DRAFT FINAL

RCRA FACILITY INVESTIGATION REPORT
MUGGINS MOUNTAIN OB/OD FACILITY
YPG-35a, b, and c
U.S. ARMY GARRISON YUMA PROVING GROUND

Submitted To:

U.S. ARMY GARRISON YUMA PROVING GROUND

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ACRONYMS AND ABBREVIATIONS

ADEQ	Arizona Department of Environmental Quality
AGFD	Arizona Game and Fish Department
AMSL	Above Mean Sea Level
bgs	Below Ground Surface
BOG	Burn on Ground
BTV	Background Threshold Value
CLP	Contract Laboratory Program
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	Chemical of Concern
COPC	Chemical of Potential Concern
COPEC	Chemical of Potential Ecological Concern
CSM	Conceptual Site Model
DoD	Department of Defense
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
°F	Degrees Fahrenheit
ft	Feet
GPL	Groundwater Protection Level
HE	High Explosive
HI	Hazard Index
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Hazard Quotient
HRA	Human Health Risk Assessment
HSWA	Hazardous and Solid Waste Amendment
IA	Installation Assessment
KFR	Kofa Firing Range
km	Kilometers
LOAEL	Lowest Observable Adverse Effects Level
Ma	Million Years
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
mg/kg	Milligram per Kilogram
mph	Miles Per Hour
NA	Not Applicable
ND	Non Detect
NFA	No Further Action
NOAEL	No Observable Adverse Effects Level
NRCS	National Resource Conservation Service
nrSRL	Non-Residential Soil Remediation Level
OB/OD	Open Burn/Open Detonation
OD	Open Detonation
OU	Operable Unit
PD	Point Detonating

ACRONYMS AND ABBREVIATIONS (CONTINUED)

QAPP	Quality Assurance Project Plan
QR	Qualitative Reconnaissance
RA	Release Assessment
RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-1,3,5-tiazine
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
rSRL	Residential Soil Remediation Level
RKT	Rocket
SRL	Soil Remediation Level
SVOC	Semivolatile Organic Compound
TRV	Toxicity Reference Value
UCL	Upper Confidence Level
U.S.	United States
USACHPPM	U.S. Army Center for Health Promotion and Preventative Medicine
USAGYPG	U.S. Army Garrison Yuma Proving Ground
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WP	White Phosphorus

EXECUTIVE SUMMARY

This report presents the results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) activities conducted for the Muggins Mountain former open burn/open detonation (OB/OD Facility) (YPG-35a, b, and c) located at U.S. Army Garrison Yuma Proving Ground (USAGYPG) near Yuma, Arizona. This report also includes a human health and ecological risk assessment, which evaluates the potential for human health and ecological impacts from assumed exposures to chemicals of potential concern (COPCs) within the site.

Muggins Mountain OB/OD facility is comprised of three sites, YPG-35 a, b, and c (Figure 2.1) and is divided into two time periods of operation, 1950s through 1974 and 1985 through the late 1990s. Initially in 1952 until 1974, the area was used as the primary OB/OD facility for USAGYPG. Operations were discontinued in 1974 and no further OB/OD activities were conducted at the site until it was reopened in 1985. In 1985, a munitions recovery program was initiated to uncover and demolish buried on-site munitions using OD operations. In the late 1990s all operations were discontinued and the site was closed.

Previous investigations at YPG-35a, b, and c include sampling activities conducted during 2002 and 2003 and a geophysical survey conducted in 2006. The 2002 sampling event consisted of soil sampling the OD pit area located southwest of the loop access road, the burn on ground (BOG) area and the white phosphorus (WP) area. The 2003 sampling event included the collection of soils samples from four areas where loose propellant was previously identified and five washes located downstream from the OD pits. In 2006 a geophysical survey was conducted at YPG-35b and c. This survey identified ten suspected burial trenches (TR-2 through TR-11) at YPG-35b and three suspected burial trenches (TR-12 and TR-14) at YPG-35c.

The RFI activities at YPG-35a, b, and c consisted of conducting an instrument-aided qualitative reconnaissance (QR) survey at YPG-35a and conducting site surveys, drilling soil borings, collecting associated soil samples, and collecting soil samples from YPG-35b and c.

The instrument-aided QR survey was conducted across 340 acres of YPG-35a, and included the majority of YPG-35a and the northern and southern portions of YPG-35c. A total of 134 waypoints were taken during the QR survey; of those, 75 contained various amounts of munitions debris (MD) and 15 contained various munitions and explosives of concern (MEC). The majority of the MEC was located in the southeastern portion of YPG-35a, with no MEC identified north of YPG-35c and south of YPG-35b.

During the site survey of YPG-35b and c, MEC disposal pits TR-2 through TR-11 (located in YPG-35b) and dunnage pits TR-12 through TR-14 (located in YPG-35c) were reacquired. These pits were not been sampled due to explosive safety concerns and are considered uncharacterized because there is no information about these features other than the possibility that they may contain buried MEC and MD. Uncharacterized pits will be considered *a priori* to pose an unacceptable risk at the site and will be carried forward into the corrective measures study (CMS). Soil sampling locations from 2002 and 2003 sampling events were also reacquired at YPG-35c, and the locations of 20 proposed soil borings (SB001 through SB020) at YPG-35b were staked during the site survey.

Following the site survey, a total of 54 surface soil samples, 52 subsurface soil samples, and seven field duplicates were collected from YPG-35b and c and analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, explosives, and perchlorate. Surface and subsurface soil samples were collected from locations adjacent to uncharacterized features to determine if waste or chemicals extend beyond the established boundaries based on the results of previous investigations, instrument-aided QR survey, and visual survey results. Numerous inorganic compounds were detected in surface and subsurface soils that exceeded the background threshold values (BTVs); however, only one metal (lead) was found to slightly exceed its corresponding groundwater protection level (GPL) but not its corresponding Arizona residential soil remediation level (rSRL) in a single surface soil sample. Lead contamination is believed to be associated with surface metallic debris from the large open trench located within the burial trench area. This metal is believed to be stable and

has not migrated to any significant degree, based on concentrations less than remediation goals in underlying samples.

A human health and ecological risk assessment was performed for YPG-35a, b, and c to assess potential risks and hazards from exposure to contaminants in soils and to recommend either no further action (NFA) (if the risks and hazards are acceptable) or of the development of cleanup goals and remedial alternatives under a CMS task if unacceptable risks or hazards were identified.

Results of the ecological risk assessment (ERA) at YPG-35c show site related exposures to 2,4-dinitrotoluene, lead, and selenium may result in adverse effects for plants; and site related exposures to 2,4-dinitrotoluene, nitrobenzene, perchlorate, and selenium may result in adverse effects for invertebrates. Similarly, site related exposures to di-n-butyl phthalate, 2,4-dinitrotoluene, and 2,6-dinitortoluene may result in adverse effects for the desert shrew, little pocket mouse, American kestrel, Gambel's quail, verdin, and Sonoran desert tortoise.

Results of the human health risk assessment (HRA) at YPG-35c indicate lead as a chemical of concern (COCs) and a potential human health risk. However, the human health hazard can be diminished with the remediation of sample site BOG-02 (Section 5.1.2). Ecological receptors will still be at risk regardless of the clean-up of BOG-02. If remediating YPG-35c based upon human health risks alone is not an acceptable remedial action objective, a CMS would be required at YPG-35c to evaluate risks to ecological receptors.

A CMS is recommended for YPG-35b, to include the large open trench TR-1 and ten suspected burial trenches (TR-2 through TR-11) that were uncharacterized due to explosive safety concerns. The CMS should also include the three uncharacterized burial trenches (TR-12 and TR-14) as well as, areas containing elevated levels of site related compounds in soil posing an unacceptable ecological risk present at YPG-35c. Finally, the CMS should include mitigation of explosive risks associated with MEC/MD identified during the QR survey conducted within the boundaries of YPG-35a as part of the RFI.

SECTION 1.0
INTRODUCTION

This report was prepared by Parsons, Inc. (Parsons) for the U.S. Army Garrison Yuma Proving Ground (USAGYPG) located near Yuma, Arizona. The purpose of this document is to present activities, procedures, and results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for YPG-35a, b, and c, a former OB/OD facility located within the southwest portion of the Kofa Firing Range (KFR) approximately 3 miles southeast of the KFR complex. This RFI was performed pursuant to contract number W91ZLK-05-D-0016, Task Order 0002.

The objectives of the RFI were to: 1) collect data to adequately characterize the site; 2) conduct a risk assessment (human and ecological) to determine if constituents have been released to the environment which pose a risk to human health or the environment; and 3) determine if chemical constituents are present at levels that pose a threat to groundwater.

1.1 REGULATORY FRAMEWORK

YPG-35 a, b, and c, also known as the Muggins Mountain former OB/OD Facility, has been identified during the RCRA Facility Assessment (RFA) at USAGYPG as potentially containing hazardous waste. Historical records and previous investigations of past activities at the site indicate the use of the site for demilitarization of conventional muntions, which includes demolition and disposal/burial. Several burial trenches have been identified at the site as containing or potentially containing munititions and explosives of concern (MEC); therefore regulation of the site has followed the RCRA process as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984. Under Subtitle C of RCRA, the State of Arizona has the authority to implement the RCRA program and many of the HSWA requirements. The Arizona Department of Environmental Quality (ADEQ) monitors RCRA compliance and enforces its provisions at USAGYPG. For example, the USAGYPG is currently operating the open burn/open detonation (OB/OD) areas under a RCRA Part B permit issued in June of 2007. Primarily, RCRA regulations traditionally apply to active waste management facilities;

however, HSWA added provisions to RCRA that enable inactive solid waste sites to be investigated and, if needed, remediated through a "corrective action" program. Based on these provisions, the YPG-35 sites at USAGYPG have been included within the USAGYPG Part B Permit and currently fall under the administration of RCRA and ADEQ.

The regulatory framework under which RFIs are completed is the RCRA corrective action process. The authority for RCRA corrective action is derived from RCRA Section 3004(u) and is comprised of four phases:

- RFA - Identifies releases and potential releases of hazardous wastes or constituents from the site.
- RFI - Verifies release(s) from the site and characterizes the nature and extent of contaminant migration.
- Corrective Measures Study (CMS) - Determines appropriate corrective measures for the site.
- Corrective Measures Implementation (CMI) – Provides the design, construction, operation and maintenance, and monitoring of the corrective measures.

An RFA was previously conducted at the YPG-35 sites (Tetra Tech, 1998). This RFA report was completed to satisfy the requirements of the RCRA permit issued by the state of Arizona. Subsequently a Release Assessment (RA) was conducted for the YPG-35 sites (Argonne, 2001). Based on the recommendation of the RFA and RA, an RFI has been completed for the YPG-35 sites as part of the RCRA closure process.

The Muggins Mountain former OB/OD Facility was identified in the RFA report as solid waste management unit SWMU 57. According to the report, base records and interviews indicate a history of solid waste disposal at the site(s), which includes the disposal of regulated waste such as munitions and explosives of concern. YPG-35a, b, and c, was used for the disposal of conventional munition demilitarization related waste, and is therefore subject to the rules and statues of the ADEQ Solid Waste Unit under ARS § 49-701 (3)(b) and (29) and the United States Environmental Protection Agency (USEPA) (40 CFR 258.1(c)).

1.2 DESCRIPTION AND HISTORY OF USAGYPG

The USAGYPG installation is located in a remote area of southwestern Arizona, bordered on the west by the Colorado River (Figure 1.1). It lies 37 kilometers (km) (23 miles) northeast of the city of Yuma along U.S. Highway 95, between Interstate Highways 8 and 10, and is approximately 200 km (125 miles) west of Phoenix, Arizona and 288 km (180 miles) east of San Diego, California. The nearest major population center to USAGYPG is the city of Yuma, which has a population of approximately 91,000 inhabitants (U.S. Census Bureau, 2009). The USAGYPG is one of the Department of Defense's (DoD's) largest installations, and encompasses an area of approximately 830,000 acres in size, or roughly 1300 square miles. Comparatively, it is slightly larger than the state of Rhode Island.

The USAGYPG is a general purpose facility with a 50 year history of testing weapon systems of all types and sizes. Equipment and munitions tested at the installation consist of medium and long-range artillery; aircraft target acquisition equipment and armament, armored and wheeled vehicles, a variety of munitions, and personnel and supply parachute systems. Testing programs are conducted for all U.S. military services, friendly foreign nations, and private industry. The USAGYPG is the Army's center for desert natural environment testing; the management center of cold weather testing at the Cold Regions Test Center (Alaska); and tropic testing at the Tropic Test Center (various locations). It is one of 22 major test ranges that comprise the DoD Major Range Test Facility Base.

Military use of USAGYPG began in 1942 for training desert troops (USAEHA, 1988). The mission changed in January 1943 when the site began to be used as a testing ground for bridges, river crossing equipment, boats, vehicles, and well drilling equipment under the designation Yuma Test Branch, Corps of Engineers. On October 1, 1947, it was designated the Engineering Research and Development Laboratories, Yuma Test Branch, Sixth Army. This installation was deactivated in January 1950 because of a military austerity program; however, on April 1, 1951, it was reactivated as the Yuma Test Station for desert environmental testing of equipment ranging from tanks to water purification units. On August 1, 1962, the station was assigned to the U.S. Army

Materiel Command, and on July 1, 1963, it was renamed Yuma Proving Ground (USAEHA, 1988).

Today, USAGYPG has a working population of approximately 3000 people, including test and support soldiers, civil service employees, and supporting civilian contractors. It hosts about 23,000 visitors per year, including test customers, training units, U.S. government and foreign dignitaries, local organizations, and school groups (USAGYPG, 2009).

1.3 REPORT ORGANIZATION

This report contains the results of the RFI activities, including results of a nature and extent evaluation and human health and ecological risk assessment. The report is divided into seven sections and five appendices, and contains the necessary elements as required by the RFI program.

Section 1 **Introduction** – Presents the project overview including the regulatory framework and a description and history of USAGYPG.

Section 2 **Environmental Setting** – Provides a description of the environmental settings of the USAGYPG installation and the YPG-35a, b, and c. This section also includes an overview of the site location, description, and history of waste disposed of at the site.

Section 3 **Previous Investigations** – Describes previous investigations and activities conducted at YPG-35a, b, and c.

Section 4 **Nature and Extent Investigation** – Identifies the RFI approach and strategies along with investigation results and recommendations.

Section 5 **Human Health and Ecological Risk Assessment** – Provides an evaluation of the risks associated with potential waste buried at YPG-35a, b, and c.

Section 6 **Summary and Recommendations** – Summarizes human health and ecological risk screening results along with a corrective action evaluation and recommendations.

Section 7 **References** – Provides information resources cited in the report.

Appendix A Field Logs

Appendix B Site Photographs

Appendix C Analytical Data and Quality Control Tables

Appendix D Calculation of Background Threshold Values

Appendix E Ecological Risk Assessment

Appendix F Historical Data

SECTION 2.0

ENVIRONMENTAL SETTING

2.1 U.S. ARMY GARRISON YUMA PROVING GROUND FACILITY

2.1.1 Topography

The USAGYPG installation is located within the Sonoran Desert Southern Basin and Range Physiographic Province. The distinctive topography within this province consists of elongate low rugged uplifted mountains trending north-northwest with intervening sediment-filled valleys. The majority of the basins are structural depressions filled with alluvial sediments from the river systems that dissect the area and locally derived sediments from the surrounding mountains (Entech Engineers, 1988; Argonne, 2004).

Four major landforms are present: 1) alluvial fan (47% of the total area); 2) mountain highlands (27% of total area); 3) active washes (14% of the total area); and 4) alluvial plain (8% of the total area). The remaining 4% of the total USAGYPG land area consists of badlands, pediment, alluvial terrace, old terrace, and dunes (DRI, 2009).

The relief of the mountain ranges is relatively low but the topography is rugged, with slopes locally exceeding 40%. The maximum elevation of 2,822 feet (ft) above mean sea level (AMSL) occurs in the Chocolate Mountains and the lowest elevation, 195 ft AMSL, is just south of the Main Administrative Area. Surface drainage in the northern and western portion of USAGYPG flows west into the Colorado River while the remainder flows south into the Gila River. Most of the surface flow occurs on lowland washes that generally have slopes on the order of 1% to 3% and are dry except during occasional periods of intense rainfall (Entech Engineers, 1987).

2.1.2 Climate

Because the USAGYPG is in the Sonoran Desert, its climate is typical of a low elevation, hot, arid desert. It is characterized by high daytime temperatures with large daily temperature variations, low relative humidity, and very low average precipitation.

The average monthly air temperature ranges from a low of 47.6 degrees Fahrenheit (°F) in January to a high of 106.8°F in July (NWS, 2011). The average annual precipitation in Yuma and other areas along the lower Colorado River is very low, approximately 3.5 inches per year (NWS, 2011). Rainfall occurs predominantly in the form of summertime thunderstorms, which are sometimes very intense and produce local flash flooding. Evaporation in the arid climate is very high. The Yuma Citrus Station, located eight miles southwest of the city of Yuma, has an average annual pan evaporation rate of 99.2 inches per year, approximately 30 times the average annual precipitation (2.6 inches per year) (WRCC, 2012).

The wind speed in the Yuma area averages from 7.1 miles per hour (mph) during September through February to 8.6 mph from March through August with a yearly mean of 7.8 mph (NWS, 2012). The prevailing direction is from the north from late autumn until early spring (Oct. - Feb.), westerly to northwesterly in the spring (Mar. – May). Winds associated with the summer monsoons shift and come out of the south and south-southeast (WRCC, 2012).

2.1.3 Soils

Eight distinct soil types based on textural description, in accordance with the National Resource Conservation Service (NRCS), occur over the entire USAGYPG facility. These soil types, along with their corresponding percentages (DRI, 2009), are described in Table 2.1.

2.1.4 Hydrology

2.1.4.1 Surface Water

No perennial lakes or streams are present within USAGYPG, however, two major rivers flow through the adjacent desert. The Colorado River traverses a generally north-south direction, west of USAGYPG. The mostly dry Gila River drainage traverses an east-west direction, south of USAGYPG. Surface drainage on the northern and western part of USAGYPG flows into the Colorado River, with the central and eastern parts of USAGYPG flowing into the Gila River. Both rivers have breached their banks during wet

years and caused property damage. However, upstream dams and reservoirs, such as Mittry Lake, Martinez Lake, Squaw Lake, Imperial Dam, Ferguson Lake, and Senator Wash Reservoir (all located along the Colorado River west of USAGYPG) and Painted Rock Dam (on the Gila River) have decreased the severity of recent flood events.

Surface water within USAGYPG is limited to brief periods during and after intense rainfall events which produce flash flooding and ponding in low areas (Argonne, 2004). Infrequent rainfall produces localized flash-flooding and temporary surface water, especially during thunderstorms in August and September. Rainfall averages 3.5 inches per year, and the evaporation pan rate is 99.2 inches per year (WRCC, 2012). The combination of low precipitation and high evaporation prevents surface water from infiltrating deeply into the soil. Thus, most of the year, desert washes are dry. The dry washes vary in size, from less than 3 ft in width and depth, to more than a half mile in width and 30 ft in depth. Each wash contains numerous smaller channels that can change course during major flood events.

The USAGYPG has few natural, year-round sources of water. Some natural water sources have been modified to provide year-round water to wildlife. The four types of natural and artificial water sites are described below (Palmer, 1986):

- Tinajas are naturally occurring, bowl-shaped cavities scoured out of bedrock. Tinajas are usually found at the base of waterfalls where the bedrock formation that created the waterfall changes from harder to softer rock. Rocks trapped in the cavity increase scouring. Tinajas are usually located in the mountain canyons.
- Enhanced tinajas are tinajas that have been artificially improved to increase and prolong water storage capacity. Most enhanced tinajas retain water throughout the year.
- Water catchments are storage tanks, sized from 1500 to 34,500 gallons, constructed by Arizona Game and Fish Department (AGFD). These tanks are located in the Cibola and Kofa Regions.
- Other artificial water sources have developed over the years as a result of leaking landscape irrigation pipes, excess water released by stand pipes, or by pumping water into impoundments (Morrill, 1990). These include Lake Alex, which is a well-pumped impoundment near Pole Line Road and north of Red Bluff

Mountain in the eastern Kofa Region, and Ivan's Well, which is a well-pumped impoundment near Growl Road and Kofa Mohawk Road in the Kofa Region.

2.1.4.2 Groundwater

The principal water-producing aquifer within USAGYPG is the unconsolidated alluvial aquifer. This aquifer varies in thickness from tens of feet at the margins of the basins to hundreds of feet in the center of the basins. Based on the results of a hydrogeologic study of this aquifer conducted in the early 1980s (Entech Engineers, 1988), the top of the groundwater aquifer ranges in elevation from approximately 155 to 200 ft AMSL. The depth to groundwater ranged from 30 ft below ground surface (bgs) in Well X (located in the main Cantonment area near the Colorado River) to greater than 600 ft bgs in Well M (located near the Castle Dome Heliport). Water levels in these wells did not substantially change over a one-year period in 1987 (Entech Engineers, 1988). The potentiometric surface data suggest that the direction of groundwater flow is southwest toward the Colorado and Gila Rivers. The groundwater gradient is approximately 4 to 5 ft/mile upgradient of the major pumping wells, and less than about 4 ft/mile near the rivers. Near the rivers, the groundwater elevation becomes shallower, and it may be within 10 ft of the surface in floodplain deposits (Click and Cooley, 1967). Local precipitation and runoff are very minor sources of groundwater recharge.

Groundwater was also observed in the underlying bedrock (Entech Engineers, 1988). However, in the bedrock the water quality is more mineralized and groundwater flow is much slower than the overlying unconsolidated aquifer due to fracture flow and lack of permeability. According to the U.S. Geological Survey (USGS), the estimated recoverable groundwater in the aquifer of the basin is 50 million acre-ft. The estimated annual inflow and outflow to the aquifer is 65 thousand acre-ft (Freethey and Anderson, 1986).

2.1.5 Geology

The USAGYPG is located within the Sonoran Desert Southern Basin and Range Physiographic Province. The distinctive topography within this province is uplifted mountains with intervening sediment-filled valleys associated with the tectonic extension

which started approximately 19 Million years (Ma) ago. The majority of the basins are structural depressions filled with alluvial sediments from the river systems that dissect the area and locally derived sediments from the surrounding mountains (Anderson et al, 1992).

The basement rocks in the vicinity of the USAGYPG and surrounding areas are Pre-Tertiary metamorphic and igneous rocks consisting of schist, gneiss, granite, and weakly metamorphosed sedimentary rocks, all intruded by dikes of diorite porphyry and overlain by a thick series of lavas cut by dikes of rhyolite porphyry. Later Tertiary non-marine red-bed sedimentary rocks and volcanics overlie the basement sequence. The Laguna Mountains and Chocolate Mountains are made up of 33 Ma Tertiary volcanics. The late Tertiary, Miocene-Pliocene Bouse Formation overlies a 5.47 Ma tuff. The Bouse Formation is a massive siltstone unit with a basal limestone and is lacustrine/estuarine in origin.

The Palomas and Tank Mountains contain mostly extrusive igneous rocks with lesser amounts of metamorphic rocks. Intrusive igneous rocks are also found in the southern part of the Palomas Mountains. The Muggins Mountains are made up of metamorphic and extrusive igneous rocks with some sedimentary rocks. The Middle Mountains are composed of mostly extrusive igneous rocks with metamorphic and sedimentary rocks. The Trigo and Chocolate Mountains are largely extrusive igneous rocks with some metamorphic rocks. The basins or lowlands between mountain ranges are composed of alluvium which is typically comprised of sand, silt, and clay layers of Quaternary origin. The depth of the sediments is not known; however, wells 1,300 ft in depth have not reached the basin's bedrock floor (Entech Engineers, 1987). Sand dunes are visible features along the base of some mountains in the USAGYPG vicinity. Also, there is evidence in the Materiel Test Area that sand dunes existed in the geologic past. Cross-bedded sands, indicating the presence of buried sand dunes, were found by the U.S. Bureau of Reclamation in soil borings at the petroleum, oil, and lubricants bladder test spill site (USBR, 1993).

2.2 HISTORY

Muggins Mountain OB/OD is comprised of three sites, YPG-35 a, b, and c (Figure 2.1) and is divided into two time periods of operation 1950s through 1974 and 1985 through the late 1990s. Initially in 1952 until 1974, the area was used as the primary OB/OD facility for USAGYPG. Operations were discontinued in 1974 and no further OB/OD activities were conducted at the site until it was reopened in 1985. In 1985, a munitions recovery program was initiated to uncover and demolish buried on-site munitions using OD operations. In the late 1990s all operations were discontinued and the site was closed. The following subsections further discuss the two time periods of operation at Muggins Mountain OB/OD.

2.2.1 Operations from 1950s through 1974

During this period of operations it appears activities were limited to two locations burial trenches (YPG-35b) and OB/OD Area (YPG-35c). The burial trenches (YPG-35b) were used as a storage area for scrap munitions collected throughout USAGYPG. Thousands of inert rounds were reported to have been stored at the site and demilitarized as a result of range cleanup (USATHAMA, 1980). Standard DoD OB/OD procedures in place at the time were used in the detonation process. Munition types that were stored and disposed of on-site included; 75mm, 105mm, 155mm, 8" and 12" projectiles and up to 2,000 lb bombs (USATHAMA, 1980). Following the closure of the site in 1974 and over the next three years, pits and trenches were excavated and filled with munitions scrap and debris. In 1977, burial actions were discontinued and no additional activities were reported to have occurred at the site until 1985.

Various OB/OD operations were performed in the area, which was designated as OB/OD, and also known as YPG-35c. Activities that occurred at YPG-35c during the 1950s and 1960s were not well documented. Interviews with personnel who were involved in past activities indicate that operations involved a relatively large number of detonation pits and only a few OD instances occurred each month. The general use of this area as the base-wide OB/OD facility was discontinued in 1974 when activities were moved to the new OB/OD facility Kofa MTR located approximately 7 ½ miles north-northwest of site YPG-35c (USATHAMA, 1980). Upon the closure of the site in 1974,

disposal of collected MEC/MD was conducted via burial within the Muggins Mountain OB/OD facility (USATHAMA, 1980).

