YUMA PROVING GROUND
YUMA, ARIZONA

DRAFT FINAL CORECTIVE MEASURES STUDY WORK PLAN FOR INACTIVE LANDFILLS YPG-029 AND YPG-141

Submitted to:
U.S. ARMY GARRISON YUMA PROVING GROUND

April 2013

Prepared by:
PARSONS
Salt Lake City, Utah

DRAFT FINAL

CORECTIVE MEASURES STUDY WORK PLAN
FOR
INACTIVE LANDFILLS YPG-029 AND YPG-141
U.S. ARMY GARRISON
YUMA PROVING GROUND

Submitted To:

U.S. ARMY GARRISON YUMA PROVING GROUND

Prepared By:

PARSONS

Registered Professional Engineer (Civil)
CERTIFICATE NO
49007
EDWARD G.
STAES
Date Signed 4/10/2013
ARIZONA U.S.A.
Expires 3/31/2013

April 2013

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

ADEQ	Arizona Department of Environmental Quality
AFCEE	Air Force Center for Environmental Excellence
ADWR	Arizona Department of Water Resources
bgs	Below Ground Surface
BTV	Background Threshold Values
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	Chemical of Concern
COPC	Chemical of Potential Concern
DoD	Department of Defense
EC	Engineering Control
FRTR	Federal Remediation Technology Roundtable
ft	Feet
GPL	Groundwater Protection Level
HRA	Human Risk Assessment
HSWA	Hazardous and Solid Waste Amendment
IC	Institutional Control
LUC	Land Use Control
mg/kg	Milligram per Kilogram
OB/OD	Open Burn/Open Detonation
OMB	Office of Management and Budget
PAH	Polycyclic Aromatic Hydrocarbon
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
nrSRL	Nonresidential Soil Remediation Level
rSRL	Residential Soil Remediation Level
SVOC	Semivolatile Organic Compound
TPV	Total Present Value
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAGYPG	U.S. Army Garrison Yuma Proving Ground
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
yd^3	Cubic Yard(s)

SECTION 1.0
INTRODUCTION

This Corrective Measures Study (CMS) Work Plan was prepared by Parsons Government Services, (Parsons) for the U.S. Army Garrison Yuma Proving Ground (USAGYPG) located near Yuma, Arizona. The purpose of this document is to present the selection criteria and the remedial alternatives that will be evaluated in the CMS to mitigate hazards associated with Resource Conservation and Recovery Act (RCRA) Sites YPG-029 and YPG-141. This CMS Work Plan was prepared pursuant to contract number W91ZLK-05-D-0016, Task Order 0002.

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 93,064 (U.S. Census Bureau, 2010). 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 1,300 square miles. Comparatively, it is slightly larger than the state of Rhode Island.

1.1 REGULATORY FRAMEWORK

Six inactive landfills were identified during the RCRA Facility Assessment (RFA) at USAGYPG as potentially containing hazardous waste; therefore, regulatory procedures regarding the landfills have 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 inactive landfill 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 the CMS is 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:

- RCRA Facility Assessment (RFA) - Identifies releases and potential releases of hazardous wastes or constituents from the site.
- RCRA Facility Investigation (RFI) - Verifies release(s) from the site and characterizes the nature and extent of contaminant migration.
- 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 six inactive landfill sites (Tetra Tech EM Inc., 1998). The RFA Report was completed to satisfy the requirements of the RCRA permit issued by the state of Arizona. Based on the recommendation of the RFA, RFIs were completed for inactive landfills YPG-029 and -141 (Parsons, 2013a, and 2013b).

The six abandoned landfills were identified in the RFA as solid waste management units based on records and interviews indicating a potential history of solid waste disposal, which could include the presence of regulated waste such as munitions and solvents. Facility engineering drawings, results of the RFA, and personnel interviews indicate that YPG-029 and -141 had previously been used by USAGYPG as municipal landfills.

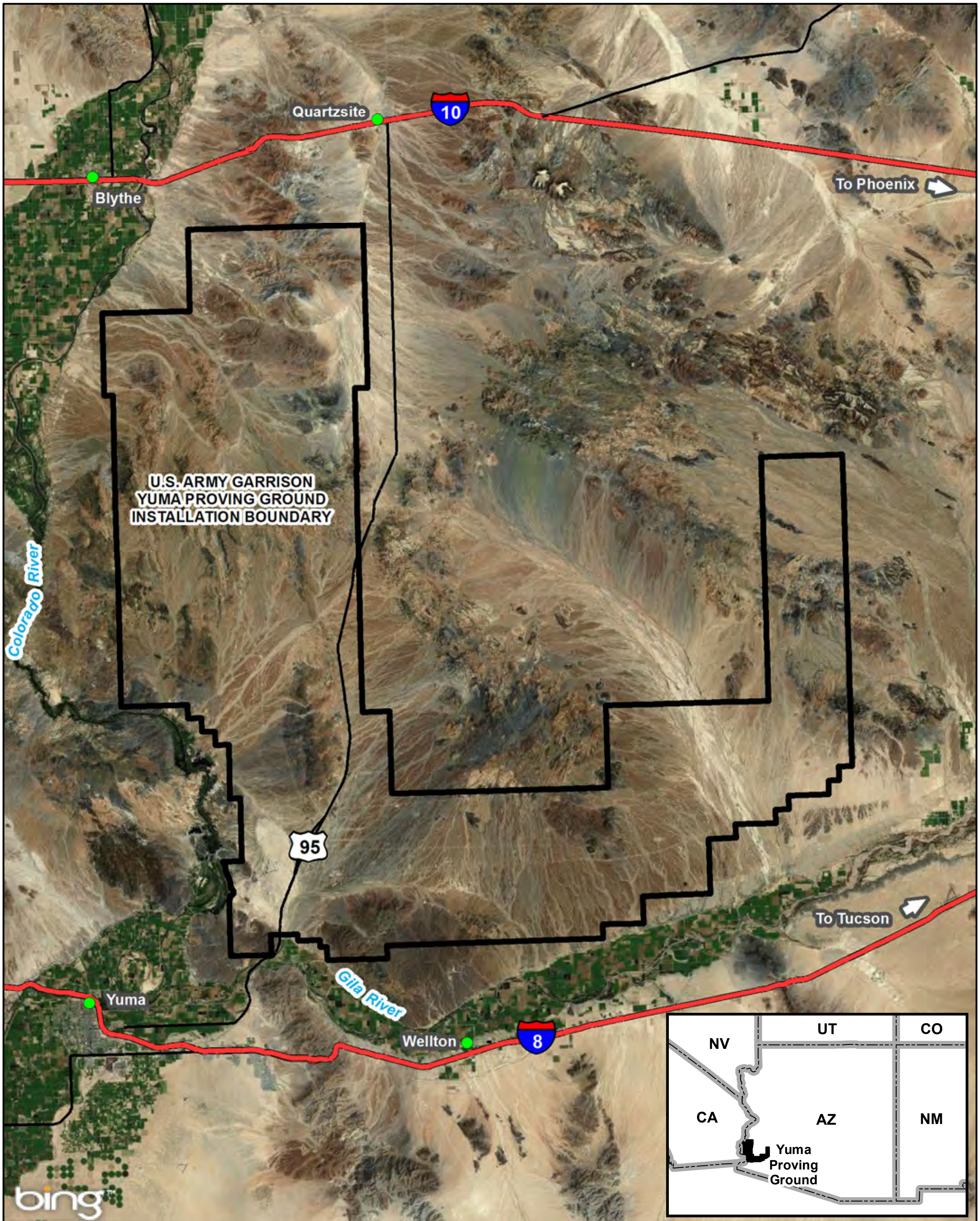


FIGURE 1.1

REGIONAL LOCATION

U.S. Army Garrison Yuma Proving Ground

X:\GISCADD\projects\yuma\mapfiles\CMS_WP_29_141\general_locmap.mxd 2/27/2013

No visual evidence of hazardous waste or munitions debris was identified during the RFI activities at landfills YPG-029 and -141. Additionally no contaminants of concern (COCs) were identified and therefore no active remediation is required. Landfills YPG-029 and -141 require a CMS to prevent future exposure to the waste. Because of the similarities of these two sites, a single CMS will be conducted to address the corrective action objectives.

1.2 REPORT ORGANIZATION

This CMS Work Plan is organized into seven sections, including this introduction and meets the requirements of USAGYPG RCRA Permit, Part VI, Section F.2 (a through e).

Section 1 **Introduction** – Presents the project overview including the regulatory framework for the CMS Work Plan.

Section 2 **Background Information** – Provides a summary of the RFIs conducted at YPG-029 and -141.

Section 3 **Corrective Action Objectives** – Presents the corrective action objectives developed for the landfills.

Section 4 **CMS Approach** – Provides a summary of the corrective actions that will be evaluated in the CMS and the evaluation criteria that will be used as the basis for the selection of the preferred alternative.

Section 5 **Data and Information Sources** – Presents a list of existing data acquired during the RFI activities and a list of additional literature that will be used during the CMS.

Section 6 **CMS Report Outline** – Presents a proposed outline for the CMS Report.

Section 7 **Schedule** – Provides a schedule for the deliverables and review cycles for the CMS Report.

Section 8 **References** – Provides information resources cited in this report.

SECTION 2.0
BACKGROUND INFORMATION

This section provides a brief summary of site-specific environmental settings and the RFI activities and results for landfills YPG-029 and -141. Figure 2.1 shows the locations of each of these sites at USAGYPG. Additional details are available in the RFI Reports for YPG-029 (Parsons, 2013a), and YPG-141 (Parsons, 2013b).

