

Revised Final
RCRA Facility Investigation Report
for
SWMU 2, SWMU 5, SWMU 9, and SWMU 11

Marine Corps Air Station Yuma
Yuma, Arizona



Contract Number: N62473-07-C-6018

28 December 2007

Prepared for:



Department of the Navy
Southwest Division
Naval Facilities Engineering Command
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Under subcontract with:
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7722 E. Topeka Place
Yuma, Arizona 85365

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 by DIRECTOR

12/30/07

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Executive Summary

Executive Summary

This report presents the results of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at four solid waste management units (SWMUs) for Marine Corps Air Station (MCAS) Yuma in Yuma, Arizona. CDM Federal Programs Corporation (CDM) performed the RFI for Naval Facilities Engineering Command (NAVFAC) Southwest under Contract Number N68711-00-D-0004, Delivery Order Number 0067 and Contract Number N62473-07-C-6018 (under subcontract with Gutierrez Canales Engineering, P.C. [GCE]).

The RFI was conducted for SWMU 2 (Former Munitions Wash Area), SWMU 5 (Auxiliary Air Field II [Aux II] Debris Piles), SWMU 9 (Former Accumulation Area for Burn Residue), and SWMU 11 (Former Explosive Ordnance Disposal [EOD] Range). A RCRA Facility Assessment (RFA) Report and a RFA Addendum were prepared for the Yuma segment of the Barry M. Goldwater Range (BMGR) in 2002 and 2003, respectively (Booz Allen 2002 and Arizona Department of Environmental Quality [ADEQ] 2003). The RFA and RFA Addendum concluded that past activities conducted at these SWMUs may have resulted in the release of contaminants to site soils.

The objective of the RFI is to determine whether a release of hazardous substances has occurred and to determine if further action is necessary.

This report describes the field activities and results of the RFI conducted from 21 September 2004 through 29 September 2004 and 30 July 2007 through 31 July 2007. All fieldwork was conducted in accordance with procedures presented in the Final RFI Work Plan (CDM 2004). The following summarizes the tasks completed and the results for each SWMU.

SWMU 2 (Former Munitions Wash Area)

- Four soil borings were installed using direct push technology (DPT) in September 2004. The borings were located to provide maximum horizontal coverage of the 200 square foot area.
- Three primary soil samples were collected from each boring, one each at surface, 5 feet below ground surface (bgs), and at DPT refusal (7.5 to 9 feet bgs).
- A total of 12 primary soil samples and six quality control (QC) samples (two soil and four aqueous) were collected and submitted for volatile organic compound (VOC) and nitrate analyses.

- VOC and nitrate concentrations were below the screening levels identified in the Final RFI Work Plan (CDM 2004), therefore, no release of hazardous substances has occurred and no further action (NFA) under RCRA is recommended.

SWMU 5 (Aux II Debris Piles)

- Twenty soil borings were installed in September 2004 using DPT. The borings were located where debris was being stored and where evidence of past storage (e.g., surface soil staining) was found on the 1.5 acre site.
- Six of the 20 borings were completed to 20 feet bgs per the Final RFI Work Plan, but the remaining 14 borings reached DPT refusal between 9.5 to 18.5 feet bgs due to moderately cemented sandstone. Three to five primary soil samples were collected from each boring.
- A total of 86 primary soil samples and 11 QC samples (nine soil and two aqueous) were collected and submitted for total petroleum hydrocarbon (TPH), lead, and perchlorate analyses.
- Lead and perchlorate concentrations were below the screening levels identified in the Final RFI Work Plan (CDM 2004).
- The following TPH concentrations were detected:
 - TPH as motor oil (carbon range 24 through 36) in six soil samples between 48 milligrams per kilogram (mg/kg) and 160 (estimated) mg/kg and in one soil sample at an estimated concentration of 3,100 mg/kg (screening level is 4,100 mg/kg); most concentrations were detected from surface soil samples.
 - TPH as diesel (carbon range 10 through 24) in 63 soil samples at concentrations ranging from 1.7 mg/kg to 33 mg/kg and in one soil sample at 510 mg/kg (screening level is 4,100 mg/kg).
 - TPH as gasoline (carbon range 6 through 10) in five soil samples between 68 and 100 micrograms per kilogram ($\mu\text{g}/\text{kg}$) and in one soil sample at a concentration of 430 $\mu\text{g}/\text{kg}$ (no available screening criteria).

Based upon the TPH concentrations, the TPH contamination is not anticipated to be a human health threat or to migrate to groundwater (approximately 130 feet bgs at SWMU 5).

- Three borings completed in September 2004 encountered a 2- to 3-inch layer of light gray, ash-like powder at depths ranging from 13 to 16 feet bgs. Results of the September 2004 soil samples collected above and below the powder had no detections of chemicals above applicable screening levels.

- Four additional borings were installed using DPT in July 2007 to further investigate the nature of the light gray, ash-like powder and determine whether it was resultant of open detonation activities. The powder was encountered in three of the four borings at depths ranging from 2 to 14 feet bgs and coinciding with depths at which gravel began to occur. The powder was deposited at the top and sides of the DPT sleeves; a distinct "layer" of the powder was never encountered. Upon further evaluation, it was determined that the powder was pulverized rock/gravel resulting from the DPT installation method rather than a distinct "layer" resulting from past open detonation activities.
- A total of six primary samples were collected in July 2007 from the three borings that encountered the light gray powder; each sample consisted of both native soil and the light gray powder of interest. Samples were submitted for analyses of explosives, metals, semivolatile organic compounds (SVOCs), and nitrate. Three QC samples (one soil and two aqueous) were also collected and submitted for the same analyses as the primary soil/powder samples.
- No explosives or SVOCs were detected above laboratory reporting limits in any of the soil/powder samples. Nitrate and all metals concentrations, except arsenic, were below the screening levels identified in the Final RFI Work Plan (CDM 2004). Arsenic concentrations ranged from 2.66 mg/kg to 11.7 mg/kg with two samples meeting or exceeding the 10 mg/kg screening level.
- Results from the screening human health risk evaluation performed for this RFI indicate the total cancer risk is 1×10^{-6} , which is within the risk management range. Arsenic was the only carcinogenic chemical detected. Noncancer hazards were also calculated and arsenic had the greatest contribution; however, the hazard index (HI) was 1.0 which is an acceptable index.
- Analytical results of samples collected in 2004 and 2007 do not indicate perchlorate, TPH, explosive, SVOC, metal, or nitrate contaminations at levels that could pose a threat to human health or the environment. Therefore, no release of hazardous substances has occurred and NFA under RCRA is recommended.

SWMU 9 (Former Accumulation Area for Burn Residue)

- Four soil borings were installed using DPT in September 2004. The borings were located in a linear pattern to provide maximum horizontal coverage of the 200 square foot area.
- Three primary soil samples were collected from two borings, one each at surface, 5 feet bgs, and at DPT refusal (9 to 10 feet bgs). Four primary soil samples were collected from the remaining two borings, one each at surface, at 5 feet bgs, at 10 feet bgs, and at DPT refusal (15 feet bgs).

- A total of 14 primary soil samples and four QC samples (one soil and three aqueous) were collected and submitted for VOC, SVOC, metals, explosives, perchlorate, and white phosphorus analyses.
- All concentrations were below the screening levels identified in the Final RFI Work Plan (CDM 2004); therefore, no release of hazardous substances has occurred and NFA under RCRA is recommended.

SWMU 11 (Former EOD Range)

- The trench was excavated in September 2004 to a depth of approximately 10 feet bgs, with approximate dimensions of 58 feet by 22 feet. Excavation unearthed non-explosive "range trash" consisting of various articles of debris, including empty rocket motor casings, an empty napalm bomb, barrels, practice bombs, an expended tube from a TOW missile, and practice warheads. No unexploded ordnance (UXO) was found in the trench. No evidence that the "range trash" had been treated by burning or open detonation was found and NFA under RCRA is recommended for the trench portion of SWMU 11.
- A portion of the dighole was excavated in September 2004 to a depth of approximately 3 feet bgs uncovering nonexplosive "range trash" and a thin layer of black ash and burned munitions (20 millimeter [mm] rounds and 25 mm shell casings). This provides evidence that landfilling and open burning/burying of munitions occurred. A Corrective Measure Study under RCRA is recommended for the dighole portion of SWMU 11.

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Acronyms and Abbreviations

AAC	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
amsl	above mean sea level
Aux II	Auxiliary Airfield II
BMGR	Barry M. Goldwater Range
bgs	below ground surface
°C	degrees Celsius
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS	corrective measures study
COC	chain of custody
COPC	chemical of potential concern
DOE	United States Department of Energy
DPT	direct push technology
EOD	explosives ordnance disposal
EPA	United States Environmental Protection Agency
GCE	Gutierrez Canales Engineering, P.C.
GPL	groundwater protection level
GPS	global positioning system
HHRA	human health risk assessment
HI	hazard index
ID	identification
IDW	investigation-derived waste
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDC	Laboratory Data Consultants
MCAS	Marine Corps Air Station
mg/kg	milligrams per kilogram
MLWA	Military Lands Withdrawal Act
mm	millimeter
MS	matrix spike
MSD	matrix spike duplicate
MTR	munitions treatment range

Acronyms and Abbreviations (continued)

NAVFAC	Naval Facilities Engineering Command
Navy	United States Department of the Navy
NFA	no further action
NFESC	Naval Facilities Engineering Service Center
PA	preliminary assessment
PPE	personal protective equipment
PRG	preliminary remediation goal
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RPD	relative percent difference
SAP	sampling and analysis plan
SDG	sample delivery group
SI	site investigation
SOP	standard operating procedure
SRL	soil remediation level
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TPH	total petroleum hydrocarbon
µg/kg	micrograms per kilogram
UTM	Universal Transverse Mercator
UXO	unexploded ordnance
VOC	volatile organic compound

Section One

Section 1

Introduction

1.1 Purpose

This report presents the results of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at four solid waste management units (SWMUs) for Marine Corps Air Station (MCAS) Yuma in Yuma, Arizona. CDM Federal Programs Corporation (CDM) performed the RFI in September 2004 and July 2007 for Naval Facilities Engineering Command (NAVFAC) Southwest under Contract Number N68711-00-D-0004, Delivery Order Number 0067 and Contract Number N62473-07-C-6018 (under subcontract with Gutierrez Canales Engineering, P.C. [GCE]).

A RCRA Facility Assessment (RFA) Report and a RFA Addendum were prepared for the Yuma segment of the Barry M. Goldwater Range (BMGR) in 2002 and 2003, respectively (Booz Allen 2002 and Arizona Department of Environmental Quality [ADEQ] 2003). A RFA is the first step in the RCRA corrective action program. The purpose of a RFA is to evaluate and identify SWMUs that may have released or have the potential to release hazardous substances to the environment. The RFA makes preliminary determinations regarding potential or known releases of concern and the need for further action. The RFA (Booz Allen 2002) and RFA Addendum (ADEQ 2003) recommended further investigation under a RFI for SWMU 2 (Former Munitions Wash Area), SWMU 5 (Auxiliary Air Field II [Aux II] Debris Piles), SWMU 9 (Former Accumulation Area for Burn Residue), and SWMU 11 (Former Explosive Ordnance Disposal [EOD] Range).

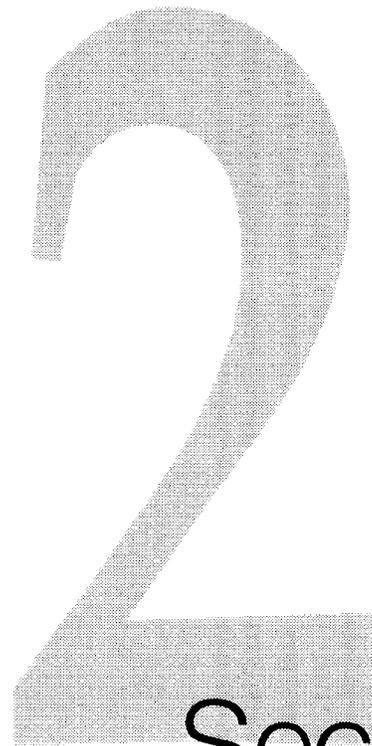
The RFI is the second step of the RCRA corrective action program. A RFI is a detailed investigation, which determines the nature and extent of potential releases of hazardous substances, and provides information necessary for developing a strategy for addressing the release (United States Department of Energy [DOE] 1994).

The objective of the RFI is to determine whether a release of hazardous substances has occurred and based on the results, determine whether no further action (NFA) or further investigation and/or remedial action is necessary. The investigation intended to gather additional information regarding the presence and lateral and vertical extent of contamination at each of the sites. Determinations for SWMU 2, SWMU 5, and SWMU 9 were based on results from soil sampling activities and determination for SWMU 11 was based on the results of excavation activities.

1.2 Report Organization

This report contains the following sections and appendices:

- Section 1 provides the introduction.
- Section 2 describes the site locations and history.
- Section 3 presents the strategy and scope of the RFI.
- Section 4 presents a summary of the RFI investigation activities.
- Section 5 presents the findings of the RFI.
- Section 6 presents the quality assurance (QA)/quality control (QC) summary.
- Section 7 presents the conclusions and recommendations.
- Section 8 presents references used in this report.
- Appendix A presents photographs from the field investigation.
- Appendix B contains the direct push technology (DPT) boring logs.
- Appendix C presents a table of the validated analytical results and includes a compact disk with the 2004 and 2007 data validation packages in PDF format.
- Appendix D presents the Universal Transverse Mercator (UTM) coordinates taken during RFI field activities.