2.2.2 Operations from 1985 through Late 1990s

In 1985, cleanup operations began, at a large open trench referred to as TR-1 (Figure 2.1). Cleanup consisted of retrieving munitions from trench TR-1 and subsequently the OB/OD Area YPG-35c was reactivated in the 1985-1986 timeframe to provide detonation support for suspected live munitions. During the retrieval operations, OD activities were frequent and the detonation pits were defined and limited in area. Operations at the OB/OD area continued during the cleanup of TR-1 until the late 1990s, when cleanup operations of open trench TR-1 were discontinued.

Based on interviews with demolition personnel, who were supporting TR-1 removal operations, activities occurring at the OB/OD facility consisted of munitions OD, phosphorus and propellants OB, and dunnage pit burning for disposal.

2.3 SITE DESCRIPTIONS

The entire Muggins Mountain OB/OD area is approximately 500 acres in size and includes burial trenches, open burn areas, and open detonation pits.

2.3.1 YPG-35a – General Muggins Mountain Open Burn/Open Detonation Area

The YPG-35a site consists of approximately 360 acres. It encompasses the former OB/OD facility area with exception of the Burial Trenches Area (YPG-35b) and the OB/OD Area (YPG-35c) (Figure 2.1). No known burial trenches or areas of soil contamination are known to occur outside of the YPG-35b and -35c boundaries; however, based on site history, two concerns have been identified at YPG-35a:

1. Miscellaneous Surface Debris. The YPG-35a area is sparsely scattered with miscellaneous surface debris that may include MEC/MD. The area may also contain undocumented burial trenches.
2. Desert Washes. Both YPG-35b and -35c contain dry stream beds where open detonation (OD) activities were reported to have occurred. Other

undocumented OD operations may have also occurred in the dry stream beds located within the YPG-35a area.

2.3.2 YPG-35b – Burial Trenches Area

A geophysical survey and visual observations at YPG-35b identified one large open trench (TR-1) and ten suspected burial trenches (TR-2 through TR-11) where MEC/MD disposal may have occurred (Figure 2.2) (Jason, 2007; Appendix B). The Burial Trench Area encompasses approximately 12 acres and the areas of the anomalies suspected to be the burial trenches cover approximately 50-percent of the 12 acres.

2.3.2.1 Large Open Trench (TR-1)

The large open trench (TR-1) at the site is approximately 300 ft long by 25 ft wide by 30 ft deep, and is located in the northwestern portion of the Burial Trench Area (Figure 2.2). Based on historical records and visual observations, the trench contains assorted munitions, some of which remain visible in the bottom sidewalls of the excavation. Though the trench is believed to contain mostly inert materials, it is possible that live munitions and associated munitions constituent (MC) are present. The trench sidewalls appeared to be eroded and unstable in places. A berm on the northwest side of the trench was constructed on reinforced engineered mesh. This berm partially surrounds the trench and prevents rainwater runoff from entering the trench.

Scattered boxes of MEC, a remotely-operated base plate removal machine, and miscellaneous MEC/MD were previously stored in the area of the large open trench. The majority of the MEC/MD was stored on nearly level areas surrounding the trench area and confined to the northwest side of the road entering the Burial Trench Area (Figure 2.2). Miscellaneous MEC/MD items are currently present within the trench and MD is currently visible along the graded area surrounding the trench. The trench may also include non-MEC related scrap such as non-explosive wax and fillers, wooden boxes, banding, nails, scrap metal, wire, and municipal waste.

2.3.2.2 Suspected Burial Trenches

The ten suspected burial trenches identified during the 2007 geophysical survey (Jason, 2007) are located to the northwest and southeast of TR-1 (Figure 2.2), and have been designated as TR-2 through TR-11. The contents of these 10 trenches are unknown; however, prior to 1987, two of the trenches in this area were reported to have been excavated and completely emptied and backfilled. The two emptied trenches were reported to contain 105 and 155 mm artillery shell casings. No documentation exists describing exactly where these two trenches were located and what they contained.

2.3.3 YPG-35c – Open Burn/Open Detonation Area

The YPG-35c site has been designated as the OB/OD Area of the Muggins Mountain and includes the Open Detonation Pits, the Buried and Open Dunnage Pits, the Burn on Ground (BOG) Area, the White Phosphorus (WP) Area, and the General OB/OD Areas (Figure 2.3). These areas are described in the following sub-sections.

2.3.3.1 Open Detonation Pits

The open detonation pits area encompasses a large disturbed section of the OB/OD Area that is approximately 7.5 acres in size, and contains numerous small detonation pits. Included in these pits are numerous open pits on the south and southwest side of Loop Road (Figure 2.3). Many of the OD pits are located along or within two primary dry stream beds, and the area surrounding the OD pits is scattered with MD.

2.3.3.2 Buried and Open Dunnage Pits

Two buried trenches (TR-12 and TR-13), identified as possible dunnage pits, were delineated during the geophysical survey of the OB/OD Area and are located to the east of Loop Road (Figure 2.3). A third dunnage pit TR-14 in the OB/OD Area remains open and is relatively empty, with a small amount of MD in the bottom of the open trench. Small areas of burned material and stained soils are also visible within the pit. Solid waste with MD residue was reportedly burned and cleaned out of the pits so they could be reused.

2.3.3.3 Burn on Ground Area

The BOG Area is portion of the OB/OD Area where open burning of loose propellant, which was placed directly on the ground, occurred. Based on visual evidence of disturbed circular features in the desert pavement, other detonations may have occurred in the area.

2.3.3.4 White Phosphorus Area

The WP Area consists of metal pads and a visual white residue both covering approximately 1 acre. There are a total of five separate metal pads constructed of 6-8 inch thick metal sheets each approximately 4 ft by 4 ft. The visual WP residue is present on the ground and covers an area of approximately 100 ft by 400 ft.

2.3.3.5 General Open Burn/Open Detonation Areas

The General OB/OD Area is approximately 15 acres and is overlapped by the OD Pits, three dunnage pits, and the WP area identified on Figure 2.3. Loose propellant is scattered on the ground throughout the OB/OD Area. Evidence shows the loose propellant may have been scattered from propellant blown out of casings from mortars and rockets. The area is very loosely defined by propellant scattered on the eastern portion of YPG-35c but does not include the BOG Propellant Area.

2.4 TOPOGRAPHY

The Former Muggins Mountain OB/OD Facility (YPG-35a) is characterized by desert features common to the Sonoran Desert. The OB/OD Area (YPG-35a) slopes gradually from south to northwest, and the Burial Trench Area (YPG-35b) is essentially flat. The areas have several ephemeral stream beds which create some topography variation. The elevation of the YPG-35a through c ranges from 470 ft to 547 ft AMSL.

2.5 GEOLOGY

The shallow subsurface lithology at Muggins Mountain consists of silty sand with lesser amounts of gravel. In general, the soils are fine to medium grained and are also light reddish brown in color and vary in size. The shallow subsurface was defined during

the drilling of 34 soil borings within YPG-35b and c. Soil borings ranged in depth from 0-20 ft bgs (Section 4.1.3). The silty sand and gravel encountered during drilling ranged from fine to coarse and the gravel size ranged from pea to cobble. The sand and gravel is well-graded and is light reddish brown in color. Areas where clay was present the color changed to a gray undertone.

The alluvium at YPG-35 a through c is likely the result of two distinct sources: the nearby paleo-Colorado River alluvial deposits; and, secondarily, locally-derived alluvium from Muggins Mountain to the east.

2.6 HYDROLOGY

2.6.1 Surface Water

There are no perennial surface water sources within YPG-35a through c; although there are several ephemeral streams within the boundary. Surface water at the site drains to the northwest to westerly.

2.6.2 Groundwater

Groundwater at USAGYPG is present in two distinct systems: a deep groundwater unit found in volcanic bedrock at depths greater than 500 ft, and a shallower aquifer found in basin-fill sediments comprised largely of alluvial and floodplain deposits. Based on depth to water measurements from USAGYPG production wells, the depth of the shallow aquifer varies widely, ranging from 30 to 40 feet near the Colorado River, to greater than 330 ft in basin areas north of Muggins Mountain. All production wells at USAGYPG, with the exception of Well M near the Castle Dome Heliport, are screened in the shallow aquifer unit. The groundwater from the deeper unit is generally mineralized and too deep to be of significance (Gutierrez-Palmenberg, 2001). Groundwater flow in the region north of Muggins Mountain is to the southwest toward the Colorado and Gila Rivers. A groundwater gradient of approximately 4-5 feet per mile was established for the shallow aquifer north of Muggins Mountain in areas not affected by production well pumping (Entech Engineers, 1988). Groundwater recharge in the YPG-35 area is largely from deeper subsurface inflow from the Castle Dome Plain,

north-northwest of Muggins Mountain. Minor recharge may also come from sporadic stream flow in Muggins Mountain during rare periods of heavy precipitation. Due to very low annual rainfall, averaging around 3 inches per year, precipitation does not provide any direct recharge to basin groundwater and nearly all rainfall is lost to the atmosphere by evapotranspiration (Entech Engineers, 1988).

There are no existing groundwater wells in the Muggins Mountain vicinity, so the depth to groundwater at YPG-35 is unknown. Predicting the depth to groundwater at YPG-35 is also difficult since the deeper lithology underlying the area has not been documented. However, because YPG-35 is located in alluvium along the flanks of Muggins Mountain, it is most likely underlain by coarse-grained sands and gravels that overlie bedrock at depth. Groundwater in such areas is usually quite deep and unconfined. Perched groundwater zones, if present, would likely be minor and discontinuous due to the high energy alluvial depositional environment that characterizes the flanks of mountains. These areas are commonly dominated by highly permeable deposits of sands and gravel and have a small fraction of low-permeability clay and silt layers necessary for perched water environments. If bedrock underlies the YPG-35 site, there would be a possibility of additional perched water present at or near the sediment-bedrock interface, but only if the bedrock were characterized by low fracture density. However, fractures are common in ancient metamorphic rocks such as those present at Muggins Mountain, and if groundwater were present, it would likely be fracture controlled. A similar analogy to this at USAGYPG is the Castle Dome area north of Muggins Mountain. Based on geologic data from Well M in that area, no perched water zones were found above the water table, and the static water level in Well M exceeds 600 ft. Geologic logs of Well M show bedrock was encountered at 210 feet below land surface, but groundwater was not observed until a depth of 780 ft (Entech Engineers, 1988).

If groundwater at YPG-35 is within the unconsolidated sediments above bedrock, an estimate of the depth to groundwater can be developed from water production wells at USAGYPG. The closest production well (Well W) is located approximately 3 miles to the northwest of Muggins Mountain in the Kofa administration area. A contoured

potentiometric surface map of the shallow aquifer was developed from production well water elevation data collected from 1980-1985 (Entech Engineers, 1988). Based on this map, a projected groundwater level elevation at Muggins Mountain in the vicinity of YPG-35 would be between 170 and 180 ft AMSL. Since the surface elevation at YPG-35 is between 470 ft to 547 ft AMSL, a depth to groundwater of between 300 and 400 ft could be expected if bedrock is not encountered.

2.7 VEGETATION

Vegetation across the Former Muggins Mountain OB/OD Facility consists of low-lying shrubs and brush including desert ironwood, palo verde, catclaw acacia, saguaro cactus, ocotillo, Anderson thornbush, Smoketree, and creosote bush. Brittlebush, saltbush, and Bebbia are some common shrubs in the Muggins Mountains.

2.8 LAND USE

The Muggins Mountain OB/OD Facility and surrounding area is controlled and owned by the Army and is part of USAGYPG. Areas surrounding YPG-35 is utilized for military testing and training and there is no other land use planned for the foreseeable future. Lands surrounding USAGYPG are for the most part managed by other Federal agencies and are undeveloped and sparsely populated. The nearest developed population centers are located to the south of USAGYPG, such as Welton and Yuma.

SECTION 3.0

PREVIOUS INVESTIGATIONS

This section describes previous investigations and activities conducted at YPG-35-a, through c. These activities were performed to characterize the sites, and included soil sampling and geophysical surveys. These investigative activities are described in the following subsections.

3.1 RCRA FACILITY ASSESSMENT/REMEDIAL ACTION DOCUMENTS

3.1.1 1997 RCRA Facility Assessment

The 1997 RFA (Tetra Tech, 1998) included a historical records review for selected sites at USAGYPG. The following list summarizes the previous activities conducted at the Muggins Mountain former OB/OD Facility, which were described in the RFA:

- An Initial Installation Assessment (IIA) was conducted in 1978 by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). The IIA Report recommended cleanup operations be conducted at the Muggins Mountain Ammunition Disposal Trench. The report concluded that no facility-wide preliminary survey was needed.
- An on-site CERCLA Installation Assessment (IA) was performed in February 1987 to determine if hazardous waste disposal conditions had changed since the USATHAMA IIA report was published in 1980. The UASATHAMA 1988 report concluded that site investigations should be performed at the Muggins Mountain Ammunition Disposal Trench, and again recommended that no facility-wide investigation be conducted.

A site inspection was also performed as part of the RCRA Facility Assessment (Tetra Tech, 1998). In the assessment report, the Muggins Mountain OB/OD Site is designated as SWMU 57. Although, the report also states there were numerous disposal trenches in the area and that at least some were excavated, SWMU 57 is identified solely

as the large, partially excavated trench. The report also identified SWMU-58 as the area adjacent to the large, open trench where scrap metal retrieved from the trench was stockpiled. The Tetra Tech report made no specific action recommendations for either SWMU-57 or -58, but did indicate that response actions for the operable units (OUs) would be part of the closure process already started at that time.

3.1.2 1998 USACHPPM Survey

The U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM) conducted a survey of the Muggins Mountain OB/OD site in 1998 to evaluate its risk to human health and the environment. The resulting report (USACHPPM, 1998) stated the potential for significant environmental contamination from the inert munitions disposal trench is negligible and localized in the soil immediately below the trench's bottom. It was expected that various explosive compounds and metals commonly used in the construction of projectiles and other munitions items would potentially be present, but no sampling was conducted at the time. The report further stated that the potential health risk to humans would be limited to worker exposure, and health risks to workers due to environmental exposure from chemicals is expected to be low. At that time, the only potentially completed exposure pathway was dust inhalation, which was not expected to contribute significantly to human health risk.

3.1.3 2001 EPA Release Assessment

Based on review of the 1998 RCRA Facility Assessment, a RA of the SWMUs at USAGYPG was performed. The purpose of the RA was to evaluate SWMUs identified during the RFA, as well as other SWMUs that may be discovered, with the goal of reviewing recommendations listed in the report and coming to an independent conclusion. The objective was to determine, for each SWMU, whether no further action (NFA) or further action should be implemented. The Muggins Mountains sites identified in the report, along with recommendations are presented below in Table 3.1.

3.2 1997 CLOSURE PLAN

In 1997, a closure plan for the Muggins Mountain OB/OD Site was prepared and issued in March. The plan identified a process which would cleanup and close the site by removing any contaminated soils to contaminant-specific action levels presented in the plan. The closure plan was based on the premise that retrieval/removal of munitions and contaminated soil from the large open trench was to be completed as necessary until action levels were met. Due to evolving knowledge of the Muggins Mountain OB/OD Site, the 1997 Closure Plan was never implemented and it was decided that the ultimate closure of the site would have to differ significantly from actions presented in the plan.

3.3 2002 INITIAL SITE SAMPLING

An initial sampling effort was conducted at the Muggins Mountain former OB/OD site on December 4, 2002 in accordance with the *Initial; Site Sampling Plan; Muggins Mountain OB/OD Sites* (Jason, 2002a) and documented in an undated memorandum showing results titled *Sampling Event at Muggins Mountain OB/OD Site, Yuma Proving Ground, December 4, 2002 (Jason, 2002b) and Closure Process Document; Muggins Mountain OB/OD Sites* (Jason, 2003a).

The purpose of this soil sampling was to better understand the types, nature, and potential magnitude of contamination. The sampling event consisted of collecting propellant and soil samples from 15 OD pits located in the OD pit area southwest of the loop access road, eight samples from the BOG Propellant Area, and four samples from the WP area (Figure 4.1). Results of this sampling event, summarized in Table 3.2, show one sample from the BOG Propellant Area with a lead concentration of 17,000 mg/kg (BOG-02); well above the Arizona residential soil remediation level (rSRL) of 400 mg/kg and the non-residential soil remediation level (nrSRL) of 800 mg/kg. A sample collected at the WP Area also exceeded the rSRL for lead with a concentration of 512 mg/kg (WP-04). One sample collected at the WP Area had a detection of 2,4-dinitrotoluene (DNT) at 780 mg/kg that exceeded the rSRL of 120 mg/kg but not the nrSRL of 1,200 mg/kg. Additionally, two explosive compounds (2,4,6-trinitrotoluene [TNT] and 2-amino-2,6-dinitrotoluene) were detected in one OD pit sample (HE-07) at concentrations of 270 and 13 mg/kg (respectively), which exceed rSRLs of 31 and 12 mg/kg but not the nrSRLs of

319 and 120 mg/kg. No other constituents detected during this sampling event had concentrations above the nrSRL or rSRL.

3.4 2003 SITE SAMPLING

In April 2003 additional sampling was conducted at the Muggins Mountain site in accordance with *Initial Site Sampling Plan; Muggins Mountain OB/OD Sites* (Jason, 2003b) and documented in an undated memorandum showing results titled *Sampling Event: Propellant Areas at Muggins Mountain OB/OD Site, Yuma Proving Ground* (Jason, 2003c). This document was received by USAGYPG on June 26, 2003.

The April 2003 sampling event included the collection of soil samples from four areas where loose propellant was identified (PA-1 through PA-4) and five washes below or downstream from the OD pits (WS-1 through WS-5) (Figure 4.1). Analytical data packages or reports for this sampling event were not obtained from the laboratory and the summary table (Table 3.3) could not be verified. During this sampling event, six explosives were reported to have had concentrations in excess of the residential SRLs. Nitroglycerin, 2,4,6-TNT, and 1,3-Dinitrobenzene were detected at sample location B-8 with concentrations of 19,000, 110, and 18 mg/kg, respectively. Although this sample is discussed in the text of previous documents, the type of material sampled and the purpose of collecting this sample is unknown and was not recorded. The B-8 sample is thought to have been collected from an area approximately 400 ft south of YPG-35c. A surface soil sample of propellant at location PA-3 had concentrations of 2,4-DNT at 14,000 mg/kg, 2,6-DNT at 750 mg/kg, and 2,4,6-TNT at 44 mg/kg. Concentrations of 2,4-DNT 2,6-DNT, and 2,4,6-TNT, detected in a soil sample collected from 3-6 inches bgs (PS-3) adjacent to the propellant sampled (PA-3), were significantly lower at 34, 1.1, and 0.09 mg/kg, respectively. This indicates that migration of these explosives from the source material into the underlying soil is limited, probably due to low rainfall and high evaporation rates. Samples labeled as "WS" were collected within the dry stream bed to measure possible downstream migration of explosive compounds identified in the previous samples collected in 2002 from the OD pits. These "WS" samples did not have concentrations of explosives above SRLs (Table 3.3).

3.5 2006 SAMPLING EVENT

In April 2006, sampling was conducted in the berm construction area and documented in the *Muggins Mountain Trench Area Berm Sampling and Construction Summary Report* (Jason, 2006). The berm construction area measured 32 ft wide by 640 ft long, and a sample grid was developed for every 15 linear feet of proposed berm. Random grid sampling was performed within the berm area, and three grab samples from each section were collected from the surface, from the 1.0-1.5 ft bgs interval, and from the 2.0-2.5 ft bgs interval. Because unexploded ordnance (UXO) was encountered during the sampling effort, the surface soil samples were the only samples submitted to the lab for analysis (Jason, 2006). Of the proposed 44 samples, 42 were collected and analyzed for explosives (SW8330). Two sample locations were omitted due to the presence of UXO. Analytical results for soil samples collected at the berm construction area were below Arizona rSRLs and nrSRLs.

3.6 2007 GEOPHYSICAL SURVEY

In 2007, a geophysical survey was conducted over the entire YPG-35b site and over an area located in the southeast corner of YPG-35c believed to contain buried trenches. The areas surveyed were determined from historical documents, verbal accounts of personnel working in the area, and visual observations (Jason, 2007). A geophysical survey was not conducted over a large open trench (TR-1), located in YPG-35b, or the area immediately surrounding the trench due to the safety hazard associated with the presence of MEC.

Results of the geophysical survey identified ten suspected burial trenches within YPG-35b (TR-2 through TR-11) (Figure 4.1) and two burial trenches within the surveyed area of YPG-35c (TR-12 and TR-13) (Figure 4.2). The open dunnage pit TR-14 was also identified at that time.

SECTION 4.0

NATURE AND EXTENT OF CONTAMINATION INVESTIGATION

A nature and extent of contamination investigation was conducted at YPG-35a, b, and c as part of the RFI. A description of the investigation activities and results of these activities are presented in the following sections. This section also presents an evaluation of whether sufficient sampling was conducted to adequately characterize the nature and extent of chemicals detected in site media, and provides data to support a human health and ecological risk screening evaluation.

4.1 INVESTIGATION ACTIVITIES

Investigation activities at YPG-35 a, b, and c included the following:

- An instrument-aided qualitative reconnaissance (QR) survey was conducted at YPG-35a and the northern and southern portions of YPG-35c where no known burial trenches or former OB/OD sites are located. Surveys were performed by UXO-qualified technicians. The survey documented a number of MD and MEC items and areas with evidence of detonation/disposal (i.e. OB/OD) activities.
- A site survey was conducted at YPG-35b and c to reacquire soil sampling locations from the 2002 and 2003 investigations (Jason, 2002a and Jason, 2003b) and mark predetermined locations for the RFI soil sampling event conducted by Parsons. The site survey was also conducted to reacquire previously identified burial/trench areas.
- A total of 34 soil borings were drilled and 52 subsurface soil samples collected from various boring depths at YPG-35b and c to determine if chemical constituents from MEC/MD have been released into the soil and have migrated horizontally outside suspected trench areas, defined by magnetic anomalies. Sampling locations were selected to avoid direct contact with magnetic anomalies due to safety concerns for potentially encountering UXO. Areas with geophysical anomalies represent possible buried MEC and MD items and are considered *a priori* to present an unacceptable explosive risk and no intrusive investigations was conducted in these areas. These areas will be addressed in the CMS and this report recommends corrective action be taken for those areas.
- A total of 54 surface soil samples were collected from YPG-35b and c to provide additional analytical data (in addition to data collected during the 2002 and 2003 sampling events) to assist in evaluating potential surface soil contamination source areas.

Table 4.1 presents the investigation activities conducted during the RFI and the characterization objectives of each activity.

4.1.1 YPG-35a

Prior to the RFI there were no known burial or former OB/OD areas within YPG-35a; therefore, no soil samples were planned or collected. However, an instrument-aided QR survey was conducted at the site to locate and document areas with surface MEC or MD and locate areas where OB/OD activities may have been conducted. The site survey was conducted by two UXO-qualified technicians. The field team followed predetermined survey transects which were spaced approximately 200 ft apart over the YPG-35a area (Parsons, 2010). A Schonstedt magnetometer and a Garmin 550 global positioning system (GPS) were used to document the location of surface MEC and MD and site features. Planned survey transects over YPG-35a are presented in the work plan (Parsons, 2010). Results of the instrument-aided QR survey are presented in Section 4.2.1.

4.1.2 YPG-35b

Investigational activities at YPG-35b (Figure 4.1) were initiated with a site survey conducted to relocate the buried trenches TR-2 through TR-11 identified during the previous geophysical survey (Jason, 2007). Soil boring locations were also staked during the site survey, as shown in the work plan (Parsons, 2010). Soil boring locations were selected using a grid with 200 ft by 200 ft cell dimensions. The grid was transposed over the affected area of the site (extending past the current site boundary). One soil boring was then selected inside each grid. When selecting soil boring locations, areas of suspected buried trenches (TR-2 through TR-11) were avoided because of safety concerns; however, soil boring locations were placed in areas around the perimeter of the suspected buried trenches. The soil boring locations were selected to characterize the horizontal extent of buried waste and to determine if chemical contamination was released outside the area of geophysical anomalies and site features.

Following the site survey, 20 soil borings (SB001 through SB020) were drilled and two to three soil samples were collected from each boring. Soil borings were typically drilled to 6 ft bgs; however, four borings located adjacent to the burial areas were drilled to 20 ft bgs. Soil samples were collected from each boring at 0-0.5 ft bgs and 5.5-6 ft bgs depth intervals. An

additional sample was collected from the 19-20 ft bgs depth interval from the four borings located adjacent to the burial areas. Sampling was performed in accordance with the Quality Assurance Project Plan (QAPP) Appendix A of the work plan (Parsons, 2010), and soil samples were sent to an off-site laboratory to be analyzed for explosives, metals, perchlorate, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs). A summary of soil sampling activities at YPG-35b is presented in Table 4.2 and analytical results of the sampling event are presented in tabular form in Appendix C.

There are ten features (TR2 through TR-11) at YPG-35b that have not been sampled due to safety concerns. These features are considered uncharacterized; however, because there is no information about these features other than the possibility that they may contain buried MEC and MD, they will be considered *a priori* to pose an unacceptable risk at the site and will be carried forward into the CMS.

4.1.3 YPG-35c

Investigational activities at YPG-35c (Figure 4.2) consisted of performing an instrument-aided QR survey in the northern and southern portions of the site where no known burial trenches or former OB/OD sites have previously been identified. Additionally a site survey was conducted over the remaining YPG-35c area. During the site survey the buried trenches identified during the 2007 geophysical survey (TR-12 through TR-14) (Jason, 2007) were re-located, OB/OD features and soil sample locations from previous investigations (Jason 2002a and Jason 2003b) were reacquired, and new soil boring locations, as presented in the work plan (Parsons, 2010), were staked. Following the site survey, soil sampling of the following six areas was conducted to complete the characterization and delineate the extent of possible buried MEC/MD and chemical contamination outside of the geophysical anomaly areas:

- Dunnage Pits – 35CSB010 through 35CSB012
- Northeast Area - 35CSB013, 35CSS017 through 35CSS019 and 35CSS023 through 35CSS025
- Southeast Area - 35CSS20 through 35CSS21
- Southwest Area - 35CSS29 through 35CSS31
- Loop Road Area - 35CSS022 and 35CSS026 through 35CSS029

- Detonation Pits - 35CSB001 through 35CSB009, 35CSB014, 35CSS001 through 35CSS011 and 35CSS013 through 35CSS016

Sampling of the BOG Area (BOG-01 through BOG-08), WP Area (35-WP-01 through 35-WP-04), propellant area located south of the dunnage pits (PA-1 through PA-4 and PS-1 through PS-4), and various dry washes (WS-1 through WS-5) was conducted during previous investigations at the site, and additional sampling was not proposed in the work plan and was determined unnecessary.

