41.68781083	-70.54155654	10-APR-14 3:25:42PM	4	
29	41.68808685	-70.5423804	10-APR-14 3:35:16PM	3	
30	41.68838969	-70.54302782	10-APR-14 3:40:49PM	3	
31	41.68456527	-70.5383249	14-APR-14 12:55:22PM	14	1/2 to 3 inches deep. 14 more found 10 feet south
32	41.68481321	-70.53615868	14-APR-14 1:17:50PM	16	
33	41.68287054	-70.5328319	14-APR-14 1:38:39PM	0	
34	41.68321738	-70.53321512	14-APR-14 1:44:50PM	5	approx. 2 bullets per sq ft
35	41.68320238	-70.53273501	14-APR-14 1:54:26PM	2	found in an area of approx 20 sq ft
36	41.68555451	-70.53284691	14-APR-14 2:03:19PM	2	
37	41.68573991	-70.53311571	14-APR-14 2:08:38PM	3	
38	41.68611995	-70.53284573	14-APR-14 2:13:20PM	2	
39	41.68636235	-70.53271531	14-APR-14 2:18:42PM	0	
40	41.68731353	-70.53646605	14-APR-14 2:28:21PM	10	in downed tree root ball
41	41.68789004	-70.53606564	14-APR-14 2:33:04PM	3	
42	41.68816958	-70.53582994	14-APR-14 2:38:59PM	4	approx. 4 bullets per sq ft
43	41.68871951	-70.53615508	14-APR-14 2:49:26PM	4	found in an area of approx. 3 sq ft
44	41.68724086	-70.54349913	14-APR-14 3:07:04PM	2	
45	41.68704649	-70.54418268	14-APR-14 3:16:27PM	2	
46	41.68731957	-70.54538079	14-APR-14 3:22:28PM	1	in an area of approx. 100 sq ft
47	41.68357579	-70.54499757	14-APR-14 3:34:50PM	1	in an area of approx. 25 sq feet

Photo 1 – Whites Metal Detector – searching for signals

Photo 2 – Clearing surface vegetation and root mass

Photo 3 – Single .30 Cal bullet

Photo 4 – Single .30 Cal bullet (at point of pen)

Photo 5 – Two .30 Cal bullets

Photo 6 – Examples of bullets as found in the field

Photo 7 – Dimensions and conditions of bullets

APPENDIX F PROJECT NOTE
Addendum to Sampling, Soil Removal and Monitoring
at Small Arms Ranges
August 2014

Project Note Addendum to the May 2014 Project Note for "Sampling, Soil Removal, and Monitoring at Small Arms Ranges"

Impact Area Groundwater Study Program
Camp Edwards, MA

Date: August 14, 2014

1.0 PURPOSE

This Project Note Addendum defines soil sampling and excavations planned for several Small Arms Ranges (SARs) at Camp Edwards. These activities are supplemental to the May 2014 Project Note for Sampling, Soil Removal and Monitoring at Small Arms Ranges. The need for these activities was identified after the May 2014 Project Note was signed and approved. Specifically, the proposed work addresses new S-1/GW-1 cleanup standards for lead promulgated in the Massachusetts Contingency Plan (MCP) by the Massachusetts Department of Environmental Protection (MassDEP) in June 2014.

Figure 1-1 shows the locations of the SARs at Camp Edwards. Orange circles highlight the locations where actions are planned in the May 2014 Project Note and red circles identify those areas addressed in this addendum.

2.0 SCOPE OF WORK

This section describes the sampling activities at the SARs that are proposed in addition to or in modification of the May 2014 Project Note. All soil samples will be ground according to EPA Method 8330B. All excavated soil will be transported off-site to an appropriate landfill.

2.1 FORMER B RANGE

Post-excavation sampling of Excavation Area B-1 in 2009 detected 202 parts per million (ppm) of lead. Soil will be removed from the area identified as Excavation Area B-1 (Figure 2-1) in an attempt to reduce lead concentrations to below the new MCP S-1/GW-1 level of 200 ppm. Six inches of soil will be removed and transported off site. The area measures approximately 400 square feet so the expected quantity of soil to be removed is 7.5 cubic yards. A post-excavation 30-point multiple-increment sample and two replicates (three samples total) will be collected from the area and analyzed for lead. The need for any further excavation will be determined based on the analytical results.

2.2 FORMER C RANGE

A 140 by 70 foot sample grid will be laid out to cover the area where previous sampling detected elevated concentrations of lead at the range in 2001 and 2002, specifically locations 136AA, 136AB, 136AC, 136AD, 136J and 136M. This area along with 136D was found to have an average lead concentration of 223 ppm as documented in the SAR Investigation Report. A 100-point multiple-increment sample and two replicates (three samples total) will be collected from 0 to 3 inches from the sample area and analyzed for lead. The sample location is shown on Figure 2-2. The need for further investigation or excavation will be determined based on the analytical results.

2.3 FORMER D RANGE

Soil removal in 2009-10 at Former D Range reduced concentrations of lead to below 300 ppm in the areas excavated. However, at three post-excavation sample locations the remaining lead concentrations were above the new 200 ppm standard. These locations are identified as D-1Aa, D-1Ab, and D-1Ac on Figure 2-3. Six inches of soil will be removed from the current ground surface at these three locations and transported off site. The volume to be removed is approximately 200 cubic yards. A post-excavation 100-point multiple-increment sample will be taken from each sub area and analyzed for lead. Two replicates (three samples total) will be collected from one of the sub areas and analyzed for lead. The need for any further excavation will be determined based on the analytical results.

2.4 G RANGE

Under the recently revised MCP, the upper concentration limit for lead is now 6,000 ppm. This is above the maximum concentration of lead identified in samples collected from G Range and the planned excavation work described in the May 2014 Project Note may not be required. The IAGWSP will proceed with the sampling of the grid behind the berm described in the May 2014 Project Note. A final decision of actions at G Range will be based on the sample results and will be documented in a future project note addendum.

3.0 REPORTING

The results of the multiple-increment sampling and excavation work will be reviewed with the regulatory agencies along with the work previously proposed in the May 2014 Project Note to determine whether or not any additional sampling or excavation is required. Upon completion of this scope of work and any additional actions, a completion of work report will be prepared to document the work performed and the resulting site conditions. This report will include figures showing the extent of the various excavations. Tables summarizing post-excavation laboratory results will also be included.

4.0 SIGNATURES

The signatures below represent concurrence with the above project note addendum.

8 August 2014
EPA Representative

Henry Chui 8/14/2014
MassDEP Representative

14 AUG 2014
Impact Area Groundwater Study Program Representative

FIGURES


L-2 Range
L-3 Range
Former R Range
Q Range
T Range
L-4 Range
L Range (50-80s)
A Range
B Range
C Range
D Range
E Range
Former B Range
Sierra Range West
Sierra Range East
Former N Range (67-79)
L Range (1941-1950s)/L-1 Range
500 Yard Rifle Range
Former C Range
Former D Range
Succonsette Pond
Former K Range
P Range
O Range
N Range
KD Range West
E-1 Range Firing Point
E-1 Range
E-2 Range
G Range
H Range
K Range
J Range
I Range
KD Range East
Former M-4 Range
Former M-3 Range
Former M-2 Range (M Range)
Former M-1 Range (M Range)
Skeet Range 2
Skeet Range 1
GAGB Range
Location of Proposed Work - Addendum
Location of Proposed Work - May 2014 PN
Small Arms Range
Impact Area Boundary
JBCC Boundary
Cape Cod Bay
Buzzards Bay
Nantucket Sound
Figure 1-1
Location of Small Arms Ranges
0
4,000
Feet
N
P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig1-1_Location_of_SARs.mxd

Impact Area Groundwater Study Program

LEGEND

- Surface Sample
- Surface Sample > 300 mg/Kg Lead
- Gun and Mortar Location
- Excavation Area
- Vegetative Clearing Area
- Monitoring Well
- MIS Sample

AMEC Sample
Tetra Tech Sample
Tetra Tech Sample July 2008
[#] - mg/Kg Lead

Sample ID Suffix Key:

CS - Compost Site	RF - Range Floor
EX - Depression Area Location	TL - Target Line
HS - Hillside	BB - Berm
FL - Firing Line	SB - South of Berm

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83, UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