2.1 RFI INVESTIGATION ACTIVITIES

The investigation activities at YPG-029 and -141 consisted of removing surface debris, performing a post-surface removal geophysical survey, excavating exploratory test pits, and drilling vertical soil borings. Magnetometer geophysical surveys were conducted to outline the areas of subsurface metallic debris. Exploratory test pits were excavated to determine the vertical and horizontal extent of buried debris, and soil borings were drilled to confirm the horizontal and vertical extent determinations.

Surface and subsurface soil samples were collected from the test pits and soil borings to determine if chemical constituents had been released from the waste; and if so, whether the constituents pose a threat to human health or the environment. Surface and subsurface soil samples from the test pit locations and soil borings were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), explosives, and metals. Additionally, a background test pit was excavated at each site and one associated surface sample and one subsurface soil sample were collected and analyzed for metals for use in background threshold value (BTV) calculations.

The vertical and horizontal extent of impacts to soil was determined by comparing soil concentrations of chemicals of potential concern (COPCs) to remediation goals (State of Arizona residential soil remediation levels [rSRLs] and nonresidential [nrSRLs] and minimum groundwater protection levels [GPLs]). In addition, metals detections were evaluated using BTVs to determine if the detection is a result of site activities. A human health and ecological risk assessment was performed to assess potential risks and hazards from exposure to contaminants in soils.

Because of the arid climate at USAGYPG and because depth to groundwater at YPG-029 and YPG-141 is approximately 197 feet (ft) below ground surface (bgs), groundwater was not investigated during RFI activities; however, a soil-to-groundwater evaluation was presented in the human health and risk assessment in the RFI Reports (Section 5.3). Results of this evaluation indicate that concentrations of lead and within the buried waste layer are stable, have not migrated to any significant degree, and are not expected to impact groundwater.

2.2 RFI RESULTS SUMMARY

2.2.1 YPG-029

The YPG-029 site is located on the Kofa Firing Range east of U.S. Highway 95 (Figure 2.1), approximately 1¼ miles south-southeast of the Kofa Fire station and within 200 yards of the new Kofa sewage lagoon. The YPG-029 site encompasses an area of approximately five acres (Figure 2.2). The YPG-029 site is generally flat with a slight rise in elevation to the east. There are also several small drainage areas immediately north and south of the site. During periods of intense rainfall, the drainage area may experience surface water flow for short periods of time. Vegetation at YPG-029 is sparse and much of the site has been disturbed due to the landfill disposal activities. The generalized lithology at YPG-029 consists of a sequence of unconsolidated silty sand and gravel, strongly cemented sandy clay, and white sand units. Based on the regional potentiometric surface, groundwater would be anticipated to occur at approximately 200 ft bgs and flow southwest with a hydraulic gradient of 1 to 4 ft per mile (Jason, 2007).

There is conflicting information regarding the dates the site was in operation as a landfill; however, disposal activities at the site may have occurred during the late 1960s. Wood and metal debris surrounded a large pile of washed gravel that is located on the northern portion of the site. This gravel and surface debris appears associated with the construction of two wastewater ponds that are located to the north of the site. Prior to the surface debris removal action in November 2009, numerous pieces of scrap metal, including a metal box and drum, were present on the ground surface in the northeastern portion of the site. Scrap wood and metal strapping/banding and other metal debris were

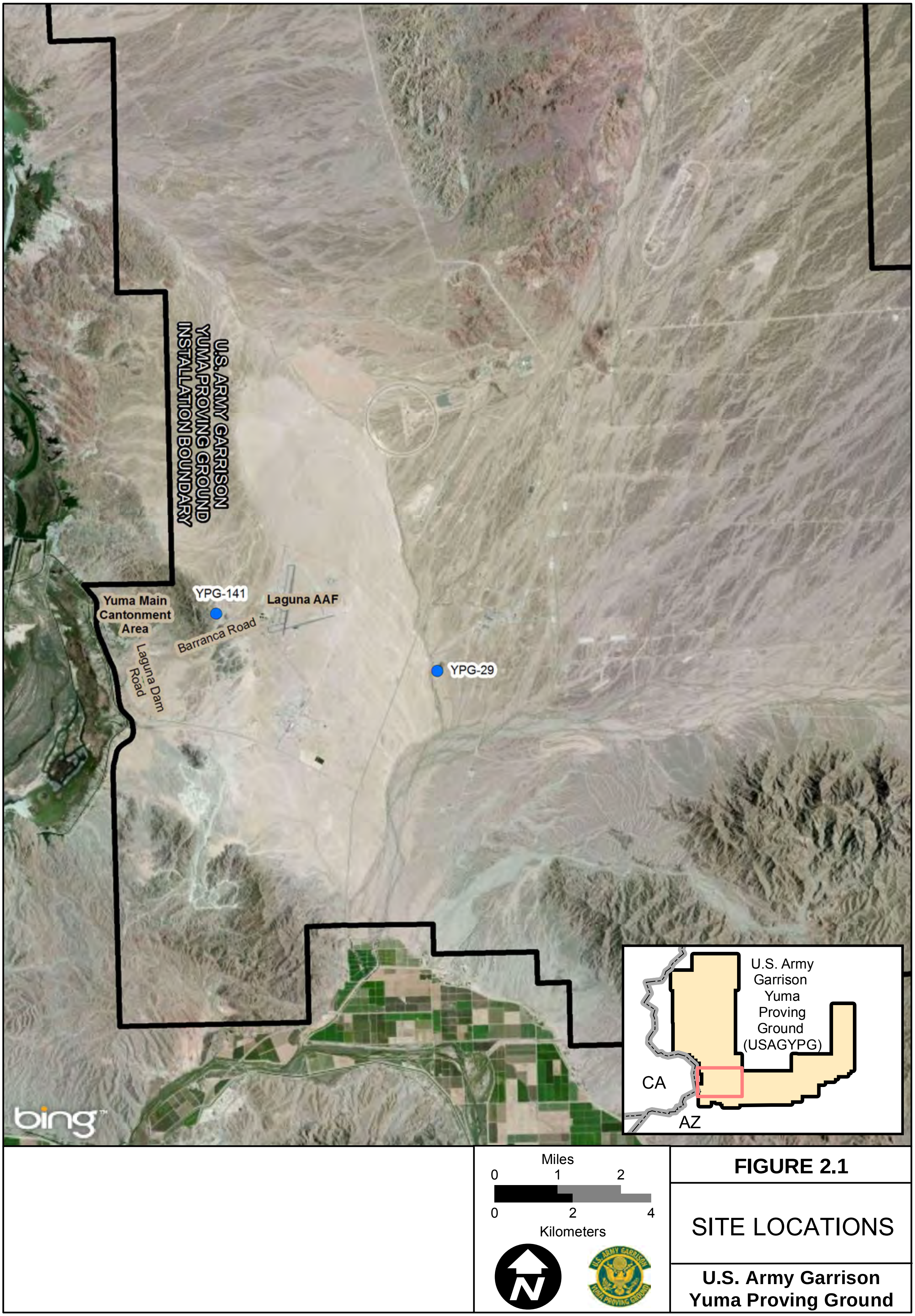
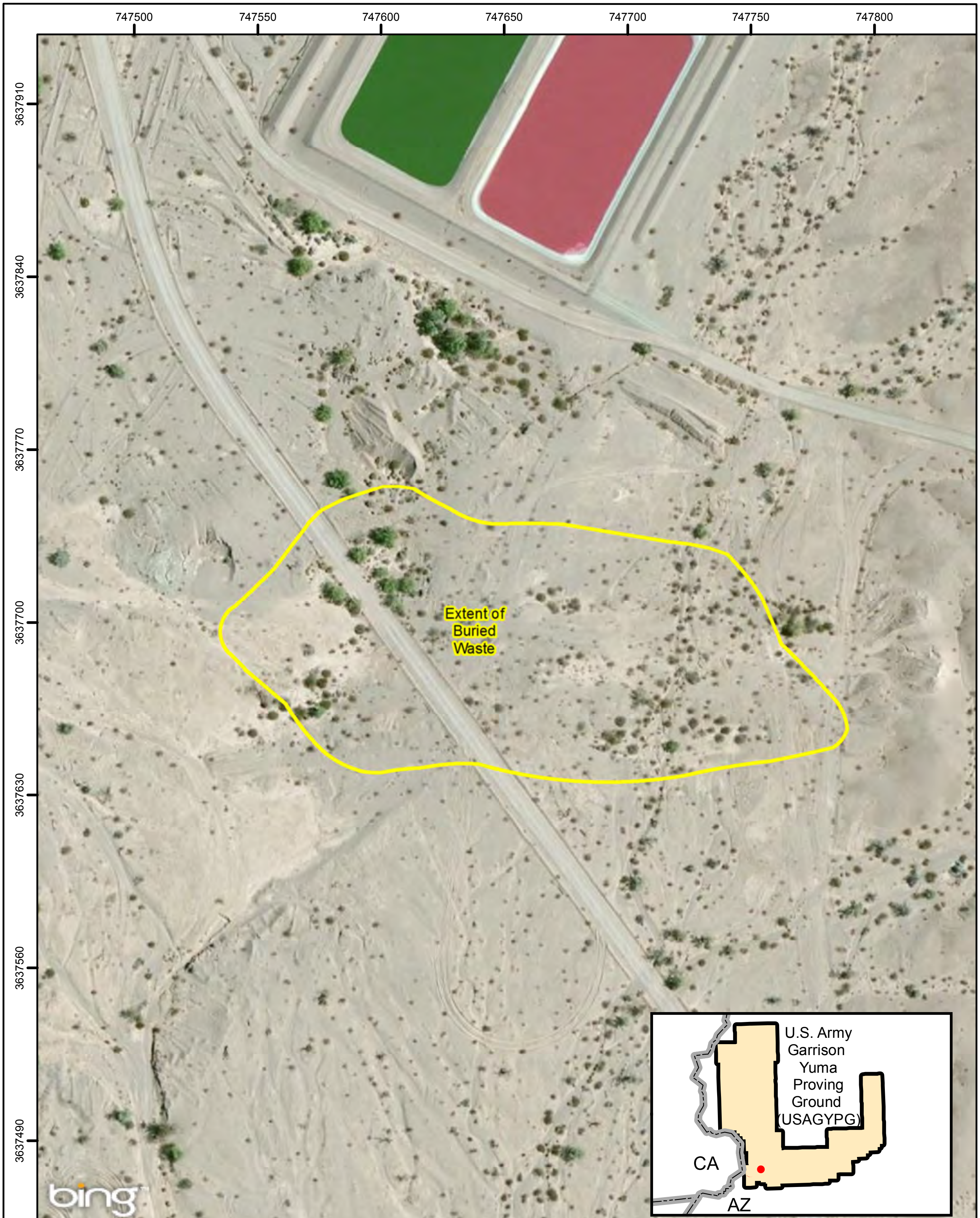


FIGURE 2.1

SITE LOCATIONS

U.S. Army Garrison Yuma Proving Ground

X:\GISCADD\projects\yuma\mapfiles\CMS_WP_29_141\site_locations.mxd 2/27/2013



LEGEND

Extent of Buried Waste

North and East Coordinates in WGS 1984, UTM, Zone 11, Meters.