Section
Two

Section 2

Site Descriptions and Physical Setting

2.1 Site Location

MCAS Yuma is located in the City of Yuma in the southwestern corner of Arizona. MCAS Yuma operates four subranges in the BMGR: two manned ranges, an air-to-air gunnery range, and an air combat maneuvering range. An area location map indicating MCAS Yuma and the BMGR is provided as Figure 2-1.

SWMU 2 (Former Munitions Wash Area) is located on the northwest quadrant of the Munitions Treatment Range (MTR). SWMU 5 (Aux II Debris Piles) is located southwest of Aux II on the BMGR. SWMU 9 (Former Accumulation Area of Burn Residue) is located one mile north of the MTR and approximately a quarter mile south of Aux II. SWMU 11 (Former EOD Range) is located less than one mile southwest of the MTR. The locations of the subject SWMUs (as determined by global positioning system [GPS] measurements taken during field activities) are shown on Figure 2-2.

2.2 BMGR History

The BMGR is, and has been, an important facility for training pilots in aerial and air-to-ground combat since 1941. It is highly valued for its year-round flying weather and expansive, unencumbered air and land space that can accommodate a variety of military training needs. This combination of features is unequalled elsewhere in the continental United States. As urban and other development pressures force restrictions on the operation of military aircraft at other range locations, the BMGR will become increasingly vital to the nation's defense.

Acquisition of the BMGR for military aviation training purposes began in 1941, shortly before the United States entered World War II. Congress officially set aside 2.6 million acres of the BMGR with the 1986 Military Lands Withdrawal Act (MLWA) and designated it the Barry M. Goldwater Air Force Range under management of the United States Air Force. Congress extended authorization of the BMGR once more and re-designated BMGR management responsibilities with the 1999 MLWA. The BMGR is authorized for use by the Secretaries of the Air Force and Navy for 25 years until 2024 and provides that the United States Department of Defense may apply for an extension to that authorization should there be a continuing military need for the BMGR beyond 2024. The 1999 MLWA designates the western portion as BMGR-West (Yuma Segment), consisting of 1,017,990 acres with about 186 miles of exterior perimeter, and the eastern portion of the range as BMGR-East (Gila Bend Segment), consisting of a 1,651,235 acre parcel with approximately 280 miles of exterior perimeter. The airspace over the Gila

Bend Segment belongs to, and is controlled by, the United States Air Force, while the Yuma Segment belongs to and is controlled by the United States Department of the Navy (Navy). Ground access to these segments is also controlled by the agency controlling the overlying airspace. Control by the Navy is administered through MCAS Yuma; Luke Air Force Base administers United States Air Force control.

2.3 Topography

Topography across the BMGR varies from an elevation of 200 feet above mean sea level (amsl) on the western boundary to over 4,000 feet amsl on the eastern boundary. Approximately eight mountain ranges cross the BMGR, including the Gila, Cabeza Prieta, Sierra Pinta, Copper, Granite, Mohawk, Grant, Growler, Saucedo, and Sand Tank Mountains (west to east). Regional topography slopes north and west; however, localized topography is controlled by the numerous mountain ranges that cross the BMGR in a northwest-southeast orientation (CDM 2003).

Elevations of SWMUs 2, 5, 9, and 11 range from 200 to 250 amsl. The sites are vegetated with native desert shrubs and grasses

2.4 Surface Waters

There are several small lakes and playas on the southern portion of the BMGR within Cabeza Prieta National Wildlife Refuge. The closest surface waters to the SWMUs included in this RFI are the Colorado River to the west (15 miles) and Gila Rivers to the north (12 miles), respectively, both of which are beyond the west and north boundaries of the BMGR.

2.5 Groundwater

Numerous groundwater studies have been conducted on surrounding perimeter areas of the BMGR. The three largest and deepest basins are Lechuguilla, Mohawk-Tule, and San Cristobal. The major water-bearing units in the perimeter areas are found above and below thick lacustrine clay layers. Studies done of the Lechuguilla Desert (location of SWMUs) and Mohawk-Tule Valley indicate a shallow unconfined aquifer at depths ranging from 125 feet below ground surface (bgs) in the east-central portion of the Valley to 366 feet bgs in the west-central area. A sand and gravel aquifer is suspected to exist beneath the lacustrine clay deposit that is found at depths ranging from 600 to 1500 feet bgs (CDM 2003).

The United States Bureau of Reclamation collects groundwater elevation data from several piezometers in the BMGR (several in the vicinity of the SWMUs). East of the Algodones Fault (SWMUs 2, 5, and 9), groundwater flows to the southeast and ranges in depth between 130 and 140 feet bgs. West of the Algodones Fault (SWMU 11), groundwater flows to the south at a depth of approximately 80 feet bgs (CDM 2003).

2.6 Climate and Land Use

Climatic data can be inferred from weather stations located in communities around the northern and eastern borders of the range. In general, the BMGR has a climate that is characterized by: (1) low precipitation that is distributed between summer and winter rainy seasons, (2) hot summers and mild winters, (3) limited cloudiness, (4) moderate winds, and (5) relative low humidity. Annual precipitation is 3.2 inches per year (CDM 2003).

Land use within the BMGR has been significantly restricted because of the withdrawal of land through the 1986 MLWA. Livestock grazing and mining have not been allowed since 1941. Right-of-ways are limited to utilities and a railroad, both of which parallel Highway 85 on the eastern side of the BMGR. No special use or temporary use permits have been issued on the BMGR. Future issuance of these types of permits are unlikely (CDM 2003).

There are no formal recreation areas in proximity to the RFI SWMUs. However, the various subranges in the Yuma Segment may be open for recreational activity (e.g., hunting) and visitors must gain access to the BMGR from MCAS Yuma Range Management.

2.7 Site Histories

Descriptions of past activities at SWMUs 2, 5, 9, and 11 are provided below. These descriptions are taken from the Final RFI Work Plan (CDM 2004).

2.7.1 SWMU 2 (Former Munitions Wash Area)

The area designated as SWMU 2 is approximately 200 square feet in size and is located on the northwest quadrant of the MTR, just south of the former open burn trenches (the open burn trenches were clean-closed in 1998). From 1988 until 1993, the munitions wash area was used infrequently for pink/red water treatment. During operation of the self-contained unit, a fire was lit underneath a 55-gallon drum containing water. Upon boiling, munitions to be demilitarized were placed in the boiling water inside the drum. The munitions would be boiled out into the water and the clean shell would be removed and preserved. The water from the drum would then be poured into four metal pans. Each pan was six feet wide by six feet long by four inches deep and the pans were located over bare ground near the drum. The water would be allowed to evaporate from the metal pans. A crystallized residue (e.g., trinitrotoluene) would remain in the pans after the water had evaporated and gasoline would be poured over the pans and lit to destroy the residue. Only approximately 300 gallons of pink/red water were treated at this unit and the pans and drum were removed from the site in 1995.

Site soils were sampled and analyzed for volatile organic compounds (VOCs) and nitrate during the RFI to determine if a release of hazardous substances has occurred.

2.7.2 SWMU 5 (Aux II Debris Piles)

SWMU 5 is approximately 1.5 acres in size and is located southwest of Aux II. This site is used to stockpile scrap metal from inert/demilitarized ordnance and jet assisted take-off canisters. According to a previously conducted Preliminary Assessment (PA), the site was described as a former temporary storage location for refuse items in the 1940s and 1950s. The two debris piles reportedly contained lumber, tires, old vehicle parts, paint cans, and construction materials. Several areas of petroleum-stained soil were observed at the site during the PA. The PA recommended the site for further investigation. Soil sampling was conducted at a similar debris pile site on the east side of Aux II as a part of a Site Investigation (SI) conducted in 1995. Analytical results from the SI indicated that concentrations of arsenic (1.8 milligrams per kilogram [mg/kg]) and beryllium (0.29 mg/kg) in site soils were significantly lower than the State of Arizona Residential soil remediation levels (SRLs) of 10 mg/kg and 1.4 mg/kg (AAC 2002), respectively. The RFA Addendum recommended soil sampling to address the petroleum-stained soil cited in the PA and SI.

Site soils were sampled and analyzed for total petroleum hydrocarbons (TPH), metals, explosives, semivolatile organic compounds (SVOCs), nitrate, and perchlorate during the RFI to determine if a release of hazardous substances has occurred.

2.7.3 SWMU 9 (Former Accumulation for Burn Residue)

The area designated as SWMU 9 is approximately 200 square feet in size and is located 1 mile north of the MTR on the Aux II access road. From 1988 until 1993, open burning of munitions was conducted at the MTR (the open burn trenches were clean-closed in 1998). During open burning operations, large pieces of scrap metal were removed from the trenches after open burn events and accumulated on the ground for disposal or recycling. These large pieces of scrap metal and solid residues that remained after an open burn usually included metal casings, soot, and residual ash from paper, wood, cardboard, etc. Due to the method of waste storage in this area (directly on the ground), the potential exists for a release of hazardous substances to soil.

Site soils were sampled and analyzed for VOCs, SVOCs, metals, explosives, perchlorate, and white phosphorus during the RFI to determine if a release of hazardous substances has occurred.

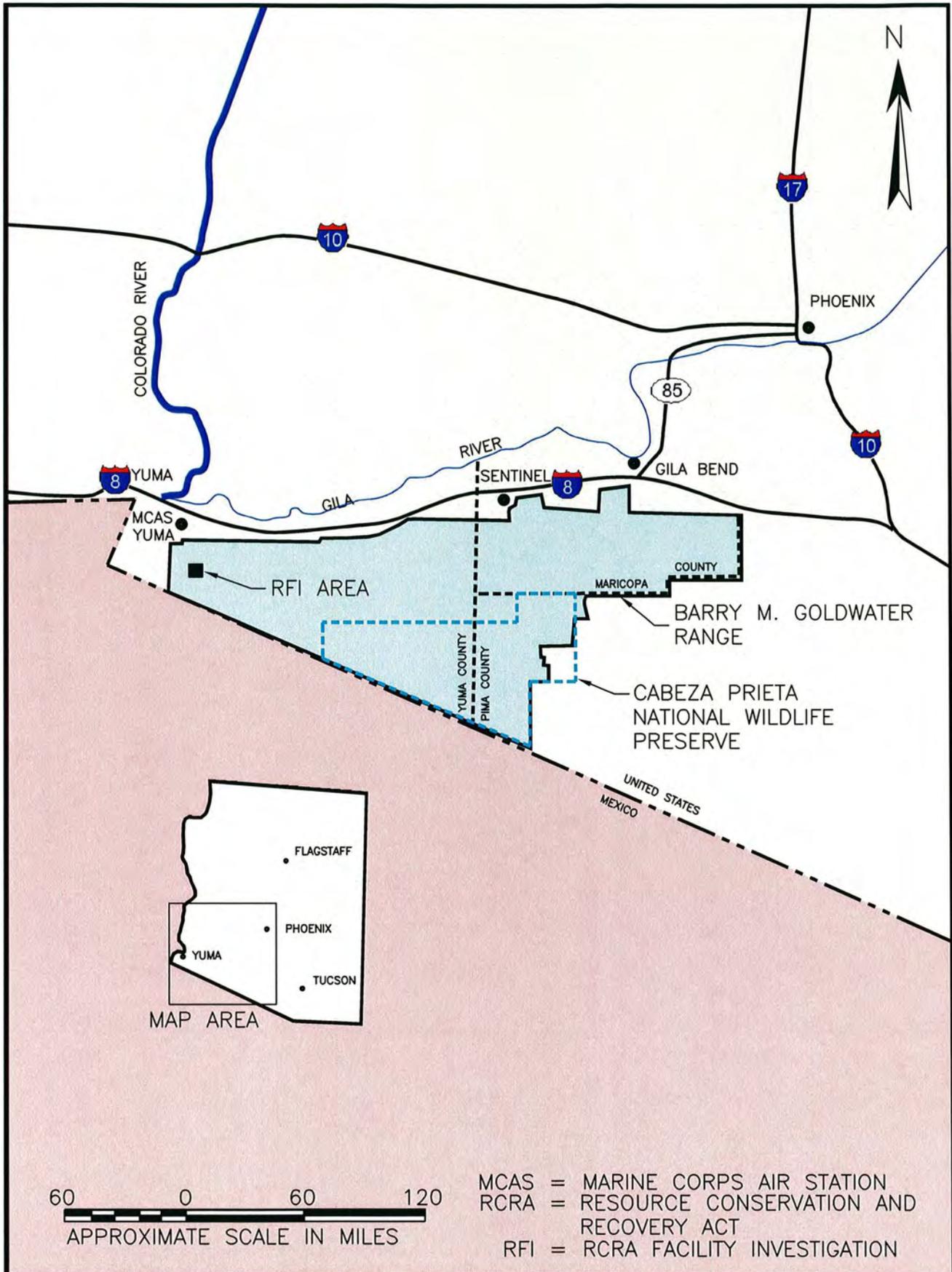
2.7.4 SWMU 11 (Former EOD Range)

SWMU 11 is located approximately 1 mile from the southwest corner of the MTR. Upon visual investigation, SWMU 11 was found to consist of a man-made trench

(approximately 2 feet deep, 14 feet wide, and 50 feet long) and a dighole (approximately 2 feet deep and 21 feet in diameter). The site was used in the past for on-range munitions treatment by open burning and open detonation. The 1992 PA alleged that munitions were treated by detonation (in shotholes), burned in pits to remove any remaining active explosive residue, and then, after burning, the material was reportedly covered with native soil (i.e., buried). On-range destruction of munitions is consistent with "use for intended purpose" and is therefore, not considered a solid waste (40 Code of Federal Regulations [CFR] 266.202). However, "use for intended purpose" does not include burial of munitions.

