ATTACHMENT H

CLOSURE PLAN

Table of Contents

Section **Page**

H.1 Closure Performance Standard 1

H.2 Final Closure Activities 1

H.2.1 Maximum Extent of Operations 1

H.2.2 Maximum Inventory and Waste Removal 2

H.2.3 Closure Decontamination Procedures 2

H.2.4 Schedule for Closure 2

H.2.5 Survey 2

H.3 Notification of Closure and Notice to Local Land Authority 3

H.4 References 3

LIST OF EXHIBITS

Exhibit H-1 Sampling and Analysis Plan for Closure

ATTACHMENT H
Closure Plan

This section is submitted in accordance with the requirements of 40 CFR 264.110 through 264.115. A post closure plan is not expected to be required since no contaminants will be left in place at closure. Permit Attachment H is a draft Closure Plan. If in the future, the Permittee decides to close the MTR, the permittee must submit a revised closure plan for ADEQ approval no later than ninety days prior to closure, and in accordance with the permit modification procedures of R18-8-270.A (40 CFR 270.41, 40 CFR 270.42 et seq.) The Permittee cannot commence with any of the steps (e.g., notification of closure) involved in final closure of facility without formal approval for its revised closure plan from ADEQ.

This plan identifies all steps that will be necessary to close MCAS Yuma's MTR at the end of its intended operating life. The MCAS Yuma Environmental Department will maintain the closure plan record copy. This plan will be updated by issuing either page changes or new copies, as appropriate, to all plan addressees.

H.1 Closure Performance Standard

This closure plan is designed to ensure that the MTR is a clean closure, in accordance with State and Federal regulations, without a requirement for post-closure monitoring (40 CFR 264.111(a)). Clean closure requires demonstration that any hazardous substances remaining onsite do not pose a threat to human health or the environment (40 CFR 264.111(b)), and that closure is conducted in accordance with applicable regulations (40 CFR 264.111 (c)). This demonstration can be made by ensuring that onsite concentrations of hazardous substances are at or below regulatory health-based standards. Background concentrations of metals in soil are also a consideration when performing constituent comparison analyses.

H.2 Final Closure Activities

Closure of the MTR is not currently planned. However, should future circumstances or decisions require the operator to discontinue operations; the procedures for final closure described below will be followed. Soil sampling will be conducted per the Sampling and Analysis Plan for the MTR (GCE 2013) (Exhibit H-1). If no contaminants exceeding action levels are found to be present, the MTR will be graded over. If contaminant concentrations in soils are found to exceed action levels (based on SRLs), further action will be taken upon consultation with ADEQ.

H.2.1 Maximum Extent of Operations

The type and maximum extent of operations is described in detail in Attachment C.

H.2.2 Maximum Inventory and Waste Removal

The OD areas are used to treat listed hazardous waste (i.e., EPA Waste Code D003-Reactive). Current practices preclude the storage of any explosive waste material on the BMGR, and for safety reasons, this prohibition will continue to be enforced.

Soil potentially impacted above action levels from historic treatment efforts, if encountered, will be addressed as residuals as described in the closure decontamination process (Attachment H).

H.2.3 Closure Decontamination Procedures

Following the final OD operations at the MTR, the facility will be closed. Inventory disposal will not be of concern because the final volume of explosive ordnance would have been treated by detonation.

The OD areas will be inspected for any unexploded ordnance, debris, ash, and staining. Any unexploded ordnance would be subjected to additional detonation processes, until no identifiable material remained. Soil sampling will be conducted per the Sampling and Analysis Plan for the MTR (GCE 2013) (Exhibit H-1). If no contaminants exceeding action levels are found to be present, the MTR will be graded over. If contaminant concentrations in soils are found to exceed action levels, further action will be taken upon consultation with ADEQ.

Upon ADEQ-approved clean closure, no post-closure monitoring is required.

H.2.4 Schedule for Closure

The BMGR is an integral part of the defense system of the United States; it is not anticipated that final closure will occur. However, a final closure date of 2064 (i.e., 50 years) has been estimated.

Closure activities will begin no later than 30 days after final OD operations are conducted. Within 90 days after the receipt of the final volume of hazardous wastes to be treated, all waste must be removed from the site. Closure must be completed within 180 days.

Notification of intent to close must be sent to ADEQ 45 days before beginning final closure. Final closure will be supervised and certified by an independent registered professional engineer in Arizona. Within 60 days of completion of closure activities, a certificate of closure will be submitted to ADEQ (40 CFR 264.115).

H.2.5 Survey

A professional land surveyor licensed in the State of Arizona will prepare and certify a survey of the MTR. The purpose of the survey is to document sample locations and closure facilities, along with site boundaries and any other pertinent details. All salient field locations (e.g., sample locations and treatment facilities) will be surveyed to a permanent USGS benchmark. All survey data will be included in the closure certification.

H.3 Notification of Closure and Notice to Local Land Authority

The location of closed OD sites will be noted on MCAS Yuma real estate property records. Because of the clean closure, post-closure uses of the land are not restricted. Notification will also be provided to appropriate State agencies.

H.4 References

GCE 2014. Sampling and Analysis Plan for Closure of the Munitions Treatment Range, Marine Corps Air Station Yuma, Yuma, Arizona. January 31.

Exhibit H-1

Sampling and Analysis Plan for Closure

1.0 SAP Worksheet #1 -- Title and Approval Page

DRAFT
SAMPLING AND ANALYSIS PLAN
Closure
(Field Sampling Plan and Quality Assurance Project Plan)

Munitions Treatment Range
Marine Corps Air Station
Yuma, Arizona

Prepared for:
Department of the Navy
Southwest Division Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132

Prepared by:
Gutierrez Canales Engineering
1851 West 24th Street, Suite 201
Yuma, Arizona 85364

Prepared under:
Contract No. N62473-10-C-5014
DCN: GCE-5014-0000-0001

Registered Professional Engineer (Civil)
CERTIFICATE NO.
55066
ERIC SOL
GARDNER
Date Signed 9/16/14
ARIZONA U.S.A.
EXPIRES 9/30/16

Reviewed by: Angela Wimberly
Angela Wimberly (NAVFAC SW)

Approved by: Frederick Daniel
Frederick Daniel (MCAS Yuma)

1.1 EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) describes the rationale, scope of work (SOW), procedures, and methodologies to be employed for the future closure of the MTR during collection and analysis of samples from: active shotholes, pits of fragmentation and White Phosphorus detonation located at the Munitions Treatment Range (MTR) at Marine Corps Air Station (MCAS) Yuma. This SAP will be utilized for site closure sampling.

The closure process will include pre-closure sampling and analysis and further investigation and/or remedial activities, if necessary. The purpose of this SAP is to present a pre-closure sampling strategy, including a field sampling methodology and QA and quality control (QC) measures. The objective of the sampling event is to characterize the environmental condition upon cessation of MTR open detonation activities and evaluate the need for further investigation and/or remediation prior to closure. This will be accomplished through the collection of surface and subsurface soil and rinse water samples for the Class A and B and White Phosphorus detonation areas. All samples will be analyzed for the following:

- Metals, EPA Methods 6010B and 7470;
- Volatile organic compounds (VOCs), EPA Method 8260B;
- Semivolatile organic compounds (SVOCs), EPA Method 8270C;
- Explosives, EPA Method 8330;
- White Phosphorus, EPA Method 7580;
- Perchlorate, EPA Method 6850; and

SAP **Worksheets**

1.0 SAP Worksheet #1 -- Title and Approval Page 1
2.0 SAP Worksheet #2 -- SAP Identifying Information 7
3.0 SAP Worksheet #3 -- Distribution List 11
4.0 SAP Worksheet #4 -- Project Personnel Sign-Off Sheet 12
5.0 SAP Worksheet #5 -- Project Organizational Chart 13
6.0 SAP Worksheet #6 -- Communication Pathways 14
7.0 SAP Worksheet #7 -- Personnel Responsibilities and Qualifications Table 15
8.0 SAP Worksheet #8 -- Special Personnel Training Requirements Table 16
9.0 SAP Worksheet #9 -- Project Scoping Session Participants Sheet 17
10.0 SAP Worksheet #10 -- Problem Definition 18
11.0 SAP Worksheet #11 -Project Quality Objectives/Systematic Planning Process Statements 19
12.0 SAP Worksheet #12 -- Measurement Performance Criteria Table 23
13.0 SAP Worksheet #13 -- Secondary Data Criteria and Limitations Table 24
14.0 SAP Worksheet #14 -- Summary of Project Tasks 25
15.0 SAP Worksheet #15 -- Reference Limits and Evaluation Table 30
16.0 SAP Worksheet #16 -- Project Schedule / Timeline Table 36
17.0 SAP Worksheet #17 -- Sampling Design and Rationale 37
18.0 SAP Worksheet #18 -- Sampling Locations and Methods 38
20.0 SAP Worksheet #20 -- Field Quality Control Sample Summary Table 40
21.0 SAP Worksheet #21 -- Project Sampling SOP References Table 41
22.0 SAP Worksheet #22 -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table 42
24.0 SAP Worksheet #24 -- Analytical Instrument Calibration Table 44
25.0 SAP Worksheet #25 -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table 56
26.0 SAP Worksheet #26 -- Sample Handling System 62
27.0 SAP Worksheet #27 – Sample Custody Requirements Table 63
28.0 SAP Worksheet #28 -- Laboratory QC Samples Table 67
29.0 SAP Worksheet #29 -- Project Documents and Records Table 78
30.0 SAP Worksheet #30 -- Analytical Services Table 79
31.0 SAP Worksheet #31 -- Planned Project Assessments Table 80
32.0 SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses 81
33.0 SAP Worksheet #33 -- QA Management Reports Table 82
34.0 SAP Worksheet #34 -- Verification (Step I) Process Table 83
35.0 SAP Worksheet #35 -- Validation (Steps IIa and IIb) Process Table 84
36.0 SAP Worksheet #36 –Analytical Data Validation (Steps IIa and IIb) Summary Table 86
37.0 SAP Worksheet #37 -- Usability Assessment 87

Figures

Figure 1 – Area Location Map
Figure 2 – Site Location Map

Appendices

Appendix A GCE Standard Operating Procedures
Appendix B Site Health and Safety Plan

Acronyms

AA	Atomic Absorption
ANSI/ASQ	American National Standards Institute/American Society for Quality
ASTM	American Society for Standards and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	Contract Laboratory Program
COC	Chain of Custody
CRDL	Contract-Required Detection Limit
CSM	Conceptual Site Model
CTO	Contract Task Order
DoD	Department of Defense
DCN	Document Control Number
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EPA	Environmental Protection Agency
EWI	Environmental Work Instruction
FCR	Field Change Request
FSP	Field Sampling Plan
GC	Gas Chromatograph
GCE	Gutierrez Canales Engineering
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information System
GPC	Gel Permeation Chromatography
GPS	Global Positioning System
ICP	Inductively Coupled Plasma
IDQTF	Intergovernmental Data Quality Task Force
LCS	Laboratory Control Sample
LFB	Laboratory Fortified Blank
LIMS	Laboratory Information Management Systems
MARLAP	Multi-Agency Radiological Laboratory Analytical Protocols (Manual)
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MOU	Memorandum of Understanding
MPC	Measurement Performance Criteria
MQO	Measurement Quality Objectives
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSR	Management Systems Review
NAVFAC SW	Naval Facilities Engineering Command Southwest Division
NEDD	Navy Electronic Data Deliverable
NEIC	National Enforcement Investigations Center
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List

PA/SI	Preliminary Assessment/Site Investigation
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PDF	Portable Document Format
PM	Project Manager
PQOs	Project Quality Objectives
PRP	Potentially Responsible Party
PRQL	Project-Required Quantitation Limit
PT	Proficiency Testing (previously known as performance evaluation (PE) sample)
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit
QMP	Quality Management Plan
QS	Quality System
QSM	Quality Systems Manual
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
rSRL	Residential Soil Remediation Level
RT	Retention Time
SAP	Sampling and Analysis Plan
SD	Standard Deviation
SDG	Sample Delivery Group
SOP	Standard Operating Procedure
SQLs	Sample Quantitation Limits
SRM	Standard Reference Material
SVOA	Semivolatile Organic Analytes
SVOC	Semivolatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedure
TBD	To Be Determined
TSA	Technical Systems Audit
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
VOA	Volatile Organic Analytes
VOC	Volatile Organic Compounds

2.0 SAP Worksheet #2 -- SAP Identifying Information

Site Name/Number: Pre-Closure Soil Sampling of the Munitions Treatment Range

Operable Unit: MCAS Yuma

Contractor Name: Gutierrez Canales Engineering, P.C.
Contract Number: N62473-10-C-5014

Contract Title: **N62473-10-C-5014**

2.1 Reference Documents

This SAP was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (U.S. EPA 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS (U.S. EPA 2002). EPA Introduction to Closure/Post-Closure (40 CRF Parts 264 through 265, Subpart G), September 2005.*

2.2 Regulatory Program

This Project is conducted in accordance with the rules of the Federal Resource Conservation and Recovery Act (RCRA).

2.3 Type of SAP

This SAP is a project-specific SAP.

2.4 Scoping Sessions

Scoping Session	Date
N/A	Refer to Worksheet #9

2.5 Relevant SAP

Title	Date
N/A	

2.6 Project Stakeholders

Marine Corps Air Station (MCAS) Yuma – Lead Agency/Permit Holder
Department of Navy (DON) – Contract Execution and Management
Arizona Department of Environmental Quality (ADEQ) - Lead Regulatory Agency

2.7 Lead Organization

As a contract project manager, NAVFAC SW supports the lead agency by ensuring the collection of representative media samples, accurate analysis of samples, verification of data, and archival and reporting of data in accordance with this SAP (Worksheet #7).

2.8 Omitted SAP Elements

- No secondary data was used in the development of this SAP (Worksheet #13).
- Independent data validation will be performed on laboratory results (Worksheet #36).

2.9 Not Applicable SAP Worksheets

SAP elements and required information that are not applicable to the project are noted below. Further explanation is provided in the previous section (Section 2.8) and in the appropriate SAP worksheet(s).

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	
2	Table of Contents SAP Identifying Information	
3	Distribution List	
4	Project Personnel Sign-Off Sheet	
Project Organization		
5	Project Organizational Chart	
6	Communication Pathways	
7	Personnel Responsibilities and Qualifications Table	
8	Special Personnel Training Requirements Table	
Project Planning/ Problem Definition		
9	Project Planning Session Documentation (including Data Needs tables) Project Scoping Session Participants Sheet	
10	Problem Definition, Site History, and Background. Site Maps (historical and present)	
11	Site-Specific Project Quality Objectives	
12	Measurement Performance Criteria Table	
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	Worksheet #2, Section 2.8
14	Summary of Project Tasks	

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
15	Reference Limits and Evaluation Table	
16	Project Schedule/Timeline Table	
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	
18	Sampling Locations and Methods/ SOP Requirements Table Sample Location Map(s)	
19	Analytical Methods/SOP Requirements Table	
20	Field Quality Control Sample Summary Table	
21	Project Sampling SOP References Table Sampling SOPs	
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	
Analytical Tasks		
23	Analytical SOPs Analytical SOP References Table	
24	Analytical Instrument Calibration Table	
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain-of-Custody Form and Seal	
Quality Control Samples		
28	QC Samples Table Screening/Confirmatory Analysis Decision Tree	
Data Management Tasks		
29	Project Documents and Records Table	
30	Analytical Services Table Analytical and Data Management SOPs	
C. Assessment Oversight		
31	Planned Project Assessments Table Audit Checklists	
32	Assessment Findings and Corrective Action Responses Table	
33	QA Management Reports Table	
D. Data Review		
34	Verification (Step I) Process Table	
35	Validation (Steps IIa and IIb) Process Table	

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
36	Validation (Steps IIa and IIb) Summary Table	Worksheet #2, Section 2.8
37	Usability Assessment	

3.0 SAP Worksheet #3 -- Distribution List

Title/Role	Organization
Project RPM	NAVFAC SW
MCAS Project Coordinator	MCAS Yuma
Director, Range Compliance & Inspection Division	MCAS Yuma
QAM	GCE
SSHO	GCE
PM	GCE
PM	ADEQ
PM	EMAX laboratory
PM	LDC, Inc

Acronyms

GCE	Gutierrez Canales Engineering
NAVFAC SW	Naval Facilities Engineering Command Southwest
PM	Project Manager
QAM	Quality Assurance Manager
RPM	Remedial Project Manager
SSHO	Site Safety and Health Officer
ADEQ	Arizona Department of Environmental Quality

4.0 SAP Worksheet #4 -- Project Personnel Sign-Off Sheet

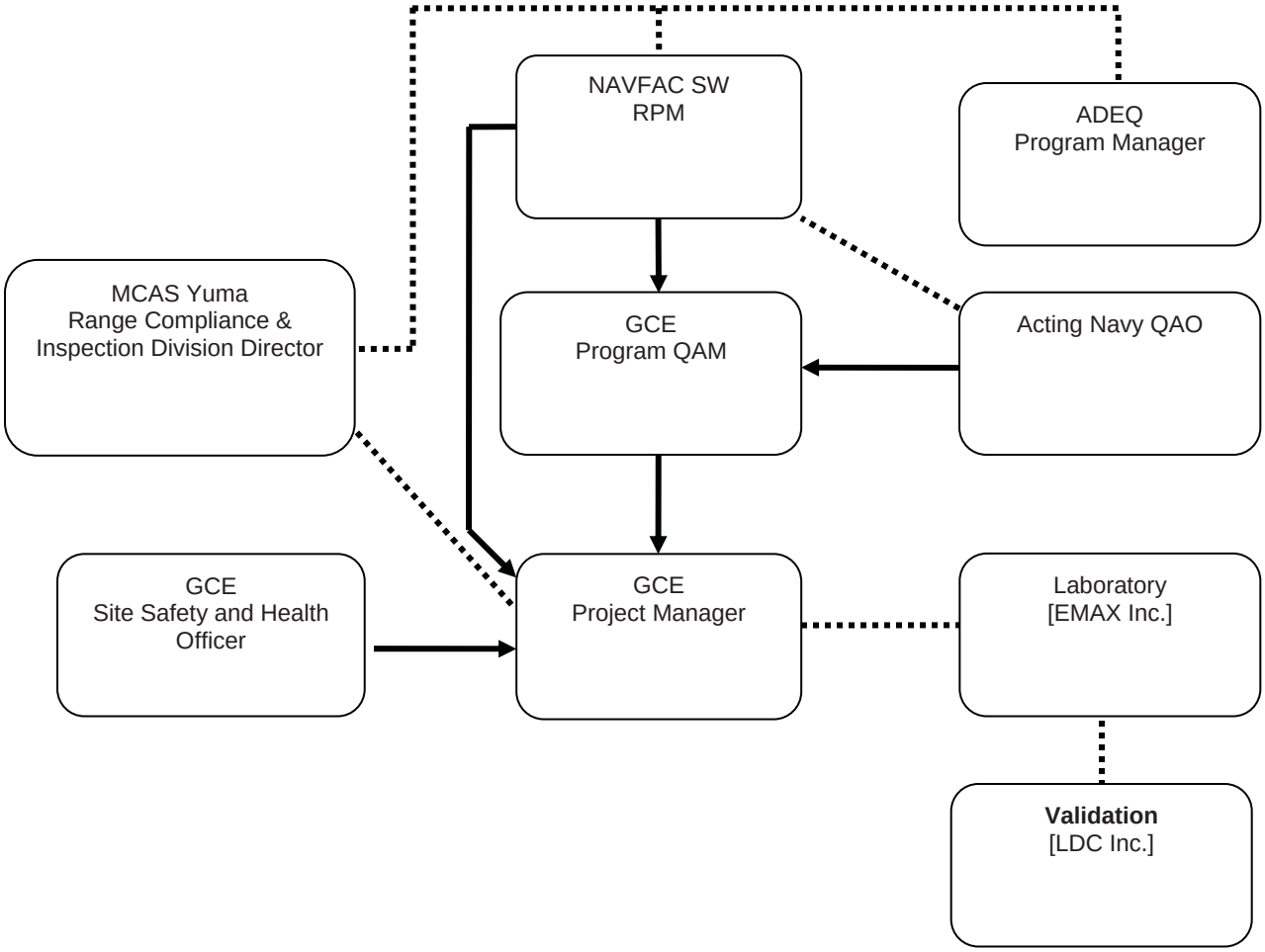
Key personnel will sign this sheet as part of the readiness review conducted prior to field work

Organization/Title/Role	Signature/email receipt	SAP Section Reviewed	Date SAP Read
GCE PM		All Worksheets	
GCE SSHO		All Worksheets	
GCE QAM		All Worksheets	
EMAX/ Laboratory PM		Worksheets: 12,13,15,19,22,23,24 ,25,26,27,30,32	
LDC, Inc. PM		Worksheets: 12,13,15,19,22,23,24 ,25,26,27,30,32	
Range Compliance & Inspection Division Director		All Worksheets	
UXO Technician		All Worksheets	

Notes:
GCE Gutierrez Canales Engineering
PM Project Manager
QAM Quality Assurance Manager
SSHO Site Safety and Health Manager

5.0 SAP Worksheet #5 -- Project Organizational Chart

Lines of Authority ——— Lines of Communication ·····



6.0 SAP Worksheet #6 -- Communication Pathways

The following information describes the communication pathways, modes of communication, and notification timelines that will be used during the project, after the SAP has bee approved.

Communication Drivers	Responsible Affiliation	Procedure
Field Change Notice (FCN)	GCE Project Manager	GCE PM will document any minor deviation from the SAP by notifying the GCE QAM by phone and e-mail within 24 hours and will submit a FCN within 48 hours. All completed FCNs will be included as an appendix in the final report
Field Audit	GCE QAM	GCE QAM may conduct a field audit during project fieldwork. Audit results are maintained in GCE's project and QA files. Any issues requiring corrective action will be documented and assigned an appropriate response period.
Stop Work	GCE PM GCE QAM GCE SSHO NAVFAC SW RPM	GCE QAM, GCE PM, GCE SSHO, or NAVFAC SW Rep. may stop work in response to any serious quality- or safety- related issue if warranted. In this case, the issue and proposed corrective action will be documented with planned timing for implementation. The Stop Work Notice will be submitted to the NAVFAC SW Rep. by e-mail within 24 hours.

7.0 SAP Worksheet #7 -- Personnel Responsibilities and Qualifications Table

Title/Role	Organizational Affiliation	Responsibilities
Project Manager	GCE	Responsible for implementing all activities specified in the Delivery Order. Supervises preparation of the Sampling and Analysis Plan (SAP) by the GCE Team Monitors field activities to ensure compliance with SAP.
Quality Assurance Manager	GCE	Responsible for ensuring GCE Team's programmatic and project-specific compliance with QA policies generally, and this SAP specifically. Ensures SAP conforms to current NAVFAC SW and UFP QAPP requirements Ensures GCE team maintains proper training, certification, and experience to execute project-specific tasking. Responsible for GCE's environmental quality, including oversight of environmental program to ensure compliance with Federal State and local regulatory requirements and with Department of Navy policy; development of project plans; coordination of laboratory and data validation services; review of project-specific requirements as outlined in SAPs; and support to GCE PMs.
Site Safety and Health Officer	GCE	Responsible for implementing the Site Safety and Health Plan, determining appropriate site control measures, and identifying personal protection levels. Leads daily safety briefings for the GCE Team, subcontractor personnel, and site visitors.
NAVFAC SW Project RPM	NAVFAC SW	The Navy representative is directly responsible for project execution and coordination with base representatives and NAVFAC SW management team.
Laboratory Project Manager	EMAX Laboratories Inc.	Responsible for delivering analytical services that meet the requirements of the SAP. Reviews and understands all analytical requirements of this SAP. Works with GCE QA Manager to confirm sample delivery schedules and ensure performance according to specifications. Reviews the laboratory data package before it is delivered to the GCE QA Manager.

8.0 SAP Worksheet #8 -- Special Personnel Training Requirements Table

Routine training, as specified in the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) training requirements (Title 29 CFR 1910.120) apply to those persons conducting field work. The regulation states that all personnel involved in characterization or remediation of an uncontrolled hazardous waste site shall be required to have 40 hours of certified training and three days of supervised field experience. In compliance with Title 29 CFR 1910.120, GCE's Environmental Department protocol requires "general site workers," those individuals performing field activities such as collecting media samples, to have completed the appropriate OSHA HAZWOPER training course.

Personnel who are on site to perform occasional inspection and sampling activities are unlikely to experience exposure over the permissible exposure limit and published exposure limits. They may be considered "workers on site only occasionally for a specific limited task." These workers must have 24 hours of training and one day of actual field experience. Employees who have minimal (low risk) exposure or low probability of exposure to hazardous substances are covered by other OSHA standards, such as the Hazard Communication Standard, Title 29 CFR 1910.120.

All GCE site workers will be 40-hour trained and will meet the minimum standard for supervised field experience. In compliance with regulatory procedures related to training, at least one GCE supervisor having received the OSHA 8-hr Hazardous Waste Supervisor training will be on-site at all times. All GCE employees have been trained in first aid and cardiopulmonary resuscitation (CPR). At least one GCE employee, properly trained and certified in adult first aid and CPR, will be assigned and on-site at all times work is being performed.

All soil monitoring activities are to be performed under the supervision of trained UXO. These qualified EOD personnel must meet the requirements listed in 40 CFR 260.10 for explosives/munitions emergency response: an individual trained in chemical or conventional munitions or explosives handling, transportation, render-safe procedures, or destruction techniques. This requirement is met through basic NAVSchool EOD training.

9.0 SAP Worksheet #9 -- Project Scoping Session Participants Sheet

Project Name: *Munitions Treatment Range* Project Manager: Eric Gardner	Site Name: Marine Corps Air Station Site Location: Yuma, Arizona

Date of Session: November 6, 2013
Scoping Session Purpose: Project Kick-Off Meeting

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Frederick Daniel	Director, Range Compliance & Inspection Division	MCAS Yuma	(928) 269-2809	frederick.daniel@usmc.mil	Installation
Tom Sheffield	Environmental Specialist	MCAS Yuma	(928) 269-2936	thomas.sheffield@usmc.mil	Installation
Andy Klakulak	Project SSHO	GCE	(928) 388-8964	aklakulak@neiaw.com	SSHO
Stacy Gutierrez	Project QAM	GCE	(928) 920-4054	stacyg@neiaw.com	QAM
Eric Gardner	Project Manager	GCE	(928) 581-5425	egardner@neiaw.com	PM

9.1 Action Items:

GCE to prepare the following:

- *APP / SSHP*
- *SAP in accordance with UFP/NAVFAC standards*

10.0 SAP Worksheet #10 -- Problem Definition

This worksheet provides the first of seven steps of the DQO process as detailed by the U.S. EPA (U.S. EPA, 2006). The process is used to determine the type, quantity, and quality of the data necessary to support decision-making regarding current site conditions and future site management decisions.

Inherent in the development of DQOs is a systematic and logical approach intended to yield an efficient sampling design based on accepted levels of potential decision errors. A thorough understanding of the site's physical setting and background is essential to the DQO process. The following subsections provide a description of the physical setting and operations at the MCAS Yuma.

10.1 Site Description and History

MCAS Yuma is located in the City of Yuma in the southwestern corner of Arizona. The Barry M. Goldwater Range (BGR), a 2.8 million acre area, is divided into two segments; the eastern two-thirds is designated the Gila Bend segment (approximately 1.6 million acres) and the western third is designated the Yuma segment. The Yuma segment occupies approximately 760,000 acres and is operated by MCAS Yuma. MCAS Yuma operates four sub ranges in the BGR: two manned ranges, an air-to-air gunnery range and an air combat maneuvering range. These sub ranges haven been important MCAS Yuma facilities for training pilots in aerial and air-to-ground combat since 1941.

The MTR, a 1000 meter square area located on the far western boundary of the Yuma segment of the BGR, is regulated under RCRA. The MTR facility is used to treat ordnance stockpiled at MCAS Yuma as well as ordnance and explosive end items from other military bases and bombing ranges, from local government-owned manufacturing facilities, and from local manufacturers under contract to the United States government located in Arizona and California.

The MTR was formerly used for open burning and open detonation. The two former open burn trenches were clean-closed in accordance with federal and State of Arizona regulations and requirements in October 1998. The MTR is currently used for open detonation activities, including fragment, non-fragment, and white phosphorus detonation. At present, there are two main detonation areas, including the Class A and B Detonation Area and the White Phosphorus Detonation Area. Both detonation areas are located in the central portion of the MTR.

10.2 Step 1- State the Problem

The purpose of the investigation is to evaluate the potential for soil contamination due to munitions treatment at the MTR.

11.0 SAP Worksheet #11 - Project Quality Objectives/Systematic Planning Process Statements

This worksheet presents Steps 2 through 7 of the DQO process as detailed by the U.S. EPA (U.S. EPA, 2006). The process is a series of steps based on the scientific method designed to specify the type, quantity and quality of environmental data needed to support defensible decisions based on current conditions and proposed activities at an environmental site.

The following subsections provide the primary study goal of the proposed work, the information inputs and analytical approach that will be used to achieve the study goals, as well as the performance criteria that will be used to assure that the data used to make decisions is of sufficient quality.

11.1 Step 2 - Identify the Goals of the Study

The goal of this study is the characterization of the soils at the Class A and B Detonation Area and White Phosphorus Detonation Area for contaminants of concern.

11.2 Step 3 - Identify Information Inputs

Information that will be used by MCAS Yuma to aid in the decision and closure process will be derived from the following:

1. Analytical results from samples collected during this investigation.
2. Corporate knowledge of historical operations at the MTR.

11.3 Step 4 - Define the Boundaries of the Study

Soil

Install up to five soil borings using direct push technology (DPT) to 10 feet below ground surface (bgs) in active shothole(s)/pit(s). Collect up to 3 soil samples from each boring. Drill to a depth of up to 10 feet bgs in each boring and collect three soil samples from each boring from depths of approximately 0-1.5 feet bgs, 4.5-6 feet bgs and 8.5-10 feet bgs.

11.4 Step 5 - Develop the Analytical Approach/Identify Decision Rules

Step 5 involves determination of theoretical "if… then …" decision rules that define how the decision-makers (MCAS Yuma) will choose among alternative actions. This section provides an explanation of decision rules that will be applied to the investigation areas. The Decision Rules for this study are based upon a comparison of laboratory analytical results to residential soil remediation levels (rSRL) or groundwater protection levels (GPLs) established by ADEQ (see Worksheet 15). All samples will be analyzed at a fixed base laboratory as follows:

Analyte	EPA Analytical Method	Matrix
Explosives	8330	Soil
Metals	6010/7470	Soil
VOCS	8260	Soil
SVOCS	8270	Soil
Perchlorate	6850	Soil
White Phosphorus	7580	Soil

The principal Decision Rules for this sampling event are:

1) Are concentrations in the soil at the MTR above action levels?

   a) **If** the concentrations of hazardous substances in the active shotholes/pits, exceed the residential SRLs or GPLs, **then** MCAS Yuma will excavate and dispose of the contaminated soil and also take confirmatory samples to confirm that residual soil samples are below the action levels.

   b) **If** the concentrations of hazardous substances in soil sample in the active shotholes/pits do not exceed the residential SRLs or GPLs, **then** no further action will be necessary.

11.5 Step 6 - Specify Performance or Acceptance Criteria

Tolerable limits on decision errors, which are used to establish performance goals for the data collection design, are specified in this step. Decision makers (MCAS Yuma) are interested in knowing the true value of the contaminant concentration. Since analytical data can only estimate these values, decisions that are based on measurement data could be in error (decision error). There are two reasons why the decision makers may not know the true value of the constituent concentration. These are:

1. Concentrations may vary over time and space. Limited sampling may miss some features of this natural variation because it is usually impossible or impractical to measure every point of a population. Sampling design error occurs when the sampling design is unable to capture the complete extent of natural variability that exists in the true state of the environment.