Feet
0 90 180
0 25 50
Meters

N

FIGURE 2.2

YPG-029
SITE MAP

U.S. Army Garrison Yuma Proving Ground

X:\GISCADD\projects\yuma\mapfiles\CMS_WP_29_141\RFI_29_2009_extent_buried_waste.mxd 2/27/2013 present across the site, especially along the northwestern and western areas of the site. Depressions and disturbed vegetation also have been noted in the south central region of the landfill, and these coincide with metallic anomalies identified during a previously conducted geophysical (magnetometer) survey (Jason, 2007).

The surface debris removal action at YPG-029 consisted of the removal and the recycling of 1.5 cubic yards (yd^3) of metal debris which included metal banding, empty steel drums, wire, nails and miscellaneous metallic items. Other surface debris removed at the time, included scrap wood and a variety of construction items. Following the removal action, a geophysical survey was conducted to outline the areas of subsurface metallic debris disposal. Geophysical survey results showed magnetic anomalies in an area near the center of the site, which are believed to coincide with buried metallic debris. Based on the results of the geophysical survey, 22 biased test pits and two soil borings were excavated to define the vertical and horizontal extent of the buried waste. One background test pit and associated soil samples were also collected for use in calculating BTVs for metals. The geophysical survey results, test pit, and boring locations are shown on Figure 2.3. Figure 2.3 also shows the location of cross section A-A'. Cross section A-A' is shown on Figure 2.4.

A total of 38 soil samples were collected from the test pits and analyzed to determine if chemical constituents have been released from the waste, and if so, do the constituents pose a threat to human health or the environment. At test pits where waste was encountered, subsurface soil samples were collected from within and below the waste. Of the 22 test pits excavated, seven test pits contained solid waste, which included glass and plastic bottles, wood, metal banding, small pieces of tar, metal pipe, aluminum cans, Styrofoam™ cups, food packaging, children's toys, clothing items, and a 1959 Arizona license plate. In addition to the samples collected from test pits, two subsurface soil samples were collected from the two soil borings drilled at the site.

Analytical results from soil sampling at YPG-029 show that although inorganic compounds (arsenic, chromium, copper, lead, magnesium, molybdenum, silver, vanadium, and zinc) were detected in surface soils and in several waste zones that exceeded BTVs, none of these concentrations exceeded the ADEQ rSRLs, nrSRLs or

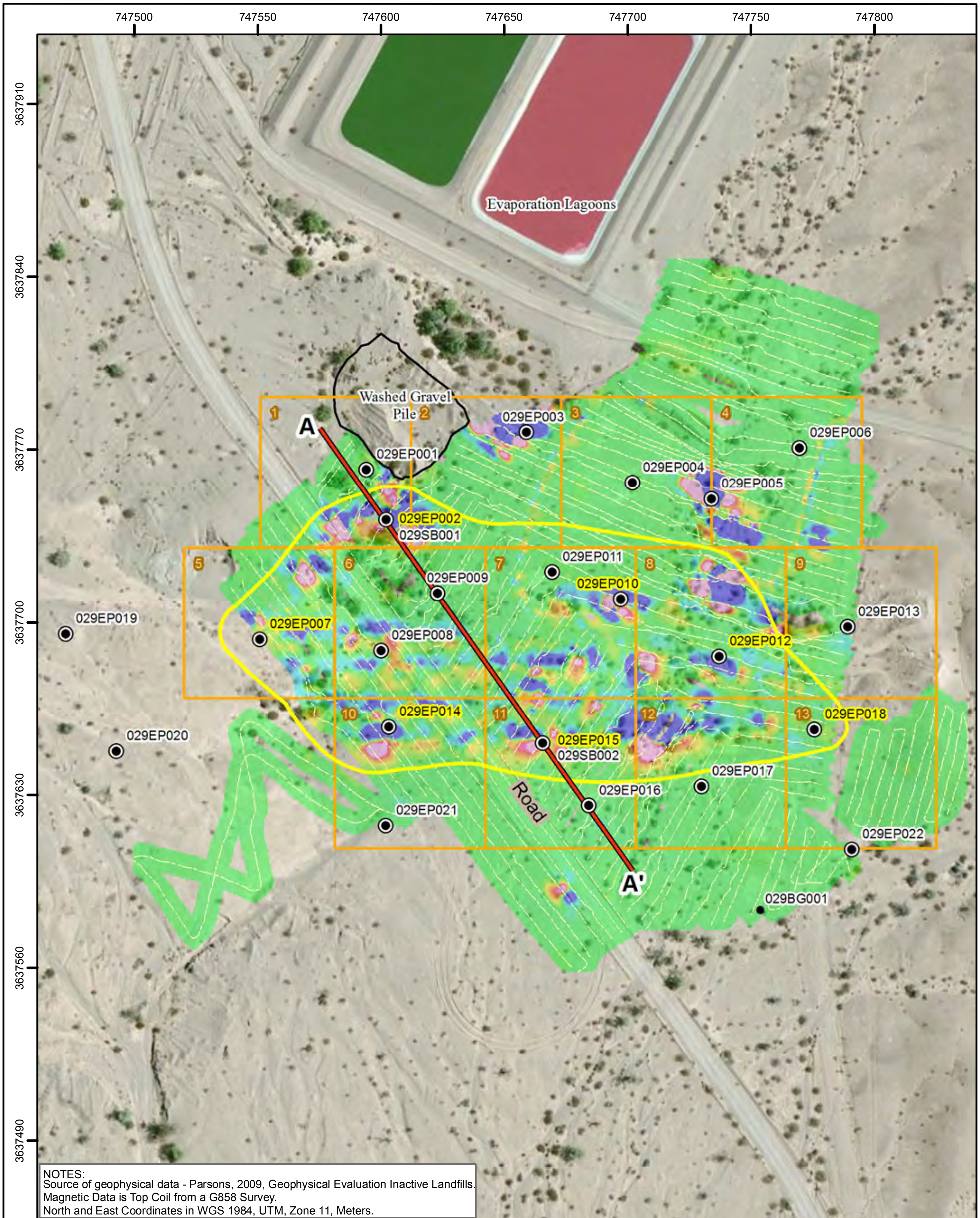
GPL remediation goals. Numerous detections of organic compounds were also detected sporadically across the site; however, these detections were near the instrument detection level and were in most cases one to two orders of magnitude lower than the remediation goals (i.e., the rSRLs, nrSRLs and GPLs).

Surface and subsurface investigation activities conducted during the RFI delineated the extent of buried waste at the YPG-029, and determined that waste at the site consists of municipal mixed with industrial waste. The presence of charred wood and low levels of hydrocarbons and polyaromatic hydrocarbons (PAHs) suggests some of the waste may have been burned. No visual evidence of hazardous waste or munitions debris was identified in the excavation pits at the site and analytical data indicates that there are no hazardous constituents above rSRLs, nrSRLs or GPLs; therefore, no further sampling is required.

A human health and ecological risk assessment was performed for YPG-029 to assess potential risks and hazards from exposure to contaminants in soils. The results of the human risk assessment (HRA) indicate that there are no COCs identified as potential hazards for human or ecological receptors.

2.2.2 YPG-141

Site YPG-141 is located approximately one mile northeast of the Main Administrative Area, north of Barranca Road and west of Laguna Army Airfield (Figure 2.1). The site consists of approximately 4.1 acres (Figure 2.5), is generally flat, and located along a drainage plain that trends from north to south. A dry wash borders the site on the eastern side; however, during periods of intense rainfall, the drainage area may experience surface water flow for short periods of time. Vegetation at YPG-141 is sparse, and much of the site has been disturbed due to the landfill disposal activities. Bedrock outcrops border the south-southeastern edges of the site. The generalized lithology consists of a sequence of unconsolidated silty sand and gravel, strongly cemented sandy clay, and white sand units. Based on the regional potentiometric surface, groundwater would be anticipated to occur at approximately 200 ft bgs and flow southwest with a hydraulic gradient of 1 to 4 ft per mile (Jason, 2007).



NOTES:
Source of geophysical data - Parsons, 2009, Geophysical Evaluation Inactive Landfills.
Magnetic Data is Top Coil from a G858 Survey.
North and East Coordinates in WGS 1984, UTM, Zone 11, Meters.