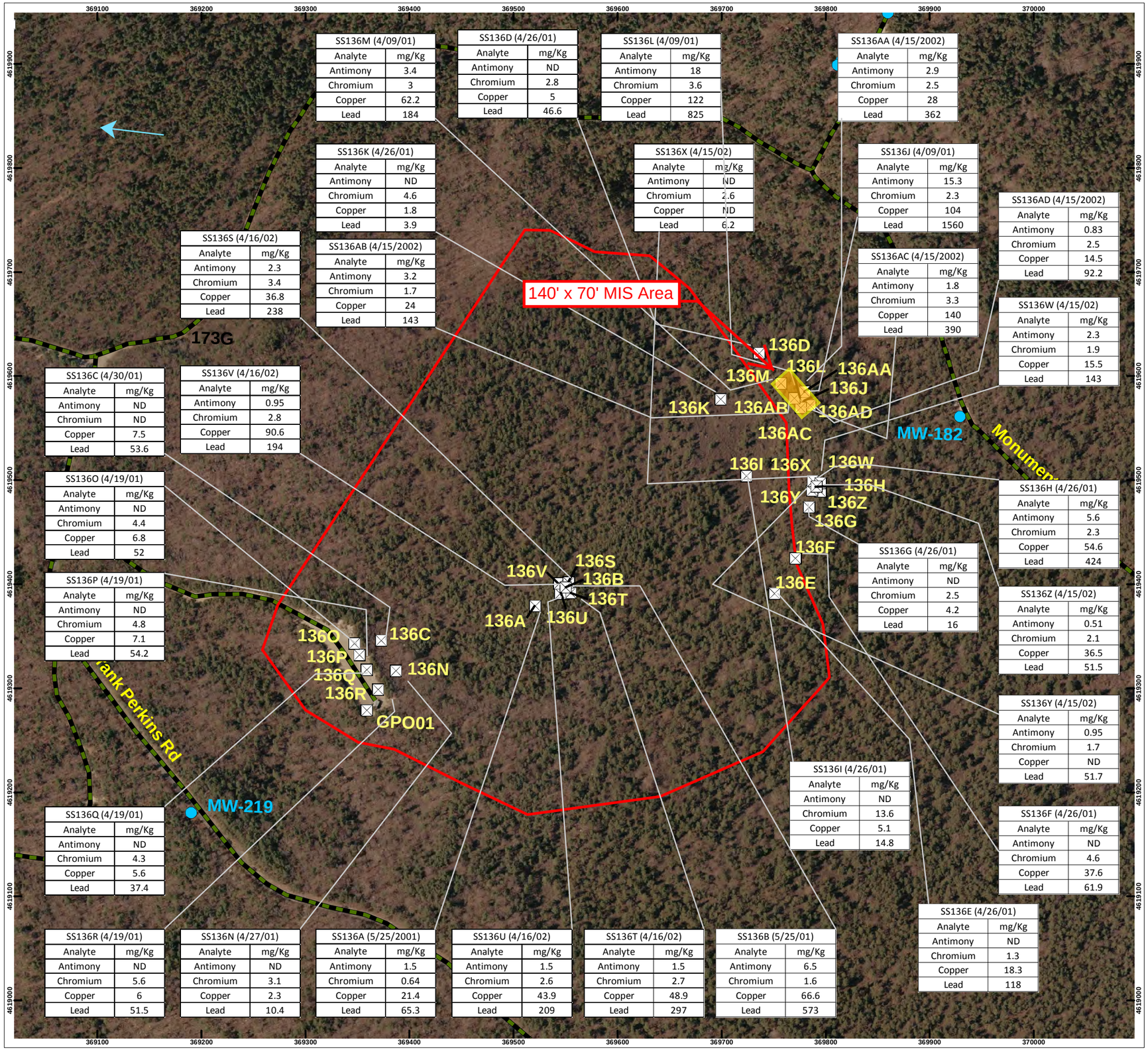
20 0 20 40 Feet

TITLE

Former B Range Sampling and Excavation Areas

FIGURE
2-1

P:\GIS\MMR\SmallArmsRange\GIS\SpatialMXD\20140321_SAR_ProjectNote\Fig2-2_FormerB_SamplingAreas.mxd



SS136M (4/09/01)	
Analyte	mg/Kg
Antimony	3.4
Chromium	3
Copper	62.2
Lead	184

SS136D (4/26/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	2.8
Copper	5
Lead	46.6

SS136L (4/09/01)	
Analyte	mg/Kg
Antimony	18
Chromium	3.6
Copper	122
Lead	825

SS136AA (4/15/2002)	
Analyte	mg/Kg
Antimony	2.9
Chromium	2.5
Copper	28
Lead	362

SS136K (4/26/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	4.6
Copper	1.8
Lead	3.9

SS136X (4/15/02)	
Analyte	mg/Kg
Antimony	ND
Chromium	2.6
Copper	ND
Lead	6.2

SS136J (4/09/01)	
Analyte	mg/Kg
Antimony	15.3
Chromium	2.3
Copper	104
Lead	1560

SS136AD (4/15/2002)	
Analyte	mg/Kg
Antimony	0.83
Chromium	2.5
Copper	14.5
Lead	92.2

SS136S (4/16/02)	
Analyte	mg/Kg
Antimony	2.3
Chromium	3.4
Copper	36.8
Lead	238

SS136AB (4/15/2002)	
Analyte	mg/Kg
Antimony	3.2
Chromium	1.7
Copper	24
Lead	143

SS136AC (4/15/2002)	
Analyte	mg/Kg
Antimony	1.8
Chromium	3.3
Copper	140
Lead	390

SS136W (4/15/02)	
Analyte	mg/Kg
Antimony	2.3
Chromium	1.9
Copper	15.5
Lead	143

SS136C (4/30/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	ND
Copper	7.5
Lead	53.6

SS136V (4/16/02)	
Analyte	mg/Kg
Antimony	0.95
Chromium	2.8
Copper	90.6
Lead	194

SS136H (4/26/01)	
Analyte	mg/Kg
Antimony	5.6
Chromium	2.3
Copper	54.6
Lead	424

SS136O (4/19/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	4.4
Copper	6.8
Lead	52

SS136G (4/26/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	2.5
Copper	4.2
Lead	16

SS136P (4/19/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	4.8
Copper	7.1
Lead	54.2

SS136Z (4/15/02)	
Analyte	mg/Kg
Antimony	0.51
Chromium	2.1
Copper	36.5
Lead	51.5

SS136Y (4/15/02)	
Analyte	mg/Kg
Antimony	0.95
Chromium	1.7
Copper	ND
Lead	51.7

SS136I (4/26/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	13.6
Copper	5.1
Lead	14.8

SS136F (4/26/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	4.6
Copper	37.6
Lead	61.9

SS136Q (4/19/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	4.3
Copper	5.6
Lead	37.4

SS136E (4/26/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	1.3
Copper	18.3
Lead	118

SS136R (4/19/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	5.6
Copper	6
Lead	51.5

SS136N (4/27/01)	
Analyte	mg/Kg
Antimony	ND
Chromium	3.1
Copper	2.3
Lead	10.4

SS136A (5/25/2001)	
Analyte	mg/Kg
Antimony	1.5
Chromium	0.64
Copper	21.4
Lead	65.3

SS136U (4/16/02)	
Analyte	mg/Kg
Antimony	1.5
Chromium	2.6
Copper	43.9
Lead	209

SS136T (4/16/02)	
Analyte	mg/Kg
Antimony	1.5
Chromium	2.7
Copper	48.9
Lead	297

SS136B (5/25/01)	
Analyte	mg/Kg
Antimony	6.5
Chromium	1.6
Copper	66.6
Lead	573

Impact Area Groundwater Study Program

LEGEND

- Area of Interest (Range)
- Existing Monitoring Well
- Historic Soil Sample Location
- MIS Sample Location
- Groundwater Flow Direction

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83,
UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

225 0 225 450 Feet

TITLE

Former C Range Sample Area

N

FIGURE **2-2**

Document Path: P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20130531_SAR_IR_Figures\Fig5-7A_FormerCRange.mxd

Impact Area Groundwater Study Program

LEGEND

- Surface Sample
- Surface Sample > 300 mg/Kg Lead
- Proposed Excavation Area
- Area of Excavation
- Laydown Area (Materials/Equipment/Soil Stockpiles)
- Vegetative Clearing Area
- MIS Sample Area

AMEC Sample
Tetra Tech Sample
Tetra Tech Sample July 2008
Tetra Tech Sample August 2009

[#] - mg/Kg Lead

Sample ID Suffix Key:
HS - Hillside
FL - Firing Line
RF - Range Floor
BB - Berm

Data presented for surface soil samples only

Only the highest concentration is reported for any analyte at locations where multiple samples were collected

NOTES & SOURCES

Map Coordinates: NAD83, UTM Zone 19N, Meters
Historical Photo: 1:2400 digital color aerial photograph
Source: EarthData International of Maryland
0.3 meter Resolution
Flown: October 2002

20 0 20 40 Feet

TITLE

Former D Range Sampling and Excavation Areas

N

FIGURE
2-3

P:\GIS\MMR\SmallArmsRange\GIS\SpatialMXD\20140321_SAR_ProjectNote\Fig2-4_FormerD_SamplingAreas.mxd

APPENDIX G PROJECT NOTE
Second Addendum to the May 2014 Sampling, Soil Removal and Monitoring at Small Arms Ranges Project Note
December 2014

Project Note - Second Addendum to the May 2014 Project Note for "Sampling, Soil Removal, and Monitoring at Small Arms Ranges"

Impact Area Groundwater Study Program
Camp Edwards, MA

Date: December 18, 2014

1.0 PURPOSE

This Project Note Second Addendum defines excavation and an additional round of soil sampling planned for several Small Arms Ranges (SARs) at Camp Edwards. These activities are in addition to the scope of work described in the May 2014 Project Note for Sampling, Soil Removal and Monitoring at Small Arms Ranges and the August 2014 Addendum to the May 2014 Project Note. The need for these activities was identified after results of the sampling described in the first addendum were received.

Figure 1 shows the locations of the SARs at Camp Edwards. Orange circles highlight the locations where actions are planned per the May 2014 Project Note, the First Addendum, and/or this Second Addendum. Results of the laboratory analysis of the samples collected for the May 2014 and August 2014 Project Notes are included in Table 1. The relative standard deviation calculations for replicate samples are provided in Table 2.

2.0 SOIL SAMPLING

This section describes the sampling activities that are proposed. All samples will be collected according the CRREL multiple-increment sample (MIS) method and all soil samples will be ground according to EPA Method 8330B. All samples described in this project note will extend from the ground surface to a depth of 3 inches, except where otherwise indicated. The intent is to conduct the sampling and receive results in order to determine if excavation of these areas is needed to meet applicable goals. The work is intended to be timed such that any additional excavations can be completed in one mobilization along with the excavation areas already identified in previous project notes. The work to be conducted is described in the following paragraphs.

2.1 B RANGE

The July 2014 sampling at B Range found that lead and tungsten concentrations in some areas behind the berm (to the east) exceed actionable concentrations. As a result, a sample will be collected for lead and tungsten analyses in the area further downrange from the last downrange sample (BR02DR) (see Figure 2). The sample will be a 100-point MIS measuring approximately 200 feet by 50 feet.

2.2 FORMER B RANGE

Sample FBR140L was collected from the berm area on the west side of the range in July 2014 and analyzed for lead and antimony. The lead concentration in this sample was found to exceed actionable concentrations. As a result, additional samples will be collected along the berm further south and north of sample FBR140L and behind the berm in order to define the extent of lead contaminated soil. The sample to the south will be a 100-point MIS measuring approximately 40 feet by 80 feet. The sample to the north of FBR140L will be a 50-point MIS measuring approximately 40 feet by 40 feet. An additional sample area will be established

behind the backstop berm. This sample will be a 100-point MIS measuring approximately 50 feet by 200 feet. Two replicates (three samples total) will be collected from this grid. The approximate sample locations are shown on Figure 3. These dimensions may be field adjusted to account for the actual dimensions and layout of the berm. All samples will be analyzed for lead.