The dunnage pits could not be directly sampled due to safety concerns regarding the presence of MEC; however, three soil borings (035CSB010 – 035CSB012) were drilled to 20 ft bgs near the pits and samples were collected from 0-0.5 ft bgs, 5.5-6.5 ft bgs, and 19.5-20.5 ft bgs intervals.

In the northeast area, several OB/OD-related features were identified during previous investigations (Jason, 2004). During the current investigation, the features were reestablished and associated soil samples were collected. Investigational activities included the drilling of one soil boring (035CSB013) to 20 ft bgs and collecting associated soil samples from depth intervals of 0-0.5 ft bgs, 5.5-6.5 ft bgs, and 19.5-20.5 ft bgs. Three surface soils samples (035CSS017 – 035CSS019) and three associated dry-wash soil samples (035CSS023 – 035CSS025) were also collected from this area at a depth interval of 0-0.5 ft bgs.

Investigational activities in the southeast area consisted of collecting surface soil samples (035CSS20 and 035CSS21) where OB/OD features were identified during previous investigations (Jason, 2004). These locations are not part of the large OD pit cluster located to the west. Soil samples were analyzed for explosives, SVOCs, metals, and perchlorate.

Investigational activities in the southwest area consisted of collecting surface soil samples from dry wash areas located downstream from the large concentration of OD pits (035CSS029 – 035CSS031). Samples from the dry wash areas were collected to verify that contaminants from the large concentration of OD pits have not migrated downstream.

Several OB/OD-related features were also identified during the previous investigations in the areas of Loop Road. During the current investigation, these features were surveyed, reestablished and sampled. One surface soil sample (035CSS022) and three dry-wash samples (035CSS026 – 035CSS028) were collected in this area from a depth interval of 0-0.5 ft bgs.

Although the Detonation Pits area was sampled during previous investigations (35-HE-01 – 35-HE-16), additional soil sampling was conducted due to the large cluster of pits which possibly represent an extended area of contamination. As in the Burial Trenches area, sample locations were determined by transposing a grid with 200 ft by 200 ft cells dimensions over the suspected area. In cell locations (035CSB001 – 035CSB009 and 035CSB014), where soil samples had been previously collected and/or detonation pits identified, borings were drilled to 20 ft bgs and soil samples were collected at depth intervals of 0-0.5 ft bgs, 5.5-6.5 ft bgs, and 19.5-20.5 ft bgs. Surface soil samples (035CSS001 – 035CSS011 and 035CSS013 – 035CSS016) were collected from the other cell locations to determine if contamination extends beyond the clusters.

Soil sampling was performed in accordance with the QAPP (Appendix A of the work plan) (Parsons, 2010), and soil samples were sent to an off-site laboratory to be analyzed for VOCs (not analyzed for surface samples), SVOCs, explosives, metals, and perchlorate. A summary of soil sampling activities at YPG-35c is presented in Table 4.3 and analytical results of the sampling event presented in tabular form in Appendix C.

There are three features (TR12 through TR-14) at YPG-35c that have not been sampled due to safety concerns related to the presence of MEC. These features are considered uncharacterized; however, because there is no information about these features other than the possibility that they may contain buried MEC and MD, they will be considered *a priori* to pose an unacceptable risk at the site and will be carried forward into the CMS.

4.1.4 Planned Versus Completed RFI Activities

Table 4.4 presents activities proposed in the work plan (Parsons, 2010) versus activities completed during the investigation at YPG-35a, b and c. In additional to the activities presented in the work plan, no supplemental activities were conducted at the site. The only change in scope was the addition of two areas to the instrument-aided QR survey. These areas are located in the northern and southern portions of YPG-35c, and were added to the survey because there was no evidence of burial or OB/OD activities the areas and they could be safely surveyed using this method.

4.2 INVESTIGATION RESULTS

4.2.1 Instrument-Aided QR Survey Results

The previously described instrument-aided QR survey was conducted across 340 acres of YPG-35, and included the majority of YPG-35a and the northern and southern portions of YPG-35c. Approximately 41,800 linear ft of transects covered the area and munitions within site of the walked transects were recorded. Waypoints were taken at intervals of approximately 500 linear ft and notable land features were also recorded. Table 4.5 provides a summary of the instrument-aided QR survey, and includes waypoints taken and MEC/MD encountered during the survey. Figure 4.3 is the associated map, which identifies waypoints, transects followed, and the location of MEC/MD. A total of 134 waypoints were taken during the QR survey; of those, 75 contained various amounts of MD and 15 contained various MEC items (Table 4.4 and Figure 4.4). The majority of the potential MEC items were located in the southeastern portion of YPG-35a, with no MEC identified north of YPG-35c and south of YPG-35b. The south-southeast boundary of YPG-35a shown on Figure 4.4 was selected arbitrarily during the initial site surveys/historical record reviews as part of the RA. Based on the QR survey, the site boundaries may be extended to the south.

4.2.2 Site Survey Results

During the site survey, dunnage pits TR-2 through TR-11 (located in YPG-35b) and TR-12 through TR-14 (located in YPG-35c) were reacquired. Soil sampling locations from 2002 and 2003 sampling events were also reacquired at YPG-35c. The soil sampling locations included samples collected from the BOG area (BOG-01 through BOG-08), WP area (WP-01 through WP-04), HE area (HE-01 through HE-16), propellant area (PA-1 through PA-4 and PS-1 through PS-4), and various washes (WS-1 through WS-5) (Jason, 2003b). Results of these previous sampling events are reported in Appendix F. In addition to reacquiring previous soil sample locations, the locations of 20 proposed soil borings (SB001 through SB020) at YPG-35b were staked during the survey. These borings were located within pre-established grids presented in the work plan (Parsons, 2010).

4.2.3 Data Quality

The analytical data from surface soil samples and soil samples collected from soil borings have been reviewed, verified, and validated with regard to quality and usability. No major quality control issues were discovered during the quality control assessment; therefore, the data are considered complete and usable for decision making purposes. With the exception of one rejected result, which did not affect the overall characterization of the site, all results were usable. Data were validated by a third-party data validator using the protocols listed in the QAPP (Appendix A; Parsons, 2010) and USEPA Contract Laboratory Program (CLP) National Functional Guidelines. A more detailed analytical quality control summary report is included in Appendix C. Appendix C also contains a table of all analytical results (Table C.1).

4.2.4 Soil Screening Values

4.2.4.1 Background Threshold Values

The objectives of collecting soil samples at YPG-35a and b were to:

1. Determine if soils outside the uncharacterized features (e.g. buried trenches) were impacted by site activities,
2. Evaluate the vertical and horizontal extent of areas outside the uncharacterized features, and
3. Provide data to support human health and ecological risk screening assessments (Section 5.0).

Background soil borings were drilled to the north and west of the site to evaluate metals results and determine if site activities have impacted soils. One surface and one subsurface soil sample were collected from each soil boring and analyzed for 24 metals. These data were combined into a background soil dataset. Organic compounds were not analyzed in the background soils and detections of organic constituents are considered site related. The background metals data were processed using the statistical approach presented in Appendix A of the RFI Work Plan (Parsons 2010, Appendix A). Statistical calculations of the data were used to derive a background threshold value (BTV) for each detected metal. The BTVs represent the ninety-five percent upper confidence level for the background value. The BTV calculation methods, background dataset, and the BTVs for metals at YPG-35 are presented in Appendix D.

The BTVs were used to establish background metals concentrations for the purposes of identifying soils that may have been impacted by activities at the site. If a soil sample concentration exceeded the BTV, it was assumed that the concentration may be a result of site activities. A final step in the evaluation of metals concentrations in soils was the application of professional judgment (e.g., changes in soil type and an evaluation of concentration gradients) to evaluate whether soil sample results with metals concentrations that exceed the BTV are a result of site activities.

4.2.4.2 Remediation Goals

The vertical and horizontal extent of impacts to soil was determined by comparing soil concentrations to remediation goals. Remediation goals include the state of Arizona nrSRLs and the minimum groundwater protection levels (GPLs). The nrSRLs are published in Appendix A of the Arizona Administrative Code R18-7-205 (ADEQ, 2007). The GPLs are based on state of Arizona guidance document *A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality* (ADEQ, 1996). Vertical and horizontal extent of soil impacted by site activities is defined by soil samples that have concentrations that exceed remediation goals.

4.2.5 Evaluation of Soil Analytical Results

The purpose of this section is to present and evaluate metals and organic constituents detected during the RFI. The evaluation includes comparing soil metal concentrations to BTVs and remediation goals, and comparing organic constituents to remediation goals. The specific evaluation includes the following:

1. Identifying chemicals of potential concern (COPCs) detected in characterized site soils with concentrations above BTVs for metals.
2. Determining which (if any) chemicals identified during Step 1 and any detected organic chemicals exceeded corresponding ADEQ nrSRLs or GPLs.
3. Using professional judgment (consisting of an evaluation of the magnitude, frequency, and spatial distributions of chemical concentrations) to determine if adequate soil sampling was conducted for the chemicals identified in Step 2.

A total of 54 surface soil samples, 52 subsurface soil samples, and seven field duplicates were collected from YPG-35b and c and analyzed for VOCs, SVOCs, metals, explosives, and perchlorate (Section 4.1). Surface and subsurface soil samples were collected from locations adjacent to uncharacterized features to determine if waste or chemicals extend beyond the established boundaries based on the results of previous investigations, instrument-aided QR survey, and visual survey results.

Detections in surface and subsurface soil samples consisted of select VOCs, SVOCs, explosives, metals, and perchlorate (Tables 4.6, 4.7 and 4.8). The BTV and remediation goal comparison steps are presented below. Sampling locations and analyte concentrations detected above remediation goals are presented on Figures 4.1 and 4.2.

Step 1 – Background Threshold Value Comparison

The first step in evaluating impacts to soil at YPG-35b and c was to compare the analytical inorganic soil sample results to the BTVs. The BTV calculation method was presented in the RFI Work Plan (Parsons, 2010) and included background samples from the periphery of YPG-35 (Appendix D). Table 4.6 presents the inorganic soil sample results for samples collected during the field investigation. Soil concentrations were compared to the BTVs and results shown in bold font indicate values that exceed the BTV. A total of 44 soil samples of the 106 soil samples analyzed have inorganic concentrations greater than their respective BTV. Of the 44 samples with inorganic concentrations greater than BTVs, 31 were collected from the surface, 8 were collected from the 5.5 – 6.5 ft bgs interval, and 4 samples were collected from the 19.5 – 20.5 ft bgs interval. Table 4.9 details the soil boring and samples with metals exceeding BTVs.

Based on the results of the BTV comparison antimony, arsenic, beryllium, calcium, cobalt, magnesium, sodium, and vanadium were eliminated from further evaluation because the soil concentrations in these metals were less than BTVs. The metals aluminum, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, thallium, and zinc were carried forward to the subsequent steps in this analysis.

Step 2 – nrSRL and GPL Comparison

The extent of contamination was evaluated by comparing inorganic (Table 4.6) and organic (Table 4.7) analytical results to the remediation goals (i.e., ADEQ nrSRLs and minimum GPLs). Detected organic compounds and inorganic results with concentrations above BTVs were included in this evaluation (i.e., potentially site-related inorganics). The evaluation showed that although several organic compounds were detected in site soils, no organic compounds had concentrations above their corresponding rSRLs or GPLs.

One metal (lead) was found at an estimated concentration of 300 mg/kg in one surface soil sample (35BSB007) collected from the site. This concentration slightly exceeded its corresponding GPL of 290 mg/kg but not the corresponding rSRL of 400 mg/kg. The soil sample collected from the 5.5-6.5 ft bgs interval of this boring had an estimated lead concentration of 32.5 mg/kg. This concentration exceeded the BTV of 14 mg/kg, but not the corresponding GPL or rSRL.

Step 3 - Professional Judgment

Lead was detected above its corresponding GPL, but not its corresponding rSRL, in a single surface soil sample from a boring location at YPG-35b. The lead contamination may be associated metallic surface debris, since the boring was located on the boundary of the burial trench area. Therefore, the horizontal and vertical extent of contamination has been determined for lead and additional sampling for lead is not warranted.

4.2.6 Groundwater Evaluation

A groundwater evaluation was not performed as part of the RFI at YPG-35. YPG-35 is a large site and prior to installing groundwater wells, it is necessary to define: extent of buried MEC waste, types of wastes, potential constituents of concern, and extent of soil contamination. Results of the soil investigation combined with the QR survey and previous geophysical surveys provide an understanding of the areas of concern. The Muggins Mountain hydrogeology is discussed in Section 2.6.2. There are no groundwater monitoring wells in the Muggins Mountain vicinity, so the type of aquifer underlying the site and depth to groundwater is unknown. YPG-35 is located in alluvium along the flanks of Muggins Mountain. Muggins Mountain is comprised of metamorphic bedrock which only yields water in substantial quantities when the

rock is fractured. This bedrock may continue to dip under the shallow alluvium present at YPG-35 and underlie the area. Groundwater within the bedrock would be expected to be limited to areas of fracturing due to the low porosity of the dense rock. If bedrock indeed underlies the site, there is a possibility of a localized perched water bearing zone located within the unconsolidated sediments directly above the bedrock interface. If groundwater at YPG-35 is within the unconsolidated sediments above bedrock, an estimate of the depth to groundwater at YPG-35 is estimated between 300 and 400 ft.

4.3 CONTAMINATION ASSESSMENT

A total of 106 surface and soil boring samples were collected from YPG-35b and c. Of the samples analyzed, numerous inorganic compounds were detected in surface and subsurface soils that exceeded BTVs; however, only one metal (lead) was found to slightly exceed its corresponding GPL. Lead contamination is believed to be associated with surface metallic debris from the large open trench located within the burial trench area. This metal is believed to be stable and has not migrated to any significant degree, based on concentrations less than remediation goals in underlying samples.

4.4 NATURE AND EXTENT RECOMMENDATIONS

Based on results of past and current soil sampling activities, the nature and extent of contamination investigation has been completed. Only one metal (lead) slightly exceeds the corresponding remediation goals (i.e., GPL) and the extent of lead has been defined. All other inorganic and organic constituents have been delineated to the BTV or identified remediation goal. Areas of buried or uncharacterized wastes have been delineated. Due to safety concerns from potential MEC, no intrusive work was completed and these areas were considered a priori to present an unacceptable explosive risk. These areas of buried and uncharacterized wastes will be recommended for corrective action in the corrective measures study (CMS).

Groundwater samples were not collected as part of the RFI but groundwater monitoring is recommended as part of the corrective measures program. The corrective measures program should develop decision rules for the installation of groundwater wells based on whether a perched water bearing zone is identified, bedrock is encountered, and depth of alluvium.

Further corrective measure decisions will be developed based on the human and ecological risk assessments, as presented in Section 5.0. Risk assessments will include results of the current sampling activities and results of the 2002and 2003 sampling events (Jason, 2002b and Jason, 2003c).

SECTION 5.0
HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

The objectives of the human health risk assessment (HRA) and ecological risk assessment (ERA) were to:

- Assess potential risks and hazards from exposure to site soils.
- Support development of either a no further action (NFA) decision (if no unacceptable risks or hazards are identified) or cleanup goals and remedial alternatives under the CMS task (if unacceptable risks and/or hazards are identified).

This Section presents the methods and results of the HRA and ERA performed as one of the steps of the RFI for YPG-35a through 35c.

5.1 SCREENING LEVEL HUMAN HEALTH RISK ASSESSMENT

This screening level HRA evaluates the potential for human health impacts from assumed exposures to COPCs within YPG-35a through 35c, an inactive landfill at USAGYPG in Yuma, Arizona. The results of this HRA provide a basis for decisions regarding further action, if necessary, with respect to the COPCs at the site.

Following U.S. Environmental Protection Agency (USEPA) (1989) guidance, the HRA process consists of six major components:

- Development of the Conceptual Site Model (CSM)
- Selection of COPCs
- Estimation of chemical exposure
- Toxicity assessment
- Risk characterization
- Uncertainty analysis

Each step of the HRA process is discussed in detail below. This HRA was conducted using methods consistent with USEPA (1989, 1990, 2002, 2010) guidance.

5.1.1 Development of the Conceptual Site Model

Developing a CSM is a critical step in properly evaluating potential exposures at a site. The CSM is a comprehensive representation of the site that documents the potential for exposure (under current and future land use) to chemicals at a site based on the source of contamination, the release mechanism, migration routes, exposure pathways, and receptors either at the site or that may reasonably be anticipated to be at the site (USEPA, 2002).

Three sites, YPG-35a through YPG-35c, make up the former Muggins Mountain OB/OD area (Figure 2.1). Muggins Mountain was used from 1952 until 1974 for the treatment of unused, rejected, and waste munitions from various localities around USAGYPG. The entire site is approximately 500 acres and includes burial trenches, open burn areas, and open detonation pits (Parsons, 2010). Muggins Mountain is located within the southwestern portion of the Kofa Firing Range, approximately 3 miles southeast of the Kofa Administration Area at the base of Muggins Mountain. The three areas are described in more detail below:

- YPG-35a General Muggins Mountain OB/OD Area: approximately 360 acres and excludes YPG-35b and YPG-35c. Open detonation operations may have occurred in dry stream beds within the site. Miscellaneous surface debris may also be present as kick-outs from OB/OD operations at YPG-35b and YPG-35c. However, a visual instrument-aided reconnaissance was performed by a qualified UXO technician at YPG-35a and no surface debris or OB/OD sites were found. Therefore, it is assumed that there were no releases at YPG-35a and the site is not evaluated further here.
- YPG-35b Burial Trenches Area (13.47 acres): a geophysical survey and visual observations at YPG-35b have identified one large open trench (TR-1) and 10 suspect burial trenches (TR-2 to TR-11) where MEC and MD disposal may have occurred (Figure 2.2). The burial trenches (TR-2 to TR-11) are assumed to contain buried MEC.
- YPG-35c OB/OD Area of Muggins Mountain (52.98 acres): includes detonation pits, open dunnage pit TR-14, two suspected burial trenches TR-12 and TR-13, an area where propellants were burned on the ground surface called the "BOG Propellant Area", and an area where WP was burned on the ground surface (Figure 2.3). The burial trenches (TR-12 to TR-14) are assumed to contain buried MEC.

In 1977, burial actions were discontinued and no additional activities are reported to have occurred at the site until 1985. Cleanup operations began in 1985, which involved removing and disposing of munitions from the burial trenches at YPG-35b. Subsequently, the OB/OD Area was reactivated in the 1985-1986 timeframe to provide detonation support for live or suspected-live munitions removed from open trench TR-1 at YPG-35b. Operations at the OB/OD area continued to support the Burial Trenches Area cleanup until the late 1990s, when cleanup of open trench TR-1 was discontinued.

For the forseeable future, Muggins Mountain will remain vacant unused land. The site has been listed in the base master plan as "to be removed from consideration for new construction projects," meaning that there are no plans for development of the site in the future.

5.1.2 Selection of Chemicals of Potential Concern

The COPCs are those chemicals detected in environmental media at the site for which may result in adverse health effects. The selection of COPCs consisted of a three step process, as follows:

- Data review;
- Exclusion of essential nutrients;
- Identification of metals elevated above background; and
- Screening against risk-based screening levels.

Each of these steps is presented below.

The data collected by Parsons at the site is presented in detail in Section 4. Briefly, a total of 20 soil borings were drilled at YPG-35b from which a total of 48 samples (including 4 duplicates) were collected. At YPG-35c, 14 borings were advanced from which a total of 35 samples (including 3 duplicates) were collected. Note that no borings were advanced within burial trenches TR-2 to TR-14 due to the potential presence of MEC. However, borings were advanced adjacent to the trenches (Figures 4.1 and 4.2). An additional 31 (including 1 duplicate) surface (0-0.5 ft bgs) grab samples were collected at YPG-35c. All samples were analyzed for metals via USEPA Methods 6010B and 7471A, VOCs via USEPA Method 8260B, SVOCs via USEPA Method

8270C, explosives via USEPA Method 8330, nitroguanidine via UW29 or USEPA Method 8330. The sample locations are shown in Figures 4.1 and 4.2.

Jason and Associates (2002b, 2003c) completed two sampling events in 2002 and 2003 at YPG-35c. Twenty seven soil samples were collected in December 2002, analyzed for lead USEPA Method 6010B, explosives USEPA Method 8330, and SVOCs via USEPA Method 8270C, and are designed with WP, HE, and BOG in Figure 4.2. In the 2003 sampling event, 9 samples were collected, analyzed for metals via USEPA Methods 6010B and 7471, explosives via USEPA Method 8330, perchlorate via USEPA Method 6850, and are designated with a B, PA, PS, or WS. All samples collected by Jason and Associates (2002b, 2003c) were used in this assessment (Figure 4.2), except for PA-3 and B-8 which were samples of propellant found on the ground surface and are not representative of soils. Two samples were also collected outside the YPG-35a,b,c site boundaries and were excluded from the risk assessment; i.e., B-8 and WS-1. These samples are also not shown on Figure 4.2.

The quality of the data collected by Parsons was evaluated in Appendix C. As part of the data quality assessment, the data was assigned qualifiers. Data without qualifiers and data with J qualifiers were considered appropriate for risk assessment purposes (USEPA, 1989, 1992). U and UJ qualified data were considered to be non-detect (ND) but usable for risk assessment purposes. R qualified data were excluded from this risk assessment (USEPA, 1989, 1992). The data collected by Jason and Associates (2002b, 2003c) was not validated following USEPA Contract Laboratory Program (CLP) National Functional Guidelines as was done for the data collected by Parsons (see Appendix C). Therefore, the data collected by Jason was used here as is. The data collected from 0-6.5 ft bgs was evaluated in the selection of COPCs. Normally, data from 0-10 ft bgs would be used in the selection of COPCs; however, no soil samples were collected between 6.5 and 19 ft bgs at YPG-35b or YPG-35c. Therefore, all data from 0-6.5 ft bgs was used in the selection of COPCs.

Essential human nutrients are toxic only at very high doses (i.e., much higher than those associated with exposure at a site) and were excluded as COPCs. These include calcium, iron, magnesium, potassium, and sodium (USEPA 1989).

Next, metals were compared to the BTVs (see Appendix D). Metals detected at concentrations below the BTVs were assumed to be present at background concentrations and were not evaluated further, while metals detected at concentrations greater than the BTVs were evaluated in the next step.

At YPG-35b, the following metals were detected at concentrations greater than the BTVs at 0-6.5 ft bgs (Table 5.1):

- Barium
- Cadmium
- Chromium, total
- Lead
- Manganese
- Mercury
- Molybdenum
- Thallium (no BTV and, therefore, assumed to be elevated)
- Zinc

At site YPG-35c, the following metals were detected at concentrations greater than the BTVs at 0-6.5 ft bgs (Table 5.2):

- Aluminum
- Cadmium
- Chromium, total
- Copper
- Lead
- Manganese
- Mercury
- Molybdenum
- Nickel
- Selenium
- Silver (no BTV and, therefore, assumed to be elevated)
- Thallium (no BTV and, therefore, assumed to be elevated)
- Zinc

Lastly, the maximum detected concentrations of inorganics exceeding the BTVs and all detected organic compounds were compared to the ADEQ (2007) nrSRLs. Those chemicals detected at concentrations exceeding the nrSRLs were identified as COPCs for evaluation in the HRA. The non-residential SRLs were used in the selection of COPCs as the site will not be developed in the future.

At YPG-35b, none of the chemicals were detected at concentrations exceeding the nrSRLs outside of the burial trenches (Table 5.1). Therefore, no COPCs were identified at site YPG-35b. Since no COPCs were selected for evaluation at YPG-35b, no further evaluation outside of the burial trenches is required, as detailed in the approved work plan (Parsons 2010). Therefore, risks to human health from potential exposures to COPCs at YPG-35 b are not anticipated and further action is not needed at the site on the basis of human health risk outside of the burial trenches.

At YPG-35c, only lead was detected at concentrations exceeding the nrSRLs outside of the burial trenches (Table 5.2). Since lead exceeded nrSRLs, a Tier 2 evaluation was performed as outlined in the Parsons (2010) work plan. A Tier 2 evaluation is considered a refinement step and consists of comparing 95% upper confidence limits (UCLs) to the nrSRLs. The UCL for lead in soils at YPG-35c is 1,150 mg/kg which still exceeds the nrSRL (Table 5.3). However, the UCL appears to be heavily influenced by the maximum concentration of 17,000 mg/kg, which was detected at BOG-2 by Jason (2002b). If BOG-02 is remediated, the UCL would drop to 57.62 mg/kg (Table 5.4), well below the nrSRL, eliminating non-residential human health risks due to assumed exposures to lead at YPG-35c. Therefore, it is recommended that sample location BOG-02 be remediated to eliminate the potential risks to non-residential human receptors from potential exposures to lead. Following remediation, it is anticipated that no other action will be required outside of the burial trenches at the site to meet the nrSRL requirements set forth by ADEQ.

At both YPG-35b and 35c, there were burial trenches (TR-2 through TR-14) that were assumed to contain MEC. The potential presence of MEC is assumed *a priori* to represent an unacceptable explosive hazard. Due to safety concerns from the potential presence of MEC, the trenches could not be sampled and the risks and hazards from

assumed exposures to chemicals that may be present in the trenches could not be assessed.

5.2 ECOLOGICAL RISK ASSESSMENT

This ERA evaluates the potential for ecological impacts from potential exposure to chemicals of potential ecological concern (COPECs) in soils at YPG-35 b and c. The results of this ERA provide a basis for consideration in making decisions regarding further action with respect to the COPECs in soils at the site. This section presents a summary of the ERA for YPG-35 b and c. The ERA is presented in detail in Appendix E.

Following USEPA (1997, 1998) guidance, the ERA process consists of four major components:

- Problem formulation
- Analysis
- Risk characterization
- Uncertainty analysis

This section presents a summary of the ERA for sites YPG-35a through 35c. The ERA is presented in detail in Appendix E. Each step of the ERA process is summarized below

5.2.1 Problem Formulation

5.2.1.1 Habitat Characterization

USAGYPG is located in the Sonoran Desert, a low elevation, hot, arid desert. It is characterized by high daytime temperatures with large daily temperature variations, low relative humidity, and very low average precipitation. No perennial lakes or streams occur within USAGYPG; however, two major rivers flow through the adjacent desert; (i.e., the Colorado and Gila Rivers) See Section 2.1 for additional information regarding the climate and surface water hydrology of USAGYPG.