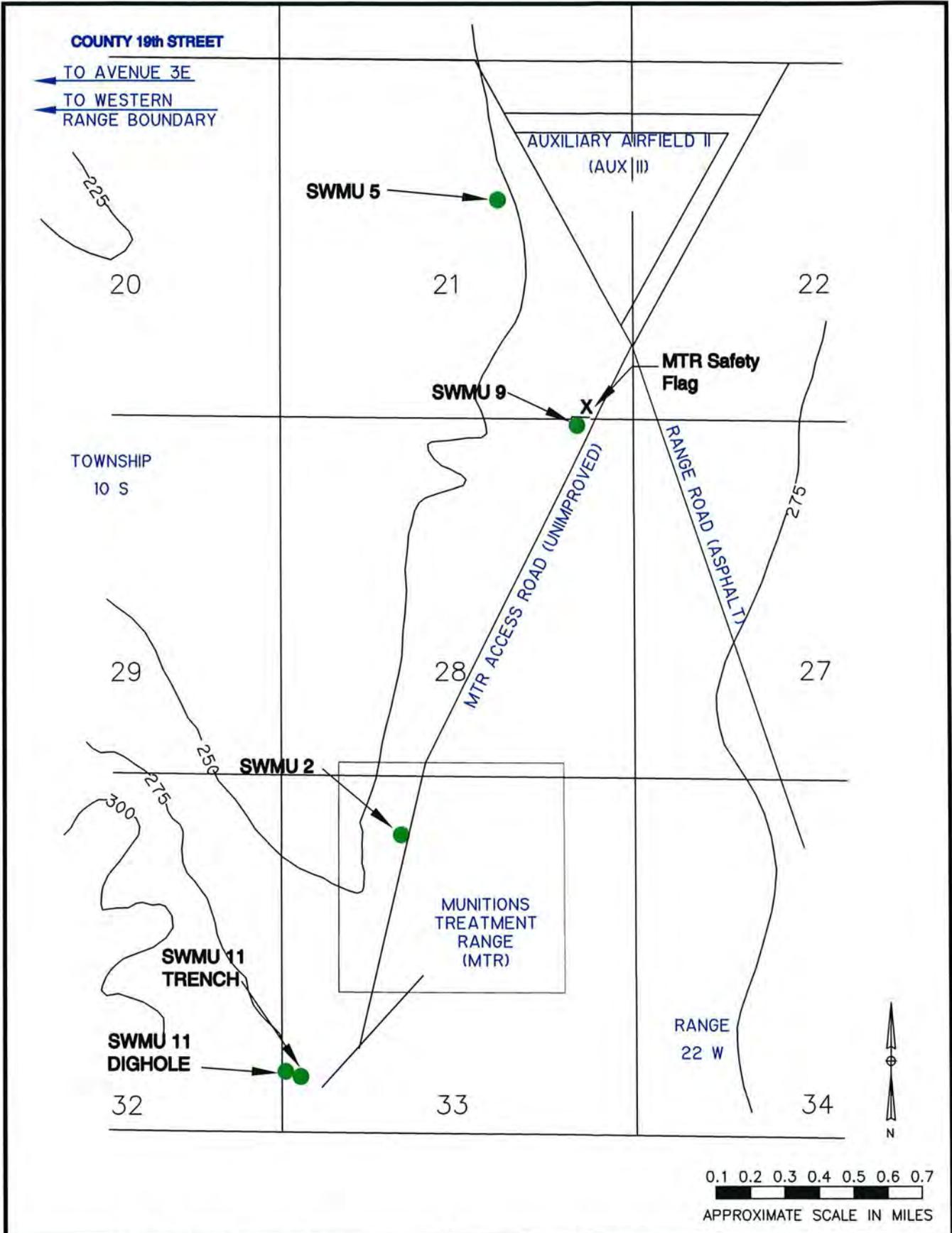
The trench and dighole were excavated during the RFI to determine if munitions were actually treated by open burning and then buried at SWMU 11.

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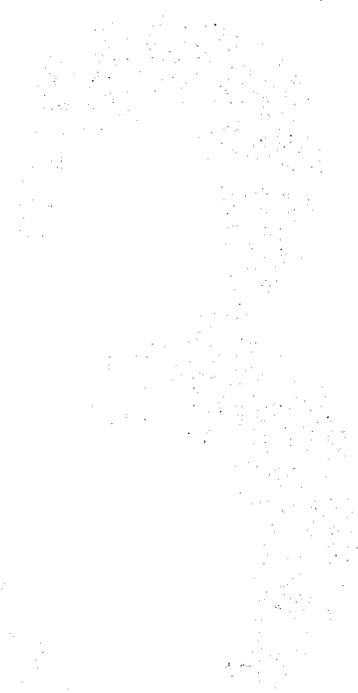


MCAS = MARINE CORPS AIR STATION
 RCRA = RESOURCE CONSERVATION AND RECOVERY ACT
 RFI = RCRA FACILITY INVESTIGATION

RCRA FACILITY INVESTIGATION YUMA, ARIZONA		AREA LOCATION MAP		FIGURE 2-1
CDM Federal Programs Corporation	DATE: 10/07	BARRY M. GOLDWATER RANGE MCAS YUMA, YUMA, ARIZONA		
	MODIFIED BY: <i>J. Brown</i>	FN: 001_RPT PROJECT NO. 6231-001		



RCRA FACILITY INVESTIGATION YUMA, ARIZONA		SITE LOCATION MAP		FIGURE
CDM	9444 FARNHAM STREET	DATE: 10/2007	BARRY M. GOLDWATER RANGE MCAS YUMA, YUMA, ARIZONA	2-2
	SAN DIEGO, CALIFORNIA	FN: 001_RPT		
MODIFIED BY: <i>J. Brown</i>	PROJECT NO. 6231-001			



Section
Three

Section 3

Strategy and Scope of RFI

3.1 RFI Strategy

The objective of the RFI is to determine if hazardous substances have been released to the environment, whether the onsite concentrations of those substances exceed regulatory health-based standards or site-specific risk criteria, and whether further action is necessary.

As described in the Final RFI Work Plan, the State of Arizona Residential SRLs (AAC 2002), the United States Environmental Protection Agency (EPA) Residential Preliminary Remediation Goals (PRGs) for perchlorate only (EPA 2004a), and the ADEQ Groundwater Protection Levels (GPLs) (for VOCs only) (ADEQ 1996) are the applicable soil screening levels for this study (CDM 2004). These screening levels are provided in Table 3-1.

The Final RFI Work Plan states that chemicals found to exceed screening levels in site soils at SWMU 2, SWMU 5, or SWMU 9 will be considered chemicals of potential concern (COPCs). A Human Health Risk Assessment (HHRA) will be performed for all COPCs to determine the appropriate action protective of human health and if the HHRA determines that further action is required, a corrective measures study (CMS) will be performed to identify a remedial alternative. If chemical concentrations do not exceed the applicable soil screening levels (Table 3-1), then it will be concluded that no release of hazardous substances has occurred, and NFA will be recommended for the site.

For SWMU 11, if the findings of this RFI determine that an additional RFI is necessary (i.e., evidence of burned and buried munitions are found), and an HHRA is subsequently conducted that identifies the need for further action, then a CMS will be recommended. Upon identification that further action is required, a new work plan for the CMS will be developed. If no evidence of burned and buried munitions is found, then NFA will be recommended for the site.

3.2 Scope of RFI

The scope of work for sites SWMU 2, SWMU 5, SWMU 9, and SWMU 11 includes the following:

1. Conduct soil sampling at SWMU 2 (VOCs and nitrate), SWMU 5 (TPH, metals, explosives, SVOCs, nitrate, and perchlorate), and SWMU 9 (VOCs, SVOCs, metals, explosives, perchlorate, and white phosphorus) to determine the

presence or absence of soil contamination and if present, characterize the nature and extent of soil contamination as a result of past or current practices for use, storage, and disposal of hazardous substances.

- a. SWMU 2: Install four DPT borings; collect five primary soil samples from each boring (surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs) for a total of 20 primary samples; analyze samples for VOCs and nitrate.
 - b. SWMU 5: 2004: Install 20 DPT borings; collect five primary soil samples from each boring (surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs) for a total of 100 primary samples; analyze samples for TPH, lead, and perchlorate. 2007: Install three additional DPT borings; collect two primary soil samples from each boring where light gray, ash-like powder is found for a total of six primary soil samples; analyze six soil samples for metals, explosives, SVOCs, and nitrate.
 - c. SWMU 9: Install four DPT borings; collect five primary soil samples from each boring (surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs) for a total of 20 primary samples; analyze samples for VOCs, SVOCs, explosives, perchlorate, and white phosphorus.
2. Conduct excavation at SWMU 11 to determine if burned and buried munitions exist as a result of past EOD activities.
 3. Prepare a comprehensive report describing field methodologies, conditions encountered, analytical results, surveyed locations using GPS, conclusions, and recommendations for each SWMU.
 4. Conduct an HHRA for SWMU 2, SWMU 5, and/or SWMU 9, if determined to be necessary based on the results of the RFI.
 5. Conduct a CMS for SWMU 2, SWMU 5, SWMU 9, and/or SWMU 11, if determined to be necessary based on the results of the RFI or HHRA.

**Table 3-1
Applicable Soil Screening Levels**

Analyte	Soil Screening Level	Screening Level Source
Unit of Measure	mg/kg	
Metals - EPA Methods 6010B and 7470		
Arsenic	10	Residential SRL
Barium	5300	Residential SRL
Cadmium	38	Residential SRL
Chromium	2100	Residential SRL
Lead	400	Residential SRL
Mercury	6.7	Residential SRL
Selenium	380	Residential SRL
Silver	380	Residential SRL
Nitrate - EPA Method 353.3		
Nitrate	100000	Residential SRL
Perchlorate - EPA Method 314		
Perchlorate	7.8	Residential PRG
VOCs - EPA Method 8260B		
1,1,1,2-Tetrachloroethane	23	Residential SRL
1,1,1-Trichloroethane	1	GPL
1,1,2,2-Tetrachloroethane	4.4	Residential SRL
1,1,1,2-Tetrachloroethane	23	Residential SRL
1,1,2-Trichloroethane	6.5	Residential SRL
1,1-Dichloroethane	0.81	GPL
1,1-Dichloroethene	0.36	Residential SRL
1,1-Dichloropropene	NA	
1,2,3-Trichlorobenzene	NA	
1,2,3-Trichloropropane	0.014	Residential SRL
1,2,4-Trichlorobenzene	570	Residential SRL
1,2,4-Trimethylbenzene	NA	
1,2-Dibromo-3-Chloropropane	0.015	GPL
1,2-Dibromoethane	0.049	Residential SRL
1,2-Dichlorobenzene	72	GPL
Dibromochloromethane	53	Residential SRL
2,2-Dichloropropane	NA	
1,2-Dichloroethane	0.21	GPL
1,2-Dichloroethylene (cis)	4.9	GPL
1,2-Dichloroethylene (trans)	8.4	GPL
1,2-Dichloropropane	0.28	GPL
1,3,5-Trimethylbenzene	NA	
1,3-Dichlorobenzene	500	Residential SRL
1,3-Dichloropropane	NA	
1,4-Dichlorobenzene	9.3	GPL
2-Butanone (Methyl Ethyl Ketone)	7100	Residential SRL
2-Chlorotoluene	160	Residential SRL
2-Hexanone	NA	
4-Bromofluorobenzene	NA	

Table 3-1 (continued)
Applicable Soil Screening Levels

Analyte	Soil Screening Level	Screening Level Source
Unit of Measure	mg/kg	
<i>VOCs - EPA Method 8260B (continued)</i>		
4-Chlorotoluene	NA	
4-Isopropyltoluene	NA	
4-Methyl-2-Pentanone	NA	
Acetone	2100	Residential SRL
Benzene	0.62	Residential SRL
Bromobenzene	NA	
Bromochloromethane	NA	
Bromodichloromethane	6.3	Residential SRL
Bromoform	560	Residential SRL
Bromomethane	6.8	Residential SRL
Carbon disulfide	7.5	Residential SRL
Carbon tetrachloride	1.6	GPL
Chlorobenzene	65	Residential SRL
Chlorodibromomethane	NA	
Chloroethane	NA	
Chloroform	2.5	Residential SRL
Chloromethane	12	Residential SRL
cis-1,3-Dichloropropene	NA	
Dibromomethane	NA	
Dichlorodifluoromethane	94	Residential SRL
Ethylbenzene	120	GPL
Ethylene Dibromide	NA	
Hexachlorobutadiene	13	Residential SRL
Isopropylbenzene	NA	
Methylene Chloride	77	Residential SRL
N-Butylbenzene	NA	
N-Propylbenzene	NA	
Napthalene	2600	Residential SRL
P-Isopropyltoluene	NA	
Sec-Butylbenzene	NA	
Sec-Dichloropropane	NA	
Styrene	36	GPL
Tert-Butylbenzene	NA	
Tetrachloroethene	1.3	GPL
Toluene	400	GPL
Total Xylenes	2200	GPL
Trans-1,3-Dichloropropene	NA	
Trichloroethene	0.61	GPL
Trichlorofluoromethane	380	Residential SRL
Vinyl Chloride	0.016	Residential SRL