Sample FBR140QR was collected from the berm area on the east side of the range in July 2014 and analyzed for lead and antimony. The lead concentration in this sample was found to exceed actionable concentrations. Additional samples will be collected along the berm further east of sample FBR140QR in order to define the extent of lead contaminated soil. The sample will be a 50-point MIS measuring approximately 20 feet by 50 feet. The approximate sample location is shown on Figure 3. The sample will be analyzed for lead.

2.3 FORMER C RANGE

Sample MISFCR136-A, collected in September 2014, was found to have a lead concentration greater than actionable concentrations. Therefore, further sampling surrounding this sample location will be conducted to determine the extent of the lead contamination. Six additional 100-point MIS approximately 140 feet by 70 feet in size will be collected around grid FCR136-A as shown on Figure 4. In addition, a deeper 30-point MIS and two replicates (three samples total) will be collected from 1.5 to 2 feet deep at sample location FCR136-A. All samples will be analyzed for lead.

2.4 G RANGE

Sampling of area GR01DR, downrange of the berm (northeast), in July 2014 identified elevated concentrations of lead exceeding actionable concentrations. Therefore, additional sampling further downrange is proposed to determine the extent of the lead contamination. A 100-point MIS will be collected from an area measuring approximately 160 feet by 50 feet directly downrange from area GR01DR as shown on Figure 5. This sample will be analyzed for lead.

2.5 N RANGE

Sampling at areas NR01DR and NR02DR, downrange of the berm (northwest), in August 2014 identified elevated concentrations of lead. Therefore, additional sampling further downrange is proposed to determine the extent of the lead contamination. Two 100-point MIS will be collected from the areas behind NR01DR and NR02DR, each measuring approximately 175 feet by 50 feet, as shown on Figure 6. These samples will be analyzed for lead.

2.6 FORMER D RANGE

Sampling at areas FDR135U and FDR135GT, located in downrange locations, identified elevated concentrations of lead in August 2014 as shown in Figure 7. These areas have been targeted for soil excavation as described in the next section. Given the elevated concentrations of lead found in the August sampling, three additional MIS areas will be sampled to confirm the extent of contamination. Two areas measure approximately 100 feet by 90 feet and 100 feet by 80 feet. A 100-point MIS will be collected from each of these areas. The third area is smaller, measuring approximately 40 feet by 80 feet. A 50-point MIS will be collected from this area. Two replicates (three samples total) will be collected from one of the three new MIS grids. All samples will be analyzed for lead.

3.0 EXCAVATIONS

Soil excavation is required in several locations to reduce detected metals concentrations to acceptable levels. This section describes the scope of excavation needed as a result of the sampling conducted in summer 2014. Note that other soil excavation was previously scoped in the May and August 2014 project notes.

All soil will be excavated to a depth of approximately 6 inches unless otherwise specified. All soil will be disposed off site in an appropriate landfill. Any additional characterization of the soil required by the receiving facility will be completed in conjunction with the excavation work.

3.1 B RANGE

Area BR02DR (Figure 2) was sampled previously and found to contain elevated metals concentrations. This area will be excavated to a depth of 6 inches and the soil will be properly disposed off-site. A post-excavation soil sample will be collected and analyzed for lead and tungsten.

(Excavation of areas B6 and BR02A was scoped in the May 2014 Project Note.)

3.2 FORMER B RANGE

Area FBR140L will be excavated to a depth of 2 feet and area FBR140QR will be excavated to a depth of 6 inches, and the soil will be properly disposed off-site. Post-excavation soil samples will be collected from each area and analyzed for lead. These areas are shown on Figure 3.

(Excavation of area B-1 was scoped in the August 2014 Project Note.)

3.3 FORMER D RANGE

Areas FDR135U and FDR135GT (Figure 7) will be excavated to a depth of 6 inches and the soil will be properly disposed off-site. Post-excavation soil samples will be collected from each area and analyzed for lead.

(Excavation of areas D1Aa, D1Ab, and D1Ac was scoped in the August 2014 Project Note.)

3.4 G RANGE

Area GR01DR (Figure 5) will be excavated to a depth of 6 inches and the soil will be properly disposed off-site. Post-excavation soil samples will be collected and analyzed for lead and tungsten.

(Excavation of area GR01A was scoped in the May 2014 Project Note.)

3.5 FORMER M2 RANGE

Areas FM2R02DR-A and FM2R03DR-A (Figure 8) will be excavated to a depth of 6 inches and the soil will be properly disposed off-site. Post-excavation soil samples will be collected from each area and analyzed for lead.

(Excavation of areas FMRM202A, FMRM203A, FMRM204A and FMRM205A was scoped in the May 2014 Project Note.)

3.6 N RANGE

Areas NR01ADR and NR02ADR (Figure 6) will be excavated to a depth of 3 to 6 inches and the soil will be properly disposed off-site. Post-excavation soil samples will be collected from each area and analyzed for lead.

(Excavation of areas NR01A and NR02A was scoped in the May 2014 Project Note.)

4.0 REPORTING

The results of the multiple-increment sampling and excavation work will be reviewed with the regulatory agencies along with the results of the previous SAR sampling to determine whether or not any additional sampling or excavation is required. Upon completion of this scope of work and any additional actions, a completion of work report will be prepared to document the work performed and the resulting site conditions. This report will include figures showing the extent of the various excavations. Tables summarizing post-excavation laboratory results will also be included.

5.0 SIGNATURES

The signatures below represent concurrence with the above sampling project note.

18 Dec 2014
EPA Representative

Henry Cui 12/18/2014
MassDEP Representative

18 DEC 2014
Impact Area Groundwater Study Program

FIGURES


L-2 Range
L-3 Range
Former R Range
Q Range
T Range
L-4 Range
L Range (50-80s)
A Range
B Range
C Range
D Range
E Range
Sierra Range West
Sierra Range East
Former N Range (67-79)
L Range (1941-1950s)/L-1 Range
Former B Range
Former C Range
500 Yard Rifle Range
Former D Range
Former K Range
Succonsette Pond
P Range
O Range
N Range
KD Range West
E-1 Range Firing Point
E-1 Range
E-2 Range
KD Range East
Former M-4 Range
G Range
K Range
J Range
H Range
I Range
Former M-3 Range
Former M-2 Range (M Range)
Former M-1 Range (M Range)
Skeet Range 2
Skeet Range 1
GAGB Range
Location of Proposed Work - Post Decision Document
Small Arms Range
Impact Area Boundary
JBCC Boundary
Cape Cod Bay
Buzzards Bay
Nantucket Sound
Figure 1
Location of Small Arms Ranges
0
4,000
Feet
N
P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig1-1_Location_of_SARs.mxd

BR01A (4/15/2013)	
Analyte	mg/Kg
Antimony	5.0
Chromium	ND
Copper	35
Lead	593
Tungsten	23.4

BR02A (4/15/2013)	
Analyte	mg/Kg
Antimony	8.2
Chromium	ND
Copper	2970
Lead	826
Tungsten	133

BR02DR (7/29/2014)	
Analyte	mg/Kg
Antimony	2.6J
Antimony	1.5J
Antimony	4.1J
Lead	348J
Lead	197J
Lead	475J
Tungsten	159
Tungsten	106
Tungsten	148

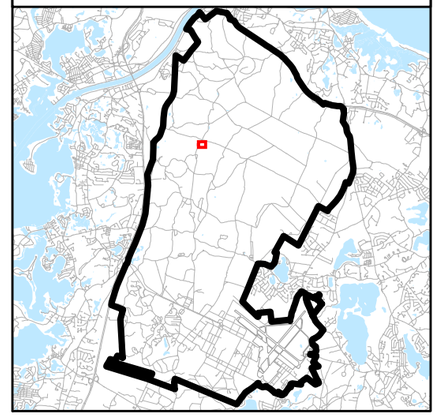
BR03A (4/15/2013)	
Analyte	mg/Kg
Antimony	3.0
Chromium	ND
Copper	36
Lead	464
Tungsten	9.9

Impact Area Groundwater Study Program

LEGEND

- B Range
- Excavation Area
- Proposed Sampling Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
B Range

0 70 Feet

N

US Army Corps of Engineers
New England District

M:\MMR\2014\SmallArmsRanges\Soils\PNaddendum\Figures\Fig2_B_120114.pdf
M:\MMR\2014\SmallArmsRanges\Soils\PNaddendumMXDs\Fig2_B_112414.mxd
December 1, 2014 DWN: MTW CHKD: DRS

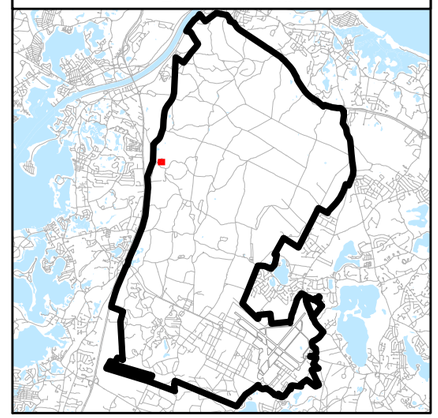
FIGURE
2

Impact Area Groundwater Study Program

LEGEND

- Former B Range
- Excavation Area
- Proposed Sampling Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
Former B Range

0 40 Feet

US Army Corps of Engineers
New England District

M:\MMR\2014\SmallArmsRanges\Soils\PNaddendum\Figures\Fig3_FmrB_121014.pdf
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December 10, 2014 DWN: MTW CHKD: DRS

