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DEPARTMENT OF THE AIR FORCE
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HOLLOMAN AIR FORCE BASE NEW MEXICO

29 September 2014

DeAnna Rothhaupt
Chief, Holloman AFB Environmental
550 Tabosa Avenue
Holloman AFB NM 88330-8458

USEPA, Region 6 (6PD-F)
Attn: Mr. Chuck Hendrickson, Project Manager
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

SUBJECT: Transmittal of Responses to Comments on Three Submittals for Munitions Response Sites XU853/XU854, RR869a, and FI857at Holloman Air Force Base, New Mexico (EPA I.D. # NM6572124422)

Dear Mr. Hendrickson,

Holloman AFB is pleased to submit the Responses to Comments, dated July 17, 2014 on the following submittals: Remedial Investigation (RI) Work Plan (WP) for XU854 Missile Test Stand Area and XU854 Able 51 Area Munitions Response Sites (MRSs), RI WP for RR869a Debris Field MRS, and Engineering Evaluation/Cost Analysis (EE/CA) for FI857a Former Bunker MRS.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions regarding this submittal, please contact me at (575) 572-3931.

Sincerely,

DEANNA ROTHHAUPT, GS-12, DAFC

Attachment:
Responses to Comments on Three Submittals: RI WP for XU853/XU854 MRSs, RI WP for RR869a MRS, and EE/CA for FI857a MRS.

cc: Mr. John Kieling, NMED HWB
Mr. David Strasser, NMED HWB

Common Comment and Response Worksheet (Version 3)

							Document Title (version) Draft Final RI WPs for XU853-XU854 and RR869a MRSs and Draft Final EE/CA for FI857a MRS	Contract/TO Number/EPA I.D. # FA8903-13-C-0008/NM6572124422
							Document Title (version) Draft Final RI WP for XU853 and XU854 MRSs	Contract/TO Number/EPA I.D. # FA8903-13-C-0008/NM6572124422
Item	**Source**	**Section**	**Page**	**Para**	**Line**	**Class**	**Comment**	**Response**
1	USEPA	1.6.2, CSE Phase II results:					The report states that no MEC was found in either MRA. But the intact small arms ammunition found in both MRAs are considered MEC [Final Army MMRP RI/FS Guidance, Nov. 2009, Section 4.2.1]. Also, is there any evidence of formal small arms training here? Is there any record of such training here? Or does this seem to be a minor ad hoc usage of small arms?	Comment noted. Please note that Section 1.6.2 provides a summary of the CSE Phase II results at XU853 and XU854 MRAs as provided in the Final MRSPP QA Panel approved CSE Phase II Report (dated September 2013). The CSE Phase II visual survey identified intact small arms ammunition (5.56mm and 7.62mm) which were documented and disposed of by Holloman AFB EOD. Regarding the status of these items as MEC, the Army Position Paper, Small Arms Ammunition (SAA) – Explosives Safety or Human Health Risk dated 28 March 2013 (considered final), that formalizes a DoD position on whether SAA should be considered MEC from an explosive safety perspective concluded that: "A munitions response should evaluate and when merited be conducted on ranges used exclusively for training with SAA from an environmental (i.e., address residue MC) not explosives safety (i.e., address MEC) perspective." Also, since there is no historical record of small arms training conducted at the two MRSs, and since the CSE Phase II visual survey did not discover any evidence of formal small arms training (e.g., targets, berms, and firing positions), small arms debris discovered at both sites during the CSE Phase II suggest recent but minor undocumented usage of small arms. In addition, FPM contacted David Rizzuto (Holloman AFB Contractor Support) regarding the possibility that XU853/XU854 might be used for BEEF training activities. The organization responsible for BEEF Training area at Holloman AFB confirmed that XU853/XU854 MRSs have not been used for this training. The text for the CSE Phase II Results for the Missile Test Stand Area MRA and for the CSE Phase II Results for the Able 51 Area MRA has been revised as follows: "No MEC was encountered in the MRA during the visual survey; therefore, no MC sampling was conducted in the MRA. Although intact small arms ammunition (SAA) was identified during the visual survey, there is no historical record of small arms training conducted at the MRA, and since the CSE Phase II visual survey did not discover any evidence of formal small arms training (e.g., targets, berms, and firing positions), the small arms debris discovered at the MRA during the CSE Phase II suggest recent but minor undocumented usage of small arms. Therefore, no MC sampling for lead was conducted in the MRA. As a result, no human health or ecological screening was conducted for this site. The CSE Phase II concluded that any human health or ecological risks at this site was expected to be similar to background conditions."
2	USEPA	1.7.1, MEC Exposure Pathway Analysis:					The pathway is reported incomplete due to lack of MEC, discounting smoke grenades & grenade simulators, which "present a potential explosive hazard". Also, a projectile was reported found in Able 51 area and there were several types of MD found, which indicate potential MEC. And the text seems to assume that the visual surveys [no details of the surveys were given in the text] were 100% thorough, not missing anything; this is not necessarily a good assumption. The pathway analysis should be reevaluated.	Agreed. The CSM has been revised to show MEC pathways as potentially complete for both XU853 and XU854 MRSs. Also, text in Section 1.7.1 has been revised to reflect this change. Additionally, the CSM will be updated based on information collected during the RI and the updated CSM will be provided in the RI Report.

3	USEPA	1.7.2, MC Exposure Pathway Analysis:					"There are no known aquatic environments present within the XU853 and XU854 MRSs. Therefore, this pathway is believed to be incomplete." Lost River is adjacent to this area to the northwest; has this pathway been considered?	Comment noted. There are no wetlands or surface water within the MRSs boundary. However, given the potential for overland flow during storm events, the revised CSM shows this MC pathway for biota as potentially complete. Also, text in Section 1.7.1 has been revised to reflect this change. Additionally, the CSM will be updated based on information collected during the RI and the updated CSM will be provided in the RI Report.
4	USEPA	1.8					Both MRSs have buildings that have been used for storage. The nature of the materials stored, and any potential or known releases of COCs from stored materials, should be reported and evaluated, including MC and non-MC COCs. This information will be needed for unrestricted-use site closeout, but may be beyond the scope of this investigation.	Comment noted. Based on available historical information there is no record of the nature of materials stored in buildings located at XU853 and XU854 MRSs, and therefore, there is no record of potential contaminants of concern in these buildings. FPM will coordinate with Holloman AFB Restoration Manager to determine the path forward related to investigation of the buildings at XU853 and XU854 MRSs.
5	USEPA	3.1.2.3					The decision process needs adjustment and reporting of further details. First, MEC has already been found in the form of small arms ammunition; this MEC may or may not present explosive or MC hazards, depending on the amount present and/or historically used. Second, the presence of several types of MD already indicate past MEC usage, which presents the potential for MEC presence from duds, misfires, abandonments, lost items, and burials. Known MD/MEC presence and distribution should be evaluated, with the evaluation results used in the RI to define areas which need further investigation for potential MEC items. Results from the RI might then be adequate to recommend NFA for the site or sites.	Comment noted. With respect to SAA classification as MEC please see FPM's response to comment # 1. The decision process in the WP text will be clarified to include previously collected information. The first bullet in Section 3.1.2.3 has been revised as follows: • "Do the previously collected information regarding the presence and distribution of MD and the RI surface clearance and intrusive investigation data indicate the presence of MEC/MPPEH/MD at the MRSs? o If yes, then a MEC HA is required to evaluate the potential explosive hazard. o If there are portions of the MRSs where MEC/MPPEH/MD is not present, recommend o NFA for these portions and acreage reduction for the MRSs. o If no MEC/MPPEH/MD is found, then recommend NFA for MEC for the entire MRSs."
6	USEPA						Will the base place institutional controls on these sites to prevent further munitions usage? If not, it may be useless to attempt to get NFA status for these sites?	Agreed. The Air Force objective for XU853 and XU854 MRSs under the current contract is to achieve site closeout with unrestricted use/unlimited exposure. Once site closeout is achieved, it will be the responsibility of HAFB, based on mission requirements, to determine an appropriate future land use.
7	USEPA	3.1.2.6					This section has 24 lines of text discussing false positives and their minimization. But it has only 19 words on false negatives. False positives lead to increased costs, but false negatives lead to undiscovered risks that are left on the site. This section needs to also address tolerance limits that minimize false negatives.	Agreed. The following text has been inserted at the end of the fifth paragraph in **Section 3.1.2.6**: "FPM will implement a rigorous QC program to ensure no false negatives occur during the RI. This includes initial and daily geophysical equipment QC checks, static and positional accuracy tests for RTK-GPS, IVS and blind seeding program, QC reprocessing of 10 % of initially processed geophysical data, and QC inspection of minimum of 10% of the areas intrusively investigated. All QC tests including their tolerance limits are discussed in detail in **Section 4.0**."

8	USEPA	3.2 - 3.4					Proposed surface clearance and DGM are planned to be done only on planned transects/grids. This will results in investigation of only very small percentages of the sites. Since most of the munitions that have been found are non-fragmenting and have no known range boundaries, applicability of survey-area statistical methods (e.g., VSP) is limited and there is no assurance that the areas not investigated are clear of MEC. I recommend visual surface clearance over 100% of the areas; if these surveys find new areas of MEC/MD, the RI work should be adjusted to investigate those areas.	Comment noted. A comprehensive visual survey (comprised of transect lines separated by approximately 8-10 meters) was performed at both XU853 and XU854 MRSs during the CSE Phase II. Surface MD distribution was well-characterized at both MRSs, therefore, there is no need for 100% surface clearance as part of the RI. In addition, based on historical usage of two MRSs, there is no known or suspected target area within either MRS. Therefore, potential subsurface MEC items are assumed to be randomly distributed across each site. As a result, VSP software was not used for determining the spacing between the DGM transects, but they were rather located randomly based on the underlying assumption that there as an equal likelihood of finding a subsurface MEC anywhere in the MRS. The following text has been inserted in **Section 3.4.2** to ensure that all potentially contaminated areas will be investigated: "Based on initial DGM and intrusive results, additional transects and/or grids may be required to better delineate areas (if any) to adequately determine the nature and extent of MEC/MPPEH."
9	USEPA	Table 3-3					SSLs: EPA issued new Regional Screening Levels (RSLs) in May 2014; these RSLs are generally updated twice a year and should be incorporated into the program as they change. This update made soil screening levels for most of the COCs higher than the previous RSLs, with many RSLs 10 times higher than those listed in this table.	Agreed. The USEPA RSLs in **Table -3-3** and in UFP-QAPP Worksheet #15 have been revised to reflect the May 2014 values. These tables have also been revised to show NMED-approved basewide background levels.
10	USEPA	3.7.3					Discolored soils may be due to spills of liquids such as liquid fuels. Analyses for VOCs, SVOCs, and TPHs may also be needed to determine whether there were releases of these types of liquids here.	Comment noted. All rocket/missile propellant constituents known to have been in use at two MRSs have been listed in **Section 3.7.3**. VOCs, SVOCs, and TPHs are not considered potential contaminates of concern at these sites. No changes to the text were required.
11	USEPA	6.1.6					"The buffer around the White Sands Pupfish habitat overlaps a portion of the XU853 MRS (Figure 6-1)." This buffer area signifies a need to evaluate potential for exposure of Pupfish to releases from these sites.	Agreed. Human Health and Ecological Risk Assessments were not conducted for XU853 during the CSE Phase II because no potential MC sources were found during the site survey. If potential MC sources are discovered during the RI, FPM will compare analytical results (i.e., concentrations of metals, explosives, and propellants) to appropriate screening levels, and if exceedances of applicable standards are identified through the evaluation of existing conditions, FPM will perform Human Health and Ecological Risk Assessments for XU853 (including the buffer around the White Sands Pupfish habitat) as described in **Sections 3.9.2** and **3.9.3**. The risk assessments will be performed only for parameters that exceed the applicable screening criteria. No changes to the text were required.
12	USEPA	Appendix D (UFP-QAPP), Worksheet #11					Do the listed potential MC metals include the metals in the charges of the smoke, flare, and signal items found on site?	Comment noted. The MC metals associated with the charges of the smoke, flare, and signal items found on site are aluminum, antimony, iron, magnesium (as magnesium nitrate), and potassium (as potassium perchlorate). The analytes aluminum, antimony, iron, nitrate, and perchlorate are included in the list for analysis. As nitrate and perchlorate are included in the list of analytes, the associated metals of the compounds, magnesium and potassium, are not included in the list for separate analysis. In addition, there are no USEPA or NMED soils or groundwater screening levels available for the magnesium or potassium. No changes to the text were required.
13	USEPA	Appendix D, Worksheet #11					Both solid and liquid rocket fuels were reportedly used at these sites. Are the propellant MCs listed here inclusive of all such fuels used here?	Please see response to comment # 10 above.