Table 3-1 (continued)
Applicable Soil Screening Levels

Analyte	Soil Screening Level	Screening Level Source
Unit of Measure	mg/kg	
SVOCs - EPA Method 8270C		
1,2,4-Trichlorobenzene	570	Residential SRL
1,1-Biphenyl	3300	Residential SRL
1,2-Dichlorobenzene	1100	Residential SRL
1,3-Dichlorobenzene	500	Residential SRL
1,4-Dichlorobenzene	190	Residential SRL
1,2-Diphenylhydrazine	5.6	Residential SRL
2,4,5-Trichlorophenol	6500	Residential SRL
2,4,6-Trichlorophenol	400	Residential SRL
2,4-Dichlorophenol	200	Residential SRL
2,4-Dimethylphenol	1300	Residential SRL
2,4-Dinitrophenol	130	Residential SRL
2,4-Dinitrotoluene	130	Residential SRL
2,6-Dinitrotoluene	65	Residential SRL
2-Chloronaphthalene	5200	Residential SRL
2-Chlorophenol	91	Residential SRL
2-Methylnaphthalene	NA	
2-Methylphenol	3300	Residential SRL
2-Nitroaniline	3.9	Residential SRL
2-Nitrophenol	NA	
2,2-Oxybis(1-Chloropropane)	NA	
3,3-Dichlorobenzidine	9.9	Residential SRL
3-Nitroaniline	NA	
4,6-Dinitro-2-methylphenol	NA	
4-Bromophenyl phenyl ether	NA	
4-Chloro-3-methylphenol	NA	
4-Chloroaniline	260	Residential SRL
4-Chlorophenyl phenyl ether	NA	
4-Methylphenol	330	Residential SRL
4-Nitroaniline	NA	
4-Nitrophenol	NA	
Acenaphthene	3900	Residential SRL
Acetophenone	0.49	Residential SRL
Aniline	19	Residential SRL
Anthracene	20000	Residential SRL
Atrazine	20	Residential SRL
Benz(a)anthracene	6.1	Residential SRL
Benzo(a)pyrene	0.61	Residential SRL
Benzo(b)fluoranthene	6.1	Residential SRL
Benzo(g,h,i)perylene	NA	
Benzo(k)fluoranthene	61	Residential SRL
Benzoic acid	260000	Residential SRL
Benzyl alcohol	20000	Residential SRL

**Table 3-1 (continued)
Applicable Soil Screening Levels**

Analyte	Soil Screening Level	Screening Level Source
Unit of Measure	mg/kg	
<i>SVOCs - EPA Method 8270C (continued)</i>		
Benzidine	0.0019	Residential SRL
Benzyl Butyl Phthalate	13000	Residential SRL
Benzaldehyde	6500	Residential SRL
Bis(2-chloro-1-methylethyl)ether	63	Residential SRL
Bis(2-chloroethoxy)methane	NA	
Bis(2-chloroethyl)ether	0.43	Residential SRL
Bis(2-ethylhexyl)phthalate	320	Residential SRL
Butyl benzyl phthalate	13000	Residential SRL
Caprolactam	33000	Residential SRL
Carbazole	220	Residential SRL
Chrysene	610	Residential SRL
Dibenzo(a,h)anthracene	0.61	Residential SRL
Dibenzofuran	260	Residential SRL
Diethyl phthalate	52000	Residential SRL
Dimethyl phthalate	650000	Residential SRL
Di-n-butyl phthalate	NA	
Di-n-octyl phthalate	1300	Residential SRL
Fluoranthene	2600	Residential SRL
Fluorene	2600	Residential SRL
Hexachlorobenzene	2.8	Residential SRL
Hexachlorobutadiene	13	Residential SRL
Hexachlorocyclopentadiene	450	Residential SRL
Hexachloroethane	65	Residential SRL
Indeno(1,2,3-cd)pyrene	6.1	Residential SRL
Isophorone	4700	Residential SRL
Naphthalene	2600	Residential SRL
Nitrobenzene	18	Residential SRL
N-Nitroso-di-n-Propylamine	0.63	Residential SRL
N-Nitrosodimethylamine	0.087	Residential SRL
Pentachlorophenol	25	Residential SRL
Phenanthrene	NA	
Phenol	39000	Residential SRL
Pyrene	2000	Residential SRL
<i>TPH - EPA Method 8015 Modified</i>		
Diesel (C10-C24)	4100	Residential SRL
Gasoline (C6-C10)	NA	
Motor Oil (C24-C36)	4100	Residential SRL
Kerosene (C11-C17)	4100	Residential SRL

Table 3-1 (continued)
Applicable Soil Screening Levels

Analyte	Soil Screening Level	Screening Level Source
Unit of Measure	mg/kg	
Explosives - EPA Method 8330		
1,3,5-Trinitrobenzene (TNB)	3.3	Residential SRL
1,3-Dinitrobenzene (DNB)	6.5	Residential SRL
2,4,6-Trinitrotoluene (TNT)	33	Residential SRL
2,4-Dinitrotoluene (DNT)	130	Residential SRL
2,6-DNT	65	Residential SRL
2-Amino-4,6-DNT	NA	
2-Nitrotoluene	NA	
3-Nitrotoluene	650	Residential SRL
4-Amino-2,6-DNT	NA	
4-Nitrotoluene	650	Residential SRL
Cyclotetramethylene tetranitramine (HMX)	NA	
Nitrobenzene	18	Residential SRL
Cyclotrimethylene trinitramine (RDX)	40	Residential SRL
2,4,6-Trinitrophenylnitramine (Tetryl)	650	Residential SRL
White Phosphorus - EPA Method 7580		
White Phosphorus	1.5	Residential SRL

NOTES:

NA = Not available

mg/kg = milligrams per kilogram

Residential SRLs:

Residential Soil Remediation Levels (SRLs) are used as screening levels for nitrate, SVOCs, metals, explosives, and white phosphorus.

SRLs are used as screening levels for VOCs when a GPL is not available.

SRL values are taken from Arizona Administrative Code, Title 18 Environmental Quality, Chapter 7 Department of Environmental Quality Remedial Action, Appendix A Soil Screening Criteria (AAC 2002).

GPLs:

Groundwater Protection Levels (GPLs) are used as screening levels for VOCs.

GPL values are taken from Arizona Department of Environmental Quality's "A Screening Method to Determine Soil Concentrations Protective of Groundwater Quality" (ADEQ 1996).

Residential PRGs:

Residential Preliminary Remediation Goals (PRG) are used as a screening level for perchlorate.

PRG value is taken from EPA Region 9 PRG values (EPA 2004a).

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4

Section
Four

Section 4

Investigation Activities

CDM performed sampling activities at SWMUs 2, 5, and 9 to measure various chemical concentrations in site soils. Field activities included screening for unexploded ordnance (UXO), soil sampling using DPT, sample handling and documentation, management and disposal of investigation-derived waste (IDW), collection of QC samples, and decontamination of sampling and DPT equipment. Post-sampling activities included submission of samples to a Naval Facilities Engineering Service Center (NFESC) and State of Arizona certified analytical laboratory and data management and evaluation.

Field activities at SWMU 11 included screening for UXO, soil excavation using a backhoe, and identification and documentation of excavated materials.

The field effort was conducted from 21 September 2004 through 29 September 2004 at all four SWMUs and additional investigation at SMWU 5 was conducted from 30 July 2007 through 31 July 2007. All fieldwork in 2004 and 2007 was performed in accordance with the Final RFI Work Plan (CDM 2004). Photographs of the field activities are presented in Appendix A.

4.1 UXO Screening

Frederick E. Daniel Jr. (MCAS Yuma Environmental Department) and various EOD specialists (MCAS Yuma EOD Department) accompanied the field team to each site and provided initial and ongoing screening for UXO at each proposed sampling and excavation location. Once UXO screening was completed at each boring, the UTM coordinates of the boring locations were marked using a handheld Garmin GPS.

4.2 Soil Sampling - SWMUs 2, 5, and 9

For this investigation, 32 soil borings (four at SWMU 2, 24 at SWMU 5, and four at SWMU 9) were surveyed using a Garmin GPS, installed, logged, and sampled to measure various contaminant concentrations in site soils. Figures 4-1, 4-2, and 4-3 present the boring locations, number of samples, sample depths, and laboratory analyses for SWMU 2, SWMU 5, and SWMU 9, respectively. Borings were completed to 20 feet bgs or DPT refusal; refusal varied throughout the sites from 9 to 18.5 feet bgs.

4.2.1 Direct Push Technology Boring Installation and Sampling

After UXO screening and GPS marking were completed, a track-mounted DPT rig was used to install the borings. DPT work in September 2004 was performed by ResonantSonic International, a subcontractor to CDM. DPT work in July 2007 was

performed by Interphase, a subcontractor to GCE. A single-walled sampling system (MacroCore) was initially attached to the DPT push rods and advanced into the soil using a vibratory hammer and hydraulics. After several marginally successful attempts (caving in and early DPT refusal), a dual-tube system was attached to the DPT and provided substantially better sample recovery. Soil samples were collected in polyethylene sleeves lining the sampler. Upon retrieval from the sampler, VOC and TPH samples were immediately collected from the end of the sleeves using EnCore™ samplers. The sleeves were then cut to 6 inch lengths and capped with Teflon™ squares and plastic end caps for the remaining analyses.

Soil samples were collected in September 2004 at 5 foot intervals and in July 2007 at depths where light gray, ash-like powder was encountered. All soil samples were collected following the procedures described in the Final RFI Work Plan (CDM 2004). Boring logs are included in Appendix B.

4.2.2 Laboratory Analyses

A total of 118 primary samples, 13 field duplicates, four equipment rinsates (one each at SWMUs 2, 5, and 9), two source blanks, and three trip blanks (one per cooler containing samples for VOC analysis) were collected from the sites. Figures 4-1, 4-2, and 4-3 present summaries of the samples and analyses for each site.

GPL Laboratories of Gaithersburg, Maryland analyzed the samples collected in September 2004. EMAX Laboratories of Torrance, California analyzed the samples collected in July 2007. Both laboratories are NFESC approved and State of Arizona-certified. All data were sent to Laboratory Data Consultants (LDC) for independent data validation (see Section 6.2). A table of the validated analytical results and a compact disk with the 2004 and 2007 data validation reports in PDF format are presented in Appendix C.

4.2.3 Sample Handling and Documentation

All samples were labeled and handled as described in the Final RFI Work Plan (CDM 2004). Samples were labeled with the following information: sample identification (ID), analyses required, sample matrix, preservative, date and time sampled, and initials of the CDM and/or GCE employee that collected the sample.

Sample ID numbers consisted of a unique code to indicate the sampling location. The following protocol was used to identify each sample:

The first portion of the sample number represents the year the sample was collected and the investigation abbreviation (04RFI). The second portion of the sample number represents the site abbreviation (SWMU2). The boring number (01 through 20) is the third portion of the ID. The fourth portion of the sample identification number is a

sample code, either "1" for a primary sample, "3" for a field duplicate sample, "5" for an equipment rinsate blank, or "7" for a source blank. The last portion of the sample number represents the sample depth.

The following is an example of a sample identification:

04RFI-SWMU2-03-1-15

This example identifies the sample was collected in the year 2004, for the RFI, at SWMU 2, boring number 3, is a primary sample, and was collected at 15 feet bgs.

Labels were affixed to each DPT sleeve and taped with clear packing tape to avoid water damage then placed in self-sealing plastic bags. EnCore samplers were placed in self-sealing bags, labeled, and taped.

Samples were packaged and shipped in accordance with the applicable CDM Standard Operating Procedures (SOPs) presented in the Final RFI Work Plan (CDM 2004). Sample IDs and analytical requests were recorded on the appropriate chain-of-custody (COC) form, and after all labeling and custody information was verified, the samples and signed COC forms were placed in an insulated cooler for shipment to the analytical laboratory. Adequate ice was used to maintain cooler temperature at 4 ± 2 degrees Celsius ($^{\circ}\text{C}$) during shipment. The cooler was sealed with strapping tape and a signed custody seal was applied to the cooler lid.

The CDM and/or GCE employee(s) who collected the samples maintained custody of the samples at the appropriate cooler temperature until delivery to Federal Express. The samples were sent via Federal Express to GPL Laboratories or EMAX Laboratories daily.

4.3 Excavation - SWMU 11

Investigation at SWMU 11 began at the trench with a complete screening and clearing of debris by the EOD specialist. After the site was cleared of all debris, the boundaries of the former trench and the excavation boundaries were marked (Figure 4-4) and the UTM coordinates were recorded using a handheld Garmin GPS. Excavation (using a backhoe) began at the northeast corner of the trench and was performed by Advanced Environmental Concepts, Inc., a CDM subcontractor. Upon discovery of debris, excavation would cease until the EOD specialist identified and cleared the debris. The trench was excavated to an approximate depth of 10 feet bgs where native soil was encountered. All debris uncovered from the excavation activities was placed next to the trench and the excavated soil was placed back into the trench. Photographs of the excavated trench and the uncovered debris are shown in Appendix A.

Investigation at the dighole also began with a complete screening and clearing of debris by the EOD specialist. The boundaries of the dighole and the excavation boundaries were then marked and the UTM coordinates were recorded using a handheld Garmin GPS. Upon discovery of debris, excavation ceased until the EOD specialist identified and cleared the debris. The dighole was excavated to an approximate depth of 3 feet bgs where burned and buried munitions were encountered. The excavated soil (placed on plastic sheeting adjacent to the dighole) was covered with plastic and left on site. Photographs of the dighole excavation are provided in Appendix A.

4.4 Management and Disposal of Investigation-Derived Waste

IDW generated during this project consisted of the following:

- Unused soil samples collected using the DPT sampler;
- Excavated soil from trench and dighole;
- Non-reactive fragments/scrap metal from EOD clearances (boreholes and excavation areas);
- Water from decontamination activities; and
- Personal protective equipment (PPE), such as nitrile gloves.