2. Analytical methods and instruments are never perfect; hence, a measurement can only estimate the true value of an environmental sample. Measurement error refers to a combination of random and systematic errors that inevitably arise during the various steps to the measurement process.

The combination of sampling design and measurement error is the total study error. Since it is impossible to eliminate total study error, basing decisions on sample concentration may lead to a decision error. The probability of decision error is controlled by adopting a scientific approach in which the data are used to select between one condition (the null hypothesis) and another (the alternative hypothesis). The null hypothesis is presumed to be true (not rejected) in the absence of evidence to the contrary. According to the primary questions (objective) stated in Step 5 above, the null and alternative hypotheses are as follows:

Primary Question:

Does the soil at the MTR contain concentrations exceeding project action levels?

Null Hypothesis:

Concentrations **ARE NOT** above project action levels in soil.

Alternative Hypothesis

Concentrations **ARE** above project action levels in the soil.

Possible Decision Errors

A false positive or “Type I” decision error refers to the type of error made when the null hypothesis is rejected when it is true; and a false negative or “Type II” decision error refers to the type of error made when the null hypothesis is not rejected when it is false.

For this project, a Type I decision error would result in deciding hazardous residues are present at the site, when no contamination exists. A Type II decision error would result in deciding that hazardous residues are NOT present, when they are actually present. A Type II decision error may cause harm to the environment and/or human health, whereas a Type I decision error may cause money to be spent when it is not required; therefore, a Type II error is less acceptable than a Type I error.

GCE will present the analytical results of the sampling and analysis in an Annual Report. The Annual Report will include: the project scope, the sampling results, comparison of data to project screening levels and conclusions and recommendations.

11.6 Step 7 - Develop the Detailed Plan for Obtaining Data

This section describes the rationale for the sample locations, quantities, and the analytical methods proposed for this project. GCE will Install up to five soil borings using direct push technology (DPT) to 10 feet below ground surface (bgs) in active shothole(s)/pit(s). All samples will be analyzed for the following parameters: Explosives (EPA Method 8330), Metals (EPA Methods 6010/7471), VOCs (EPA Method 8260), SVOCs (EPA Method 8270), Perchlorate (EPA Method 6850) and White Phosphorus (EPA Method 7580).

12.0 SAP Worksheet #12 -- Measurement Performance Criteria Table

Measurement Performance Criteria Table – Field QC Samples

QC Sample	Analytical Group[1]	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Equipment Rinsate (Equipment Blank) (Rinsate Blank)	Explosives Metals VOCs SVOCs White Phosphorus Perchlorate Ammonia	1/day	Sensitivity/ Contamination (Accuracy/Bias)	Detections<QLs	S
Field Duplicate	Explosives Metals VOCs SVOCs White Phosphorus Perchlorate	1/10 samples (10% of total samples)	Precision	Relative Percent Difference (RPD) (≤50 %)	S
Source Water Blank (Field Blank)	Explosives Metals VOCs SVOCs White Phosphorus Perchlorate Ammonia	1/sampling event/change in source of decontamination water	Sensitivity/Contamination (Accuracy/Bias)	Detections <QLs (Worksheet #15)	S
Temperature Blank	Explosives Metals VOCs SVOCs White Phosphorus Perchlorate	1/shipping container	Representativeness	4° C ± 2° C	S

13.0 SAP Worksheet #13 -- Secondary Data Criteria and Limitations Table

(No secondary data was used in developing this SAP)

14.0 SAP Worksheet #14 -- Summary of Project Tasks

14.1 Sampling Tasks

This project will consist of collection and analysis of 105 soil samples.

The investigation will be completed using following approach:

Soil

Install up to five soil borings using direct push technology (DPT) to 10 feet below ground surface (bgs) in up to seven (7) shothole(s)/pit(s). If the number of shotholes exceeds seven (7) at the time of closure, seven (7) shotholes will be selected to provide maximum horizontal coverage of the detonation areas. Collect up to 3 soil samples from each boring (up to 105 total samples). Drill to a depth of up to 10 feet bgs in each boring and collect three soil samples from each boring from depths of approximately 0-1.5 feet bgs, 4.5-6 feet bgs and 8.5-10 feet bgs.

14.2 Analytical Tasks

Soil samples collected from the MTR will be analyzed for: Explosives (EPA Method 8330), Metals (EPA Methods 6010/7471), VOCs (EPA Method 8260), SVOCs (EPA Method 8270), Perchlorate (EPA Method 6850) and White Phosphorus (EPA Method 7580).

14.3 Quality Control Tasks

QA is an integrated system of activities in the area of quality planning, assessment, and improvement to provide the project with a measurable assurance that the established standards of quality are met. QC checks, including both field and laboratory, are specific operational techniques and activities used to fulfill the QA requirements. Worksheets #12 and #28 summarize the collection frequencies for the various field and laboratory QC samples, respectively.

14.3.1 Field Duplicate Samples

Field duplicate/replicate samples will be collected at a rate of 10% of the total number of samples. If fewer than 10 samples are collected, one duplicate sample will be collected.

14.3.2 Equipment Rinsate Blanks

Equipment rinsate blanks will be collected daily during sampling to ensure that non-dedicated sampling devices have been decontaminated effectively. Equipment rinsate blanks will consist of the rinse water used in the final step of the sampling equipment decontamination procedure. Rinsate samples will be collected at a frequency of one per day during sampling events. Rinsate samples may be collected more frequently if required to meet the project DQOs.

14.3.3 Trip Blanks

Trip blanks are hydrochloric acid (HCL)-preserved organic-free water prepared by the fixed based laboratory in 40-milliliter (mL) volatile organic analysis (VOA) vials that will be carried

into the field, stored with the sample, and returned to the laboratory for VOC analysis. Trip blanks will be used to determine whether samples have been cross contaminated with TPH- purgeable and/or VOCs during sample collection and transportation. Since trip blanks pertain only to TPH- purgeable and VOCs, the vial must be free of any headspace. Trip blanks will be provided in each cooler containing samples to be analyzed for VOCs analyzed for TPH and VOCs.

14.3.4 Source Blanks (Field Blanks)

Source blanks are collected to ensure that water used during decontamination is not a source of contamination. Source blank samples will be collected at a frequency of one for each source of water used for equipment rinsate blanks (for the duration of the sampling). If the source for decontamination water changes, additional source blank samples will be collected. To prepare source blanks, the sample containers will be filled with source water at the same time that it is used for decontamination. The source water used for decontamination purposes will consist of commercially available deionized water.

14.3.5 Temperature Blanks

Temperature blank samples will accompany each cooler that contains samples with a temperature preservative requirement. The temperature blank will be prepared either by the analytical laboratory or the field sampling crew by filling VOA vials with de-ionized (DI) water. The temperature of the samples will be verified upon arrival at the analytical laboratory using the temperature blank.

14.3.6 Laboratory Quality Control

Laboratory QC is addressed through the analysis of laboratory QC samples, documented internal and external laboratory QC practices, and laboratory audits. The types of laboratory QC samples will be project/chemical specific, but may include laboratory control samples, laboratory duplicates, matrix spikes (MSs) surrogate standards, internal standards, method blanks, and instrument blanks. MSs, matrix spike duplicates (MDSs), and laboratory control samples (LCSs) are analyzed for every batch of up to 20 samples and serve as a measure of analytical accuracy. Surrogate standards are added to all samples, blanks, MSs, MSDs, and LCSs which are analyzed for organic compounds in order to evaluate the method's accuracy and to help determine matrix interferences. Definitions of each type of laboratory QC sample are listed in the following subsections. For laboratory measurements, if any of the QC checks are outside the acceptance criteria, corrective actions will be taken in accordance with the laboratory's quality assurance program (LQAP)

14.3.7 Laboratory Control Samples

Laboratory control samples include blank spikes and blank spike duplicates. Blank spike samples are designed to check the accuracy of the laboratory analytical procedures by measuring a known concentration of an analyte in the blank spike samples. Blank spike duplicate samples are designed to check laboratory accuracy and precision of the analytical procedures by measuring a known concentration of an analyte in the blank spike duplicate sample. Blank spike and blank spike duplicate samples are prepared by the laboratory using clean laboratory matrices spiked with the same spiking compounds used for matrix spikes at levels approximately 10 times greater than the method detection limit (MDL). Laboratory control samples will be processed with each analytical batch consisting of 20 samples or less.

14.3.8 Laboratory Duplicates

Laboratory duplicates are two aliquots of a sample taken from the same sample container under laboratory conditions and analyzed independently. The analysis of laboratory duplicates allows the laboratory to measure the precision associated with laboratory procedures. Laboratory duplicate samples will be processed with each analytical batch consisting of 20 samples or less.

14.3.9 Matrix Spikes

MS and MSD samples are designed to check the precision and accuracy of the analytical methods through the analysis of a field sample with a known amount of analyte added. Additional sample volume of MS and MSD samples is collected in the field in the same manner as field duplicate samples. In the laboratory two portions of the sample are spiked with a standard solution of target analytes. MS and MSD samples are analyzed for the same parameters as the field samples, and analytical results will be evaluated for precision and accuracy of the laboratory process and effects of the sample matrix. A minimum of one MS/MSD will be analyzed each day that field samples are analyzed, at a rate of one per 20 field samples or one per batch, whichever is more frequent.

14.3.10 Surrogate Standards

Surrogates are chemical compounds with properties that mimic analytes of interest, but that are unlikely to be found in environmental samples. Surrogates will be added to all field and QC samples and analyzed by gas chromatography (GC) or GC/mass spectroscopy to assess the recovery of the laboratory process, and to detect QC problems. The concentration and type of surrogates used are based on the LQAP.

14.3.11 Internal Standards

Like the surrogate standard, an internal standard is a chemical compound, unlikely to be found in environmental samples, that is added as a reference compound for sample quantification. Internal standard procedures are used for the analysis of volatile organics and extractable organics using GC/MS, and also can be used for other GC and high performance liquid chromatography (HPLC) analytical methods. The concentration and type of internal standards used will be based on the LQAP.

14.3.12 Method Blanks

Method blanks are designed to detect contamination of field samples that may occur in the laboratory. Method blanks verify that method interference caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Method blanks are deionized water for aqueous samples. A minimum of one method blank will be analyzed each day that field samples are analyzed at the rate of 1 per 20 field samples. A method blank must be analyzed daily. The concentration of the target compounds in the method blank sample must be less than five times the MDL. If the blank is not under the specified limit, the source contamination is to be identified and correct actions taken.

14.4 Equipment Decontamination

Decontamination of non-disposable equipment will be performed to prevent the introduction of extraneous material into sample and to prevent cross-contamination between samples.

Decontamination procedures are discussed in detail in GCE-SOP 2-3, which is included in Appendix A.

In general, decontamination of non –disposable sample equipment will be conducted using the following procedures:

1. Fill three separate 5 gallon buckets with water. Two of the buckets should be filled with potable water, and the third with deionized (DI) water.

2. Mix the potable water in one of the buckets with a laboratory grade detergent, such as Alconox or Liquinox.

3. Scrub the equipment with a brush, using the detergent/water solution.

4. Rinse with potable water (2nd bucket) and rinse again with DI water (3rd bucket).

5. Reassemble the equipment and place it in a clean area on plastic or aluminum foil. If aluminum foil is used, wrap the equipment with the dull side “in” (i.e. toward the equipment).

6. Equipment rinsate samples will be collected from decontaminated equipment daily to provide a QC check on the decontamination procedure above. At least one field blank (source water used in the decontamination procedure) will be collected in the beginning of the investigation and analyzed for all target compounds.

14.5 Investigation Derived Waste Disposal

Wastes that are anticipated to be generated during this sampling project may include decontamination water, and personal protective equipment. These wastes will be containerized on site and stored temporarily in 55 gallon drums or other suitable containers for future disposal. Drums will be labeled and stored in a secure facility on pallets with spill control as appropriate.

Disposal of wastes will be determined based on the analytical results of the media in question. Contaminated wastes will be transported to an authorized disposal facility, in accordance with local, state and federal regulations.

14.6 Investigation Derived Waste Disposal Data Management

All field observations and laboratory results will be linked to a unique sample location through the use of the sample labeling procedures described in Worksheet #27. Field observations and measurement data will be recorded on the field forms and in a field notebook to provide a permanent record of field activities. All data that are hand-entered will be subjected to a review of a second person to minimize data entry errors. A check for completeness of field records (logbooks, field forms, databases, electronic spreadsheets) will ensure that all requirements for field activities have been fulfilled, complete records exist for each activity, and the procedures specified in this SAP have been implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event.

Hard copies of the data reports received from the laboratories will be filed chronologically and will be stored separately from the electronic files. Hard copies of data signed by a representative of the analytical laboratory will be compared to any electronic versions of the data to confirm that the conversion process has not modified the reported results. Any

additional reporting formats will be completed and electronic and hard copies will be stored in different locations at GCE facilities.

Following the data review process, GCE will enter the sample results into an electronic database. Data will be compiled with spatial and temporal qualifiers (location ID and sample date) so that it will be possible to rapidly plot or review changes in the concentration of target analytes at each sampling point over time.

15.0 SAP Worksheet #15 -- Reference Limits and Evaluation Table

15.1 -- Reference Limits and Evaluation Table (6020A Soil)

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference[1]	Project Quantization Limit Goal (mg/kg)	Laboratory-specific	
					RL (mg/kg)	MDL (mg/kg)
Arsenic	7440-38-2	10	rSRLs	1	0.5	0.1
Barium	7440-39-3	15,000	rSRLs	1	0.5	0.1
Cadmium	7440-43-9	39	rSRLs	1	0.5	0.1
Chromium	7440-47-3	120,000	rSRLs	1	0.5	0.1
Lead	7439-92-1	400	rSRLs	1	0.5	0.1
Mercury	7439-97-6	23	rSRLs	1	0.1	0.02
Selenium	7782-49-2	390	rSRLs	1	0.5	0.1
Silver	7440-22-4	390	rSRLs	1	0.5	0.1

Note:
1 – Residential Soil Remediation Level (rSRLs), Arizona Department of Environmental Quality

15.2 – Reference Limits and Evaluation Table (8330 Soil)

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal (ug/Kg)	Laboratory-specific	
					QLs (ug/Kg)	MDLs (ug/Kg)
HMX	2691-41-0	3100000	rSRLs	400	400	100
RDX	121-82-4	500	rSRLs	400	400	100
1,3,5-TNB	99-35-4	1800000	rSRLs	400	400	100
1,3-DNB	99-65-0	6100	rSRLs	400	400	100
2,4-DNT	121-14-2	1200000	rSRLs	400	400	100
2,6-DNT	606-20-2	61000	rSRLs	400	400	100
2,4,6-TNT	118-96-7	18000	rSRLs	400	400	100
2-AM-4,6-DNT	35572-78-2	NA	NA	400	400	100
2-Nitrotoluene	88-72-2	NA	NA	400	400	100
3-Nitrotoluene	99-08-1	NA	NA	400	400	100
4-AM-2,6-DNT	19406-51-0	NA	NA	400	400	100
4-Nitrotoluene	99-99-0	NA	NA	400	400	100
Tetryl	479-45-8	NA	NA	400	400	100
Nitrobenzene	98-95-3	20000	rSRLs	400	400	100

Note:
1 – Residential Soil Remediation Level (rSRLs), Arizona Department of Environmental Quality

15.3 – Reference Limits and Evaluation Table (8260 Soil)

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (ug/kg)	Laboratory-specific	
					QLs (ug/Kg)	LODs (ug/Kg)
Acetone	67-64-1	14000000	rSRL	10	10	5
Benzene	71-43-2	650	rSRL	5	5	1
Bromobenzene	108-86-1	28000	rSRL	5	5	1
Bromochloromethane	74-97-5	NE	NA	5	5	1
Bromodichloromethane	75-27-4	830	rSRL	5	5	1
Bromoform	75-25-2	69000	rSRL	5	5	2
Bromomethane	74-83-9	3900	rSRL	10	10	2
2-Butanone (MEK)	78-93-3	23000000	rSRL	10	10	5
n-Butylbenzene	104-51-8	240000	rSRL	5	5	1
sec-Butylbenzene	135-98-8	220000	rSRL	5	5	1
tert-Butylbenzene	98-06-6	390000	rSRL	5	5	1
Carbon disulfide	75-15-0	360000	rSRL	5	5	1
Carbon tetrachloride	56-23-5	250	rSRL	5	5	1
Chlorobenzene	108-90-7	150000	rSRL	5	5	1
Chloroethane	75-00-3	3000	rSRL	5	5	2
Chloroform	67-66-3	940	rSRL	5	5	1
Chloromethane	74-87-3	48000	rSRL	5	5	2
2-Chlorotoluene	95-49-8	NE	NA	5	5	1
4-Chlorotoluene	106-43-4	NE	NA	5	5	1
Dibromochloromethane	124-48-1	1100	rSRL	5	5	1
1,2-Dibromo-3-chloropropane	96-12-8	530	rSRL	5	5	2
1,2-Dibromoethane	106-93-4	29	rSRL	5	5	1
Dibromomethane	74-95-3	NE	NA	5	5	1
1,1-Dichloroethane	75-34-3	510000	rSRL	5	5	1
1,2-Dichloroethane	107-06-2	280	rSRL	5	5	1
1,2-Dichlorobenzene	95-50-1	600000	rSRL	5	5	1
1,3-Dichlorobenzene	541-73-1	530000	rSRL	5	5	1
1,4-Dichlorobenzene	106-46-7	3500	rSRL	5	5	1
Dichlorodifluoromethane	75-71-8	94000	rSRL	5	5	2
1,1-Dichloroethene	75-35-4	NE	NA	5	5	1
cis-1,2-Dichloroethene	156-59-2	NE	NA	5	5	1
trans-1,2-Dichloroethene	156-60-5	NE	NA	5	5	1

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (ug/kg)	Laboratory-specific	
					QLs (ug/Kg)	LODs (ug/Kg)
1,1-Dichloropropene	563-58-6	NE	NA	5	5	1
1,2-Dichloropropane	78-87-5	NE	NA	5	5	1
1,3-Dichloropropane	142-28-9	NE	NA	5	5	1
2,2-Dichloropropane	594-20-7	NE	NA	5	5	2
cis-1,3-Dichloropropene	10061-01-5	NE	NA	5	5	1
trans-1,3-Dichloropropene	10061-02-6	NE	NA	5	5	1
Ethylbenzene	100-41-4	400000	rSRL	5	5	1
2-Hexanone (MBK)	591-78-6	NE	NA	10	10	5
Hexachlorobutadiene	87-68-3	7000	rSRL	5	5	2
Isopropylbenzene	98-82-8	92000	rSRL	5	5	2
p-Isopropyltoluene	99-87-6	NE	NA	5	5	1
Methylene Chloride	75-09-2	9300	rSRL	10	10	2
4-Methyl-2-pentanone (MIBK)	108-10-1	5300000	rSRL	10	10	5
tert-Butyl methyl ether	1634-04-4	32000	rSRL	5	5	1
Naphthalene	91-20-3	56000	rSRL	10	10	2
n-Propylbenzene	103-65-1	240000	rSRL	5	5	1
Styrene	100-42-5	1500000	rSRL	5	5	1
1,1,1,2-Tetrachloroethane	630-20-6	3200	rSRL	5	5	1
1,1,2,2-Tetrachloroethane	79-34-5	420	rSRL	5	5	1
Tetrachloroethene	127-18-4	NE	NA	5	5	1
Toluene	108-88-3	650000	rSRL	5	5	1
1,1,1-Trichloroethane	71-55-6	1200000	rSRL	5	5	1
1,1,2-Trichloroethane	79-00-5	740	rSRL	5	5	1
1,2,3-Trichlorobenzene	87-61-6	NE	NA	5	5	2
1,2,4-Trichlorobenzene	120-82-1	62000	rSRL	5	5	2
Trichloroethene	79-01-6	NE	NA	5	5	1
Trichlorofluoromethane	75-69-4	390000	rSRL	5	5	2
1,2,3-Trichloropropane	96-18-4	5	rSRL	5	5	2
1,2,4-Trimethylbenzene	95-63-6	52000	rSRL	5	5	2
1,3,5-Trimethylbenzene	108-67-8	21000	rSRL	5	5	2
Vinyl Chloride	75-01-4	85	rSRL	5	5	2
m-Xylene & p-xylene	136777-61-2	NE	NA	10	10	2

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (ug/kg)	Laboratory-specific	
					QLs (ug/Kg)	LODs (ug/Kg)
o-Xylene	95-47-6	NE	NA	5	5	1

Note:
1 – Residential Soil Remediation Level (rSRLs), Arizona Department of Environmental Quality

15.4 – Reference Limits and Evaluation Table (8270 Soil)

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (ug/kg)	Laboratory-specific	
					QLs (ug/Kg)	LODs (ug/Kg)
Acenaphthene	83-32-9	3700000	rSRL	333	333	167
Acenaphthylene	208-96-8	NE	NA	333	333	167
Anthracene	120-12-7	22000000	rSRL	333	333	167
Azobenzene	103-33-3	5000	SRL	333	333	167
Benzo(a)anthracene	56-55-3	690	rSRL	333	333	167
benzo(a)pyrene	50-32-8	69	rSRL	333	333	167
Benzo(b)fluoranthene	205-99-2	690	rSRL	333	333	167
Benzo(g,h,i)perylene	191-24-2	NE	NA	333	333	167
Benzo(k)fluoranthene	207-08-9	6900	rSRL	333	333	167
Benzyl Alcohol	100-51-6	18000000	SRL	333	333	167
bis(2-chloroethoxy)methane	111-91-1	NE	NA	333	333	167
bis(2-chloroethyl)ether	111-44-4	230	rSRL	333	333	167
bis(2-chloroisopropyl)ether	108-60-1	790000	rSRL	333	333	167
bis(2-Ethylhexyl)phthalate	117-81-7	39000	rSRL	333	333	167
4-Bromophenyl-phenylether	101-55-3	NE	NA	333	333	167
Butylbenzylphthalate	85-68-7	NE	NA	333	333	167
Carbazole	86-74-8	27000	rSRL	333	333	167
4-Chloro-3-methylphenol	59-50-7	NE	NA	333	333	167
4-Chloroaniline	106-47-8	240000	rSRL	333	333	167
2-Chloronaphthalene	91-58-7	NE	NA	333	333	167
2-Chlorophenol	95-57-8	63000	rSRL	333	333	167
4-Chlorophenyl-phenylether	7005-72-3	NE	NA	333	333	167
Chrysene	218-01-9	68000	rSRL	333	333	167
Dibenzo(a,h)anthracene	53-70-3	NE	NA	333	333	167

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (ug/kg)	Laboratory-specific	
					QLs (ug/Kg)	LODs (ug/Kg)
Dibenzofuran	132-64-9	140000	rSRL	333	333	167
1,2-Dichlorobenzene	95-50-1	600000	rSRL	333	333	167
1,3-Dichlorobenzene	541-73-1	530000	rSRL	333	333	167
1,4-Dichlorobenzene	106-46-7	3500	rSRL	333	333	167
3,3'-Dichlorobenzidine	91-94-1	1200	rSRL	333	333	167
2,4-Dichlorophenol	120-83-2	180000	rSRL	333	333	167
Diethylphthalate	84-66-2	NE	NA	333	333	167
2,4-Dimethylphenol	105-67-9	1200000	rSRL	333	333	167
Dimethylphthalate	131-11-3	NE	NA	333	333	167
Di-n-butylphthalate	84-74-2	NE	NA	333	333	167
4,6-Dinitro-2-methylphenol	534-52-1	NE	NA	667	667	167
2,4-Dinitrophenol	51-28-5	120000	rSRL	667	667	167
2,4-Dinitrotoluene	121-14-2	120000	rSRL	333	333	167
2,6-Dinitrotoluene	606-20-2	61000	rSRL	333	333	167
Di-n-octylphthalate	117-84-0	2400000	rSRL	333	333	167
Fluoranthene	206-44-0	2300000	rSRL	333	333	167
Fluorene	86-73-7	2700000	rSRL	333	333	167
Hexachlorobenzene	118-74-1	340	rSRL	333	333	167
Hexachlorobutadiene	87-68-3	7000	rSRL	333	333	167
Hexachloroethane	67-72-1	39000	rSRL	333	333	167
Indeno(1,2,3-cd)pyrene	193-39-5	690	rSRL	333	333	167
Isophorone	78-59-1	580000	rSRL	333	333	167
2-Methylnaphthalene	91-57-6	NE	NA	333	333	167
2-Methylphenol	95-48-7	3100000	rSRL	333	333	167
4-Methylphenol	106-44-5	3100000	rSRL	333	333	167
Naphthalene	91-20-3	56000	rSRL	333	333	167
2-Nitroaniline	88-74-4	180000	rSRL	333	333	167
3-Nitroaniline	99-09-2	18000	rSRL	333	333	167
4-Nitroaniline	100-01-6	26000	rSRL	333	333	167
Nitrobenzene	98-95-3	20000	rSRL	333	333	167
2-Nitrophenol	88-75-5	NE	NA	333	333	167
4-Nitrophenol	100-02-7	NE	NA	667	667	167
n-Nitrosodimethylamine	62-75-9	NE	NA	333	333	167

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal (ug/kg)	Laboratory-specific	
					QLs (ug/Kg)	LODs (ug/Kg)
n-Nitroso-di-n-propylamine	621-64-7	NE	NA	333	333	167
n-Nitrosodiphenylamine	86-30-6	NE	NA	333	333	167
Pentachlorophenol	87-86-5	3200	rSRL	667	667	167
Phenanthrene	85-01-8	NE	NA	333	333	167
Phenol	108-95-2	18000000	rSRL	333	333	167
Pyrene	129-00-0	2300000	rSRL	333	333	167
1,2,4-Trichlorobenzene	120-82-1	62000	rSRL	333	333	167
2,4,5-Trichlorophenol	95-95-4	6100000	rSRL	333	333	167
2,4,6-Trichlorophenol	88-06-2	6100	rSRL	333	333	167

Note:
1 – Residential Soil Remediation Level (rSRLs), Arizona Department of Environmental Quality

15.5 - Reference Limits and Evaluation Table (White 7580 Phosphorus Soil)

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal (ug/Kg)	Laboratory-specific	
					QLs (ug/Kg)	MDLs (ug/Kg)
White Phosphorus	7723-14-0W	34	rSRL	1	1	0.2379

Note:
1 – Residential Soil Remediation Level (rSRLs), Arizona Department of Environmental Quality

15.6 - Reference Limits and Evaluation Table (Perchlorate 6850 Soil)

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal (ug/Kg)	Laboratory-specific	
					QLs (ug/Kg)	MDLs (ug/Kg)
Perchlorate	14797-73-0	100	rSRL	4	4	1

Note:
1 – Residential Soil Remediation Level (rSRLs), Arizona Department of Environmental Quality

16.0 SAP Worksheet #16 -- Project Schedule / Timeline Table

Date	Milestone	Deliverable
November 5, 2013	Kick-off Meeting	Attendance
January 18, 2014	Draft APP and SSHP	Draft plans submitted to NAVFAC RPM and MCAS
January 18, 2014	Draft Work Plan and SAP	Draft plans submitted to ADEQ NAVFAC RPM and MCAS
February 28, 2014	Final APP and SSHP	Final draft plans submitted to ADEQ NAVFAC RPM and MCAS
February 28, 2014	Final Work Plan and SAP	Final plans submitted to NAVFAC RPM and MCAS
February 20, 2014	Well Installation	Field crew on site
TBD	Soil Sampling	Field sampling crew on site

17.0 SAP Worksheet #17 -- Sampling Design and Rationale

The goal of this study is to evaluate the potential soil contamination to determine if concentrations pose a risk to human health. This goal will be accomplished through sampling and analysis of soil samples. Specifically, 105 soil samples will be collected to characterize the pre-closure conditions at the MTR. All samples will be analyzed for: Explosives (EPA Method 8330), Metals (EPA Methods 6010/7471), VOCs (EPA Method 8260), SVOCs (EPA Method 8270), Perchlorate (EPA Method 6850) and White Phosphorus (EPA Method 7580).

18.0 SAP Worksheet #18 -- Sampling Locations and Methods

This table presents all of the site locations that will be sampled.

Sampling Location	**Matrix**	**Depth** (Feet, bgs)	**Analytical Group**	**Number of Samples** (identify field duplicates)
Active shothole/pit of a detonation (annual)	Soil	0-1.5 feet bgs 4.5-6 feet bgs 8.5-10 feet bgs	Explosives Metals VOCs SVOCs Perchlorate White Phosphorus	105 Soil

19.0 SAP Worksheet #19 -- Analytical SOP Requirements Table

Matrix	**Analytical Group**	**Analytical and Preparation Method / SOP Reference**	**Containers** (number, size, and type)	**Sample volume** (units)	**Preservation Requirements** (chemical, temperature, light protected)	**Maximum Holding Time** (preparation / analysis)
Solid	Explosives	8330A	4oz Glass Jar	30-g	6°C	14 days / 40 days
Solid	Metals	6020A	4oz Glass Jar	2-g	6°C	180 days
Solid	VOCs	5035/8260B	3 x 5g encores	3x5g	6°C	48 hours/14 days
Solid	SVOCs	3550B/8270C	4oz Glass Jar	30g	6°C	14 days / 40 days
Solid	Perchlorate	6850	4oz Glass Jar	10-g	6°C	28 days
Solid	White Phosphorus	7580	8 oz Amber Glass	40-g	4°C as Little Head space as possible	30 days to analysis

20.0 SAP Worksheet #20 -- Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates (10%)	No. of MS/MSDs (5%)	No. of Field (Source) Blanks[1]	No. of Equipment Blanks[1]	No. of VOA Trip Blanks[2]	No. of PT Samples[3]	Total No. of Samples to Lab
Soil	Explosives	105	11	6	1	1	0	0	124
Soil	Metals	105	11	6	1	1	0	0	124
Soil	VOCs	105	11	6	1	1	0	0	124
Soil	SVOCs	105	11	6	1	1	0	0	124
Soil	Perchlorate	105	11	6	1	1			124
Soil	White Phosphorus	105	11	6	1	1			124

Acronyms:

MS/MSD matrix spike/matrix spike duplicate
PT proficiency testing

Notes:
1 Number of samples assumes 1 days of field sampling activities.
2 One per ice chest containing VOC or SVOC samples.
3 Proficiency Testing (PT) samples will not be collected during this project.

21.0 SAP Worksheet #21 -- Project Sampling SOP References Table

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work?	Comments
1-1	Sample Custody	Gutierrez Canales Engineering	N/A	No	Appendix A
1-2	Packaging and Shipping of Environmental Samples	Gutierrez Canales Engineering	N/A	No	Appendix A
1-3	Field Logbook Content and Control	Gutierrez Canales Engineering	N/A	No	Appendix A
2-2	Investigation Derived Waste	Gutierrez Canales Engineering	N/A	No	Appendix A
2-3	Decontamination of Field Equipment	Gutierrez Canales Engineering	Non-Disposable Sampling Equipment	No	Appendix A

22.0 SAP Worksheet #22 -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference	Comments
Photoionization Detector (PID)	Calibration	Daily	Calibrates to known standard	Return to Manufacturer-Replace with rental unit	GCE Field Tech/ GCE Project Manager	Worksheet 14	Make sure battery is recharged/functional.