14	USEPA	Appendix D, Worksheet #11					Analyses of soil samples at found MEC/MPPEH items should be inclusive of all MCs associated with the particular item found, but need not include non-associated MCs. Further, if small intact MEC items are found on the surface as singles or small clusters, with no signs of leakage, I see no need to sample the soils under them at these two sites. [cross-reference: main text Section 3.7]	Agreed. The soil samples at MEC/MPPEH find locations will be analyzed for explosives and metals associated with all known or suspected MEC/MPPEH at two MRSs. Only those metals associated with specific MEC/MPPEH will be reported. In addition, the signs of leakage of intact MEC items are not always apparent; therefore, FPM chose the conservative approach to sample all locations where MEC items are found.
15	USEPA	Appendix D, Worksheet #11, Decision Rule 1					"In addition, MD items found at these two MRSs are associated with MEC items (e.g. smoke grenades and hand grenade simulators) that are not associated with high explosives, and as such, do not represent sources of MC." I disagree with this statement: the definition of MC (munitions constituents) includes nonexplosive materials [ref: 10 U.S.C. 2710(e)(3)]. Soil sampling for MC should not be discounted based on lack of HE fill.	Agreed. This sentence has been deleted from the Worksheet # 11 in A**ppendix D**.
16	USEPA	Appendix D, Worksheet #15					EPA's RSLs have changed; see comment on Table 3-3, above.	Agreed. Please see response to comment # 9 above.
17	USEPA	QAPP:	PDF file pp. 352-353				**Figures 2** and **3** [PDF file pp. 352-353] show the proposed incremental sampling (IS) decision units, which range from 0.60 acres to 1.1 acres. But the IS procedures in SOP#1 recommend decision unit maximum size of only 0.625 acres. Why are some of these units larger than recommended?	Agreed. The UFP-QAPP **Figures 2** and **3** have been revised to include the modified decision units.

Date	Reviewer	Document Title (version)	Contract/TO Number/EPA I.D. #
		Draft Final EE/CA for FI857a MRS	FA8903-13-C-0008/NM6572124422

Item	Source	Section	Page	Para	Line	Class	Comment	Response
1	USEPA						The area of the FI857a MRS is minimized, based on MD finds. This seems acceptable except that the area should be expanded to cover the grenade throw distance around the grenade pin. There should be a contingency to increase the clearance area if there are indications that MD extend beyond any edge of the area.	Agreed. The following sentence has been added at the end of the first paragraph in **Section 4.2.4**: "In addition, if perimeter anomalies are found or if surface clearance and/or intrusive investigation results indicate the MEC/MPPEH presence beyond the MRS boundary, FPM will extend surface clearance and DGM investigation to determine the extent of contamination."
2	USEPA	Sections 4-6, Alternatives analysis:					The recommended alternative (#4) is good: 100% surface & subsurface removal based on a Geonics G-858 magnetometer survey.	Comment noted.

Date	Reviewer	Document Title (version)	Contract/TO Number/EPA I.D. #
		Draft Final RI WP for RR869a MRS	FA8903-13-C-0008/NM6572124422

Item	Source	Section	Page	Para	Line	Class	Comment	Response
1	USEPA	1.6					In the CSE Phase I visual survey, "The field team observed potential high explosive fragments and MD consistent with a missile or drone crash site." But in the CSE Phase II visual survey, no such fragments are reported. And based upon that lack of found fragments, no MC sampling is proposed in this RI work plan, according to this text. The CSE Phase II transects apparently missed the Phase I fragment finds. Based on the finds of potential explosive chunks in the CSE Phase I survey, and the nature of military crash sites, this work plan should include soil sampling at any finds of suspected explosive during the proposed 100% areal investigation of this site. In disagreement with this section of text, Sections 3.1.1 and 3.7 plan for MC sampling at finds of MEC/MPPEH. Please correct the text.	Agreed. The CSE Phase II visual survey covered significant portion of the site and identified numerous MD items including debris from a 2.75 inch rocket launcher, assorted rocket debris in several locations, unidentified metallic debris in one location, and frag in another location. These items, and their locations, are consistent with the CSE Phase I findings. See also response to comment # 2 below. FPM agrees that areas with significant amount of MD may be considered a potential source for MC contamination. **Sections 3.1.1** and **3.7** have been revised to state that MC sampling will be conducted at locations where MEC/MPPEH items are identified as well as in areas with significant amounts of MD. In addition the last paragraph of UFP-QAPP Worksheet #11 bullet 1 "State the Problem" has been revised to state the same.
2	USEPA	1.6.2	1-11				"Figure 1-2 shows the CSE Phase II Identified items and visual reconnaissance transects." The figure does not show the transects. Please add the transects to the figure.	Agreed. The CSE Phase II visual survey transects have been added to WP **Figure 1-2** and UFP-QAPP **Figure 2**. In addition, the symbols and descriptions of the items found during the CSE Phase II visual survey have been revised in these figures to more accurately reflect the information presented in the Final CSE Phase II report.
3	USEPA						Shotguns shells and clay target debris were found at this site, presenting potential concerns for lead shot and for PAH contaminants from clay targets in soil. This work plan should include evaluation of the distribution of these debris items and contingencies to sample for related COCs if the amount of debris is significant.	Comment noted. Only one .50 caliber projectile and several clay target debris were discovered during the CSE Phase II at RR869a. No shotgun shells were reported as observed during either the CSE Phase I or II visual surveys. Also, there is no historical record of small arms training activities at RR869a MRS. Therefore, CSE Phase II data indicates only minor undocumented usage of small arms at this site and does not indicate a potential lead or PAH concern. However, if during the RI a significant amount of shotgun shells and/or clay target debris is found sampling for related CoCs (lead and PAHs) will be conducted. In addition site-specific QAPP and RI WP have been revised to include sampling and analysis of lead and PAHs.
4	USEPA	3.1.2.6					This section has 24 lines of text discussing false positives and their minimization. But it has only 19 words to describe false negatives. False positives lead to increased costs, but false negatives lead to undiscovered risks that are left on the site. This section needs to also address tolerance limits that minimize false negatives.	Agreed. The following text has been inserted at the end of the fifth paragraph in **Section 3.1.2.6**: "FPM will implement a rigorous QC program to ensure no false negatives occur during the RI (there are no tolerance limits on false negative occurrence). This includes initial and daily geophysical equipment QC checks, static and positional accuracy tests for RTK-GPS, IVS and blind seeding program, QC reprocessing of 10 % of initially processed geophysical data, and QC inspection of minimum of 10% of the areas intrusively investigated. All QC tests including their tolerance limits are discussed in detail in **Section 4.0**."
5	USEPA	3.7					"USEPA also publishes Regional Screening Levels (RSLs) (USEPA, 2013)." EPA's latest RSLs were published May 2014.	Agreed. The USEPA RSLs in **Table -3-3** and in UFP-QAPP Worksheet #15 have been revised to reflect the May 2014 values.

Column A: Comment Identifier Number
Column B: Source (Commenter/Authority)

Comment Classifications
(C) Critical: Critical comments will result in a critical issue. Provide convincing support.

Column C:	Section Number of Comment
Column D:	Page Number of Comment (first page associated
Column E:	Paragragh number, on page, of Comment Line Number (within Paragraph above) of
Column F:	Comment
Column G:	Comment Classification
Column H:	Comment
Column I:	Response
Notes:	Comments must be actionable ("add the following text:…", "delete…", "change text to:")
	Place only one comment per row.
	Classify comment as C, M, S, or A.

(M) Major: Major comments are significant concerns that may result in a major issue. This category may be used with a general statement of concern followed by a detailed comment on the specific

(S) Substantive: An entry in the document that appears to be or is potentially unnecessary, misleading, incorrect, or confusng.

(A) Administrative: Administrative comments correct inconsistencies between different sections, typographical and grammatical errors.

FINAL

ENGINEERING EVALUATION/COST ANALYSIS

FI857a FORMER BUNKER MRS

HOLLOMAN AIR FORCE BASE
NEW MEXICO
RCRA PERMIT NUMBER: NM6572124422-2

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for:

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Ave., Suite 163
Joint Base San Antonio Lackland, Texas 78236-9853

October 2014

Prepared by:

FPM Remediations, Inc.

584 Phoenix Drive
Rome, NY 13441

URS Group, Inc.
7720 N 16th Street, Suite 100
Phoenix, AZ 85020-4493

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EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) was prepared by FPM Remediations, Inc. (FPM) under FPM's Air Force Civil Engineer Center Contract FA8903-13-C-0008, to support the United States Air Force (USAF) Military Munitions Response Program. The purpose of the EE/CA is to develop and evaluate Removal Action (RA) alternatives for reduction of Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH) risks to human health potentially present at the FI857a Former Bunker Munitions Response Site (MRS) located at Holloman Air Force Base (AFB), near Alamogordo, New Mexico. The MEC/MPPEH may be present on the surface and subsurface of the ground due to past military munitions use of the property.

Holloman AFB is located in south-central New Mexico, seven miles west of the city of Alamogordo in Otero County. The 0.8-acre FI857a MRS is located in the southeast portion of the Base. It is suspected that the site was used as a former storage bunker. Based on the Comprehensive Site Evaluation Phase II, munitions that may be found at this site include M38 practice bombs and hand grenades.

The following four RA alternatives were evaluated for FI857a as part of this EE/CA:

1. No Action,
2. Land Use Controls (LUCs),
3. Surface Removal of MEC/MPPEH Combined with LUCs, and
4. Surface and Subsurface Removal of MEC/MPPEH.

No Action alternative involves no active response or land use restrictions to locate, remove, dispose of, or limit the exposure to any potential MEC/MPPEH present within the MRS. The No Action approach is routinely retained in the EE/CA evaluation of alternatives in accordance with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to provide a baseline for comparison of other response technologies and alternatives.

The LUCs alternative includes engineering controls (e.g., fencing and warning signage) and institutional controls (e.g., military orders preventing access to the MRS). As part of this alternative, fencing would be placed along the perimeter of the site and frequent signage would be put in place.

For Alternative 3, the Surface Removal of MEC/MPPEH includes instrument-aided surface clearance of any MEC/MPPEH items which may exist on the surface of the ground or are protruding from the ground, and are located during the sweep and subsequently removed by the Unexploded Ordnance (UXO) team. LUCs would be implemented upon completion of surface MEC/MPPEH removal to minimize potential exposure to remaining subsurface MEC/MPPEH. LUCs will be comprised of educational and awareness programs for Base personnel and visitors and can be undertaken in number of formal and informal methods including both printed and visual media. LUCs will also include dig permits from Holloman AFB prohibiting digging without a construction support by UXO personnel.