LEGEND

Top Sensor Magnetic Reading (nT/M)

-91.0 -46.2 -1.3 34.6 70.5 106.4 151.3 196.2 241.0

- Background Sample
- Test Pit
- Cross Section
- Path Lines of Geophysical Survey
- Washed Gravel Pile
- Extent of Buried Waste
- 2 Sampling Grid with Grid ID
- 027EP015 Test Pits with Waste

Feet: 0 90 180

Meters: 0 25 50

N

FIGURE 2.3

YPG-029
GEOPHYSICAL
SURVEY RESULTS

U.S. Army Garrison
Yuma Proving Ground

X:\GISCADD\projects\yuma\mapfiles\CMS_WP_29_141\RFI_29_2009_magnetic_buried_waste.mxd 2/27/2013

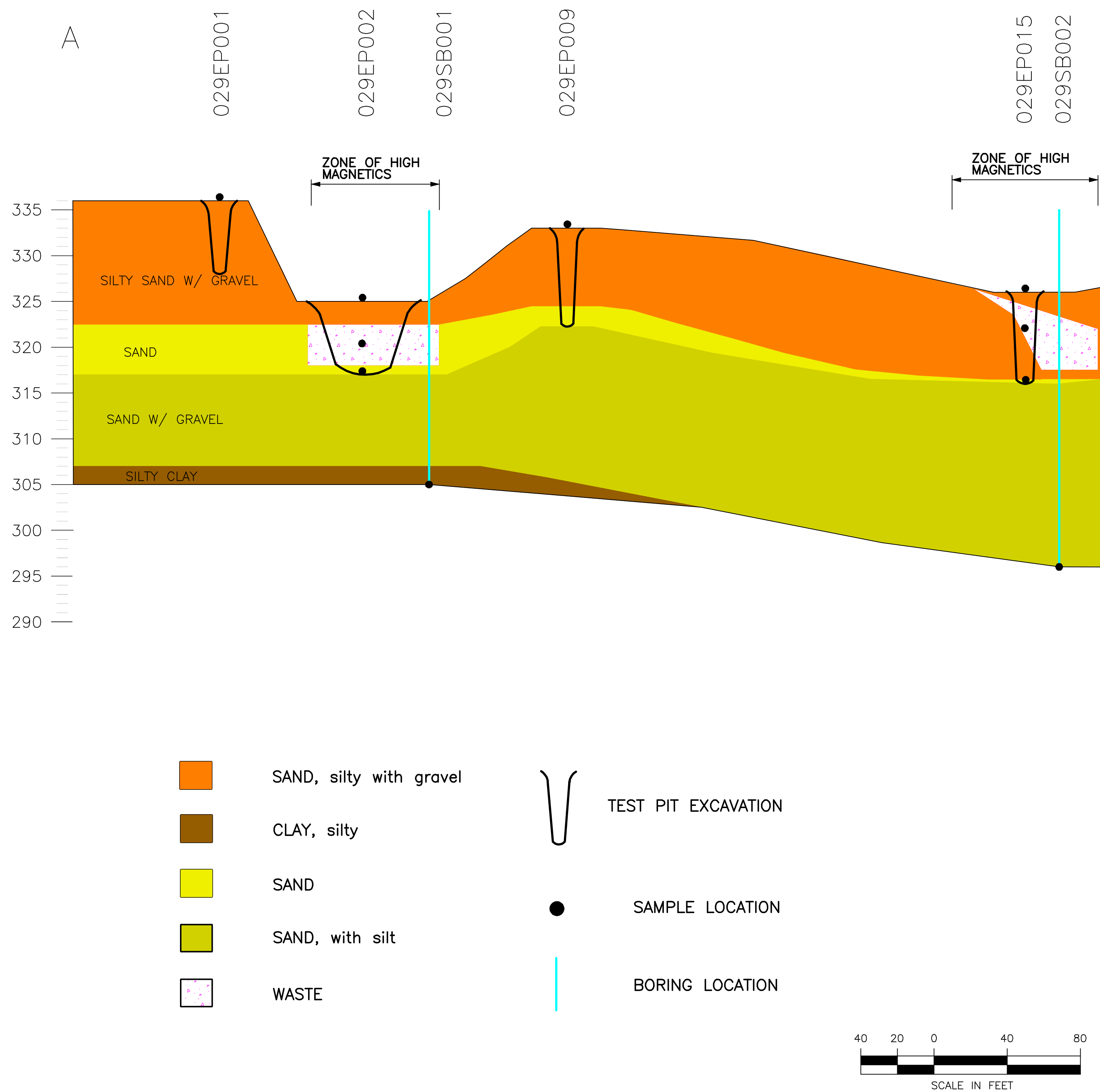
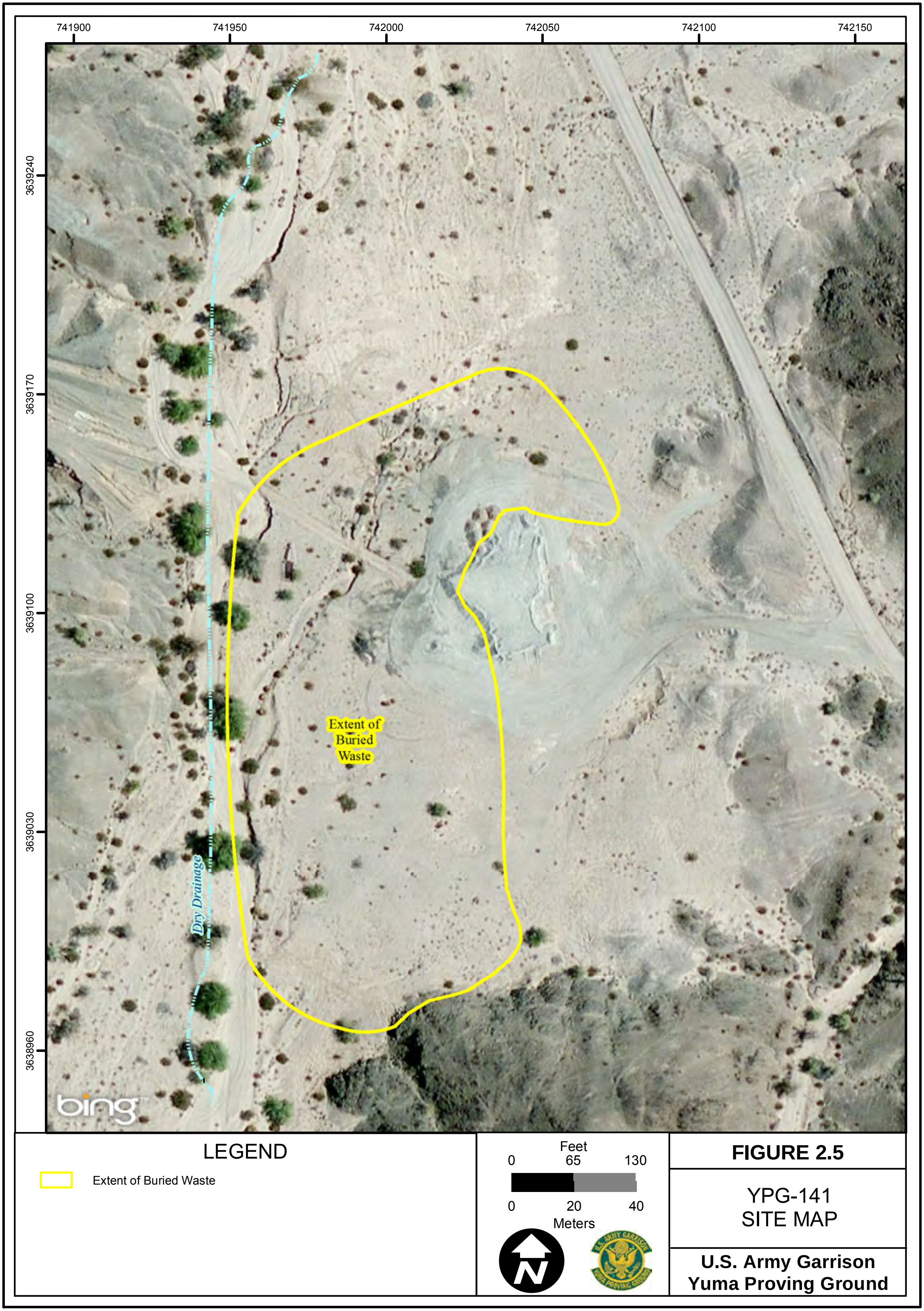


FIGURE 2.4

YPG-029
CROSS SECTION VIEW
OF TEST PITS
FROM A TO A'

YUMA PROVING GROUND



X:\GISCADD\projects\yuma\mapfiles\CMS_WP_29_141\RFI_141_2009_extent_buried_waste.mxd 2/27/2013

Disposal activities reportedly occurred at the site from 1964 to 1967. Prior to a surface debris removal action of November 2009, abundant glass debris, burnt wood, and various metal scrap including cast-iron pipes, cans, cable, wire, metal banding/strapping, and other miscellaneous debris were present at the surface and within the drainage channel in the northwestern portion of the site. In addition, metallic anomalies identified during a geophysical survey indicated the presence of buried waste in the south central region of the landfill (Jason, 2007). A large pile of gravel-sized crushed concrete is present near the center of the site, and is believed to be from a housing/administration area demolition project.