23.0 SAP Worksheet #23 -- Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and / or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
EMAX-8330	Nitroaromatics & Nitramines by HPLC, Rev. 7	DEFINITIVE	Organic –HPLC in Water Soil	HPLC	EMAX	N
EMAX-353.3	Nitrogen, Nitrate-Nitrite by Copper –Cadmium Reduction, Rev 4	DEFINITIVE	Wet Chem in Water Soil	SPECTROPHOTOMETER	EMAX	N
EMAX-8260	Volatile Organics by GCMS Rev.9	DEFINITIVE	Organic -GC in Water Soil	GCMS	EMAX	N
EMAX-8270	Semivolatile Organics by GCMS Rev.5	DEFINITIVE	Organic -GC in Water Soil	GCMS	EMAX	N
EMAX-6020	Trace Metals by ICP-MS Rev.8	DEFINITIVE	Metals in Water Soil	ICP-MS	EMAX	N
EMAX-7470	Mercury in Liquid Waste Rev. 7	DEFINITIVE	Metals in Water Soil	COLD VAPOR	EMAX	N
EMAX-7471	Mercury in Solid or Semisolid Waste Rev.7	DEFINITIVE	Metals in Water Soil	COLD VAPOR	EMAX	N
EMAX-8015D	Diesel Range Organics (Dro), Revision 5	DEFINITIVE	Organic -GC in Water Soil	GC	EMAX	N
EMAX-8015G	Gasoline Range Organics (Gro), Revision 4	DEFINITIVE	Organic -GC in Water Soil	GC	EMAX	N
EMAX-8015AZ	AZ C10-C32 Hydrocarbons in Soil Rev. 2	DEFINITIVE	Organic -GC in Soil	GC	EMAX	N

24.0 SAP Worksheet #24 -- Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Initial Calibration (ICAL) –	Initial calibration prior to sample analysis	1. Average response factor (RF) for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, and ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. 2. RSD for RFs for CCCs: VOCs ≤ 30% and one option below: a. Option 1: linear-mean RSD for all analytes ≤ 15% b. Option 2: linear least squares regression r ≥ 0.995 when RSD >15% c. Option 3: non-linear regression – coefficient of determination r^2 ≥ 0.99 (6 points will be used for second order, 7 points shall be used for third order)	Locate the source of the problem. If expected RFs are not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial calibration If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration. If CCC is non-compliant, it could be a result of system leaks, or reactive column sites or standard degradation. Correct the problem and recalibrate. If RSD is non-compliant, check for outlier and repeat that ICAL point; otherwise perform instrument troubleshooting and repeat calibration	Analyst	EMAX-8260 /DOD QSM
GC/MS	Second source calibration verification	Once after each initial calibration	Value of second source for all project analytes within ±20% of expected value (initial source) except for the following compounds due to erratic chromatographic behavior: bromomethane, chloroethane, chloromethane, dichlorodifluoromethane within +/- 35% of expected value.	Prepare fresh standard and reanalyze second source to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance, and rerun initial calibration and second source verification standard. If problem continues, new standards may need to be purchased, prepared, and analyzed.	Analyst	EMAX-8260 / DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Calibration Verification (CV)	Daily, before sample analysis, and every 12 hours of analysis time	1. Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, and ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethene. 2. %Difference/Drift for CCCs and target compounds ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration.) except for the following compounds due to erratic chromatographic behavior: bromomethane, chloroethane, chloromethane, dichlorodifluoromethane within +/- 30% of expected value (unless they are project analytes of interest)	If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration. If CCC is non-compliant, it could be a result of system leaks, or reactive column sites or standard degradation. Correct the problem and recalibrate	Analyst	EMAX-8260 / DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Initial Calibration (ICAL) –	Initial calibration prior to sample analysis	SPCCs average RF ± 0.050 and %RSD for RFs for CCCs < 30% and one option below (1). linear – mean RSD for all analytes ≤15% (2). linear – least squares regression r ≥ 0.995, when RSD >15% (3). non-linear – COD r^2 > 0.990 (6 points shall be used for second order, 7 points shall be used for third	Locate the source of the problem. If expected RFs are not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial calibration If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration. If CCC is non-compliant, it could be a result of system leaks, or reactive column sites or standard degradation. Correct the problem and recalibrate. If RSD is non-compliant, check for outlier and repeat that ICAL point; otherwise perform instrument troubleshooting and repeat calibration	Analyst	EMAX-8270
GC/MS	Second source calibration verification	Once after each initial calibration	Value of second source for all analytes within ±20% of expected value (initial source) except for the following compounds due to erratic chromatographic behavior: benzidine, 4,6-dinitro-2-methylphenol, 4-chloroaniline, benzylalcohol, n-Nitrosodimethylamine, 4-nitrophenol, 2-nitroaniline, pyridine, benzoic acid and 3-nitroaniline within +/- 35% of expected value.	Prepare fresh standard and reanalyze second source to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance, and rerun initial calibration and second source verification standard. If problem continues, new standards may need to be purchased, prepared, and analyzed.	Analyst	EMAX-8270 / DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS	Calibration Verification (CV)	Daily, before sample analysis, and every 12 hours of analysis time	SPCCs average RF ≥ 0.050; and CCCs and target analytes ≤ 20% difference (when using RFs) or drift (when using least squares regression or non-linear calibration) except for the following compounds due to erratic chromatographic behavior: benzidine, 4,6-dinitro-2-methylphenol, 4-chloroaniline, benzylalcohol, n-Nitrosodimethylamine, 4-nitrophenol, 2-nitroaniline, pyridine, benzoic acid and 3-nitroaniline within +/- 30% of expected value.	If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration. If CCC is non-compliant, it could be a result of system leaks, or reactive column sites or standard degradation. Correct the problem and recalibrate	Analyst	EMAX-8270 / DOD QSM
HPLC	Initial Calibration (ICAL) –	Initial calibration prior to sample analysis and as needed.	One of the following options: 1) RSD for all analytes ≤20% 2) linear – least squares regression r > =0.995 3) non-linear – COD > 0.990 (6 points shall be used for second order, 7 points shall be used for third order)	Locate the source of the problem. If expected RSD is not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial Calibration	Analyst	EMAX-8330

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HPLC	ICV	Once after each initial calibration	All project analytes within established retention time windows. GC Methods: All project analytes within ±20% of expected value from ICAL. HPLC / IC Methods: All project analytes within ±15% of expected value from ICAL.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	EMAX-8330
HPLC	Continuing Calibration Verification	Daily, before sample analysis, after every 10 field samples, and at the end of analysis sequence.	All project analytes within established retention time windows. GC Methods: All project analytes within ±20% of expected value from ICAL. HPLC / IC Methods: All project analytes within ±15% of expected value from ICAL.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyse all samples since last successful CCV. If problem persists, repeat ICAL.	Analyst	EMAX-8330
ICPMS	Initial Calibration (ICAL) –	Daily	If more than one calibration standard is used, r>= 0.995	Locate the source of the problem. Check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem and then repeat initial Calibration	Analyst	EMAX-6020 DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICPMS	Low Level Calibration Check Standard	Once after each initial calibration	Value of all project analytes within 20% of true value.	Diagnose the problem. Prepare fresh standard and re-analyze to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	EMAX-6020 DOD QSM
ICPMS	ICV	Once after each initial calibration	Value of all project analytes within 10% of true value.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	EMAX-6020 DOD QSM
ICPMS	Continuing Calibration Verification	After every 10 field samples, and at the end of analysis sequence.	Value of all project analytes within 10% of true value.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyse all samples since last successful CCV. If problem persists, repeat ICAL.	Analyst	EMAX-6020 DOD QSM
CVAA	Initial Calibration (ICAL) –	Daily	r>= 0.995	Locate the source of the problem. Check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem and then repeat initial Calibration	Analyst	EMAX-7470 EMAX-7471 DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
CVAA	ICV	Once after each initial calibration	Value of all project analytes within 10% of true value.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	EMAX-7470 EMAX-7471 DOD QSM
CVAA	Continuing Calibration Verification	After every 10 field samples, and at the end of analysis sequence.	Value of all project analytes within 20% of true value.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	EMAX-7470 EMAX-7471 DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC-MS	Initial Calibration (ICAL) –	Initial calibration prior to sample analysis and as needed.	One of the following options: 1) RSD for all analytes ≤20% 2) linear – least squares regression r > =0.995	Locate the source of the problem. If expected RSD is not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial Calibration	Analyst	EMAX-6850/ DOD QSM
LC-MS	Second source calibration verification	Once after each initial calibration	Value of second source for all analytes within ±15% of expected value (initial source).	Prepare fresh standard and reanalyze second source to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance, and rerun initial calibration and second source verification standard. If problem continues, new standards may need to be purchased, prepared, and analyzed.	Analyst	EMAX-6850/ DOD QSM
LC– MS	Continuing Calibration	Daily, before sample analysis, every 12 hours, and at the end of analysis sequence.	Within ±15% of expected value.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyse all samples since last successful CCV. .	Analyst	EMAX-6850/ DOD QSM

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC– MS	LOD Verification (per batch); Perchlorate spike concentration approximately 2x LOD.	Prior to sample analysis and at the end of the sequence.	Within ±30% of expected value.	Diagnose and correct problem. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyse all samples since last successful LODV. If a samples with perchlorate result between RL and LOD is bracketed by a failing LODV, it must be re-analyzed. Samples with concentrations above the LOQ can be reported.	Analyst	EMAX-6850/ DOD QSM
LC– MS	Isotope Ratio 35Cl/37Cl	Every sample, batch QC and standard.	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated. Theoretical ratio ~ 3.06. Must fall within 2.3 to 3.8.	If criteria are not met, the sample must be rerun. If the sample was not pretreated, the sample should be reextracted using cleanup procedures. If, after cleanup, the ratio still fails, use alternative techniques to confirm presence of perchlorate (i.e., a post spike sample, dilution to reduce any interference, etc.).	Analyst	EMAX-6850/ DOD QSM
GC	Initial Calibration (ICAL) –	Initial calibration prior to sample analysis and as needed.	One of the following options: 1) RSD for all analytes ≤20% 2) linear – least squares regression r > =0.995 3) non-linear – COD > 0.990 (6 points shall be used for second order, 7 points shall be used for third order)	Locate the source of the problem. If expected RSD is not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial Calibration	Analyst	EMAX-8015G EMAX-8015D EMAX-8015AZ

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC	ICV	Once after each initial calibration	All project analytes within established retention time windows. All project analytes within ±20% of expected value from ICAL.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.	Analyst	EMAX-8015G EMAX-8015D EMAX-8015AZ
GC	Continuing Calibration Verification	Daily, before sample analysis, after every 10 field samples, and at the end of analysis sequence.	All project analytes within established retention time windows. All project analytes within ±20% of expected value from ICAL.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyse all samples since last successful CCV. If problem persists, repeat ICAL.	Analyst	EMAX-8015G EMAX-8015D
GC	Continuing Calibration Verification	Daily, before sample analysis, after every 10 field samples, and at the end of analysis sequence.	All project analytes within established retention time windows. All project analytes within ±30% of expected value from ICAL.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyse all samples since last successful CCV. If problem persists, repeat ICAL.	Analyst	EMAX-8015AZ
SPECTROMETER	ICAL	Daily	Correlation Coefficient (r2) >0.995	Locate the source of the problem. If outliers exist, prepare fresh calibration standards and repeat ICAL. If problem persist, perform Photometric Linearity Check. If maximum absorbance is non-compliant, replace the spectrometer lamp and repeat the ICAL	Analyst	EMAX-353.3

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
SPECTROMETER	ICV	After ICAL	All analytes within + 10% of expected value	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persist perform instrument maintenance to correct the problem and repeat ICAL.	Analyst	EMAX-353.3
SPECTROMETER	CCV	Daily before sample analysis, at the end of the analysis sequence	All analytes within + 10% of expected value	Repeat calibration and reanalyze all samples since last successful calibration.	Analyst	EMAX-353.3

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/FPD (SW7580)	Initial Calibration	Upon instrument receipt, for major instrument changes, or when continuing calibration verification (CCV) does not meet criteria	Analyze the calibration standards at Six concentration levels are required for a quadratic fit and five for a linear fit. The standards should bracket the concentration range expected in samples. Analyze one standard at the PQL. Analyze each calibration standard and tabulate peak area response versus the concentration in the standard. An initial calibration curve is constructed by the TotalChrom data system for P4 using the concentration and peak areas of the initial calibration standards. The calibration curve is constructed using a linear or quadratic fit of the data. The initial calibration acceptance criterion using linear curve fitting is that the correlation coefficient (r) must be equal to or greater than 0.99. The initial calibration acceptance criterion using quadratic curve fitting is that the coefficient of determination (COD) must be greater than or equal to 0.99.	Repeat calibration if criteria are not met	Analyst/Supervisor	OP-SW-7580
GC/FPD (SW7580)	Continuing Calibration	A CCV is analyzed at the beginning, and end of each sequence and after every ten samples.	Acceptance criteria for the CCV is that the result for the CCV quantitated against the curve is within ±15% of the target value. Samples must be bracketed with CCV standards that meet the 15% criterion.	1)Evaluate System 2) Reanalyze 3)Recalibrate 4) Rerun all samples to last compliant CCV	Analyst/Supervisor	OP-SW-7580

25.0 SAP Worksheet #25 -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference
GCMS GC HPLC ICPMS COLD VAPOR HPLC MS	Parameter Setup	Physical check	Examples: Check that the autosampler is functioning as expected Check that temperature program is set at the most recently determined optimum condition. IC: Check pressure, effluent, detector, flowrate is set as per SOP.	Initially; prior to each use	Autosampler must move to the expected position when activated. Refer to instrument optimize temperature program setup.	Reset to SOP set-up, if parameter checks reveal deviations. Notate all adjustments in Daily Maintenance Log. Examples: Reset autosampler, if problem persist perform autosampler troubleshooting prior to instrument use. Reset to optimized temperature setup (e.g., if temperature program is optimized at the following conditions: Initial Temp=40°C, hold for 1 min, Ramp= 6°C, Final Temp=200°C, Injection port=160°C Interface=250°C, then the	EMAX Chemist	EMAX-8330 EMAX-8260 EMAX-8270 EMAX-8015G EMAX-8015D EMAX-8015AZ EMAX-6850 EMAX-6020

Instrument Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference
						instrument setting must be on that condition when checked.)		
GC-MS	Detector maintenance	Column change, failing tune	Change detector and/or pump oil	Oil level/quality visually examined monthly; oil physically changed every 6 months	Tune passes; scan does not indicate presence of air/water	Refill or exchange the oil; clean parts; reanalyze tune	EMAX Chemist	EMAX-8270
GC-MS	Parameter Set-up	Physical Check	Various - Check Autosampler, GC settings, temperature programs, etc.	Initially, prior to each use.	Set-up in accordance to SOP guides.	Reset to SOP requirements	EMAX Chemist	EMAX-8270
GC-MS	Traps	Instrument performance – failing CCV	Change trap	When responses start to drop; failing CCV	Lack of moisture; CCV pass	Replace and rebake traps; reanalyze CCV or recalibrate instrument	EMAX Chemist	EMAX-8260
GC-MS	Detector maintenance	Column change, failing tune	Change detector and/or pump oil	Oil level/quality visually examined monthly; oil physically changed every 6	Tune passes; scan does not indicate presence of air/water	Refill or exchange the oil; clean parts; reanalyze tune	EMAX Chemist	EMAX-8260

Instrument Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference
				months				
GC-MS	Parameter Set-up	Physical Check	Various - Check Autosampler, GC settings, temperature programs, etc.	Initially, prior to each use.	Set-up in accordance to SOP guides.	Reset to SOP requirements	EMAX Chemist	EMAX-8260
Spectrometer	Daily Check	Physical check	Examples: Check Lamp stability, Photometric noise, ensure sufficient instrument warm-up (min 15 minutes), verify proper wavelength.	Daily, prior to each use	No physical defects and performance checks within limits.	Reset to SOP set-up, if parameter checks reveal deviations. Notate all adjustments in Daily Maintenance Log.	EMAX Chemist	EMAX-353.3
GCMS ICPMS LCMS	Tune Check	Instrument Performance	Conformance to instrument tuning.	Initially; prior to DCC	Compliance to ion abundance criteria as specified by the method.	Repeat tune check to rule out standard degradation or inaccurate injection. If problem persist perform retune the instrument and repeat tune check.	EMAX Chemist	EMAX-8260 EMAX-8270 EMAX-6850 EMAX-6020
LCMS	ICS	Instrument performance and interference	Conformance to interference limits	At minimum daily and once per batch.	Within 30% of true value	Terminate analysis, reanalyze ICS to rule out standard degration or inaccurate injection. If problem persist,	EMAX Chemist	EMAX-6850

Instrument Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference
						perform instrument maintenance, repeat calibrations and reanalyze all associated samples. Potential issues include cleanup columns and analytical column.		
ICPMS	ICS/ICSA	Instrument Performance	Conformance to interference check	Prior to sample analysis	**ICS-A:** Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified impurity from a spiked analyte.)Within **ICS-AB** ± 20% of expected value	Terminate analysis, reanalyze ICS to rule out standard degration or inaccurate injection. If problem persist, perform instrument maintenance, repeat calibrations and reanalyze all associated samples.	EMAX Chemist	EMAX-6020
ICPMS	ICB/CCB	Instrument Performance	Instrument contamination check	After every calibration Verification – Before samples, after every 10, and at the end of sequence.	No analytes detected ≥ LOD	Determine possible source of contamination and apply appropriate measure to correct the problem. Reanalyze calibration blank and all associated samples.	EMAX Chemist	EMAX-6020
Cold Vapor	ICB/CCB	Instrument Performance	Instrument contamination	After every calibration	No analytes detected ≥ LOD	Determine possible source of contamination and	EMAX Chemist	EMAX-7470 EMAX-7471

Instrument Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference
			check	Verification – Before samples, after every 10, and at the end of sequence.		apply appropriate measure to correct the problem. Reanalyze calibration blank and all associated samples.		
Spectrometer	ICB/CCB	Instrument Performance	Instrument contamination check	After every calibration verification	No analytes detected > RL	Determine possible source of contamination and apply appropriate measure to correct the problem. Reanalyze calibration blank and all associated samples.	EMAX Chemist	EMAX-353.3
Gas chromatograph equipped with a flame photometric detector with a phosphorus lens	Septum replacement: Remove the septum nut. Remove the old septum and replace it with a new one. Replace the septum nut, hand tighten, and then tighten 1/4 turn more. Do not over-tighten the septum nut. Injection port liner replacement: Remove the split/splitless weldment assembly, exposing the top of the injection port liner. Lift the liner out of the injection port. Clean or replace it with a new liner packed loosely with a small plug of deactivated glass wool. Replace the O-ring at the top of the liner. Replace the weldment assembly, ensuring that the Oring seals around the insert.	White Phosphorus	Check gas supply. Check seal, liner, and septum.	As needed	CCV +/-15% of target value	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	ALS SOP OP-SW-7580 ALS SOP Lab-002

Instrument Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person[2]	SOP Reference
	Detector maintenance: Refer to the manufacturer maintenance manual for specific maintenance procedures for each type of detector. Routine maintenance includes, as required: cleaning and/or replacing jets and collectors; replacing O-rings, etc.							

26.0 SAP Worksheet #26 -- Sample Handling System

Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Field Sampling Personnel/ Gutierrez Canales Engineering
Sample Packaging (Personnel/Organization): Field Sampling Personnel/ Gutierrez Canales Engineering
Coordination of Shipment (Personnel/Organization): Quality Assurance Manager/Project Manager / Gutierrez Canales Engineering
Type of Shipment/Carrier: Commercial Express Courier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Indra Patel, EMAX Laboratories
Sample Custody and Storage (Personnel/Organization): Indra Patel, EMAX Laboratories
Sample Preparation (Personnel/Organization): Marina Lyudmirskaya, EMAX Laboratories
Sample Determinative Analysis (Personnel/Organization): Various chemists and technicians, EMAX Laboratories
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 30 days, or as required on project specific basis
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 30 days, or as required on a project specific basis
Biological Sample Storage (No. of days from sample collection): NA
SAMPLE DISPOSAL
Personnel/Organization: Richard Beauvil, EMAX Laboratories
Number of Days from Analysis: 30 days, or as required on a project specific basis

27.0 SAP Worksheet #27 – Sample Custody Requirements Table

27.1 Sample Identification

To provide a method of tracking each sample through collection, analysis, data review, and data reduction, a sample identification system has been established for sampling activities at MCAS Yuma. The sample identification system is designed to be compatible with the NEDD standard. Sample number identification will be assigned in the field according to the following sample identification system:

- A ten-character or less designation of the month year and location
- A two-character designation for the sample type
- A one-character designation for sample number
- A three-character designation of the depth interval.
- A two-character designation for consecutive samples from the same location
- A one-character designation for primary (1) or duplicate (3) sample.

An example of the numbering system is:

1113MTR**-** FG1**-** 0.0**-** 01**-** 1

(FG-Fragmentation Detonation Area, WP-White Phosphorus Detonation Area) Sample /Number (1)**-** Depth(0.0')- First Sample Collected (01)**-** Primary Sample (1) [3=duplicate]

Field QC samples subjected to chemical analysis, such as equipment rinsate blanks, field blanks, and trip blanks will also be named this way; sequentially numbered as collected in the field with site characterization samples. Field QC samples will be submitted to the laboratory under blind identification. Field QC samples will not be identified as QC samples in the sample name or on the COC.

In the following hypothetical example, the first samples collected at the site are from fragmentation detonation area FG.

- A soil sample is collected.
- A duplicate soil sample is collected.
- Following the sampling, a field blank is collected.

In accordance with the protocol described above; the samples would be named as follows:

The soil sample would be named	1213MTR-FG1-0.0-01-1
The duplicate sample would be named	1213MTR-FG1-0.0-01-3
The field blank would be named	1213MTR-FG1-0.0-02-1

Temperature blanks will be labeled as temperature blanks. Temperature blanks are not subject to chemical analysis.

Cross-reference information regarding the Station ID, the assigned sample identification number, and whether the sample is a field quality control sample, will be documented in the field logbook. These logbooks will be maintained in the project file.

27.2 Sample Custody

All samples will be recorded on COC forms using the sample ID described above. COCs will be completed using waterproof ink and in a manner to ensure entries are legible. Any errors made by the individual completing the COC shall be crossed out with a single line, initialed, and dated. The COC serves as the legal documentation of the sample custody since it records the transfer of the samples from field personnel to the laboratory to ensure that no tampering occurs.

The COC form will be signed by the individual responsible for custody of the sample containers, and the original will accompany the samples to the laboratory. One copy of the COC form will be kept by the project manager and/or the quality assurance manager and included in the project files. Information to be recorded on the COC form should include:

- Immediately after sample collection, a sample label will be completed with indelible ink and affixed to each sample container. Each sample will be placed in a re-sealable plastic bag to keep the sample container and label dry.
- Samples accumulated before transfer to the laboratory will be stored in an ice-filled chest and properly protected from breakage.
- A designated sample cooler will be filled with sample containers and properly protected from breakage. Sufficient packing material will be used to prevent sample containers from making contact during shipment. Enough wet ice will be added (double-bagged in re-sealable plastic bags) to maintain sample temperature requirements (4 ± 2°C). Field samples and ice will be collectively bagged in plastic trash bags, taped shut, and placed in the shipping container, to avoid water leakage. If the shipping container used is equipped with a drain plug, the plug will be taped shut both inside and outside to further ensure that there is no water leakage.
- The COC form will be completed and signed by GCE's field personnel and courier (if other than the sampler) for the samples transported to the laboratory. The COC will be placed in a re-sealable plastic bag, and taped to the inside of the container lid.
- The shipping container will be closed and taped shut with strapping tape (filament type) completely around at both ends.
- Since the samples are to be delivered to the laboratory using a commercial shipment courier service, custody seals will be used on each container to provide tampering detection. The signed and dated custody seals will be placed on the front right and back left of the shipping container, and will be covered with wide, clear tape.

International Air Transportation Association regulations will be adhered to when shipping samples by air courier services. The package must be scheduled for priority overnight service to ensure that the temperature preservative requirement is not exceeded. Saturday deliveries will be coordinated with the laboratory.

27.3 Laboratory Receipt and Custody

The laboratory will designate a sample custodian. Upon receipt, this individual is responsible for inspecting the sample shipment, recording the temperature of the temperature blank (if applicable) and verifying the correctness of the COC records. The sample custodian will accept the samples by signing the COC form and noting the condition of the samples in the space provided on the COC form and on the Sample Receipt form. In case of breakage or discrepancies between the COC form, sample identification numbers, or requested analysis, the sample custodian will notify the GCE QAM as soon as possible. All discrepancies associated with COC forms or sample breakage will be relayed to GCE's QAM within 24-hours so corrective action can be implemented appropriately. The COC is generally considered to be a legal document and thus will be filled out legibly and as error free as possible.

Samples received by the laboratory will be entered into a sample management system, which must include:

- Laboratory sample number
- Field sample designation
- Analytical batch numbers
- List of analyses requested for each sample container.

Immediately after receipt, the samples will be stored in an appropriate secure storage area. The laboratory will maintain custody of the samples as required by the contract or until further notification by the GCE PM or QAM. The analytical laboratory will maintain written records showing the chronology of sample handling during the analysis process by various individuals at the laboratory.

27.4 Field Document and Records

A project-specific field logbook will be used to provide daily records of significant events, observations, and measurements during field investigation. The field logbook also will be used to document all sampling activities. The logbooks will be kept in the possession of the field team leader during the on-site work and all members of the field team will have access to the logbook. The logbook will be maintained as a permanent record. Any errors found in the logbook will be verified, crossed-through, and initialed by the person discovering the error.

The field logbook is intended to provide sufficient data and observations to reconstruct events that occurred during field activities. The field logbook should be permanently bound and pre-paginated; the use of designated forms should be used whenever possible to ensure that field records are complete. The following items are examples of information that may be included in the field logbook:

- Name, date, and time of entry
- Names and responsibilities of field crew members
- Names and titles of any site visitors
- Descriptions of field procedures, and problems encountered
- Number and amount of samples taken at each location

- Details of sampling location, including sampling coordinates
- Sample identification numbers of all samples collected
- Date and time of collection
- Sample collector
- Sample collection method
- Decontamination procedures
- Field instrument calibration and maintenance
- Field measurements (e.g., organic vapor) and general observations.

28.0 SAP Worksheet #28 -- Laboratory QC Samples Table

Matrix	Soil
Analytical Group	VOCs
Analytical Method / SOP Reference	8260 EMAX-8260

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½RL. For common laboratory contaminants, no analytes detected > RL. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Chemist	Accuracy/Bias - Contamination	No analytes detected > ½RL. For common laboratory contaminants, no analytes detected > RL. Blank result must not otherwise affect sample results.
Surrogate	Every analytical sample	Refer to QC Limit Table below	Correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	EMAX Chemist	Accuracy/Bias	Refer to QC Limit Table below
LCS	One per sample preparation batch	Refer to QC Limit Table below with DOD ME Guidance	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Chemist	Accuracy/Bias	Refer to QC Limit Table below

Matrix	Soil					
MS/MSD	Project designated sample matrix QC	Refer to QC Limit Table below	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.	EMAX Chemist	Interferences - Accuracy/Bias - Precision	Refer to QC Limit Table below

Matrix	Soil
Analytical Group	SVOCs
Analytical Method / SOP Reference	Method 8270 EMAX-8270

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½RL. For common laboratory contaminants, no analytes detected > RL. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Chemist	Accuracy/Bias - Contamination	No analytes detected > ½RL. For common laboratory contaminants, no analytes detected > RL. Blank result must not otherwise affect sample results.
Surrogate	Every analytical sample	Refer to QC Limit Table below	Correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	EMAX Chemist	Accuracy/Bias	Refer to QC Limit Table below
LCS	One per sample preparation batch	Refer to QC Limit Table below with DOD ME Guidance	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Chemist	Accuracy/Bias	Refer to QC Limit Table below
MS/MSD	Project designated sample matrix QC	Refer to QC Limit Table below	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.	EMAX Chemist	Interferences - Accuracy/Bias - Precision	Refer to QC Limit Table below

Matrix	Soil
Analytical Group	METALS
Analytical Method / SOP Reference	7470/ EMAX-7470 7471/ EMAX-7471 6020 / EMAX-6020

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½RL. For common laboratory contaminants, no analytes detected > RL. Blank result must not otherwise affect sample results.	Re-prep and reanalyze blank and all samples processed with the non-conforming blank.	EMAX Analyst	Accuracy/Bias - Contamination	No analytes detected > ½RL. For common laboratory contaminants, no analytes detected > RL. Blank result must not otherwise affect sample results.
LCS	One per preparation batch	% Rec. : 80-120	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Analyst	Accuracy/Bias	% Rec. : 80-120
MS/MSD	Project designated sample matrix QC.	%Rec.: 80-120 RPD +-20%	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.	EMAX Analyst	Interferences - Accuracy/Bias - Precision	%Rec.: 80-120 RPD +-20%
Dilution Test	Per sample preparation batch.	1:5 dilution must agree within +- 10% of the original determination	Perform post digestion spike addition	EMAX Analyst	Accuracy/Bias)	1:5 dilution must agree within +- 10% of the original determination

Matrix	Soil					
Analytical Spike	When Dilution Test fails or analyte concentration in all samples < 50x LOD	Recovery within 75-125% of expected value	Run all samples by method of standard addition (MSA)	EMAX Analyst	Interferences - Accuracy/Bias - Precision	Recovery within 75-125% of expected value
PT	Bi-annual	Within Study Limits	Review source of error, perform corrective action and rerun PT sample.	EMAX Analyst	Accuracy/Bias	

Matrix	Soil
Analytical Group	Wet Chemistry
Analytical Method / SOP Reference	EMAX-353.3

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch	All analytes <1/2 QLs	Re-prep and reanalyze MB and all samples processed with the non-conforming MB.	EMAX Chemist	Accuracy/Bias - Contamination	All analytes <1/2 QLs
LCS	One in the absence of MS/MSD	% Rec. : 80-120	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Chemist	Accuracy/Bias	% Rec. : 80-120
MS	Project designated sample matrix QC.	%Rec.: 75-125 RPD: ± 20%	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.	EMAX Chemist	Interferences - Accuracy/Bias -	%Rec.: 75-125 RPD: ± 20%
MD	Project designated sample matrix QC.	RPD: ± 20%	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the	EMAX Chemist	Interferences - Accuracy/Bias - Precision	RPD: ± 20%

Matrix	Soil					
			sample.			
PT	Bi-annual	Within Study Limits	Review source of error perform corrective action PT sample.	EMAX Chemist	Accuracy/Bias	Within Study Limits

Matrix	Soil
Analytical Group	Explosives
Analytical Method / SOP Reference	8330

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch	All analytes <1/2 QLs. Blank result must not otherwise affect sample results.	Re-prep and reanalyze MB and all samples processed with the non-conforming MB.	EMAX Chemist	Accuracy/Bias - Contamination	All analytes <1/2 QLs. Blank result must not otherwise affect sample results.
Surrogate	Every analytical sample	Refer to QC Limit Table below	Correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	EMAX Chemist	Accuracy/Bias	Refer to QC Limit Table below
LCS	One per sample preparation batch	Refer to QC Limit Table below	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Chemist	Accuracy/Bias	Refer to QC Limit Table below
MS/MSD	Project designated sample matrix QC.	Refer to QC Limit Table below	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.	EMAX Chemist	Interferences - Accuracy/Bias - Precision	Refer to QC Limit Table below
PT	Bi-annual	Within PT Study Limits	Review source of error perform corrective action PT sample.	EMAX Chemist	Accuracy/Bias	Within PT Study Limits

Matrix	Soil
Analytical Group	Perchlorate
Analytical Method / SOP Reference	Method 6850/ EMAX-6850

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½ RL. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Chemist	Accuracy/Bias - Contamination	No analytes detected > ½ RL. Blank result must not otherwise affect sample results.
LCS	One per sample preparation batch	% Rec. : 80-120	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.	EMAX Chemist	Accuracy/Bias	% Rec. : 80-120
MS/MSD	Project designated sample matrix QC	%Rec.: 80-120 RPD +-15%	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.	EMAX Chemist	Interferences - Accuracy/Bias - Precision	%Rec.: 80-120 RPD +-15%