Alternative 4 includes 100% surface removal of MEC/MPPEH and removal of the following subsurface anomalies:

- Those that show characteristics of burial pits and

- All individual geophysical anomalies above the established threshold based on the MRS background noise determined by an Instrument Verification Strip/Geophysical System Verification.

In no case will any excavations and removals exceed 10 feet. Removal activities will be performed by experienced UXO-qualified personnel. Following removal of all anomalies identified, the intrusive investigated area will be restored as close as possible to its original state.

These four (4) alternatives were evaluated using the effectiveness, implementability, and cost criteria set forth in the NCP guidance for conducting EE/CAs. Alternative 4 was ranked best in terms of effectiveness and cost and had the best overall ranking. Alternative 4 is the recommended RA alternative for FI857a MRS. It is both the most protective of human health over the long term and the most cost effective.

According to Sections 300.415(m) and 300.820 of the NCP, community relations and administrative record activities will be performed as two forms of public participation necessary for all RAs. The Lead Agency (USAF) will designate a spokesperson to inform the public about the release and actions taken, to respond to questions, and to notify immediately affected citizens, and State and local officials. In addition, the USAF will establish an administrative record and make the administrative record available to the public at a central location or near the site, if applicable. Comments from the public on the selection of this RA alternative will be incorporated into the Action Memorandum identifying the preferred alternative for the site.

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percent
°F	Degrees Fahrenheit
AAAF	Alamogordo Army Air Field
AFB	Air Force Base
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BIP	Blow-in-Place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	Contaminant of Potential Concern
CSE	Comprehensive Site Evaluation
DDESB	Department of Defense Explosives Safety Board
DGM	Digital Geophysical Mapping
DoD (DD)	Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
EM	Engineering Manual
EM61	Geonics EM61-MK2
EOD	Explosive Ordnance Disposal
ESS	Explosives Safety Submission
FPM	FPM Remediations, Inc.
FS	Feasibility Study
ft	feet
G-858	Geometrics G-858 Cesium Vapor Magnetometer
GRA	General Response Action
GSV	Geophysical System Verification
HDR	HDR Environmental, Operations and Construction, Inc.
HASP	Health and Safety Plan
HSTT	High Speed Test Track
in	inches
IVS	Instrument Verification Strip
lb	pound
kg	kilogram
LOD	Limit of Detection
LUCs	Land Use Controls
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
mg	milligram
MHAT	MEC Hazard Assessment Tool
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NA	Not Applicable
NFA	No Further Action
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMED	New Mexico Environment Department
NTCRA	Non-Time-Critical Removal Action
ppm	parts per million
PRSC	Post Removal Site Control
RA	Removal Action
RACER	Remedial Action Cost Engineering and Requirements
RAO	Removal Action Objective
RI	Remedial Investigation
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SDA	Safe Disposal Area
SSL	Soil Screening Level
TBC	To Be Considered
TDS	Total Dissolved Solids
SKY	Sky Research, Inc
TMV	Toxicity, Mobility or Volume
USAF	United States Air Force
USACE	U. S. Army Corp of Engineers
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance
WP	Work Plan
WSMR	White Sands Missile Range
WWII	World War II
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) is being performed in support of the United States Air Force (USAF) Military Munitions Response Program (MMRP) at Holloman Air Force Base (AFB) near Alamogordo, New Mexico. The purpose of this EE/CA is to develop and evaluate Removal Action (RA) alternatives and associated costs to mitigate hazards associated with surface and subsurface Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH) suspected to be present within the FI857a Former Bunker Munitions Response Site (MRS). This hazard was identified during the Comprehensive Site Evaluation (CSE) Phase II (HDR Environmental, Operations and Construction, Inc. [HDR], 2013) investigation at Former Bunker Munitions Response Area (MRA) 857. The EE/CA assumes that no additional site assessment activities will be necessary to determine the appropriate RA alternative.

This document follows the United States Environmental Protection Agency's (USEPA's) guidance provided in document 540/R93/057 Guidance on Conducting Non-Time-Critical Removal Actions (NTCRAs) under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USEPA, 1993).

1.1 Project Authorization

The MMRP was created by Congress in 2001 under the Defense Environmental Restoration Program as established by Section 211 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and is codified in Sections 2701-2710 of Title 10 of the United States Code (U.S.C.). This EE/CA is being developed in accordance with the USAF MMRP cleanup process that follows the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as promulgated under the CERCLA and as amended by SARA. The EE/CA is being completed by the FPM Remediations, Inc. (FPM) Team, under FPM's Air Force Civil Engineer Center Contract FA8903-13-C-0008, to support the USAF MMRP.

The USAF is the Lead Agency for this EE/CA. Participation of and cooperation with federal, state, and local authorities and the local public will be solicited for the duration of this activity and for all environmental restoration activities at Holloman AFB. Participation of these entities is required for the environmental restoration process and aids in ensuring the protection of human health and the environment. Federal, state, and local authorities will have input into the actions implemented at Holloman AFB through planning meetings, plan review, and the public comment process. Concerns of the federal, state, and local authorities will be solicited and provisions of federal, state, and local regulations will be given full consideration for all actions taken at Holloman AFB.

1.2 Purpose and Scope

The purpose of this EE/CA is to evaluate alternatives to reduce risks associated with suspected surface and subsurface explosive hazards at the FI857a Former Bunker MRS to support an RA. The CSE Phase II investigation found physical evidence of Munitions Debris (MD) at FI857a MRS indicating the potential presence of surface and subsurface MEC/MPPEH. The EE/CA documents existing site characterization data, provides an analysis of alternatives, and identifies the preferred action to protect human health and the environment.

1.3 Report Organization

The EE/CA has been organized as follows:

Section 1: Introduction – describes the project authorization and purpose and scope.

Section 2: MRS Characterization – presents Holloman AFB location and operational history, FI857a MRS description, previous investigations performed at FI857a, and streamlined risk evaluation.

Section 3: Development of Remedial Action Objectives (RAOs) – describes the regulatory requirements for the RA, including Applicable or Relevant and Appropriate Requirements (ARARs) and the RAOs.

Section 4: Identification and Analysis of RA Alternatives – provides detailed description and analysis of RA alternatives.

Section 5: Comparative Analysis of RA Alternatives – provides a comparative analysis of alternatives.

Section 6: Recommendations – summarizes the recommended RA alternative and provides the RA schedule.

Section 7: References – provides a list of references used to develop this EE/CA.

2.0 MRS CHARACTERIZATION

2.1 Installation Location and Background

Holloman AFB is located in south-central New Mexico, seven miles west of the city of Alamogordo in Otero County (**Figure 2-1**). It is adjacent to the White Sands Missile Range (WSMR). A portion of the Base to the south is bordered by Route 70, which also runs roughly north-south and parallel to the eastern boundary of the Base. Holloman AFB occupies approximately 50,763 acres of land. It is contiguous to the much larger (2.2 million acre) WSMR, and located to the southeast to the WSMR. The southern portion of Holloman AFB contains the flight line, composed of a series of runways running north-south, east-west, and northeast southwest. The Main Base is located at the southeast corner of the installation, where Route 70 borders the installation. The Main Base contains housing and administrative buildings. The West Area and the North Area refer to the improved areas around the original airfield (southeastern triangle formed by the runways). The High Speed Test Track (HSTT) runs north-south and is located northwest of the airfield. The track is the world's longest of its kind at 9.5 miles and has been used for an array of missile testing for decades and is still in use today. Access to Holloman AFB requires admittance through the security gate and there is a fence around the installation.

Holloman AFB began nine months after the U.S. entered World War II (WWII), and was an integral facility in the early stages of the U.S. space program throughout the Cold War. On 6 February 1942, construction began on an extensive bombing and gunnery range later known as the Alamogordo Bombing and Gunnery Range. On 10 August 1942, the Alamogordo Army Air Field (AAAF) was officially established. Because the facility was initially intended to be used by Great Britain as part of their WWII British Training Program for bomber crews, the Base was designed after Royal Air Force bases. The first atomic bomb was detonated at the Trinity Site in the northwest corner of the Alamogordo Bombing and Gunnery Range (now the WSMR) on 16 July 1945. In 1946, as more lands became available within the Tularosa Basin, the AAAF was reassigned to be a missile development facility. With the creation of the USAF as a separate service, the facility came under the direction of the Air Materiel Command, which decided that the facility would be used to conduct guided missile programs. On 13 January 1948, the Base was renamed Holloman AFB, after Col. George V. Holloman, an early pioneer in guided missile development.

To support the Holloman mission of developing guided missiles, the Army Ordnance Corps built White Sands Proving Grounds at about this time. The combination of the White Sands Proving Grounds and Alamogordo Bombing Range was 100 miles long and 40 miles wide. On 1 September 1952, the two ranges were combined to form the Integrated White Sands Range. From 1952 to 1970, missile development and testing at White Sands included the Snark, Matador, Mace, Falcon, Aerobee, JB-2 Loon, and Firebee missiles. High speed sled tests, high altitude balloon projects, and Aeromedical Field Laboratory experiments were also conducted. Testing activities included the Central Inertial Guidance Test Facility and the Radar Target Scatter Test Facility.

In 1972, the Base was taken over by Tactical Air Command and became primarily a fighter base with some continued developmental testing. On 15 November 1991, command responsibility passed from the 833rd Air Division to the 49th Wing. Today, the 49th Wing provides leadership

to the installation. Two projects begun during the Cold War era continue on the Base: the HSTT and the Primate Research Lab (both considered tenant organizations).

2.2 Former Bunker Location and Operational History

The Former Bunker MRA 857 consists of 20.6 acres and is located approximately 3,280 ft east of Runway 22-16 and 1,300 ft north-northwest of a water tower (**Figure 2-1**). According to available historical information, the area is a historic storage bunker and suspected former security forces training area. The 1996 archaeological survey performed at this MRA (Sale et al., 1996a) identified bomb tail section, four missile casings, nine bomb casings, drone parts, and a 1942 .30-06 caliber cartridge within the remnants of a collapsed wooden tower. Laboratory of Anthropology Site Record describes the area as an "ammo storage (approx. 70 x 70 x 10') hole" with ammunition boxes and approximately 350 .30-06 caliber cartridges along with wood posts, wire mesh, and a sawhorse.

Based on the results of the CSE Phase II investigation, the Former Bunker MRA 857 was recommended to be split into two MRSs due to MD: FI857 encompassing 19.8 acres and FI857a encompassing 0.8 acres (**Figure 2-2**). FI857 MRS was recommended for No Further Action (NFA). The FI857a Former Bunker MRS contains small arms, hand grenade, and M38 practice bomb debris and is the focus of this EE/CA.