Approximately 62 species of mammals, 141 species of birds, 33 species of reptiles, and three species of amphibians have been observed at USAGYPG. No fish

have been recorded at USAGYPG. Numerous plant species have been recorded at USAGYPG, including eight Arizona special status species (Table E.1).

5.2.1.2 Site Description and Land Use

As discussed in Section 2.3 and 5.1.1, the Muggins Mountain OB/OD area (Figure 2.1) is located within the southwestern portion of the Kofa Firing Range, approximately 3 miles southeast of the Kofa Administration Area at the base of Muggins Mountain. The area includes burial trenches, open burn areas, and open detonation pits. As stated previously, only YPG sites 35 b and c were evaluated.

For the forseeable future, Muggins Mountain will remain vacant unused land. The site has been listed in the base master plan as "to be removed from consideration for new construction projects," meaning that there are no plans for development of the site in the future.

Much of the site has been disturbed by past landfill disposal activities and has little to no vegetation. Vegetation across the Former Muggins Mountain OB/OD Facility consists of low-lying shrubs and brush including desert ironwood, palo verde, catclaw acacia, saguaro cactus, ocotillo, Anderson thornbush, Smoketree, and creosote bush. Brittlebush, saltbush, and Bebbia are some common shrubs in the Muggins Mountains.

5.2.1.3 Selection of Representative Ecological Receptors

Ecological receptors (i.e., representative species) include non-domesticated plants and wildlife that may reasonably be expected to inhabit or regularly forage at the site, given current and anticipated future site conditions. As generally recognized by ERA guidance documents, it is impractical to evaluate all possible ecological receptors for a given site. Instead, a few species representative of the habitat functions and trophic structure present are selected for evaluation in the ERA. The representative species selected for evaluation are listed in Table 5.2.

5.2.1.4 Selection of Chemicals of Potential Ecological Concern

Using the process presented in Appendix E, the following COPECs were selected for each site (Tables E2 and E3):

- YPG-35b
    - Bis(2-ethylhexyl)phthalate
    - Cadmium
    - Lead
    - Manganese
    - Thallium
    - Zinc

- YPG-35c
    - Antimony
    - Benzoic acid
    - Bis(2-ethylhexyl)phthalate
    - Cadmium
    - Copper
    - Di-n-butyl phthalate
    - 1,3-Dinitrobenzene
    - 2,4-Dinitrotoluene
    - 2,6 Dinitrotoluene
    - Lead
    - Manganese
    - Mercury
    - Nitrobenzene
    - Nitroguanidine
    - Perchlorate
    - Selenium
    - Tetryl
    - 2,4,6-Trinitrotoluene
    - Vanadium
    - Zinc

All COPECs were evaluated in this ERA.

5.2.1.5 Exposure Pathways

Exposures to COPECs were quantitatively evaluated for the following pathways at YPG-35 b and c:

- Incidental ingestion of soils
- Ingestion of site-associated biota

These pathways are described in detail in Appendix E. Note that there is no surface water at YPG-35 b and c and groundwater occurs at approximately 300-400 ft bgs at the site (Section 2.6.2). Therefore, the surface water, sediment, and groundwater exposure pathways were determined to be incomplete and were not evaluated.

5.2.2 Analysis

Toxicity reference values (TRVs) are used to evaluate the potential hazards from the exposure estimated for each COPEC. TRVs protective of reproductive and developmental effects were used in this ERA. The sources from which the TRVs were obtained are provided in Appendix E.

To estimate exposures, exposure point concentrations (EPCs) were calculated for the COPECs in soils as the lesser of the UCL and the maximum detected concentration. For plants and invertebrates, the soil EPC was used to evaluate exposures. For birds, mammals, and reptiles, dietary exposures were estimated using bioaccumulation models, estimated ingestion rates, and dietary composition. The models and parameters used to estimate dietary exposures are described in detail in Appendix E.

5.2.3 Risk Characterization

Risk characterization involves two components; hazard estimates and risk description. For vertebrates, hazard estimates are based on the comparison of average daily dose to the chemical- and receptor-specific TRVs and are expressed as a hazard quotient (HQ). For invertebrates and plants, the HQ is calculated by dividing the soil EPC by the benchmark concentration. The HQs greater than one indicate that adverse effects may occur. A no observable adverse effects level (NOAEL)-based HQ of 1 is the threshold at or below which the contaminant is unlikely to cause adverse ecological effects; NOAEL-based HQs greater than 1 indicate that exposures exceed a no-effect dose and do not necessarily indicate that adverse effects will occur. Lowest observable adverse effects level (LOAEL)-based HQs better indicate the potential for adverse effects to receptors because they are based on effect-based toxicological data. Thus, LOAEL-

based HQs greater than one indicate that adverse effects will probably occur, but whether or not significant effects would actually occur cannot be judged with certainty.

At both YPG-35b and 35c, there were burial trenches (TR-2 through TR-14) that were assumed to contain MEC. Due to safety concerns from the potential presence of MEC, the trenches could not be sampled and the hazards from assumed exposures to chemicals that may be present in the trenches could not be assessed.

5.2.3.1 Plant and Invertebrate Receptor Hazard Estimates

At YPG-35b, site related exposures to thallium may result in adverse effects for plants while site related exposures are not expected to result in adverse effects for invertebrates. At YPG-35c, site related exposures to 2,4-dinitrotoluene, lead, and selenium may result in adverse effects for plants; and site related exposures to 2,4-dinitrotoluene, nitrobenzene, perchlorate, and selenium may result in adverse effects for invertebrates.

5.2.3.2 Vertebrate Receptor Hazard Estimates

At YPG-35b, the LOAEL-based HQs and hazard indexes (HIs) (i.e., the sum of all HQs for an individual receptor) were less than the threshold value of one for all receptors. Indicating adverse effects to vertebrate receptors from soil exposures at YPG-35b are unlikely. In contrast, for YPG-35c, the LOAEL-based hazard indexes exceeded the threshold value of one for all receptors except the kit fox. Assumed exposures to di-n-butyl phthalate, 2,4-dinitrotoluene, and 2,6-dinitortoluene may result in adverse effects for the desert shrew, little pocket mouse, American kestrel, Gambel's quail, verdin, and Sonoran desert tortoise.

5.2.4 Uncertainty Analysis

All risk assessments involve the use of assumptions, professional judgment, and imperfect data to varying degrees, which results in uncertainty in the final hazard estimates. A complete discussion of the uncertainties associated with this ERA is presented in detail in Appendix E.

5.3 SOIL-TO-GROUNDWATER EVALUATION

One soil boring sample at YPG-35b has a lead concentration of 300 mg/kg, which exceeded its corresponding minimum GPL at the 0-0.5 ft bgs interval. However, the same sample location, at a deeper interval of 5.5-6.5 ft bgs, has a lead concentration of 32.5 mg/kg, which is over a 90% reduction in concentrations and is well below the minimum GPL. Since the lead does not appear to be migrating vertically and the depth to groundwater is estimated to be approximately 300-400 ft bgs, it is highly unlikely concentrations at the site could adversely affect groundwater in the future.

Although a site-specific leachability study could be conducted to determine the ratio of leachable lead, the site-specific vertical migration data support that the lead is sufficiently stable and would not adversely impact groundwater at the site; and therefore, a leachability study is not warranted. Furthermore, there was one out of 20 samples collected at the site with concentrations which exceed the minimum GPL. However, there are portions of the site considered *a priori*, to present an unacceptable risk at the site, and the waste in these areas has not been fully characterized. Evaluation of future groundwater impacts at the site should focus on these uncharacterized locations and should be addressed in the CMS. At YPG-35c no chemical concentrations exceeded the minimum GPL.

5.4 CONCLUSIONS OF THE RISK ASSESSMENT

One of the final steps of an RFI includes an evaluation of the human health and ecological risks associated with potential exposure to hazardous constituents which may be present at a site. The objectives of this risk assessment were to assess potential risks and hazards from exposure to contaminants in soils and to recommend either NFA (if the risks and hazards are acceptable) or of the development of cleanup goals and remedial alternatives under a CMS task if unacceptable risks or hazards were identified.

At both YPG-35b and 35c, there were burial trenches (TR-2 through TR-14) that were assumed to contain MEC. The potential presence of MEC is assumed a priori to represent an unacceptable explosive hazard. Due to safety concerns from the potential presence of MEC, the trenches could not be sampled and the risks and hazards from

assumed exposures to chemicals that may be present in the trenches could not be assessed.

At YPG-35b, site related exposures to thallium may result in adverse effects for plants while site related exposures are not expected to result in adverse effects for invertebrates. For the vertebrate receptors, the LOAEL-based HQs and HIs (i.e., the sum of all HQs for an individual receptor) were less than the threshold value of one for all receptors, indicating adverse effects to vertebrate receptors from soil exposures at YPG-35b are unlikely.

At YPG-35c, site related exposures to 2,4-dinitrotoluene, lead, and selenium may result in adverse effects for plants; and site related exposures to 2,4-dinitrotoluene, nitrobenzene, perchlorate, and selenium may result in adverse effects for invertebrates. Similarly, site related exposures to di-n-butyl phthalate, 2,4-dinitrotoluene, and 2,6-dinitortoluene may result in adverse effects for the desert shrew, little pocket mouse, American kestrel, Gambel's quail, verdin, and Sonoran desert tortoise.

SECTION 6.0
SUMMARY AND RECOMMENDATIONS

An RFI has been completed at YPG-35 a, b, and c to 1) collect data to adequately identify and characterize the nature and extent of buried waste and the areas outside the known burial trenches; 2) conduct a risk assessment (human and ecological) to determine if constituents have been released to the environment which pose a risk to human health or the environment; and 3) evaluate if chemical constituents are present at levels that pose a threat to groundwater.

Muggins Mountain open burn/open detonation OB/OD is comprised of three sites, YPG-35 a, b, and c (Figure 2.1) and is divided into two time periods of operation 1950s through 1974 and 1985 through the late 1990s. Initially in 1952 until 1974, the area was used as the primary OB/OD facility for USAGYPG. Operations were discontinued in 1974 and no further OB/OD activities were conducted at the site until it was reopened in 1985. In 1985, a munitions recovery program was initiated to uncover and demolish buried on-site munitions using OD operations. In the late 1990s all operations were discontinued and the site was closed.

Previous investigations at YPG-35a, b, and c include sampling activities conducted during 2002 and 2003 and a geophysical survey conducted in 2006. The 2002 sampling event consisted of soil sampling the OD pit area located southwest of the loop access road, the BOG area and the WP area. The 2003 sampling event included the collection of soils samples from four areas where loose propellant was previously identified and five washes located downstream from the OD pits. In 2006 a geophysical survey was conducted at YPG-35b and c. This survey identified ten suspected burial trenches (TR-2 through TR-11) at YPG-35b and three suspected burial trenches (TR-12 and TR-14) at YPG-35c.

The RFI activities conducted during investigation of YPG-35a, b, and c included an instrument-aided QR survey conducted at YPG-35a and the northern and southern portions of YPG-35c, and a visual site survey at YPG-35b and c. MEC/MD was found in areas surrounding YPG-35b and c, in the area designated as YPG-35a. During the site survey, MEC disposal pits TR-2 through TR-11 (located in YPG-35b) and dunnage pits

TR-12 through TR-14 (located in YPG-35c) were reacquired. These pits were not sampled due to explosive safety concerns and are considered uncharacterized because there is no information about these features other than the possibility that they may contain buried MEC/MD. The dunnage pits will be considered *a priori* to pose an unacceptable explosive risk at the site and will be carried forward into the CMS. Soils within or below these MEC disposal and dunnage pits have not been characterized.

In addition to the site surveys, a total of 106 surface and soil boring samples were collected from YPG-35b and c during the RFI. Numerous inorganic compounds were detected in surface and subsurface soils that exceeded BTVs; however, only one metal (lead) was found to slightly exceed its corresponding GPL. Lead contamination is believed to be associated with surface metallic debris from the large open trench located within the burial trench area. This metal is believed to be stable and has not migrated to any significant degree, based on concentrations less than remediation goals in underlying samples.

Analytical results obtained from the current and previous investigations at the site were used to complete an HRA and ERA. The objectives of this risk assessment were to assess potential risks and hazards from exposure to contaminants in soils and to recommend either NFA (if the risks and hazards are acceptable) or of the development of cleanup goals and remedial alternatives under a CMS task if unacceptable risks or hazards were identified.

Results of the ERA at YPG-35b show site related exposures to thallium may result in adverse effects for plants while site related exposures are not expected to result in adverse effects for invertebrates. ERA results also show that adverse effects to vertebrate receptors from soil exposures at YPG-35b are unlikely.

Results of the ERA at YPG-35c show potential site related exposures to 2,4-dinitrotoluene, lead, and selenium may result in adverse effects for plants; and site related exposures to 2,4-dinitrotoluene, nitrobenzene, perchlorate, and selenium may result in adverse effects for invertebrates. Similarly, site related exposures to di-n-butyl phthalate, 2,4-dinitrotoluene, and 2,6-dinitortoluene may result in adverse effects for the desert shrew, little pocket mouse, American kestrel, Gambel's quail, verdin, and Sonoran desert tortoise. The potential risk posed to the ecological receptors may be limited to small

pockets of higher concentration of selected compounds and should be evaluated as part of a CMS.

Results of the HRA at YPG-35c indicate lead as a chemical of concern (COC) and a potential human health risk. However, the human health hazard can be diminished with the remediation of sample site BOG-02 (Section 5.1.2). Similarly, "hot spot" removal of soils containing higher concentrations of 2,4-dinitrotoluene would reduce the risk to ecological receptors.

A CMS is recommended for YPG-35b, to include the large open trench TR-1 and ten suspected burial trenches (TR-2 through TR-11) that were uncharacterized due to explosive safety concerns. The CMS should also include the three uncharacterized burial trenches (TR-12 and TR-14) as well as, areas containing elevated levels of site related compounds in soil posing an unacceptable ecological risk present at YPG-35c. Finally, the CMS should include mitigation of explosive risks associated with MEC/MD identified during the QR survey conducted within the boundaries of YPG-35a as part of the RFI.

SECTION 7.0

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TABLES

TABLE 2.1
SOIL TYPES AT USAGYPG

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Soil Type	Composition	Percent of USAGYPG	Landforms	pH
Rositas	sand	0.0019	dunes and sand sheets	8.0
Superstition-Rositas	sand	0.0843	sandy eolian deposits	7.8 to 8.4
Carrizo	extremely gravelly loamy coarse sand	0.1434	flood plains, alluvial fans, fan piedmonts and bolson floors	7.8 to 8.0
Riverbend	extremely cobbly sandy loam	0.0054	stratified fan alluvium	7.8 to 8.2
Cristobal-Gunsight	silty, clayey gravel with sand to extremely gravelly loamy fine sand to very gravelly silt	0.2897	fan alluvium	8.2
Gunsight-Chuckawalla	extremely gravelly sandy loam to extremely gravelly loamy fine sand to very gravelly silt	0.1764	fan terraces or stream terraces	8.3
Carsitas-Chuckawalla	extremely gravelly sand to extremely gravelly loamy fine sand to very gravelly silt loam	0.0262	alluvial fans, moderately steep valley fills and dissected remnants of alluvial fans	Unspecified, generally characterized as mildly to moderately alkaline
Lithic Torriorthents	extremely gravelly sandy loam	0.2728	steeper hillsides and mountain slopes	8.2 to 8.4

Source: DRI, 2009.

TABLE 3.1
SUMMARY OF RECOMMENDATIONS FOR MUGGINS MOUNTAIN SITES
U.S. ARMY GARRISON YUMA PROVING GROUND

Tracking Numbers		Description/ Name	Recommendations	
			1998 RCRA Facility Assessment	2001 Release Assessment
SWMU 57 (partial)	YPG-35a	Muggins Mountain Ammunition Disposal Trench	No action recommended, but closure should be completed along with closure of SWMU 57	Defer to on-going closure activity
SWMU 57 (partial)	YPG-35b	Muggins Mountain Ammunition Disposal Demolition Area	No action recommended. Site is undergoing closure under approved plan.	Defer to on-going closure activity
SWMU 57 (partial)	YPG-35c	Muggins Mountain Ammunition Disposal Scrap Metal Storage Area	No action recommended, but closure should be completed along with closure of SWMU 57. Unit is undergoing closure under approved plan.	Defer to on-going closure activity

TABLE 3.2
SUMMARY OF ANALYTICAL RESULTS FROM DECEMBER 2002
MUGGINS MOUNTAIN OB/OD SITE

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

	Analytical Results by Sample Number (mg/kg)[1,2]															Residential SRL[3]
Constituents	**BOG-02**	**BOG-05**	**HE-01**	**HE-02**	**HE-03**	**HE-04**	**HE-05**	**HE-07**	**HE-08**	**HE-13**	**HE-14**	**WP-01**	**WP-02**	**WP-03**	**WP-04**	
Location	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	**-35c**	
Metals Detected Above Residential rSRL																400
Lead	**17,000**														**512**	
Explosives																
1,3,5-Trinitrobenzene								2.2						3.6		1,800
2,4,6-Trinitrotoluene								270						3.4		31
2-Amino-4,6-Dinitrotoluene								12								12
4-Amino-2,6-Dinitrotoluene								**13**								12
2,4-Dinitrotoluene				22	18			1.3					11	**780**		120
2,6-Dinitrotoluene														43		61
RDX		2.4			2.1			1.1	11		7					50
HMX		0.85							1.1		7					3,100
Semivolatile Organic Compounds																
2,4-Dinitrotoluene			25	4	2.9	0.85	0.35				0.5	1.5	9.7	88	13	120
2,6-Dinitrotoluene			1.2							0.62			0.66	6	0.59	61
Benzoic Acid										2.4						240,000
bis(2-Ethylhexyl)phthalate					0.33											390
Diethyl phthalate			5.4	16	10	1.1	1.1							62		49,000
Dimethyl phthalate																610,000
Dibutyl phthalate			12	3.8	1.3		0.45					2..2	8.4	53	7.2	6,100

Definitions:

OB/OD = open burn/open detonation. mg/kg = milligrams per kilogram. rSRL = Arizona residential soil remediation level. RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine. HMX = octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine. SVOCs = semivolatile organic compounds. QAPP = Quality Assurance Project Plan.

Notes:

[1] With the exception of lead, values not shown were below detection limits. Lead values shown were above the rSRL of 400 mg/kg. Bolded values indicate those above the rSRL

[2] Samples labeled HE-09, -10,-12 analyzed for explosives. All analytes were detected at concentrations less than the detection limit. Samples labeled BOG-01, -03, -04 were analyzed for SVOCs, explosives and metals. All organic analytes were detected at concentrations less than the detection limit.

[3] Residential soil remediation goals as referenced in Table A.3.3 of the QAPP or Arizona SRLs (ADEQ, 2007). Bolded values indicate those above the rSRL.

TABLE 3.3
SUMMARY OF ANALYTICAL RESULTS FROM APRIL 2003
MUGGINS MOUNTAIN OB/OD SITE

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

	Analytical Results by Sample Number (mg/kg)[1]								
Constituents	**PA-3**	**PS-1**	**PS-3**	**WS-1**	**WS-2**	**WS-3**	**WS-4**	**WS-5**	**Residential**
Location	**-35a**	**-35a**	**-35a**	**-35a**	**-35a**	**-35a**	**-35a**	**-35a**	**SRL[2]**
Metals									
Lead	7.2	12.1	21.9	8.9	4.5	21.6	24.5	3.2	400
Arsenic		4.6	7.3	3.4	3.0	2.7	1.8	5.2	10
Explosives									
1,3-Dinitrobenzene		0.06	0.14	1.3	0.53	0.12			6.1
1,3,5-Trinitrobenzene				2.1	0.45	0.077	0.11		1,800
2,4,6-Trinitrololuene	**44**	0.25	0.09	0.11					31
2,4-Dinitrololuene	**14,000**	50	34						120
2,6-Dinitrololuene	**750**		1.10						61
RDX		0.27	0.74						50
2-Nitrotoluene	120	0.34							730
4-Nitrotoluene			0.16					0.69	130
Nitroglycerine			6.8						390
Nitroguanidine	0.24		0.35						6,100
HMX			0.22			1.1			3,100
2-Amino-4,6-dinitrolouene	**67**	0.14			0.49	0.21	0.075	0.082	12
Perchlorate		0.047	0.337	0.017	0.017		0.016		55

Definitions:

OB/OD = open burn/open detonation. mg/kg = milligrams per kilogram. rSRL = Arizona residential soil remediation level. RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine. HMX = octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine. QAPP = Quality Assurance Project Plan.

Notes:

[1] All samples were analyzed explosives (SW-8332) and metals (5010/7471) constituents. Those not not shown had concentrations below detection limits.

[2] Residential SRLs as referenced in Table A.3.3 of the QAPP or Arizona rSRLs (ADEQ, 2007). Bolded values indicate those above the rSRL.

TABLE 4.1
CHARACTERIZATION OBJECTIVES
RCRA FACILITY INVESTIGATION - YPG-35a, b, and c

U.S. ARMY GARRISON YUMA PROVING GROUND, YUMA, ARIZONA

Field Activity	Characterization Objective of Field Activity						
	Reacquire Features and Confirm Findings of Previous Investigations	Document Locations of Possible Detonation Pits, Burial Trenches and MEC/MD	Define Boundary of Area	Evaluate Potential Surface Soil Contamination Source Areas	Evaluate Potential Subsurface Soil Contamination Source Areas	Determine if Contamination is Migrating from Source Areas	Determine Concentrations of Background Metals
Instrument-Aided Qualitative Reconnaissance		360 acres (YPG-35a)					
Site Survey	12 acres (YPG-35b) 7.5 acres (YPG-35c)	12 acres (YPG-35b) 7.5 acres (YPG-35c)	12 acres (YPG-35b) 7.5 acres (YPG-35c)				
Soil Borings	35BSB001-35BSB020 35CSB001–35CSB013	35BSB001-35BSB020 35CSB001–35CSB013	35BSB001-35BSB020 35CSB001–35CSB013				
Surface Soil Sample				35BSB001-35BSB020 35CSS001-35CSS011 35CSS013-35CSS031 35CSB010–35CSB013 54 surface soil samples collected near trenches and OB/OD pits			
Subsurface Soil Sample					35BSB001–35BSB020 35CSB001-35CSB014 52 subsurface soil samples collected near trenches and OB/OD pits	35BSB001–35BSB020 35CSB001-35CSB014 52 subsurface soil samples collected near trenches and OB/OD pits	
Background Soil Samples							BG001-BG009 1 surface and 1 subsurface soil sample collected from each soil boring

Definitions: MEC = munitions and explosives of concern. MD = munitions debris. OB/OD = open burn/open detonation.

TABLE 4.2
SOIL SAMPLING SUMMARY
YPG-35b (BURIAL TRENCHES AREA)

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Sample Location	Total Depth (ft bgs)	Sample Depth (ft bgs)			Notes
		First	Second	Third	
35BSB001	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB002	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB003	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB004	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB005	20.5	0-0.5	5.5-6.5	19.5-20.5	No stain, debris or other evidence of contamination observed.
35BSB006	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB007	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB008	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB009	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB010	7	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB011	20.5	0-0.5	5.5-6.5	19.5-20.5	No stain, debris or other evidence of contamination observed.
35BSB012	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB013	21	0-0.5	5.5-6.5	19-20	No stain, debris or other evidence of contamination observed.
35BSB014	6.5	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB015	7	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB016	7	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB017	7	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB018	20.5	0-0.5	5.5-6.5	19.5-20.5	No stain, debris or other evidence of contamination observed.
35BSB019	7	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.
35BSB020	7	0-0.5	5.5-6.5	NA	No stain, debris or other evidence of contamination observed.

Definitions: ft = feet. bgs = below ground surface.

TABLE 4.3
SOIL SAMPLING SUMMARY
YPG-35c (OB/OD AREA)

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Sample Type	Sample Location	Total Depth (ft bgs)	Sample Depth (ft bgs)			Notes
			First	Second	Third	
Soil Boring (Grid 1)	35CSB001	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 2)	35CSS001	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid 3)	35CSB002	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid 4)	35CSB003	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 5)	35CSS002	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid 6)	35CSB004	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid 7)	35CSB005	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 8)	35CSS003	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 9)	35CSS004	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 10)	35CSS005	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 11)	35CSS006	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 12)	35CSS007	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 13)	35CSS008	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 14)	35CSS009	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 15)	35CSS010	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 16)	35CSS011	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid 17)	35CSB014	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid C18)	35CSB006	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid 19)	35CSB007	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid 20)	35CSB008	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Soil Boring (Grid 21)	35CSB009	20.5	NA	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 22)	35CSS012	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 23)	35CSS013	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 24)	35CSS014	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Grid 25)	35CSS015	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Soil Boring (Dunnage Pits 1)	35CSB010	20.5	0-0.5	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Soil Boring (Dunnage Pits 2)	35CSB011	20.5	0-0.5	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Soil Boring (Dunnage Pits 3)	35CSB012	20.5	0-0.5	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.

TABLE 4.3 (CONTINUED)
SOIL SAMPLING SUMMARY
YPG - 35c (OB/OD AREA)

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Sample Type	Sample Location	Total Depth (ft bgs)	Sample Depth (ft bgs)			Notes
			First	Second	Third	
Soil Boring (Northeast Area 1)	35CSB013	20.5	0-0.5	5.5-6.5	19.5-20.5	No stain, debris, or evidence of contamination observed.
Surface Soil (Northeast Area 1)	35CSS016	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Northeast Area 2)	35CSS017	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Northeast Area 3)	35CSS018	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Southeast Area 1)	35CSS019	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Southeast Area 2)	35CSS020	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Surface Soil (Loop Road 1)	35CSS021	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Northeast Area 1)	35CSS022	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Northeast Area 2)	35CSS023	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Northeast Area 2)	35CSS024	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Loop Road 1)	35CSS025	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Loop Road 2)	35CSS026	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Loop Road 3)	35CSS027	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Southwest Area 1)	35CSS028	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Southwest Area 2)	35CSS029	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.
Dry-Wash Soil (Southwest Area 3)	35CSS030	0	0-0.5	NA	NA	No stain, debris, or evidence of contamination observed.