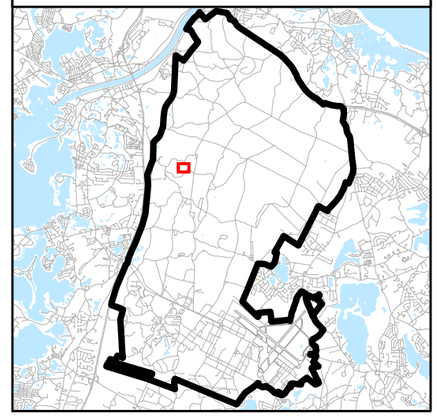
FIGURE 3

Impact Area Groundwater Study Program

LEGEND

- Former C Range
- Proposed Sampling Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Sampled
Former C Range

0 100 Feet

US Army Corps of Engineers
New England District

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December 1, 2014 DWN: MTW CHKD: DRS

FIGURE 4

GR01A (4/15/2013)	
Analyte	mg/Kg
Antimony	25.4
Copper	207
Lead	3850
Tungsten	33.0

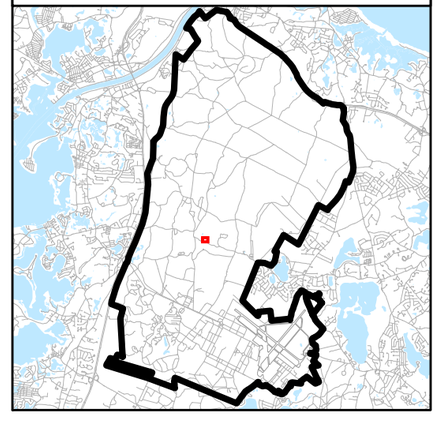
GR01DR (7/28/2014)	
Analyte	mg/Kg
Antimony	23.4J
Antimony	11.3J
Antimony	10.7J
Lead	2340J
Lead	1810J
Lead	1540J
Tungsten	15
Tungsten	11.3
Tungsten	4.9

Impact Area Groundwater Study Program

LEGEND

- G Range
- Excavation Area
- Proposed Sampling Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
G Range

0 50 Feet

N

US Army Corps of Engineers
New England District

M:\MMR\2014\SmallArmsRanges\Soils\IPNaddendum\Figures\Fig5_G_120114.pdf
M:\MMR\2014\SmallArmsRanges\Soils\IPNaddendumMXDs\Fig5_G_112414.mxd
December 1, 2014 DWN: MTW CHKD: DRS

FIGURE 5

NR02DR (8/21/2014)	
Antimony	1.5
Lead	380
Tungsten	ND

NR02A (4/17/2013)	
Analyte	mg/Kg
Antimony	1.8
Copper	43.2
Lead	337

NR01A (4/17/2013)	
Analyte	mg/Kg
Antimony	4.3
Copper	81.7
Lead	724

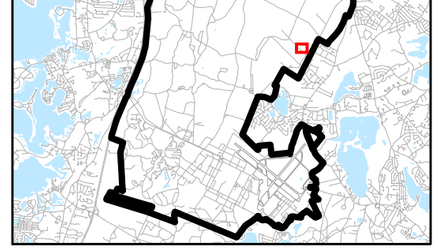
NR01DR (8/21/2014)	
Analyte	mg/Kg
Antimony	2.1
Antimony	1.9
Antimony	1.5
Lead	595
Lead	521
Lead	382
Tungsten	ND
Tungsten	ND
Tungsten	ND

Impact Area Groundwater Study Program

LEGEND

- N Range
- Excavation Area
- Proposed Sampling Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
N Range

0 100 Feet

N

US Army Corps of Engineers
New England District

M:\MMR\2014\SmallArmsRanges\Soils\PNaddendum\Figures\Fig6_N_120114.pdf
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December 1, 2014 DWN: MTW CHKD: DRS

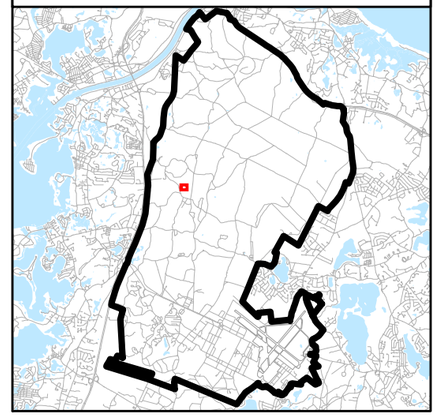
FIGURE 6

Impact Area Groundwater Study Program

LEGEND

- Former D Range
- Excavation Area
- Proposed Sampling Areas

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
Former D Range

0 60 Feet

N

US Army Corps of Engineers
New England District

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December 18, 2014 DWN: MTW CHKD: DRS

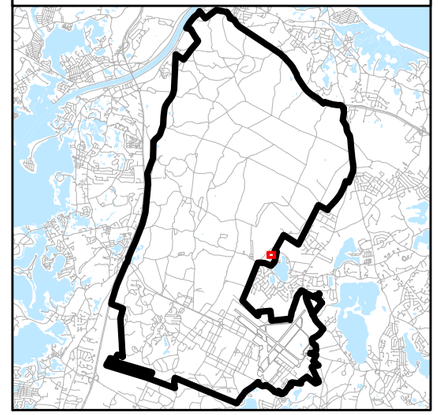
FIGURE 7

Impact Area Groundwater Study Program

LEGEND

- Former M2 Range
- Excavation Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated
Former M2 Range

0 60 Feet

N

US Army Corps of Engineers
New England District

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December 1, 2014 DWN: MTW CHKD: DRS

FIGURE 8

TABLES

Table 1 - Post DD Small Arms Ranges Soil Results

Location	Northing (N83 utm)	Easting (N83 utm)	Ground Elevation (ft msl)	Sample ID	Sample Type	Analyte	Short Name	Test Method	Reported Result	Qualifier	Units	MDL	RL	Begin Depth	End Depth	Matrix	Log Date	Site/ SLX List
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A	N1	Tungsten	W	SW6020A	159		MG/KG	0.062	0.50	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A	N1	Antimony	SB	SW6010C	2.6	J	MG/KG	0.19	0.99	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A	N1	Lead	PB	SW6010C	348	J	MG/KG	0.15	0.49	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R1	FR1	Antimony	SB	SW6010C	1.5	J	MG/KG	0.19	0.99	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R1	FR1	Lead	PB	SW6010C	197	J	MG/KG	0.15	0.49	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R1	FR1	Tungsten	W	SW6020A	106		MG/KG	0.12	0.99	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R2	FR2	Tungsten	W	SW6020A	148		MG/KG	0.062	0.49	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R2	FR2	Antimony	SB	SW6010C	4.1	J	MG/KG	0.19	1.0	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R2	FR2	Lead	PB	SW6010C	475	J	MG/KG	0.15	0.50	0	0.25	SO	07/29/2014	B Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A	N1	Lead	PB	SW6010C	184		MG/KG	0.15	0.50	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A	N1	Tungsten	W	SW6020A	5.8	J	MG/KG	0.012	0.099	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A_R1	FR1	Tungsten	W	SW6020A	34.8	J	MG/KG	0.013	0.10	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A_R1	FR1	Lead	PB	SW6010C	504		MG/KG	0.15	0.50	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A_R2	FR2	Lead	PB	SW6010C	191		MG/KG	0.15	0.49	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A_R2	FR2	Tungsten	W	SW6020A	4.9	J	MG/KG	0.012	0.098	0	0.25	SO	08/19/2014	C Range
CR04N	4620184	370408.9	206.9	MISCR04N-A	N1	Lead	PB	SW6010C	138		MG/KG	0.15	0.50	0	0.25	SO	08/19/2014	C Range
CR04N	4620184	370408.9	206.9	MISCR04N-A	N1	Tungsten	W	SW6020A	18.7	J	MG/KG	0.012	0.10	0	0.25	SO	08/19/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A	N1	Tungsten	W	SW6020A	20.9	J	MG/KG	0.12	1.0	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A	N1	Lead	PB	SW6010C	243		MG/KG	0.15	0.50	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A_R1	FR1	Tungsten	W	SW6020A	120	J	MG/KG	0.12	1.0	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A_R1	FR1	Lead	PB	SW6010C	268		MG/KG	0.15	0.50	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A_R2	FR2	Tungsten	W	SW6020A	37.1	J	MG/KG	0.12	0.99	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A_R2	FR2	Lead	PB	SW6010C	473		MG/KG	0.15	0.49	0	0.25	SO	08/20/2014	C Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A	N1	Lead	PB	SW6010C	224		MG/KG	0.15	0.49	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A	N1	Antimony	SB	SW6010C	4.8	J	MG/KG	0.19	0.99	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A_R1	FR1	Antimony	SB	SW6010C	2.3	J	MG/KG	0.19	1.0	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A_R1	FR1	Lead	PB	SW6010C	228		MG/KG	0.15	0.50	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A_R2	FR2	Lead	PB	SW6010C	180		MG/KG	0.15	0.50	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A_R2	FR2	Antimony	SB	SW6010C	2.7	J	MG/KG	0.19	1.0	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-B	N1	Lead	PB	SW6010C	623		MG/KG	0.15	0.50	1.75	2	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-B	N1	Antimony	SB	SW6010C	9.9	J	MG/KG	0.19	1.0	1.75	2	SO	07/31/2014	Former B Range
FBR140QR	4619917	368948	118.9	MISFBR140QR-A	N1	Antimony	SB	SW6010C	6.4		MG/KG	0.19	1.0	0	0.25	SO	08/01/2014	Former B Range
FBR140QR	4619917	368948	118.9	MISFBR140QR-A	N1	Lead	PB	SW6010C	664		MG/KG	0.15	0.50	0	0.25	SO	08/01/2014	Former B Range
FCR136	4619584.4	369769.3	231	MISFCR136-A	N1	Lead	PB	SW6010C	950		MG/KG	0.10	0.50	0	0.25	SO	09/19/2014	Former C Range
FCR136	4619584.4	369769.3	231	MISFCR136-A_R1	FR1	Lead	PB	SW6010C	728		MG/KG	0.10	0.49	0	0.25	SO	09/19/2014	Former C Range
FCR136	4619584.4	369769.3	231	MISFCR136-A_R2	FR2	Lead	PB	SW6010C	759		MG/KG	0.10	0.50	0	0.25	SO	09/19/2014	Former C Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A	N1	Lead	PB	SW6010C	1200		MG/KG	0.15	0.49	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A	N1	Antimony	SB	SW6010C	9.3		MG/KG	0.19	0.98	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A_R1	FR1	Antimony	SB	SW6010C	11.7		MG/KG	0.19	1.0	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A_R1	FR1	Lead	PB	SW6010C	1370		MG/KG	0.15	0.50	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A_R2	FR2	Lead	PB	SW6010C	1120		MG/KG	0.15	0.50	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A_R2	FR2	Antimony	SB	SW6010C	9.7		MG/KG	0.19	0.99	0	0.25	SO	08/01/2014	Former D Range
FDR135U	4618879.6	369773.5	243.6	MISFDR135U-A	N1	Lead	PB	SW6010C	558		MG/KG	0.15	0.50	0	0.25	SO	08/01/2014	Former D Range
FDR135U	4618879.6	369773.5	243.6	MISFDR135U-A	N1	Antimony	SB	SW6010C	7.8		MG/KG	0.19	1.0	0	0.25	SO	08/01/2014	Former D Range
FM2R02DR	4616225.5	372993	118.9	MISFM2R02DR-A	N1	Antimony	SB	SW6010C	0.87	J	MG/KG	0.19	0.99	0	0.25	SO	08/07/2014	M-2
FM2R02DR	4616225.5	372993	118.9	MISFM2R02DR-A	N1	Lead	PB	SW6010C	279		MG/KG	0.15	0.50	0	0.25	SO	08/07/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A	N1	Lead	PB	SW6010C	340		MG/KG	0.15	0.50	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A	N1	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A_R1	FR1	Antimony	SB	SW6010C	0.74	J	MG/KG	0.19	1.0	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A_R1	FR1	Lead	PB	SW6010C	216		MG/KG	0.15	0.50	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A_R2	FR2	Antimony	SB	SW6010C	0.56	J	MG/KG	0.19	1.0	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A_R2	FR2	Lead	PB	SW6010C	151		MG/KG	0.15	0.50	0	0.25	SO	08/06/2014	M-2
FM2R04DR	4616253	373008.9	140.7	MISFM2R04DR-A	N1	Lead	PB	SW6010C	54.1		MG/KG	0.15	0.50	0	0.25	SO	08/06/2014	M-2
FM2R04DR	4616253	373008.9	140.7	MISFM2R04DR-A	N1	ND for 2 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/06/2014	M-2
FM2R05DR	4616265.5	373016	148.2	MISFM2R05DR-A	N1	Lead	PB	SW6010C	34.0		MG/KG	0.15	0.49	0	0.25	SO	08/06/2014	M-2
FM2R05DR	4616265.5	373016	148.2	MISFM2R05DR-A	N1	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/06/2014	M-2
FNR01FL	4620793.1	374066.5	190.9	MISFNR01FL-A	N1	Antimony	SB	SW6010C	0.24	J	MG/KG	0.19	1.0	0	0.25	SO	07/29/2014	Former N Range
FNR01FL	4620793.1	374066.5	190.9	MISFNR01FL-A	N1	Lead	PB	SW6010C	9.9	J	MG/KG	0.15	0.50	0	0.25	SO	07/29/2014	Former N Range
FNR02FL	4620670.3	374002.5	204.7	MISFNR02FL-A	N1	Lead	PB	SW6010C	10.5		MG/KG	0.15	0.50	0	0.25	SO	07/30/2014	Former N Range
FNR02FL	4620670.3	374002.5	204.7	MISFNR02FL-A	N1	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A	N1	Lead	PB	SW6010C	24.9		MG/KG	0.15	0.50	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A	N1	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A_R1	FR1	Lead	PB	SW6010C	25.0		MG/KG	0.15	0.49	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A_R1	FR1	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A_R2	FR2	Lead	PB	SW6010C	23.8		MG/KG	0.15	0.50	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A_R2	FR2	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	07/30/2014	Former N Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A	N1	Tungsten	W	SW6020A	15.0		MG/KG	0.012	0.098	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A	N1	Antimony	SB	SW6010C	23.4	J	MG/KG	0.19	0.99	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A	N1	Lead	PB	SW6010C	2340	J	MG/KG	0.15	0.50	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R1	FR1	Tungsten	W	SW6020A	11.3		MG/KG	0.012	0.098	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R1	FR1	Antimony	SB	SW6010C	11.3	J	MG/KG	0.19	0.99	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R1	FR1	Lead	PB	SW6010C	1810	J	MG/KG	0.15	0.50	0	0.25	SO	07/28/2014	G Range