2.3 Physical Description

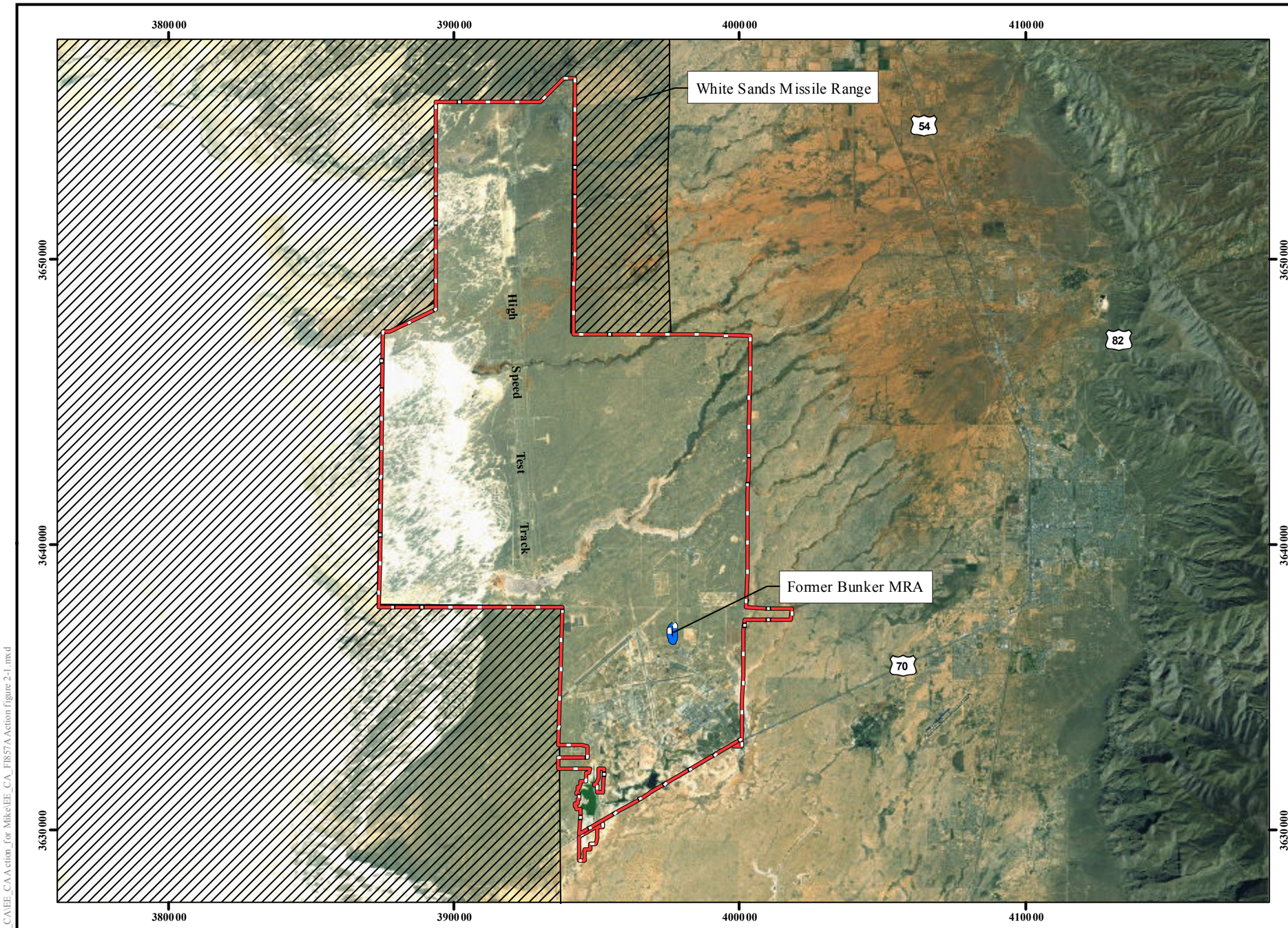
2.3.1 Climate

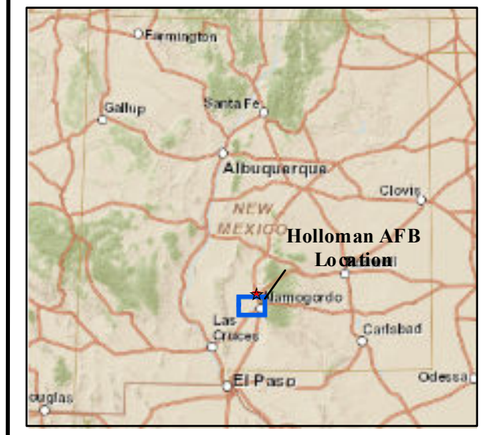
Holloman AFB is located in a semi-arid region within the northern portion of the Chihuahuan Desert. Its climate resembles other semi-arid regions with warm to hot summer days, cool nights, and mild winters. Monthly mean high temperatures range from 55 degrees Fahrenheit (°F) in January to 93.6°F in August. Monthly mean low temperatures range from 29°F in January to 66°F in July. Evapotranspiration is usually high due to dry air, large daily solar radiation totals, seasonally high winds, and warm temperatures. Seasonal fluctuation in precipitation rates is a result of prevailing wind directions, which can bring in frontal storms from the north or the Pacific or Caribbean cyclonic systems. Holloman averages 13.20 inches (in) of annual rainfall. Nearly half of this amount falls within the months of July through September, known as the summer monsoons. Monsoon thunderstorms are generally short in duration and high in intensity. Occurrences are highly variable from year to year and one or two short-term events may contain a large percentage of the net annual precipitation. Average annual snowfall is approximately 4.5 in.

2.3.2 Topography

Holloman AFB lies within the Tularosa basin of south-central New Mexico. This area is part of the Mexican Highland section of the Basin and Range physiographic province and is characterized by fault block mountains interspersed with low desert plains and basins. The Base lies on relatively flat alluvial plains below the Sacramento Mountains. These plains are bordered to the west by the White Sands dune field. Elevations range from 4,000 to 4,250 feet (ft) above mean sea level (Sky Research, Inc. [SKY], 2011)

The FI857a MRS exhibits relatively flat topography.





Legend

Installation Boundary

NOTES:

Revision Date: 4/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 12,000 feet

0 1,850 3,700 Meters

0 6,000 12,000 Feet

N W E S

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Holloman Air Force Base
Alamogordo, NM

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FIGURE 2-1

Holloman Air Force Base Location

FPM Remediations, Inc.

2014

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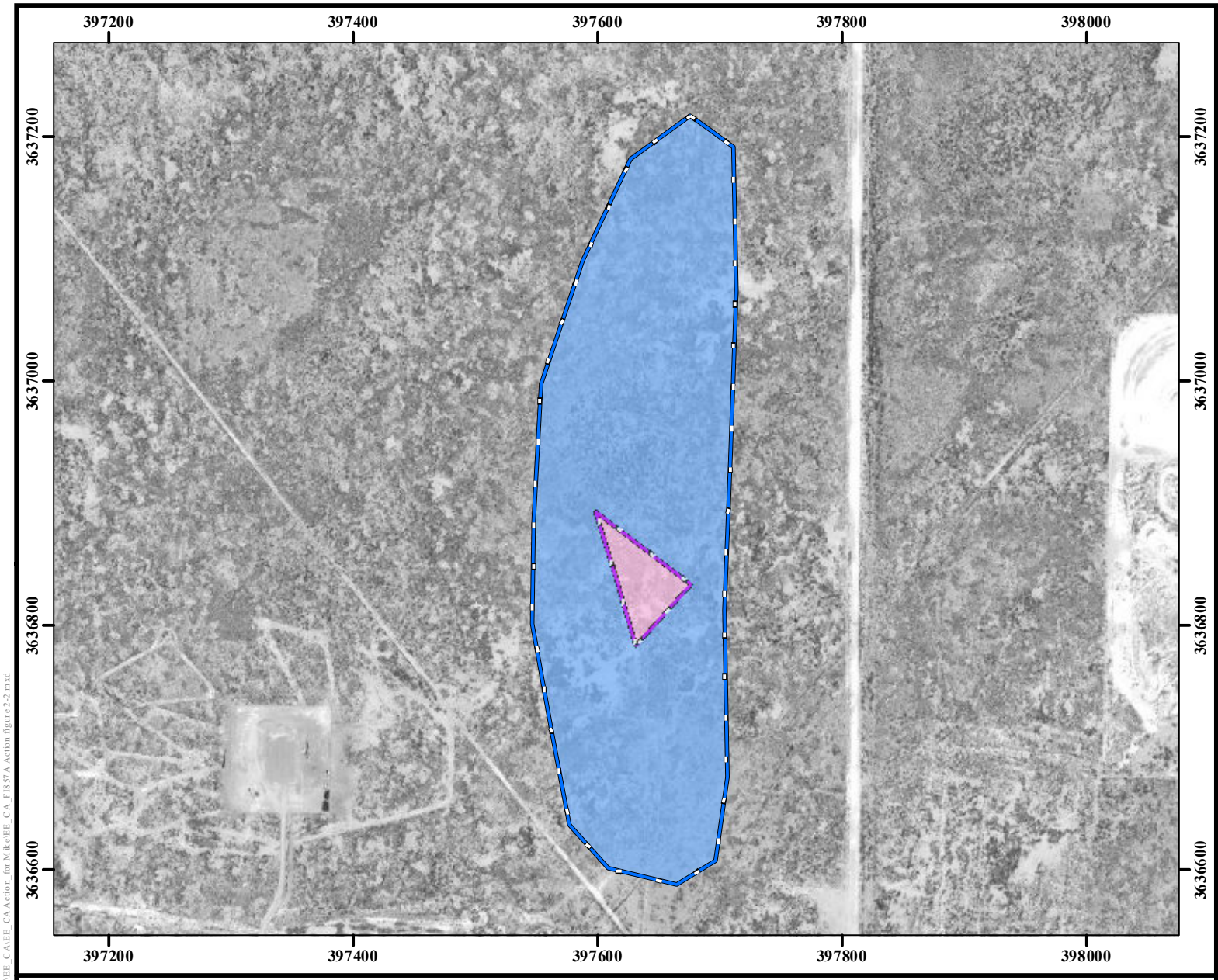

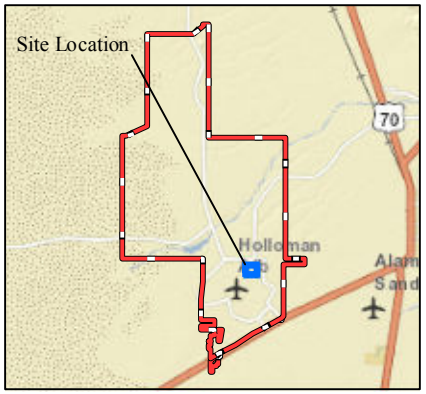

Legend

- Former Bunker MRA 857 (20.6 acres)
- FI857a Former Bunker MRS (0.8 acres)-EE/CA
- FI857 Former Bunker MRS No Further Action (19.8 acres)
- Installation Boundary

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FIGURE 2-2

FI857a Former Bunker
MRS Location

NOTES:
Revision Date: 4/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 400 feet
0 60 120 Meters
0 200 400 Feet

N W E S

FPM Remediations, Inc.

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2.3.3 Soils

The soils on Holloman AFB are basin fill deposits formed primarily from alluvial and eolian processes. All soils have a high gypsum and salt content, primarily due to the eastern migration of gypsum sands from WSMR and White Sands National Monument. Holloman AFB has three primary soil types: several associations and complexes of Holloman, Gypsum Land, and Yesum soils, located in the flats; Dune Land, found in the White Sands dunes; and Mead silty clay loam soil, found in the alluvial floodplains (including most jurisdictional wetlands). None of the soil types are very productive, due to high gypsum and salt content, and all are highly subject to both wind and water erosion when the vegetation is sparse or the soil is exposed.

The soils at the FI857a MRS consist of the Yesum-Nasa complex.

2.3.4 Geology and Hydrogeology

Holloman AFB is located in the Tularosa Basin, a downfaulted, closed, intermountain basin located in the southern portion of the Rio Grande Rift. The Tularosa Basin is a bolson, which is a basin with no surface drainage outlet, in which sediments are carried by surface water into the closed basin and deposited (Bhate Environmental Associates, Inc., 2007). Basin fill of the Tularosa Basin is derived from the erosion of the uplifted material and fluvial deposits from the Rio Grande River. The Basin fill consists of unconsolidated coarse- to fine-grained alluvial fan deposits along the rims of the basin that are gradational toward the basin into finer-grained alluvial, fluvial, and lacustrine deposits. Evaporite materials, such as selenite, are present.