Definitions: ft bgs = feet below ground surface. NA = not applicable.

TABLE 4.4
PLANNED VERSUS COMPLETED INVESTIGATIONS
YPG-35a, b, and c

U.S. ARMY GARRISON YUMA PROVING GROUND, YUMA, ARIZONA

Field Activity	Characterization Objective of Field Activity						
	Survey Locations Proposed	Survey Locations Completed	Soil Borings Proposed	Soil Borings Proposed	Soil Samples Proposed	Soil Samples Completed	Explanation
Instrument-Aided QR Survey	360 acres (YPG-35a and northern and southern portions of YPG-35c)	360 acres (YPG-35a and northern and southern portions of YPG-35c)					The southern portion of YPG-35c was added to the instrument-aided QR survey because there was no evidence of burial of OB/OD activities in that area
Site Survey	12 acres (YPG-35b) 7.5 acres (YPG-35c)	12 acres (YPG-35b) 7.5 acres (YPG-35c)					
Soil Borings			35BSB001-35BSB020 35CSB001–35CSB013	35BSB001-35BSB020 35CSB001–35CSB013			
Surface Soil Sample					35BSB001-35BSB020 35CSS001-35CSS011 35CSS013-35CSS031- 35CSB010–35CSB013 54 surface soil samples proposed near trenches and OB/OD pits	35BSB001-35BSB020 35CSS001-35CSS011 35CSS013-35CSS031 35CSB010–35CSB013 54 surface soil samples collected near trenches and OB/OD pits	
Subsurface Soil Sample					35BSB001 – 35BSB020 35CSB001 - 35CSB014 52 subsurface soil samples proposed near trenches and OB/OD pits	35BSB001–35BSB020 35CSB001-35CSB014 52 subsurface soil samples collected near trenches and OB/OD pits	
Background Soil Samples					BG001 - BG009 1 surface and 1 subsurface soil sample proposed from each of nine soil borings	BG001 - BG009 1 surface and 1 subsurface soil sample collected from each soil boring	

Definitions: QR = qualitative reconnaissance. OB/OD = open burn/open detonation.

Table 4.5
INSTRUMENT-AIDED QR SURVEY RESULTS
YPG-35a

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Waypoint	Vegetation	MD Items	MEC Items	Notes
AA-001	None	1-25 MD Items	1-PD Fuze	Waypoints added to MG16
AA-002	None	25-50 MD Items	--	Waypoints added to MG16
BB-001	Light	25-50 MD Items	1-2.75" RKT Fuze Live	Off Track in MG8
MG10-001	Light	--	--	
MG10-002	None	1-25 MD Items	--	
MG10-003	None	1-25 MD Items	--	
MG10-004	Light	1-25 MD Items	1-155 mm HE	
MG10-005	None	--	--	
MG10-006	None	--	--	
MG12-001	None	1-25 MD Items	--	
MG12-002	None	--	--	
MG12-003	None	1-25 MD Items	--	
MG12-004	None	1-25 MD Items	--	
MG12-005	Light	25-50 MD Items	1-30 mm HE	
MG12-006	None	1-25 MD Items	--	
MG12-007	None	--	--	
MG12-008	None	--	--	
MG12-009	None	--	--	
MG12-010	None	1-25 MD Items	--	
MG13-001	None	1-25 MD Items	--	
MG13-002	Light	50-100 MD Items	--	Unsafe to continue, too steep and rocky
MG14-001	None	1-25 MD Items	--	
MG14-002	Light	50-100 MD Items	1-30 mm HE	
MG14-003	None	50-100 MD Items	1-20 mm HE	
MG14-004	None	25-50 MD Items	--	
MG15-001	None	1-25 MD Items	--	
MG15-002	None	25-50 MD Items	--	
MG15-003	None	1-25 MD Items	--	Unsafe to continue, too steep and rocky
MG16-001	None	1-25 MD Items	--	Short trek and could not get to south end too steep and rocky
MG17-001	None	1-25 MD Items	--	
MG17-002	None	1-25 MD Items	--	
MG17-003	Light	1-25 MD Items	--	
MG17-004	None	>100 MD Items	--	Appears to be a detonation area (disposal)
MG17-005	None	>100 MD Items	--	Appears to be a detonation area (disposal)
MG17-006	Light	50-100 MD Items	Various MEC	Some MEC with in sight of waypoint-Fuzes, Motars, Rockets
MG18-001	None	--	--	

Table 4.5 (continued)
INSTRUMENT-AIDED QR SURVEY RESULTS
YPG-35a
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Waypoint	Vegetation	MD Items	MEC Items	Notes
MG18-002	None	--	--	
MG18-003	Light	--	--	
MG20-001	Light	--	--	
MG20-002	Light	--	--	
MG20-003	None	2x MD Items	--	
MG20-004	None	1-25 MD Items	--	Several pieces of MD between waypoints
MG20-005	Light	1-25 MD Items	--	
MG20-006	None	1-25 MD Items	--	Wash at waypoint has MD
MG20-007	Light	1-25 MD Items	--	
MG20-008	Light	1-25 MD Items	--	
MG20-009	None	1-25 MD Items	--	
MG20-010	None	1-25 MD Items	--	
MG20-011	Medium	1-25 MD Items	--	
MG20-012	None	25-50 MD Items	1-loose piece HE	Softball Size
MG20013	None	25-50 MD Items	1-60 mm mortar	No fuze HE
MG20-014	Light	25-50 MD Items	--	
MG20-015	Medium	50-100 MD Items	See Notes	Several pieces of MD and MEC were located between waypoints in this area
MG21-001	Medium	--	--	
MG21-002	Heavy	--	--	
MG22-001	Medium	--	--	
MG22-002	Heavy	--	--	
MG23-001	Heavy	--	--	
MG23-002	None	1x MD Item	--	
MG23-003	None	--	--	
MG24-001	Heavy	--	--	
MG24-002	Medium	>100 MD Items	--	Pile of MD and debris 4' X 6'
MG24-003	Medium	1-25 MD Items	2-105 mm HE	
MG24-004	Light	--	--	
MG24-005	Light	--	--	
MG25-001	Heavy	--	--	
MG25-002	Heavy	--	--	
MG25-003	None	25-50 MD Items	--	Assorted MD and Scrap Pile 10' x 8'; 4-M46s
MG25-004	Light	1-25 MD Items	--	
MG25-005	None	--	--	

Table 4.5 (continued)
INSTRUMENT-AIDED QR SURVEY RESULTS
YPG-35a

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Waypoint	Vegetation	MD Items	MEC Items	Notes
MG26-001	Light	--	--	
MG26-002	Light	--	--	
MG26-003	Medium	--	--	
MG27-001	Medium	--	--	
MG27-002	Light	--	--	
MG27-003	None	--	--	
MG28-001	Medium	--	--	
MG28-002	Medium	--	--	
MG28-003	None	--	--	
MG29-001	Heavy	--	--	
MG29-002	None	--	--	
MG29-003	Medium	--	--	
MG30-001	None	--	--	
MG30-002	None	--	--	
MG30-003	None	--	--	
MG31-001	None	--	--	
MG31-002	None	--	--	
MG31-003	None	--	--	
MG32-001	None	--	--	
MG32-002	None	1-25 MD Items	2-75 mm HE	
MG32-003	Light	1-25 MD Items	--	
MG33-001	None	1-25 MD Items	--	
MG33-002	Light	1-25 MD Items	--	
MG33-003	None	25-50 MD Items	1-155 mm HE 2-75 mm HE	One piec of MD looked like it could be a gator mine.
MG33-004	Light	1-25 MD Items	--	
MG33-005	None	--	--	
MG34-001	None	--	--	
MG34-002	None	--	--	
MG34-003	Medium	--	--	
MG35-001	None	--	--	
MG35-002	None	--	--	
MG35-003	Light	--	--	
MG35-004	None	1x MD Item	--	
MG35-005	Light	--	--	
MG36-001	None	1-25 MD Items	--	
MG36-002	None	1-25 MD Items	--	Too steep to get to line, walked parallel path
MG36-003	Light	1-25 MD Items	--	

Table 4.5 (continued)
INSTRUMENT-AIDED QR SURVEY RESULTS
YPG-35a

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Waypoint	Vegetation	MD Items	MEC Items	Notes
MG36-004	Light	1-25 MD Items	1-2.75 inch RKT Warhead, HE	
MG36-005	None	1-25 MD Items	--	
MG8-001	None	--	--	
MG8-002	None	1-25 MD Items	--	
MG8-003	None	1-25 MD Items	--	
MG8-004	None	--	--	
MG8-005	None	1-25 MD Items	--	
MG8-006	None	1-25 MD Items	--	
MG8-007	None	1-25 MD Items	--	
MG8-008	None	1-25 MD Items	--	
MG8-009	None	1-25 MD Items	--	
MG8-010	None	--	--	
MG8-011	None	--	--	
MG8-012	None	1-25 MD Items	--	
MG8-013	None	1-25 MD Items	--	
MG8-014	None	1-25 MD Items	--	
MG8-015	None	25-50 MD Items	--	
MG8-016	None	1-25 MD Items	--	
MG8-017	None	1-25 MD Items	--	
MG8-018	None	1-25 MD Items	--	
MG8-019	None	--	--	
MG8-020	None	--	--	
MG8-021	None	--	--	
MG8-022	None	--	--	
MG8-023	None	1-25 MD Items	--	
MG8-024	None	1-25 MD Items	--	
MG8-025	None	1-25 MD Items	--	

Definitions: QR = qualitative reconnaissance. MD = munitions debris. MEC = munitions and explosives of concern. PD = point detonating. RKT = rocket. HE = high explosive. mm = millimeter.

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
			rSRL	76,000	31	10	15,000	23	39	NV	17,000	1,400	3,100	NV	400
			GPL	NV	35	290	12,000	150	29	NV	590	NV	NV	NV	290
			BTV	20,000	--	8.9	350	0.89	0.24	81,000	14	8.2	61	25,000	14
35BSB001	0-0.5	N	27-Jan-11	9,110		4.42	120 J	0.47 J	**0.65**	28,200	9.88 J	4.89 J	16.1 J	12,500	7.58 J
35BSB001	5.5-6.5	N	27-Jan-11	7,590		5.55	132 J	0.37 J	0.092 J	10,400	7.15 J	4.12 J	27.9 J	12,800	7.34 J
35BSB002	0-0.5	N	27-Jan-11	6,780		3.25	126 J	0.32 J	**0.3**	16,200	8.44 J	4.23 J	14.3 J	11,600	9.3 J
35BSB002	5.5-6.5	N	26-Jan-11	8,660		8.65	205 J	0.47 J	0.073 J	10,200	12.5 J	5.59 J	34.8 J	13,900	8.05 J
35BSB003	0-0.5	N	26-Jan-11	7,660		2.82	121 J	0.35 J	**0.29**	17,300	9.89 J	4.36 J	12.7 J	12,200	9.74 J
35BSB003	5.5-6.5	N	26-Jan-11	7,630		4.71	140 J	0.36 J	0.1 J	13,200	8.48 J	4.53 J	20.8 J	12,800	6.67 J
35BSB004	0-0.5	N	27-Jan-11	6,700		2.82	143 J	0.33 J	**1.05**	20,300	9.74 J	3.96 J	26 J	11,100	**26.6 J**
35BSB004	5.5-6.5	N	27-Jan-11	7,590		6.76	241 J	0.4 J	0.11 J	27,000	8.68 J	3.85 J	22.5 J	12,100	7.49 J
35BSB004	5.5-6.5	FD	27-Jan-11	8,470		6.99	278 J	0.44 J	0.12 J	24,100	9.44 J	4.21 J	24.6 J	12,800	7.93 J
35BSB005	0-0.5	N	27-Jan-11	9,010		4.02	140 J	0.45 J	**0.75**	36,500	10.3 J	4.85 J	14.7 J	12,700	6.64 J
35BSB005	19.5-20.5	N	27-Jan-11	4,760		3.11	141 J	0.3 J	0.055 J	14,700	5.67 J	2.6 J	16.7 J	7,330	5.78 J
35BSB005	5.5-6.5	N	27-Jan-11	8,620		5.53	191 J	0.33 J	0.087 J	10,000	9 J	3.91 J	17.1 J	15,000	6.3 J
35BSB006	0-0.5	N	26-Jan-11	6,090		3.35	193 J	0.29 J	**0.61**	18,500	9.56 J	3.72 J	13.6 J	11,100	**32.2 J**
35BSB006	5.5-6.5	N	26-Jan-11	7,540		5.23	168 J	0.31 J	0.09 J	23,500	10.5 J	4.04 J	34 J	13,800	5.28 J
35BSB007	0-0.5	N	20-Jan-11	9,030 J		8.5	317	0.39 J	**2.54**	35,900 J	**31.7 J**	6.15 J	43.2 J	**77,800 J**	**300 J**
35BSB007	5.5-6.5	N	20-Jan-11	9,060 J		3.68	**561**	0.32	**1.64**	33,500 J	**14.3 J**	4.79 J	29.8 J	15,100 J	**32.5 J**
35BSB008	0-0.5	N	26-Jan-11	7,110		3.06	108 J	0.34 J	0.21	17,000	9.47 J	4.3 J	12 J	11,300	7.83 J
35BSB008	5.5-6.5	N	26-Jan-11	7,110		3.51	93.9 J	0.3 J	0.1 J	31,300	9.06 J	3.9 J	22.5 J	12,000	4.98 J
35BSB009	0-0.5	N	26-Jan-11	9,310		3.56	136 J	0.45 J	0.15 J	26,500	11.3 J	4.79 J	13.7 J	12,600	7.53 J
35BSB009	5.5-6.5	N	26-Jan-11	7,690		3.88	157 J	0.36 J	0.13 J	35,900	9.88 J	3.9 J	21.9 J	12,800	5.65 J
35BSB010	0-0.5	N	20-Jan-11	8,370 J		4.59	156	0.36	0.18 J	42,300 J	10.4 J	4.32 J	11.8 J	12,700 J	7.5 J
35BSB010	5.5-6.5	N	20-Jan-11	7,910 J		3.16	142	0.3	0.18 J	25,100 J	10.1 J	4.29 J	14.4 J	13,200 J	7.53 J
35BSB011	0-0.5	N	20-Jan-11	7,890 J		2.67	127	0.32	0.053 J	24,200 J	10.9 J	4.64 J	14.5 J	13,400 J	13.4 J
35BSB011	19.5-20.5	N	24-Jan-11	5,830		3.73	114 J	0.38	0.15 J	49,800	5.75	3.12	12.6 J	8,050	5.58
35BSB011	19.5-20.5	FD	24-Jan-11	5,430		3.29	94.4	0.35	0.14 J	46,400	5.44	2.97	12.5 J	7,610	5.72
35BSB011	5.5-6.5	N	18-Jan-11	9,050 J		3.7	103	0.37		13,000 J	12.3 J	4.96 J	13.2 J	15,800 J	7.99 J

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
			rSRL	76,000	31	10	15,000	23	39	NV	17,000	1,400	3,100	NV	400
			GPL	NV	35	290	12,000	150	29	NV	590	NV	NV	NV	290
			BTV	20,000	--	8.9	350	0.89	0.24	81,000	14	8.2	61	25,000	14
35BSB012	0-0.5	N	19-Jan-11	11,900 J		3.37	148	0.53	0.039 J	36,300 J	11.5 J	5.64 J	13.4 J	15,000 J	9 J
35BSB012	5.5-6.5	N	24-Jan-11	7,540		4.91	152	0.39 J	0.1 J	42,900 J	10.2	3.7	18.1 J	10,900	6.57
35BSB013	0-0.5	N	24-Jan-11	10,800		4.52	119	0.54 J	0.21	37,800	10.3	4.94	13.4 J	13,200	8.32
35BSB013	19-21	N	24-Jan-11	3,500		2.18	85.4	0.28 J	0.1 J	45,700	3.52	1.94	9.6 J	5,390	4.13
35BSB013	5.5-6.5	N	24-Jan-11	7,040		4.83	252	0.35 J	0.1 J	38,200	9.05	3.65	13.2 J	11,000	7.97
35BSB014	0-0.5	N	24-Jan-11	9,040		3.84	131	0.46 J	0.16 J	26,100	10.6	5.03	12.9 J	13,000	8.26
35BSB014	5.5-6.5	N	24-Jan-11	7,740		3.61	129	0.4 J	0.065 J	15,700	8.6	3.91	31.1 J	12,600	6.84
35BSB015	0-0.5	N	19-Jan-11	8,010 J		4.09	148	0.34		34,200 J	10.2 J	5.34 J	11.6 J	13,700 J	6.34 J
35BSB015	5.5-6.5	N	19-Jan-11	9,050 J		4.12	162	0.31		39,900 J	13.4 J	5.9 J	15.1 J	15,000 J	5.84 J
35BSB016	0-0.5	N	19-Jan-11	6,210 J		2.63	111	0.27		24,700 J	9.01 J	3.92 J	10.1 J	10,900 J	7.02 J
35BSB016	5.5-6.5	N	19-Jan-11	8,330 J		3.87	121	0.31		18,400 J	11 J	4.37 J	16.2 J	14,200 J	9.53 J
35BSB017	0-0.5	N	19-Jan-11	6,840 J		2.37	114	0.32	0.014 J	23,800 J	8.78 J	3.86 J	9.66 J	10,100 J	5.71 J
35BSB017	0-0.5	FD	19-Jan-11	7,670 J		2.85	126	0.36	0.033 J	48,000 J	9.81 J	4.25 J	10.3 J	11,500 J	6.29 J
35BSB017	5.5-6.5	N	19-Jan-11	4,110 J		3.6	**358**	0.22	0.019 J	27,400 J	5.78 J	2.64 J	4.03 J	6,660 J	4.42 J
35BSB018	0-0.5	N	25-Jan-11	7,740		3.45	143	0.39 J	0.15 J	30,100	9.8	4.15	10.8 J	11,800	7.47
35BSB018	19.5-20.5	N	26-Jan-11	3,190		1.47 J	46.9	0.2 J	0.065 J	12,600	3.59	2.17	8.41 J	5,460	4.09
35BSB018	5.5-6.5	N	25-Jan-11	7,910		3.61	83.4	0.34 J	0.084 J	13,600	12.6	4.5	14.4 J	14,100	5.44
35BSB019	0-0.5	N	19-Jan-11	8,320 J		4.05	165	0.33		27,700 J	10.4 J	4.67 J	11.1 J	13,800 J	6.44 J
35BSB019	5.5-6.5	N	19-Jan-11	7,630 J		4.09	155	0.33		49,200 J	8.97 J	3.86 J	8.22 J	12,700 J	6.7 J
35BSB020	0-0.5	N	26-Jan-11	8,930		4.13	176	0.43 J	0.12 J	31,300	10.2	4.28	12.8 J	12,700	6.67
35BSB020	5.5-6.5	N	26-Jan-11	7,560		5.77	316	0.37 J	0.098 J	44,000	10.2	3.67	44.7 J	11,700	5.82
35CSB001	19.5-20.5	N	31-Jan-11	2,690		2.11	181	0.2 J	0.085 J	15,400 J	2.81 J	1.81	8.32	4,470 J	3.68 J
35CSB001	5.5-6.5	N	31-Jan-11	8,200		5.7	262	0.56	0.075 J	35,600 J	9.97 J	4.68	44.2	15,500 J	4.88 J
35CSB002	19.5-50.5	N	31-Jan-11	3,930		1.88	102	0.21	0.037 J	13,400 J	3.43 J	1.99	15.4	6,390 J	3.26 J
35CSB002	5.5-6.5	N	31-Jan-11	7,450		4.36	141	0.5	0.1 J	31,900 J	12.7 J	5.01	21.7	14,100 J	4.61 J
35CSB002	5.5-6.5	FD	31-Jan-11	7,790		4.66	164	0.54	0.09 J	23,900 J	**14.5 J**	5.48	39.7	15,100 J	4.78 J

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
			rSRL	76,000	31	10	15,000	23	39	NV	17,000	1,400	3,100	NV	400
			GPL	NV	35	290	12,000	150	29	NV	590	NV	NV	NV	290
			BTV	20,000	--	8.9	350	0.89	0.24	81,000	14	8.2	61	25,000	14
35CSB003	19.5-20.5	N	01-Feb-11	3,480		2	61	0.19 J	0.04 J	13,300 J	3.45 J	1.93	10	5,440 J	3.42 J
35CSB003	5.5-6.5	N	01-Feb-11	9,500		4.56	189	0.53		37,400 J	10.8 J	4.57	27.7	14,500 J	4.43 J
35CSB004	19.5-20.5	N	01-Feb-11	4,050		2.24	94.2	0.21	0.078 J	28,000 J	3.42 J	1.94	15.8	5,500 J	3.64 J
35CSB004	5.5-6.5	N	01-Feb-11	8,380		6.8	136	0.5		33,600 J	9.27 J	3.92	14.8	14,200 J	4.58 J
35CSB005	19.5-20.5	N	01-Feb-11	3,030		1.76	27.4	0.17 J	0.062 J	17,000 J	2.63 J	1.75	14.3	4,770 J	3.14 J
35CSB005	5.5-6.5	N	01-Feb-11	9,570		4.18	124	0.51	0.016 J	29,900 J	12.2 J	4.69	18.4	16,000 J	3.73 J
35CSB006	19.5-20.5	N	02-Feb-11	3,700		1.97	139	0.2 J	0.048 J	17,800 J	3.56	1.88	6.76	5,310 J	3.81 J
35CSB006	19.5-20.5	FD	02-Feb-11	3,510		1.95	222	0.21	0.039 J	15,600 J	3.55	1.73	6.67	5,540 J	4.06 J
35CSB006	5.5-6.5	N	02-Feb-11	7,810		4.17	98.3	0.45	0.019 J	32,400 J	13 J	3.81	18.6	12,800 J	4.98 J
35CSB007	19.5-20.5	N	40575	3,230		3.4	87.2	0.21	0.067 J	16,000 J	3.31	1.8	12.1	5,180 J	3.58 J
35CSB007	5.5-6.5	N	01-Feb-11	6,520		4.74	165	0.39	0.043 J	44,100 J	7.16	3.19	15.9	10,500 J	4.01 J
35CSB008	19.5-20.5	N	01-Feb-11	3,600		3.34	79.6	0.22	0.086 J	19,400 J	3.08	1.81	6.69	5,000 J	3.51 J
35CSB008	5.5-6.5	N	01-Feb-11	9,230		3.29	127	0.52		17,200 J	13.7	4.99	26.3	16,200 J	7.16 J
35CSB009	19.5-20.5	N	03-Feb-11	3,790		3.19	83.6	0.24	0.06 J	21,700 J	3.79	1.84	17.8	5,930 J	3.06 J
35CSB009	5.5-6.5	N	03-Feb-11	8,930		2.75	155	0.49	0.025 J	20,300 J	11.3	4.63	20.6	15,600 J	4.77 J
35CSB010	0-0.5	N	07-Feb-11	16,900 J		2.56 J	124	0.61	0.16 J	32,700	**16.4 J**	7.17	17.1	21,000	11.1 J
35CSB010	19.5-20.5	N	07-Feb-11	11,300 J		2 J	159	0.28 J	0.063 J	13,900	**18.7 J**	6.08	30.6	21,700	4.91 J
35CSB010	5.5-6.5	N	07-Feb-11	10,200 J		3.21	258	0.34	0.072 J	29,700	12.6 J	5.3	45.6	18,500	5.12 J
35CSB011	0-0.5	N	07-Feb-11	18,900 J		4.4	249	0.78	0.24 J	44,000	**14.2 J**	6.88	22.8	19,800	12.6 J
35CSB011	19.5-20.5	N	07-Feb-11	10,400 J		2.63 J	117	0.34 J	0.056 J	11,700	11.6 J	5.84	35.4	20,300	5.59 J
35CSB011	5.5-6.5	N	07-Feb-11	13,000 J		4.38	277	0.4 J	0.086 J	35,000	**16.2 J**	6.62	**63.4**	22,300	8.21 J
35CSB012	0-0.5	N	07-Feb-11	18,600 J		4.46	279	0.77	**0.33 J**	54,400	**14.1 J**	6.78	29	19,900	13.4 J
35CSB012	19.5-20.5	N	07-Feb-11	4,720 J		1.7	280	0.16 J	0.047 J	11,300	5.45 J	2.35	23.4	7,820	3.31 J
35CSB012	5.5-6.5	N	07-Feb-11	12,100 J		2.96 J	177	0.32 J	0.05 J	24,100	**17 J**	6.73	39.9	22,100	5.85 J
35CSB013	0-0.5	N	08-Feb-11	13,200 J		4.06	220	0.52	0.14 J	28,400	13 J	5.8	14.7	17,600	8.76 J
35CSB013	0-0.5	FD	08-Feb-11	13,600 J		4.01	231	0.52	0.12 J	25,000	13.6 J	6.66	15.7	18,000	8.5 J