Table 1 - Post DD Small Arms Ranges Soil Results

Location	Northing (N83 utm)	Easting (N83 utm)	Ground Elevation (ft msl)	Sample ID	Sample Type	Analyte	Short Name	Test Method	Reported Result	Qualifier	Units	MDL	RL	Begin Depth	End Depth	Matrix	Log Date	Site/ SLX List
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R2	FR2	Antimony	SB	SW6010C	10.7	J	MG/KG	0.19	1.0	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R2	FR2	Lead	PB	SW6010C	1540	J	MG/KG	0.15	0.50	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R2	FR2	Tungsten	W	SW6020A	4.9		MG/KG	0.013	0.10	0	0.25	SO	07/28/2014	G Range
KDR44	4616151	372356	155.3	MISKDR44-A	N1	Chromium, Hexavalent	CR6	SW7196A	0.17	J	MG/KG	0.10	0.40	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A	N1	Chromium	CR	SW6010C	52.2		MG/KG	0.12	0.50	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A_R1	FR1	Chromium	CR	SW6010C	54.0		MG/KG	0.12	0.50	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A_R1	FR1	Chromium, Hexavalent	CR6	SW7196A	2.5		MG/KG	0.10	0.40	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A_R2	FR2	Chromium	CR	SW6010C	53.7		MG/KG	0.12	0.50	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A_R2	FR2	Chromium, Hexavalent	CR6	SW7196A	4.2		MG/KG	0.10	0.40	0	0.25	SO	07/28/2014	KD SAR
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A	N1	Antimony	SB	SW6010C	2.1		MG/KG	0.19	0.99	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A	N1	Lead	PB	SW6010C	595		MG/KG	0.15	0.49	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A	N1	ND for 1 Analytes	Tungsten	SW6020A	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R1	FR1	Antimony	SB	SW6010C	1.9		MG/KG	0.19	1.0	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R1	FR1	Lead	PB	SW6010C	521		MG/KG	0.15	0.50	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R1	FR1	ND for 1 Analytes	Tungsten	SW6020A	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R2	FR2	Antimony	SB	SW6010C	1.5		MG/KG	0.19	0.99	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R2	FR2	Lead	PB	SW6010C	382		MG/KG	0.15	0.50	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R2	FR2	ND for 1 Analytes	Tungsten	SW6020A	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/21/2014	N Range
NR02DR	4617886.6	374261.5	171	MISNR02DR-A	N1	Antimony	SB	SW6010C	1.5		MG/KG	0.19	0.98	0	0.25	SO	08/21/2014	N Range
NR02DR	4617886.6	374261.5	171	MISNR02DR-A	N1	Lead	PB	SW6010C	380		MG/KG	0.15	0.49	0	0.25	SO	08/21/2014	N Range
NR02DR	4617886.6	374261.5	171	MISNR02DR-A	N1	ND for 1 Analytes	Tungsten	SW6020A	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/21/2014	N Range