Prominent local physiographic features include the Sacramento Mountains to the east, San Andres Mountains, and White Sands National Monument to the west (49th Fighter Wing, 2009). The Tularosa Basin was formed as a structural trough during the Middle to Late Cenozoic era. Alluvial fill deposition includes; sand, gravel, and clay in alluvial fans along the basin margins and extensive lake, alluvial, and evaporate deposits within the interior basin. Streams sustained by groundwater discharge within the basin include Salt Creek and Malpais Spring. It is estimated that the groundwater resources of the Tularosa Basin contain over 100 million-acre ft of brackish groundwater. A wide range of water chemistries including sodium chloride, carbonate, and sulfate-based brine waters exist in the basin and water with salinity from 1,000 parts per million (ppm) Total Dissolved Solids (TDS), approximate to fresh water, to over 20,000 ppm TDS, approximate to sea water, can be found within the basin. The primary source of groundwater recharge is percolation of rainwater and a minor contribution from stream run-off along the western edge of the Sacramento Mountains.

Beneath Holloman AFB, groundwater ranges from 5 to 50 ft below ground surface (bgs), with shallower groundwater found on the southern end of the Base. Groundwater flow is generally toward the southwest with localized influences from the variations in Base topography with shallower groundwater found on the southern end of the Base (SKY, 2011).

2.3.5 Hydrology

The only permanent water in the Tularosa Basin is found in small streams between Alamogordo and Three Rivers, New Mexico. There are no perennial streams within Holloman AFB or in the nearby surrounding landscape; however, a set of perennial pools exist within the Base. They are the final one-third of the Lost River, a set of pools near the confluence of Ritas and Malone Draws, and the Salt Lakes just south of the Lost River and Camera Pad Road Pond. There are at least nine prominent east-west drainages that receive intermittent flows during seasonal

thunderstorms. The largest of these drainages is the Lost River drainage system, including Malone Draw, Carter Draw, and Ritas Draw. Prior to extensive management of the surface topography and construction of U.S. Highway 70/82, Dillard Draw emptied into the Main Base, creating a network of flats and playas including what are now Lake Holloman, Stinky Playa, and Pond G. Construction activities have disrupted the natural flow of this wetland ecosystem (SKY, 2011).

There are no wetlands or surface water associated with the FI857a MRS.

2.3.6 Vegetation

The vegetation of Holloman AFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca also occur (SKY, 2011).

Vegetation at the FI857a MRS is consistent with desert scrubland.

2.3.7 Ecological Profile

No federally listed species covered under the Endangered Species Act currently reside at Holloman AFB. Several federally listed species, however, have been observed at the Base in the past. Mountain plover (proposed federally threatened) nested at Lake Holloman during the 1980s. Brown pelicans (recently delisted) are occasionally observed at Lake Holloman and the constructed wetlands. Peregrine falcons (recently delisted) regularly forage at Lake Holloman. Five other sensitive species currently receive no federal protection: a lichen (*A. clauzadeana*), proposed for rare and endangered listing; the grama grass cactus, included due to its former candidate status; the White Sands pupfish, a state-endangered species; the western burrowing owl, a species of concern; and the western snowy plover, also a species of concern.

No rare, threatened or endangered species are expected to inhabit FI857a MRS.

2.3.8 Structures and Utilities

There are 716 buildings within a two-mile radius of the FI857a MRS, primarily to the south. These buildings include Base residential housing, recreational, operational and mission support buildings, and buildings that support the flight line. No buildings are located at the MRS. No cultural resources are identified within the MRS.

2.3.9 Current and Future Land Uses

FI857a MRS is currently unused and no future land use changes are anticipated. There is no fencing or other controls associated with the FI857a; however, access to Holloman AFB requires admittance through the security gate and there is a fence around the installation. Therefore, access to this site is restricted for the general public, but is open to Base personnel, contractors, and Base residents. Trespassers can also access the area.

2.4 Previous Investigations

MMRP investigations conducted at the MRA 857 include:

- Modified CSE Phase I (Shaw Environmental, Inc., 2010), and
- CSE Phase II (HDR, 2013).

2.4.1 Modified CSE Phase I

Modified CSE Phase I was completed in 2010. Prior to the start of the CSE Phase I, no MRAs had been discovered at Holloman AFB and it was believed that there was a low probability of a significant number of MRAs being found at the Base. Therefore, the USAF has modified the CSE Phase I process by deferring some actions typically performed in a Phase I, to the CSE Phase II, if a Phase II is required. For this Modified CSE Phase I, it was determined that a Conceptual Site Model, Munitions Response Site Prioritization Protocol (MRSPP), and Hazard Ranking System scoring elements were not required. The activities performed during the CSE Phase I included identification and review of data repositories located both on and off the installation, interviews with Base personnel, and visual surveys.

Modified CSE Phase I investigation at the Former Bunker MRA 857 included a visual survey. No evidence of MEC/MPPEH was identified. The remains of a wooden platform, wood debris, and piles of lumber were observed at the MRA.

2.4.2 CSE Phase II

A CSE Phase II investigation was performed at the Former Bunker MRA 857 in 2012. The visual survey was conducted to identify the location and features of the area as well as to determine whether evidence of MEC is present at the MRA and whether Munitions Constituents (MC) (e.g., explosives) are present above regulatory screening levels (**Figure 2-3**).

Large amounts of wooden debris consistent with possible towers as well as one large rectangular area of wood debris from an unknown structure were observed during the visual survey. Two small depressions associated with wood and wire mesh debris were also documented.

Small arms debris identified at the MRA included .22, .32, 7.62 millimeter (mm), and .50 caliber casings, as well as a 7.62 mm link and a .50 cal link. MD consisting of a grenade pin, one (1) M38 practice bomb box fin, and nine (9) M38 practice bomb casings with no spotting charges present were observed at the area. These practice bombs were nearly intact with no damage and grouped together indicating that they were likely disposed of at the location. Other items of interest were four light fiberglass mock munitions, one displaying a bomb lug, lying near a wire mock aircraft. One (1) flight controller box, possibly from a drone aircraft, was also documented at the MRA. No MEC source was identified during the visual survey; therefore, no samples were collected for explosives analysis.

Thirty seven (37) surface soil samples were collected and analyzed for lead using X-Ray Fluorescence (XRF) (**Figure 2-4**). Lead analysis results ranged from below the Level of Detection (LOD) (12 milligram (mg)/kilogram (kg) to 24 mg/kg. Of the 37 samples collected, 18 were below the LOD (12 mg/kg). No samples exceeded the screening level of 400 mg/kg. Soil samples from twelve (12) XRF locations (high, medium, and low concentrations in the data range, per Method 6200) from different CSE Phase II MRAs were sent for off-site laboratory analysis to evaluate the accuracy of the XRF analytical method. Out of these twelve (12) correlation samples one sample was taken from the MRA 857. The XRF and lab analytical results were plotted and compared using a linear regression process to measure slope. The correlation analysis based on all twelve (12) samples showed that data collected at the MRA 857 were acceptable for risk assessment purposes.

Based on results from the human health risk assessment it is unlikely that lead is associated with potential risks to current or future receptors at the MRA 857. Maximum and mean lead

concentrations exceeded the Ecological Soil Screening Level for only the most sensitive receptor category, and were less than the 50th percentile lead background concentration for the western United States as reported in USEPA, 2005. Therefore, lead does not pose a potential ecological risk at the Former Bunker MRA.

Based on CSE Phase II visual survey results the MRA 857 was split into two MRSs: FI857 Former Bunker (19.8 acres) and FI857a Former Bunker (0.8 acres). MEC and MC above the level of concern were not identified at both sites; however, FI857a contains surface MD (**Figure 2-3**).

Both sites FI857 and FI857a were prioritized based on relative risk, using the MRSPP scoring system. The MRS Priority is determined by selecting the highest rating from the Explosives Hazard Evaluation, Chemical Hazard Evaluation, and Human Health Hazard Evaluation modules and ranges from 1 to 8. Priority 1 and 8 indicate the highest and the lowest potential hazards, respectively. Only a site with a chemical warfare hazard can receive an MRSPP Priority of 1. FI857 obtained an MRSPP score of 8 and was recommended for NFA, while FI857a obtained an MRSPP score of 7 and was recommended for further munitions response action. Therefore, this EE/CA is developed for FI857a MRS.

2.5 Streamlined Risk Evaluation

2.5.1 MEC Exposure Pathway Analysis

The MEC Exposure Pathway Analysis for FI857a MRS is shown in **Figure 2-5.** Based on the CSE Phase II results, the potential for MEC/MPPEH at the FI857a MRS was found in the form of MD associated with M38 practice bombs and hand grenades (pin only).

A variety of naturally occurring processes may alter the condition of the land at the site resulting in a potentially explosive subsurface item being exposed at the surface and becoming more accessible to contact with people or the environment. These processes may include frost heave, flooding and erosion. A variety of intrusive activities by people also may alter the condition of the land at the site in a manner that a subsurface MEC item may become exposed at the surface. These may include construction activities that involve excavation.

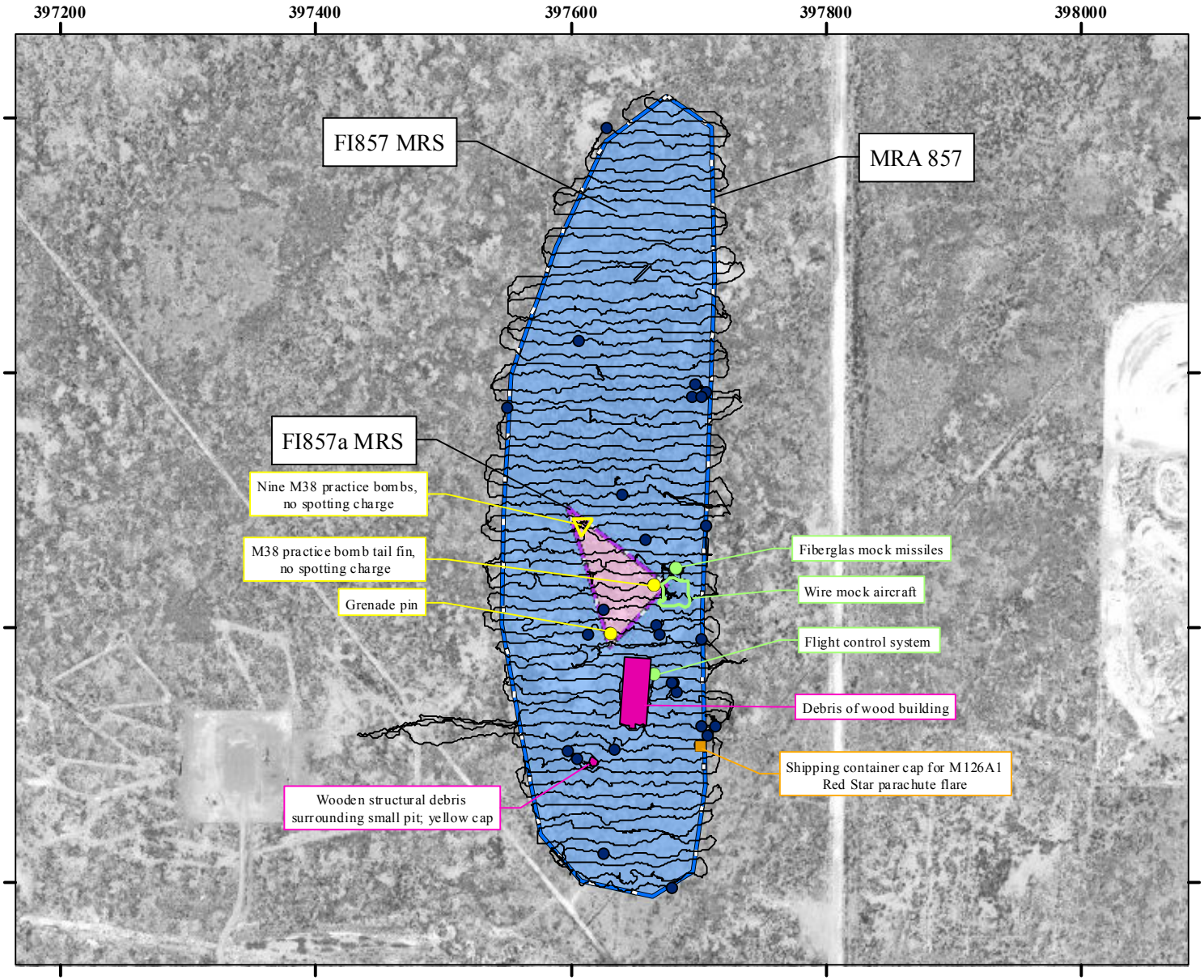
The FI857a MRS is accessible by human receptors, including Base personnel, Base residents, and contractors; and may be accessible to trespassers. Exposure pathways are shown to be incomplete for all of these receptor categories for MEC on the both soil surface and subsurface.