Matrix	Soil
Analytical Group	White Phosphorus
Analytical Method/SOP Reference	SW7580

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	Each day/batch of analysis, the analyst must analyze a method blank to demonstrate that interferences from the analytical system are under control before any samples are analyzed.,	No analytes detected Background interferences coeluting with method analytes should be below half the PQL.	Investigate source of contamination. Rerun method blank prior to analysis of samples, if possible. Evaluate samples and associated QC: if blank results are above LOQ, report sample results that are < LOQ or > 10 times blank concentration. Reanalyze blank and samples >LOQ and < 10 times blank.	Analyst/Supervisor	Bias/Contamination	Same as QC Acceptance Limits
LCS	One per prep batch of 20 or fewer samples of similar matrix or one per day, whichever comes first	75 to 125% Recovery	Evaluate and reanalyze, if possible. If MS/MSD performed same day and found acceptable, narrate. If the LCS recoveries are high but the sample results are <LOQ, narrate. Otherwise, reprep and reanalyze.	Analyst/Supervisor	Accuracy/Bias	Same as QC Acceptance Limits

Matrix	Soil
Analytical Group	White Phosphorus
Analytical Method/SOP Reference	SW7580

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD	One per prep batch of 20 or fewer samples of similar matrix or one per day, whichever comes first	65% to 135%	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met, unless RPD indicates obvious extraction/analysis difficulties; then, reprep MS/MSD.	Analyst/Supervisor	Accuracy/Bias	Same as QC Acceptance Limits
Results between LOD and LOQ	NA	Apply “J” qualifier to results between LOD and LOQ.	NA	Analyst/Supervisor	Accuracy	Apply “J” qualifier to results between LOD and LOQ

29.0 SAP Worksheet #29 -- Project Documents and Records Table

Document	Where Maintained
Field notes/logbook	GCE project file
COC forms	GCE project file
Audit Checklists/reports	GCE and EMAX project files
Corrective action forms/reports	GCE and EMAX project files
Laboratory data package	GCE project file
Laboratory equipment calibration logs	EMAX project file
Sample preparation logs	EMAX project file
Run logs	EMAX project file
Sample disposal records	EMAX project file

30.0 SAP Worksheet #30 -- Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory / Organization
Soil	Explosives	Worksheet #18 contains all sample locations and sample IDs	8330	14 Day/ 30 Day Final	EMAX Laboratories Inc. 1835 W. 205th St. Torrance, CA 90501 310.618.8889 EMAX PM: Molly Nguyen	PACE Analytical 940 S. Harney St. Seattle, WA 98108 206.767.5060
Soil	Metals	Worksheet #18 contains all sample locations and sample IDs	3050B/6010B/ 6020	14 Day/ 30 Day Final	EMAX Laboratories Inc. 1835 W. 205th St. Torrance, CA 90501 310.618.8889 EMAX PM: Molly Nguyen	PACE Analytical 940 S. Harney St. Seattle, WA 98108 206.767.5060
Soil	VOCs	Worksheet #18 contains all sample locations and sample IDs	8260	14 Day/ 30 Day Final	EMAX Laboratories Inc. 1835 W. 205th St. Torrance, CA 90501 310.618.8889 EMAX PM: Molly Nguyen	PACE Analytical 940 S. Harney St. Seattle, WA 98108 206.767.5060
Soil	SVOCs	Worksheet #18 contains all sample locations and sample IDs	8270	14 Day/ 30 Day Final	EMAX Laboratories Inc. 1835 W. 205th St. Torrance, CA 90501 310.618.8889 EMAX PM: Molly Nguyen	PACE Analytical 940 S. Harney St. Seattle, WA 98108 206.767.5060
Soil	White Phosphorus	See Worksheet #18	7580	21 Business Days	ALS Laboratory Group	
Soil	Perchlorate	Worksheet #18 contains all sample locations and sample IDs	6850	14 Day/ 30 Day Final	EMAX Laboratories Inc. 1835 W. 205th St. Torrance, CA 90501 310.618.8889 EMAX PM: Molly Nguyen	PACE Analytical 940 S. Harney St. Seattle, WA 98108 206.767.5060

31.0 SAP Worksheet #31 -- Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA)	Person(s) Responsible for Monitoring Effectiveness of CA
Readiness Review	1/ Prior to initiating fieldwork	Internal	GCE	GCE -Project Manager	GCE- Project Team/Field Personnel	GCE- Project Manager	GCE- Project Manager
Field Sampling TSA	1/At start of field sampling activities	Internal	GCE	GCE- Quality Assurance Manager	GCE- Project Manager	GCE- Quality Assurance Manager	GCE- Quality Assurance Manager GCE- Project Manager
Field Documentation Review	Daily	Internal	GCE	GCE- Quality Assurance Manager, GCE- Project Manager	GCE- Project Manager	GCE- Quality Assurance Manager	GCE- Quality Assurance Manager GCE- Project Manager

32.0 SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Readiness Review	Written Readiness Review Report	Quality Assurance Manager, GCE	5 days after review	Addendum to Readiness Review	QA Manager, GCE Project Manager, GCE	5 Days
Field Sampling Technical Systems Audit	Written Audit Report	Project Manager, GCE	5 days after audit	Corrective Action Form and/or Field Change Notice (FCN)	QA Manager, GCE Project Manager, GCE NAVFAC RPM	Within 24 Hours
Field Documentation Review	Field Data Review Checklist	Project Manager, GCE	Upon completion of review	Corrective Action Form	Project Manager, GCE	2 Days

33.0 SAP Worksheet #33 -- QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Readiness Review	1/ Prior to initiating fieldwork	10 days prior to initiation of field activities	Project Manager, GCE	Quality Assurance Manager, GCE
Field Sampling TSA	1/At start of field sampling activities	5 days after initiation of sampling activities	Quality Assurance Manager, GCE	Project Manager, GCE
Field Documentation Review	Daily	5 days after completion of field activities	Quality Assurance Manager, GCE	Project Manager, GCE

34.0 SAP Worksheet #34 -- Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
COC forms	COC forms will be reviewed internally upon their completion and verified against the packed sample containers they represent. The shipper's signature on the COC should be initialed by the reviewer, a copy of the COC retained in the project file, and the original and remaining copies taped inside the container for shipment.	Internal	Field Sampling Personnel (GCE)
Field notes/logbook	Field notes and/or entries into the field logbook will be reviewed internally and placed in the project file upon project completion.	Internal	Field Sampling Personnel (GCE) Quality Assurance Manager (GCE)
Audit reports	Upon report completion, a copy of all audit reports will be place in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file.	Internal/ External	Field Sampling Personnel (GCE) Quality Assurance Manager (GCE)
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages will be verified externally according to the data validation procedures specified in Worksheet #36 of this SAP.	Internal/ External	EMAX Laboratories Inc.
Electronic data deliverables	All EDDs will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received EDDs will be verified externally against the hardcopy laboratory data packages.	Internal/ External	EMAX Laboratories Inc.

35.0 SAP Worksheet #35 -- Validation (Steps IIa and IIb) Process Table

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Communication	Establish that required communication procedures were followed by field or laboratory personnel.	Project Manager (GCE) Quality Assurance Manager (GCE)
IIa	Sampling Methods and Procedures	Establish that the required sampling methods were used and that any deviations were noted. Ensure that the sampling procedures and field measurements met performance criteria and that any deviations were documented.	Quality Assurance Manager (GCE)
IIa	Holding Times	Ensure that samples were analyzed within holding times specified in method, procedure, or contract requirements. If holding times were not met, confirm that deviations were documented and that appropriate notifications were made as stated in GCE's Statement of Work to the laboratory.	Quality Assurance Manager (GCE)
IIa	Analytes	Ensure that required lists of analytes were reported as specified in governing documents. (i.e. method procedure or contract).	Quality Assurance Manager (GCE)
IIa	Analytical Methods and Procedures	Establish that the required analytical methods were used and that any deviations were noted. Ensure that the QC samples met performance criteria and that any deviations were documented.	Quality Assurance Manager (GCE)
IIa	Data Qualifiers	Determine that the laboratory data qualifiers were defined in the laboratory data package and applied as specified.	Quality Assurance Manager (GCE)
IIa	Field Transcription	Authenticate transcription accuracy of sampling data (i.e. from field logbook to report).	Quality Assurance Manager (GCE) Project Manager (GCE)
IIb	Sampling Plan	Determine whether the sampling plan was executed as specified (i.e. the number, location, and type of field samples were collected and analyzed as specified in the SAP/QAPP).	Quality Assurance Manager (GCE) Project Manager (GCE)
IIb	Sampling Procedures	Evaluate whether sampling procedures were followed with respect o equipment and proper sampling support (e.g. techniques, equipment, decontamination, volume, temperature, preservative, etc.)	Quality Assurance Manager (GCE) Project Manager (GCE)

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIb	Co-located Field Duplicates	Compare results of collocated field duplicates with criteria established in the SAP/QAPP.	Quality Assurance Manager (GCE)
IIb	Project Quantitation Limits	Determination that quantitation limits were achieved, as outlined in the SAP/QAPP, and that the laboratory successfully analyzed a standard at the quantitation limit	Quality Assurance Manager (GCE)
IIb	Performance Criteria	Evaluate QC data against project specific performance criteria in the SAP/QAPP (i.e. evaluate quality parameters beyond those outlined in the methods).	Quality Assurance Manager (GCE)

36.0 SAP Worksheet #36 –Analytical Data Validation (Steps IIa and IIb) Summary Table

Independent (third party) data validation will not be conducted as part of this project.

37.0 SAP Worksheet #37 -- Usability Assessment

This section describes the QA/QC activities that occur after the data collection phase of the project has been completed to ensure that data conforms to the specified criteria and thus are useful for their intended purpose.

37.1 Usability Assessment Objectives

The data quality is a function of the sampling plan rationale and the procedures used to collect the samples, as well as the analytical methods and instrumentation used. As discussed in the following sections, data collected during this investigation will be evaluated for usability with respect to precision, accuracy, representativeness, completeness, comparability and sensitivity to determine whether the project DQOs have been met. All validated data collected for this investigation will be identified and included in a data usability assessment. The data usability assessment will be completed by GCE personnel under the oversight of Andy Klakulak, the GCE Project Manager. Mr. Klakulak also will be responsible for the coordination and performance of the usability assessment.

37.2 Precision

Precision quantifies the repeatability of a given measurement. Given the limited number of field and QC samples for this project, precision will be measured by the analyses of both field and laboratory duplicate samples, including MS/MSD. The laboratory will review the QC samples to ensure that internal QC data lie within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken. The findings of the usability of the data relative to precision will be included in the report, including any limitations on the data set and/or individual analytical results. Precision is estimated by calculating the relative percent difference (RPD) of the duplicate samples, as shown in the following equation:

$$RPD = \frac{|A - B|}{(A + B)/2} \times 100$$

Where:

A = First duplicate concentration
B = Second duplicate concentration

37.3 Accuracy

Accuracy refers to the percentage of a known amount of analyte recovered from a given matrix. It measures the bias in a measurement system. A measurement is accurate when the value reported does not differ (by a specified amount) from the true value, or from the known concentration of a MS or standard. The accuracy of the analytical determinations will be valued based on the analyses of LCS, MS/MSD, and surrogate spikes (where applicable). The findings of the usability of the data relative to accuracy will be included in the report, including any limitations on the data set and/or individual analytical results. Percent recoveries are estimated using the following equation:

$$\textit{Percent Recovery} = \frac{S - C}{T} \times 100$$

Where:

S = Measured spike sample concentration
C = Sample concentration
T = True or actual concentration of the spike

37.4 Representatives

Representatives expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Sample representativeness will be assessed in terms of adherence to established sample collection procedures, required preservation, storage, and holding times. The findings of the usability of the data relative to representativeness will be included in the report, including any limitations on the data set and/or individual analytical results.

37.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount expected to be obtained under normal conditions. Completeness is determined based on the number of valid points (data not rejected) relative to the total number of validated data. In addition to validated results, broken, spilled samples, and any other problems that may compromise sample representativeness are included in the assessment of completeness.

$$\text{Completeness (\%)} = \frac{\text{Number of Valid Measurements}}{\text{Total Number of Measurement}} \times 100$$

A completeness standard of 90% was established for this project in the approved SAP prepared by CDM Federal Programs Corporation in December of 2005. This standard is based upon generally accepted industry practice, and will be used for this sampling event. The findings of the usability of the data relative to representativeness will be included in the report, including any limitations on the data set and/or individual analytical results.

37.6 Comparability

Comparability expresses the confidence with which one data set is compared with another. This evaluation criterion is critical for use in analyzing temporal trends in constituent variations within the sampling domain. Comparability will be achieved by using standard methods for sampling and analyses, presenting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. The findings of the usability of the data relative to comparability will be included in the report, including any limitations on the data set and/or individual analytical results.

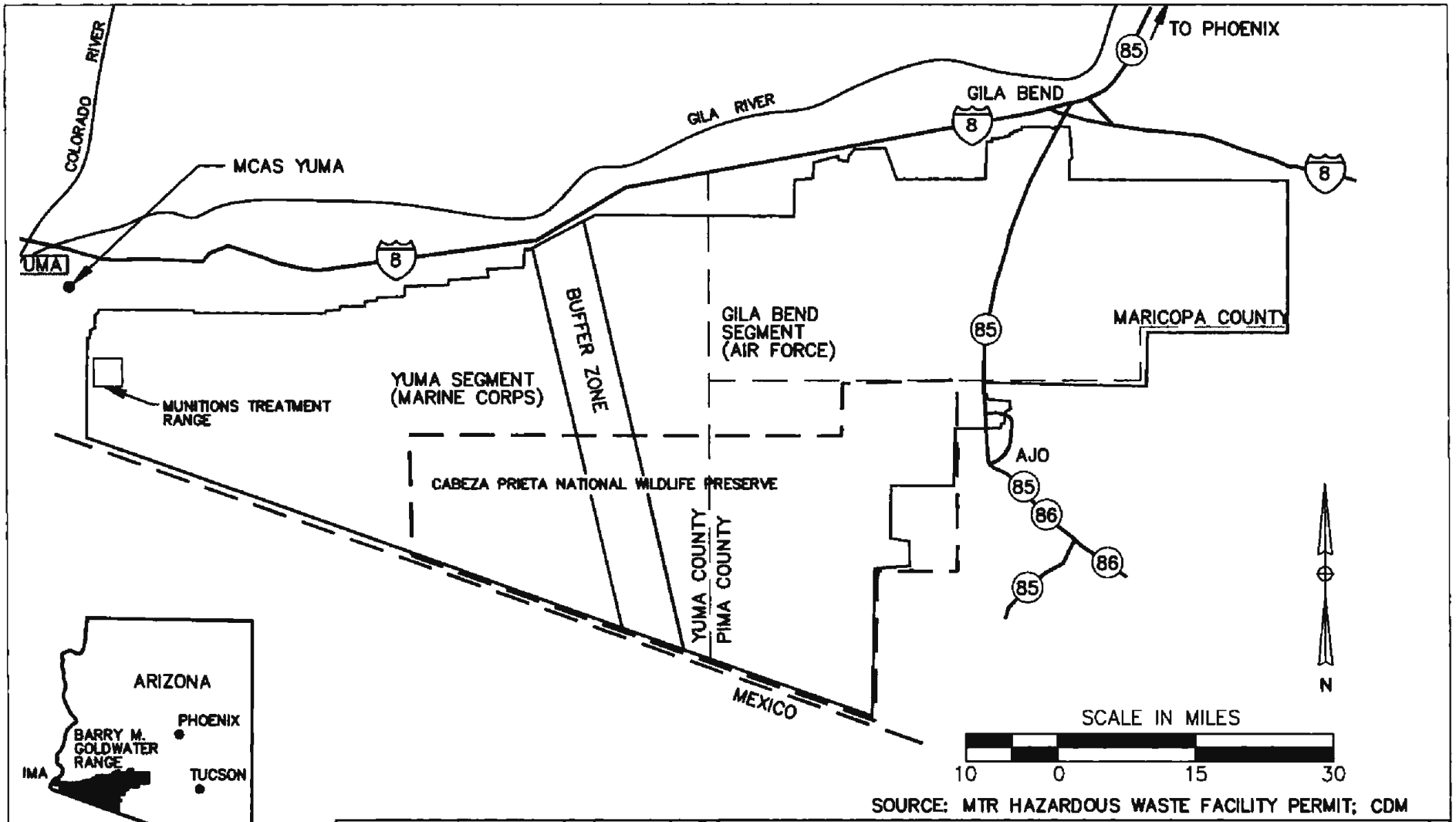
37.7 Sensitivity

Sensitivity is the ability of the analytical test method and/or instrumentation to differentiate between detector responses to varying concentrations of the target constituent. Methodology to establish sensitivity for a given analytical method or instrument includes examination of standardized blanks, instrument detection limit studies, and calibration of the quantitation limits. The findings of the usability of the data relative to sensitivity will be included in the report, including any limitations on the data set and/or individual analytical results.

37.8 Usability Findings

The findings of the usability assessment will be presented in a *Site Assessment Report* and will include, in addition to the criteria described above, an analysis of any discrepancies in the chain of custody, missed holding times for analysis, modifications to the scope of work, field changes, potential matrix interferences, and potential environmental impacts due to site conditions or meteorological effects.

FIGURES



SOURCE: MTR HAZARDOUS WASTE FACILITY PERMIT; CDM

LOCATION PLAN

PREPARED BY

GCE

1851 W. 24th Street
YUMA, ARIZONA 85364 (928) 317-1401
Email: gce@gcepc.com

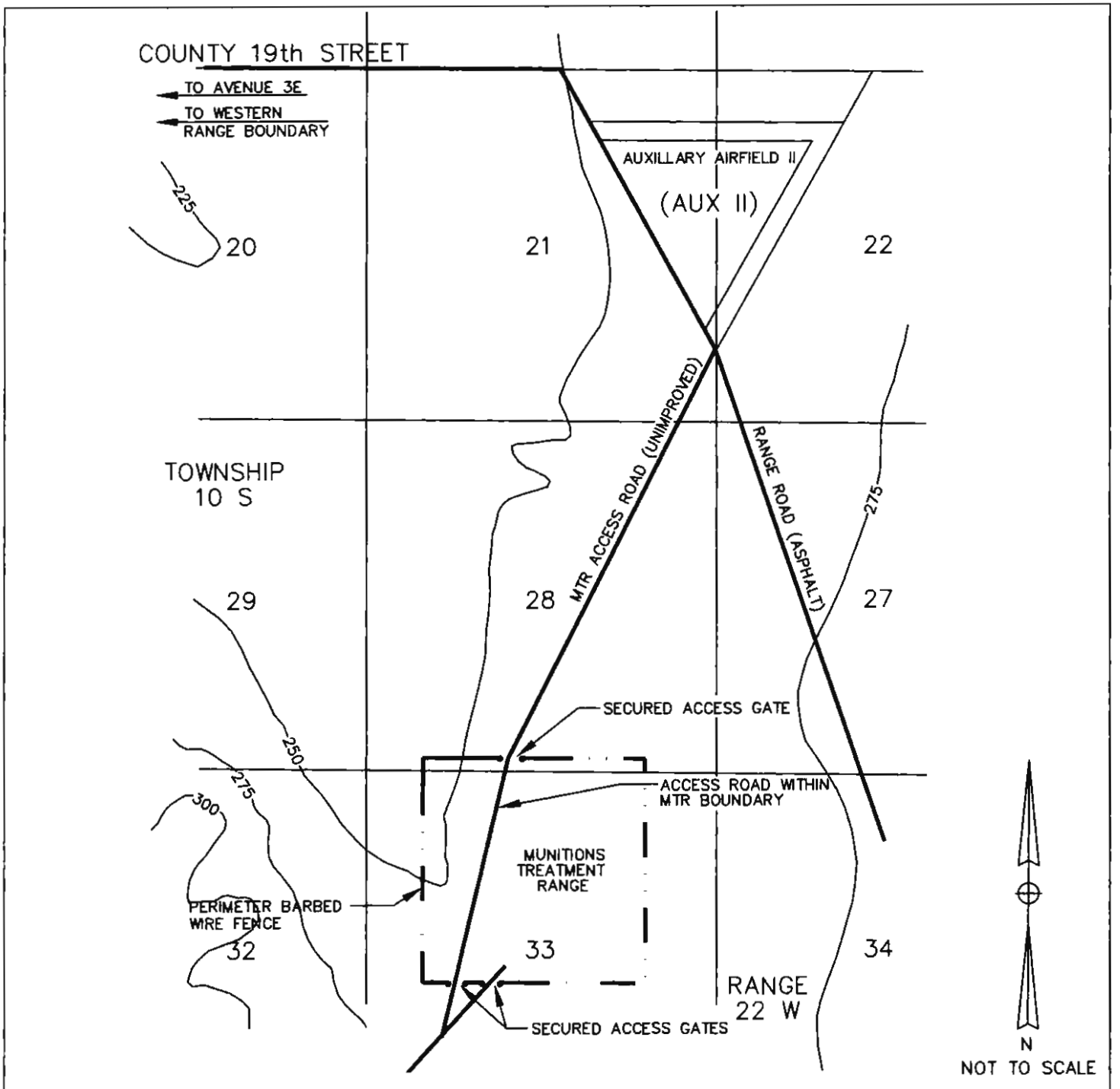
GCE PROJECT NO: 10GC007

AREA LOCATION MAP

MUNITIONS TREATMENT RANGE
BARRY M. GOLDWATER RANGE
MCAS YUMA, YUMA, ARIZONA

SIZE	PROJECT NO.	PROJECT MANAGER	REV
-	10GC007	STACY GUTIERREZ	0

SCALE	NTS	DATE	DECEMBER 2013	DWG	FIGURE 2-1



SOURCE: MTR HAZARDOUS WASTE FACILITY PERMIT; CDM

PREPARED BY

GCE
1851 W. 24th Street
YUMA, ARIZONA 85364 (928) 317-1401
Email: gce@gcepc.com

SITE LOCATION MAP

MUNITIONS TREATMENT RANGE
BARRY M. GOLDWATER RANGE
MCAS YUMA, YUMA, ARIZONA

SIZE	PROJECT NO.	PROJECT MANAGER	REV
-	10GC007	STACY GUTIERREZ	0

GCE PROJECT NO: 10GC007	SCALE	NTS	DATE	DECEMBER 2013	DWG	FIGURE 2-2

APPENDICES

APPENDIX A

STANDARD OPERATING PROCEDURES (SOPs)

Reviewed by:

MARK GALATE
Name

FIELD MANAGER
Title

Mark Galate 3-8-12
Signature **Date**

Approved by:

Stacy Gutierrez
Name

Quality Assurance Manager
Title

3/8/12
Signature **Date**

1.0 Objective

Due to the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in the project files.

Note: This SOP is intended to present basic sample custody requirements, along with common options. Specific sample custody requirements should be presented in the project-specific QAPP.

2.0 Background

2.1 Definitions

Sample – sample is material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody – A sample is under custody if:

1. It is in your possession
2. It is in your view, after being in your possession
3. It was in your possession and you locked it up
4. It is in a designated secure area

Chain-of-Custody Record – A chain-of-custody record is a form used to document the transfer of custody of samples from one individual to another.

Custody Seal – A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

Sample Label – A sample label is an adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag – A sample tag is attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is not feasible to place adhesive labels on the container (e.g., in the case of small sampling tubes).

3.0 Responsibilities

Sampler – The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader – The field team leader (FTL) is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The FTL is also responsible for coordinating with the subcontractor laboratory to ensure that adequate information is recorded on custody records. The FTL determines whether proper custody procedures were followed during fieldwork and decides if additional samples are required.

Field Sample Custodian – The field sample custodian, when designated by the FTL, is responsible for accepting custody of samples from the sampler(s) and properly packing and shipping the samples to the laboratory assigned to do the analyses. A field sample custodian is typically designated only for large and complex field efforts.

4.0 Required Supplies

- Chain-of-custody records
- Sample labels
- Custody seals
- Clear tape

5.0 Procedures

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a chain-of-custody record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations prior to the actual fieldwork. As few people as possible should handle samples.
2. Complete sample labels or tags for each sample using waterproof ink.
3. Maintain personal custody of the samples (in your possession) at all times until custody is transferred for sample shipment or directly to the analytical laboratory.

Transfer of Custody and Shipment

1. Complete a chain-of-custody record for all samples. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents

sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory.

- The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the chain-of-custody record.
- In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.
- If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of custody record.

Note: If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign, and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher.

2. Package samples properly for shipment and dispatch to the appropriate laboratory for analysis. Each shipment must be accompanied by a separate chain-of-custody record. If a shipment consists of multiple coolers, samples in the coolers may be recorded on a single chain-of-custody record.
3. The original record will accompany the shipment, and the copies will be retained by the FTL and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the FTL as part of the permanent documentation. The shipping number from the freight bill shall be recorded on the applicable chain-of-custody record.

Procedure for Completing Chain-of-Custody Record

The following procedure is to be used to fill out the chain-of-custody record. The record provided herein is an example chain-of custody record. If another type of custody record (i.e., provided by the EPA contract laboratory program or a subcontract laboratory) is used to track the custody of samples, the custody record should be filled out in its entirety.

1. Record project number.
2. Record FTL for the project.
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record sample location number.
6. Note preservative added to the sample.

7. Record sample number.
8. Note preservatives added to the sample.
9. Note media type (matrix) of the sample.
10. Note sample type (grab or composite).
11. Enter date of sample collection.
12. Enter time of sample collection.
13. When required by the client, enter the names or initials of the samplers next to the sample location number of the sample they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter matrix spike/matrix spike duplicate (MS/MSD) if sample is for laboratory quality control or other remarks (e.g., sample depth).
16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.
17. If sample tags are used, record the sample tag number in the "Remarks" column.
18. The originator checks information entered in Items 1 through 16 and then signs the top left "Relinquished by" box, prints his/her name, and enters the current date and time.
19. Send the complete chain of custody with the samples to the laboratory; Retain additional copies for the project file or distribute as required to the appropriate sample coordinators.
20. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under "Remarks" on the chain-of custody record. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps the copy.

Attachment 1 is an example Chain of Custody form to be used by GCE Field personnel.

5.2 Sample Labels and Tags

Unless the client directs otherwise, sample labels or tags will be used for all samples collected or accepted.

1. Complete on label or tag with the information required by the client for each sample container collected. A typical label or tag would be completed as follows:
   - Record the project code (i.e., project or task number).
   - Enter the station number (sample number) if applicable.
   - Record the date to indicate the month, day, and year of sample collection.
   - Enter the time (military) of sample collection.

- Place a check to indicate composite of grab sample.
- Record the station (sample) location.
- Sign in the space provided.
- Place a check next to 'yes" or "no" to indicate if a preservative was added.
- Place a check under "Analyses" next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. **Note**: Do not write in the box for "laboratory sample number."
- Place or write additional relevant information under "Remarks."

2. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.
3. Double –check that the information recorded on the sample tag is consistent with the information recorded on the chain-of-custody.

5.3 Sample Shipping

The standard operating procedure listed below defines the requirements for packaging and shipping environmental samples.

- SOP 1-2, Packaging and Shipping Environmental Samples

Reviewed by:

MARK GALATE
Name

FIELD MANAGER
Title

Mark Galate 3-8-12
Signature **Date**

Approved by:

Stacy Gutierrez
Name

Quality Assurance Manager
Title

3/8/12
Signature **Date**

1.0 Packaging and Shipping of All samples

This standard operating procedure (SOP) applies to the packaging and shipping of all environmental samples. If the sample is preserved or radioactive, the following sections may also be applicable.

Section 2.0-Packaging and Shipping Samples Preserved with Sodium Hydroxide
Section 3.0-Packaging and Shipping Samples Preserved with Hydrochloric Acid
Section 4.0-Packaging and Shipping Samples Preserved with Nitric Acid
Section 5.0-Packaging and Shipping Samples Preserved with Sulfuric Acid
Section 6.0-Packaging and Shipping Limited-Quantity Radioactive Samples

1.1 Objective

The objective of this SOP is to outline the requirements for the packaging and shipment of environmental samples. Additionally, Sections 2.0 through 6.0 outline requirements for the packaging and shipping of regulated environmental samples under the Department of Transportation (DOT) Hazardous Materials Regulations, the International Air Transportation Association (IATA), and International Civil Aviation Organization (ICAO) Dangerous Goods Regulations for shipment by air and applies only to domestic shipment (including data loggers and self-contained breathing apparatus (SCBAs) or bulk chemicals that are regulated under the DOT, IATA, and ICAO.

1.2 Background

1.2.1 Definitions

Environmental Sample- An aliquot of air, water, plant material, sediment, or oil that represents the contamination levels on a site. Samples of potential contaminants sources, like tanks, lagoons, or non aqueous phase liquids are normally not "environmental" for this purpose. This procedure applies only to environmental samples that contain less than reportable quantities for any foreseeable hazardous constituents according to DOT regulations promulgated in 49 CFR-Part 172.101 Appendix A.

Custody Seal- A custody seal is a narrow adhesive-backed seal that is applied to individual sample containers and/or the container (i.e., cooler) before offsite shipment. Custody seals are used to demonstrate that sample integrity has not been compromised during transportation from the field to analytical laboratory.

Inside Container- The container, normally made of glass or plastic, that actually contacts the shipped material. Its purpose is to keep the sample from mixing with the ambient environment.

Outside Container- The container, normally made of metal or plastic, that the transporter contacts. Its purpose is to protect the inside container.

Secondary Containment- The outside container provides secondary containment if the inside container breaks (i.e., plastic overpackaging if liquid sample is collected in glass.)

Excepted Quantity- Excepted quantities are limits to the mass or volume of a hazardous material in the inside and outside container below which DOT, IATA, or ICAO regulations do not apply. The excepted quantity limits are very low. Most regulated shipments will be made under limited quantity.

Limited Quantity- Limited quantity is the maximum amount of a hazardous material below which there are specific labeling or packaging exceptions.

Qualified Shipper- A qualified shipper is a person who has been adequately trained to perform the functions of shipping hazardous materials.

1.2.2 Discussion

Proper packaging and shipping is necessary to ensure the protection and the integrity of environmental samples shipped for analysis. These shipments are potentially subject to regulations published by DOT, IATA, or ICAO. Failure to abide by these rules places the risk of serious fines. The analytical holding for the samples must not be exceeded. The samples should be packed in time to be shipped for overnight delivery. Make arrangements with the laboratory before sending samples for weekend delivery.

1.2.3 Associated Procedures

- SOP 1-1, Sample Custody

1.3 Required Equipment

- Coolers with return address of the appropriate office
- Heavy-duty plastic garbage bags
- Plastic sip-type bags, small and large
- Clear tape
- Nylon reinforced strapping tape

- Duct tape
- Vermiculite (or equivalent nonflammable material that is inert and absorbent)
- Bubble wrap (optional)
- Ice
- Custody seals
- Completed chain-of-custody record or contact laboratory program (CLP) custody records, if applicable
- Completed bill of lading
- "This End Up" and directional arrow labels
- Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

1.4 Packaging Environmental Samples

The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of "environmental sample" and are not a hazardous material as defined by DOT. Professional judgment and/or consultation with qualified persons such as the appropriate health and safety coordinator or the health and safety manager should be observed.

2. Select a sturdy cooler in good repair. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler. Line the cooler with a large heavy-duty plastic bag.

3. Be sure that the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-1, Sample Custody).

4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Binding the vials together with a rubber band on the outside of the bag, or separating them so that they do not contact each other, will reduce the risk of breakage. Bottles may be wrapped in bubble wrap. Optionally, place three to six VOA vials in a quart metal can and then fill the can with vermiculite of equivalent. Note: Trip blanks must be included in coolers containing VOA samples.