Table 2 - Relative Standard Deviation of Replicate Samples

Location	Northing (N83 utm)	Easting (N83 utm)	Ground Elevation	Sample ID	Sample Type	Analyte	Short Name	Test Method	Reported Result	Qualifier	Units	MDL	RL	Begin Depth	End Depth	Matrix	Log Date	Site/ SLX List
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A	N1	Antimony	SB	SW6010C	2.6	J	MG/KG	0.19	0.99	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R1	FR1	Antimony	SB	SW6010C	1.5	J	MG/KG	0.19	0.99	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R2	FR2	Antimony	SB	SW6010C	4.1	J	MG/KG	0.19	1.0	0	0.25	SO	07/29/2014	B Range
								AVG	2.73									
								SD	1.07									
								RSD	**39 %**									
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A	N1	Lead	PB	SW6010C	348	J	MG/KG	0.15	0.49	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R1	FR1	Lead	PB	SW6010C	197	J	MG/KG	0.15	0.49	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R2	FR2	Lead	PB	SW6010C	475	J	MG/KG	0.15	0.50	0	0.25	SO	07/29/2014	B Range
								AVG	340.00									
								SD	113.63									
								RSD	**33 %**									
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A	N1	Tungsten	W	SW6020A	159		MG/KG	0.062	0.50	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R1	FR1	Tungsten	W	SW6020A	106		MG/KG	0.12	0.99	0	0.25	SO	07/29/2014	B Range
BR02DR	4620425.8	370494.4	166.9	MISBR02DR-A_R2	FR2	Tungsten	W	SW6020A	148		MG/KG	0.062	0.49	0	0.25	SO	07/29/2014	B Range
								AVG	137.67									
								SD	22.84									
								RSD	**17 %**									
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A	N1	Lead	PB	SW6010C	184		MG/KG	0.15	0.50	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A_R1	FR1	Lead	PB	SW6010C	504		MG/KG	0.15	0.50	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A_R2	FR2	Lead	PB	SW6010C	191		MG/KG	0.15	0.49	0	0.25	SO	08/19/2014	C Range
								AVG	293.00									
								SD	149.23									
								RSD	**51 %**									
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A	N1	Tungsten	W	SW6020A	5.8	J	MG/KG	0.012	0.099	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A_R1	FR1	Tungsten	W	SW6020A	34.8	J	MG/KG	0.013	0.10	0	0.25	SO	08/19/2014	C Range
CR02DR	4620148.3	370398.6	214.9	MISCR02DR-A_R2	FR2	Tungsten	W	SW6020A	4.9	J	MG/KG	0.012	0.098	0	0.25	SO	08/19/2014	C Range
								AVG	15.17									
								SD	13.89									
								RSD	**92 %**									
CR04S	4620170	370405	210.9	MISCR04S-A	N1	Lead	PB	SW6010C	243		MG/KG	0.15	0.50	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A_R1	FR1	Lead	PB	SW6010C	268		MG/KG	0.15	0.50	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A_R2	FR2	Lead	PB	SW6010C	473		MG/KG	0.15	0.49	0	0.25	SO	08/20/2014	C Range
								AVG	328.00									
								SD	103.04									
								RSD	**31 %**									
CR04S	4620170	370405	210.9	MISCR04S-A	N1	Tungsten	W	SW6020A	20.9	J	MG/KG	0.12	1.0	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A_R1	FR1	Tungsten	W	SW6020A	120	J	MG/KG	0.12	1.0	0	0.25	SO	08/20/2014	C Range
CR04S	4620170	370405	210.9	MISCR04S-A_R2	FR2	Tungsten	W	SW6020A	37.1	J	MG/KG	0.12	0.99	0	0.25	SO	08/20/2014	C Range
								AVG	59.33									
								SD	43.40									
								RSD	**73 %**									
FBR140L	4619845.4	368905	112.9	MISFBR140L-A	N1	Antimony	SB	SW6010C	4.8	J	MG/KG	0.19	0.99	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A_R1	FR1	Antimony	SB	SW6010C	2.3	J	MG/KG	0.19	1.0	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A_R2	FR2	Antimony	SB	SW6010C	2.7	J	MG/KG	0.19	1.0	0	0.25	SO	07/31/2014	Former B Range
								AVG	3.27									
								SD	1.10									
								RSD	**34 %**									
FBR140L	4619845.4	368905	112.9	MISFBR140L-A	N1	Lead	PB	SW6010C	224		MG/KG	0.15	0.49	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A_R1	FR1	Lead	PB	SW6010C	228		MG/KG	0.15	0.50	0	0.25	SO	07/31/2014	Former B Range
FBR140L	4619845.4	368905	112.9	MISFBR140L-A_R2	FR2	Lead	PB	SW6010C	180		MG/KG	0.15	0.50	0	0.25	SO	07/31/2014	Former B Range
								AVG	210.67									
								SD	21.75									
								RSD	**10 %**									
FCR136	4619584.4	369769.3	231	MISFCR136-A	N1	Lead	PB	SW6010C	950		MG/KG	0.10	0.50	0	0.25	SO	09/19/2014	Former C Range
FCR136	4619584.4	369769.3	231	MISFCR136-A_R1	FR1	Lead	PB	SW6010C	728		MG/KG	0.10	0.49	0	0.25	SO	09/19/2014	Former C Range
FCR136	4619584.4	369769.3	231	MISFCR136-A_R2	FR2	Lead	PB	SW6010C	759		MG/KG	0.10	0.50	0	0.25	SO	09/19/2014	Former C Range
								AVG	812.33									
								SD	98.16									
								RSD	**12 %**									
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A	N1	Antimony	SB	SW6010C	9.3		MG/KG	0.19	0.98	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A_R1	FR1	Antimony	SB	SW6010C	11.7		MG/KG	0.19	1.0	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A_R2	FR2	Antimony	SB	SW6010C	9.7		MG/KG	0.19	0.99	0	0.25	SO	08/01/2014	Former D Range
								AVG	10.23									
								SD	1.05									
								RSD	**10 %**									
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A	N1	Lead	PB	SW6010C	1200		MG/KG	0.15	0.49	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A_R1	FR1	Lead	PB	SW6010C	1370		MG/KG	0.15	0.50	0	0.25	SO	08/01/2014	Former D Range
FDR135GT	4618885.2	369805.6	248.2	MISFDR135GT-A_R2	FR2	Lead	PB	SW6010C	1120		MG/KG	0.15	0.50	0	0.25	SO	08/01/2014	Former D Range
								AVG	1230.00									
								SD	104.24									
								RSD	**8 %**									

Table 2 - Relative Standard Deviation of Replicate Samples

Location	Northing (N83 utm)	Easting (N83 utm)	Ground Elevation	Sample ID	Sample Type	Analyte	Short Name	Test Method	Reported Result	Qualifier	Units	MDL	RL	Begin Depth	End Depth	Matrix	Log Date	Site/ SLX List
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A_R1	FR1	Antimony	SB	SW6010C	0.74	J	MG/KG	0.19	1.0	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A_R2	FR2	Antimony	SB	SW6010C	0.56	J	MG/KG	0.19	1.0	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A	N1	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/06/2014	M-2
								AVG	0.65									
								SD	0.09									
								RSD	**14**	**%**								
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A	N1	Lead	PB	SW6010C	340		MG/KG	0.15	0.50	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A_R1	FR1	Lead	PB	SW6010C	216		MG/KG	0.15	0.50	0	0.25	SO	08/06/2014	M-2
FM2R03DR	4616239	373001	130.9	MISFM2R03DR-A_R2	FR2	Lead	PB	SW6010C	151		MG/KG	0.15	0.50	0	0.25	SO	08/06/2014	M-2
								AVG	235.67									
								SD	78.40									
								RSD	**33**	**%**								
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A	N1	Lead	PB	SW6010C	24.9		MG/KG	0.15	0.50	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A_R1	FR1	Lead	PB	SW6010C	25		MG/KG	0.15	0.49	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A_R2	FR2	Lead	PB	SW6010C	23.8		MG/KG	0.15	0.50	0	0.25	SO	07/30/2014	Former N Range
								AVG	24.57									
								SD	0.54									
								RSD	**2**	**%**								
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A	N1	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A_R1	FR1	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	07/30/2014	Former N Range
FNR03FL	4620570.4	373999.5	200.3	MISFNR03FL-A_R2	FR2	ND for 1 Analytes	Pb Sb	SW6010C	ND	UJ	MG/KG	ND	ND	0	0.25	SO	07/30/2014	Former N Range
								AVG	No value									
								SD	No value									
								RSD	**No value**	**%**								
GR01DR	4616851.6	370603	152.3	MISGR01DR-A	N1	Antimony	SB	SW6010C	23.4	J	MG/KG	0.19	0.99	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R1	FR1	Antimony	SB	SW6010C	11.3	J	MG/KG	0.19	0.99	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R2	FR2	Antimony	SB	SW6010C	10.7	J	MG/KG	0.19	1.0	0	0.25	SO	07/28/2014	G Range
								AVG	15.13									
								SD	5.85									
								RSD	**39**	**%**								
GR01DR	4616851.6	370603	152.3	MISGR01DR-A	N1	Lead	PB	SW6010C	2340	J	MG/KG	0.15	0.50	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R1	FR1	Lead	PB	SW6010C	1810	J	MG/KG	0.15	0.50	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R2	FR2	Lead	PB	SW6010C	1540	J	MG/KG	0.15	0.50	0	0.25	SO	07/28/2014	G Range
								AVG	1896.67									
								SD	332.30									
								RSD	**18**	**%**								
GR01DR	4616851.6	370603	152.3	MISGR01DR-A	N1	Tungsten	W	SW6020A	15		MG/KG	0.012	0.098	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R1	FR1	Tungsten	W	SW6020A	11.3		MG/KG	0.012	0.098	0	0.25	SO	07/28/2014	G Range
GR01DR	4616851.6	370603	152.3	MISGR01DR-A_R2	FR2	Tungsten	W	SW6020A	4.9		MG/KG	0.013	0.10	0	0.25	SO	07/28/2014	G Range
								AVG	10.40									
								SD	4.17									
								RSD	**40**	**%**								
KDR44	4616151	372356	155.3	MISKDR44-A	N1	Chromium	CR	SW6010C	52.2		MG/KG	0.12	0.50	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A_R1	FR1	Chromium	CR	SW6010C	54		MG/KG	0.12	0.50	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A_R2	FR2	Chromium	CR	SW6010C	53.7		MG/KG	0.12	0.50	0	0.25	SO	07/28/2014	KD SAR
								AVG	53.30									
								SD	0.79									
								RSD	**1**	**%**								
KDR44	4616151	372356	155.3	MISKDR44-A	N1	Chromium, Hexavalent	CR6	SW7196A	0.17	J	MG/KG	0.10	0.40	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A_R1	FR1	Chromium, Hexavalent	CR6	SW7196A	2.5		MG/KG	0.10	0.40	0	0.25	SO	07/28/2014	KD SAR
KDR44	4616151	372356	155.3	MISKDR44-A_R2	FR2	Chromium, Hexavalent	CR6	SW7196A	4.2		MG/KG	0.10	0.40	0	0.25	SO	07/28/2014	KD SAR
								AVG	2.29									
								SD	1.65									
								RSD	**72**	**%**								
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A	N1	Antimony	SB	SW6010C	2.1		MG/KG	0.19	0.99	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R1	FR1	Antimony	SB	SW6010C	1.9		MG/KG	0.19	1.0	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R2	FR2	Antimony	SB	SW6010C	1.5		MG/KG	0.19	0.99	0	0.25	SO	08/21/2014	N Range
								AVG	1.83									
								SD	0.25									
								RSD	**14**	**%**								
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A	N1	Lead	PB	SW6010C	595		MG/KG	0.15	0.49	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R1	FR1	Lead	PB	SW6010C	521		MG/KG	0.15	0.50	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R2	FR2	Lead	PB	SW6010C	382		MG/KG	0.15	0.50	0	0.25	SO	08/21/2014	N Range
								AVG	499.33									
								SD	88.30									
								RSD	**18**	**%**								
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A	N1	ND for 1 Analytes	Tungsten	SW6020A	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R1	FR1	ND for 1 Analytes	Tungsten	SW6020A	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/21/2014	N Range
NR01DR	4617852.1	374219.5	172.9	MISNR01DR-A_R2	FR2	ND for 1 Analytes	Tungsten	SW6020A	ND	UJ	MG/KG	ND	ND	0	0.25	SO	08/21/2014	N Range
								AVG	No value									
								SD	No value									
								RSD	**No value**	**%**								

APPENDIX H PROJECT NOTE
Third Addendum to the May 2014 Sampling, Soil Removal and Monitoring at Small Arms Ranges Project Note
June 2015

Project Note - Third Addendum to the May 2014 Project Note for "Sampling, Soil Removal, and Monitoring at Small Arms Ranges"

Impact Area Groundwater Study Program
Camp Edwards, MA

Date: June 18, 2015

1.0 PURPOSE

This Project Note Third Addendum defines excavation and an additional round of soil sampling planned for several Small Arms Ranges (SARs) at Camp Edwards. These activities are in addition to the scope of work described in the May 2014 Project Note for Sampling, Soil Removal and Monitoring at Small Arms Ranges, the August 2014 Addendum to the May 2014 Project Note and the December 2014 Second Addendum to the May 2014 Project Note. The need for these activities was identified after results of the sampling were received.