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
			rSRL	76,000	31	10	15,000	23	39	NV	17,000	1,400	3,100	NV	400
			GPL	NV	35	290	12,000	150	29	NV	590	NV	NV	NV	290
			BTV	20,000	--	8.9	350	0.89	0.24	81,000	14	8.2	61	25,000	14
35CSB013	19.5-20.5	N	08-Feb-11	4,520 J	0.19 J	2.58	103	0.23	0.071 J	25,800	4.18 J	2.09	11.6	5,640	3.83 J
35CSB013	5.5-6.5	N	08-Feb-11	10,900 J		3.79	188	0.37 J	0.06 J	34,000	13.2 J	5.59	41.2	20,100	5.31 J
35CSB014	19.5-20.5	N	03-Feb-11	3,450		2.89	120	0.2	0.065 J	18,500 J	3.27	1.77	9.97	5,000 J	3.49 J
35CSB014	5.5-6.5	N	03-Feb-11	7,500		6.63	172	0.43	0.035 J	52,800 J	8.17	3.32	14.1	10,300 J	5.39 J
35CSS001	0-0.5	N	25-Jan-11	11,400		3.63	191	0.56 J	**0.53**	22,200	**14.2**	6.04	30.8 J	15,700	**170**
35CSS002	0-0.5	N	25-Jan-11	10,100		4.25	204	0.48 J	**0.54**	29,000	**15.2**	4.87	44 J	13,800	**18.8**
35CSS003	0-0.5	N	25-Jan-11	8,520		2.95	154	0.34 J	**1.07**	20,500	12	4.53	**124 J**	13,000	**16.9**
35CSS004	0-0.5	N	25-Jan-11	11,700		5.3	233	0.54 J	**0.51**	27,200	**14.9**	5.82	49.2 J	16,200	13.2
35CSS005	0-0.5	N	25-Jan-11	12,900	0.24 J	4.12	161	0.67 J	**0.31**	28,900	12.7	6.07	39.6 J	17,800	11.2
35CSS006	0-0.5	N	10-Feb-11	**21,400 J**		3.06 J	167	0.84	0.16 J	32,300	13.9 J	7.76	25.2	23,600	**50.2 J**
35CSS007	0-0.5	N	02-Feb-11	11,200		4.55	283	0.56	0.24	35,000 J	9.12	4.56	23.3	12,300 J	**21.1 J**
35CSS008	0-0.5	N	02-Feb-11	8,150		5.9	170	0.37	**0.58**	27,700 J	9.46	4.09	**142**	15,900 J	**38.7 J**
35CSS009	0-0.5	N	10-Feb-11	17,000 J	0.15 J	2.97	149	0.68	**0.32**	37,700	13.6 J	6.78	42.8	20,200	13.6 J
35CSS010	0-0.5	N	10-Feb-11	14,800 J		4.88	230	0.63	**0.48**	37,000	**18.3 J**	5.92	**62.6**	21,200	**19.9 J**
35CSS011	0-0.5	N	10-Feb-11	16,200 J		3.63	236	0.66	**0.25 J**	43,000	13.6 J	6.14	28	20,300	11.3 J
35CSS013	0-0.5	N	12-Jan-11	7,600		3.79	107		0.16 J	31,800	7.94	3.58	28.5	11,800 J	10.5 J
35CSS014	0-0.5	N	40555	9,270		4.84	161		0.32	28,700	11.7	4.32	38.8	19,300 J	20.6 J
35CSS015	0-0.5	N	12-Jan-11	9,150		5.43	198		0.17 J	27,000	9.31	4.58	22.5	13,300 J	9.27 J
35CSS016	0-0.5	N	12-Jan-11	8,130		2.87	117		**0.36**	11,500	9.32	4.46	22.9	12,200 J	10.8 J
35CSS017	0-0.5	N	12-Jan-11	11,400		4.11	114	0.18 J	0.064 J	21,000	11.3	5.21	12.9	14,300 J	9.83 J
35CSS018	0-0.5	N	12-Jan-11	9,990		3.79	138		0.033 J	21,400	10.8	4.87	11.2	13,900 J	8.81 J
35CSS019	0-0.5	N	12-Jan-11	12,200		5.28	154	0.17 J	0.051 J	23,000	11.8	5.64	14.4	15,600 J	9.77 J
35CSS020	0-0.5	N	12-Jan-11	10,300		3.45	85.6	0.043 J	0.11 J	21,000	10.7	5.36	23.3	14,300 J	10.9 J
35CSS021	0-0.5	N	12-Jan-11	10,900		4.24	144	0.02 J	0.22	30,100	12.1	5.12	19.8	17,800 J	13.8 J
35CSS022	0-0.5	N	12-Jan-11	11,800		7.06	213	0.1 J	**0.46**	18,900	**14.2**	5.85	52.7	16,800 J	**17.3 J**
35CSS023	0-0.5	N	11-Jan-11	6,620		2.66	103		0.034 J	9,630	8.51	4.26	14.5	12,000 J	7.89 J

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium (Total)	Cobalt	Copper	Iron	Lead
			rSRL	76,000	31	10	15,000	23	39	NV	17,000	1,400	3,100	NV	400
			GPL	NV	35	290	12,000	150	29	NV	590	NV	NV	NV	290
			BTV	20,000	--	8.9	350	0.89	0.24	81,000	14	8.2	61	25,000	14
35CSS024	0-0.5	N	11-Jan-11	7,040		3.05	107		0.028 J	8,040	8.28	6.38	14	14,300 J	9.35 J
35CSS025	0-0.5	N	11-Jan-11	6,980		2.48	112		0.073 J	14,400	8.78	4.11	14.8	11,600	9.33
35CSS026	0-0.5	N	11-Jan-11	6,610		2.4	125			13,500	7.52	4.84	13.3	12,400	8
35CSS027	0-0.5	N	11-Jan-11	6,650		3.08	142		**0.35**	22,500	9.33	4.24	**76.3**	12,500 J	**17.1 J**
35CSS028	0-0.5	N	11-Jan-11	7,190		2.91	129		**0.25**	26,100	9.79	4.08	23.9	11,800 J	**27.4 J**
35CSS029	0-0.5	N	11-Jan-11	7,760		3.08	223		**2.56**	20,900	13.1	4.07	**76.3**	13,500 J	**45.4 J**
35CSS030	0-0.5	N	11-Jan-11	6,480		2.73	118		0.21	20,800	8.34	3.95	25.8	12,300 J	**16.1 J**
35CSS031	0-0.5	N	11-Jan-11	5,290		2.59	88.2		0.22	17,000	6.02	2.83 J	14 J	9,870 J	8.37 J
35CSS031	0-0.5	FD	11-Jan-11	4,660		2.57	92.4		**0.36**	25,600	6.32	2.59	22.2	8,530 J	9.73 J

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			rSRL	NV	3300	23	390	1,600	NV	390	390	NV	5.2	78	23,000
			GPL	NV	NV	12	NV	590	NV	290	NV	NV	12	NV	NV
			BTV	12,000	440	0.005	1.1	18	6,700	0.67	--	8,400	--	36	70
35BSB00	0-0.5	N	27-Jan-11	6,230 J	294 J	**0.048**	0.52 J	10.1	3,160			1,650		17.8 J	43.5 J
35BSB00	5.5-6.5	N	27-Jan-11	4,100 J	238 J		0.57 J	6.65	2,630			827		16.1 J	41.8 J
35BSB00	0-0.5	N	27-Jan-11	4,230 J	213 J		0.51 J	7.69	2,870			94.6		16.2 J	40.3 J
35BSB00	5.5-6.5	N	26-Jan-11	4,210 J	266 J		0.55 J	8.04	2,920			528		17.5 J	47.7 J
35BSB00	0-0.5	N	26-Jan-11	5,770 J	257 J	**0.008 J**	0.49 J	9.68	3,120			112		17.6 J	42.3 J
35BSB00	5.5-6.5	N	26-Jan-11	4,350 J	246 J		0.6 J	8.59	3,050			458		17.6 J	40.4 J
35BSB00	0-0.5	N	27-Jan-11	4,560 J	236 J		0.46 J	8.47	2,740			91.4		16.3 J	63.7 J
35BSB00	5.5-6.5	N	27-Jan-11	4,190 J	203 J		0.59 J	7.49	2,460			1,010		18.6 J	42 J
35BSB00	5.5-6.5	FD	27-Jan-11	4,500 J	220 J		0.55 J	8.19	2,630			1,140		20.1 J	45.3 J
35BSB00	0-0.5	N	27-Jan-11	7,800 J	309 J		0.52 J	10.3	3,850			1,840		18.9 J	50.4 J
35BSB00	19.5-20.5	N	27-Jan-11	2,450 J	150 J		0.41 J	4.66	1,420			1,360		13.7 J	26.5 J
35BSB00	5.5-6.5	N	27-Jan-11	4,780 J	241 J	**0.0073 J**	0.41 J	7.8	3,760			710		15.6 J	45 J
35BSB00	0-0.5	N	26-Jan-11	3,990 J	221 J	**0.0056 J**	0.55 J	7.64	2,390			99.9		16.8 J	39.1 J
35BSB00	5.5-6.5	N	26-Jan-11	4,310 J	206 J		0.63 J	7.78	3,180			467		22 J	50 J
35BSB00	0-0.5	N	20-Jan-11	5,920 J	**628**		**1.99 J**	15.6 J	3,080			277			**231**
35BSB00	5.5-6.5	N	20-Jan-11	5,310 J	200		0.53 J	10.8 J	3,620			397		15.2 J	52.8
35BSB00	0-0.5	N	26-Jan-11	4,610 J	252 J	**0.0077 J**	0.4 J	8.74	2,430			103		16.5 J	36.4 J
35BSB00	5.5-6.5	N	26-Jan-11	3,970 J	188 J		0.5 J	6.94	3,120			854		15.4 J	39.7 J
35BSB00	0-0.5	N	26-Jan-11	5,230 J	253 J		0.48 J	10	3,210			97.4		17.2 J	38.7 J
35BSB00	5.5-6.5	N	26-Jan-11	4,470 J	211 J		0.56 J	8.06	3,300			765		15.5 J	42.3 J
35BSB01	0-0.5	N	20-Jan-11	5,160 J	220		0.5 J	8.91 J	3,740			120		17.9 J	37
35BSB01	5.5-6.5	N	20-Jan-11	4,740 J	228		0.78 J	8.35 J	3,590			240		14.7 J	38.8
35BSB01	0-0.5	N	20-Jan-11	4,880 J	255		0.61 J	9.2 J	3,580			83		16.5 J	40.8
35BSB01	19.5-20.5	N	24-Jan-11	2,910	282		0.46 J	5.46	1,310			1,310	**0.17 J**	18.1	25.8 J
35BSB01	19.5-20.5	FD	24-Jan-11	2,770	267		0.39 J	5.24	1,310			1,230	**0.29 J**	17.3	25.3 J
35BSB01	5.5-6.5	N	18-Jan-11	5,090 J	246		0.82 J	10 J	3,920			535		15.7 J	44.3

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			rSRL	NV	3300	23	390	1,600	NV	390	390	NV	5.2	78	23,000
			GPL	NV	NV	12	NV	590	NV	290	NV	NV	12	NV	NV
			BTV	12,000	440	0.005	1.1	18	6,700	0.67	--	8,400	--	36	70
35BSB01	0-0.5	N	19-Jan-11	7,570 J	309		0.56 J	11.8 J	4,410			638	**0.24 J**	18 J	42.6
35BSB01	5.5-6.5	N	24-Jan-11	4,200	192		0.69 J	7.25	2,380			1,500		21.2	35.5 J
35BSB01	0-0.5	N	24-Jan-11	6,400	289		0.55 J	10.8	2,960			133	0.16 J	19.3	44 J
35BSB01	19-21	N	24-Jan-11	1,840	155		0.21 J	3.15	921			1,570	**0.13 J**	16.5	17.3 J
35BSB01	5.5-6.5	N	24-Jan-11	3,830	227		0.56 J	6.55	2,650			1,110		23.6	33.3 J
35BSB01	0-0.5	N	24-Jan-11	5,860	282	0.0038 J	0.47 J	10.6	2,900			192		18.9	39.6 J
35BSB01	5.5-6.5	N	24-Jan-11	4,120	215		0.6 J	7.27	2,940			676		16.6	46 J
35BSB01	0-0.5	N	19-Jan-11	5,390 J	246		0.53 J	9.58 J	3,720			4,170		17.9 J	**95.2**
35BSB01	5.5-6.5	N	19-Jan-11	6,030 J	227		0.95 J	13.2 J	4,090			576		24 J	40.2
35BSB01	0-0.5	N	19-Jan-11	4,800 J	233		0.46 J	7.8 J	2,720			85.1		15.5 J	32.8
35BSB01	5.5-6.5	N	19-Jan-11	4,840 J	248		0.85 J	8.23 J	3,910			181		16.4 J	48.9
35BSB01	0-0.5	N	19-Jan-11	4,880 J	224	0.0045 J	0.37 J	7.92 J	2,630			90.4		15.3 J	31.1
35BSB01	0-0.5	FD	19-Jan-11	5,580 J	247		0.58 J	8.82 J	3,120			118		16.8 J	34.9
35BSB01	5.5-6.5	N	19-Jan-11	2,420 J	247		0.37 J	4.53 J	1,210			891		22.3 J	15.8
35BSB01	0-0.5	N	25-Jan-11	4,680	254		0.49 J	8.53	3,060			103		17.3	40.4 J
35BSB01	19.5-20.5	N	26-Jan-11	1,730	193		0.16 J	3.7	911			801		12.7	16.2 J
35BSB01	5.5-6.5	N	25-Jan-11	4,530	200		0.5 J	8.81	3,680			691		15.8	42.3 J
35BSB01	0-0.5	N	19-Jan-11	5,210 J	243		0.46 J	9.55 J	3,670			129		17.5 J	38
35BSB01	5.5-6.5	N	19-Jan-11	4,840 J	211		0.52 J	7.13 J	3,400			793		16.8 J	38.1
35BSB02	0-0.5	N	26-Jan-11	4,890	236		0.45 J	9.5	3,070			109		17.4	37.2 J
35BSB02	5.5-6.5	N	26-Jan-11	4,500	184		0.57 J	7.32	2,820			542		19.1	52.4 J
35CSB00	19.5-20.5	N	31-Jan-11	1,630 J	186		0.33 J	3.56	969 J	0.2 J		937 J		10.6	15
35CSB00	5.5-6.5	N	31-Jan-11	5,550 J	254		0.36 J	7.51	4,920		**0.098 J**	1,510		27.8	56.7
35CSB00	19.5-50.5	N	31-Jan-11	2,060 J	167		0.23 J	3.72	1,480			936 J		11.8	20.6
35CSB00	5.5-6.5	N	31-Jan-11	4,970 J	214 J		0.6 J	9.82	4,250	0.33 J	**0.055 J**	1,220		21.2	43.7
35CSB00	5.5-6.5	FD	31-Jan-11	5,280 J	220		0.56 J	11.4	4,840	0.27 J	**0.057 J**	1,230		23.4	57

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			rSRL	NV	3300	23	390	1,600	NV	390	390	NV	5.2	78	23,000
			GPL	NV	NV	12	NV	590	NV	290	NV	NV	12	NV	NV
			BTV	12,000	440	0.005	1.1	18	6,700	0.67	--	8,400	--	36	70
35CSB00	19.5-20.5	N	01-Feb-11	1,890 J	152		0.32 J	3.56	1,140			958 J		10.5	16.2
35CSB00	5.5-6.5	N	01-Feb-11	5,530 J	208		0.44 J	8.9	4,750			1,400		22.9	46.1
35CSB00	19.5-20.5	N	01-Feb-11	2,100 J	161		0.22 J	3.77	1,230			1,010		12.5	19.6
35CSB00	5.5-6.5	N	01-Feb-11	4,910 J	207		0.37 J	7.43	4,140			1,450		20.5	39.2
35CSB00	19.5-20.5	N	01-Feb-11	1,620 J	143		0.17 J	3.11	854 J			817 J		10.7	17.2
35CSB00	5.5-6.5	N	01-Feb-11	5,290 J	205		0.39 J	9.07	4,730			1,240		22.7	42.5
35CSB00	19.5-20.5	N	02-Feb-11	2,060 J	152		0.27 J	3.55	1,040			1,080		11.9	14.7
35CSB00	19.5-20.5	FD	02-Feb-11	2,030 J	149		0.28 J	3.53	1,020			1,080		12.7	15.2
35CSB00	5.5-6.5	N	02-Feb-11	4,650 J	235		**1.29**	7.45	3,650			1,720		19.8	36.5
35CSB00	19.5-20.5	N	40575	1,850 J	154		0.31 J	3.67	970 J			1,130		12.4	16.8
35CSB00	5.5-6.5	N	01-Feb-11	4,050 J	168		0.25 J	5.99	2,840			1,770		18.2	31.8
35CSB00	19.5-20.5	N	01-Feb-11	2,010 J	150		0.16 J	3.47	1,020			1,230		11.7	14.5
35CSB00	5.5-6.5	N	01-Feb-11	5,370 J	223		0.56 J	9.95	4,990			964		21.2	47.1
35CSB00	19.5-20.5	N	03-Feb-11	2,630 J	143		0.089 J	3.43	1,150			963		17.8	20.9
35CSB00	5.5-6.5	N	03-Feb-11	5,160 J	219		0.22 J	8.21	4,740			1,120		17.2	43.7
35CSB01	0-0.5	N	07-Feb-11	9,010 J	392	**0.0076 J**	0.35 J	15.2	5,950	**0.97 J**		1,200		28.1 J	52.6 J
35CSB01	19.5-20.5	N	07-Feb-11	6,070 J	331		1.03 J	11.7	5,690			972		25.1 J	53.8 J
35CSB01	5.5-6.5	N	07-Feb-11	5,870 J	237		0.6 J	11.5	5,090	**1.51 J**		1,200		25.1 J	52.7 J
35CSB01	0-0.5	N	07-Feb-11	9,620 J	403		0.51 J	15.5	6,150	0.56 J		2,570		28.4 J	58.1 J
35CSB01	19.5-20.5	N	07-Feb-11	5,500 J	292		**1.15 J**	9.58	4,810	**1.09 J**		896		29.8 J	51.2 J
35CSB01	5.5-6.5	N	07-Feb-11	7,420 J	291	**0.0087 J**	0.83 J	13.2	5,770	0.52 J		710		32.2 J	**74.2 J**
35CSB01	0-0.5	N	07-Feb-11	9,380 J	403	**0.025**	0.56 J	15.2	6,110			1,370		26.9 J	55.1 J
35CSB01	19.5-20.5	N	07-Feb-11	2,370 J	128		0.19 J	5.06	1,820			622		13.8 J	26.1 J
35CSB01	5.5-6.5	N	07-Feb-11	7,030 J	287		0.56 J	13.6	6,150	**0.71 J**		1,190		28.4 J	62.2 J
35CSB01	0-0.5	N	08-Feb-11	7,600 J	332		0.59 J	12.4	4,370	0.28 J				25.4 J	44.5 J
35CSB01	0-0.5	FD	08-Feb-11	7,680 J	330		0.56 J	12.7	4,340	0.47 J		136		26.6 J	45.1 J

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			rSRL	NV	3300	23	390	1,600	NV	390	390	NV	5.2	78	23,000
			GPL	NV	NV	12	NV	590	NV	290	NV	NV	12	NV	NV
			BTV	12,000	440	0.005	1.1	18	6,700	0.67	--	8,400	--	36	70
35CSB01	19.5-20.5	N	08-Feb-11	1,980 J	218		0.21 J	3.67	1,170			700		15.6 J	16.7 J
35CSB01	5.5-6.5	N	08-Feb-11	6,670 J	293		0.63 J	9.86	4,940	0.4 J		565		26.4 J	56 J
35CSB01	19.5-20.5	N	03-Feb-11	1,920 J	146		0.32 J	3.52	1,070			1,340		10.6	15.5
35CSB01	5.5-6.5	N	03-Feb-11	4,480 J	175		0.58 J	6.64	2,790			2,560		21.1	31.3
35CSS00	0-0.5	N	25-Jan-11	6,430	355	0.0039 J	1.07 J	**19.9**	4,140			424		17.7	**79.1 J**
35CSS00	0-0.5	N	25-Jan-11	6,210	283		0.81 J	11.5	3,970			3,490		19.5	57.3 J
35CSS00	0-0.5	N	25-Jan-11	4,820	241		0.55 J	11.3	3,440			147		17	**100 J**
35CSS00	0-0.5	N	25-Jan-11	7,060	282		0.64 J	13.9	5,160			1,070		23.4	62.2 J
35CSS00	0-0.5	N	25-Jan-11	6,970	348		0.56 J	13.7	4,770			768	**0.47 J**	14.8	50.2 J
35CSS00	0-0.5	N	10-Feb-11	10,300 J	**498**		0.73 J	16.4	**6,880**	**0.8 J**		872		25.3 J	58.9 J
35CSS00	0-0.5	N	02-Feb-11	6,970 J	278		0.22 J	10.2	4,090			1,950		20.8	42.5
35CSS00	0-0.5	N	02-Feb-11	4,480 J	242		0.52 J	9.83	3,230			266		14.4	**76**
35CSS00	0-0.5	N	10-Feb-11	8,590 J	384	**0.0071 J**	0.74 J	15.4	5,390			1,020		21.8 J	62.6 J
35CSS01	0-0.5	N	10-Feb-11	7,670 J	346	0.0043 J	0.61 J	16.2	5,170		**0.25 J**	289		23.1 J	**85.9 J**
35CSS01	0-0.5	N	10-Feb-11	8,540 J	367	**0.0076 J**	0.46 J	13.6	5,720	**0.7 J**		1,530		25.8 J	53.1 J
35CSS01	0-0.5	N	12-Jan-11	4,350 J	226		0.51 J	7.93	3,070	0.29 J		157		8.5 J	45.8
35CSS01	0-0.5	N	40555	5,790 J	308	0.0049 J	0.65 J	11.3	3,600	0.59 J		1,430		13.4 J	65
35CSS01	0-0.5	N	12-Jan-11	6,110 J	245		0.38 J	10	3,380	**0.79 J**		2,400		16.7 J	66.2
35CSS01	0-0.5	N	12-Jan-11	5,200 J	289		0.24 J	9.64	2,700			96.1		17.1 J	**77.7**
35CSS01	0-0.5	N	12-Jan-11	8,090 J	303		0.29 J	11.8	3,030	0.51 J		242		17.6 J	42.7
35CSS01	0-0.5	N	12-Jan-11	7,050 J	295		0.28 J	10.7	2,870	0.51 J		128		16.7 J	39.7
35CSS01	0-0.5	N	12-Jan-11	7,130 J	321	0.0038 J	0.42 J	12.3	3,290	0.6 J		145		18.2 J	45.8
35CSS02	0-0.5	N	12-Jan-11	6,110 J	306		0.3 J	11.6	3,590	0.52 J		709		15.4 J	44.6
35CSS02	0-0.5	N	12-Jan-11	7,680 J	345		0.39 J	11.7	4,280	0.64 J		6,800		14.2 J	46
35CSS02	0-0.5	N	12-Jan-11	6,410 J	284		0.36 J	12.7	4,860	0.55 J		633		22.2 J	69.5
35CSS02	0-0.5	N	11-Jan-11	4,480 J	262		0.52 J	8.19	2,590	0.38 J		82.7		16.3 J	36.7

TABLE 4.6

INORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			rSRL	NV	3300	23	390	1,600	NV	390	390	NV	5.2	78	23,000
			GPL	NV	NV	12	NV	590	NV	290	NV	NV	12	NV	NV
			BTV	12,000	440	0.005	1.1	18	6,700	0.67	--	8,400	--	36	70
35CSS02	0-0.5	N	11-Jan-11	4,370 J	302		0.39 J	8.46	2,810	0.43 J		81.5		17.2 J	35.4
35CSS02	0-0.5	N	11-Jan-11	5,210	326		0.31 J	8.2	2,550	0.45 J		92.2		14.4	34.3
35CSS02	0-0.5	N	11-Jan-11	3,910	354		0.36 J	7.83	2,880	0.4 J		64.9		11	32.8
35CSS02	0-0.5	N	11-Jan-11	3,700 J	233		0.54 J	10	2,870	0.38 J		89.7		10.5 J	**124**
35CSS02	0-0.5	N	11-Jan-11	5,060 J	228		0.17 J	8.86	2,910	0.37 J	**0.055 J**	133		12.4 J	46.8
35CSS02	0-0.5	N	11-Jan-11	4,600 J	242	**0.0082 J**	0.71 J	9.41	3,420	0.47 J		109		13.8 J	**168**
35CSS03	0-0.5	N	11-Jan-11	3,930 J	224	**0.01 J**	0.44 J	8.13	3,110	0.27 J		82.3		13.2 J	**109**
35CSS03	0-0.5	N	11-Jan-11	3,620 J	202		0.41 J	5.26	2,010	0.47 J		98 J		12.9 J	34.2
35CSS03	0-0.5	FD	11-Jan-11	3,240 J	301	0.0041 J	0.31 J	5.3	2,000	0.22 J		87.3		10 J	31.7

Definitions:

ft bgs = feet below ground surface. BTV = background threshold value. rSRL = Arizona residential soil remediation level (ADEQ, 2007). GPL = Arizona minimum groundwater protection level (ADEQ, 1996). NV = no value. N = normal sample. FD = field duplicate. J = estimated value.

Notes:

[1]Results are reported in units of milligrams per kilogram (mg/kg). Bolded values indicate those above the BTV. Highlighted values indicate those above the GPL. No values exceed the rSRL.