5. Place 2 to 4 inches of vermiculite (or equivalent) into a cooler that has been lined with a garbage bag, and then place the bottles and cans in the bag with sufficient space to allow for the additional packing material

between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Glass containers are less likely to break when packed vertically rather than horizontally.

6. While placing sample containers into the cooler, conduct an inventory of the contents of the shipping cooler against the chain-of-custody record. The chain-of-custody with the cooler should reflect those samples within the cooler.

7. Put ice in large zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags are required (dependent on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4° Celsius (C) if the analytical method requires cooling. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

8. Place the completed chain-of-custody record for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

9. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed chain-of-custody seal across the opening of the cooler on opposite sides. The custody seals should be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

10. The shipping container lid must be marked "THIS END UP" and arrow labels that indicate the proper upward position of the container should be affixed to the cooler. A label containing the name and address of the shipper shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

2.0 Packaging and Shipping Samples Preserved with Sodium Hydroxide

2.1 Containers

The inner packaging container (and amount preservative) that may be used for these shipments includes:

Table 2-1
Excepted Quantities of Sodium Hydroxide Preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
		pH	Conc.	40ml	125 ml	250ml	500ml	1L
NaOH	30%	>12	0.08%	0	0.25	0.5	1	2

2.2 Responsibility

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

2.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Inner packings may consist of glass or plastic jars no larger than 1 pint
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

2.4 Packaging Samples Preserved with Sodium Hydroxide

The following steps are to be followed when packaging NaOH limited-quantity samples shipments.

- All openings in sample containers will be sealed with waterproof tape from the inside to ensure control of interior contents. Also, the drain plug shall be taped from the outside of the cooler.

- All sample containers will properly labeled and secured with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative
- Wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a zip-type bag, removing trapped air.
- Glass containers may be placed inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full address and state with zip code with both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.

3.0 Packaging and Shipping Samples Preserves with Hydrochloric Acid

3.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Table 3-1
Excepted Quantities of Hydrochloric Acid Preservatives

Preservative		Desired in Final Sample		Quantity of Preservative (ml) for Specified Container		
		pH	Conc.	40ml	125 ml	250ml
HCl	2N	<1.96	0.04%	0 .2	0.5	1

3.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservatives in each sample so that accurate determination of quantities can be made.

3.3 Packaging Samples Preserved with Hydrochloric Acid

The following steps are to be followed when packaging limited-quantity sample shipments.

- All openings in sample containers shall be sealed with waterproof tape from the inside to ensure control of interior contents. Also, the drain plug shall be taped from the outside of the cooler.
- All sample containers will be properly labeled and secured with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative

- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a zip-type bag, removing trapped air.
- Glass containers may be placed inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full address and state with zip code with both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.

4.0 Packaging and Shipping Samples Preserved with Nitric Acid

4.1 Containers

The inner packaging container (and amount preservative) that may be used for these shipments includes:

Table 4-1
Excepted Quantities of Nitric Acid Preservatives

Preservative	Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
	pH	Conc.	40ml	125 ml	250ml	500ml	1L
HNO_3 6N	<1.62	0.15%	0	2	4	5	8

4.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservatives in each sample so that accurate determination of quantities can be made.

4.3 Packaging Samples Preserved with Nitric Acid

The following steps are to be followed when packaging limited-quantity samples shipments.

- All openings in sample containers shall be sealed with waterproof tape from the inside to ensure control of interior contents. Also, the drain plug shall be taped from the outside of the cooler.
- All sample containers will be properly labeled and secured with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative

- Wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a zip-type bag, removing trapped air.
- Glass containers may be placed inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or dust tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full address and state with zip code with both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.

5.0 Packaging and Shipping Samples Preserved with Sulfuric Acid

5.1 Containers

The inner packaging container (and amount preservative) that may be used for these shipments includes:

Table 5-1
Excepted Quantities of Sulfuric Acid Preservatives

Preservative	Desired in Final Sample		Quantity of Preservative (ml) for Specified Container				
	pH	Conc.	40ml	125 ml	250ml	500ml	1L
H_2SO_4 37N	<1.15	0.35%	0.1	.25	0.5	1	2

5.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservatives in each sample so that accurate determination of quantities can be made.

5.3 Packaging Samples Preserved with Sulfuric Acid

The following steps are to be followed when packaging limited-quantity samples shipments.

- All openings in sample containers shall be sealed with waterproof tape from the inside to ensure control of interior contents. Also, the drain plug shall be taped from the outside of the cooler.
- All sample containers will be properly labeled and secured with waterproof tape prior to sampling.
- At a minimum the label must contain:
  - Project name
  - Project number
  - Date and time of sample collection
  - Sample location
  - Sample identification number
  - Collector's initials
  - Preservative

- Wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a zip-type bag, removing trapped air.
- Glass containers may be placed inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
- Seal the garbage bag by tying or taping.
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
- Wrap strapping tape or dust tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full address and state with zip code with both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler
- Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment.

6.0 Packaging and Shipping Limited-Quantity Radioactivity Samples

6.1 Containers

The inner packaging container that may be used for these shipments includes:

- Any size sample container

6.2 Description/Responsibilities

- The qualified shipper will determine that the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.
- The qualified shipper will ship all samples that meet the Class 7 definition of radioactive materials and meet the activity requirements specified in Table 7 of 49 CFR 173.425, as Radioactive Materials in Limited Quantity. The qualified shipper will verify that all packages and their contents meet the requirements of 49 CFR 173.421, *Limited Quantities of Radioactive Materials.*
- The packaging used for shipping will meet the general requirements for packaging and packages specified in 49 CFR 173.24 and the general design requirements provided by 173.410. These standards state that a package must be capable of withstanding the effect of any acceleration, vibration, or resonance that may arise under normal condition of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts or other securing devices even after repeated use.
- If the shipment is from a DOE facility, radiological screenings will be completed on all samples taken. The qualified shipper will review the results of each screening (alpha, beta, and gamma speciation). Samples will not be shipped offsite until the radiological screening has been performed.
- The total activity for each package will not exceed the relevant limits listed in Table 7 of 49 CFR 173.425. The A_2 value of the material will be calculated based on all radionuclides found during previous investigations (if any) in the area from which the samples are derived. The A_2 values to be used will be the most restrictive of all potential radionuclides as listed in 49 CFR 173.435.
- The radiation level at any point on the external surface of the package bearing the sample(s) will not exceed 0.005 millisievert/hour (mSv/Hr); which is equivalent to 0.5 millirem/hour (mrem/Hr). These will be verified by dose and activity monitoring prior to shipment of the package.

- The removable radioactive surface contamination of the external surface of the package will not exceed the limits specified in 49 CFR 173.443(a).
- The qualified shipper will verify that the outside of the inner packaging is marked "Radioactive".
- The qualified shipper will verify that the excepted packages prepared for shipment under the provisions of 49 CFR 173.421 have a notice enclosed, or shown on the outside of the package, that reads, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**

6.3 Additional Required Equipment

The following equipment is needed in addition to the required listed in Section 1.3.

- Survey documentation/radiation screening results (if shipping from DOE or radiological sites)
- Orientation labels
- Excepted quantities level
- Consignor/consignee

6.4 Packaging of Limited-Quantity Radioactive Samples

The following steps are to be followed when packaging limited-quantity sample shipment.

- The cooler is to be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.
- All openings in sample containers shall be sealed with waterproof tape from the inside to ensure control of interior contents. Also, the drain plug shall be taped from the outside of the cooler.
- All sample containers will be properly labeled and secured with waterproof tape prior to sampling.
- At a minimum the label must contain:
    - Project name
    - Project number
    - Date and time of sample collection
    - Sample location
    - Sample identification number
    - Collector's initials
    - Preservative

- Wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
- Place the bubble-wrapped container into a zip-type bag, removing trapped air.
- Glass containers inside a polyethylene bottle filled with vermiculite; seal the bottle.
- Place sufficient amount of vermiculite in the bottom of the cooler to absorb any leakage that may occur.
- Place a garbage bag in the cooler.
- Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
- Place sufficient amount of double-bagged ice around the samples to maintain the required temperature (4^0 C).
- Seal the garbage bag by tying or taping.
- Place a label marked Radioactive on the outside of the sealed bag.
- Enclose a notice that includes the name of the consignor or consignee and the following statement: **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**
- Note that both DOT and IATA apply different limits to the quantity in the inside packing and in the outside packing
- The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
- Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
- If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody form.
- Wrap strapping tape or dust tape around both ends of the cooler and around the cooler lid.
- Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
- Place a label on the front of the cooler with the company name, contact name, phone number, full address and state with zip code with both shipper and recipient.
- Affix package orientation labels on two opposite sides of the cooler/package.
- Affix a completed Excepted Quantities label to the side of the cooler/package.
- Secure any marking and labels to the surface of the cooler with clear water proof tape to prevent accidental removal during shipment.

7.0 References

U.S. Environmental Protection Agency, *Sampler's Guide to the Contract Laboratory Program*, EPA/540/P-90/106, December 1990

U.S. Environmental Protection Agency, Region IV, *Standard Operating Procedures and Quality Assurance Manual*, February 1991.

U.S. Environmental Protection Agency Rule, 40 CFR 136

Appendix A
Dangerous Goods and Hazardous Materials Inspection Checklist For Shipping Limited-Quantity

Sample Packaging

Yes	No	N/A	
☐	☐	☐	The VOA vials are wrapped in bubble wrap and placed inside a zip-type bag.
☐	☐	☐	The VOA vials are placed into a polyethylene bottle, filled with vermiculite, and tightly sealed.
☐	☐	☐	The drain plug is taped inside and outside to ensure control of interior contents.
☐	☐	☐	The samples have been placed inside garbage bags with sufficient bags of ice to preserve samples at 4° C.
☐	☐	☐	The cooler weighs less than the 66-pounds limit for limited-quantity shipment.
☐	☐	☐	The garbage bag has been sealed with tape (or tied) to prevent movement during shipment.
☐	☐	☐	The chain-of-custody record has been secured to the interior of the cooler lid.
☐	☐	☐	The cooler lid and sides have been taped to ensure a seal.
☐	☐	☐	The custody seals have been placed on both the front and back hinges of the cooler, using waterproof tape.

Air Waybill Completion

Yes	No	N/A	
☐	☐	☐	The shipper's name, company, and address; the account number, date, internal billing reference number; and the telephone number have been included.
☐	☐	☐	The recipient's name and company along with a telephone number have been included.
☐	☐	☐	The number of packages and their weights have been filled out.
☐	☐	☐	The Name, Place and Date, Signature, and Emergency Telephone Number appears at the bottom of the FedEx Airbill.
☐	☐	☐	The Emergency Contact Information at the bottom of Airbill is truly someone who can respond any time of the day or night.

Proper Shipping Name	Class or Division	UN or ID No.	Packing Group	Sub Risk	Quantity	Packing Instruction	Authorization
Hydrochloric Acid Solution	8	UN1789	II		1 plastic box x 0.5 L	Y809	Ltd. Qty.
Nitric Acid Solution (with less than 20%)	8	UN2031	II		1 plastic box x 0.5 L	Y807	Ltd. Qty.
Sodium Hydroxide Solution	8	UN1824	II		1 plastic box x 0.5 L	Y809	Ltd. Qty.
Sulfuric Acid Solution	8	UN2796	II		1 plastic box x 0.5 L	Y809	Ltd. Qty.

Sample Cooler Labeling

Yes	No	N/A	
☐	☐	☐	The proper shipping name, UN number, and Ltd. Qty. appears on the shipping container
☐	☐	☐	The corresponding hazard labels are affixed on the shipping container; the labels are not obscured by tape.
☐	☐	☐	The name and address of the shipper and receiver appear on the top and side of the shipping container.
☐	☐	☐	The air waybill is attached to the top of the shipping container.
☐	☐	☐	Up arrows have been attached to opposite sides of the shipping container.
☐	☐	☐	Packaging tape does not obscure markings or labeling.

Reviewed by:

MARK GALATE
Name

FIELD MANAGER
Title

Mark Galate 3-8-12
Signature **Date**

Approved by:

Stacy Gutierrez
Name

Quality Assurance Manager
Title

3/8/12
Signature **Date**

1.0 Objective

The objective of this standard operating procedure (SOP) is to set the criteria for content entry and form of field logbooks. Field logbooks are an essential tool to document field activities for historical and legal purposes.

2.0 Background

2.1 Definitions

Biota- The flora and Fauna of a region

Magnetic Declination Corrections – Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion

Information recorded in field logbooks includes field team names, observations, data, calculations, date/time, weather, and description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain deviations from plans and descriptions of wastes, biota, geologic material and site features including sketches, maps or drawings as appropriate.

3.0 Responsibilities

Field Team Leader – The field team leader (FTL) is responsible for ensuring that the format and content of data entries are in accordance with this procedure.

Site Personnel- All employees who make entries in field logbooks during onsite activities are required to read this procedure prior to engaging in this activity. The FTL will assign field logbooks to site personnel who will be responsible for their care and maintenance. Site personnel will return field logbooks to the records file at the end of the assignment.

4.0 Required Supplies

- Site-specific plans
- Field Notebook
- Indelible black or blue ink pen
- Ruler/Scale

5.0 Procedures

5.1 Preparation

In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with procedures applicable to the field activity being performed. These procedures should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation. These procedures should be located at the field office.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the logbook. Prior to use in the field, the following information shall be recorded on the cover of the logbook:

- Field logbook Project Number/Document control number
- Activity (if the logbook is to be activity-specific) and location
- Name of project contact and phone number(s)
- Start date
- In specific cases, special logbooks may be required (e.g. waterproof paper for stormwater monitoring etc.)

5.2 Operation

Requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information need not be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.

Specific requirements for field logbook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.

- Initial and date all changes
- Multiple authors must sign out the logbook by inserting the following:
  - Date and Time
  - Name of individual making entry
  - Names of field team and other persons onsite
  - Description of activity being conducted including station or location (i.e., well, boring, sampling location number) if appropriate.
  - Weather conditions (i.e. Temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
  - Level of personal protection to be used
  - Required calibration information
  - Serial/tracking numbers on documentation (e.g. carrier air bills)

Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (E.G. data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is toward the top of the page. Maps, sketches, figures, or data that will not fit on a logbook page should be referenced and attached to the logbook to prevent separation.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personal protection equipment.

5.3 Post-Operation

To guard against loss of data due to damage or disappearance of logbooks, completed pages shall be periodically scanned and saved in the electronic project file. Other field records shall be scanned and saved regularly and as promptly as possible to the electronic project file.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated, and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

6.0 Restrictions/ Limitations

Field logbooks constitute the official record of onsite technical work, investigations, and data collection activities. Their use, control and ownership are restricted to activities pertaining to specific field operations carried out by personnel and their subcontractors. They are documents that may be used in court to indicate dates, personnel, procedures, and techniques employed during site activities. Entries made in these logbooks should be factual, clear, precise, and non-subjective. Field logbooks, and entries within, are not to be used for personal use.

Reviewed by:

MARK GALATE
Name

FIELD MANAGER
Title

Mark Galate 3-8-12
Signature **Date**

Approved by:

Stacy Gutierrez
Name

Quality Assurance Manager
Title

3/8/12
Signature **Date**

1.0 Objective

This standard operating procedure (SOP) presents guidance for the management of investigation-derived waste (IDW). The primary objective for managing IDW during field activities include:

- Leaving the site in no worse condition than existed prior to field activites
- Remove wastes that pose an immediate threat to human health or the environment
- Proper handling of onsite wastes that do not require offsite disposal or extended above-ground containerization
- Complying with the federal, state, and facility applicable or relevant and appropriate requirements (ARARs)
- Careful planning and coordination of IDW management options
- Minimizing the quantity of IDW.

2.0 Background

2.1 Definitions

Hazardous Waste- Discarded material that is regulated listed waste, or waste that exhibits ignitability, corrosivity, reactivity, or toxicity as defined in 40 CFR 261.3 or state regulations.

Investigation-Derived Wastes (IDWs)- Discarded materials resulting from field activities such as sampling, surveying, drilling, excavations, and decontamination processes that, in present form, posses no inherent value or additional usefulness without treatment. Wastes may be solid, liquid, or gaseous, or multiphase materials that may be classified as hazardous or non-hazardous.

Mixed-Waste- Any material that has been classified as hazardous and radioactive.

Radioactive Wastes- Discarded materials that are contaminated with radioactive constituents with specific activities in concentrations greater than the latest regulatory criteria (i.e., 10 CFR 20).

Treatment, Storage, and Disposal Facility (TSDF)- Permitted facilities that accept hazardous waste shipments for further treatment, storage, and/or disposal. These facilities must be permitted by the U.S. Environmental Protection Agency (EPA) and appropriate state agencies.

2.2 Discussion

Field Investigation activities result in the generation of waste materials that may be characterized as hazardous or radioactive waste. IDW's may include drilling muds, cuttings, and purge water from test pit and well installation; purge water, soil, and other materials from collection of samples; residues from testing of treatment technologies and pump and treat systems; personal protective equipment (PPE); solutions (aqueous or otherwise) used to decontaminate non-disposal protective clothing and equipment; and other wastes or supplies used in sampling and testing potentially hazardous or radiologically contaminated material.

The client's representatives may not be aware of all potential contaminants. The management of IDW must comply with applicable regulatory requirements.

3.0 Responsibilities

Site Manager- The site manager is responsible for ensuring that all IDW procedures are conducted in accordance with the SOP. The site manager is also responsible for ensuring that handling of IDW is in accordance with site-specific requirements.

Project Manager- The project manager is responsible for identifying site-specific requirements for the disposal of IDW in accordance with federal, state, and/or facility requirements.

Field Crew Members- Field crew members are responsible for implementing this SOP and communicating any unusual or unplanned condition to the project manager's attention.

4.0 Required Equipment

Equipment required for IDW containment will vary according to site-specific/client requirements. Management decisions concerning the necessary equipment required should consider: containment method, sampling, labeling, maneuvering, and storage (if applicable). Equipment must be onsite and inspected before commencing work.

4.1 Required Equipment

The appropriate containment device (drums, tanks, etc.) will depend on site- or client-specific requirements and the ultimate disposition of the IDW. Typical IDW containment devices can include:

- Plastic sheeting (polyethylene) with a minimum thickness of 20 millimeters

- Department of Transportation (DOT) approved steel containers
- Bulk storage tanks comprised of polyethylene or steel

Containment of IDW should be segregated by waste type (i.e., solid or liquid, corrosive or flammable, etc.) and source location. Volume of the appropriate containment device should be site-specific.

4.2 IDW Container Labeling

A "Waste Container" or "IDW Container" label or indelible marking should be applied to each container. Labeling or marking requirements for onsite IDW not expected to be transported offsite are:

- Labels and marking that contain the following information: project name, generation date, location of waste origin, container identification number, sample number (if applicable), and contents (drill cuttings, purge water, PPE, etc.).
- Each label or marking will be applied to the upper one-third of the container as least twice, on opposite sides.
- Containers that are 5 gallons or less may only require one label or set of markings.
- Labels or markings will be positioned on a smooth part of the container. The label must not be affixed across container bungs, seams, ridges, or dents.
- Labels must be constructed of a weather-resistive material with markings made with a permanent marker or paint pen and capable of enduring the expected weather conditions. If markings are used, the color must be easily distinguishable from the drum color.
- Labels will be secured in a manner to ensure the label remains affixed to the container.

Labeling or marking requirements for IDW expected to be transported offsite must be accordance with the requirements of 49 CFR 172.

4.3 IDW Container Storage

Staging areas for IDW containers should be predetermined and in accordance with site-specific and/or client requirements. Arrangements should be made prior to field mobilization as to the methods and personnel required to safely transport IDW containers to the staging area. Transportation offsite onto a public roadway is prohibited unless 49 CFR 172 requirements are met.

4.4 IDW Container Storage

Containerized IDW should be staged pending chemical analysis or further onsite treatment. Staging areas and bulk storage procedures are to be determined according to site-specific requirements. Containers are to be stored in such a fashion that the labels can be easily read. A secondary/spill container must be provided as appropriate.

5.0 Procedures

The three general options for managing IDW are (1) collection and onsite disposal, (2) collection for offsite disposal, and (3) collection and interim management. Attachment 1 summarizes media-specific information on generation processes and management options. The option selected should take into account the following factors:

- Type (soil, sludge, liquid, debris), quantity, and source of IDW
- Risk posed by managing the IDW onsite
- Compliance with regulatory requirements
- IDW minimization and consistency with the IDW remedy and the site remedy

In all cases the client should approve the plans for IDW. Formal plans for the management of IDW must be prepared as part of a work plan or separate document.

5.1 Preparation

5.1.1 Soil/Sludge/Sediment

The options for handling soil/sludge/sediment IDW are as follows:

1. Return to boring, pit, or source immediately after generation as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will to be replaced at a greater depth than where it was originally so that it will not contaminate "clean" areas).
2. Spread around boring, pit, or source within the area of contamination (AOC) as long as returning the media to these areas will not increase site risks (e.g., direct contact with surficial contamination).
3. Consolidate in a pit within the AOC as long as returning the media to these areas will not increase site risks (e.g., the contaminated soil will not be replaced as a greater depth than where it was originally so that it will not contaminate "clean" areas).
4. Send to onsite TSDF- may require analytical analysis prior to treatment/disposal.

Note: These options may require client and/or regulatory approval.

5.1.2 Aqueous Liquids

The options for handling aqueous liquid IDW are as follows:

1. Discharge to surface water, only when IDW is not contaminated.
2. Discharge to ground surface close to the well, only if soil contaminants will not be mobilized in the process and the action will not contaminate clean areas. If IDW from the sampling of background upgradient wells is not a community concern or associated with soil contamination, this presumably uncontaminated IDW may be released on the ground around the well.
3. Discharge to sanitary sewer.
4. Send to onsite TSDF-may require analysis prior to treatment/disposal.

Note: These options may require analytical results to obtain client and/or regulatory approval.

5.1.3 Disposal PPE

The options for handling disposable PPE are as follows:

1. Double-bag contents in non-transparent rash bags and place in outsite industrial dumpster, only if PPE is not contaminated.
2. Containerize, label, and send to onsite TSDF- may require analysis prior to treatment/disposal.

5.2 Offsite Disposal

Before sending to an offsite TSDF, analysis may be required. Also, manifests are required. Arrangements must be made with the client responsible for the site. The TSDF and transporter must be permitted for the respective wastes. All costs associated with disposal of Investigation Derived Wastes are the responsibility of GCE.

5.2.1 Soil/Sludge/Sediment

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., drummed, covered in a waste pile) or returned to its source until final disposal. The management option selected should take into account the potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.2 Aqueous Liquids

When the final site remedy requires offsite treatment and disposal, the IDW may be stored (e.g., mobile tanks or drums) until final disposal. The management option selected should take into account the potential for increased risks,

applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.2.3 Disposable PPE

When the final site remedy requires offsite treatment disposal, the IDW may be containerized and stored. The management option selected should take into account potential for increased risks, applicable regulations, and other relevant site-specific factors (e.g., weather, storage space, and public concern/perceptions).

5.3 Interim Measures

All interim measures must be approved by the client and regulatory agencies.

1. Storing IDW onsite until the final action may be practical in the following situations:
    a. Returning wastes (especially sludges and soils) to their onsite source area would require re-excavation for disposal in the final remediation alternative.
    b. Interim storage in containers may be necessary to provide adequate protection to human health and the environment.
    c. Offsite disposal options may trigger land disposal regulations under the Resource Conversation and Recovery Act (RCRA). Storing IDW until the final disposal of all wastes from the site will eliminate the need to address this issue more than once.
    d. Interim storage may be necessary to provide time for sampling and analysis.
2. Segregate and containerize all waste for future treatment and/or disposal.
    a. Containment options for soil/sludge/sediment may include drums or covered waste piles in AOC.
    b. Containment options for aqueous liquids may include mobile tanks or drums.
    c. Containment options for PPE may include drums or roll-off boxes.

6.0 Restrictions/Limitations

Site Managers Should Determine the Most Appropriate Disposal Option for Aqueous Liquids on a Site-Specific Basis. Parameters to consider, especially when determining the level of protection, include the volume of IDW, the contaminants present in the groundwater, the presence of contaminants in the soils at the site, whether the groundwater or surface water is a drinking water supply, and whether the groundwater plume is contained or moving. Special disposal/handling may be needed for drilling fluids because they may contain significant solid components.

Disposable sampling materials, disposable PPE, decontamination fluids, etc. will always be managed on a site-specific basis. **Under no circumstances should these types of materials be brought back to the office.**

7.0 References

Environmental Resource Center. 1992. *Hazardous Waste Management Compliance Handbook*, Van Nostrand Reinhold.

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U.S. Environmental Protection Agency. January 1992. *Guide to Management of Investigation-Derived Wastes*, 9345.3-03FS

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Attachment 1
IDW Management Options

Type of IDW	Generation Processes	Management Options
Soil	• Well/Test pit installations • Borehole drilling • Soil sampling	**Onsite Disposal** • Return to boring, pit, or source immediately after generation • Spread around boring, pit, or source within the AOC • Consolidate in a pit (within the AOC) • Send to onsite TSDF **Offsite Disposal** • Client to send to offsite TSDF **Interim Management** • Store for future treatment and/or disposal
Sludge/Sediment	• Sludge pit/sediment sampling	**Onsite Disposal** • Return to boring, pit, or source immediately after generation • Send to onsite TSDF **Offsite Disposal** • Client to send to offsite TSDF **Interim Management** • Store for future treatment and/or disposal
Aqueous Liquids (groundwater, surface water, drilling fluids, wastewaters)	• Well installation/development • Well purging during sampling • Groundwater discharge during pump tests • Surface water sampling • Wastewater sampling	**Onsite Disposal** • Pour onto ground close to well (no hazardous waste) • Discharge to sewer • Send to onsite TSDF **Offsite Disposal** • Client to send to offsite commercial treatment unit • Client to send to publicly owned treatment works (POTW) **Interim Management** • Store for future treatment and/or disposal
Decontamination Fluids	• Decontamination of PPE and equipment	**Onsite Disposal** • Send to onsite TSDF • Evaporate (for small amounts of low contamination organic fluids) • Discharge to ground surface **Offsite Disposal** • Client to send to offsite TSDF • Discharge to sewer **Interim Management** • Store for future treatment and/or disposal

Type of IDW	Generation Processes	Management Options
Disposable PPE and Sampling Equipment	• Sampling procedures or other onsite activities	**Onsite Disposal** • Place in onsite industrial dumpster • Send to onsite TSDF **Offsite Disposal** • Client to send to offsite TSDF **Interim Management** • Store for future treatment and/or disposal

Adapted from U.S. Environmental Protection Agency, Guide to Management of Investigation-Derived Wastes, 9345-03FS, January 1992

Reviewed by:

MARK GALATE
Name

FIELD MANAGER
Title

Mark Galate 3-8-12
Signature **Date**

Approved by:

Stacy Gutierrez
Name

Quality Assurance Manager
Title

3/8/12
Signature **Date**

1.0 Objective

The objective of this standard operating procedure (SOP) is to describe the general procedures required for decontamination of field equipment at non-radioactive sites. This SOP serves as a guide and is applicable at most sites: however, it should be noted that site-specific conditions (i.e. type of contamination, type of media sampled) and the governing agency (i.e. EPA, DOE, ASACE) may require modifications to the decontamination procedures provided in this SOP.

2.0 Background

2.1 Definitions

Analyte- Free Water- Tap water that has been treated so that the water contains no detectable heavy metals or other inorganic compounds. Analyte-free water should be stored only in clean glass, stainless steel, or plastic containers that can be closed when not in use.

Clean– Free of visible contamination and when decontamination has been completed in accordance with this SOP.

Cross Contamination- The transfer of contaminants through equipment or personnel from the contamination source to less contaminated or non-contaminated samples or areas.

Decontamination- The process of rinsing or otherwise cleaning the surfaces of equipment to rid them of contaminants and to minimize the potential for cross contamination of samples or exposure of personnel.

Organic-Free/Analyte-Free Water – Tap water that has been treated so that the water meets the analyte-free water criteria and contains no detectable organic compounds. Organic-free/analyte-free water should be stored only in clean glass, Teflon, or stainless steel containers that can be closed when not in use.

Potable Water- Tap water may be obtained from any municipal system. Chemical analysis of the water source may be required before it is used.

Soap – Low-sudsing, non-phosphate detergent such as Liquinox ™ and Alconox.

2.2 Discussion

Decontamination of field equipment is necessary to ensure acceptable quality of samples by preventing cross contamination. Further, decontamination reduces health hazards and prevents the spread of contaminants offsite.

3.0 Responsibilities

Field Team Leader – The field team leader (FTL) ensures that the field personnel are trained in the performance of this procedure and that decontamination is conducted in accordance with this procedure. The FTL may also be required to collect an document rinsate samples to provide quantitative verification that these procedures have been correctly implemented.

4.0 Required Supplies

- Stiff-bristle scrub brushes
- Plastic buckets and troughs
- Soap
- Nalgene or Teflon sprayers or wash bottles or 2 to 5 gallon, manual-pump sprayer (pump sprayer material must be compatible with the solution used)
- Plastic sheeting
- Disposable wipes, rags, or paper towels
- Potable water
- Analyte-free water
- Organic-free/analyte free water
- Gloves, safety glasses and other protective clothing as specified in the site-specific health and safety plan
- High-pressure pump with soap dispenser or steam-spray unit (for large equipment only)
- Tools for equipment assembly and disassembly (as required)

5.0 Procedures

All reusable equipment (non-dedicated) used to collect handle, or measure samples will be decontaminated before coming into contact with any sample. Decontamination of equipment will occur either at a central decontamination station or at portable decontamination stations set up at the sampling location, drill site, or monitoring well location. The centrally located decontamination station will include an appropriately sized bermed and lined area on which equipment decontamination will occur and shall be equipped with a collection system and storage vessels. In certain circumstances, berming is not required when small quantities of water are being generated and for some short duration field activities (i.e. pre-remedial sampling). Equipment should be transported to the decontamination station in a manner to prevent cross-contamination of equipment and/or area. Precautions taken may include enclosing augers in plastic wrap while being transported on a flatbed truck.

The decontamination area will be constructed so that contaminated water is either collected directly into appropriate containers (5-gallon buckets or steel wash tubs) or within the berms of the decontamination area that then drains into

a collection system. Water from the collection system will be transferred into 55 gallon drums or portable tanks for storage. Typically, decontamination water will be staged until sampling results or waste characterization results are obtained and evaluated and the proper disposition of the waste is determined. The exact procedure for decontamination waste disposal should be discussed in the field plan.

All items that will come into contact with potentially contaminated media will be decontaminated before use and between sampling and/or drilling locations. If decontaminated items are not immediately used, they will be covered either with clean plastic or aluminum foil depending on the size of the item. All decontamination procedures for the equipment being used are as follows.

General Guidelines

- Potable, analyte-free, and organic free/analyte free water should be free of all contaminants of concern. Following the field plan, analytical data from the water source may be required.
- Decontaminated equipment will be allowed to air dry before being used.
- Documentation for all cleaning will be recorded in the appropriate logbook.
- Gloves, boots, safety glasses, and any other personnel protective clothing and equipment will be used as specified in the site-specific health and safety plan.

5.1 Heavy Equipment Decontamination

Heavy equipment includes drilling rigs and backhoes. Follow these steps when decontaminating this equipment:

- Establish a bermed decontamination area that is large enough to fully contain the equipment to be cleaned. If available, an existing wash pad or appropriate paved and bermed area may be used; otherwise, use one or more layers of heavy plastic sheeting to cover the ground surface and berms. All decontamination pads should be upwind of the area under investigation.
- With the rig/equipment in place, spray areas exposed to contaminated material (soils) using a hot water high-pressure sprayer. Be sure to spray down all surfaces, including the undercarriage.
- Use brushes, soap, and potable water to remove dirt whenever necessary.