Unused soil samples and excavated soil from the trench were placed back in the boreholes and trench, respectively. Excavated soil from the dighole was placed on plastic next to the dighole, covered with plastic, and left on-site. Non-reactive fragments and scrap metal excavated from the trench were left next to the trench to be collected by MCAS Yuma and recycled. Decontamination water (< 1 gallon per site) was allowed to evaporate onsite and paper towels and PPE were placed in trash bags and subsequently disposed of as non-hazardous solid waste.

4.5 Equipment Decontamination

All downhole sampling equipment, excluding the sampler push rods, were decontaminated after each discrete sample was collected. Sampler push rods were decontaminated between boreholes. The DPT rig was decontaminated before the first borehole and before leaving the site.

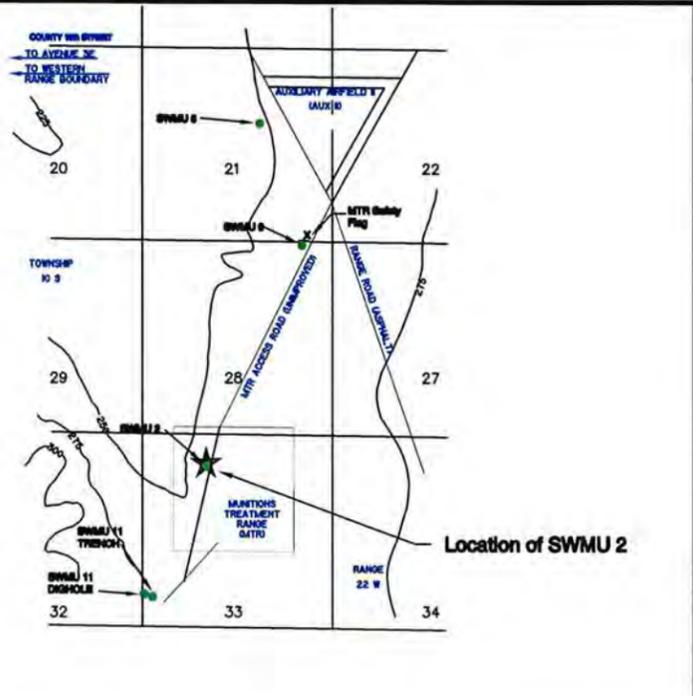
4.6 Deviations from Work Plan

The Final RFI Work Plan prescribed the collection of five primary soil samples per boring, one each at surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, and 20 feet bgs for SWMUs 2, 5, and 9. Only three primary soil samples were collected from each of the four borings as SWMU 2 due to early DPT refusal varying from 7.5 to 9 feet bgs. A backhoe was brought to SWMU 2 to investigate the soil layers at the refusal depth

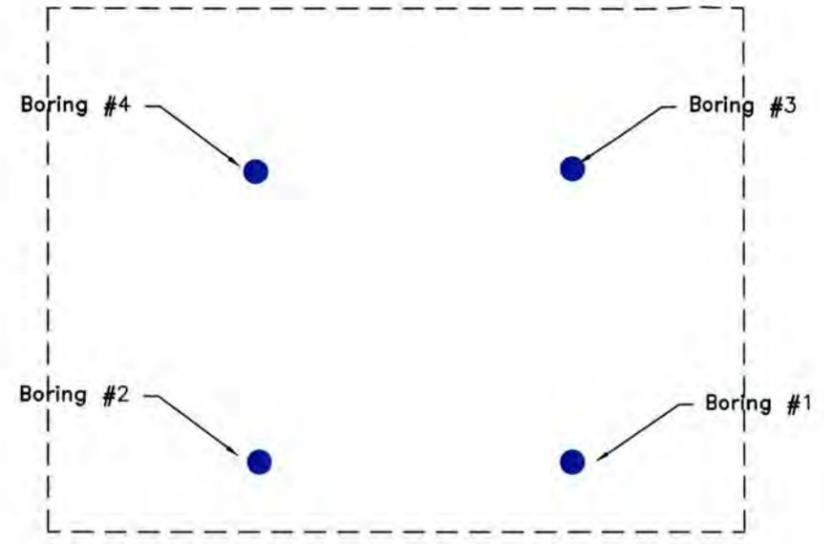
(photographs of SWMU 2 excavation included in Appendix A). Excavation showed a silty sand and gravel layer starting at approximately 5 feet bgs that continued to 9 feet bgs where the backhoe reached refusal. The soil from 7.5 to 9 feet bgs was moderately friable and moderately cemented sandstone (lithologic log included in Appendix B). It was determined that samples could not be collected at SWMU 2 past 9 feet bgs with DPT sampling. Similar conditions were encountered at SWMUs 5 and 9. DPT refusal was encountered from 9.5 to 18.5 feet bgs at SWMU 5 with the exception of six borings that were completed to 20 feet bgs. DPT refusal at SWMU 9 ranged from nine to 15 feet bgs. Regional geological information gathered from the Bureau of Reclamation (Bureau of Reclamation interview conducted by Frederick E. Daniel Jr.) supports the existence of a consolidated sandstone layer throughout the BMGR ranging in depth from 3 feet bgs to 5 feet bgs and ranging in thickness from 8 to 11 feet.

GPS readings were taken at each borehole and the excavation boundaries using a Garmin GPS. The GPS points were later imported into AutoCAD and indicated obvious errors in the measurements. Upon contacting Garmin, it was discovered that a deliberate 30 foot error is added to the signal, making accurate measurements of small scale areas nearly impossible. Since the UTM coordinates measured in the field represent a rough approximation of the boring locations, they were not used for the creation of the site specific figures (Figures 4-1, 4-2, 4-3, and 4-4) and should not be used to physically locate the exact boring locations. Figures 4-1, 4-2, 4-3, and 4-4 present an approximate scale based on rough field measurements and observations. However, on a larger scale, the measurements represent a more accurate placement and were used for the site location map (Figure 2-2). The UTM coordinates recorded during field activities are presented in Appendix D.

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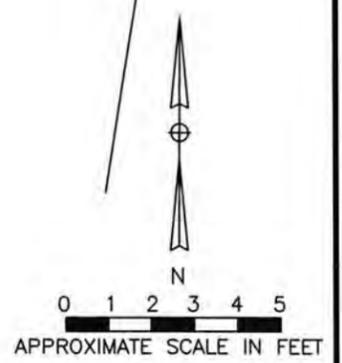
Legend
 ● = Boring
 - - - = Approximate SWMU 2 Boundary



Boring Number	Number of Samples	Sample Depths
1	3	Surface, 5 feet bgs, 9 feet bgs
2	3	Surface, 5 feet bgs, 7.5 feet bgs
3	3	Surface, 5 feet bgs, 9 feet bgs
4	3	Surface, 5 feet bgs, 9 feet bgs
Total = 12		

All soil samples were analyzed for VOCs (EPA Method 8260B) and nitrate (EPA Method 300).

- Quality Control Samples**
- 2 field duplicates
 - 1 equipment rinsate
 - 2 trip blanks
 - 1 source blank



Note: Approximate scale based on rough field measurements

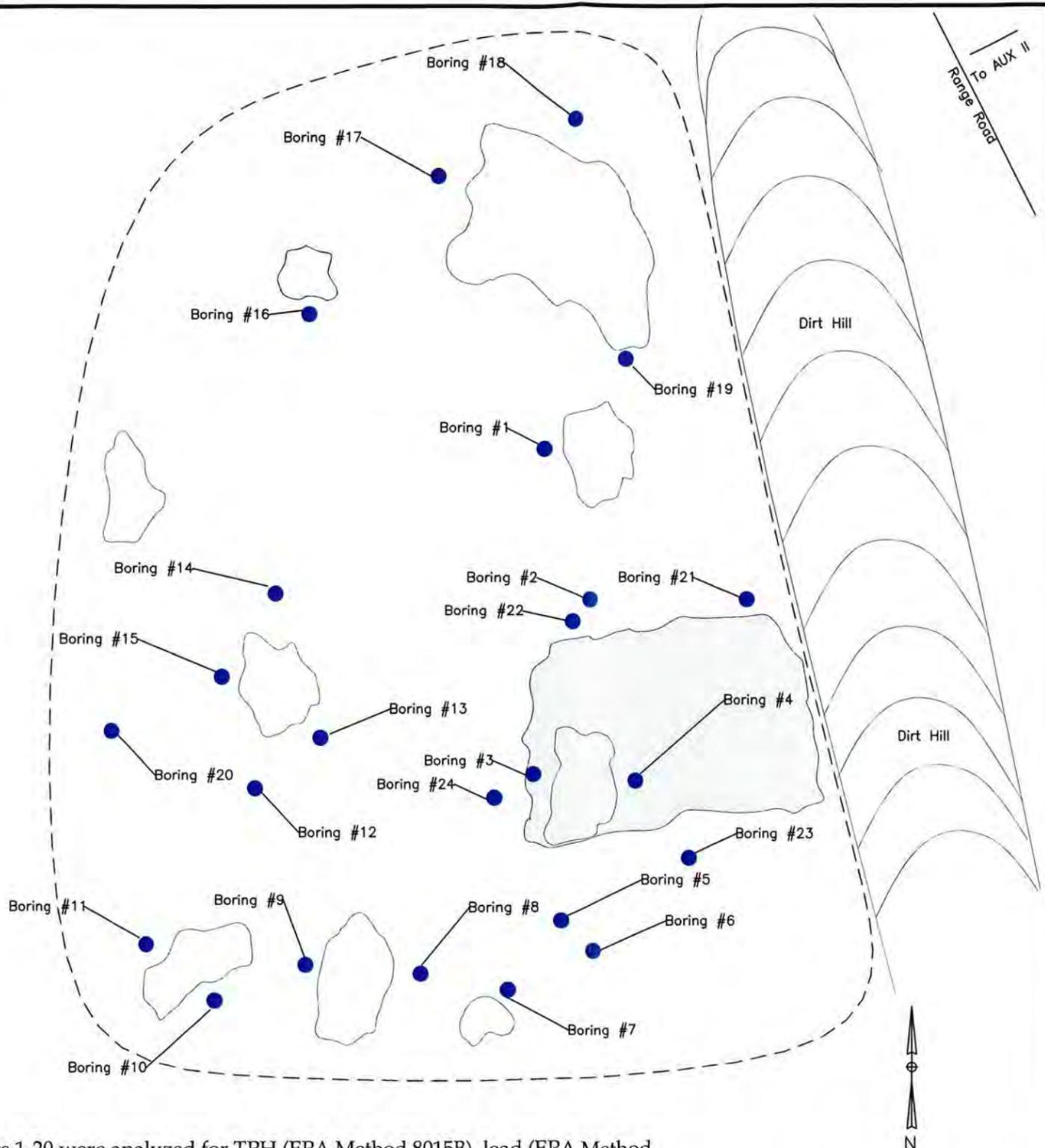
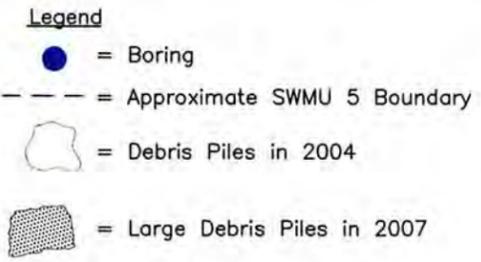
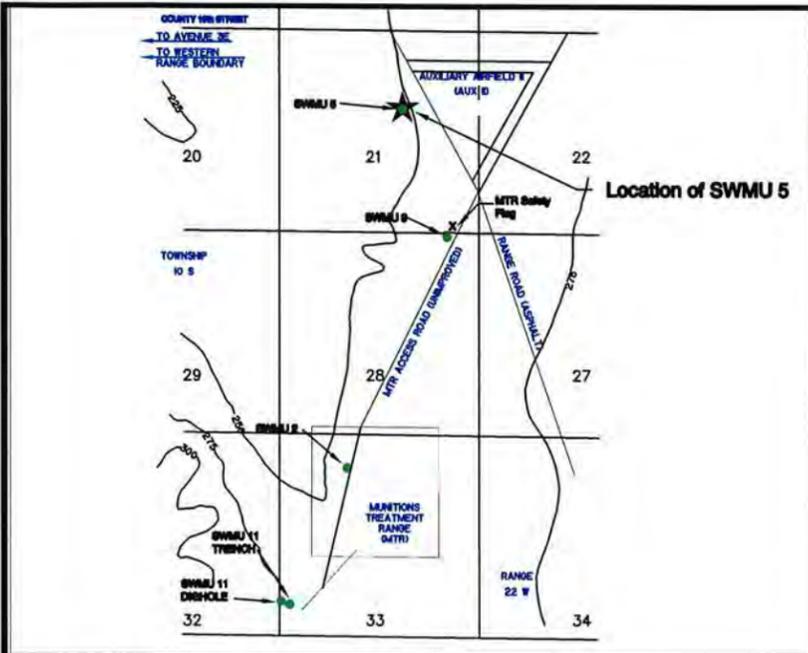
RCRA FACILITY INVESTIGATION
YUMA, ARIZONA

CDM	9444 FARNHAM STREET SAN DIEGO, CALIFORNIA 858-268-3383	DATE: 10/2007
		FN: 001_RPT
MODIFIED BY: <i>J. Brown</i>	PROJECT NO.	6231-001