TABLE 4.7

ORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-Dinitrotoluene	2-Methylnaphthalene	2-Methylphenol (o-Cresol)	2-Nitrotoluene	4-Amino-2,6-Dinitrotoluene	bis(2-Ethylhexyl) Phthalate
			rSRL	1,800	6.1	31	120	61	12		3,100	9.3	12	390
			GPL											
35BSB002	0-0.5	N	27-Jan-11											
35BSB002	5.5-6.5	N	26-Jan-11											0.0254 J
35BSB007	0-0.5	N	20-Jan-11				0.14 J	0.1 J						
35BSB007	5.5-6.5	N	20-Jan-11				0.13 J	0.085 J		0.0769 J	0.0181 J			
35BSB009	5.5-6.5	N	26-Jan-11											0.0284 J
35BSB010	0-0.5	N	20-Jan-11				0.19 J	0.12 J						
35BSB010	5.5-6.5	N	20-Jan-11				0.15 J	0.093 J						
35BSB011	0-0.5	N	20-Jan-11				0.083 J	0.066 J						
35BSB011	5.5-6.5	N	18-Jan-11				0.081 J	0.075 J	0.32 J					
35BSB012	0-0.5	N	19-Jan-11				0.073 J	0.059 J						
35BSB015	0-0.5	N	19-Jan-11				0.15 J	0.078 J						
35BSB015	5.5-6.5	N	19-Jan-11				0.1 J	0.066 J						
35BSB016	0-0.5	N	19-Jan-11				0.12 J	0.082 J	0.041 J					
35BSB016	5.5-6.5	N	19-Jan-11				0.078 J	0.059 J						
35BSB017	0-0.5	N	19-Jan-11				0.048 J	0.041 J						
35BSB017	0-0.5	FD	19-Jan-11				0.087 J	0.092 J	0.3 J					
35BSB017	5.5-6.5	N	19-Jan-11				0.13 J	0.093 J						
35BSB018	0-0.5	N	25-Jan-11				0.028 J							
35BSB019	0-0.5	N	19-Jan-11				0.13 J	0.095 J						
35BSB019	5.5-6.5	N	19-Jan-11				0.14 J	0.096 J						
35BSB020	0-0.5	N	26-Jan-11											
35CSB001	19.5-20.5	N	31-Jan-11											0.0171 J
35CSB001	5.5-6.5	N	31-Jan-11	0.095 J	0.013 J	0.046 J	0.057 J	0.024 J						0.0146 J
35CSB002	5.5-6.5	N	31-Jan-11											
35CSB002	5.5-6.5	FD	31-Jan-11											

TABLE 4.7

ORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-Dinitrotoluene	2-Methylnaphthalene	2-Methylphenol (o-Cresol)	2-Nitrotoluene	4-Amino-2,6-Dinitrotoluene	bis(2-Ethylhexyl) Phthalate
			rSRL	1,800	6.1	31	120	61	12		3,100	9.3	12	390
			GPL											
35CSB003	5.5-6.5	N	1-Feb-11											
35CSB004	5.5-6.5	N	1-Feb-11											
35CSB005	5.5-6.5	N	1-Feb-11											
35CSB006	5.5-6.5	N	2-Feb-11											
35CSB007	5.5-6.5	N	1-Feb-11	0.011 J			0.019 J							
35CSB008	5.5-6.5	N	1-Feb-11	0.016 J										0.0165 J
35CSB009	5.5-6.5	N	3-Feb-11											
35CSB010	0-0.5	N	7-Feb-11											
35CSB010	5.5-6.5	N	7-Feb-11											0.0193 J
35CSB011	0-0.5	N	7-Feb-11	0.085 J	0.025 J	0.045 J	1.4	0.045 J						
35CSB011	19.5-20.5	N	7-Feb-11											0.0361 J
35CSB011	5.5-6.5	N	7-Feb-11				0.16 J	0.016 J						
35CSB012	0-0.5	N	7-Feb-11				0.57	0.032 J						
35CSB013	5.5-6.5	N	8-Feb-11											0.0307 J
35CSB014	5.5-6.5	N	3-Feb-11	0.051 J	0.0055 J		0.033 J							
35CSS001	0-0.5	N	25-Jan-11	0.058 J			0.21 J							
35CSS002	0-0.5	N	25-Jan-11				0.36							
35CSS003	0-0.5	N	25-Jan-11			0.26	0.277 J					0.079 J		
35CSS004	0-0.5	N	25-Jan-11				0.029 J							0.049 J
35CSS005	0-0.5	N	25-Jan-11	0.015 J			0.065 J							
35CSS006	0-0.5	N	10-Feb-11	0.011 J			0.0084 J							
35CSS007	0-0.5	N	2-Feb-11	0.099 J	0.012 J		0.36	0.035 J	0.035 J					
35CSS008	0-0.5	N	2-Feb-11			0.027 J	2.4	0.14 J						
35CSS009	0-0.5	N	10-Feb-11	0.11 J		0.026 J	0.29						0.08 J	
35CSS010	0-0.5	N	10-Feb-11				1.3	0.069 J					0.013 J	

TABLE 4.7

ORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene	2-Amino-4,6-Dinitrotoluene	2-Methylnaphthalene	2-Methylphenol (o-Cresol)	2-Nitrotoluene	4-Amino-2,6-Dinitrotoluene	bis(2-Ethylhexyl) Phthalate
			rSRL	1,800	6.1	31	120	61	12		3,100	9.3	12	390
			GPL											
35CSS011	0-0.5	N	10-Feb-11				0.027 J							
35CSS013	0-0.5	N	12-Jan-11				0.456		0.14 J					
35CSS014	0-0.5	N	12-Jan-11				0.35	0.016 J						
35CSS015	0-0.5	N	12-Jan-11				0.024 J							
35CSS016	0-0.5	N	12-Jan-11			0.027 J	0.59	0.051 J	0.074 J					
35CSS020	0-0.5	N	12-Jan-11				0.88	0.068 J						
35CSS021	0-0.5	N	12-Jan-11	0.086 J	0.0055 J		0.016 J							
35CSS022	0-0.5	N	12-Jan-11	0.64		0.049 J	0.094 J		0.043 J				0.083 J	
35CSS023	0-0.5	N	11-Jan-11			0.39								
35CSS026	0-0.5	N	11-Jan-11			0.15 J	1.27							
35CSS027	0-0.5	N	11-Jan-11				0.753							
35CSS028	0-0.5	N	11-Jan-11				0.96	0.063 J						
35CSS029	0-0.5	N	11-Jan-11				0.026 J		0.34					
35CSS030	0-0.5	N	11-Jan-11			0.4	2.9	0.23 J						
35CSS031	0-0.5	N	11-Jan-11			0.73 J	1.1 J							0.13 J
35CSS031	0-0.5	FD	11-Jan-11			0.52	1.56							

TABLE 4.7

ORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Chrysene	Diethyl Phthalate	Di-n-Butyl Phthalate	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX)	Nitroglycerin	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX)	Pentaerythritol Tetranitrate (PETN)	Tetryl
			rSRL	680	49,000	6,100	50	9.3	3,100		610
			GPL								
35BSB002	0-0.5	N	27-Jan-11		0.0956 J	0.03 J					
35BSB002	5.5-6.5	N	26-Jan-11			0.00836 J					
35BSB007	0-0.5	N	20-Jan-11								
35BSB007	5.5-6.5	N	20-Jan-11								
35BSB009	5.5-6.5	N	26-Jan-11								
35BSB010	0-0.5	N	20-Jan-11								
35BSB010	5.5-6.5	N	20-Jan-11								
35BSB011	0-0.5	N	20-Jan-11								0.047 J
35BSB011	5.5-6.5	N	18-Jan-11								
35BSB012	0-0.5	N	19-Jan-11								
35BSB015	0-0.5	N	19-Jan-11								
35BSB015	5.5-6.5	N	19-Jan-11								
35BSB016	0-0.5	N	19-Jan-11								
35BSB016	5.5-6.5	N	19-Jan-11								
35BSB017	0-0.5	N	19-Jan-11								
35BSB017	0-0.5	FD	19-Jan-11								
35BSB017	5.5-6.5	N	19-Jan-11								
35BSB018	0-0.5	N	25-Jan-11								
35BSB019	0-0.5	N	19-Jan-11								
35BSB019	5.5-6.5	N	19-Jan-11								
35BSB020	0-0.5	N	26-Jan-11	0.0223 J							
35CSB001	19.5-20.5	N	31-Jan-11								
35CSB001	5.5-6.5	N	31-Jan-11				0.38		0.042 J		
35CSB002	5.5-6.5	N	31-Jan-11				0.026 J				
35CSB002	5.5-6.5	FD	31-Jan-11				0.023 J				

TABLE 4.7

ORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Chrysene	Diethyl Phthalate	Di-n-Butyl Phthalate	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX)	Nitroglycerin	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX)	Pentaerythritol Tetranitrate (PETN)	Tetryl
			rSRL	680	49,000	6,100	50	9.3	3,100		610
			GPL								
35CSB003	5.5-6.5	N	1-Feb-11			0.0108 J	0.24		0.046 J		
35CSB004	5.5-6.5	N	1-Feb-11				0.21 J		0.029 J		
35CSB005	5.5-6.5	N	1-Feb-11				0.035 J		0.032 J		
35CSB006	5.5-6.5	N	2-Feb-11				0.015 J				
35CSB007	5.5-6.5	N	1-Feb-11				0.1 J	0.055 J	0.024 J		
35CSB008	5.5-6.5	N	1-Feb-11			0.0134 J	0.03 J	0.073 J			
35CSB009	5.5-6.5	N	3-Feb-11				0.023 J				
35CSB010	0-0.5	N	7-Feb-11			0.0163 J					
35CSB010	5.5-6.5	N	7-Feb-11								
35CSB011	0-0.5	N	7-Feb-11			0.685	6.7	0.13 J	0.15 J		
35CSB011	19.5-20.5	N	7-Feb-11								
35CSB011	5.5-6.5	N	7-Feb-11			0.0938 J	0.13 J				
35CSB012	0-0.5	N	7-Feb-11			0.146 J	0.027 J		0.038 J		
35CSB013	5.5-6.5	N	8-Feb-11								
35CSB014	5.5-6.5	N	3-Feb-11				0.05 J	0.14 J			
35CSS001	0-0.5	N	25-Jan-11			0.0238 J	0.14 J		2		
35CSS002	0-0.5	N	25-Jan-11			0.00862 J	0.044 J		0.075 J		
35CSS003	0-0.5	N	25-Jan-11		0.661	0.322 J	0.83	0.2 J	0.27		
35CSS004	0-0.5	N	25-Jan-11		0.192 J	0.0324 J	0.8	0.66	0.59		
35CSS005	0-0.5	N	25-Jan-11			0.0208 J	0.23 J		0.18 J		
35CSS006	0-0.5	N	10-Feb-11				0.06 J		0.069 J		
35CSS007	0-0.5	N	2-Feb-11		0.366	0.0547 J	1.4	0.079 J	0.53		
35CSS008	0-0.5	N	2-Feb-11		5.27	1.57	0.18 J	4.3	0.3		1.1
35CSS009	0-0.5	N	10-Feb-11		0.206 J	0.431	1	0.3 J	0.35		5.1
35CSS010	0-0.5	N	10-Feb-11		0.155 J	0.555	0.39	0.36 J	0.26		

TABLE 4.7

ORGANIC ANALYTICAL RESULTS - DETECTIONS[1]

U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Chrysene	Diethyl Phthalate	Di-n-Butyl Phthalate	Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX)	Nitroglycerin	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX)	Pentaerythritol Tetranitrate (PETN)	Tetryl
			rSRL	680	49,000	6,100	50	9.3	3,100		610
			GPL								
35CSS011	0-0.5	N	10-Feb-11		0.242 J	0.0085 J	0.14 J	0.12 J	0.084 J		
35CSS013	0-0.5	N	12-Jan-11		0.172 J	0.639	0.11 J	0.12 J			
35CSS014	0-0.5	N	12-Jan-11		7.1	0.146 J	0.14 J	2.1	0.66		
35CSS015	0-0.5	N	12-Jan-11		0.0792 J		0.05 J		0.063 J		
35CSS016	0-0.5	N	12-Jan-11		0.0876 J	0.44					
35CSS020	0-0.5	N	12-Jan-11		0.207 J	0.523					
35CSS021	0-0.5	N	12-Jan-11		0.426		0.12 J	0.2 J	0.066 J		
35CSS022	0-0.5	N	12-Jan-11			0.027 J	0.04 J	0.088 J	0.036 J		
35CSS023	0-0.5	N	11-Jan-11				0.21 J				
35CSS026	0-0.5	N	11-Jan-11			2.22	0.091 J				
35CSS027	0-0.5	N	11-Jan-11			1.15	0.17 J				
35CSS028	0-0.5	N	11-Jan-11			0.253 J		1.3			
35CSS029	0-0.5	N	11-Jan-11		0.038 J	0.151 J	0.2 J	0.41 J	0.057 J		
35CSS030	0-0.5	N	11-Jan-11			0.0499 J	0.12 J	1	0.022 J		
35CSS031	0-0.5	N	11-Jan-11		17.4	1.32 J	0.22 J	0.39 J		0 R	
35CSS031	0-0.5	FD	11-Jan-11		0.676	0.865	0.28	4.2			

Definitions:

ft bgs = feet below ground surface. rSRL = Arizona residential soil remediation level (ADEQ, 2007). GPL = Arizona minimum groundwater protection level (ADEQ, 1996). NV = no value. N = normal sample. FD = field duplicate. J = estimated value.

Notes:

[1]Results are reported in units of milligrams per kilogram (mg/kg). No values exceed the rSRL.

Table 4.8
PERCHLORATE ANALYTICAL RESULTS - DETECTIONS
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Perchlorate (mg/kg)	Location	Sample Depth (ft bgs)	Sample Type	Sample Date	Perchlorate (mg/kg)
			rSRL	55				***rSRL***	55
			GPL	NV				***GPL***	NV
35BSB001	0-0.5	N	27-Jan-11	0.27	35CSB005	5.5-6.5	N	01-Feb-11	0.1
35BSB001	5.5-6.5	N	27-Jan-11	0.0058	35CSB006	19.5-20.5	N	02-Feb-11	0.0068
35BSB002	0-0.5	N	27-Jan-11	0.0033 J	35CSB006	19.5-20.5	FD	02-Feb-11	0.011
35BSB002	5.5-6.5	N	26-Jan-11	0.0041 J	35CSB006	5.5-6.5	N	02-Feb-11	0.12
35BSB003	0-0.5	N	26-Jan-11	0.0054	35CSB007	19.5-20.5	N	01-Feb-11	0.015
35BSB003	5.5-6.5	N	26-Jan-11	0.0063	35CSB007	5.5-6.5	N	01-Feb-11	1.3
35BSB004	0-0.5	N	27-Jan-11	0.00066 J	35CSB008	19.5-20.5	N	01-Feb-11	0.0049 J
35BSB004	5.5-6.5	N	27-Jan-11	0.0089	35CSB008	5.5-6.5	N	01-Feb-11	0.26
35BSB004	5.5-6.5	FD	27-Jan-11	0.0064	35CSB009	19.5-20.5	N	03-Feb-11	0.0055
35BSB005	0-0.5	N	27-Jan-11	0.17	35CSB009	5.5-6.5	N	03-Feb-11	0.56
35BSB005	19.5-20.5	N	27-Jan-11	0.0045 J	35CSB010	0-0.5	N	07-Feb-11	0.0032 J
35BSB005	5.5-6.5	N	27-Jan-11	0.0045 J	35CSB010	19.5-20.5	N	07-Feb-11	0.0083
35BSB006	5.5-6.5	N	26-Jan-11	0.0012 J	35CSB010	5.5-6.5	N	07-Feb-11	0.039
35BSB007	0-0.5	N	20-Jan-11	0.00044 J	35CSB011	0-0.5	N	07-Feb-11	0.97
35BSB007	5.5-6.5	N	20-Jan-11	0.0035 J	35CSB011	19.5-20.5	N	07-Feb-11	0.0032 J
35BSB008	5.5-6.5	N	26-Jan-11	0.0041 J	35CSB011	5.5-6.5	N	07-Feb-11	0.0099
35BSB009	0-0.5	N	26-Jan-11	0.00041 J	35CSB012	0-0.5	N	07-Feb-11	0.02
35BSB009	5.5-6.5	N	26-Jan-11	0.011	35CSB012	19.5-20.5	N	07-Feb-11	0.0011 J
35BSB010	0-0.5	N	20-Jan-11	0.00051 J	35CSB012	5.5-6.5	N	07-Feb-11	0.03
35BSB010	5.5-6.5	N	20-Jan-11	0.0019 J	35CSB013	0-0.5	N	08-Feb-11	0.00043 J
35BSB011	19.5-20.5	N	24-Jan-11	0.0034 J	35CSB013	19.5-20.5	N	08-Feb-11	0.0011 J
35BSB011	19.5-20.5	FD	24-Jan-11	0.0034 J	35CSB013	5.5-6.5	N	08-Feb-11	0.023
35BSB011	5.5-6.5	N	18-Jan-11	0.0058	35CSB014	19.5-20.5	N	03-Feb-11	0.075
35BSB012	0-0.5	N	19-Jan-11	0.0006 J	35CSB014	5.5-6.5	N	03-Feb-11	1.9
35BSB012	5.5-6.5	N	24-Jan-11	0.024	35CSS001	0-0.5	N	25-Jan-11	0.0054
35BSB013	19-21	N	24-Jan-11	0.0037 J	35CSS002	0-0.5	N	25-Jan-11	0.63
35BSB013	5.5-6.5	N	24-Jan-11	0.0085	35CSS003	0-0.5	N	25-Jan-11	0.013
35BSB014	5.5-6.5	N	24-Jan-11	0.01	35CSS004	0-0.5	N	25-Jan-11	0.44
35BSB015	0-0.5	N	19-Jan-11	0.2	35CSS005	0-0.5	N	25-Jan-11	0.0079
35BSB015	5.5-6.5	N	19-Jan-11	0.022	35CSS006	0-0.5	N	10-Feb-11	0.017
35BSB016	0-0.5	N	19-Jan-11	0.00044 J	35CSS007	0-0.5	N	02-Feb-11	1.1
35BSB016	5.5-6.5	N	19-Jan-11	0.0014 J	35CSS008	0-0.5	N	02-Feb-11	0.0042 J
35BSB017	0-0.5	N	19-Jan-11	0.00037 J	35CSS009	0-0.5	N	10-Feb-11	1.3
35BSB017	0-0.5	FD	19-Jan-11	0.00039 J	35CSS010	0-0.5	N	10-Feb-11	0.0075
35BSB017	5.5-6.5	N	19-Jan-11	0.0021 J	35CSS011	0-0.5	N	10-Feb-11	0.19
35BSB018	0-0.5	N	25-Jan-11	0.00037 J	35CSS013	0-0.5	N	12-Jan-11	0.076
35BSB018	19.5-20.5	N	26-Jan-11	0.00029 J	35CSS014	0-0.5	N	12-Jan-11	0.58
35BSB018	5.5-6.5	N	25-Jan-11	0.013	35CSS015	0-0.5	N	12-Jan-11	0.55
35BSB019	0-0.5	N	19-Jan-11	0.00078 J	35CSS016	0-0.5	N	12-Jan-11	0.072
35BSB019	5.5-6.5	N	19-Jan-11	0.01	35CSS019	0-0.5	N	12-Jan-11	0.0003 J
35BSB020	0-0.5	N	26-Jan-11	0.00043 J	35CSS020	0-0.5	N	12-Jan-11	0.00035 J
35BSB020	5.5-6.5	N	26-Jan-11	0.034	35CSS021	0-0.5	N	12-Jan-11	160
35CSB001	19.5-20.5	N	31-Jan-11	0.00067 J	35CSS022	0-0.5	N	12-Jan-11	0.0085
35CSB001	5.5-6.5	N	31-Jan-11	0.066	35CSS023	0-0.5	N	11-Jan-11	0.00037 J
35CSB002	19.5-50.5	N	31-Jan-11	0.003 J	35CSS024	0-0.5	N	11-Jan-11	0.0014 J
35CSB002	5.5-6.5	N	31-Jan-11	0.055	35CSS026	0-0.5	N	11-Jan-11	0.0024 J
35CSB002	5.5-6.5	FD	31-Jan-11	0.052	35CSS027	0-0.5	N	11-Jan-11	0.001 J
35CSB003	19.5-20.5	N	01-Feb-11	0.0018 J	35CSS028	0-0.5	N	11-Jan-11	0.003 J
35CSB003	5.5-6.5	N	01-Feb-11	0.15	35CSS029	0-0.5	N	11-Jan-11	0.015
35CSB004	19.5-20.5	N	01-Feb-11	0.002 J	35CSS030	0-0.5	N	11-Jan-11	0.055
35CSB004	5.5-6.5	N	01-Feb-11	0.11	35CSS031	0-0.5	N	11-Jan-11	0.43
35CSB005	19.5-20.5	N	01-Feb-11	0.0015 J	35CSS031	0-0.5	FD	11-Jan-11	0.34

Definitions: ft bgs = feet below ground surface. mg/kg - milligrams per kilogram. rSRL = Arizona residential soil remediation level (ADEQ, 2007). GPL = minimum groundwater protection level (ADEQ, 1996). NV = no value. N = normal sample. FD = field duplicate.

Note: No value exceeded the rSRL for perchlorate.

TABLE 4.9
METALS EXCEEDING BACKGROUND THRESHOLD VALUES
U.S. ARMY GARRISON YUMA PROVING GROUND, YUMA, ARIZONA

Location	Depth (ft bgs)	Number of Metals Greater than BTV	Location	Depth (ft bgs)	Number of Metals Greater than BTV
35BSB001	0-0.5	2	35CSB011	5.5-6.5	4
35BSB002	0-0.5	1	35CSB011	19.5-20.5	2
35BSB003	0-0.5	2	35CSB012	0-0.5	3
35BSB004	0-0.5	2	35CSB012	5.5-6.5	2
35BSB005	0-0.5	1	35CSS001	0-0.5	5
35BSB005	5.5-6.5	1	35CSS002	0-0.5	3
35BSB006	0-0.5	1	35CSS003	0-0.5	4
35BSB007	0-0.5	7	35CSS004	0-0.5	2
35BSB007	5.5-6.5	4	35CSS005	0-0.5	2
35BSB008	0-0.5	1	35CSS006	0-0.5	5
35BSB011	19.5-20.5	1	35CSS007	0-0.5	1
35BSB012	0-0.5	1	35CSS008	0-0.5	4
35BSB013	0-0.5	1	35CSS009	0-0.5	2
35BSB013	19-21	1	35CSS010	0-0.5	6
35BSB017	5.5-6.5	1	35CSS011	0-0.5	3
35CSB001	5.5-6.5	1	35CSS014	0-0.5	2
35CSB002	5.5-6.5	1	35CSS016	0-0.5	2
35CSB006	5.5-6.5	1	35CSS022	0-0.5	3
35CSB010	0-0.5	3	35CSS027	0-0.5	4
35CSB010	5.5-6.5	1	35CSS028	0-0.5	3
35CSB010	19.5-20.5	1	35CSS029	0-0.5	5
35CSB011	0-0.5	1	35CSS030	0-0.5	3

Definitions: BTV = background threshold value.

TABLE 5.1
CHEMICALS OF POTENTIAL CONCERN
YPG-35b
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Group	Chemical	Max Detect[1] (mg/kg)	BTV (mg/kg)	nrSRL (mg/kg)	Max Detect Exceeds		COPC
					BTV	nrSRL	
Metals	Aluminum	11,900	20,000	920,000	No	No	No
	Arsenic	8.65	8.9	10	No	No	No
	Barium	561	350	170,000	Yes	No	No
	Beryllium	0.54	0.89	1,900	No	No	No
	Cadmium	2.54	0.24	510	Yes	No	No
	Chromium, total	31.7	19	1,000,000 [2]	Yes	No	No
	Cobalt	6.15	8.2	13,000	No	No	No
	Copper	44.7	61	41,000	No	No	No
	Lead	300	14	800	Yes	No	No
	Manganese	628	440	32,000	Yes	No	No
	Mercury	0.048	0.005	310	Yes	No	No
	Molybdenum	1.99	1.1	5,100	Yes	No	No
	Nickel	15.6	18	20,000	No	No	No
	Thallium	0.24	-	67	Yes	No	No
	Vanadium	24	36	1,000	No	No	No
	Zinc	231	70	310,000	Yes	No	No
SVOC	2-Methylnaphthalene	0.0769	NA	4,100[3]	NA	No	No
	2-Methylphenol (o-cresol)	0.0181	NA	3,100[3]	NA	No	No
	Bis(2-ethylhexyl)phthalate	0.0284	NA	1,200	NA	No	No
	Chrysene	0.0223	NA	2,000	NA	No	No
	Diethyl phthalate	0.0956	NA	490,000	NA	No	No
	Di-n-butyl phthalate	0.03	NA	62,000	NA	No	No

TABLE 5.1
CHEMICALS OF POTENTIAL CONCERN
YPG-35b
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Group	Chemical	Max Detect[(1)] (mg/kg)	BTV (mg/kg)	nrSRL (mg/kg)	Max Detect Exceeds		COPC
					BTV	nrSRL	
Explosives	2,4-Dinitrotoluene	0.19	NA	1,200	NA	No	No
	2,6-Dinitrotoluene	0.12	NA	620	NA	No	No
	2-Amino-4,6-dinitrotoluene	0.32	NA	120[(4)]	NA	No	No
	Nitroguanidine	0.075	NA	62,000	NA	No	No
	Perchlorate	0.27	NA	720	NA	No	No
	Tetryl	0.047	NA	6,200	NA	No	No

Definitions:

BTV = Background threshold value. COPC = chemical of potential concern. Max Detect = maximum detection value. NA = not applicable.
nrSRL = non-residential soil remediation level. SVOC = semi-volatile organic compound.

Notes:

[1] For 0-6.5 ft bgs.

[2] SRL is based on a 100% saturation ceiling limit for non-volatile organic chemicals.

[3] No nrSRL listed. USEPA Regional Screening Level (11/2011) provided.

[4] No nrSRL. nrSRL for aminodinitrotoluene used.

TABLE 5.2
TIER 1 HUMAN HEALTH RISK-BASED SCREENING
YPG-35c
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Group	Chemical	Max Detect[(1)] (mg/kg)	BTV (mg/kg)	nrSRL (mg/kg)	Max Detect Exceeds		COPC
					BTV	nrSRL	
Metals	Aluminum	24,600	20,000	920,000	Yes	No	No
	Antimony	3.3	-	410	No	No	No
	Arsenic	8.6	8.9	10	No	No	No
	Barium	1,290	350	170,000	Yes	No	No
	Beryllium	0.98	0.89	1,900	Yes	No	No
	Cadmium	20	0.24	510	Yes	No	No
	Chromium, total	32.7	19	1,000,000 [(2)]	Yes	No	No
	Cobalt	8.5	8.2	13,000	Yes	No	No
	Copper	142	61	41,000	Yes	No	No
	Lead	17,000	14	800	Yes	Yes	Yes
	Manganese	498	440	32,000	Yes	No	No
	Mercury	0.18	0.005	310	Yes	No	No
	Molybdenum	1.4	1.1	5,100	Yes	No	No
	Nickel	47.3	18	20,000	Yes	No	No
	Selenium	24	0.67	5,100	Yes	No	No
	Silver	2	-	5,100	Yes	No	No
	Thallium	1.4	-	67	Yes	No	No
	Vanadium	35	36	1,000	No	No	No
	Zinc	299	70	310,000	Yes	No	No
SVOCs	Benzoic acid	2.4	NA	1,000,000 [(2)]	NA	No	No
	Benzo(b)fluoranthene	0.13	NA	21	NA	No	No
	Bis(2-chloroethyl) ether	0.12	NA	5.8	NA	No	No
	Bis(2-ethylhexyl)phthalate	0.33	NA	1,200	NA	No	No
	Diethyl phthalate	21	NA	490,000	NA	No	No
	Dimethyl phthalate	3	NA	1,000,000 [(2)]	NA	No	No
	Di-n-butyl phthalate	61	NA	62,000	NA	No	No
	2,4-Dinitrotoluene	110	NA	1,200	NA	No	No
	2,6-Dinitrotoluene	5.7	NA	620	NA	No	No
	4-Methylphenol	0.11	NA	3,100	NA	No	No
	2-Nitrophenol	0.25	NA	1,200[(3)]	NA	No	No
	4-Nitrophenol	0.28	NA	1,200[(3)]	NA	No	No
	Pentachlorophenol	0.13	NA	90	NA	No	No

TABLE 5.2
TIER 1 HUMAN HEALTH RISK-BASED SCREENING
YPG-35c
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Group	Chemical	Max Detect[(1)] (mg/kg)	BTV (mg/kg)	nrSRL (mg/kg)	Max Detect Exceeds		COPC
					BTV	nrSRL	
Explosives	2-Amino-4,6-dinitrotoluene	12	NA	120[(4)]	NA	No	No
	4-Amino-2,6-dinitrotoluene	13	NA	120[(4)]	NA	No	No
	1,3-Dinitrobenzene	1.4	NA	62	NA	No	No
	2,4-Dinitrotoluene	780	NA	1,200	NA	No	No
	2,6-Dinitrotoluene	43	NA	620	NA	No	No
	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	11	NA	160	NA	No	No
	Nitrobenzene	4.8	NA	100	NA	No	No
	Nitroglycerin	6.8	NA	1,200	NA	No	No
	Nitroguanidine	3.7	NA	62,000	NA	No	No
	2-Nitrotoluene	0.34	NA	22	NA	No	No
	3-Nitrotoluene	1	NA	1,000[(5)]		No	No
	4-Nitrotoluene	0.69	NA	300	NA	No	No
	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2	NA	31,000	NA	No	No
	Perchlorate	160	NA	720	NA	No	No
	Tetryl	5.1	NA	6,200	NA	No	No
	1,3,5-Trinitrobenzene	3.6	NA	18,000	NA	No	No
	2,4,6-Trinitrotoluene	270	NA	310	NA	No	No

Definitions:

BTV = Background threshold value. COPC = chemical of potential concern. Max Detect = maximum detection value. NA = not applicable. nrSRL = non-residential soil remediation level. SVOC = semi-volatile organic compound.