- Remove equipment from the decontamination pad and allow it to air dry before returning it to the work site.

- Record the equipment type, date, and time and method decontamination in the appropriate logbook.

- After decontamination activities are completed, collect all contaminated wastewater, plastic sheeting, and disposable gloves, boots, and clothing in separate containers or receptacles. All receptacles containing contaminated items must be properly labeled for disposal as detailed in the field plan. Liquids and solids must be drummed separately.

5.2 Downhole Equipment Decontamination

Downhole equipment includes hollow-stem augers. Drill pipes, rods, stems, etc. Follow these steps when decontaminating this equipment:

- Set up a centralized decontamination area, if possible. This area should be set up to collect contaminated rinse waters and to minimize the spread of airborne spray.

- Set up a "clean" area upwind of the decontamination area to receive cleaned equipment for air-drying. At a minimum clean plastic sheeting must be used to cover the ground, tables, or other surfaces on which decontaminated equipment is to be placed. All decontamination pads should be upwind of any areas under investigation.

5.3 Sampling Equipment Decontamination

- Set up a decontamination line on plastic sheeting. The decontamination line should progress from "dirty" to "clean". A clean area shall be established upwind of the decontamination wash/rinse activities to dry the equipment. At a minimum, clean plastic sheeting must be used to cover the ground, table, or other surfaces that the decontaminated equipment is placed for drying.

- Disassemble any items that may trap contaminants internally. Do not reassemble the items until decontamination and air drying are complete.

- Wash the items with potable water and soap using a stiff brush as necessary to remove particulate matter and surface films. The items may be steam cleaned using soap and hot water as an alternative to brushing. Note that polyvinyl chloride or plastic items should not be steam cleaned. Items that have come into contact with concentrated and/or oily contaminants may need to be rinsed with a solvent such as hexane and allowed to air dry prior to the washing step.

- Thoroughly rinse the items with potable water.

- If sampling for metals, thoroughly rinse the items with an acid solution (e.g., 10 percent nitric acid) followed by a rinse using analyte-free water. If sampling for organic compounds, thoroughly rinse the items with solvent (e.g., isopropanol) followed by a rinse using analyte-free water. The specific chemicals used for the acid rinse and solvent rinse phases should be specified in the work plan. The acid rinsate and solvent rinsate must each be containerized separately. Acids and solvents are potentially hazardous materials and care must be exercised when using these chemicals to prevent adverse health affects (e.g., skin burns, irritation to the eyes and respiratory system, etc.). Appropriate personal protective equipment must be worn when using these chemicals. These chemicals (including spent rinsate) must be managed and stored appropriately. Special measures such as proper labels, paperwork, notification, etc. may be required when transporting of shipping these chemicals.

- Rinse the items thoroughly using organic-free/analyte-free water.

- Allow the items to air dry completely.

- If large quantities of used decontamination solutions will be generated, each type of waste should be contained in separate containers.

- Unless otherwise required, plastic sheeting and disposable protective clothing may be treated as solid, nonhazardous waste.

- Waste liquids should be sampled, analyzed for contaminants of concern in accordance with disposal regulations, and disposed of accordingly.

6.0 Restrictions/ Limitations

Nitric acid and polar solvent rinses are necessary only when sampling for metals or organics respectively. These steps should not be used, unless required, because of the potential for acid burns and ignitability hazards.

If the field equipment is not thoroughly rinsed and allowed to completely air dry before use, volatile organic residue, which interferes with the analysis, may be detected in the samples. The occurrence of residual organic solvents is often dependent on the time of year sampling is conducted. In the summer, volatilization is rapid, and in the winter, volatilization is slow. Check with your EPA region, state, and client for approved decontamination solvents.

7.0 References

American Society for Testing and Materials. 2002. Practice for Decontamination of Field Equipment at Nonradioactive Waste Sites, ASTM D5088-02. January 10.

Department of Energy. Hazardous Waste Remedial Actions Program. 1996. Standard Operating Procedures for Site Characterization, DOE/HWP-100/r1. September.

Reviewed by:

MARK GALATE
Name

FIELD MANAGER
Title

Mark Galate 3-8-12
Signature **Date**

Approved by:

Stacy Gutierrez
Name

Quality Assurance Manager
Title

3/8/12
Signature **Date**

TABLE OF CONTENTS

Section **Page**

1. INTRODUCTION 3
   - 1.1 Overview 3
   - 1.2 Objective 3
   - 1.3 Equipment and Supplies 3
2. PROCEDURES 4
   - 2.1 Pre-Mobilization Activities 4
   - 2.2 Pre-Sampling Procedures 5
     - 2.2.1 Inventory 5
     - 2.2.2 Calibration 5
     - 2.2.3 Well Inspection 5
   - 2.3 Well Purging and Sampling 5
     - 2.3.1 Set-up 6
     - 2.3.2 Purging (Low Flow Protocol) 6
     - 2.3.3 Variations from Low Flow Protocol 7
     - 2.3.4 Field Measurements 8
     - 2.3.5 Sampling 8
     - 2.3.6 Observations During Sampling 10
     - 2.3.7 Storage and Shipping 10
   - 2.4 Documentation 10

ATTACHMENT A- Background on low flow/minimal drawdown purging

1. INTRODUCTION

1.1 Overview

This Standard Operating Procedure (SOP) was prepared to provide instructions for groundwater sampling using the USEPA low-flow/minimal drawdown well purging protocol. Included in this SOP are field forms for sampling and meter calibration, instructions, and directions for documentation.

This SOP will be implemented in accordance with the following governing documents:

- Site Safety and Health Plan (SSHP), which identifies all physical, chemical, and biological hazards relevant to each field task and provides hazard mitigators to address these hazards;
- Sampling and Analysis Plan (SAP), which provides details for field sampling locations and procedures and which will be most frequently used by field staff on-site; and

1.2 Objective

The objective of low flow sampling techniques is to collect a representative groundwater sample from a monitoring well.

1.3 Equipment and Supplies

Pump and probe selection may differ depending on the well diameter, groundwater constituents, and depth to groundwater, but generally, sampling will require the following equipment:

- Peristaltic, bladder, submersible, or Waterra pump capable of a flow rate between 50 and 500 mL/minute and appropriate power supply, including compressor if needed. The pump type will principally depend on the depth to water and well diameter. Bladder or submersible pumps are preferred, peristaltic pumps are acceptable only for wells where the depth to water is less than about 25 feet, and Waterra pumps are only recommended for narrow diameter wells that cannot be sampled using a bladder or peristaltic pump.
- Field probe and flow-through cell (e.g., YSI) for measuring pH, temperature, conductance (and/or specific conductance), dissolved oxygen (DO), and oxidation-reduction potential (ORP) of groundwater, and a turbidity meter.
- Calibration solutions for the field probes, per manufacturer's requirements.
- Water level tape.

- Teflon-lined tubing, connections, and tools as appropriate; sufficient tubing to dedicate to each well.
- In-line filter apparatus (0.45-micron).
- Graduated cylinder or 1-liter bottle and stopwatch.
- 5-gallon bucket and funnel for purge water.
- Field forms for meter calibration and groundwater sample collection (included in SOP) and log book as specified in FSP.
- Personal Protective Equipment (PPE) (as specified in the SSHP).
- Air monitoring equipment as specified in SSHP.
- Decontamination supplies as specified in SAP.
- Sample containers and cooler.
- Clean plastic sheeting, paper towels, and miscellaneous supplies.
- pH paper.
- Field test kits for ferrous iron, sulfide, and alkalinity.

2. PROCEDURES

2.1 Pre-Mobilization Activities

- Obtain the construction, diameter, depth, material, screened interval, and map showing location for each monitoring well to be sampled.
- Obtain a listing of the parameters that will be measured in the field or laboratory as part of this sampling program including the required analytical method, sample volume, and holding time for each parameter. The parameters that will be measured in the field are the low-flow stabilization parameters including temperature, pH, specific conductance, ORP, DO, and turbidity. These parameters will be recorded during low flow purging and immediately prior to collection of samples for laboratory analysis. In addition, certain geochemical parameters, such as ferrous iron, will be measured in the field through test kits. Remaining parameters will be measured in the laboratory.
- Verify that all equipment on order is being shipped to the site.

2.2 Pre-Sampling Procedures

Several steps are required before sampling any of the wells. These steps ensure that instruments are functioning and properly calibrated and that the necessary equipment has been supplied for efficient and accurate sampling.

Inventory

Verify that the correct equipment has been received by the field site and that it is clean (decontaminated). Inventory sample containers to verify that the laboratory has provided the correct number of containers of the proper size and containing the correct preservative if required. To the extent possible, pre-label/tag and bundle sample containers for each well to avoid confusion during sample collection.

Verify that the appropriate PPE and ancillary supplies (e.g., paper towels, decontamination solution) have been received by the field site. The appropriate protective equipment, as specified in the SSHP, will be reviewed during a morning tailgate meeting. Contact the field manager or project manager immediately if there are discrepancies.

2.2.2 Calibration

Calibrate the field probes consistent with the manufacturer's specifications before sampling and at the start of each field day. Record the calibration data on the field calibration form provided in this SOP. A check of the calibration shall be performed at least once more during the field day. Instruments will be recalibrated as necessary (e.g., when calibration checks indicate incorrect operation) to ensure accurate measurements, and all checks and recalibrations will be recorded on field calibration forms. Calibration will also be checked if any readings during sampling are suspect.

2.2.3 Well Inspection

Inspect the well for the presence of lock and cap, surface seal integrity, obstructions, evidence of tampering, debris, or surface water collecting in flush mounts. Note any irregularities in the groundwater sampling field form included with this SOP.

2.3 Well Purging and Sampling

Sampling is performed in teams according to the health and safety protocol for the site. Sampling is performed using a five-step procedure that will be followed upon arrival at each well:

1. set-up;
2. purging;
3. measurement of field parameters and field testing;
4. sampling; and
5. clean-up and decontamination.

Detailed procedures for performing each of these steps are provided in the following subsections.

2.3.1 Set-up

All necessary equipment for purging, sampling, and storage will be brought to the well before the well is opened. Equipment will be placed on a clean plastic sheet near the well. General parameters describing the well and field condition (e.g., well identification, depth, weather, date, and time) will be documented on a field data sheet. PPE, as required by the SSHP, will be donned prior to opening well, and air monitoring will be performed per SSHP requirements while opening well. Sampling begins by opening the well and measuring the depth to the water table. The tubing, field probe, and reservoir for purged water are then set up.

2.3.2 Purging (Low Flow Protocol)

Wells are purged using the low flow/minimum drawdown protocol as described by Puls and Barcelona (1996) and summarized below. The general procedural requirements for low-flow purging are listed below.

- Lower the pump slowly down the well, positioning the well intake at the middle of the well screen.
- Minimize disturbance of the water column in the well by initiating pumping at a low rate (see below). Dedicated tubing (left in-place between sampling events) is also recommended to minimize disturbance to the water column before and during sampling.
- Begin pumping at a steady rate of 100 mL/min and measure the depth to water frequently (e.g., every minute for the first few minutes) to ensure that less than 0.1 ft of drawdown occurs. The pumping rate may be increased if drawdown is less than 0.1 ft, but the pumping rate will not exceed 500 mL/min. In some silty and/or clayey formations, drawdown may exceed 0.1 ft when pumping at 100 mL/min. If this occurs, refer to the sections on

Variations from Low Flow Protocol for alternatives to the low flow/minimum drawdown protocol.

- Field parameters and depth to water will be recorded on field data sheets a minimum of every five minutes while purging. Purging will continue until pH, temperature, specific conductance, ORP, DO, and turbidity stabilize (three consecutive readings), which is defined as follows:
    - ±0.1 units for pH;
    - ±3% for specific conductance;
    - ±10 mV for ORP;
    - ±10% for temperature;
    - ±10% for turbidity; and
    - ±10% for DO.

  DO and turbidity tend to stabilize last and are better measures of sufficient purging. Drawdown should be minimized during purging and/or sampling, not exceeding 0.1 ft, if possible.

- In the case that the above criteria for stabilization are not met before three well volumes have been pumped, then a maximum of five well volumes will be pumped before samples are taken. Also, if stabilization has not occurred after two hours of purging regardless of well volume status, samples will be collected at this point.

2.3.3 Variations from Low Flow Protocol

Wells in low-yield formations such as poorly fractured bedrock and silt or clay soils may not yield sufficient water for purging (e.g., 100 mL/min) without more than 0.1 ft of drawdown. In these cases, a modified low-flow method will be used. Currently, there is no published protocol for sampling low-recharge wells. Two modifications described below have been endorsed at one site by USUSEPA for sampling and purging wells that yield less than 100 mL/min at a drawdown of 0.1 ft.

Alternative Method 1: Less than half the casing volume is located above the well screen

Purge the well with the pump intake located at the midpoint of the well screen by constant pumping at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. Measure and record the field parameters and water depth at a minimum of five-minute intervals or at the end of every purge cycle, although it may

be difficult to obtain stable measurements of certain parameters (i.e., DO, ORP, turbidity). Cease pumping and allow the water level to recover until the standing water column in the well (length from water level to bottom of well) equilibrates to at least 90% of the static water column. Repeat the purging and cessation cycle until a minimum of one casing volume is removed from the well. The well will then be allowed to recover sufficient volume to collect the required groundwater sample from the midpoint of the screened interval, within 24 hours of the last purging event.

Alternative Method 2: More than half the casing volume is located above the well screen

The well will be purged with the pump intake located at midpoint of the well screen at a rate no greater than 500 mL/min until the water level reaches the top of the well screen. This will remove at least one-half of a casing volume of water from the well. The well is then allowed eight hours to recover, after which time a volume of water equal to the casing volume of the screened interval will be removed, removing approximately a full casing volume during the two purging events. Directly following the second purging event, the required groundwater sample is to be collected from the midpoint of the screened interval.

Other Modifications to Low Flow Sampling

Other modifications of the low-flow protocol may be required. Low-recharge wells screened across the water table are not amenable to either of the methods described above. It may not be practical to sample extremely low recharge wells using any of the cited modifications, in which case, it will be necessary to evacuate all casing water and re-sample as soon as sufficient recharge has entered the well to provide a sample. Data from such wells will be qualified to indicate the potential for sample bias.

2.3.4 Field Measurements

Field parameter measurements will be recorded following parameter stabilization (purging) and before sampling. The pumping rate and sampler intake location in the well are not to be adjusted after purging. The field parameters measured are pH, temperature, specific conductance, DO, ORP, and turbidity.

2.3.5 Sampling

Samples will be collected after field parameters have stabilized and measurements recorded. The pump rate and sample intake location will not be adjusted between purging and sampling. Samples are to be obtained from the influent line (prior) to the flow-through cell (i.e., field parameters cannot be measured during sampling). The following sampling strategy is to be followed at each location in its entirety prior to beginning a new location.

Sampling Methods by Analytical Group

Sample containers are to be filled in the order listed below and on the field data sheet using the following protocols. Note that many sample containers contain preservatives; hence, it is necessary to fill each container carefully enough to avoid or minimize overfilling, which may dilute the preservative to unacceptable levels. For each analysis, one of the corresponding containers will be tested with pH paper to confirm that the pH meets the corresponding limits stated in this SOP.

1. Volatile organic compound (VOC) samples will be collected first. Sample containers are to be completely filled so that a meniscus forms over the opening of the container. The container lid will be moistened with groundwater and screwed to the container body. The container is then turned upside down and inspected for air bubbles. If air bubbles exist in the container, then it is "topped off" to eliminate bubbles. This procedure is repeated until there are no entrapped bubbles in the container. Filled samples are stored at 4°C (±2°C).
2. Geochemistry-related parameters are to be sampled in the following order and with the following procedure:

    a) Alkalinity, ferrous iron, and sulfide measurements will be collected in the field per the field kit manufacturer's instructions.
    b) Major anions (sulfate, orthophosphate) – water will be dispensed into two 500 mL plastic bottles, sealed and stored at 4°C (±2°C).
    c) Total Organic Carbon (TOC) – water will be dispensed into a 125 mL amber glass bottle with H_3PO_4 as a preservative to achieve a pH below 2, sealed, and stored at 4°C (±2°C).
3. After all of the geochemistry-related parameters are collected, the following samples are collected:

    a) Semi-volatile organic compound (SVOC) – water will be dispensed into two 1,000 mL amber glass bottles without a preservative, sealed, and stored at 4°C (±2°C).
    b) Metals – groundwater will be split into two portions; one filtered sample and one unfiltered sample. The filtered sample (for dissolved metals analysis) will be field-filtered using a clean, disposable, 0.45-µm filter attached in-line to the sample tubing. Filtered water will be dispensed into a 500 mL wide-mouth plastic bottle with HNO_3 as a preservative to achieve a pH below 2, sealed and stored at 4°C (± 2°C). Unfiltered water (for total metals analysis) will be dispensed directly in to a 500 mL wide mouth plastic bottle with HNO_3 as a preservative to achieve a pH below 2, sealed, and stored at 4°C (± 2°C).
    c) Cyanide – water will be dispensed into one 1-L plastic bottle, preserved with NaOH to a pH of > 12, sealed, and stored at 4°C (± 2°C).

2.3.6 Observations During Sampling

Field sampling staff will identify and log any observations that may be considered unusual into a field notebook or on the groundwater sampling field form for each well. These observations include, but are not limited to: excessive bubbling within the tubing or in the sample containers as they are filled; odors such as sulfide; excessive turbidity, solids, or formation of precipitates in the samples; color changes in the water; and unusual sounds made by the equipment. In addition, sampling personnel will note the condition of the well upon arrival and inspection. If the well casing is damaged and there are anomalies in the calculated water level at the well, then the casing damage may indicate compromised sample quality.

2.3.7 Storage and Shipping

All samples will be immediately placed on ice (preferably double-bagged wet ice packs) to remain at 4°C (±2°C) prior to and during shipment to the laboratory. The sample containers will be stored in a cooler until further processing. Refer to the SOP No. 410 for sample shipping.

2.4 Documentation

Field documentation includes completed calibration records, groundwater sampling field forms, and other field notes deemed relevant. It is essential that field data sheets be filled out completely and legibly at each location, and that entries are consistent for each location and among different personnel. As referenced above, groundwater sampling data and calibration forms are provided with this SOP. The following information will be recorded:

- job, site, date, and sampler;
- well identification and description;
- depth to water;
- casing volume calculation;
- depth of pump intake during purging and sampling;
- equipment used (field probes, tubing, model and serial numbers);
- purge rate, field parameters (temperature, conductivity, DO, ORP, pH, and turbidity) and depth to water recorded every 5 minutes;
- sampling parameters;

- stabilized field parameters;
- identification, time, container types, preservatives, and analytical methods for samples; and
- space for comments.

ATTACHMENT A

BACKGROUND ON LOW-FLOW/MINIMAL DRAWDOWN PURGING

Monitoring Well Sampling

The objective of groundwater sampling is to obtain a sample that is representative of groundwater quality under ambient flow conditions. To achieve this objective, a representative groundwater sample should contain: (i) the average concentration of all chemical constituents present in the target aquifer volume; (ii) constituents in the same phase and chemical speciation as present in-situ; and (iii) only the chemical constituents that are mobile under ambient groundwater flow conditions. The purpose of this section is to describe sampling practices that are most appropriate for investigations and to discuss key issues relevant to sampling. This discussion relies in part on sampling guidance developed by the USEPA.

Traditional methods of groundwater sampling call for purging three to five casing volumes of water from a well prior to sampling (Robbins and Martin-Hayden 1991, Barcelona *et al.* 1994, Wilson *et al.* 1995). These methods are no longer recommended by USEPA because they can induce bias through sample disturbance and particle mobilization, and produce larger volumes of purge water that increase exposure potential and disposal costs. Currently, USEPA recommends the low flow protocol for obtaining groundwater samples, although new sampling methods such as diffusion samplers are gaining regulatory acceptance in some situations. The low flow protocol and modifications to the low flow protocol that may be needed under some conditions are discussed in the following sections.

Note that although this document recommends low flow purging as the most widely accepted and reliable sampling method, modifications of the low flow protocol or other sampling protocols may be applicable in certain circumstances.

Low Flow Purging

The purpose of low flow purging is to draw sufficient water into the casing from the formation to produce a representative sample without generating excessive groundwater velocities outside the casing, which can bias the sample. Properly implemented in an appropriately constructed monitoring well, low flow purging induces lateral flow from the formation directly through the well screen and into the sampler intake. Several measurements that are often important for investigation and are particularly sensitive to sampling bias caused by high flow purging include

concentrations of dissolved gasses (O_2, CO_2, methane, ethane) total metals, and ORP. An additional advantage of low flow purging is that mixing between water entering the casing and stagnant water existing in the casing is minimized, thus achieving stabilization of the purging parameters described below with less extracted volume than conventional purging.

Low flow purging uses the same stabilization criteria as conventional purging (i.e., stable temperature, DO, conductivity, E_h, pH, and turbidity), but requires careful flow regulation (typically at a rate of 0.1 to 0.5 L/min) to limit drawdown to the extent practical (less than 0.1 ft is the goal). Since low flow purging requires steady removal of water with minimal disturbance, grab samplers (e.g., bailers) cannot be used with the low flow protocol and are not recommended for either purging or sampling. According to Puls and Barcelona (1996), a representative sample can be collected when three successive measurements (taken at 5 minute intervals) are within ±0.1 units for pH, ±3% for conductivity, ±10 mV for E_h, and ±10% for turbidity and DO. The low flow sampling protocol provides for accurate measurement of in-situ values of these parameters (with the possible exception of temperature), which are important geochemical data for characterization. pH and temperature measurements tend to stabilize first, and are not particularly sensitive measures of complete purging, whereas DO and turbidity will stabilize last and are better measures of sufficient purging.

Puls and Barcelona (1996) have outlined the procedural requirements of low-flow purging as follows:

- The sampling device should be placed in the middle of the well screen to prevent the entrainment of solids from the bottom of the well into the sample (similar positioning for subsequent sampling rounds is critical for comparability of data).
- Minimize disturbance of the water column in the well by installing sampling equipment carefully or using equipment dedicated to each well, and initiating pumping at a low rate.
- Employ steady pumping at a rate that maintains less than 0.1 ft of drawdown. In most formations, this will correspond to a flow rate of 0.1 to 0.5 L/min, but may be less than 0.1 L/min in silts and clays or greater than 1 L/min in coarse sands and gravels or from large diameter wells. Sevee *et al.* (2000) provides design equations that can be used for estimating the pumping rate that yields 0.1 ft of drawdown, given well size and aquifer hydraulic conductivity.

- Purging should continue until pH, temperature, conductivity, E_h, DO, and turbidity stabilize. These measurements should be made in a sealed, flow-through cell. Of these parameters, turbidity is the best parameter for measuring sufficient purging. Satisfactory purging may require removal of more than one casing-volume of water, but typically requires less than three casing volumes.
- A dedicated, pre-installed pump or tubing is recommended to minimize the time required to sample each well. Use of dedicated pumps also prevents cross contamination of wells that can result from incomplete decontamination and causes less mixing of casing water prior to purging. The cost-effectiveness of using dedicated pumps should be assessed based on site-specific sampling requirements.

Samples should be obtained from a sampling port upstream of the flow-through cell after parameter stabilization is achieved. Samples may be field-filtered if DQOs require measurement of dissolved versus mobile chemicals. Filtering should not be used to compensate for poor sampling technique, although in some cases the generation of turbidity artifacts may be unavoidable (e.g., fine-grained formation, poorly installed wells). When filtering is needed for either reason, in-line cartridge filters are recommended because they reduce handling and exposure of the sample to the atmosphere. If maintaining accurate particle-size cutoffs is a concern in filtering, a cascade system should be used (i.e., 1-micron pre-filter, followed by filtration through 0.45-micron or other smaller size filter).

In summary, the low flow protocol is preferred because it:

- typically minimizes the volume of purge water for disposal;
- provides most accurate measurements of volatile constituents;
- ensures collection of samples representative of in-situ conditions;
- collects samples containing only the mobile fraction of particulates; and
- is less vulnerable to inconsistencies among sampling staff over time.

Low flow sampling also has several disadvantages that must be kept in mind when planning sampling programs:

- higher initial capital costs, particularly if a pump is dedicated for each monitoring well;
- more time is often required to obtain a sample, which can increase total cost;
- more sophisticated equipment is used which requires more training; and

- more equipment needs to be transported to the field (e.g., conventional purging requires only a bailer whereas low-flow purging requires a pump, air cylinder, battery, or other power source).

Careful consideration of the appropriate sampling practice is critical to investigation. Traditional sampling techniques can provide inaccurate, misleading, or incomplete information relative to many aspects of geochemistry relevant for assessment. The importance of low flow sampling at sites is emphasized by Woodward (2000) who presents a case study that illustrates that many years of traditional sampling failed to support an argument that was later demonstrated relatively easily once low flow sampling was used. In this case, traditional sampling methods indicated aerobic conditions not conducive to the degradation of the contaminants. Low-flow sampling techniques revealed that in-situ conditions were in fact anaerobic.

Modified Low Flow Protocol (low recharge wells)

Wells in low yield formations such as bedrock and clay may not be conducive to low flow purging and sampling. In these cases, pumping even at low rates may cause more than 0.1-ft of drawdown in the well or evacuate the well casing altogether. Note, however, that in these cases traditional purging is also inadequate, and it is even more important to remain cognizant of and strive to implement the goals of low flow sampling.

The practical lower limit on purge rate is a function of the casing volume, logistical constraints (time, available equipment, accessibility of the monitoring well), the required sample volume for analysis, and the tendency for sample quality to be altered as it passes through the sampling equipment. At very low pumping rates, the volume of the flow through cell must be decreased, and sample tubing length, thickness, and material may become critical. Barcelona *et al.* (1985) provide guidelines for tubing length, diameter, and thickness to minimize gas diffusion across tubing walls.

If, after consideration of these factors, it is determined that the low flow protocol is impractical, a modified low flow method should be used. Currently, there is no established protocol for sampling low recharge wells. The USEPA low flow protocol has provided guidance for low flow sampling in low permeability units and several investigators have addressed the issue of bias in VOC measurements resulting from purging of low recharge rate wells. The low flow guidance and the findings of these studies are consistent with the following modifications to the low flow protocol. These modifications have recently been endorsed by the USEPA for sampling and purging of

wells that yield less than 100 mL/min at a drawdown of 0.1 m. During implementation of these methods, constant pumping with a peristaltic or bladder pump is recommended and field parameters should be measured, although it may be difficult to obtain stable measurements of certain parameters (i.e., DO, ORP, turbidity).

Method 1
The well is purged from the midpoint of the well screen at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen. Pumping is ceased and the water level in the well is allowed to recover to static conditions. The well is purged a second time at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen at which time pumping is ceased, this is repeated until a minimum of one casing volume is removed from the well. The well is allowed to recover sufficiently to collect the required groundwater sample from the midpoint of the screened interval, within 24 hours of the last purging event.

Method 2
This method is suggested for wells that have more than half of their casing volume of water located above the well screen. The well is purged from the middle of the well screen at a rate no greater than 500 mL/min until the water level reaches the middle of the well screen. This removes at least one-half of a casing volume of water from the well. The well is then allowed eight hours to recover, after which time a volume of water equal to the casing volume of the screened interval is removed, essentially resulting in the removal of a full casing volume during the two purging events. Directly following the second purging event, the required groundwater sample is collected from the midpoint of the screened interval. If a modified low-flow protocol is required at a site, the choice of which protocol to implement should be made based on site conditions and regulatory preferences.

Other Modifications

Other modifications of the low-flow protocol may be deemed appropriate on a site-specific basis. Large diameter wells, for example, may require exceedingly long purge times at typical low-flow rates. Methods employed to sample such wells in a cost-effective manner should consider the potential to mobilize particulates, expose the sample to the atmosphere, obtain accurate field parameter measurements, and minimize waste.

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APPENDIX 2

SITE SAFETY AND HEALTH PLAN (SSHP)

APPENDIX B

SITE SAFETY AND HEALTH PLAN (SSHP)

FINAL
SITE SAFETY AND HEALTH PLAN

Closure Sampling
MARINE CORPS AIR STATION (MCAS)
YUMA, ARIZONA

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Prepared for:

Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92101

Prepared by:

1851 W. 24th Street, Suite 201
Yuma, Arizona 85364

Prepared by:

7/31/14

Stacy Gutierrez — Date
GCE Safety and Health Manager

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TABLE OF CONTENTS

1.0 INTRODUCTION 5

2.0 PROJECT DESCRIPTION 5

3.0 KEY PERSONNEL 6
3.1 Project Manager 6
3.2 Safety and Health Manager 6
3.3 Site Safety and Health Officer 6
3.4 Employee Safety Responsibility 7
3.5 Lines of Authority 8
3.5.1 Project Manager 8
3.5.2 Health and Safety Manager and Certified Industrial Hygienist 8
3.5.3 Site Safety and Health Officer 8
3.5.4 Field Team Leader 8
3.5.5 Field Team Members 9
3.5.6 U.S. Department of the Navy (Navy) Health and Safety Officer 9
3.6 Visitors 9

4.0 HAZARD ANALYSIS AND RISK MITIGATION 9
4.1 Chemical Hazards 9
4.1.1 Exposure Pathways 10
4.2 Physical Hazards 10
4.2.1 Heat Stress 11
4.2.1.1 Heat Stress Monitoring 12
4.2.1.2 Preventive Measures 12
4.2.1.3 Heat Cramps 13
4.2.1.4 Fainting 13
4.2.1.5 Heat Exhaustion 14
4.2.1.6 Heat Stroke (Sunstroke) 14
4.2.2 Utility Hazards 15
4.2.3 Hand Tool and Equipment Hazards 15
4.2.4 Slip, Trip and Fall Hazards 16
4.2.5 Noise Hazards 16
4.3 Biological Hazards 16
4.3.1 Insects, Snakes, and Animal Bites 16
4.3.2 Hantavirus and Arenavirus 17
4.3.3 West Nile Virus 17
4.4 Task-Specific Hazard Analysis and Recommended Controls 17

5.0 GENERAL HEALTH AND SAFETY REQUIREMENTS 17
5.1 Medical Monitoring of Personnel 17
5.2 Restricted Access Work Zone 18
5.2.1 Exclusion Zone 18
5.2.2 Contamination Reduction Zone 18
5.2.3 Support Zone 18
5.3 Work Limitations 18
5.4 Safety Orientation Meeting 19
5.5 Personal Protective Equipment 19
5.6 PPE Program 20

5.7 Hearing Protection 20
5.8 Safety Equipment and Materials 20

6.0 EXPOSURE MONITORING 21

7.0 HAZARD TRAINING 21

8.0 STANDARD WORK PROCEDURES 22
8.1 Area Marking 22
8.2 Heavy Equipment Operation 22
8.3 Safe Work Practices 22

9.0 COMMUNICATION PROCEDURES 23

10.0 DECONTAMINATION PROCEDURES 23
10.1 Reusable Equipment 24
10.2 Personnel 24
10.3 Investigation-Derived Material Disposal 24

11.0 CONFINED SPACE ENTRY 24

12.0 UPDATES OF HEALTH AND SAFETY PLAN 24

13.0 EMERGENCY ACTION PLAN 24
13.1 Means of Reporting Fires and Other Emergencies 25
13.2 Evacuation Procedures and Emergency Escape Route Assignment 25
13.3 Procedures to be Followed by Employees Who Remain to Operate Critical Plant Operations Before They Evacuate 25
13.4 Procedures to Account for all Employees after an Emergency Evacuation has been Completed 25
13.5 Rescue and Medical Duties for Those Employees Who are to Perform Them 25

14.0 REFERENCES 27

ATTACHMENTS

Attachment A Site Maps
Attachment B Activity Hazard Analysis
Attachment C Site Emergency Phone Numbers
Attachment D Medical Facility Address and Route Map
Attachment E Tailgate Safety Meeting Documentation

ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ACOE	Army Corps of Engineers
AHA	Activity Hazard Analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
°C	degrees Celsius
CEODU	Combined Explosives Ordnance Disposal Unit
CFR	Code of Federal Regulations
COCs	chemicals of concern
COPC	constituent of potential concern
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
dB	decibel
DCN	document control number
EZ	exclusion zone
°F	degrees Fahrenheit
FA	first aid
GCE	Gutierrez Canales Engineering
HAZWOPER	Hazardous Waste Operations and Emergency Response
LEL	Lower Explosive Limit
MCAS	Marine Corps Air Station
MSDS	material safety data sheet
MTR	Munitions Treatment Range
NAVFAC SW	Naval Facilities Engineering Command Southwest
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Level
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
RPM	Remedial Project Manager
SHM	Safety and Health Manager
SSHP	Site Safety and Health Plan

SSHO	Site Safety and Health Officer
TLV	threshold limit value
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

1.0 INTRODUCTION

This Site Safety and Health Plan (SSHP) has been prepared by Gutierrez Canales Engineering, P.C. (GCE) in conformance with Title 29 Code of Federal Regulations (CFR) 1910.120 for the Munitions Treatment Range (MTR) scope of work at the Marine Corps Air Station (MCAS) Yuma, Arizona. This plan addresses on-site health and safety procedures intended to guide field activities at the project work site. This SSHP establishes procedures to protect workers and the public from potential hazards posed by work at this site, identifies chemical and physical hazards that may be encountered, and defines the duties of key personnel. This plan was prepared for Naval Facilities Engineering Command Southwest (NAVFAC SW).