SWMU 2 (FORMER MUNITIONS WASH AREA) INVESTIGATION ACTIVITIES

BARRY M. GOLDWATER RANGE
MCAS YUMA, YUMA, ARIZONA

FIGURE
4-1



Investigation Year	Boring Number	Number of Samples	Sample Depths
2004	1	5	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 18.5 feet bgs
2004	2	5	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs
2004	3	4	Surface, 5 feet bgs, 10 feet bgs, 14 feet bgs
2004	4	5	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs
2004	5	4	Surface, 5 feet bgs, 10 feet bgs, 13 feet bgs
2004	6	5	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs
2004	7	4	Surface, 5 feet bgs, 10 feet bgs, 14.5 feet bgs
2004	8	4	Surface, 5 feet bgs, 10 feet bgs, 13 feet bgs
2004	9	4	Surface, 5 feet bgs, 10 feet bgs, 14.5 feet bgs
2004	10	4	Surface, 5 feet bgs, 10 feet bgs, 13 feet bgs
2004	11	4	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs
2004	12	5	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs
2004	13	5	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs
2004	14	5	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs, 20 feet bgs
2004	15	4	Surface, 5 feet bgs, 10 feet bgs, 14.5 feet bgs
2004	16	3	Surface, 5 feet bgs, 9.5 feet bgs
2004	17	4	Surface, 5 feet bgs, 10 feet bgs, 13 feet bgs
2004	18	4	Surface, 5 feet bgs, 10 feet bgs, 13 feet bgs
2004	19	4	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs
2004	20	4	Surface, 5 feet bgs, 10 feet bgs, 13.5 feet bgs
2007	21	0	No light gray, ash-like powder encountered
2007	22	2	12 feet bgs, 13.5 bgs
2007	23	2	4.5 feet bgs, 13 feet bgs
2007	24	2	2 feet bgs, 12 feet bgs

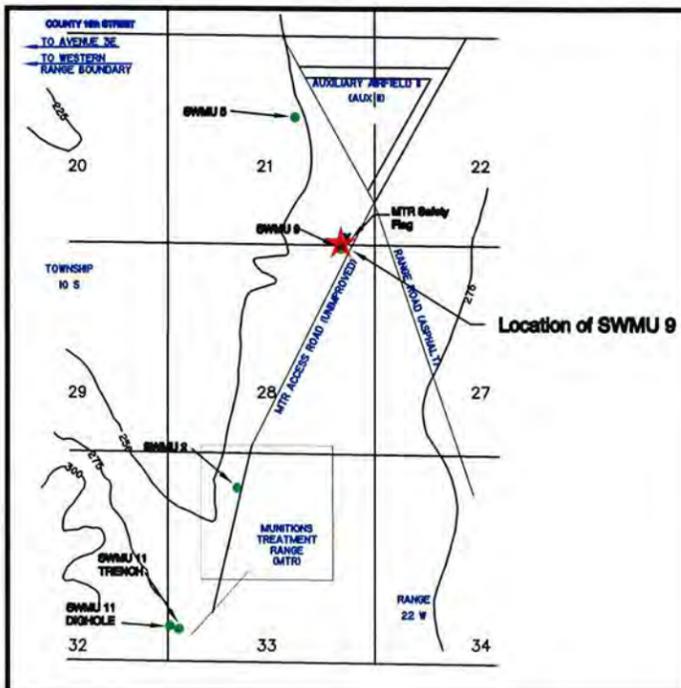
Total = 92 Primary Soil Samples

Quality Control Samples

10 field duplicates, 2 equipment rinsates, 2 source blanks

Soil samples from borings 1-20 were analyzed for TPH (EPA Method 8015B), lead (EPA Method 6010B), and perchlorate (EPA Method 314). Soil samples from borings 22-24 were analyzed for metals (EPA Methods 6010B and 7471A), explosives (EPA Method 8330), nitrate (EPA Method 353.3), and SVOCs (EPA Method 8207C).

Note: Approximate scale based on field measurements



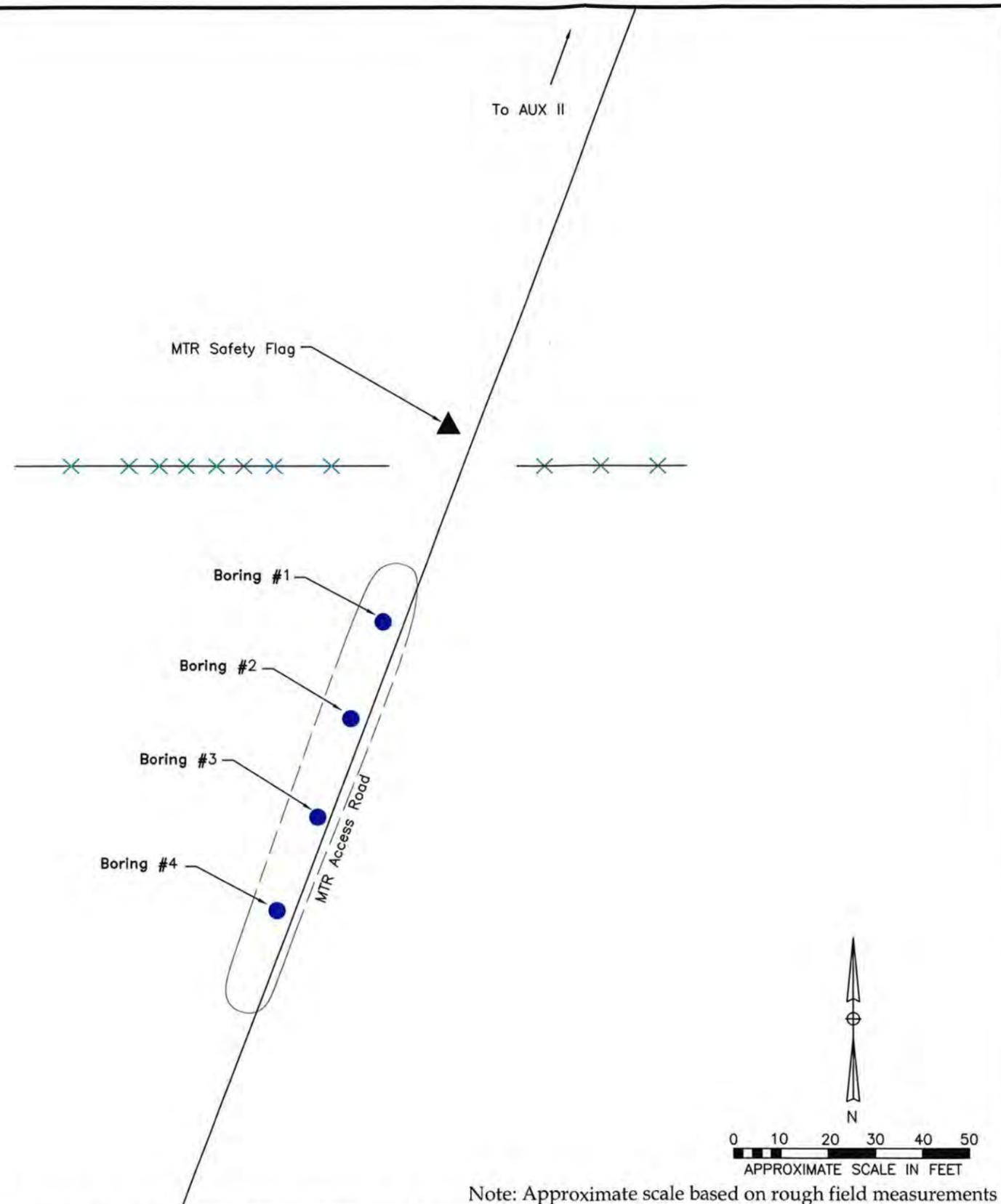
- Legend**
- = Boring
 - - - = Approximate SWMU 9 Boundary

Boring Number	Number of Samples	Sample Depths
1	4	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs
2	3	Surface, 5 feet bgs, 10 feet bgs
3	3	Surface, 5 feet bgs, 9 feet bgs
4	4	Surface, 5 feet bgs, 10 feet bgs, 15 feet bgs
Total = 14		

All soil samples were analyzed for VOCs (EPA Method 8260B), SVOCs (EPA Method 8270C), metals (EPA Methods 6010B and 7470), explosives (EPA Method 8330), perchlorate (EPA Method 314), and white phosphorus (EPA Method 8270M).

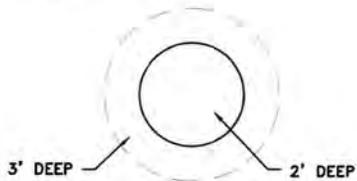
Quality Control Samples

- 1 field duplicate
- 1 equipment rinsate
- 1 trip blank
- 1 source blank

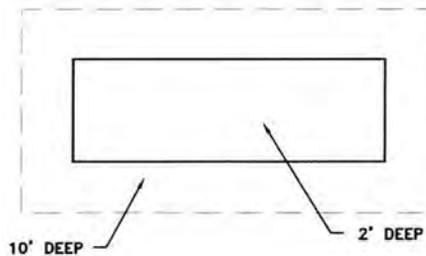


* Dighole figure indicates planned excavation boundaries. Excavation ceased at 3 feet in one portion of the dighole where burned and buried munitions were found.

DIGHOLE *

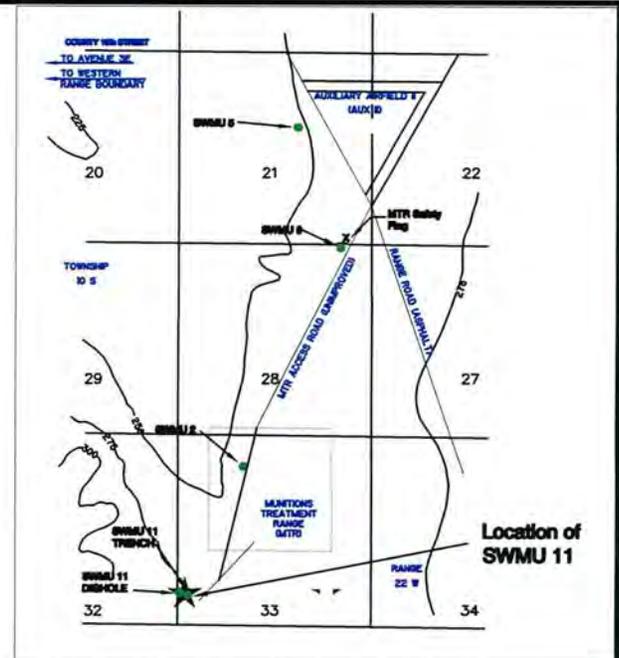


TRENCH

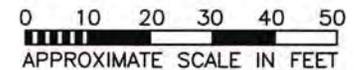


LEGEND

- Previous trench/dighole boundaries
- - - Excavation boundaries

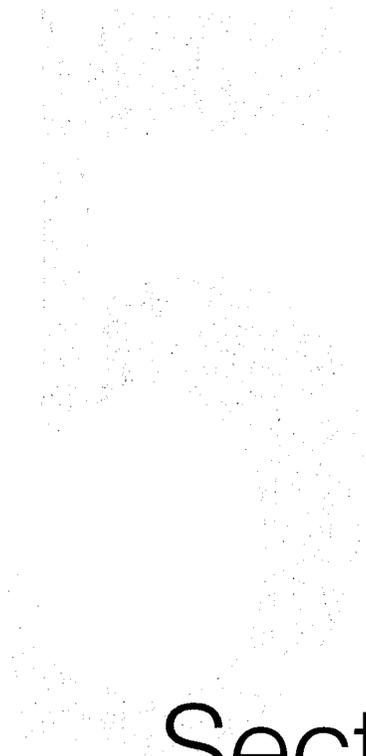


Location of SWMU 11



Note: Approximate scale based on rough field measurements

RCRA FACILITY INVESTIGATION YUMA, ARIZONA		SWMU 11 (FORMER EOD RANGE) INVESTIGATION ACTIVITIES		FIGURE
CDM	9444 FARNHAM STREET SAN DIEGO, CALIFORNIA 858-268-3383	DATE: 10/2007	BARRY M. GOLDWATER RANGE MCAS YUMA, YUMA, ARIZONA	4-4
	MODIFIED BY: <i>J. Brown</i>	PROJECT NO. 6231-001		



Section
Five

Section 5

Results

5.1 SWMUs 2, 5, and 9

Tables 5-1, 5-2, 5-3, and 5-5 provide the concentrations of chemicals detected above laboratory reporting limits in soil samples for SWMU 2 (September 2004 sampling), SWMU 5 (September 2004 sampling), SWMU 5 (July 2007 sampling), and SWMU 9 (September 2004 sampling), respectively. The soil sample locations, sample depths, and analytical methods are shown on Figures 4-1, 4-2, and 4-3. Analytical results are provided in Appendix C.

5.1.1 SWMU 2 (Former Munitions Wash Area)

Four DPT borings were installed at SWMU 2 and three primary soil samples were collected from each boring, one each at surface, 5 feet bgs, and at DPT refusal (7.5 to 9 feet bgs). A total of 12 primary soil samples and six QC samples (two soil and four aqueous) were collected and submitted for VOC and nitrate analyses (see Figure 4-1).

Nitrate was detected in six of the twelve primary soil samples ranging in concentration from 1.1 mg/kg to 12 mg/kg (screening level for nitrate is 100,000 mg/kg). Methylene chloride was detected in one primary soil sample at an estimated concentration of 13 micrograms per kilogram ($\mu\text{g}/\text{kg}$) (screening level is 77,000 $\mu\text{g}/\text{kg}$). Toluene was detected in four primary soil samples with concentrations ranging from 1.1 $\mu\text{g}/\text{kg}$ to 2.7 $\mu\text{g}/\text{kg}$ (screening level is 400,000 $\mu\text{g}/\text{kg}$).