The surface debris removal action at YPG-141 consisted of the removal of metal banding, sheet metal, cast iron pipe, chicken wire, steel rods, a jeep window, and other smaller pieces of rusted metallic debris. Approximately 5 yd3 of metallic debris was taken to the U.S. Marine Corps Yuma facility for inspection and recycling. Following the removal action, a geophysical survey was conducted at the site to confirm results of a previous geophysical investigation. Geophysical results indicate a shallow burial area extending north to south across the site (Parsons, 2010). Twenty-three magnetic anomalies were identified, of which nine are believed to coincide with surface metallic debris. Based on the results of the geophysical survey, fifteen biased test pits and three soil borings were excavated to define the vertical and horizontal extent of the buried waste. Associated soil samples were collected at the test pit and soil boring locations. One background test pit was also excavated and associated soil samples collected for use in calculating BTVs for metals. The geophysical survey results, test pit, and boring locations are shown on Figure 2.6. Figure 2.6 also shows the location of cross section A-A'. Cross section A-A' is shown on Figure 2.7.

Of the fifteen test pits excavated, seven were found to contain solid waste, which included glass and plastic bottles, burned paper and wood, rusted metal objects, pipe, partially decomposed aluminum cans, Styrofoam™ cups, food packaging, fabric, and ceramics. At test pits where waste was encountered, subsurface soil samples were collected from within and below the waste. In addition to the samples collected from test pits, three subsurface soil samples were collected from the three soil borings drilled at the site. A total of 32 soil samples were collected from the test pits and soil borings and analyzed to define the extent of detectable contamination.

Analytical results from soil sampling at YPG-141 show that, although multiple organic compounds were detected in site soils, no organic compound had a concentration above its corresponding rSRL, nrSRL, or GPL. Three metals (arsenic, copper, and lead) were found to exceed their corresponding rSRL, nrSRL, or GPL in five samples collected from three test pit locations.

One copper concentration (12,000 milligrams per kilogram [mg/kg]), located within the debris zone of test pit 141EP008 (12.5-13 ft bgs), exceeded the rSRL of 3.100 mg/kg but not the nrSRL of 41,000 mg/kg. There is no GPL for copper.

Concentrations of lead were found in samples taken from debris zones of test pits 141EP004 (546 mg/kg; 5-6 ft bgs), 141EP008 (543 mg/kg; 12.5-13 ft bgs), and 141EP011 (638 mg/kg; 3-3.5 ft bgs) at concentrations exceeding the rSRL of 400 mg/kg and the GPL of 290 mg/kg, but not the nrSRL of 800 mg/kg. Samples collected from intervals below the debris zones at the same test pits had concentrations of lead that did not exceed the BTV. The lead contamination is believed to be associated with buried metallic debris from within the landfill, and to be stable and not significantly migrating. This conclusion is based on soil sampling results that show elevated concentrations of lead found in samples collected from within the debris zone but not in samples collected from the overlying and underlying zones.

The elevated level of arsenic (21.2 mg/kg) exceeding the rSRL and nrSRL of 10 mg/kg is possibly related to a layer of mineral-rich soil in a limited area of the site not included in the cross-section. This conclusion is based on analytical results that show an elevated level of arsenic in only one sample collected from the site. This sample was collected at test pit 141EP004 from the interval located directly below the debris zone. The arsenic concentration in the sample collected from within the associated debris zone was below the BTV.

Surface and subsurface investigation activities conducted during the RFI indicate that debris at YPG-141 consists of municipal and industrial waste. The presence of charred wood and low levels of hydrocarbons and PAHs suggests a portion of the waste

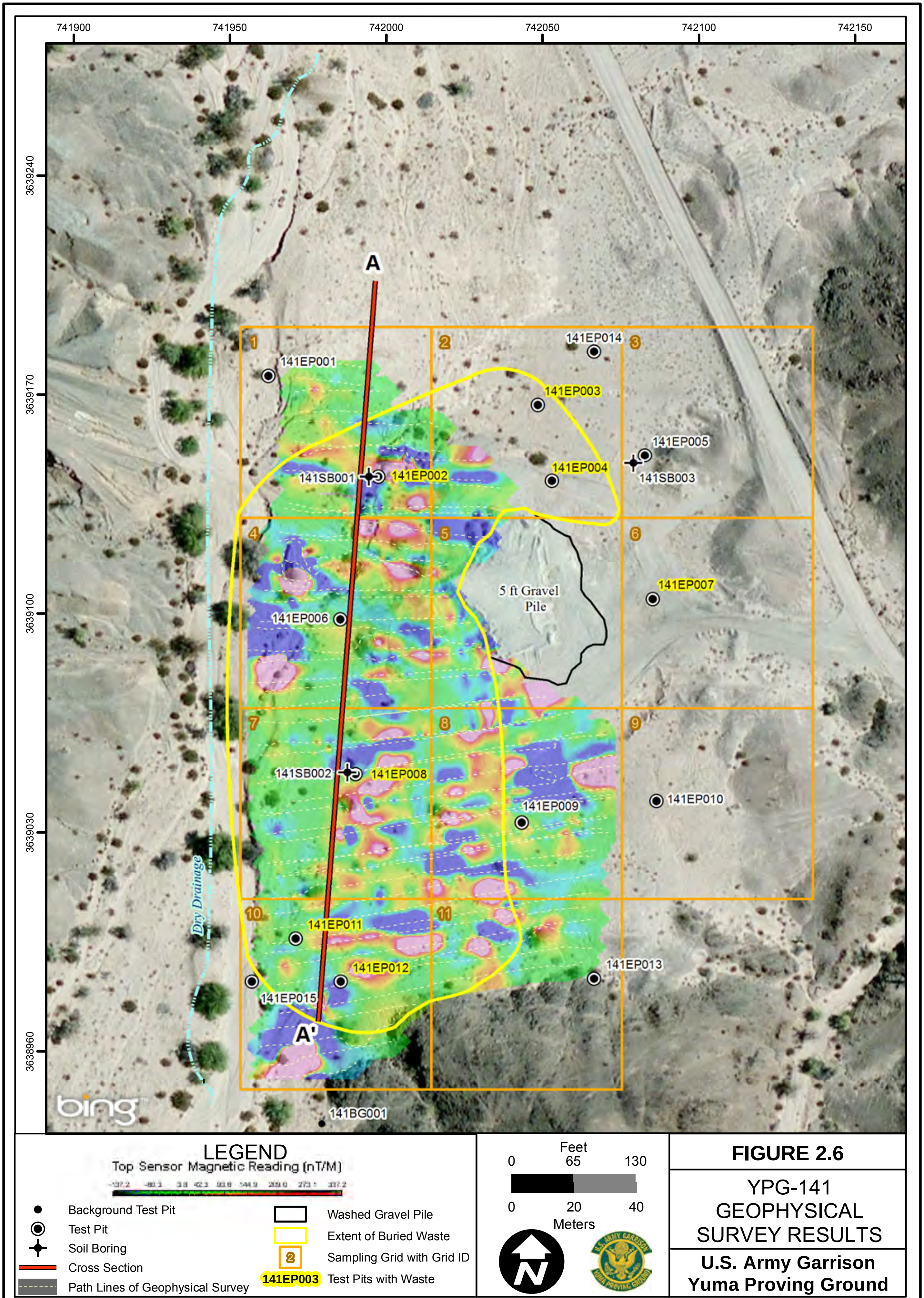


FIGURE 2.6

YPG-141 GEOPHYSICAL SURVEY RESULTS

U.S. Army Garrison Yuma Proving Ground

X:\GISCADD\projects\yuma\mapfiles\CMS_WP_29_141\RFI_141_2009_magnetic_buried_waste.mxd 2/27/2013

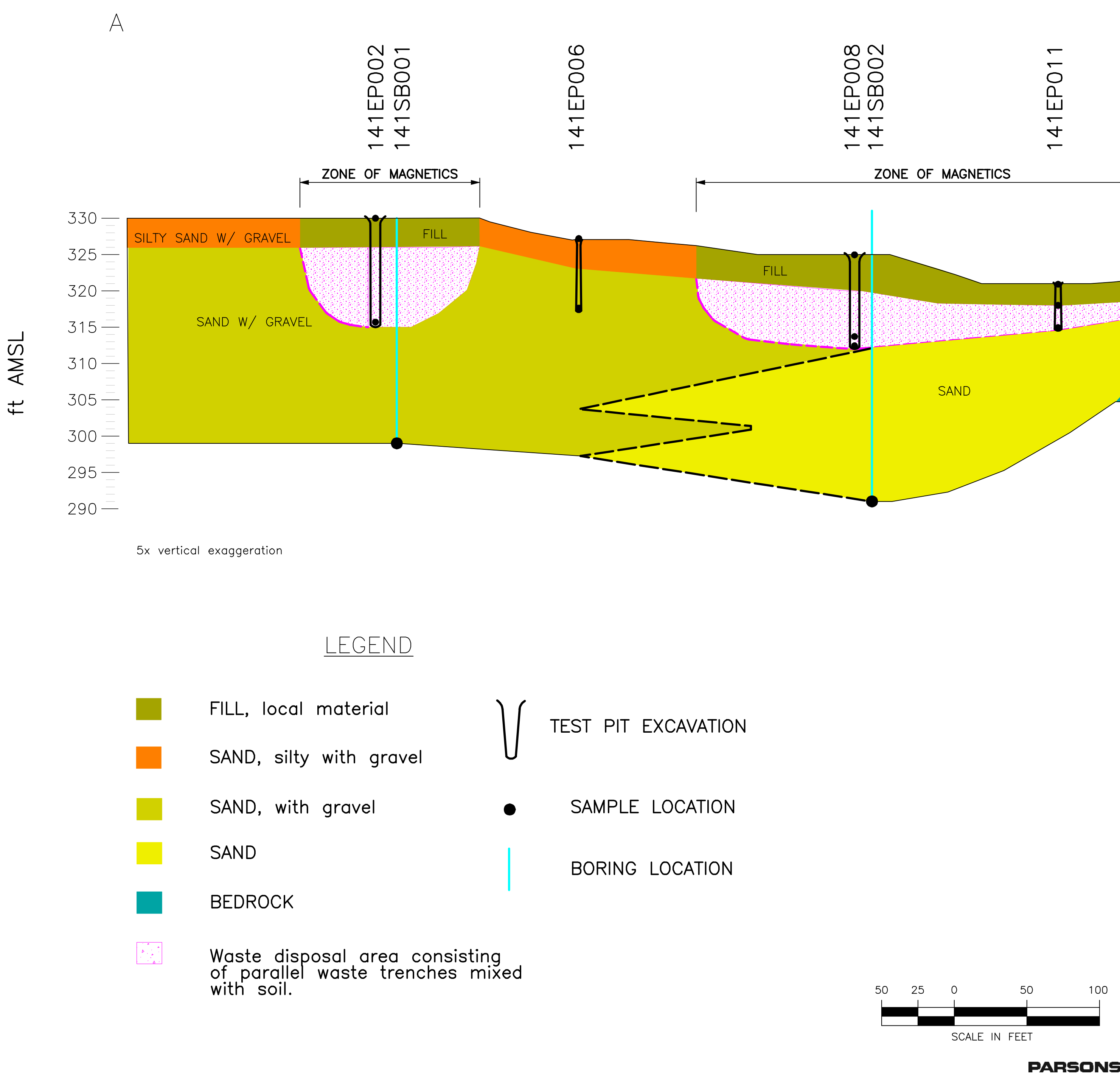


FIGURE 2.7

YPG–141
CROSS SECTION VIEW
OF TEST PITS
FROM A TO A'