Figure 1 shows the locations of the SARs at Camp Edwards. Orange circles highlight the locations where actions have been taken (or are proposed) per the May 2014 Project Note, the First Addendum, the Second Addendum and/or this Third Addendum. Results of the laboratory analysis of the samples collected to date are included in Table 1. The relative standard deviation calculations for replicate samples are provided in Table 2.

2.0 SOIL SAMPLING

This section describes the sampling activities that are proposed. All samples will be collected according the CRREL multiple-increment sample (MIS) method and all soil samples will be ground according to EPA Method 8330B. Samples at Former B Range will be collected from the surface to 3 inches in depth. Samples at Former C Range will be deeper (6 inches to 1 foot). The intent is to conduct the sampling and receive results in order to determine if excavation of these areas is needed to meet applicable goals. The work to be conducted is described in the following paragraphs.

2.1 FORMER B RANGE

Sample FBR03 was collected from the berm area on the east side of sample area FBR140QR and analyzed for lead. The lead concentration in this sample was found to exceed actionable concentrations. Additional samples will be collected along the berm further east, north and south of sample FBR03 in order to define the extent of lead contaminated soil. Each sample will be a 50-point MIS in sample areas measuring between 1,517 and 1,734 square feet in area. Two replicates (three samples total) will be collected from one of the three new sample areas. The approximate sample locations are shown on Figure 2. The samples will be analyzed for lead.

2.2 FORMER C RANGE

Surface soil samples FCR02, FCR03 and FCR07, collected in April 2015, were found to have a lead concentrations just slightly above the action levels. Therefore, further sampling will be conducted at a depth of 6 inches to 1 foot at these sample areas to better define the vertical extent of the lead contamination. A 30-point MIS will be collected from each sampling area and will be analyzed for lead. Sample grid FCR136-A has been sampled from the surface to 3

inches and from 1.5 feet to 2.0 feet. No additional samples are proposed for FCR136-A. The sample locations are shown on Figure 3.

3.0 EXCAVATIONS

Soil excavation is required in several locations to reduce detected metals concentrations to acceptable levels. This section describes the scope of excavation needed as a result of the sampling conducted in April 2015. Note that other soil excavation was previously scoped in the May, August and/or December 2014 project notes.

All soil will be excavated to a depth of approximately 6 inches unless otherwise specified. All soil will be disposed off site in an appropriate landfill. Any additional characterization of the soil required by the receiving facility will be completed in conjunction with the excavation work. Post excavation samples will be 100-point MIS collected from the base of the excavation to a depth of 3 inches. Two replicates (three samples total) will be collected from a minimum 25% of the post-excavation sample grids. A minimum of one set of replicates will be collected from each range.

3.1 FORMER B RANGE

Areas FBR03 and FBR06 will be excavated to a depth of 6 inches, and the soil will be properly disposed off-site. Post-excavation soil samples will be collected from each area and analyzed for lead. These areas are shown on Figure 2.

(Excavation of area B-1 was scoped in the August 2014 Project Note and excavation of areas FBR140L and FBR140QR was scoped in the December 2014 Project Note.)

3.2 FORMER C RANGE

Samples from Area FCR136-A collected in September 2014 exceed the action level (Figure 3). The deeper samples collected from 1.5 feet to 2.0 feet were below action level but slightly elevated above background concentration. Sample Area FCR136-A will be excavated to a depth of 6 inches, and the soil will be properly disposed off-site. Post-excavation samples will be collected from the area and analyzed for lead.

3.3 FORMER D RANGE

Sample Areas FDR05, FDR06 and FDR07 (Figure 4) will be excavated to a depth of 6 inches and the soil will be properly disposed off-site. Post-excavation soil samples will be collected from each area and analyzed for lead.

(Excavation of areas D1Aa, D1Ab, and D1Ac was scoped in the August 2014 Project Note. Areas FDR135U and FDR135GT were scoped for excavation in the December 2014 Project Note.)

3.4 G RANGE

Area GR04 (Figure 5) will be excavated to a depth of 6 inches and the soil will be properly disposed off-site. Post-excavation soil samples will be collected and analyzed for lead.

(Excavation of area GR01A was scoped in the May 2014 Project Note. Excavation of area GR01DR was scoped in the December 2014 Project Note)

3.5 N RANGE

Area NR03 (Figure 6) will be excavated to a depth of 6 inches and the soil will be properly disposed off-site. Post-excavation soil samples will be collected from each area and analyzed for lead.

(Excavation of areas NR01A and NR02A was scoped in the May 2014 Project Note. Excavation of sample areas NR01ADR and NR02ADR was scoped in the December 2014 Project Note)

4.0 REPORTING

The results of the multiple-increment sampling and excavation work will be reviewed with the regulatory agencies along with the results of the previous SAR sampling to determine whether or not any additional sampling or excavation is required. Upon completion of this scope of work and any additional actions, a completion of work report will be prepared to document the work performed and the resulting site conditions. This report will include figures showing the extent of the various excavations. Tables summarizing post-excavation laboratory results will also be included.

5.0 SIGNATURES

The signatures below represent concurrence with this project note.

18 June 2015
EPA Representative

MassDEP Representative

18 June 2015
Impact Area Groundwater Study Program

FIGURES

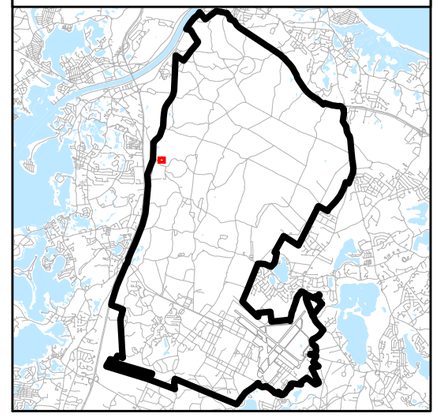

L-2 Range
L-3 Range
Former R Range
Q Range
T Range
L-4 Range
L Range (50-80s)
A Range
B Range
C Range
D Range
E Range
Sierra Range West
Sierra Range East
Former N Range (67-79)
L Range (1941-1950s)/L-1 Range
Former B Range
Former C Range
500 Yard Rifle Range
Former D Range
Former K Range
Succonsette Pond
P Range
O Range
N Range
KD Range West
E-1 Range Firing Point
E-1 Range
E-2 Range
KD Range East
Former M-4 Range
G Range
K Range
J Range
H Range
I Range
Former M-3 Range
Former M-2 Range (M Range)
Former M-1 Range (M Range)
Skeet Range 2
Skeet Range 1
GAGB Range
Location of Proposed Work - Post Decision Document
Small Arms Range
Impact Area Boundary
JBCC Boundary
Cape Cod Bay
Buzzards Bay
Nantucket Sound
Figure 1
Location of Small Arms Ranges
0
4,000
Feet
N
P:\GIS\MMR\SmallArmsRange\GIS\Spatial\MXD\20140321_SAR_ProjectNote\Fig1-1_Location_of_SARs.mxd

Impact Area Groundwater Study Program

LEGEND

- Former B Range
- Excavation Area
- Proposed Sampling Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
Former B Range

0 50 Feet

N

US Army Corps of Engineers
New England District

M:\MMR\2014\SmallArmsRanges\Soils\PNaddendum\Figures\Fig2_FmrB_061115.pdf
M:\MMR\2014\SmallArmsRanges\Soils\PNaddendumMXDs\Fig2_FmrB_061115.mxd
June 11, 2015 DWN: MTW CHKD: DRS

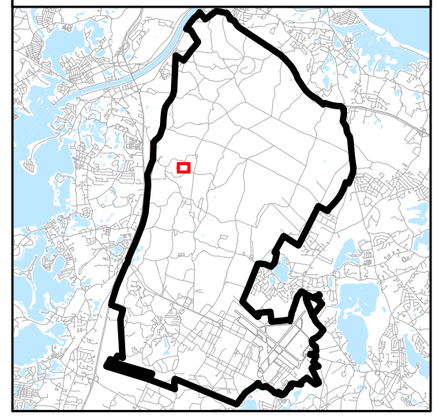
FIGURE 2

Impact Area Groundwater Study Program

LEGEND

- Former C Range
- Proposed Sampling Area
- Excavation Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Sampled
Former C Range

0 100 Feet

US Army Corps of Engineers
New England District

M:\MMR\2014\SmallArmsRanges\Soils\PNaddendum\Figures\Fig3_FmrC_062215.pdf
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June 22, 2015 DWN: MTW CHKD: DRS

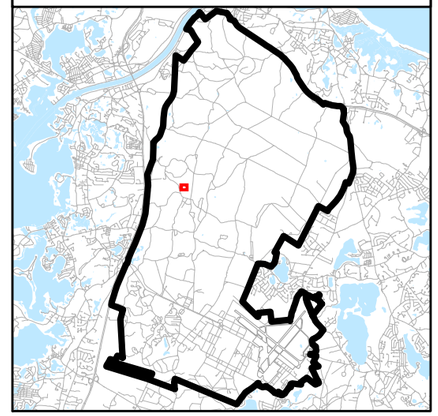
FIGURE 3

Impact Area Groundwater Study Program

LEGEND

- Former D Range
- Excavation Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
Former D Range

0 60 Feet

N

US Army Corps of Engineers
New England District

M:\MMR\2014\SmallArmsRanges\Soils\PNaddendum\Figures\Fig4_FmrD_061115.pdf
M:\MMR\2014\SmallArmsRanges\Soils\PNaddendum\MXDs\Fig4_FmrD_061115.mxd
June 11, 2015 DWN: MTW CHKD: DRS