All VOC and nitrate detections were below the screening levels (see Table 5-1).

5.1.2 SWMU 5 (Aux II Debris Piles)

SWMU 5 was initially investigated in September 2004 and was further investigated in July 2007 as described in the sections below.

5.1.2.1 September 2004 Investigation

Twenty DPT borings were installed at SWMU 5 in September 2004. Six of the 20 borings were completed to 20 feet bgs, but the remaining 14 borings reached DPT refusal at 9.5 to 18.5 feet bgs due to moderately cemented sandstone. Three to five primary soil samples were collected from each boring (see Figure 4-2). A total of 86 primary soil samples and 11 QC samples (nine soil and two aqueous) were collected and submitted for TPH, lead, and perchlorate analyses (see Figure 4-2).

Lead was detected in all soil samples at concentrations ranging from 2.0 mg/kg to 13.4 mg/kg (screening level is 400 mg/kg). Perchlorate was detected in six soil samples with concentrations ranging from 11 µg/kg to 3200 (estimated) µg/kg (screening level is 7800 µg/kg). TPH as motor oil (carbon range 24 through 36) was detected in six soil samples between 48 mg/kg and 160 (estimated) mg/kg and in one soil sample at an estimated concentration of 3100 mg/kg (screening level is 4100 mg/kg); most concentrations were detected from surface soil samples. TPH as diesel (carbon range 10 through 24) were detected in 63 soil samples at concentrations ranging from 1.7 mg/kg to 33 mg/kg and in one soil sample at 510 mg/kg (screening level is 4100 mg/kg). TPH as gasoline (carbon range 6 through 10) was detected in five soil samples between 68 and 100 µg/kg and in one soil sample at a concentration of 430 µg/kg (no available screening criteria).

All lead and perchlorate concentrations were below the screening levels and all TPH detections were below the screening levels or considered low where no screening level is available (see Table 5-2).

Along the east side of the site (adjacent to the man-made hills), a 2 to 3 inch layer of light gray, ash-like powder was found in three of the 20 DPT borings. The powder was encountered at Boring 2 at a depth of 16 feet bgs and in Boring 3 at 13 feet bgs. White and gray deposits were also found in Boring 4 at 15 feet bgs. The powder appeared to be consistent with the appearance of residual ash left at the bottom of open detonation pits; they were not consistent with ash resulting from open burning operations (dark in color, with metal fragments). Soil samples taken above and below the powder in Borings 2, 3, and 4 showed no detections of perchlorate, motor oil, or TPH as gasoline. Lead results were well below the screening criteria (400 mg/kg) ranging from 2.3 to 3.7 mg/kg and TPH as diesel was detected at concentrations between 2.5 and 4.2 mg/kg well below the screening criteria (4100 mg/kg). The powder was not encountered in the other 17 borings at SWMU 5.

5.1.2.2 July 2007 Investigation

Four additional borings (21 through 24) were installed using DPT in July 2007 to further investigate the nature of the light gray, ash-like powder found along the east side of the site and determine whether it was resultant of open detonation activities. The borings were installed as close as possible to the estimated locations of Borings 2, 3, and 4 where the powder had been found in September 2004. Site conditions had changed since the 2004 investigation. Piles of metal debris, including cars and other large immovable objects, were located in the vicinity of Borings 2, 3, and 4, therefore, Borings 21 through 24 were installed where access allowed (see Figure 4-2).

No powder was found in Boring 21; therefore, no sample was collected. Light gray, ash-like powder was encountered in Boring 22 at the top of the 8- to 12-foot DPT sleeve

Table 5-1
SWMU 11 Digihole Sampling Results

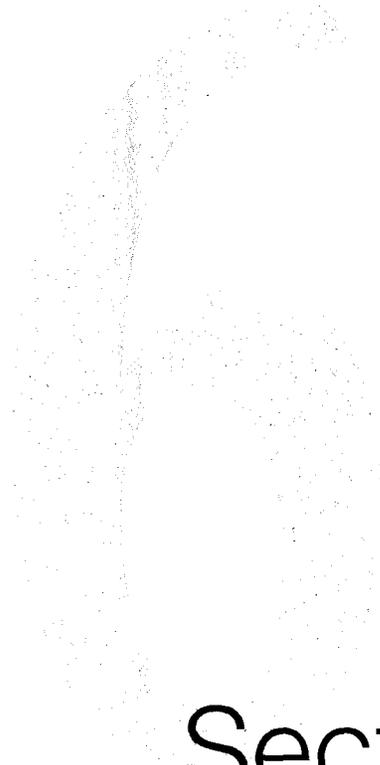
Analyte	VOCs	SVOCs	TPH	TPH	TPH	Explosives	Nitrate	Perchlorate	Metals							
EPA Lab Method	8260B	8270C	8015 AZ	8015 AZ	8015 AZ	8330	300.0	6850M	6010B							
Analyte	Toluene ^c	Diethyl phthalate ^c	Gasoline	Diesel	Motor Oil	All	Nitrate ^c	Perchlorate	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Cleanup Objective ^a	790	52,000	NE	NE	NE	Various	100,000	7.8	10	5,300	38	2,100	400	6.7	380	380
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
07CMI-SWMU11-CONF01	ND	8.8	ND	ND	ND	ND	8.41	0.0646	2.36	82	0.481 J (E4)	3.93	9.34	ND	ND	ND
07CMI-SWMU11-CONF02	ND	ND	ND	ND	ND	ND	2.57	0.0589	2.56	56.1	0.158 J (E4)	4.13	4.32	ND	ND	ND
07CMI-SWMU11-CONF03	ND	ND	ND	ND	ND	ND	19.5	0.0832	5.7	275	0.119 J (E4)	5.43	3.59	ND	ND	ND
07CMI-SWMU11-CONF04	ND	ND	ND	ND	ND	ND	6.9	0.00785	2.62	69.1	0.777 J (E4)	4.26	8.69	ND	ND	ND
07CMI-SWMU11-CONF05 ^b	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND	ND/ND	3.48/3.76	0.0971 J (R8)/0.0524 J (R8)	2.59/2.4	71.3/72.9	0.262 J (E4)/0.268 J (E4)	4.31/4.62	11.7/11.8	ND/ND	ND/ND	ND/ND
07CMI-SWMU11-CONF06	ND	ND	ND	ND	ND	ND	8.18	0.0285	3.54	79.8	ND	4.73	3.32	ND	ND	ND
07CMI-SWMU11-CONF07	ND	ND	ND	ND	ND	ND	2.84	0.00307	3.21	64.3	ND	4.44	3.84	ND	ND	ND
07CMI-SWMU11-CONF08	ND	ND	ND	ND	ND	ND	4.22	0.0605	3.04	59.9	0.182 J (E4)	7.6	117	ND	ND	ND
07CMI-SWMU11-CONF09	ND	ND	ND	ND	ND	ND	1.31	0.229	3.24	66.3	ND	4.6	3.39	ND	ND	ND
07CMI-SWMU11-CONF10	ND	ND	ND	ND	ND	ND	1.51	ND	2.48	69.2	0.211 J (E4)	4.4	3.3	ND	ND	ND
07CMI-SWMU11-CHAR01	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
07CMI-SWMU11-CHAR02	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
07CMI-SWMU11-CHAR03 ^b	0.011 J (S10,R8)/ND	-	ND/ND	-	-	-	-	-	-	-	-	-	-	-	-	-
07CMI-SWMU11-CHAR04	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
07CMI-SWMU11-CHAR05	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
07CMI-SWMU11-CHAR06	ND	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
07CMI-SWMU11-CHAR07	0.031 J (S10)	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
07CMI-SWMU11-CHAR08	0.0043 J (S10,E4)	-	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
07CMI-SWMU11-CHAR09 ^b	-	ND/ND	-	ND/ND	ND/8.1 J (E4,R8)	ND/ND	3.95/3.44	0.0618/0.0581	2.53/2.33	68.9/65.8	0.335 J (E4)/0.303 J (E4)	5.36/4.18	16.2/13.8	ND/ND	ND/ND	ND/ND

Notes:

- a - See Table 3-1 for complete list and references for cleanup objectives.
- b - Primary and field duplicate samples were collected/analyzed at this location; both results are shown.
- c - No other analytes were detected above the reporting limits for this analysis.

Acronyms/Abbreviations

- = analyte(s) not analyzed for.
- AZ = Arizona
- E4 = concentration estimated; analyte was detected below laboratory minimum reporting level.
- EPA = United States Environmental Protection Agency
- J = estimated value.
- mg/kg = milligram per kilogram
- ND = analyte not detected at a concentration above the reporting limit.
- NE = not established
- R8 = sample relative percent difference (RPD) exceeded the method control limit.
- S10 = surrogate recovery was above laboratory and method acceptance limits.
- SVOCs = semivolatile organic compounds
- VOCs = volatile organic compounds
- TPH = total petroleum hydrocarbons



Section
Six

Section 6

Quality Assurance

The collection of field data and sampling and analysis activities for the September 2004 and July 2007 RFI sampling events were performed according to guidance and QA/QC procedures described in the Sampling and Analysis Plan (SAP) and SOPs, Appendices A and B, respectively, of the Final RFI Work Plan (CDM 2004). The laboratory analyses were also performed according to proper analytical methods, detection limits, and QA/QC procedures described in the Final RFI Work Plan.

In addition to laboratory QC samples, the following field QC samples were collected and analyzed:

- 2004 Sampling: 12 field duplicate samples, three equipment rinsates (one per site), and three source water blanks (from the same source, but one per site for the analytes of concern). Three trip blank samples were also analyzed for VOCs.
- 2007 Sampling: 1 field duplicate sample, one equipment rinsate, and one source water blank.

The quality control procedures and data quality assessment are described below in Sections 6.1 and 6.2, respectively. The complete QC evaluation of the analytical data, including results of laboratory and field QC samples, is summarized below in Section 6.3. Appendix C includes the 2004 and 2007 data validation reports (on compact disk in PDF format).

6.1 Quality Control Procedures

Data verification, laboratory QC, and field QC samples used for this project are identified below.

6.1.1 Data Verification

Data collected were subjected to the data verification process that includes proof-reading and editing hard-copy data reports to assure that data correctly represent the analytical measurement. In general, verification identifies non-technical errors in the data package that can be corrected (e.g., typographical errors). Data verification also includes verifying that the sample identifiers on laboratory reports (hard copy) match those on the COC record.

6.1.2 Laboratory QC Samples

Laboratory QC samples are used to:

- Verify that procedures, such as sample handling, storage, and preparation, are not introducing variables into the process that could render the validity of samples questionable; and
- Assess data quality in terms of precision and accuracy.

QC samples are regularly prepared in the laboratory so that all phases of the sampling process are monitored. The types of laboratory QC samples prepared during the analysis of samples from the field activities are discussed below.

6.1.2.1 Method Blanks

One method blank was analyzed per batch of samples (not greater than 20 samples). The method blank is processed following the same preparatory and analytical procedures as the field-collected samples and is used to detect the presence and magnitude of contaminants or other anomalies resulting from the sample preparation and analytical procedures.

6.1.2.2 Matrix Spikes/Matrix Spike Duplicates

At a minimum, one matrix spike (MS)/matrix spike duplicate (MSD) pair was prepared and analyzed for every 20 samples for organic analyses. The MS/MSD samples are prepared by spiking a known amount of certain analytes of interest for each method into a sample of the matrix. The spiked samples are then carried through the same procedures as the unspiked field-collected samples. The percent recoveries of the spiked compounds are used as an indication of the accuracy and appropriateness of the methods for the matrix. The precision of the methods is also assessed by calculating and evaluating the relative percent difference (RPD) between the results of the MS and MSD.

6.1.2.3 Surrogates

Surrogate compounds (artificial compounds with similar chemical properties and behavior as the compounds of interest) are added to each sample analyzed for applicable organic analytical methods. The percent recoveries of these spiked surrogate compounds are used to assess the accuracy of sample preparation and analytical procedures.

6.1.3 Field QC Samples

Field QC samples were collected in accordance with the Final RFI Work Plan (CDM 2004) to evaluate the ambient sampling conditions, the thoroughness of the decontamination procedures, and the reproducibility of the field sampling techniques.

6.1.3.1 Field Duplicate Samples

During this sampling event, field duplicate samples were collected at a rate of ten percent from the same source and at the same time as the primary sample. Field duplicate results are used to evaluate the precision of the overall sampling and analytical system by comparing the RPD with the established RPD limit of 50 percent for the soil samples. Twelve field duplicates in 2004 and one field duplicate in 2007 were submitted to the laboratories and analyzed for the target contaminants.

6.1.3.2 Trip Blank Samples

Trip blank samples were provided by the subcontract laboratory (GPL Laboratories) and were included with each cooler sample shipment for VOC analysis. A total of three trip blanks were submitted to the laboratory in 2004 and analyzed to demonstrate that contamination was not originating from sample containers or from any factor during sample transport. VOC analysis was not conducted in 2007; therefore, no trip blanks were submitted in 2007.

6.1.3.3 Source Water Blanks

Three source water blank samples (one from each site) were collected in 2004 using the same distilled water source for all three samples. One additional source water blank was collected using distilled water in 2007. Each source blank was analyzed for the contaminants of concern for the respective site. The source blank samples were analyzed to demonstrate that contamination was not originating from the source water used for decontamination procedures.