Elements of this plan include personal protection, personnel and equipment safety, medical surveillance, air quality monitoring, and general on-site work practices. Additionally, this plan contains provisions for emergency response and first-aid. All personnel including government employees, subcontractors, and third parties who enter the site work zones are required to comply with this plan. Additionally, all subcontractors must submit to GCE a properly completed Activity Hazard Analysis (AHA) for review and approval prior to start of on-site work.

This plan is based on the best available information and is intended for the exclusive use by GCE's employees and subcontractors working on the site. This plan will be maintained on site and may be amended should site conditions, procedures, or personnel change. GCE claims no responsibility for use of this plan by others.

2.0 PROJECT DESCRIPTION

The scope of work for this project involves soil/groundwater monitoring, groundwater monitoring well installation, and groundwater monitoring at the MTR. The soil/groundwater monitoring will consist of surface and subsurface sampling at the MTR within existing shotholes. Groundwater monitoring will consist of collecting groundwater samples from the proposed monitoring well downgradient of the MTR. Soil and groundwater samples will be analyzed for the constituents of concern including:

- Metals- 6010B, 7470, and 7471
- Volatile Organic Compounds (VOCs)- 8260B
- Semivolatile Organic Compounds (SVOCs)- 8270C
- Explosives- 8330
- White Phosphorus- 7580
- Nitrate/Nitrate- 353.3
- Ammonia- 350.2
- Perchlorate- 314
- Total Petroleum Hydrocarbons (TPH)- 8015AZ Modified

Additional analytes may be added if ADEQ identifies a new regulated compound associated with explosives treated at the MTR, or if the United States Department of Defense begins to use a new compound for the manufacturing of explosives.

3.0 KEY PERSONNEL

3.1 Project Manager

The GCE Project Manager (PM) is Mr. Eric Gardner who will serve as the primary point of contact. PM responsibilities within the context of health and safety include documentation of site activities, implementation of emergency response, and verification of emergency action. In addition, the PM will ensure that personnel receive this plan, are familiar with the contents, and are aware of potential hazards associated with site or project operations.

3.2 Safety and Health Manager

The GCE Health and Safety Manager (SHM) is Ms. Stacy Gutierrez. The SHM is responsible for preparation of the SSHP, and oversight of the project Site Safety and Health Officer (SSHO). The SHM has the authority to stop unsafe operations, remove unqualified personnel from the work area, and approve changes to the SSHP. The PM may request the SHM to act as the SSHO.

The SHM is responsible for integrating SSHP development and implementation. SHM duties include reviewing the SSHO implementation of the SSHP, advising the SSHO on health and safety issues, reviewing any site specific plans for compliance and completeness, and establishing and monitoring health and safety procedures by conducting site safety audits.

3.3 Site Safety and Health Officer

The project SSHO will be Mr. Andrew Klakulak. SSHO duties include:

- Assuring that appropriate safety equipment is available and used according to this plan;
- Conducting safety monitoring and recording safety data;
- Contacting the base representative prior to the start of on-site work to verify methods for contacting all potential base emergency responders. Also, ensure that proper cellular telephone procedures are posted and readily available.
- Establishing the exclusion, decontamination, and support zones;
- Ensuring that everyone entering the site will sign the log-in/log-out form on a daily basis;
- Documenting accidents, incidents, and compliance issues;
- Initiating emergency response procedures when necessary, which includes establishing emergency communications with all emergency response organizations;
- Monitoring the effectiveness of personnel and equipment decontamination;
- Monitoring the effectiveness of the personal protective equipment (PPE); and
- Communicating the SSHP to site workers.

An initial kick-off meeting is planned prior to the start of field work. The health and safety section of the kick-off meeting will include a review of the SSHP by the SSHO with involved GCE personnel. The SSHP review will include the following site-specific topics: potential

physical and chemical hazards, expected safe work practices, directions to nearest medical facility, and the site evacuation procedure.

Daily, the SSHO will conduct a safety meeting before the start of work. Daily meetings typically include:

- Site hazards;
- Symptoms and signs of over-exposure to site hazards;
- Physical, chemical, and toxic properties of constituents of potential concern (COPCs);
- Emergency recognition and prevention;
- Medical facilities available and their location;
- Site evacuation routes and refuge locations;
- Use and location of PPE and emergency equipment;
- Weather effects;
- Decontamination procedures;
- Duration of the work mission; and
- Site security and control measures.

Additionally, the SSHO's responsibilities include confirmation that personnel are fit for duty, coordination of emergency medical care, posting daily air monitoring results, conducting daily site safety inspections, and inspecting health and safety equipment. The SSHO documents PPE related failures to monitor the effectiveness of the PPE program.

The SSHO will investigate accidents and prepare an accident investigation report for the PM, who will forward it to appropriate regulatory agencies depending on the nature and severity of the accident or injury. Project safety inspections will be conducted daily by the SSHO and/or the PM.

The SSHO is responsible for on-site implementation and enforcement of the site safety program and procedures. The SSHO will oversee health and safety-related monitoring and will decide when action levels dictate more stringent protection.

3.4 Employee Safety Responsibility

Each employee is responsible for his or her own safety as well as the safety of others on the work site. The employee shall use equipment in a safe and responsible manner within the guidelines of the SSHP. All project personnel working at the site will be responsible for reading, understanding, and complying with the SSHP requirements. As the prime contractor, GCE is ultimately responsible for the implementation of an effective safety and occupational health program. The Project Manager (PM), Safety and Health Manager (SHM), Project Certified Industrial Hygienist (CIH), and Site Safety and Health Officer (SSHO) are responsible for formulating and enforcing H&S requirements, and implementing the SSHP.

Managers must conduct their businesses in compliance with governmental safety regulations and company procedures. All GCE H&S procedures will be implemented for all GCE employees on all projects where GCE is the subcontractor, or a joint venture partner. If GCE is the prime contractor, GCE procedures will be applied to all GCE and subcontractor personnel.

3.5 Lines of Authority

The lines of authority are as follows:

3.5.1 Project Manager

Mr. Eric Gardner is the PM for this project. The PM has the overall responsibility for the project and to assure that the requirements of the contract are attained in a manner consistent with the SSHP requirements. The PM will coordinate with the SSHO to assure that the work is completed in a manner consistent with the SSHP.

3.5.2 Health and Safety Manager and Certified Industrial Hygienist

Ms. Stacy Gutierrez is the SHM and CIH for this project. The SHM is responsible for reviewing the SSHP and ensuring that the SSHP is complete and accurate. The Project SHM provides technical and administrative support and will be available for consultation when required. If necessary, the SHM will direct modifications to specific aspects of the SSHP to adjust for on-site changes that affect safety. The SSHO will coordinate with the SHM on necessary modifications to the SSHP. The SHM may make periodic site visits to determine compliance.

3.5.3 Site Safety and Health Officer

Mr. Andrew Klakulak will serve as the SSHO for this project. The SSHO is authorized to administer the SSHP. The SSHO is authorized to stop work when an imminent health or safety risk exists. The SSHO will review the essential safety requirements with all on-site personnel and will facilitate the daily safety meetings.

The SSHO has a direct line of communication and authority from the SHM to implement site-specific H&S requirements for this project, and is responsible for serving as the Competent Person as defined by 29 Code of Federal Regulations (CFR) 1926.32(f). Note: A review was performed and no additional standard specific competent person requirements apply to this scope of work. Responsible for daily site safety meetings; evaluating working conditions and making recommendations to PM and SHM to modify H&S procedures; inspecting all personal protective equipment (PPE) prior to use; enforcing all site-specific H&S procedures; and observing field team members for signs of exposure, stress, or other conditions related to pre-existing physical conditions and site work activities. No work will be performed unless the SSHO or a qualified alternate SSHO is present on the job site.

3.5.4 Field Team Leader

The Project Manager, Eric Gardner, will take on the role of the Field Team Leader for this project. The Field Team Leader will work in concert with the Site Safety and Health officer to implement and enforce the SSHP.

3.5.5 Field Team Members

The Field Team Members are responsible for reviewing and following the SSHP, and reporting unsafe practices to the SSHO and/or PM.

3.5.6 U.S. Department of the Navy (Navy) Health and Safety Officer

The Navy H&S Officer is responsible for reviewing this SSHP and making recommendations concerning the document to the Navy Remedial Project Manager (RPM). The Navy H&S Officer also investigates accidents to determine their root cause(s) and identifies corrective actions.

3.6 Visitors

Site visitors are required to read the SSHP and sign the Site Log/Compliance Agreement Form. Visitors will comply with relevant Occupational Safety and Health Administration (OSHA) requirements and provide their own PPE required by the SSHP. Visitors who do not adhere to the provisions of the SSHP will be required to leave the work area. Visitors who have not met OSHA training and medical surveillance requirements are not permitted to enter investigation areas where there is elevated risk due to equipment operation or hazardous materials exposure. If a visitor not meeting the applicable OSHA requirements insists on entering the site, then all site work will cease until the unqualified visitor departs the designated work area.

4.0 HAZARD ANALYSIS AND RISK MITIGATION

The objective of the hazard analysis is to list the chemical, physical, and biological hazards that may be encountered on the site. Based on the hazard analysis review, risk mitigation will serve to promote the best possible effort to identify, control, or eliminate those site hazards that are selected for consideration.

4.1 Chemical Hazards

Exposure pathways for potential contaminants that may be encountered during sampling tasks are directly related to the nature of tasks, principally the direct handling of samples, type of sampling equipment used, and effectiveness of project controls. Controlled work areas and methods are intended to mitigate potential exposures and uptake of contaminants; however, the potential still exists for exposure to contaminants that may be encountered.

Exposure pathways include:

- Inhalation - Respirable vapors or particulates present a direct route of entry for the contaminants.

- Skin absorption and contact with contaminated surfaces during sampling and contaminated material handling tasks that can be absorbed through unprotected skin or corrosion, resulting in skin irritation or potential absorption through the skin and/or skin contamination.

- Ingestion of contaminated materials adsorbed to dust particles or on surfaces resulting in potential uptake of contaminants through the gastrointestinal (GI) tract that may result in GI irritation, internal tissue irritation, and/or deposition to target organs.

- Injection while handling contaminated materials by breaking of the skin, or migration through an existing wound, resulting in localized irritation, contamination, uptake of soluble contaminants, and deposition of insoluble contaminants.

Airborne exposure is considered to be a potential exposure pathway at the site from inhalation of particulates or vapors originating from sampling activities. The potential for inhalation of COCs exists from volatilization from soil, and/or groundwater during field activities. Based on concentrations of COCs previously detected in the vicinity of the project area, and the nature of the tasks that will be completed, the potential for exposure is anticipated to be minimal. Airborne exposure to personnel outside the exclusion zone is not likely to occur based on the type of work conducted, anticipated concentration of the COCs, and dispersion through air.

Air monitoring, to determine if flammable, explosive atmospheres or personal hazards are being generated at the time of field activities, will be conducted onsite if required by the SSHO or SHM.

To mitigate potential chemical hazards at the site, recommended controls in the AHAs must be implemented (Attachment B). In addition, personal protective equipment (Section 5.5) and air monitoring equipment must also be utilized to evaluate airborne concentrations and protect workers.

4.1.1 Exposure Pathways

Identification of COC exposure pathways is based on distinguishing those routes that chemical constituents may take to affect various environmental media. Human exposure potential can be evaluated once a constituent is in an environmental medium. The potential media of concern include soil, water and air. Applicable routes of exposure include direct skin contact, ingestion and inhalation.

Direct skin contact with COCs is unlikely during planned field activities. Contact with contaminants will be limited or prevented by wearing safety glasses and protective gloves during media handling, sampling and decontamination activities.

To reduce the possibility of ingestion of COC, no eating or drinking will be allowed within the exclusion or contaminant reduction zones. Similarly, no eating, drinking, or smoking will be allowed in the support zone unless hands are washed using soap and water.

Based on the hazard analysis, chemical hazards do exist and recommended controls must be employed to prevent these hazards from occurring [see AHAs, Attachment B]. During drilling activities, PPE (Section 5.5) will be used to protect workers.

4.2 Physical Hazards

The hazard analysis has identified physical hazards associated with the execution of this project. These include operational problems as well as potential for accidents and personal injury, and are

presented in the AHA (Attachment B). The AHA describes the recommended controls that must be employed to minimize the impact of the existing hazards.

4.2.1 Heat Stress

Working in hot conditions or performing hard work in any temperature creates a great deal of heat stress on personnel who are not wearing chemical protective equipment. Additional layering of PPE creates a vapor barrier, entrapping body heat and (otherwise) evaporated sweat. All personnel should carefully monitor their own physical condition while working. In addition, supervisory personnel will direct/perform heat stress monitoring as described in Section 4.3.1.1. Work levels can increase as each individual becomes acclimatized.

Over exposure to heat from work stress, ambient temperature, and radiant heat can cause a variety of ill effects, ranging from cramps to fainting, to possible death. Employees need to assess the exposure and recognize the signs and symptoms of heat stress so they can take preventive measures. Drinking water, electrolyte fluids, protective clothing, and regular rest breaks in a cool area need to be available and used to prevent serious effects of overexposure. Heat stress can be serious. The major effects are described briefly in the following paragraphs and in detail later in this section, including symptoms and treatment.

Heat cramps are muscle spasms, caused by depletion of salt from excessive sweating, without replacement of the lost salt. Under extreme exposures, salt loss may be as much as 6 to 8 teaspoonfuls in 1 day.

Fainting, due to heat exposure, occurs when the body adapts to excess heat by dilating blood vessels in the skin and superficial muscles in order to deliver warm blood to the surface of the body where the excess energy can be delivered back to the environment. The expansion of the superficial blood vessels allows a greater than normal proportion of the circulating blood volume to be away from the central circulation (which supplies, among other organs, the brain). This lack of sufficient central pressure is worsened when a person is on his/her feet for a prolonged period of time, as gravity allows a significant blood volume to collect in the lower extremities. Combined with fatigue and mild dehydration, the diversion of blood leads to a fainting episode, as not enough blood (with oxygen and glucose) is pumped to the brain.

Heat exhaustion can result from excess loss of water and salt, and affected persons may collapse from dehydration or inadequate circulation. There is heavy sweating, little or no increase in body temperature, and a rapid pulse, up to 150 beats per minute.

Heat stroke is an extreme failure of the body thermoregulatory system, with hot, dry skin, flushed face, rapid breathing, pounding pulse, and high body temperature greater than 104°F. Continuous exposure to extreme heat for as little as 3 hours can produce heat stroke. Brain disorders may range from headache to delirium to unconsciousness. Rapid cooling is urgent to prevent death.

Other factors that may magnify harmful effects of heat exposure are chemical exposures, altitude, inadequate acclimatization, fatigue, lack of sleep, consumption of alcohol, inadequate nutrition, cardiac and respiratory conditions, and taking certain medications.

4.2.1.1 Heat Stress Monitoring

Because the incidence of heat stress depends on a variety of factors, all site workers, even those not wearing protective equipment should be monitored. Physiological monitoring of site workers required to wear semi-permeable or impermeable clothing will be conducted when ambient temperatures reach 70 degrees Fahrenheit (°F) or above. Heat stress monitoring may include the following:

Heart Rate. Count the radial pulse for 30-seconds while the site worker is at rest.

- If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
- If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

Oral Temperature. Use a oral thermometer with a disposable probe cover (3 minutes under the tongue) or a similar device (aural or temporal heat sensor) will be used to measure the oral temperature of the site worker at the end of the work period (before drinking).

- If the oral temperature exceeds 99.6°F [37.6 degrees Celsius (°C)] shorten the next work cycle by one-third without changing the rest period.
- If the oral temperature exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.
- Do not permit a site worker to wear a semi-permeable or impermeable garment when his/her oral temperature exceeds 100.6 °F (38.1°C).

Body Water Loss (if possible). Site workers may be weighed on a scale accurate to ±0.25 pounds at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration.

- Weights should be taken while the site worker wears similar clothing or, ideally, as little clothing as possible.
- The body water loss should not exceed 1.5 percent total body weight loss in a work day.

4.2.1.2 Preventive Measures

In hot environments where heat stress may be severe, the following recommendations should be considered for the protection of personnel:

- Drinking water will be made available to all personnel. The consumption of water should be encouraged and it is recommended frequent small amounts be consumed such as 1 cup every 15-20 minutes. The water will be cool drinking water and not ice cold.
- Work/rest regiment should be adjusted in accordance with the temperature and to allow each worker to properly acclimate to the site conditions.
- Breaks taken in an air conditioned or shaded cool area will reduce the heart rate and allow for a greater margin of safety in preventing heat stress conditions.

- Weighing each exposed person before and after working in the hot environment is recommended; weight loss will indicate dehydration and the urgent need to drink more water or special fluids.
- Employees should be trained in the recognition of the signs and symptoms of heat stress.
- It is imperative that treatment begin immediately if symptoms and signs of severe heat stress are present.
- Wear head covering and loose fitting, absorbent clothing, preferably cotton, to assist evaporation.
- If possible, schedule strenuous work and hot work in cooler part of the day.

4.2.1.3 Heat Cramps

Heat cramps can be caused by working in a hot environment and not replenishing fluids or electrolytes being lost while sweating.

Symptoms:

- Spasms (cramps) of the skeletal muscles.

Treatment:

- Drink water and electrolyte solutions. With proper fluid and electrolyte replacement, heat cramps may be prevented. Salt tablets are not to be used.
- General motion, stretching, and massage of the affected muscles should relieve the cramps.
- If symptoms are not relieved or if spasms are severe and multiple, transport to the nearest doctor for possible saline I.V.

4.2.1.4 Fainting

A victim who has suffered a fainting episode in the heat should be examined for any head or neck injuries, as well as other possible breaks or cuts. Other causes of fainting must be considered (low blood sugar, abnormal heart rhythm, etc.). If fainting is due to the heat, the victim will reawaken shortly, as the horizontal position returns blood to the brain and solves the major problem. In general, body temperature is not elevated.

Symptoms:

- Warning signs of a fainting spell include dizziness, lightheadedness, nausea, weakness, sweating, blurred vision, or seeing flashing lights.

Treatment:

- At the onset of symptoms, immediately assume a horizontal position or sit and lower the head between the knees.
- If fainting has occurred, the victim should be rested in a horizontal position for 15 to 30 minutes.
- Drink water and electrolyte solution (1 or 2 pints).

4.2.1.5 Heat Exhaustion

Heat exhaustion can develop after several days of exposure to high temperatures and inadequate or unbalanced replenishment of fluids. If untreated, heat exhaustion may progress to heat stoke if sweating ceases.

Symptoms:

- Skin clammy and moist, pale, muddy, or flushed.
- Oral temperature can be below the normal 98.6°F.
- The pulse may be weak with the blood pressure low, causing fainting, especially upon standing after sitting.
- Brain will be rational, but may have a headache.
- General symptoms are extreme fatigue, weakness, giddiness, and nausea. Any one symptom or all symptoms may be present.

Treatment:

- Remove and protect from sunlight and other heat sources.
- Removal all PPE from the victim and loosen clothing.
- Place the victim in a supine position with feet slightly elevated.
- Provide electrolyte solution to replenish both the salt and fluids lost from sweating.
- Provide cold water to drink and pour over face and head.
- Evacuate to cool, preferably air conditioned room.
- Transport to definitive medical care.
- Recovery typically occurs within 1 to 5 days if properly treated.

4.2.1.6 Heat Stroke (Sunstroke)

Heat stroke can occur during environmental heat exposure with lack of thermoregulation. Heat stroke may be fatal unless treated promptly and adequately (vigorously).

Symptoms:

- Skin is hot and dry, red, mottled, or cyanotic (gray to blue).
- Oral temperatures of 104°F and above.
- Heart pounding and rapid.
- The worker may become confused, delirious, unconscious, or comatose, either slowly or rapidly.

Treatment:

- Call for immediate ambulance support.
- Remove and protect from sunlight and other heat sources.
- Remove all PPE and clothing from the victim as decency permits.

- It is essential that treatment begin immediately. Rapid cooling of the body is imperative.
- Place ice packs, if available, on the forehead, behind the neck, and groin areas.
- Shade the victim from sun and any other heat source.
- Evacuate to a safe area, or if evacuation is delayed, initiate additional treatment before reaching a safe area.
- If possible, wrap the unclothed body in wet sheets and fan vigorously with cool, dry air.
- If wrapping in sheets is not feasible, fan the victim vigorously (use an electric fan if available).
- Place the victim flat on their back, or slightly elevate their head/shoulders.
- Give the victim sips of cool water, if they are conscious, coherent, and not nauseated/or vomiting.
- Sponge the victim cool water and/or to lightly spray with water (avoiding the face), while fanning the victim.
- Protect the victim from further injury if they convulse while awaiting ambulance transport by; removing obstacles that might be struck by the victim during the course of the convulsions, and placing a soft, rolled up piece of cloth or clothing between the victims teeth to prevent damage to the tongue.

4.2.2 Utility Hazards

To minimize potential hazards posed by underground and overhead utilities within the project area, the following policies and procedures will be implemented:

- All applicable utility clearance permits will be obtained and approved from base personnel and/or utility companies prior to initiating intrusive operations.
- A utility survey will be conducted to identify the location of underground and overhead utilities in the vicinity of any drilling locations.
- All available utility maps will be kept onsite at all times during drilling activities.

4.2.3 Hand Tool and Equipment Hazards

To minimize the potential of hazards associated with the use of hand tools and other equipment during field activities, the following policies and procedures will be implemented:

- All hand tools and equipment will be inspected for wear and tested for proper function prior to use.
- All maintenance records for applicable equipment will be reviewed prior to use to ensure that all scheduled maintenance has been performed.
- Good housekeeping practices will be used.
- Adequate work space will be established before operating all hand tools or equipment.

- Only trained, qualified personnel will be assigned to operate individual equipment.
- GCE personnel will not handle any subcontractor owned tools or equipment.

4.2.4 Slip, Trip and Fall Hazards

To minimize the potential for slips, trips and falls, the following procedures will be implemented:

- Tree branches, vegetation, rocks and other ground hazards will be cleared from around each boring location.
- Good housekeeping practices will be used.
- Appropriate foot protection (i.e. steel toed boots) will be worn at all times to help prevent slips and trips.
- Extreme caution will be used when working on uneven and/or wet surfaces.

4.2.5 Noise Hazards

Potential noise hazards exist during drilling operations and pilot study activities. Hearing protection (i.e. approved earplugs, earmuffs or both) will be used by all GCE field personnel and subcontractors whenever noise measurements in excess of 85 decibels (dB) are identified, either by documentation or monitoring. Hearing protection and noise monitoring requirements are described in Section 5.7.

4.3 Biological Hazards

The various biological hazards present at this site are described below. The recommended controls that must be implemented to minimize the impacts of these hazards are detailed in the AHA (Attachment B)

4.3.1 Insects, Snakes, and Animal Bites

Bees and spiders pose the most common biological hazard encountered during field work. Less frequent hazards are snakes and various other animals. Spiders thrive in the warm, wet environments of well casings and vault enclosures while snakes and other small animals may be found under rocks, plastic sheeting, tires, and other natural and man-made items that offer shelter.

Rattlesnakes must be avoided at all times. A sharp rattling sound may indicate a rattlesnake's presence. If a rattlesnake is encountered, workers should immediately leave the area and seek outside help to deal with the creature. If a rattlesnake bite does occur, the victim should be transported to the nearest medical facility as quickly as possible.

The protocol for mitigating biological hazards will begin with the SSHO identifying personnel with known allergic reactions to insect bites or stings, and notifying field supervisors prior to project assignment.

Though animal bites, insect stings, and ticks can cause localized swelling, itching, and minor pain that can often be handled by first aid treatment, sensitized individuals can experience more

serious effects such as anaphylactic shock. This type of shock can lead to severe reactions in the circulatory, respiratory, and central nervous system, and in some cases, death. In consideration of this potential, all cases of stings and bites will be handled as an emergency that requires medical attention. In the event of an animal bite, no attempt should be made to capture the animal.

4.3.2 Hantavirus and Arenavirus

Animal and bird droppings often contain mold, fungus, or bacteria posing a significant respiratory hazard that can cause lung diseases and allergies. Hantavirus and arenavirus are known to be transmitted by exposure to rodent droppings. Rodents shed the virus in their saliva, urine, and feces. Particles and droplets containing the virus can become airborne, spreading the virus as humans breathe the contaminated air.

Employees required to enter areas inhabited by wild animals will be instructed not to touch animal droppings, and to wear, at a minimum, gloves and protective full-body suites (i.e., Tyvek®). Good hygiene practices will help to minimize the potential for exposure to these hazards.

4.3.3 West Nile Virus

West Nile virus is primarily transmitted among wild birds by infected mosquitoes. The infected mosquitoes can also transmit the virus to humans, causing a mild flu-like illness that typically lasts for a few days. In rare cases, the virus can cause encephalitis, which is an inflammation of the brain.

The following precautionary measures against West Nile virus are included for field personnel:

- Maximize skin coverage using long sleeves;
- Apply an insect repellent containing N,N'-Diethyl-3-methylbenzamide (DEET) to thin clothing and exposed skin; and
- Avoid those times of day when mosquitoes are most active (dawn and dusk).

4.4 Task-Specific Hazard Analysis and Recommended Controls

The task-specific hazard analysis is conducted prior to the start of the project and is based on available information. The hazard analysis will be revised as needed, depending on work conditions and as additional requirements are identified. Any changes to the hazard analysis will be noted in the field copy of the SSHP. Notations will include project instructions provided to on-site workers and the date and time that changes were made. The AHA is available as Attachment B.

5.0 General Health and Safety Requirements

5.1 Medical Monitoring of Personnel

GCE's Medical Surveillance Program is directly supervised by a licensed physician board certified in occupational medicine, and incorporates medical monitoring. The medical monitoring of all GCE work force personnel is determined based on the results of industrial

hygiene surveys, prior site characterization, and is exposure driven. In the absence of industrial hygiene data, medical personnel will make a decision on placement in medical surveillance programs based on knowledge of the workplace, job requirements and review of employee's occupational history. If necessary, physicals or stressor-specific evaluations will be performed by a qualified physician board certified in occupational medicine. Subsequent exams are performed as frequently as medical authorities determine is necessary for the safety of the individuals involved. GCE medical consultants will determine the content of the physical. At a minimum, all GCE employees at the site shall be medically cleared to wear an air-purifying respirator.

5.2 Restricted Access Work Zone

Regulated areas: For this project, the work area may include three separate zones: an exclusion (or “hot”) zone, a contamination reduction (decon) zone (CRZ), and a support zone. The work areas have not been predetermined or mapped; however, they will be identified at the start of each day and as the active work areas migrates across the project site. Additionally, the restricted access zones may be affected by a significant change from the typical westerly wind direction.

5.2.1 Exclusion Zone

The exclusion zone (EZ) includes the area in the vicinity of well installation and sampling activities. Employees will use appropriate personal protective equipment PPE when working in those areas. The exclusion zone will be defined as an area where there is a possible respiratory or contact health hazard. In most instances, this area will be defined by a 10-meter or less radius from the operating equipment. Cones, yellow caution tape, or other appropriate delineation will identify the location of exclusion zones. Personnel entering the EZ must log in and log out from the site.

5.2.2 Contamination Reduction Zone

Personnel entering or leaving the exclusion zone will pass through the contamination reduction zone for accountability and to confine contamination. Decontamination of personnel and equipment will be performed at designated locations within the contamination reduction zone. Personal protective outer garments and respiratory protection will be removed in the contamination reduction zone, secured, and properly labeled. The contamination reduction zone is defined as the limit of the exclusion zone for this project.

5.2.3 Support Zone

The support zone consists of an area outside the contamination reduction zone. The support zone will be located to minimize potential contaminant exposure. Eating and drinking will be permitted in the support area only after washing face and hands.

All site visitors entering the site EZ/CRZ are required to sign the Accident Prevention Plan Acknowledgement Sheet.

5.3 Work Limitations

Work limitations include the following:

- Work is to be conducted during daylight hours except in an emergency.
- Eye protective equipment must be worn by all persons when sight hazards exist.
- Drilling operations will be performed under the guidance of a UXO specialist and a magnetometer will be used to monitor for UXO at all times.

5.4 Safety Orientation Meeting

Field personnel must attend a safety orientation meeting before the start of field work. The meeting will be scheduled and conducted by the PM, SHM, and the SSHO. The meeting will include but is not limited to the anticipated scope of work review of the following health and safety topics:

- SSHP review;
- Site hazards;
- Symptoms and signs of over-exposure to site hazards;
- Physical/chemical/toxicological properties of the COPCs;
- Emergency recognition and prevention;
- Medical facility locations;
- Evacuation routes and refuge locations;
- Use and location of PPE and emergency equipment;
- Weather effects;
- Decontamination procedures;
- Duration of the work mission; and
- Site security and control measures.

5.5 Personal Protective Equipment

Field personnel will be equipped with PPE appropriate for the hazardous material being handled and the nature of the work being completed. The levels of personal protective equipment to be used for work tasks have been selected based on known or anticipated hazards and expected concentrations of materials found on the site. Personnel conducting site activities in Level D will wear the following:

- Steel-toed boots;
- Long pants and long sleeved shirt;
- Reflective safety vest (when appropriate);
- Hearing protection; earplugs and earmuffs with a Noise Reduction Rating (NRR) of 28 decibels (dB) or greater (when appropriate);
- Chemical-resistant safety glasses; and
- Hard hat (when appropriate).

Level D protective equipment will be modified to include additional protective equipment where skin contact with contaminants is possible. Disposable chemical resistant nitrile gloves will be

worn when there is potential for contact with the known or suspected contamination. Modified Level D will be required if there is potential for splashes from contaminated liquid.