U.S. ARMY GARRISON
YUMA PROVING GROUND

$FILE$
$DATE$

SECTION 3.0

CORRECTIVE ACTION OBJECTIVES

Results of the remedial investigation conducted on landfills YPG-029 and -141 did not indicate a current or future risk to human health and the environment. The HRA and ERA for both sites indicated that there are no COCs identified as potential hazards for human or ecological receptors. The soil-to-groundwater evaluation shows three concentrations of lead exceeding the minimum GPL at YPG-141. Although these lead concentrations are believed to be confined to the buried waste layer and there is no evidence of vertical migration, a CMS was recommended to prevent exposure to the buried waste and leaching of material. Corrective action objectives identified for each landfill is to prevent future exposure to solid waste by:

- Providing notification of the landfill location to potential future intrusive workers,
- Restricting future infrastructure construction activities on the landfill footprint,
- Prohibit residential land use of the site, and
- Reducing the risk of waste becoming exposed at the ground surface due to long-term wind and water erosion.

Section 300.430(a)(iii)(B) of the NCP (USEPA, 1990) contains the expectation that engineering controls, such as containment, will be used for waste that poses a relatively low long-term threat where treatment is impracticable. The preamble to the NCP identifies municipal landfills as a type of site where treatment of the waste may be impracticable because of the size and heterogeneity of the contents (55 FR 8704). Waste in landfills is usually present in large volumes and consists of a heterogeneous mixture of municipal waste frequently co-disposed with industrial waste. Because treatment usually is impracticable, EPA generally considers containment to be the appropriate response action, or the "presumptive remedy," for the source areas of municipal landfill sites.

Primary response action objectives for the presumptive remedy for municipal landfill sites may include the following:

- Preventing direct contact with landfill contents;

- Minimizing infiltration and resulting contaminant leaching to ground water;
- Controlling surface water runoff and erosion;
- Collecting and treating contaminated ground water and leachate to contain the contaminant plume and prevent further migration from source area; and
- Controlling and treating landfill gas.

Due to the limited amount of organic material (food wastes) and presence of solid material reported during intrusive RI activities (Parsons, 2013a; Parsons, 2013b); the control of landfill gas at these sites will not be required.

SECTION 4.0
CMS APPROACH

4.1 GENERAL APPROACH

The purpose of the CMS is to identify and screen, develop, and evaluate potential viable corrective measures alternatives that will meet the corrective action objectives, then recommend the corrective measure(s) to be taken at YPG-029 and -141. Since no unacceptable risks to human health or the environment were identified in the RFIs for YPG-029 and -141, the alternatives proposed for the CMS will be limited to actions that will prevent future exposure to solid waste at the landfills. These actions will be screened in this section of the CMS Work Plan, prior to the development of the CMS. The following subsections identify corrective measures that meet the corrective action objectives and evaluate them as stand-alone approaches or in combination to form an alternative that meets the corrective action objectives. This CMS Work Plan recommends four alternatives for detailed evaluation in the CMS.

4.2 CORRECTIVE MEASURES IDENTIFICATION

General corrective measures are families of alternatives that meet the corrective action objectives and include passive responses, such as no action, as well as active responses that use potential technologies to address containment, treatment, excavation, storage, and disposal of waste.

A list of applicable technologies was developed as possible corrective measures for YPG-029 and -141 (Table 4.1). A preliminary screening of these technologies was performed considering their applicability to the USAGYPG landfill sites. These technologies and approaches may be used in combination or as stand-alone alternatives. Table 4.1 was developed based on the technology screening table presented in USEPA (1991), cost and technology descriptions provided in Federal Remediation Technology Roundtable (FRTR; 2002), and guidance provided in AFCEE (1999).

TABLE 4.1
PRELIMINARY TECHNOLOGY SCREENING
CMS WORK PLAN FOR YPG-029 AND -141

YUMA PROVING GROUND, YUMA, ARIZONA

Environmental Media	General Response Actions	Technology	Process Options	Description	Evaluation Comments
Soils/Landfill Contents	No Action			No action is completed at the site.	Used as a baseline for evaluation of action alternatives.
	Access Restriction (Land Use Controls)	Deed Restriction	Institutional Controls	The landfill locations would be included on the USAGYPG master plan to ensure notification is provided to Intrusive workers. Restrictions would prevent construction activities within the site boundary and provide notification to planners of the presence of the landfill.	This option alone will not sufficiently address required actions for this site.
		Groundwater Restrictions	Institutional Controls	Matrix-specific monitoring in support of general response action. Verify continuing necessity of ongoing administrative exposure controls.	Because of the lack of hazardous constituents and the depth of groundwater (115 to 200 ft bgs), no groundwater use restrictions are necessary.
		Fencing	Engineering Controls	Security fences installed around areas with waste.	Because the sites are located in remote locations on a secure facility this option would not provide significant benefits over institutional controls.
	Containment	Surface Controls	Grading	Reshaping of topography to manage infiltration and run-off to control erosion	Grading the site to reroute drainage washes away from the landfilled waste provide a method to mitigate erosion during flood events. Filling surface depressions where settlement has occurred will promote surface water runoff away from the buried waste.
			Revegetation	Seeding, fertilizing, and watering until vegetation has established itself	Establishing non-native vegetation is not practicable in the desert environment at USAGYPG. Rejected
		Cap	Native Soil	Uncontaminated native soil placed over landfill	Highly viable because direct contact and erosion are the primary hazards. Because of the high evaporation rate, very low annual precipitation, and lack of identified hazardous waste source, infiltration is not a major concern at the USAGYPG landfills. Soils may be mixed with gravel to prevent future subsidence.
			Evapotranspiration (ET) Covers	Consists of a layer of soil covered by native grasses. The soil contains no barrier or impermeable layers and uses two natural processes to control infiltration. The uncompacted soil provides a water reservoir and ET empties the soil water reservoir.	As with revegetation, establishing a grass cover is not practicable in the desert environment and will provide no additional protection than a native soil cover. Rejected

TABLE 4.1 (CONTINUED)
PRELIMINARY TECHNOLOGY SCREENING
CMS WORK PLAN FOR YPG-029 AND -141

YUMA PROVING GROUND, YUMA, ARIZONA

Environmental Media	General Response Actions	Technology	Process Options	Description	Evaluation Comments
			Single Barrier Asphalt or Concrete Cover	It is used to form a surface barrier between landfill and the environment. An asphalt concrete cap would reduce leaching through the landfill.	Because infiltration is not a major concern at the USAGYPG landfills this system provides no added benefit over using a native soil cover. Cracking and deterioration would occur over time and result in higher maintenance costs without providing any further protection. Rejected
			RCRA Subtitle D (Municipal Solid Waste) Cover	The design is generally a function of the bottom liner system or natural subsoils present. The cover must meet the following specifications: The material must have a permeability no greater than 1 x 10^{-5} cm/s, or equivalent permeability of any bottom liner or natural subsoils present, whichever is less. The infiltration layer must contain at least 45 cm of earthen material. The erosion control layer must be at least 15 cm of earthen material capable of sustaining native plant growth.	Because of the age of the landfill, depth to the water table, minimal precipitation and high pan evaporation rate, minimizing infiltration is not necessary. Estimated costs are on the order of $175,000 per acre (ITRC, 2007). Much higher capital and long-term maintenance costs without providing any further protectiveness. Rejected.
			RCRA Subtitle C (Hazardous Waste) Cover	The RCRA C multilayered landfill cap is a baseline design that is used in RCRA hazardous waste applications. These caps generally consist of an upper vegetative (topsoil) layer, a drainage layer, and a low permeability layer which consists of a synthetic liner over 2 feet of compacted clay. The compacted clay liners are effective if they retain certain moisture content but are susceptible to cracking if the clay material is desiccated. As a result alternate cap designs are usually considered for arid environments.	Because of the age of the landfill, depth to the water table, minimal precipitation and high pans evaporation rate, minimizing infiltration is not necessary. Estimated costs are on the order of $225,000 per acre (ITRC, 2007). Much higher capital and long-term maintenance costs without providing any further protectiveness. Rejected.
	Removal	Excavation	Mechanical Excavation	Use of excavation equipment to remove buried waste	Capital costs for alternative would be relatively high but may provide benefit to the government if site closure can be obtained and eliminates long-term management. Eliminates future risks. Could be combined with off-site disposal.
			Consolidation	Excavation of landfill material and redisposal in a single location	Because the land use is not expected to change for the landfill sites this option would not provide added benefit to the government. Design of a new landfill would be costly. Rejected.