FIGURE 4

GR04 (4/23/2015)	
Analyte	mg/Kg
Lead	398

GR01DR (7/28/2014)	
Analyte	mg/Kg
Antimony	23.4J
Antimony	11.3J
Antimony	10.7J
Lead	2340J
Lead	1810J
Lead	1540J
Tungsten	15
Tungsten	11.3
Tungsten	4.9

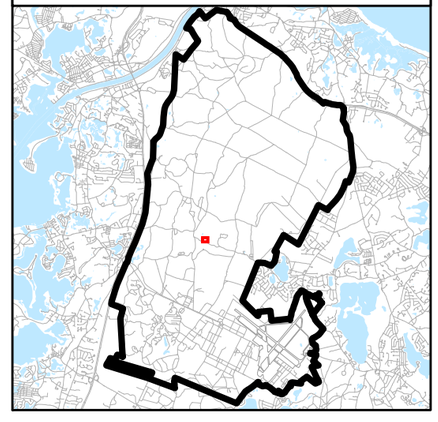
GR01A (4/15/2013)	
Analyte	mg/Kg
Antimony	25.4
Copper	207
Lead	3850
Tungsten	33.0

Impact Area Groundwater Study Program

LEGEND

- G Range
- Excavation Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
G Range

0 50 Feet

N

US Army Corps of Engineers
New England District

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June 11, 2015 DWN: MTW CHKD: DRS

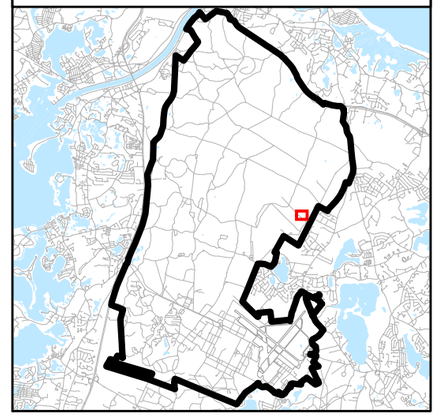
FIGURE
5

Impact Area Groundwater Study Program

LEGEND

- N Range
- Excavation Area
- Proposed Sampling Area

LOCATION MAP



NOTES & SOURCES

TITLE

Areas to be Excavated and Sampled
N Range

0 100 Feet

N

US Army Corps of Engineers
New England District

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M:\MMR\2014\SmallArmsRanges\Soils\PNaddendumMXDs\Fig6_N_112414.mxd
June 11, 2015 DWN: MTW CHKD: DRS

FIGURE 6

TABLES

Table 1
Soil Sampling Results

Location	Sample ID	Begin Depth (ft bgs)	End Depth (ft bgs)	Sample Date	Test Method	Analyte	Reported Result	Qualifier	Units	MDL	RL	Sample Type	Matrix	Site	Remarks
BR06	MISBR06-A	0	0.25	4/23/2015	SW6010C	Lead	94.1		MG/KG	0.11	0.51	N1	SO	B Range	100 pt Comp; ISM
BR06	MISBR06-A	0	0.25	4/23/2015	SW6020A	Tungsten	25.9		MG/KG	0.0038	0.10	N1	SO	B Range	100 pt Comp; ISM
FBR03	MISFBR03-A	0	0.25	4/28/2015	SW6010C	Lead	2250		MG/KG	0.11	0.52	N1	SO	Former B Range	50 pt Comp; ISM
FBR04	MISFBR04-A	0	0.25	4/27/2015	SW6010C	Lead	3.1		MG/KG	0.10	0.48	N1	SO	Former B Range	50 pt Comp; ISM
FBR05	MISFBR05-A	0	0.25	4/27/2015	SW6010C	Lead	175	J	MG/KG	0.11	0.51	N1	SO	Former B Range	100 pt Comp; ISM
FBR06	MISFBR06-A	0	0.25	4/27/2015	SW6010C	Lead	234		MG/KG	0.10	0.49	N1	SO	Former B Range	100 pt Comp; ISM
FBR06	MISFBR06-A_R1	0	0.25	4/27/2015	SW6010C	Lead	266		MG/KG	0.10	0.50	FR1	SO	Former B Range	100 pt Comp; ISM
FBR06	MISFBR06-A_R2	0	0.25	4/27/2015	SW6010C	Lead	356		MG/KG	0.11	0.51	FR2	SO	Former B Range	100 pt Comp; ISM
FCR02	MISFCR02-A	0	0.25	4/20/2015	SW6010C	Lead	224		MG/KG	0.10	0.48	N1	SO	Former C Range	100 pt Comp; ISM
FCR03	MISFCR03-A	0	0.25	4/20/2015	SW6010C	Lead	232		MG/KG	0.11	0.51	N1	SO	Former C Range	100 pt Comp; ISM
FCR04	MISFCR04-A	0	0.25	4/22/2015	SW6010C	Lead	145		MG/KG	0.10	0.49	N1	SO	Former C Range	100 pt Comp; ISM
FCR05	MISFCR05-A	0	0.25	4/20/2015	SW6010C	Lead	132		MG/KG	0.11	0.51	N1	SO	Former C Range	100 pt Comp; ISM
FCR06	MISFCR06-A	0	0.25	4/20/2015	SW6010C	Lead	151		MG/KG	0.11	0.50	N1	SO	Former C Range	100 pt Comp; ISM
FCR07	MISFCR07-A	0	0.25	4/22/2015	SW6010C	Lead	233		MG/KG	0.10	0.49	N1	SO	Former C Range	100 pt Comp; ISM
FCR136	MISFCR136-B	1.5	2	4/21/2015	SW6010C	Lead	26.3		MG/KG	0.11	0.51	N1	SO	Former C Range	30 pt Comp; ISM
FCR136	MISFCR136-B_R1	1.5	2	4/21/2015	SW6010C	Lead	47.8		MG/KG	0.098	0.47	FR1	SO	Former C Range	30 pt Comp; ISM
FCR136	MISFCR136-B_R2	1.5	2	4/21/2015	SW6010C	Lead	34.0		MG/KG	0.10	0.48	FR2	SO	Former C Range	30 pt Comp; ISM
FDR05	MISFDR05-A	0	0.25	4/22/2015	SW6010C	Lead	391		MG/KG	0.10	0.49	N1	SO	Former D Range	50 pt Comp; ISM
FDR06	MISFDR06-A	0	0.25	4/22/2015	SW6010C	Lead	642		MG/KG	0.11	0.51	N1	SO	Former D Range	100 pt Comp; ISM
FDR06	MISFDR06-A_R1	0	0.25	4/22/2015	SW6010C	Lead	518		MG/KG	0.11	0.51	FR1	SO	Former D Range	100 pt Comp; ISM
FDR06	MISFDR06-A_R2	0	0.25	4/22/2015	SW6010C	Lead	641		MG/KG	0.11	0.51	FR2	SO	Former D Range	100 pt Comp; ISM
FDR07	MISFDR07-A	0	0.25	4/23/2015	SW6010C	Lead	212		MG/KG	0.11	0.50	N1	SO	Former D Range	100 pt Comp; ISM
GR04	MISGR04-A	0	0.25	4/23/2015	SW6010C	Lead	398		MG/KG	0.099	0.47	N1	SO	G Range	100 pt Comp; ISM
NR03	MISNR03-A	0	0.25	4/28/2015	SW6010C	Lead	308		MG/KG	0.11	0.52	N1	SO	N Range	100 pt Comp; ISM
NR04	MISNR04-A	0	0.25	4/28/2015	SW6010C	Lead	178		MG/KG	0.11	0.52	N1	SO	N Range	100 pt Comp; ISM

Table 2
Relative Standard Deviation of Replicate Samples

Location	Sample ID	Begin Depth (ft bgs)	End Depth (ft bgs)	Sample Date	Test Method	Analyte	Reported Result	Qualifier	Units	MDL	RL	Sample Type	Matrix	Site	Remarks
FBR06	MISFBR06-A	0	0.25	4/27/2015	SW6010C	Lead	234		MG/KG	0.10	0.49	N1	SO	Former B Range	100 pt Comp; ISM
FBR06	MISFBR06-A_R1	0	0.25	4/27/2015	SW6010C	Lead	266		MG/KG	0.10	0.50	FR1	SO	Former B Range	100 pt Comp; ISM
FBR06	MISFBR06-A_R2	0	0.25	4/27/2015	SW6010C	Lead	356		MG/KG	0.11	0.51	FR2	SO	Former B Range	100 pt Comp; ISM
						SD	**63.3**								
						AVG	**285**								
						RSD	**22.2**								
FCR136	MISFCR136-B	1.5	2	4/21/2015	SW6010C	Lead	26.3		MG/KG	0.11	0.51	N1	SO	Former C Range	30 pt Comp; ISM
FCR136	MISFCR136-B_R1	1.5	2	4/21/2015	SW6010C	Lead	47.8		MG/KG	0.098	0.47	FR1	SO	Former C Range	30 pt Comp; ISM
FCR136	MISFCR136-B_R2	1.5	2	4/21/2015	SW6010C	Lead	34		MG/KG	0.10	0.48	FR2	SO	Former C Range	30 pt Comp; ISM
						SD	**10.9**								
						AVG	**36.0**								
						RSD	**30.2**								
FDR06	MISFDR06-A	0	0.25	4/22/2015	SW6010C	Lead	642		MG/KG	0.11	0.51	N1	SO	Former D Range	100 pt Comp; ISM
FDR06	MISFDR06-A_R1	0	0.25	4/22/2015	SW6010C	Lead	518		MG/KG	0.11	0.51	FR1	SO	Former D Range	100 pt Comp; ISM
FDR06	MISFDR06-A_R2	0	0.25	4/22/2015	SW6010C	Lead	641		MG/KG	0.11	0.51	FR2	SO	Former D Range	100 pt Comp; ISM
						SD	**71.3**								
						AVG	**600**								
						RSD	**11.9**								