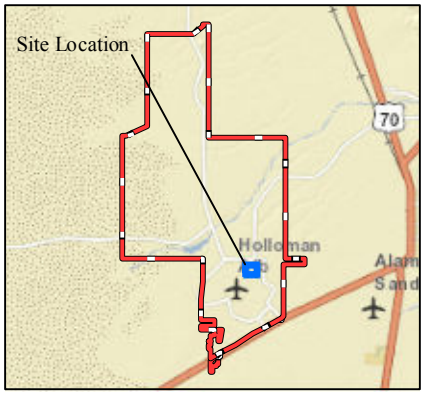
Biota are generally not considered when evaluating MEC risk because, with the exception of threatened and endangered species, risk to biotic receptors is usually evaluated at the population level. Though an individual ecological receptor may experience a negative affect from encountering MEC, MEC does not pose risk to biotic populations unless a large area of habitat were to be destroyed, for example, by a large detonation. Since rare, threatened or endangered species are not expected to inhabit the FI857a MRS, MEC exposure pathways to biota are shown as incomplete.

2.5.2 MC Exposure Pathway Analysis

MC Exposure Pathway Analysis for FI857a MRS is shown in **Figure 2-6**.

In general, migration pathways involve movement via air, water, soil, and the interfaces between these media. Based on the types of releases and the characteristics of MC/Contaminants of Potential Concern (COPCs), the fate and transport of contaminants at Holloman AFB is expected





Legend

- Munitions Debris
- Training Item
- Small Arms Debris Casing
- Range-Related Debris
- Completed Visual Survey Transects
- Training Item
- Munitions Debris
- Wood Building Footprint
- Installation Boundary

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FIGURE 2-3

CSE Phase II Visual Survey Results
Former Bunker MRA

NOTES:
Revision Date: 4/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 400 feet

0 60 120 Meters

0 200 400 Feet

N W E S

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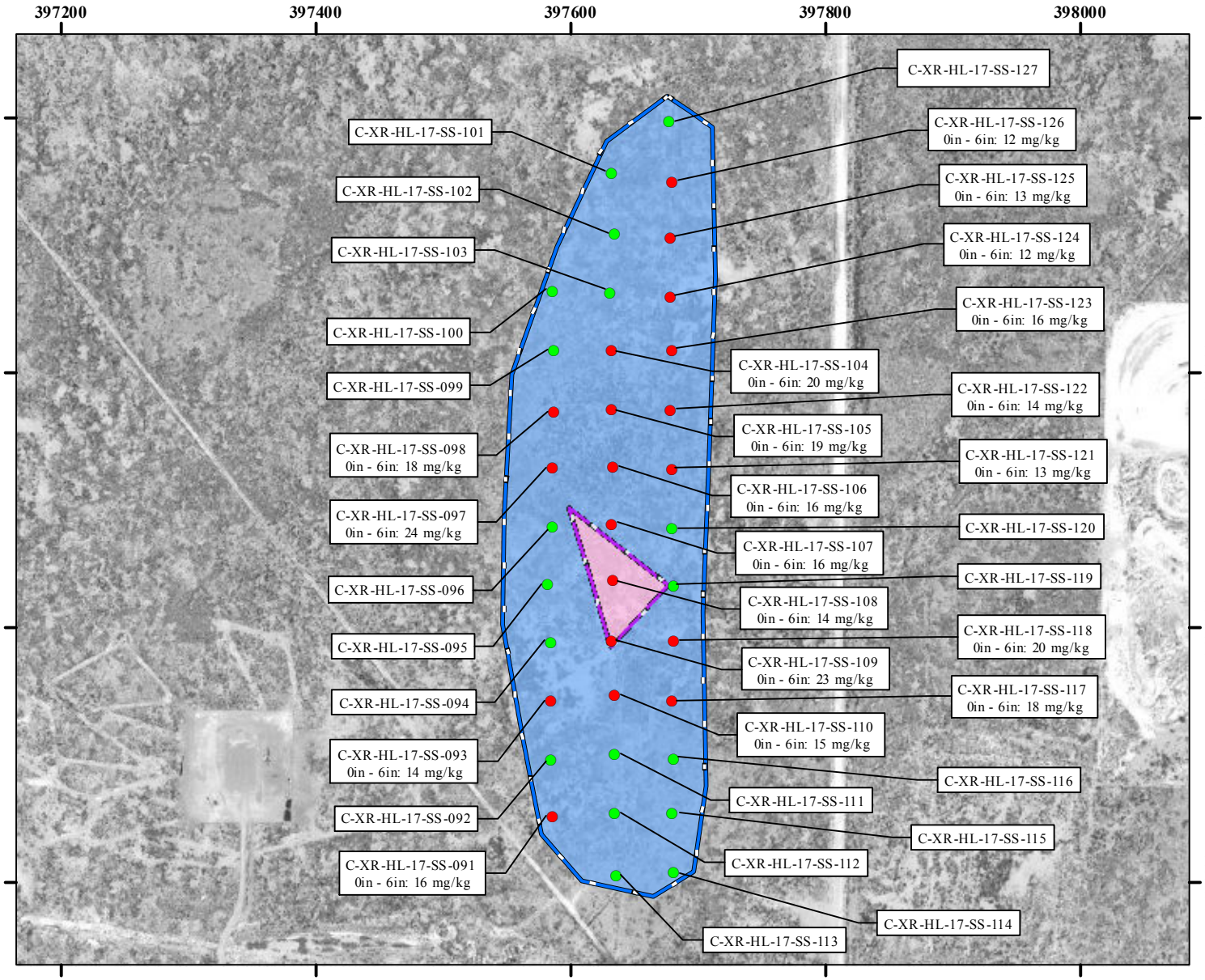

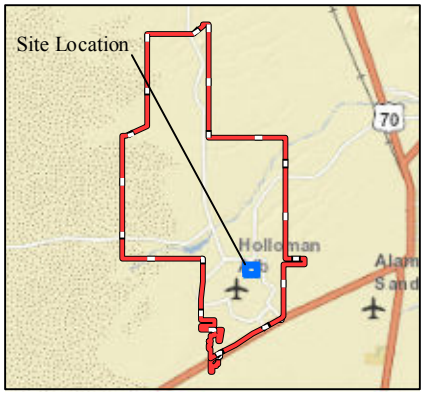

Legend

- Lead Concentration < LOD
- Lead Concentration > LOD
- Former Bunker MRA 857 (20.6 acres)
- FI857a Former Bunker MRS (0.8 acres)-EE/CA
- FI857 Former Bunker MRS No Further Action (19.8 acres)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-4

XRF Lead Sample Results
Former Bunker MRA

NOTES:
Revision Date: 4/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 400 feet
0 60 120 Meters
0 200 400 Feet

N W E S

FPM Remediations, Inc.

2014 page 2-13

Path: C:\Projects\New Mexico\GIS\EE_CA\EE_CA Action for Mike\EE_CA_FI857A Action figure 2-4.mxd

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to occur mainly in the terrestrial environment, but there is potential for migration by aquatic and atmospheric pathways as well.

In the terrestrial environment, if the contaminant is released to soil, it may volatilize, adhere to the soil by sorption, leach into the groundwater with precipitation, or degrade due to chemical (abiotic) or biological (biotic) processes. If the contaminant is volatilized from soil, it may be released to the atmosphere or migrate to groundwater. Constituents that are dissolved in groundwater may eventually be transported to a surface aquatic environment. There are no known aquatic environments present within the FI857a MRS. Therefore, this pathway is believed to be incomplete.

In the atmospheric environment, contaminants may exist as vapors or as suspended particulate matter. The transport of contaminants relies mostly on wind currents, and continues until the contaminants are returned to the earth by wet or dry deposition. Degradation of organic compounds in the atmosphere can occur due to direct photolysis, reaction with other chemicals, or reaction with photochemically generated hydroxyl radicals. Based upon the data collected during CSE Phase II activities, transport of MC/COPCs via the atmospheric environment is unlikely at Holloman AFB and therefore at FI857a as well.

Human receptors at FI857a include authorized personnel, contractors, Base residents, and possibly trespassers. The exposure pathways include direct (or incidental) ingestion of soil, dermal contact with soil, and inhalation of volatiles and fugitive dusts from contaminated soil. The exposure pathways are shown to be complete for all of these receptor categories for MC at surface. The exposure pathways are shown to be incomplete for MC in the subsurface for all human scenarios.

Ecological receptors at this site include terrestrial invertebrates, plants, and terrestrial birds, mammals, and reptiles. MC exposure pathways to biota are shown as complete at surface and incomplete at subsurface for FI857a.

There is no present-day human exposure to groundwater at Holloman AFB. The aquifer below Holloman AFB is an unconfined sole source brackish aquifer, with an average depth to groundwater of 5 to 50 ft bgs. Groundwater flow beneath the installation generally occurs from the northeast to the southwest, and depths to groundwater tend to be shallowest toward the main installation. Depending on future land use, there is a possibility that groundwater supply wells could be put in place for domestic and/or industrial uses, though the high total dissolved solids in the aquifer indicates that the water would likely need pretreatment before it was considered potable. Therefore, exposure pathways are shown to be incomplete for MC in ground water for all receptors at the FI857a MRSs.