6.1.3.4 Equipment Rinsate Samples

Three equipment rinsate samples (one from each site) were collected in 2004 and one additional equipment rinsate was collected in 2007. Each equipment rinsate sample was collected by rinsing decontaminated sampling equipment with distilled water. The equipment rinsate samples were analyzed for the same analytes as the primary samples for the respective sites to demonstrate the effectiveness of the field decontamination process.

6.2 Data Quality Assessment

6.2.1 General Data Review

The field and laboratory data collected during the current sampling round have been reviewed according to the criteria described in the Final RFI Work Plan (CDM 2004). The laboratory hard-copy analytical reports and case narratives were reviewed to verify correct sample designation, identification, and COC records and to assure that analytical method, holding time, and detection limit requirements were met. Two soil

samples (04RFI-SWMU5-19-1-0 and 04RFI-SWMU5-19-1-5) from the 2004 sampling event were analyzed for perchlorate within the method holding times, but the dilutions required for these particular samples were analyzed one day outside the holding time. All affected data were qualified accordingly during the data validation process.

6.2.2 Laboratory Data Validation

GPL Laboratories and EMAX Laboratories prepared Level IV analytical data packages for all sample analyses performed in 2004 and 2007, respectively. LDC performed independent data validation of all data packages in 2004 and 2007; 10 percent of the data was validated according to EPA Level IV protocols and the remaining 90 percent according to EPA Level III protocols. Data validation was performed following NAVFAC's *Environmental Work Instruction #1* (NAVFAC 2001) and updates from EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 2004b). NAVFAC's *Environmental Work Instruction #1* is compiled from EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994) and EPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 1999).

The data validation effort included detailed review of laboratory data packages for the sample delivery groups (SDGs) for each of the analytical parameters/methods performed. LDC's submittal letters and the results of the 2004 and 2007 data validation are included in Appendix C. The 2007 data validation package included validation of data from this RFI investigation at SWMU 5 as well as validation of other data collected at MCAS Yuma unrelated to this investigation. The 2007 data validation package is presented in its entirety; however, nonapplicable portions of the package have been blacked out.

For the selected sample results reviewed, the project goals for precision, accuracy, representativeness, completeness, and comparability, as defined in the Final RFI Work Plan, were evaluated (CDM 2004). Except as noted in the data validation reports, the data validation indicates that the analytical data obtained during this sampling event are considered to be usable for the intended investigation purposes. Seven data concentrations from the 2004 sampling event were rejected during the validation process; no data was rejected from the 2007 sampling event. All affected data were qualified accordingly during the data validation process.

6.3 QC Evaluation of the Analytical Data

This section presents the results of the evaluation of both field and laboratory QC checks. The data quality objectives as described in the Final RFI Work Plan (CDM 2004) were met for the RFI. The evaluation of the validated data sets compared the objective versus the actual data results through the use of the precision, accuracy,

representativeness, completeness, and comparability parameters. Precision, accuracy, and completeness goals for the major chemical analyses that were performed on samples collected from the sites were those specified in the EPA Contract Laboratory Program Statement of Work.

6.3.1 Field QC Samples

All field QC sample results (field duplicates, equipment rinsates, trip blanks, and source blank) were reviewed as part of the data validation activity performed during this sampling event. For additional information on the duplicate samples, see the data validation reports in Appendix C.

Field duplicate sample results for the 2004 sampling were within 50 percent RPD for the soil samples as specified in the Final RFI Work Plan except for perchlorate, acetone, methylene chloride, toluene, and diesel-range organics. Field duplicate sample results for the 2007 sampling were within the 50 percent RPD for soil samples as specified in the Final RFI Work Plan except for cadmium.

Di-n-butylphthalate, bis(2-ethylhexyl)phthalate, naphthalene, and diesel-range organics were detected in one equipment rinsate, and acetone was detected in one equipment rinsate from the 2004 sampling event. Nitrate was detected in the equipment rinsate from the 2007 sampling event.

Acetone and methylene chloride were reported in one or more of the trip blank samples from the 2004 sampling event.

Selenium, acetone, naphthalene, di-n-butylphthalate, bis(2-ethylhexyl)phthalate, and diesel-range organics were detected in one source blank sample from the 2004 sampling event. Nitrate was detected in the source blank from the 2007 sampling event.

All affected data were qualified accordingly during the data validation process.

6.3.2 Precision and Accuracy

The procedures in this section are designed to assess QC data for blanks, duplicates, controls, spikes, and surrogates. The review of these data provides information concerning the precision and accuracy measurements conducted by the laboratories and field procedures.

6.3.2.1 Laboratory Method Blanks

Lead, barium, chromium, selenium, and methylene chloride were reported in laboratory method blanks from the 2004 sampling event. All affected data points were qualified accordingly during the data validation process. No compounds were reported in the laboratory method blanks from the 2007 sampling event.

6.3.2.2 Initial and Continuing Calibration Controls

All compounds were within the method and validation criteria except for benzaldehyde, 3,3-dichlorobenzidine, benzidine, 2,4-dinitrophenol, bromomethane, 2-butanone, chloromethane, chloroethane, methylene chloride, acetone, 2-hexanone, 1,2-dibromo-3-chloropropane, and TPH as kerosene, diesel, and motor oil from the 2004 sampling event. All affected data points were qualified accordingly during the data validation process. All compounds were within the method and validation criteria except for 2-nitroaniline, benzoic acid, and n-nitrosodimethylamine for the 2007 sampling event.

6.3.2.3 Matrix Spikes/Matrix Spike Duplicates

MS/MSD results that were prepared and analyzed by the laboratory were within control limits, except for 1,1,1-trichloroethane, 1,2-dichloroethane, benzene, bromodichloromethane, bromoform, chlorobenzene, chloroform, dibromochloromethane, toluene, vinyl chloride, carbon tetrachloride, 1,1-dichloroethene, and 4-methyl-2-pentanone in one or more samples from the 2004 sampling event. MS/MSD results were within control limits except for barium in one sample from the 2007 sampling event. All affected data points were qualified accordingly during the data validation process.

6.3.2.4 Surrogates

Surrogate percent recoveries were not within required control limits for 3-nitroaniline, bromofluorobenzene, toluene-d8, and 1,2-dichloroethane in one or more samples from the 2004 sampling event. Associated results were qualified accordingly during the data validation process. Surrogate percent recoveries were within required control limits for the 2007 samples.

6.3.2.5 Laboratory Control Samples

Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) results prepared and analyzed by the laboratory were within control limits, except for 1,3,5-trinitrobenzene, bis(2-ethylhexyl)phthalate, acetone, naphthalene, and diesel range organics in one or more samples from the 2004 sampling event. All affected data were qualified accordingly during the data validation process. LCS/LCSD results were within control limits for the 2007 sampling event.

6.3.3 Representativeness

Representativeness is the reliability with which a measurement or measurement system reflects the true conditions under investigation (EPA 1993). Representativeness is influenced by the number and location of the sampling points, sampling timing and

frequency of monitoring efforts, and the field and laboratory sampling procedures (EPA 1993).

The representativeness of data was enhanced by the use of established field and laboratory procedures and their consistent application. Samples that were collected are considered to be representative of the location of sample collection.

6.3.4 Completeness

The completeness of the data is described as a ratio of the amount of data expected from the field program versus the amount of valid data actually received. Valid data are considered to be those data that have not been rejected (were not R-qualified either from data validation or internal data review). Completeness can be expressed by the following equation:

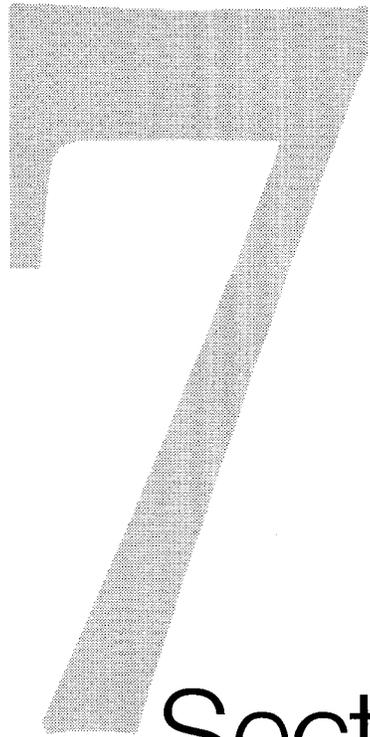
$$C = \frac{(\text{number of valid results})}{\text{total number of requested results}} \times 100$$

Based on the data validation and internal review, seven results out of 5469 were rejected. The completeness of the sample set submitted for analysis is 99.9 percent, which is within the completeness goal (90 percent) set for this project.

6.3.5 Comparability

Comparability evaluates whether the reported data is comparable with similar data reported by other organizations. The comparability of the laboratory results was found to be acceptable. All samples have been analyzed using the complete list of published methods specified in the field sampling plan. All units were consistent and appropriate for the matrix sampled.

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Section
Seven

Section 7

Conclusions and Recommendations

7.1 SWMU 2 (Former Munitions Wash Area)

Twelve primary soil samples from four soil borings were taken from the approximate 200 square foot area of SWMU 2 to determine if a release of hazardous substances occurred from previous pink/red water treatment at the former munitions wash area. Samples were analyzed for VOCs and nitrate. All concentrations were below the screening levels and NFA under RCRA is recommended for this site.

7.2 SWMU 5 (Aux II Debris Piles)

In September 2004, 86 primary soil samples from 20 soil borings were taken from the 1.5 acre area of SWMU 5 to determine if a release of hazardous substances occurred from previous or current debris storage activities at the site. Samples were analyzed for TPH, lead, and perchlorate. All lead and perchlorate concentrations were below the screening levels and low TPH concentrations were detected.

A 2- to 3-inch layer of light gray, ash-like powder was found in three borings at depths ranging from 13 to 16 feet bgs during the September 2004 investigation. Soil sample results collected above and below the powder indicated that the powder is not a potential source for soil contamination; however, it was not clear if the powder was resultant of open detonation activities.

To further investigate the nature of the light gray, ash-like powder, four additional borings were installed at SWMU 5 in July 2007. The powder was encountered in three of the four borings at depths ranging from 2 to 14 feet bgs and coinciding with depths at which gravel began to occur. The powder was deposited at the top and sides of the DPT sleeves; a distinct "layer" of the powder was never encountered. Upon further evaluation, it was determined that the powder was pulverized rock/gravel resulting from the DPT installation method rather than a distinct "layer" resulting from past open detonation activities.

Six primary samples were collected in July 2007 from the three borings that encountered the light gray powder; each sample consisted of both native soil and the light gray powder of interest. Samples were analyzed for explosives, metals, SVOCs, and nitrate. No explosives or SVOCs were detected above laboratory reporting limits in any of the soil/powder samples. Nitrate and all metals concentrations, except arsenic, were below the screening levels. Arsenic concentrations ranged from 2.66 mg/kg to 11.7 mg/kg with two samples meeting or exceeding the 10 mg/kg screening level.

Results from the screening human health risk evaluation performed using the July 2007 results indicate the total cancer risk is 1×10^{-6} , which is within the risk management range. Arsenic was the only carcinogenic chemical detected. Noncancer hazards were also considered in the risk calculations. Arsenic was again the primary driver; however, the HI was 1.0 which is within the range of acceptable hazards.

The 2004 and 2007 sampling results from SWMU 5 do not indicate perchlorate, TPH, explosive, SVOC, metal, or nitrate contaminations at levels that could pose a threat to human health or to migrate to groundwater (approximately 130 feet bgs at SWMU 5); therefore, NFA under RCRA is recommended.

7.3 SWMU 9 (Former Accumulation Area for Burn Residue)

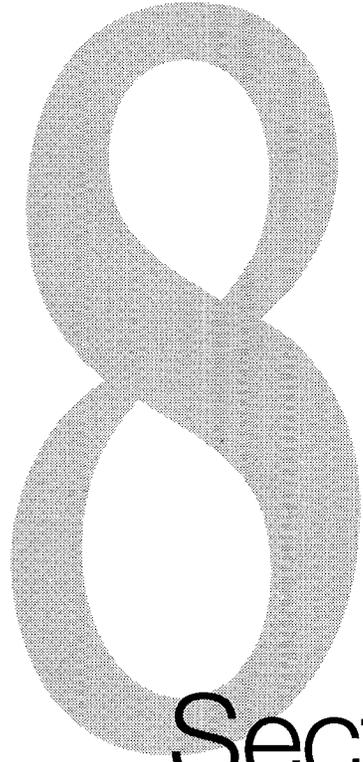
Fourteen primary soil samples from four soil borings were taken from the approximate 200 square foot area of SWMU 9 to determine if a release of hazardous substances occurred from former waste (burn residue and scrap metal) storage at the site. Samples were analyzed for VOCs, SVOCs, metals, explosives, perchlorate, and white phosphorus. All concentrations were below the screening levels and NFA under RCRA is recommended.

7.4 SWMU 11 (Former EOD Range) - Trench

Excavation of the trench unearthed non-explosive "range trash" consisting of various articles of debris, including empty rocket motor casings, an empty napalm bomb, barrels, practice bombs, an expended tube from a TOW missile, and practice warheads. No evidence that the "range trash" had been treated by burning or open detonation was found and NFA under RCRA is recommended for the trench portion of SWMU 11.

7.5 SWMU 11 (Former EOD Range) - Dighole

A portion of the dighole was excavated to a depth of approximately 3 feet bgs uncovering nonexplosive "range trash" and a thin layer of black ash and burned munitions (20 mm rounds and 25 mm shell casings). This provides evidence that landfilling and open burning/burying of munitions occurred. A Corrective Measure Study under RCRA is recommended for the dighole portion of SWMU 11.



Section
Eight

Section 8

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