5.6 PPE Program

Based on an evaluation of the potential site-specific hazards that may be encountered during execution of field activities, this project requires that all site workers be dressed in modified level D protection including: nitrile outer gloves (when handling sampling equipment), safety glasses, hearing protection (during drilling operations), hard hat, steel toe shoes, and long pants. However, when handling powdered grout, cement, or granular carbon materials, workers will be required to wear air purifying respirators equipped with HEPA filters. All PPE will be properly stored on site in the field support vehicles when not in use and inspected in accordance with the manufacturer's recommendations prior to the start of each application to insure that the integrity of each item is sufficient for its intended use. All PPE not in full and complete working order will be repaired to full function before use, or replaced. Expiration dates on all disposable PPE, such as nitrile gloves, will be examined prior to the start of fieldwork. Expired PPE will be disposed of immediately. Donning and doffing of PPE will be performed in accordance with the manufacture's recommendations, as applicable.

5.7 Hearing Protection

Hearing protection (i.e. approved earplugs, earmuffs, or both) will be used by all GCE field personnel and subcontractors whenever noise measurements in excess of 84 decibels (dB) are identified, either by documentation or monitoring. Field activities are not anticipated to generate noise levels in excess of 85 dB. As a result, hearing protection will not be required for the field activities.

If noise monitoring is necessary, a sound level meter (Type 2 or higher) or noise dosimeter will be utilized. Noise levels will be measured with the instrument's microphone placed within the monitored employee's hearing zone; an approximate two-foot diameter sphere surrounding the head, upon initiation of the task to be monitored. The instrument will be set to the A-weighted scale and on slow response. When using a dosimeter, it will be set at a 3 dB exchange rate with the threshold level set at 80 dB. The criterion level (allowable dose) will be set at 85 dB. Noise monitoring exposure limits are provided in Section 6.0.

5.8 Safety Equipment and Materials

GCE field personnel shall ensure the following safety equipment and materials are readily available at each work site:

- Emergency eyewash unit meeting the requirements of ANSI Standard Z358.1-2009
- First-aid kit;
- Fire extinguisher (20 pound ABC-rated type); and
- Photoionization detector (PID).

6.0 EXPOSURE MONITORING

Safe work practices during field work will be used to sufficiently to protect field personnel against exposure to airborne hazardous substances. If deemed necessary by the SHM, a PID and LEL meter may be used during sampling activities to ensure that hazardous conditions are not present. If measurements exceed background levels, workers will be verbally notified immediately, and actions will be taken by the SSHO to stop work and reevaluate activities.

7.0 HAZARD TRAINING

The OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) training requirements, as described in Title 29 CFR §1910.120, apply to those persons conducting field work. The regulation states that all personnel involved in characterization or remediation of an uncontrolled hazardous waste site shall be required to have 40 hours of certified training and three days of supervised field experience. In compliance with Title 29 CFR §1910.120, GCE's Environmental Department protocol requires "general site workers," those individuals performing field activities to have completed the appropriate OSHA HAZWOPER training course.

Personnel who are on site to perform occasional inspection and sampling activities and are unlikely to experience exposure over the permissible exposure limit (PEL) and published exposure limits, may be considered "workers on site only occasionally for a specific limited task." These workers must have 24 hours of training and one day of actual field experience. Employees who have minimal (low risk) exposure or low probability of exposure to hazardous substances are covered by other OSHA standards, such as the Hazard Communication Standard, Title 29 CFR §1910.120.

Training related actions that will be followed during the course of this project include a set of regulatory procedures, a pre-deployment "kick-off" meeting prior to the start of work, and daily on-site safety meetings.

Regulatory procedures related to training will consist of the presence of at least one supervisor having received the OSHA 8-hr Hazardous Waste Supervisor training who will be on-site at all times[1]. All GCE site workers will be 40-hour trained and will meet the minimum standard for experience[2]. All GCE employees have been trained in first aid, cardiopulmonary resuscitation (CPR), and blood borne pathogen awareness[3]. At least two GCE personnel properly trained and certified in adult first aid and CPR and trained in the blood borne pathogens will be assigned and on-site at all times work is being performed. All employees have been trained in proper donning and doffing procedures through the 40-hour HAZWOPER course and refresher training is current.[4]

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[1] Regulatory reference: Title 29 CFR §1910.120(e)(4), §1926.65(e)(4); NAVFAC IR Manual Chapters 11.4 and 11.9; and ACOE EM-385-1-1 §28A.02(b)(4)(b).
[2] Regulatory reference: Title 29 CFR §1910.120(e)(3)(i), §1926.65(e)(3)(i); NAVFAC IR Manual Chapter 11.4; and ACOE EM-385-1-1 §28A.02(b)(4)(a)(iii).
[3] Regulatory reference: Title 29 CFR §1926.50(c), §1910.1030; and ACOE EM-385-1-1 §28.A.02.b(13).
[4] Regulatory reference: Title 29 CFR §1910.120(e)(8), §1926.65(e)(8): NAVFAC IR Manual Chapters 11.4 and 11.9; and ACOE EM-385-1-1 §28A.02(b)(4)(a)(ii).

Copies of current OSHA training and medical clearance documents for all assigned site personnel (GCE and subcontractors) will be available on-site at all times during field work. Upon request, copies of these documents will be provided via fax, hand-delivery, or other means.

The pre-deployment "kick-off" meeting will address and review, among other issues, the identification of the chemical/physical/toxicological properties of each substance[5]; the chemical, physical, and toxicological hazards as identified in the SSHP; and the limitations and use of PPE, as presented in the HAZWOPER 40-hour training course.

An on-site "tail-gate" meeting will include a walk-through of safety procedures that will be followed during the project.

Daily safety meetings will be conducted to review issues such as symptoms and signs of overexposure to chemical hazards as presented during 40-hour HAZWOPER training[6].

8.0 STANDARD WORK PROCEDURES

Field activities are described in the work plan and will be discussed at the daily safety meeting.

8.1 Area Marking

Cones, or construction barricades and/or yellow caution tape will bound field activities, including but not limited to the exclusion zone.

8.2 Heavy Equipment Operation

Drilling equipment will be in operation at this site during field work.

8.3 Safe Work Practices

Safe work practices for site activities include the following:

- Site personnel will enter a designated exclusion zone only through the CRZ. Personnel leaving an exclusion zone must exit through the CRZ and undergo decontamination.
- Only vehicles and equipment necessary to complete work tasks will be permitted within the exclusion zone. All nonessential vehicles and equipment will remain within the support zone.
- Containers (such as drums) will be moved only with the proper equipment and will be secured to prevent dropping or loss of control during transport.
- Site personnel will avoid contact with potentially contaminated substances. Walking through puddles or mud and kneeling on the ground will be avoided whenever possible.
- Food and beverages, use of tobacco products, and application of cosmetics will not be permitted in the exclusion zone.

[5] Regulatory reference: Title 29 CFR §1210.120(c)(8), §1926.65(c)(8); and ACOE EM-385-1-1 §28.A.02.b(4)(c).
[6] Regulatory reference: Title 29 CFR §1910.120(c)(8), and ACOE EM-385-1-1 §28.A.02(b)(4)(a)(1).

- Site personnel will be required to wash their hands and faces before eating, drinking, smoking, or applying cosmetics.
- A "buddy" system will be used. Site workers will observe each other for signs of toxic exposure and heat or cold stress. Indications of adverse effects include but are not limited to: changes in complexion and skin discoloration; changes in coordination or demeanor; excessive salivation and papillary response; and changes in speech patterns. Additionally, workers will inform each other of non-visual effects of illness, such as: headache, dizziness, nausea, blurred vision, cramps, and irritation of eyes, skin, or respiratory tract.

9.0 COMMUNICATION PROCEDURES

The SSHO is assigned the responsibility to establish communications with all potential emergency response organizations prior to starting on-site work. Additionally, prior to start of on-site work, the SSHO, while identifying and establishing emergency points of contact, will also confirm and alert the nearest emergency medical facility capable and willing to deal with potentially chemically contaminated and/or seriously injured workers

Cellular phones will be present on the site while work is in progress for emergency and logistical assistance. Wireless service is available and adequate on site.

Personnel in the exclusion zone should remain in regular contact (daily before and after work commences) with either the PM, SHM, or SSHO. A failure of communication requires an immediate re-establishment of communication or cessation of work until communications can be restored.

A single 15-second long horn blast is the emergency signal that site personnel should leave the exclusion zone.

The following standard hand signals will be used in case of radio communication failure:

- Hand gripping throat: Out of air, can't breathe
- Grip partner's wrist: Leave area immediately
- Hands on top of head: Need assistance
- Thumbs up: Ok, I understand, am all right
- Thumbs down: No, negative

10.0 DECONTAMINATION PROCEDURES

The equipment decontamination procedures described in the following sections are based on guidelines appropriate for low-level contamination. When appropriate, Liquinox or Alconox cleaning solutions and deionized water rinses will be used to decontaminate equipment. Wastewater generated by equipment decontamination activities will be stored in 55-gallon containers or Department of Transportation (DOT) approved containers. The PM will label the wastewater and will arrange for this investigation-derived waste to be transported to an authorized disposal facility.

10.1 Reusable Equipment

Reusable equipment will be decontaminated before and after each use. Deionized water will be used for the following sampling equipment decontamination procedures:

- Scrub the equipment with a brush in a bucket containing Liquinox or Alconox solution and potable, distilled water.
- Triple-rinse the equipment with distilled water, and allow it to air dry.
- Reassemble the equipment and place it in a clean area on plastic or aluminum foil. If aluminum foil is used, wrap the equipment with the dull side of the aluminum foil toward the equipment.

10.2 Personnel

Remove and bag disposable chemical-resistant gloves and clothing (i.e., Tyvek) in a plastic trash bag. If cotton coveralls are used, bag and wash prior to re-wearing. Field workers will be instructed to wash hands and face using soap and water and to take a shower and wash hair as soon as possible after leaving the site.

10.3 Investigation-Derived Material Disposal

Wastes that are anticipated to be generated during the field work may include groundwater, decontamination water, and PPE. Where possible, these wastes will be containerized on site and stored temporarily in 5 or 55 gallon drums or other suitable containers. Disposal of these wastes will be based on analytical results of the item in question. Contaminated wastes will be transported to an authorized disposal facility. Waste classified as “hazardous waste” must be transported in accordance with current regulations. The PM shall maintain copies of all turn-in documents, bills-of-lading, uniform hazardous waste manifests, or waste acceptance forms demonstrating ultimate disposal of these wastes.

11.0 CONFINED SPACE ENTRY

The tasks for this project do not involve confined-space entry.

12.0 UPDATES OF HEALTH AND SAFETY PLAN

Updating of this Health and Safety Plan shall be done as frequently as necessary to ensure safe work conditions. Suggestions should be brought to the attention of the PM, SHM, or SSHO. If unforeseen situations arise, this plan will be updated accordingly.

13.0 EMERGENCY ACTION PLAN

This Emergency Action Plan (EAP) has been prepared to comply with 29CFR1910.38. The purpose of the EAP is to facilitate and organize actions during emergencies. The elements of the EAP are described in detail below.

13.1 Means of Reporting Fires and Other Emergencies

In the event of a fire or explosion at the site, the Fire Department will be contacted as soon as possible and evacuation of the site will begin immediately. Emergency phone numbers are included as Attachment C.

13.2 Evacuation Procedures and Emergency Escape Route Assignment

Workers will evacuate the exclusion zone by the most expedient route available, preferably through the contamination reduction zone. In the event site evacuation is necessary, the evacuation meeting location will be described at the daily tailgate meeting. The emergency meeting location(s) are illustrated on the Site Map (Attachment A). In all situations when an emergency results in the evacuation of the exclusion zone, personnel must not re-enter until:

- The conditions causing the emergency have been corrected.
- The existing hazards have been reassessed.
- The SSHP has been reviewed.
- Site personnel have been briefed on any changes to this SSHP.
- The route to the medical facility is included as Attachment D.

13.3 Procedures to be Followed by Employees Who Remain to Operate Critical Plant Operations Before They Evacuate

Employees are not required to remain on site during evacuation procedures.

13.4 Procedures to Account for all Employees after an Emergency Evacuation has been Completed

In the event of an evacuation, the SSHO will be responsible for ensuring that all personnel evacuated the site. The SSHO will account for all personnel at one of the meeting locations illustrated in Attachment A. The meeting location will be discussed each day in the tailgate meeting.

13.5 Rescue and Medical Duties for Those Employees Who are to Perform Them

Rescue and medical duties will be performed by the fire department. Emergency phone numbers are provided in Attachment C.

13.6 Names or Job Titles of Persons Who can be Contacted for Further Information or Explanation of Duties under the Plan

Additional information or clarification of some aspect of the plan may be obtained by contacting:

Stacy Gutierrez, PE, CIH
Health and Safety Manager
Gutierrez Canales Engineering, PC
928.920.4054

stacyg@neiaw.com

14.0 REFERENCES

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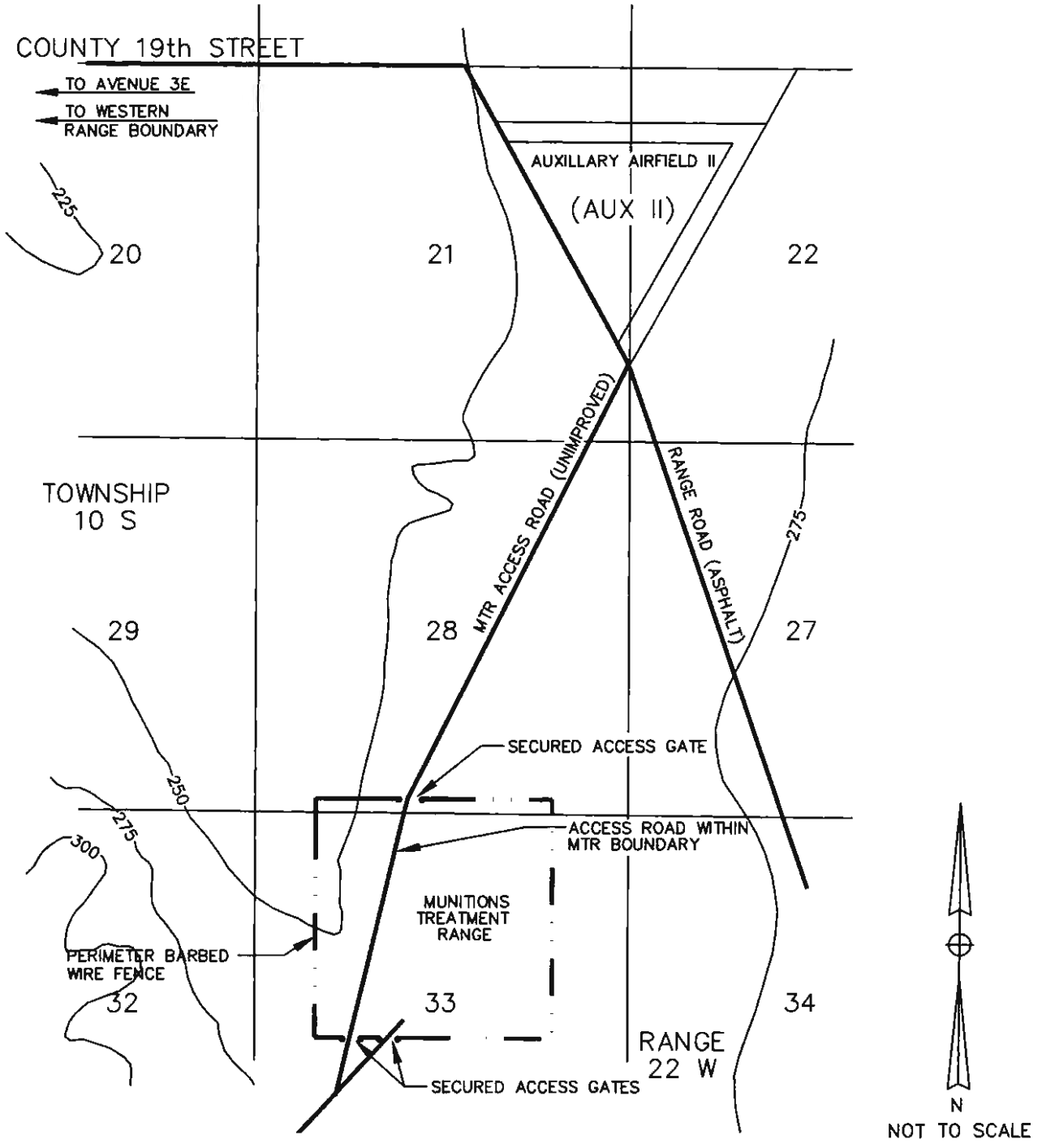
Site Safety and Health Plan Attachment A

Site Map



SOURCE: MTR HAZARDOUS WASTE FACILITY PERMIT; CDM

PREPARED BY

GCE

1851 W. 24th Street
YUMA, ARIZONA 85364 (928) 317-1401
Email: gce@gcepc.com

SITE LOCATION MAP

MUNITIONS TREATMENT RANGE
BARRY M. GOLDWATER RANGE
MCAS YUMA, YUMA, ARIZONA

SIZE	PROJECT NO.	PROJECT MANAGER	REV
-	10GC007	STACY GUTIERREZ	0

GCE PROJECT NO: 10GC007	SCALE	NTS	DATE	DECEMBER 2013	DWG	FIGURE 2-2

Site Safety and Health Plan
Attachment B

Activity Hazard Analysis

Activity Hazard Analysis (AHA) #1

Activity/Work Task: General Job Safety	Overall Risk Assessment Code (RAC) (Use highest code) **H**
Project Location: MCAS Yuma	**Risk Assessment Code (RAC) Matrix**
Contract Number: Project 10GC007	
Date Prepared: 3-Dec-13	
Prepared by (Name/Title): Stacy Gutierrez, Health & Safety Manager	
Reviewed by (Name/Title): Andrew Klakulak, Site Safety & Health Officer	

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
Working at MTR	Explosion From Unexploded Ordnance	CEODU will clear work areas and supervise work at all times.	H
Working Outdoors	Solar Radiation Hazard	Wear protective clothing to prevent exposure to the sun.	L
		Use sunscreen and reapply as needed.	
		Use shade to minimize UV exposure and heat stress.	
	Dehydration	Drink at least 1/2 liter of water an hour.	
		Work/rest regimen will be adjusted in accordance with temperature.	
		If possible, strenuous work will be scheduled during the cooler times of the day.	
	Bee, Insect, Vermin, Snakes, and Stings	Advise SSHO if you are allergic to bees or other insects prior to	L
		Do not agitate or disturb insects or other animals.	
		Avoid wearing perfumes, hair spray, or scented lotions.	
		Be aware of potential species locations (culverts, drainage pipes, junk piles, and dense shrubbery).	
		If stung, remove stinger as quickly as possible by raking your fingernail	
		Thoroughly inspect the site area prior to work.	
		Walk or hike in areas where the ground is clear, so you can see where	
		Wear protective clothing such as long heavy pants and high boots.	

		Wear gloves when using your hands to move rocks or brush.	L
		Ledges, cracks or holes are common areas where snakes and insects can be found resting.	
		Report any bites/stings to the SSHO and seek medical attention	
	Slip, Trip, and Fall Hazards	Wear proper footwear at all times.	M
		Use caution when walking on slopes or were moisture is present.	
		Follow good housekeeping procedures in work space.	
		Maintain proper lighting at the site.	
		Remove or clearly mark objects that pose tripping hazards.	
		Walk, do not run while on site.	
		Prevent water accumulation where practicable.	
		Carry objects in a manner that allows you to see in the area you are	

Equipment to be Used	**Training Requirements/Competent or Qualified Personnel name(s)**	**Inspection Requirements**
Level D PPE	Tailgate Meeting	SSHO Inspections

Activity Hazard Analysis (AHA) #2

Activity/Work Task:	Mobilization & Demobilization
Project Location:	MCAS Yuma
Contract Number:	Project 10GC007
Date Prepared:	3-Dec-13
Prepared by (Name/Title):	Stacy Gutierrez, Health & Safety Manager
Reviewed by (Name/Title):	Andrew Klakulak, Site Safety & Health Officer

Overall Risk Assessment Code (RAC) (Use highest code): **H**

Risk Assessment Code (RAC) Matrix

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
Entering MTR/Working at MTR	Explosion From Unexploded Ordnance	CEODU will provide escort at all times.	H
Driving to Site	Traffic Accident	Ensure driver has a valid state issued drivers license.	L
		Obey all traffic laws.	
		Secure all items to prevent movement\missile hazards while driving.	
		Do not use cell phones while driving unless equipped as hands-free.	
		Be alert and exercise defensive driving techniques.	
		Adjust driving speed to compensate for poor road and weather conditions.	
	Stress and Fatigue	Drivers should be capable and well rested before driving long distances. Change drivers frequently to prevent fatigue or drowsiness. Take frequent breaks as necessary.	L
		A 12 hour workday is the maximum allowed for any activity of which 10 hours may be spent driving.	
Set up necessary work zones	Back Injury/Strain	Observe proper lifting techniques to lessen the chance of injury.	L
		Ask for help if load is heavy.	
	Traffic Hazard	Wear high-visibility safety vest in traffic areas. Follow all flight line rules and policies. Watch for oncoming traffic. Use a spotter if traffic is heavy.	M
	Chemical Exposure	Plan and demarcate work zones appropriate for the type of contaminants that may be encountered onsite.	L
		If appropriate, use caution tape, cones, or other barriers to differentiate work zones.	
Packing Equipment	Back Injury/Strain	Observe proper lifting techniques lessen the chance of injury. Ask for help if load is heavy.	L

Driving from Site	Traffic Accident	Ensure driver has a valid state issued drivers license.	L
		Secure all items to prevent movement\missile hazards while driving.	
		Obey all traffic laws.	
		Do not use cell phones while driving unless equipped as hands-free.	
		Be alert and exercise defensive driving techniques.	
		Adjust driving speed to compensate for poor road and weather conditions.	
		A 12 hour workday is the maximum allowed for any activity of which 10 hours may be spent driving. Drivers should be capable and well rested before driving long distances. Change drivers frequently to prevent fatigue or drowsiness. Take frequent breaks as necessary.	

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
Level D PPE Motorized Vehicles	Tailgate Meeting Valid Driver's License	SSHO Inspections Conduct safety check prior to operation

Activity Hazard Analysis (AHA) #5

Activity/Work Task: Soil & Groundwater Sampling	Overall Risk Assessment Code (RAC) (Use highest code): **H**
Project Location: MCAS Yuma	
Contract Number: Project 10GC007	
Date Prepared: 3-Dec-13	
Prepared by (Name/Title): Stacy Gutierrez, Health & Safety Manager	
Reviewed by (Name/Title): Andrew Klakulak, Site Safety & Health Officer	
Notes: (Field Notes, Review Comments, etc.)	

Risk Assessment Code (RAC) Matrix

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
Working at MTR	Explosion from Unexploded Ordnance	CEODU will supervise work at all times.	H
Soil and Groundwater Handling	Chemical Exposure- Dermal Contact	All personnel will wear appropriate PPE including chemical resistant gloves (as approriate) and safety goggles or glasses. All personnel will be required to follow appropriate decontamination procedures.	L
	Chemical Exposure- Inhalation	PPE may be upgraded to include respiratory protection at the discretion of the SSHO and SHM.	L
	Slips, Trips, Falls	Clear obstructions from the work area. Practice good housekeeping keeping area clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces. Use caution when walking around the excavation area.	L

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
Level D PPE	Site specific training	SSHO Inspections

Activity Hazard Analysis (AHA) #3

Activity/Work Task: Well Installation	Overall Risk Assessment Code (RAC) (Use highest code) **H**
Project Location: MCAS Yuma	
Contract Number: Project 10GC007	
Date Prepared: 3-Dec-13	
Prepared by (Name/Title): Stacy Gutierrez, Health & Safety Manager	
Reviewed by (Name/Title): Andrew Klakulak, Site Safety & Health Officer	

Risk Assessment Code (RAC) Matrix

Severity	Probability: Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic	E	E	H	H	M
Critical	E	H	H	M	L
Marginal	H	M	M	L	L
Negligible	M	L	L	L	L

Notes: (Field Notes, Review Comments, etc.)

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

RAC Chart

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

Job Steps	Hazards	Controls	RAC
Working at MTR	Explosion from Unexploded Ordnance	CEODU will supervise work at all times.	H
Site Set Up	Struck By	All equipment and tools will be properly secured during transport. All vehicles and equipment will comply with airfield requirements.	M
	Slips, Trips, Falls	Clear obstructions from the excavation area. Practice good housekeeping keeping area clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces. Use caution when walking around the excavation area.	L
	Backing	Use a ground guide along with a functioning back-up alarm during equipment backing.	L
Drilling	Struck By	Utilize appropriate PPE in the exclusion zone. Ensure that ground workers have eye contact with the heavy equipment operator. Ensure that all personnel utilize appropriate hand signals to communicate with the heavy equipment operator.	M
	Chemical Exposure	All personnel will wear personnel protective equipment specified in the SSHP. Personnel and equipment decontamination procedures will be followed.	L
	Electrocution	No overhead or underground electric lines are located in the vicinity of the site.	M
	Pinch and Caught By	All motors must be shut off and electrical, mechanical and hydraulic components locked out of service when making repairs. All personnel shall be trained on kill switch locations	L
	Fire	All motors must be shut off during refueling.	M
		Fuel containers will not be stored within 10 feet of the equipment. Fuel will be stored in UL approved safety containers with contents clearly labeled.	
		Smoking in the vicinity of the equipment is not permitted.	

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
Level D PPE	Site specific training	SSHO Inspections
Motorized Vehicles	Valid state issue driver's license	Conduct safety check prior to operation.
Hand Tools	Job specific training	Applicable PPE will be inspected in accordance with manufacturer's recommendations.
	Tailgate meeting	Thoroughly inspect tools for corrosion or damage prior to use.

Site Safety and Health Plan Attachment C

Site Emergency Phone Numbers

SITE EMERGENCY PHONE NUMBERS

Hazards of Concern: VOCs, SVOCs, Metals, Explosives, White Phosphorus, Nitrates/Nitrites, Ammonia, Perchlorate, Hydrocarbons, physical burns, explosions

Minimum Level of Protection: Level D

Emergency resources are listed below.

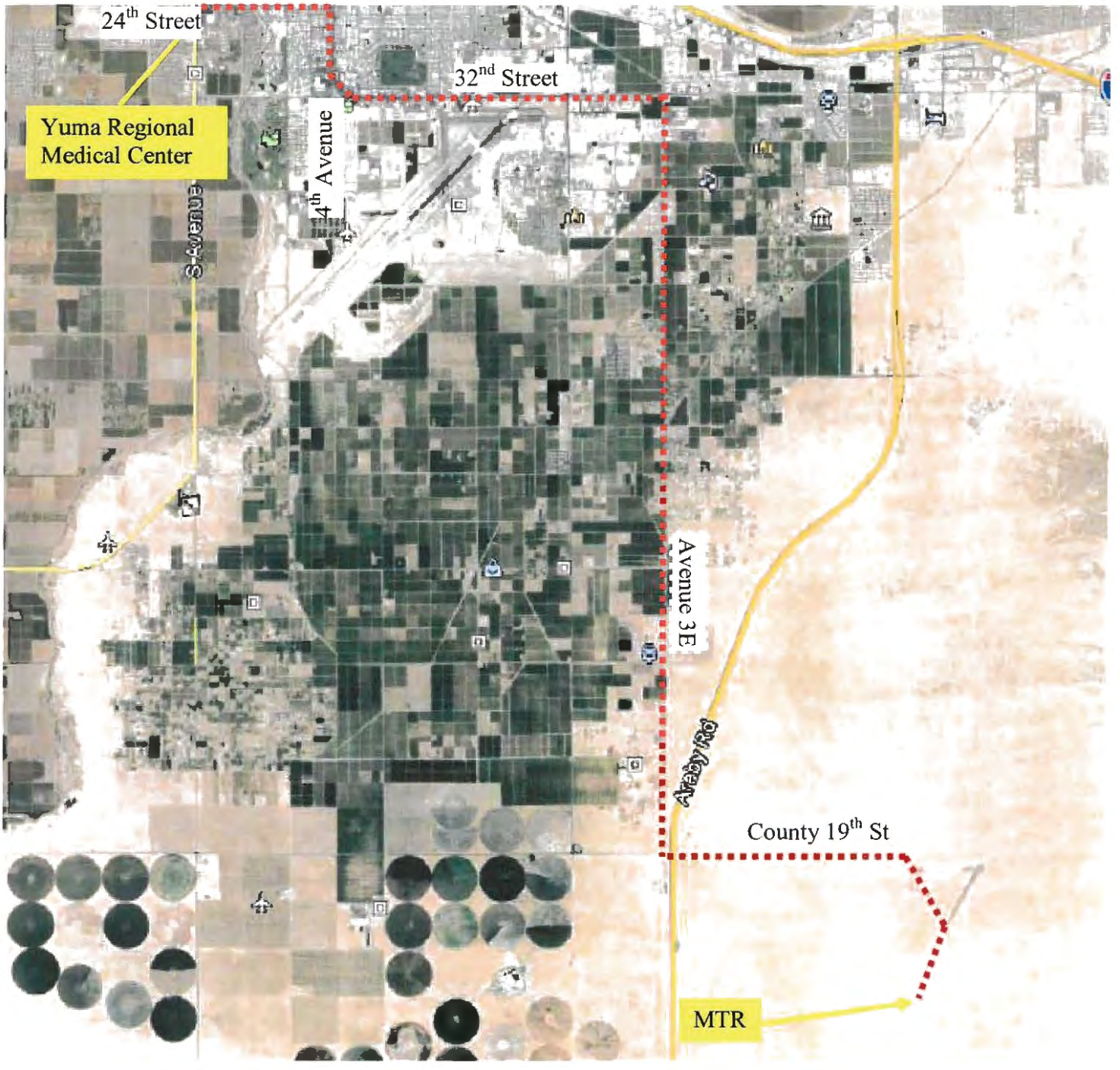
THE MOST RAPID RESPONSE TO AN EMERGENCY SITUATION WILL BE ACHIEVED BY CALLING 928-269-2333. This number is the direct dial contact with MCAS Emergency Responders/Fire Department. A call to 911 will ultimately be routed to the MCAS Fire Department.

Emergency Contact Numbers

Emergency Contact	Phone Number
Yuma Regional Medical Center	928-344-2000
Emergency Response (Fire Department)	**928-269-2333** or 911
Stacy Gutierrez, SHM	(928) 920-4054
Andrew Klakulak, SSHO	(928) 920-4122
Eric Gardner, PM	(928) 581-5425
Angela Wimberly, NAVFAC RPM	(619) 532-4168
Frederick Daniel, MCAS YUMA	(928) 941-1624

Site Safety and Health Plan
Attachment D

Medical Facility Address and Route Map



Yuma Regional Medical Center
2400 S Avenue A
928.344.2000

Yuma Regional Medical Center (YRMC) is the closest medical facility. YRMC is located at 2400 S. Avenue A.

From the Munition Treatment Range, head north east on the MTR access road. Turn Northwest onto bombing range access road via County 19th Street. Continue West on County 19th Street. Turn North via Avenue 3E and continue to 32nd Street. Travel West on 32nd Street through the "big curve" (32nd Street to 4th Avenue transition) and continue to travel North on 4th Avenue to 24th Street. Travel West to Avenue A. YRMC is on the Southwest corner of Avenue A and 24th Street.

Site Safety and Health Plan
Attachment E

Tailgate Safety Meeting Documentation

TAILGATE SAFETY MEETING DOCUMENTATION

PROJECT TAILGATE SAFETY MEETING SHEET

DATE: _____ PROJECT #: _____ WEATHER: _____

PM (Name): _____ SSHO (Name): _____

TASKS TO BE PERFORMED: _____

TASK HAZARDS:	HAZARD MITIGATION:

OTHER POTENTIAL HAZARDS OR CONCERNS: _____

REQUIRED PPE/TRAINING: _____

LESSONS LEARNED FROM PREVIOUS ACTIVITIES: _____