Figure 2-5 FI857a MRS MEC Exposure Pathway Analysis

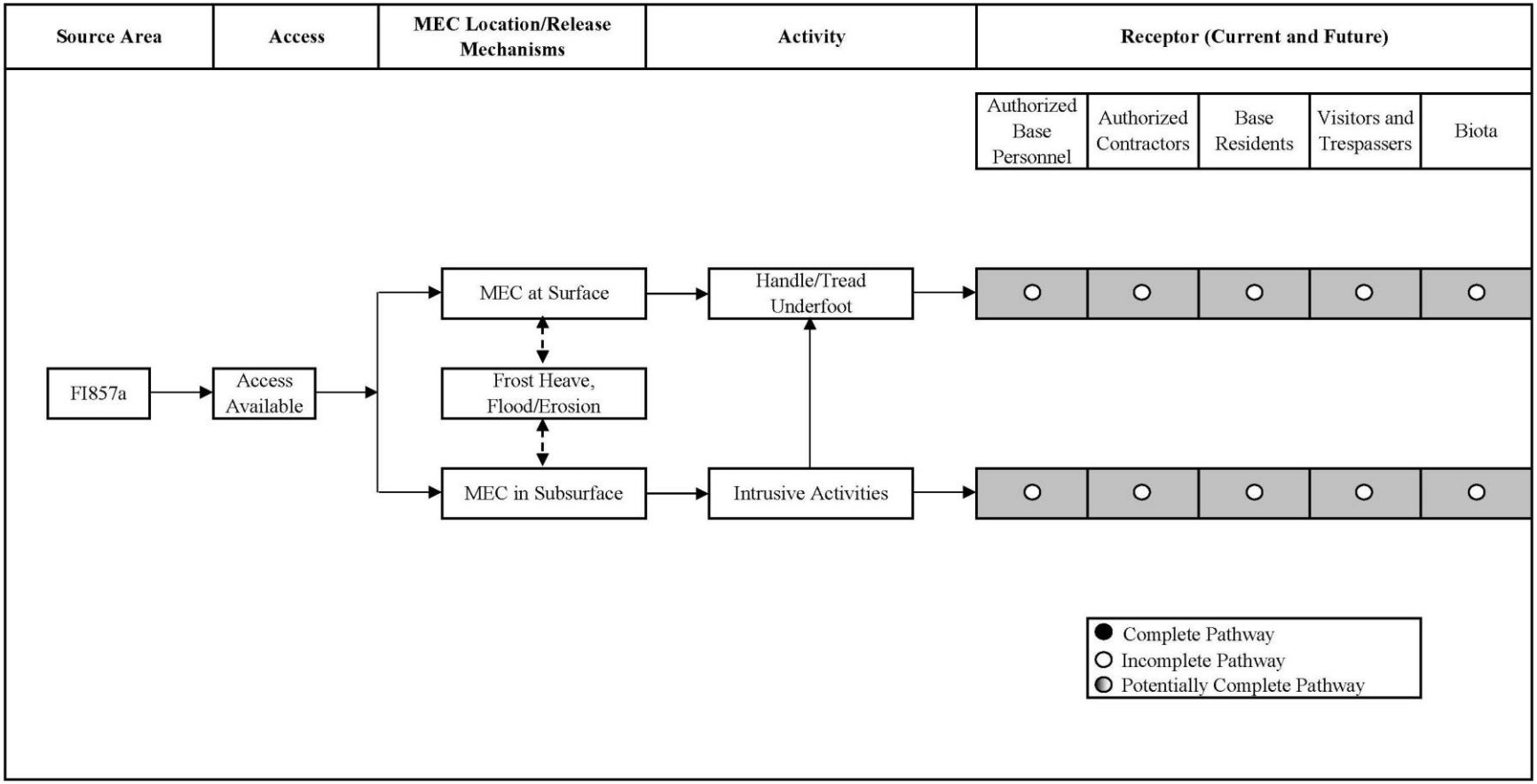
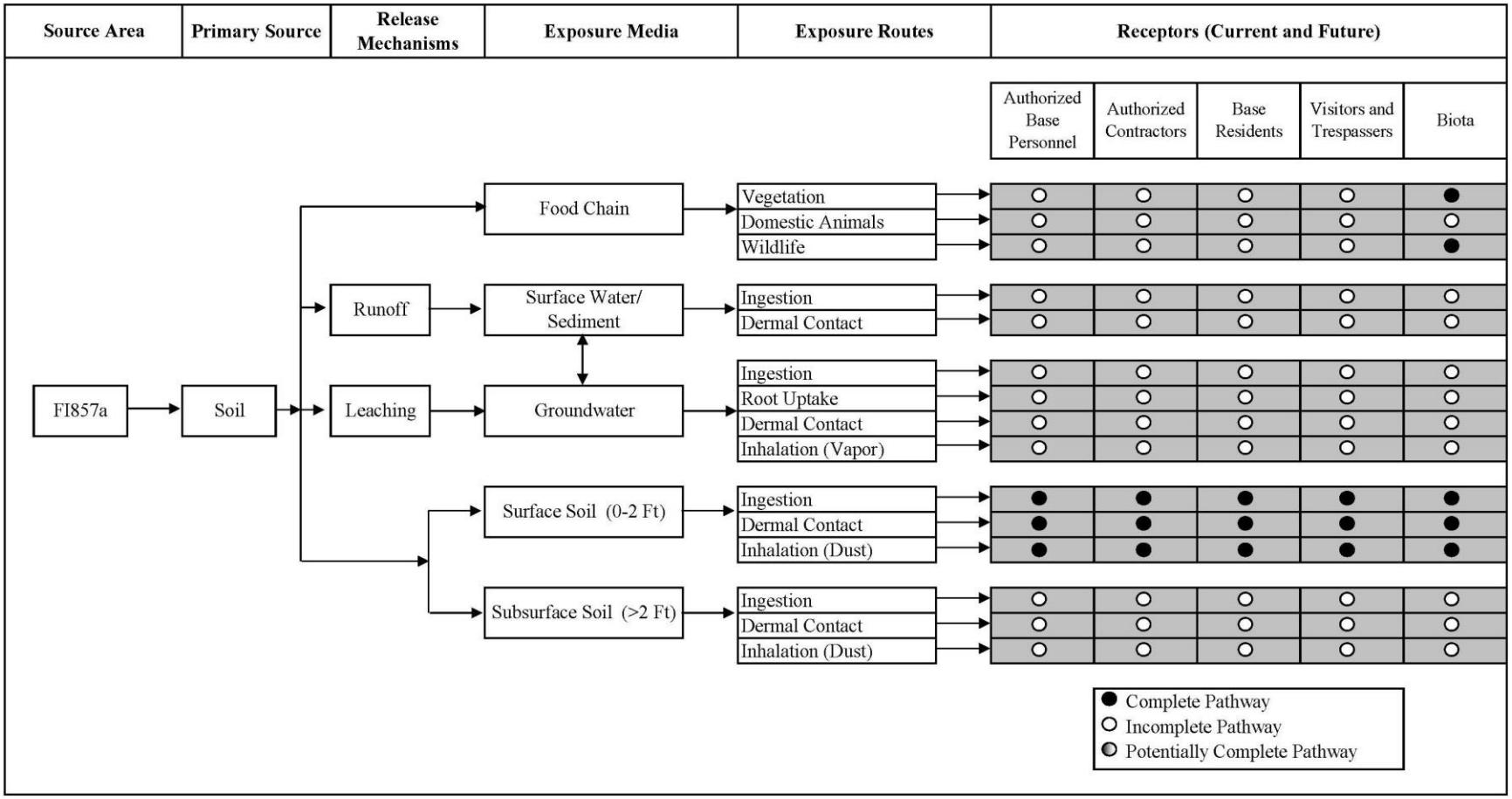


Figure 2-6 FI857a MRS MC Exposure Pathway Analysis



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3.0 DEVELOPMENT OF REMOVAL ACTION OBJECTIVES

The following sections discuss the justification for the RA, the ARARs, and the specific RAOs developed for the NTCRA at the FI857a MRS.

3.1 Justification For the Proposed Removal Action

The MEC/MPPEH potentially present on the surface and subsurface of the ground poses a potential and avoidable threat to human health and welfare. The removal of these items would reduce risk/hazards suspected to be present due to historic use of the property. Threats to human health or the environment, though not time-critical, are sufficiently serious that conditions at FI857a MRS meet the USEPA 40 Code of Federal Regulations (CFR) § 300.415(b)(2)(vi) - threat of fire or explosion - criterion for initiating an RA.

3.2 Applicable or Relevant and Appropriate Requirements

The ARARs addressing contaminated environmental media are identified in this section. The NCP (40 CFR 300.5) defines "applicable" requirements as: "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site." Only those promulgated state standards identified by a state in a timely manner that are substantive and equally or more stringent than federal requirements may be applicable.

The NCP (40 CFR 300.5) further defines "relevant and appropriate" requirements as: "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site." Like "applicable" requirements, the NCP also provides that only those promulgated state requirements identified in a timely manner and are more stringent than corresponding federal requirements may be relevant and appropriate.

USEPA identifies three basic types of ARARs. They include the following: chemical-specific, location-specific, and action-specific.

- Chemical-specific ARARs are generally health- or risk-based values that, when applied to site-specific conditions, result in numerical values. These values establish the acceptable concentration of a chemical that may be found in, or discharged to, the ambient environment.
- Location-specific ARARs are restrictions placed upon removal activities of hazardous substances solely because they are occurring in a particular place.
- Action-specific ARARs are generally technology or activity-based requirements on actions taken with respect to hazardous substances. These requirements are triggered by the particular activities that are selected to accomplish a remedy. Thus, action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. MEC/MPPEH RA will be conducted in compliance with Department of Defense (DoD), USAF, and U. S. Army

Corp of Engineers (USACE) explosive safety standards and munitions response procedures.

3.2.1 Chemical Specific ARARs

There are no chemical-specific ARARs associated with MEC.

3.2.2 Location-Specific ARARs

Location-specific ARARs set restrictions on the types of activities that can be performed based on site-specific characteristics or location. Alternative actions may be restricted or precluded based on proximity to wetlands or floodplains, presence of natural or cultural resources, or to man-made features such as existing disposal areas and local historic buildings. No location-specific ARARs guidance was identified. Final location-specific ARARs (statutes and regulations) will be determined in consultation with the USEPA, New Mexico Environment Department (NMED), and other appropriate federal and/or state agencies. These agencies are responsible for administration of programs that implement the potential location-specific ARARs.

3.2.3 Action-Specific ARARs

Based on the RA alternatives developed to address MEC at the FI857a site, certain action-specific ARARs will be considered. The action-specific ARARs are presented in **Table 3-1**. At present, New Mexico regulates military munitions through CERCLA. In addition, an RA plan approved by NMED must incorporate all substantive requirements of state law, including public participation and review, compliance with state laws and regulations, and all other technical elements to ensure protection of public health and the environment.

3.3 Removal Action Objective

Based on the NCP requirements and the applicable ARARs previously discussed, the following RAO was developed for the NTCRA at the FI857a MRS:

- Implement measures within FI857a that will minimize explosives hazards associated with MEC/MPPEH that pose a potential explosives safety risk to Base personnel, contractors, and Base residents.

Table 3-1 List of Potential Action-Specific ARARs

Standard, Requirement, or Criteria	Description	Comment
FEDERAL		
Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act of 1976 (42 U.S.C. Sect. 6901-6992K)		
Standards Applicable to Generators of Hazardous Waste (Subtitle C) (40 CFR Part 262)	Establishes standards for generators of hazardous waste.	Applicable if RA involves off-site disposal or treatment of hazardous waste. On-site generation triggers selected provisions (i.e., waste determination, accumulation time).
Standards Applicable to Transporters of Hazardous Waste (Subtitle C) (40 CFR Part 263)	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	Applicable if RA involves off-site transportation of hazardous waste.
Standards for the Management of Specific Hazardous Wastes and Specific types of Hazardous Waste Management Facilities (40 CFR Part 266)	Establishes requirements which apply to recyclable materials that are recovered or disposed on the land.	Applicable as recovered MPPEH certified as Material Documented as Safe (MDAS) would be recycled as appropriate.
Clean Water Act (33 USCA Sect. 1251-1376)		
National Pollutant Discharge Elimination System (40 CFR Parts 122.26(b)(14)(x))	Requires that storm water runoff be monitored and controlled on construction sites greater than one acre.	Applicable for remedial actions that involve vegetation removal that could result in storm water runoff.