The following subsections present a focused list of technologies and approaches for achieving the corrective action objectives for YPG-029 and -141. Because of the similarity of the landfills, this discussion is applicable to both sites.

4.2.1 No Action

The no-action alternative provides a baseline by which other alternatives are compared. Under this alternative no corrective measures would be implemented. Because surface debris was removed during the RFI at each of the sites, exposure of people to landfill solid waste is unlikely during non-intrusive activities in the short term. However, over time wind and water erosion will likely uncover additional debris. Additionally, the no-action alternative would not include Land Use Controls (LUCs) and therefore, the no-action alternative would not meet corrective action objectives.

4.2.2 Risk and Hazard Management

Risk and hazard management utilizes enforceable LUCs, including both institutional controls (ICs) and/or engineering controls (ECs) to prevent or limit exposure of receptors to potentially harmful hazards. Examples of ICs include deed notices, zoning ordinances, special use permits, restrictions on groundwater extraction, and restrictions on excavation and construction. Examples of ECs include physical barriers and access restrictions (e.g., fencing, locked gates, and warning signs). LUCs can be cost-effective, reliable, and immediately effective; they can be implemented either alone or with other remedial components. Inspections are typically required to document long-term effectiveness of LUCs. Typically risk and hazard management is easily implemented at DoD installations. Implementation of LUCs is addressed in the DoD Policy and Guidance Document on LUCs Associated with Environmental Restoration Activities (Office of the Under Secretary of Defense-Acquisition and Technology, 2001). Table 4.1 provides and initial screening of risk and hazard management methods for sites YPG-029 and 141.

4.2.3 Containment

Landfill containment is EPA's presumptive remedy for landfill remediation. In general, landfill containment has three primary objectives (AFCEE, 1999) including:

1. **Minimizing Infiltration**: Water that seeps through the waste may produce landfill leachate, which can potentially contaminate underlying soil and groundwater;
2. **Isolating Waste**: A landfill cover provides a barrier to prevent direct contact with exposed waste and receptors at the ground surface and prevents movement and future exposure of waste caused by wind and water erosion; and
3. **Controlling Landfill Gases**: The production of methane or other explosive or toxic gases poses a potential hazard in the landfill vicinity.

Containment technologies range from simple to complex depending on the risks and hazards identified at a site, whether the landfill has a bottom liner, waste types, climate, depth to groundwater, and age of the landfill. Landfill caps can range from a one-layer system of soil to a complex multi-layer system of soils and geosynthetics. In general, less complex systems are required in dry climates and more complex systems are required in wet climates. Examples of containment approaches include regrading of the site, soil covers, evapotraspiration covers, asphalt/concrete cap, RCRA Subtitle D cap for non-hazardous waste landfills, and RCRA Subtitle C landfill cap for hazardous waste applications.

Based on preliminary screening of the applicable technologies at YPG-029 and -141 landfill, the containment technology of buried solid waste using a soil cover would significantly reduce the likelihood of exposure to buried landfill waste at YPG-029 and -141. A layer of native soil would be placed over the landfill and graded to mitigate the effects of water and wind erosion, and would effectively manages risks and hazards. Overland surface drainage presents the highest risk to increasing infiltration and potentially impacting the integrity of the soil cover. The use of a native soil cover will prevent future exposure to solid waste at the landfills, control surface water runoff and erosion, and minimize infiltration. Soil covers using geosynthetics, clay layers, and vegetative covers have been rejected and will not be evaluated in the CMS due to their lack of added protectiveness, high capital costs, and long- term maintenance requirements.

4.2.4 Removal

Landfill removal includes excavation of the landfill contents and either disposing of the recovered materials in an existing permitted off-site permitted facility or in a new on-site landfill facility. Landfill removal with off-site disposal reclamation, would involve the use of traditional earth moving equipment including front end loaders and backhoes to excavate the land fill contents. A trammel (i.e., revolving cylindrical sieve) or vibrating screens would separate out soil from the waste material. Recovered soil would be stockpiled on site and sampled. Soil that meets the residential cleanup standards could then be reused as backfill material, or taken to a sanitary landfill for use as daily cover. Recovered solid waste materials would be recycled if feasible or taken to a permitted municipal solid waste landfill. The objective of landfill reclamation for the YPG-029 and -141 would be to eliminate the need to implement LUCs and maintenance of the sites and therefore reduce the long-term management costs.

4.3 CORRECTIVE MEASURES SCREENING

Except for the no action alternative, each of the three strategies (i.e., Risk and Hazard Management, containment, and removal), are viable approaches to meeting the corrective action objectives. Because containment of the waste on site using a soil cover would leave the waste in place, LUCs would need to be used to achieve the corrective action objectives. The technologies and approaches presented in Section 4.2 have been assembled into four alternatives, including:

1. No Action,
2. Land use controls,
3. Land use controls with a landfill soil cover and drainage control, and
4. Landfill removal.

These al ternatives will be evaluated f urther i n CMS us ing t he eva luation criteria presented in Section 4.4.

4.4 ALTERNATIVE EVALUATION

4.4.1 Achievement of CMS Objectives

Each of the four corrective measures alternatives will be evaluated to determine their ability to achieve the CMS objectives presented in Section 3.0 of this work plan.

4.4.2 Long-term Reliability and Effectiveness

The long-term reliability and effectiveness provides an evaluation of the alternatives' risk and effect of failure. Each alternative will be evaluated in terms of the projected useful life of the overall alternative and of its components. Useful life is defined as the length of time the level of effectiveness can be maintained.

4.4.3 Reduction of Toxicity, Mobility or Volume

As a general goal, remedies that utilize methods that are capable of eliminating or substantially reducing the inherent potential to reduce the toxicity, mobility, or volume of wastes are preferred. The RFIs for YPG-029 and -141 concluded that the landfills consist of municipal mixed with industrial waste, and no COCs were identified as potential hazards for human or ecological receptors. Because the landfills are limited to municipal and industrial waste, none of the alternatives proposed for YPG-029 and -141 utilize treatment technologies; therefore this criterion will not be evaluated in the CMS.

4.4.4 Short-Term Effectiveness

The short-term effectiveness considers the risks to workers and the surrounding community during the implementation of the remedy. The applicable factors that will be considered for YPG-029 and -141 include potential threats associated with excavation, transportation, and redisposal or containment of the waste material.

4.4.5 Implementability

Implementability addresses the technical and administrative feasibility of a remedial alternative from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. Each of the four alternatives developed for YPG-029 and -141 have a high level of implementability.

4.4.6 Cost

The relative cost of each alternative will be estimated in terms of capital cost, operations and maintenance costs, and periodic costs. For Alternatives 2 and 3, monitoring and enforcement of LUCs and maintenance and repairs of the soil cover would be required indefinitely while solid waste remains at the site. However for the cost analysis a 100-year period will be used. A total present value (TPV) cost and non-discounted cost will be calculated for each alternative. The discount rate for the TPV cost calculation will be the real discount rate from the most recent update of Appendix C of Office of Management and Budget (OMB) Circular A-94. Appendix C of the OMB Circular is updated on an annual basis, typically in the January/February timeframe. The current real discount rate applicable to calendar year 2012 is 2.0 percent for projects with 30-year durations or greater. This rate is applicable for adjusting future year expenditures in a present value calculation for Federal facility remediation projects.

4.5 REMEDY SELECTION PROCESS

4.5.1 Ranking of Corrective Measure Alternatives

The remedy selection process will include weighting the benefits and trade-offs of the criteria presented in Section 4.4. Each of the three retained alternatives will also be ranked in relative order for each criterion. Based on the initial screening of the alternatives the detailed evaluation will primarily be influenced by the results of the evaluations of long-term and short-term effectiveness, and cost. Because no alternatives being considered for YPG-029 and -141 employ treatment technologies, reduction in the toxicity, mobility or volume of wastes will not be evaluated in the CMS.

4.5.2 Remedy Selection

The selection of the final remedy will include stakeholder input including input from ADEQ and the public. The preferred alternative will be summarized in a Statement of Basis and public comments will be requested. After the public comment period a Final Decision and Response to Comments will be prepared to document the selected corrective measures, the justification for the selection, and the response to the public comments.

SECTION 5.0

DATA AND INFORMATION SOURCES

This section presents a list of existing data acquired during the RFI activities and a list of additional literature that will be used during the corrective measures study. If data gaps are found during the corrective measures study evaluation, procedures for gathering additional data are presented in this section.

5.1 EXISTING REMEDIAL INVESTIGATION DATA

The RFI activities included the collection of a variety of environmental media data, as well as geologic and hydrogeologic data. RFI data that will be used during the corrective measures alternatives evaluation include:

- Surface debris removal logs
- Magnetometer geophysical survey data
- Test pit excavation and soil boring logs
- Soil sampling analytical results
- Historical groundwater data for USAGYPG

5.2 LITERATURE DATA

In addition to data collected during the RFI, the corrective measures alternative evaluation will utilize literature data from other sources that represent similar current and/or future conditions anticipated at the landfills. These literature sources may include:

- Regional geologic or hydrogeologic studies,
- Regional meteorological data,
- Arizona Department of Water Resources (ADWR) or ADEQ data, and
- Data associated with the successful implementation of treatment technologies at other landfill sites in the U.S.