Notes:

[1] For 0-6.5 ft bgs.

[2] SRL is based on a 100% saturation ceiling limit for non-volatile organic chemicals.

[3] No nrSRL listed. nrSRL for 2,4-dinitrophenol used.

[4] No nrSRL listed. nrSRL for aminodinitrotoluene used.

[5] SRL based on chemical-specific saturation level in soil for volatile organic chemicals.

TABLE 5.3
TIER 2 HUMAN HEALTH RISK-BASED SCREENING FOR LEAD
YPG-35c
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Group	Chemical	UCL[(1)] (mg/kg)	BTV (mg/kg)	nrSRL (mg/kg)	UCL Exceeds		COPC
					BTV	nrSRL	
Metals	Lead	1,150	14	800	Yes	Yes	Yes

Definitions:

BTV = Background threshold value. COPC = chemical of potential concern. NA = not applicable. UCL = 95% upper confidence level. nrSRL = non-residential soil remediation level. rSRL = residential soil remediation level. SVOC = semi-volatile organic compound.

Notes:

[1] For 0-6.5 ft bgs.

TABLE 5.4
TIER 2 HUMAN HEALTH RISK-BASED SCREENING FOR LEAD FOLLOWING REMEDIATION AT BOG-02
YPG-35c
U.S. ARMY GARRISON YUMA PROVING GROUND, ARIZONA

Group	Chemical	UCL[(1)] (mg/kg)	BTV (mg/kg)	nrSRL (mg/kg)	Exceeds		COPC
					BTV	nrSRL	
Metals	Lead	57.62	14	800	Yes	No	No

Definitions:

BTV = Background threshold value. COPC = chemical of potential concern. NA = not applicable. nrSRL = non-residential soil remedia

Notes:

[1] For 0-6.5 ft bgs.

FIGURES

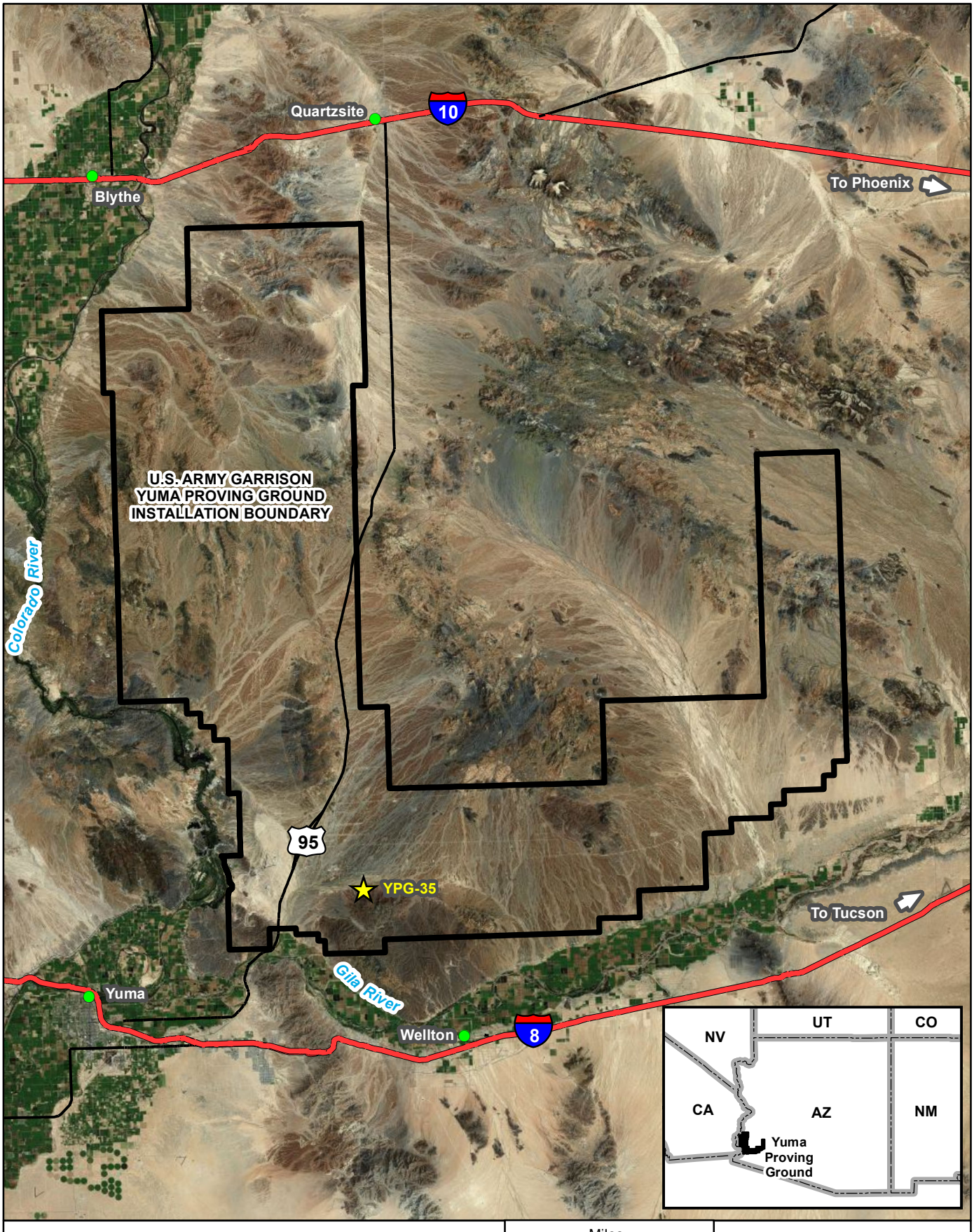

FIGURE 1.1

REGIONAL LOCATION

U.S. Army Garrison Yuma Proving Ground

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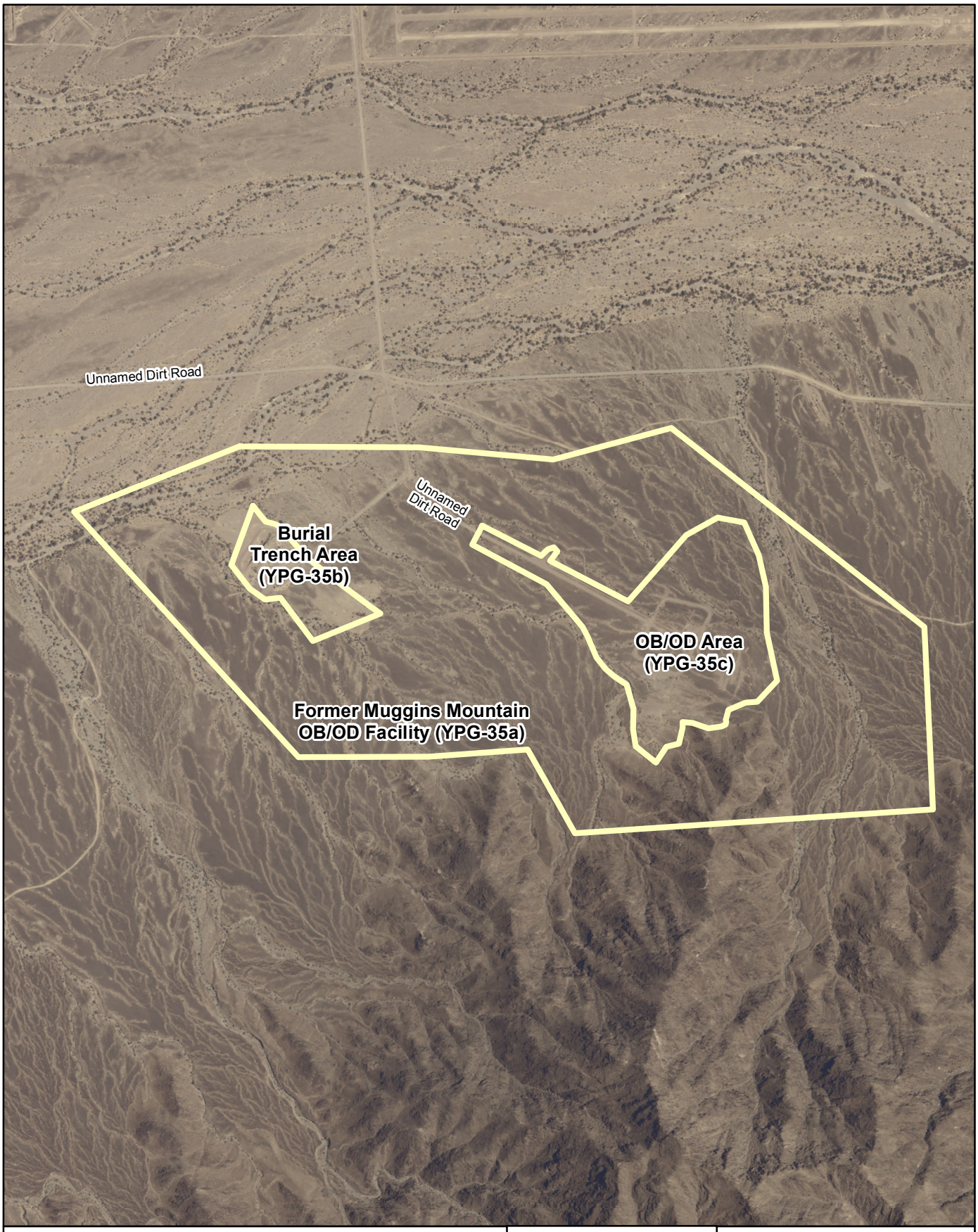


LEGEND

Site Boundary

Feet
0 575 1,150
0 175 350
Meters

FIGURE 2.1

MUGGINS MOUNTAIN FACILITY
YPG-35a, b, and c

U.S. Army Garrison Yuma Proving Ground

X:\GISCADD\projects\yuma\mapfiles\Muggins_Mt\RFI_Draft\MM_locmap.mxd 5/3/2012

LEGEND

- Buried Trench Delineated in Geophysical Survey
- Large Open Trench
- Berm
- Site Boundary

Feet
0 115 230

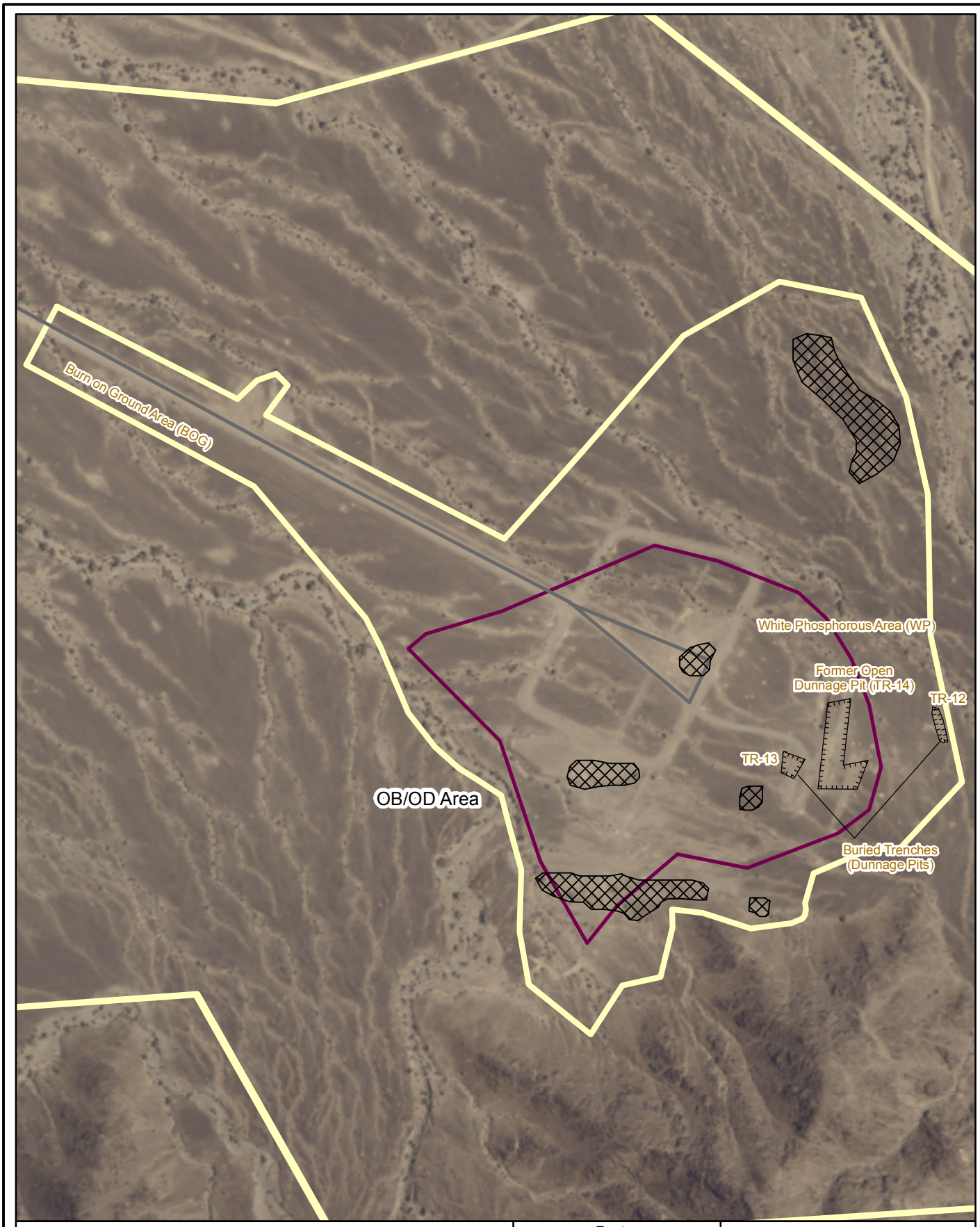
0 35 70
Meters

FIGURE 2.2

YPG-35b
BURIALTRENCH AREA,
MUGGINS MOUNTAIN
FACILITY

**U.S. Army Garrison
Yuma Proving Ground**

X:\GISCADD\projects\yuma\mapfiles\Muggins_Mt\RFI_Draft\MM_trench_area_sitemap.mxd 4/20/2012



LEGEND

- Trench
- Area of OB/OD Features
- Propellant Area
- Site Boundary

Feet
0 175 350
0 50 100
Meters

FIGURE 2.3

YPG-35c
OB/OD AREA
MUGGINS MOUNTAIN
FACILITY

U.S. Army Garrison
Yuma Proving Ground

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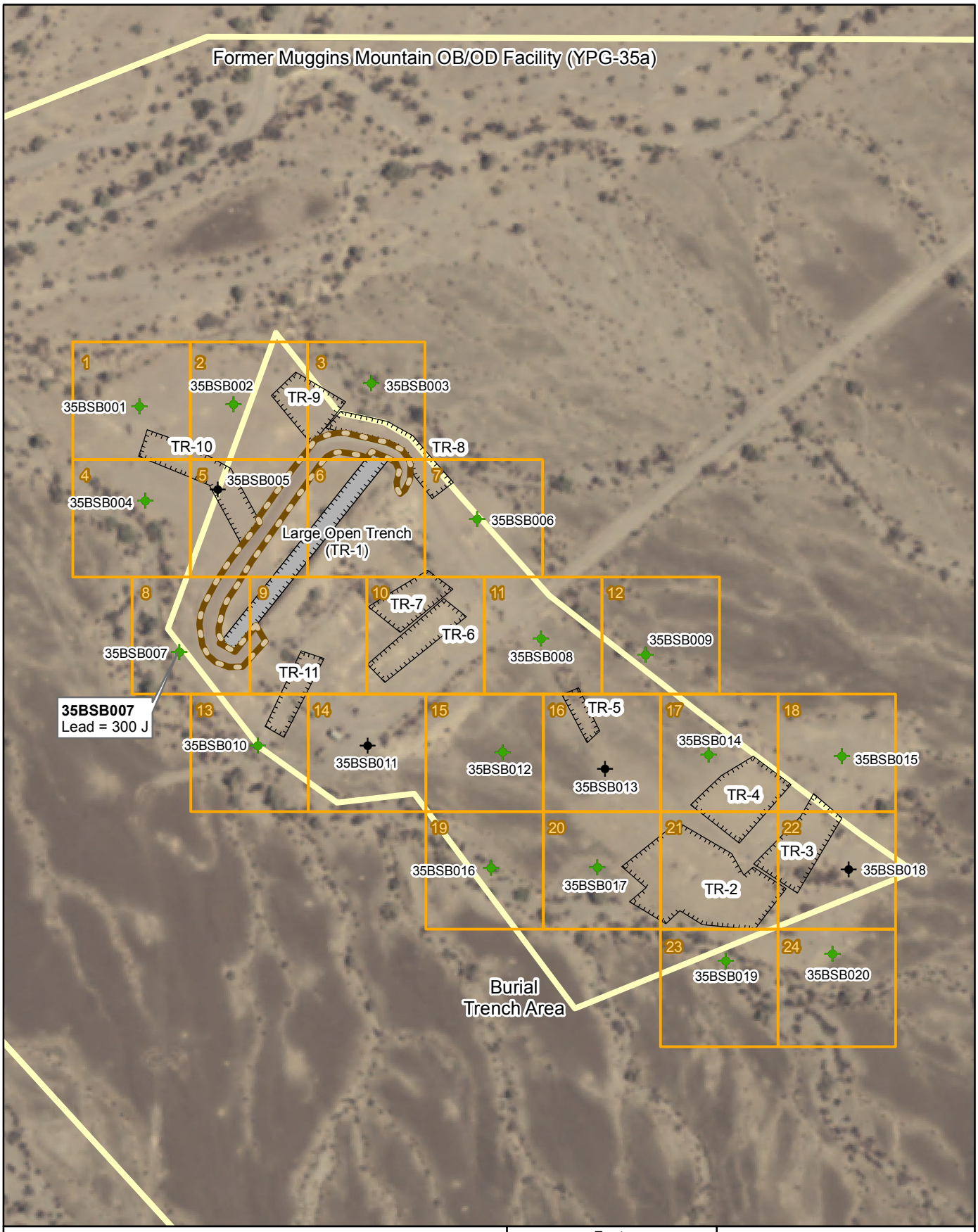

FIGURE 4.1

200 FOOT GRID
AT BURIAL TRENCHES,
MUGGINS MOUNTAIN
FACILITY, YPG-35b

U.S. Army Garrison
Yuma Proving Ground

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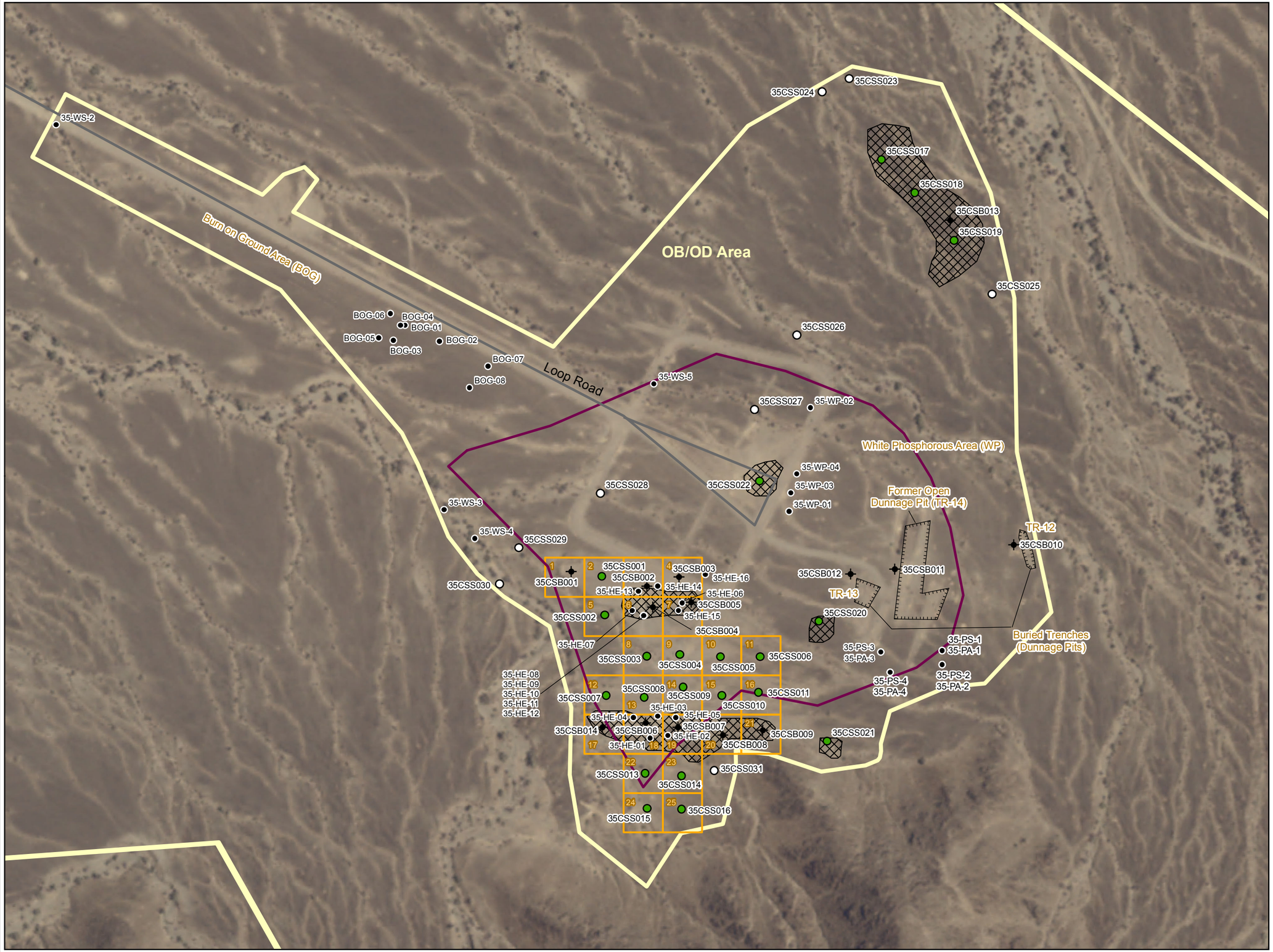


FIGURE 4.2

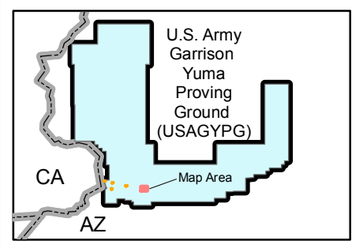
OB/OD AREA
MUGGINS MOUNTAIN
FACILITY, YPG-35c

**U.S. Army Garrison
Yuma Proving Ground**

LEGEND

- Previous Sample Location
- Surface Soil Sample
- Dry-Wash Sample
- Soil Boring (0-20 ft bgs)
- Trench - Not Sampled, Potentially Contains MEC
- Sampling Grid with Grid ID
- Area of OB/OD Features
- Propellant Area
- Site Boundary

Aerial Photograph Base: Arizona State Land Department, 2007



Feet
0 110 220
0 30 60
Meters

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FIGURE 4.3

YPG-35a
INSTRUMENT-AIDED QR
SURVEY RESULTS

**U.S. Army Garrison
Yuma Proving Ground**

LEGEND

- Waypoint
- MD at Waypoint
- MEC at Waypoint (See box at lower left)
- Transect
- Site Boundary

Aerial Photograph Base: Arizona State Land Department, 2007

Former Muggins Mountain
OB/OD Facility (YPG-35a)

Burial Trenches (YPG-35b)

OB/OD Area Boundary (YPG-35c)

MEC at WAYPOINT

AA-001 = 1-PD Fuze (off track MG15)
BB-01 = 1-2.75" RKT fuze, live (track MG8)
MG10-004 = 1-155mm HE
MG12-005 = 1-30 mm HE
MG14-002 = 1-30 mm HE
MG14-003 = 1-20 mm HE
MG17-006 = MEC within site of waypoint: fuzes, mortars, rockets
MG20-012 = 1 softball size piece of loose HE.
MG20-013 = 1-60mm mortar, no fuze, HE
MG20-015 = Several pieces MD and MEC between waypoints
MG24-03 = MEC items include 2-105mm HE
MG25-03 = 10'x8' metal scrap pile, 4-M-46s
MG32-02 = 2-75mm HEs
MG33-03 = MEC items include 1-155mm HE, 2-75mm HE
MG36-004 = 1-2.75" Rocket w/h HE

U.S. Army Garrison Yuma Proving Ground (USAGYPG)
CA
AZ
Map Area

Feet
0 300 600
0 100 200
Meters

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