5.3 DATA GAPS AND ADDITIONAL DATA GATHERING

It is currently expected that the RFI data and analytical results and literature data will provide sufficient information to conduct the corrective measures alternatives evaluation and select the proposed soil and groundwater remedies at YPG-029 and -141. If during the corrective measures alternatives evaluation it is determined that additional data is required to appropriately evaluate and rank the alternatives, supplemental CMS field activities will be proposed. These supplemental CMS activities may include, but not be limited to, the excavation of additional test pits and/or drilling of additional soil borings to evaluate treatment technologies. In the event additional CMS data gathering activities are needed, a supplemental work plan will be submitted to ADEQ for review and approval prior to conducting the field activities.

SECTION 6.0
CMS REPORT OUTLINE

Following the acceptance of the CMS Work Plan a CMS Report will be prepared using the EPA's guidance document *RCRA Corrective Action Pla*n (USEPA, 1994). Because the initial screening and identification of alternatives is presented in this CMS Work Plan the purpose of the CMS Report will be to evaluate the four alternatives proposed in Section 4. The following general outline will be used for the CMS Report.

1. Introduction
2. Site Background
3. Corrective Action Objectives
4. Development of Corrective Measures Alternatives
5. Evaluation of Corrective Measures Alternatives
6. Recommended Corrective Measures Alternative
7. References

The Corrective Measure Alternatives Evaluation section will include a comparison of each alternative's ability to achieve the pertinent evaluation criteria, and will identify the benefits and tradeoffs between the three alternatives.

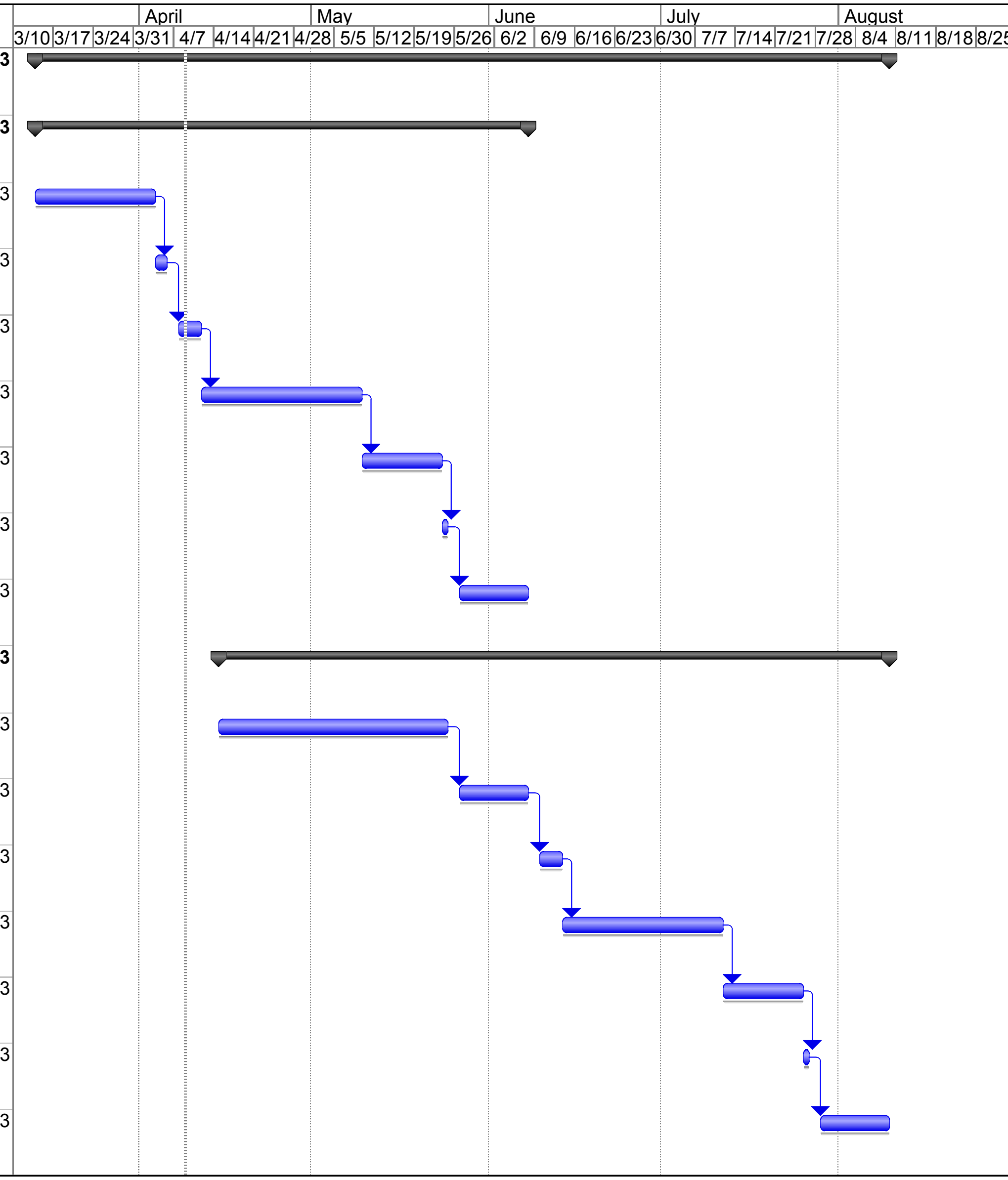
SECTION 7.0

SCHEDULE

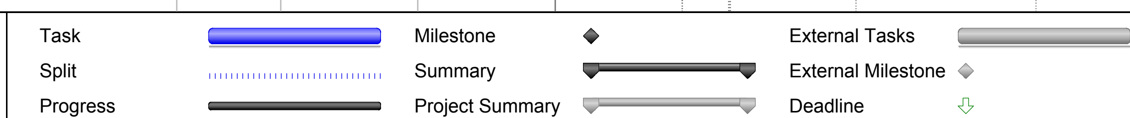
The CMS activities will be conducted in a manner that will facilitate the submittal of a draft final CMS Report to ADEQ by August 30, 2013. The schedule for the corrective measures study implementation is presented in the Gantt chart shown on Figure 7.1.

FIGURE 7.1
CMS SCHEDULE
YPG-029 and -141

ID	Task Name	Duration	Start	Finish
1	**Yuma Proving Ground CMS (YPG-029 and -141)**	**107 days**	**Thu 3/14/13**	**Fri 8/9/13**
2	**CMS Work Plan**	**62 days**	**Thu 3/14/13**	**Fri 6/7/13**
3	CMS Draft Work Plan	15 days	Thu 3/14/13	Wed 4/3/13
4	Army Review	2 days	Thu 4/4/13	Fri 4/5/13
5	CMS Draft Final Work Plan	4 days	Mon 4/8/13	Thu 4/11/13
6	ADEQ Review	20 days	Fri 4/12/13	Thu 5/9/13
7	Revise Draft Final Work Plan	10 days	Fri 5/10/13	Thu 5/23/13
8	Submit Final Work Plan	1 day	Fri 5/24/13	Fri 5/24/13
9	Approval of Final CMS Work Plan	10 days	Mon 5/27/13	Fri 6/7/13
10	**CMS Report**	**85 days**	**Mon 4/15/13**	**Fri 8/9/13**
11	CMS Report	30 days	Mon 4/15/13	Fri 5/24/13
12	Army Review	10 days	Mon 5/27/13	Fri 6/7/13
13	CMS Draft Final Work Plan	4 days	Mon 6/10/13	Thu 6/13/13
14	ADEQ Review	20 days	Fri 6/14/13	Thu 7/11/13
15	Revise Draft Final Work Plan	10 days	Fri 7/12/13	Thu 7/25/13
16	Submit Final Work Plan	1 day	Fri 7/26/13	Fri 7/26/13
17	Approval of Final CMS Work Plan	10 days	Mon 7/29/13	Fri 8/9/13



Yuma Proving Ground CMS Schedule
Date: Tue 4/9/13



SECTION 8.0

REFERENCES

Air Force Center for Environmental Excellence (AFCEE). 1999. *Landfill Remediation Project Manager's Handbook*. December.

Federal Remediation Technology Roundtable (FRTR). 2002. Remediation Technologies Screening Matrix and Reference Guide. 4th Edition. January. http://www.frtr.gov/matrix2/top_page.html.

Jason (Jason Associates Corporation). 2007. *Final Geophysical Evaluation Inactive Landfills Solid Waste Management Units* (SWMUs):37 (CCYPG-027), 36 (CCYPG-028), 41 (CCYPG-029), 39 (CCYPG-141), 40 (CCYPG-143) and CCYPG-178. U.S. Army, Yuma Proving Ground. February.

Office of the Under Secretary of Defense-Acquisition and Technology. 2001. Policy on Land Use Controls Associated with Environmental Restoration Activities. January.

Parsons. 2010. *Final RCRA Facility Investigation Work Plan for Inactive Landfills and Muggins Mountain OB/OD Sites for U.S. Army Garrison Yuma Proving Ground*. May.

Parsons. 2013a. *Final RCRA Facility Investigation Report for YPG-029 for U.S. Army Garrison Yuma Proving Ground*. March.

Parsons. 2013b. *Final RCRA Facility Investigation Report for YPG-141 for U.S. Army Garrison Yuma Proving Ground*. March.

Tetra Tech EM Inc. 1998. *Final RCRA Facility Report*. U.S. Army Yuma Proving Ground, AZ. August.

U.S. Environmental Protection Agency (USEPA). 1990. National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Final Rule). 40 CFR Part 300: 55 Federal Register 8666.

USEPA. 1991. Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites. EPA/540/P-91/001. February.

USEPA. 1994. *RCRA Corrective Action Plan*, Final. 1994. Office of Waste Programs Enforcement, Office of Solid Waste. EPA 520/R/94/004. May.

U.S. Census Bureau. 2010. 2010 Census found in State and County QuickFacts for Yuma, Arizona at: http://quickfacts.census.gov/qfd/states/04/0485540.html.