Standard, Requirement, or Criteria	Description	Comment
Clean Air Act, as amended 42 U.S.C. Sect. 7401-7671Q		
Approval and promulgation of Implementation Plans 40 CFR 52, Subpart T, Louisiana	Establishes Air Quality Control Regions and attainment dates for national standards in those regions.	Applicable for remedial activities that involve air emissions (including dust particulates) e.g., excavation.
Hazardous Materials Transportation Act (49 U.S.C. Sect. 1801-1813)		
Hazardous Materials Transportation Regulations (49 CFR Parts 107, 171-177)	Regulates transportation of hazardous materials.	Applicable if the remedial action involves transportation of hazardous materials.
U.S. Department of Transportation Regulations (49 CFR Parts 170-179)	Establishes regulations for the transportation of hazardous materials by private, common, or contract carriers by motor vehicle.	Applicable if the remedial action involves transportation of hazardous materials.
Occupational Safety and Health Act of 1970 PL 91-596; 29 USCA Sect. 651-678		
Occupational Safety and Health Standards (29 CFR Part 1910)	Establishes safety and health requirements for personnel working with hazardous materials and hazardous waste.	Applicable to on-site remedial activities.
Safety and Health Regulations for Construction (29 CFR Part 1926)	Establishes protection standards (e.g., hazard communication, excavation and trenching requirements) for workers involved in hazardous waste operations.	Applicable to on-site remedial activities.

Standard, Requirement, or Criteria	Description	Comment
Work Plans (WPs) MMRP-09-001 (USACE, 2009a)	WPs will be used to describe the goals, methods, procedures, and personnel used for field activities for all munitions response remedial or removal responses and other munitions related actions.	TBC for all alternatives that will require potential interaction with MEC/Material Documented as an Explosive hazard (MDEH) or MD.
Explosives Management Plan MMRP-09-002 (USACE, 2009b)	The Explosives Management Plan will be used to provide details for management of explosives for a specific munitions response or other munitions related project IAW applicable regulations. This Data Item Description contains the instructions for preparing WP chapters addressing explosives management for specific MR or other munitions related projects.	To be Considered (TBC) to those alternatives that may encounter MPPEH as part of remedial process.
Safety Submissions MMRP-09-003 (USACE, 2009c)	The Explosives Safety Submission (ESS) is used to provide the appropriate safety criteria for planning and siting of operations for munitions response, Recovered Chemical Warfare Material and other related projects that are in an investigative or characterization phase where there will be intentional physical contact with MPPEH, or presenting a chemical hazard.	TBC to those alternatives that will require removal of MEC/MPPEH as part of the remedial process.
Accident Prevention Plan MMRP-09-005 (USACE, 2009d)	Instructions for preparing an Accident Prevention Plan for conventional ordnance and explosives projects.	TBC to those alternatives that will require removal of MEC/MPPEH as part of the remedial process.

Standard, Requirement, or Criteria	Description	Comment
EE/CA, Remedial Investigation (RI) and Feasibility Study (FS) Reports MMRP-09-010 (USACE, 2009e)	The EE/CA Report, the RI Report and the FS Report are used to document the methods employed during site characterization and present the results of the site characterization, an analysis of response action alternatives, and the recommended response alternative. This DID provides the requirements for preparing these reports as part of the MMRP response process and other munitions related actions.	Portions of this guidance are TBC to the completion of this EE/CA.
Accident / Incident Reports MMRP-09-011 (USACE, 2009f)	The Accident/Incident Reports will be used for reporting accidents/ incidents that occur on the work site or in connection with the stated work of this contract.	TBC. Any accidents or incidents that occur during the implementation of remedial alternatives will need to be reported accordingly.
Personnel Qualifications Certification Letter MMRP-09-012 (USACE, 2009g)	The Personnel Qualifications Certification Letter is submitted by the contractor certifying that key personnel and personnel filling core labor categories meet the training and experience requirements for the position held. Resumes will be used to document personnel qualifications and experience.	TBC. Proof of training would be maintained for all Unexploded Ordnance (UXO) personnel that would work on the site in various capacities in accordance with the work required for the alternatives presented in this EE/CA. Use of properly trained personnel is required by MMRP guidelines.
Implementation of Department of Defense Explosives Safety Board (DDESB) Guidance on Minimum Separation Distances for Unintentional Detonations (DDESB, 2013)	The USACE has endorsed the use of the Hazard Fragmentation Distance for determining the minimum separation distance for unintentional detonations for MMRP responses/ projects for all MEC/MDEH	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.

Standard, Requirement, or Criteria	Description	Comment
USAF, MEC Hazard Assessment Tool (MHAT) Methodology (USAF, 2011)	This document describes the MHAT methodology for assessing potential explosive hazards to human receptors at MRS. The MHAT allows a project team to evaluate the potential explosive hazard associated with an MRS, given current or reasonably anticipated future conditions, and under various cleanup, land use activities, and Land Use Control (LUC) alternatives.	TBC for all alternatives that will involve LUCs, surface clearances, and/or subsurface clearances.
USACE Engineering and Design Military Munitions Response Actions; Engineer Manual (EM) 1110-1-4009 (USACE, 2010)	This manual provides USACE procedures to be used to perform engineering and design activities for all phases of the MMRP.	TBC for engineering and design activities under the MMRP.
USACE Safety and Health Requirements Manual; EM 385-1-1 (USACE, 2011)	This manual prescribes the safety and health requirements for all USACE activities and operations.	TBC for all on-site remedial activities.
USACE Explosives Safety and Health Requirements Manual; EM 385-1-97 (USACE, 2013)	This manual prescribes the safety and health requirements for all USACE activities and operations that involve explosives related work.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.
Air Force manual 91-201; Explosives Safety Standards (USAF, 2011)	These standards establish a central source for explosive safety criteria. It identifies hazards and states safety precautions and rules when working with explosives.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.

Standard, Requirement, or Criteria	Description	Comment
DoD Ammunition and Explosives Safety Standards; 6055.09-M (DoD, 2009)	These standards are designed to manage risks associated with DoD-titled ammunition and explosives by providing protection criteria to minimize serious injury, loss of life, and damage to property.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.
Department of Defense Instruction 4140.62, Material Potentially Presenting an Explosive Hazard (DoD, 2008)	This instruction provides policy and responsibilities for the management and disposition of MPPEH.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD
STATE		
NMED New Mexico Administrative Code Title 20 Chapter 9	Applies to the transportation, storage, transfer, processing, recycling, composting, nuisance abatement and disposal of solid waste.	Applicable for remedial actions that involve recycling of solid waste or disposal of solid waste at an approved off-site landfill.
New Mexico Statutes and Codes Chapter 74 – Environmental Improvement.	Establishes a department that will be responsible for environmental management.	Applicable for remedial actions that involve waste management and cleanup.
NMED New Mexico Administrative Code Title 20 Chapter 2 Part 1 and 75	Fugitive emissions fee A fee that specifically allows fugitive dust producing operations or activities is responsible for controlling windblown dust from earthmoving and other activities.	Potentially applicable to fugitive dust emissions during excavation, backfilling, and landscaping activities.
NMED New Mexico Administrative Code Title 20 Chapter 2 Part 7	General Provisions Emission of an air contaminant, including a fugitive emission, in excess of the quantity, rate, opacity or concentration specified by an air quality regulation or permit condition.	Potentially applicable to fugitive dust emissions during excavation, backfilling and landscaping activities.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section identifies and describes the RA alternatives that address the RAO for the FI857a MRS. The RA alternatives were developed by combining the most qualified General Response Actions (GRAs) that have been selected in the past at sites with similar conditions. The main objective of development of different alternatives is to provide decision-makers with an appropriate range of options and sufficient information to adequately compare alternatives against one another.

4.1 General Response Actions

The GRAs are broad classes of medium-specific actions such as no action, LUCs, surface removal, subsurface removal, or a combination of these that will achieve the RAO. The GRAs can be implemented through different remedial technologies and process options, defined as follows:

- Remedial technologies are the general categories of remedies such as detection, removal, disposal, and access restrictions;
- Process options are specific categories of remedies within each remedial technology, and are used to implement each remedial technology.

4.1.1 Identifications of Technologies and Process Options

The GRAs with corresponding remedial technologies and process options that were used for development of RA alternatives for FI857a MRS are summarized in **Table 4-1** and described as follows:

- **No Action** – No remedial action would be taken to address the potential MEC/MPPEH, MD, or range related debris hazards.
- **LUCs** – This GRA includes access restrictions and educational programs. In general access restrictions may include installing and maintaining fencing around controlled areas, posting warning signs prohibiting entry, or implementing zoning, planning or deed restrictions. In addition, as part of this alternative, administrative controls (including anomaly avoidance measures and UXO Construction Support) and deed restrictions would be implemented that could include stipulation that property could be used only for surface activities. Construction support would include a qualified UXO team, usually consisting of a minimum one UXO Technician Level III and one UXO Technician Level I, provides MEC avoidance by escorting site users in high risk areas and observing grading or other construction activities. The UXO team would halt all activities if MEC is encountered. For excavation activities in the MRS, this process option would likely require UXO personnel conducting an RA to the maximum excavation depth or the maximum penetration depth prior to excavation activities. Zoning/planning could be implemented to control the designated land use (agricultural, etc.). Educational programs would be tailored to community needs and could include public meetings, distribution of fact sheets, exhibits, videos, and educational signage at the MRS.
- **Surface MEC/MPPEH Removal –** Removal of MEC/MPPEH from the entire surface of the MRS. Analog metal detectors (e.g., Whites all metal detectors) and magnetometers (e.g., Schonstedt) would be used to provide instrument assistance in identifying metal items

exposed at the surface. Recovered MEC/MPPEH would be handled, stored, destroyed, and demilitarized in accordance with the DDESB Guidance for Clearance Plans (DDESB, 1998), and the USACE Military Munitions Response Actions, EM 1110-1-4009 (USACE, 2010). All recovered MD and other metallic cultural debris items would be moved to a central location inspected, certified as MDAS. MEC/MPPEH (determined as MDEH would be destroyed by detonation using Blow-in-Place (BIP) or consolidated detonation procedures. BIP is the destruction of MEC for which the risk of movement beyond immediate vicinity of discovery is not considered acceptable. Normally, this is accomplished by placing an explosive charge alongside the item. Waste streams generated from BIP operations may fall under further regulatory guidance with respect to treatment and/or final disposition. Consolidated Detonations are defined as the collection, configuration, and subsequent destruction by explosive detonation of MEC for which the risk of movement has been determined to be acceptable either within a current working sector or at an establish demolition ground. This option has an increased risk associated with handling and transporting live MEC, and requires oversight by specially trained UXO technicians or Explosive Ordnance Disposal (EOD) personnel and restricted access during detonation. EOD and other applicable organizations require notification of detonation activities. All MDAS would be transported from the site to an alternate off-site location for disposal/recycling.

- **Subsurface MEC/MPPEH Removal -** Removal of subsurface anomalies, potentially representing MEC/MPPEH, to a depth based on the anticipated penetration of suspected munitions or technology limitation. The most common digital detection technologies considered for detecting and mapping subsurface anomalies are electromagnetic induction sensors (e.g., Geonics EM61-MK2 [EM61] and magnetometers (e.g., Geometrics G-858 Cesium Vapor Magnetometer [G-858]). In general, G-858 represents a more robust system for detecting and mapping munitions of interest at greater depths than EM61. The detection capabilities of magnetometers and electromagnetic induction sensors are not anticipated to be impacted by site geology or anthropogenic sources. This should be confirmed with use of Instrument Verification Strip (IVS)/Geophysical System Verification (GSV). Demolition operations of discovered MEC/MPPEH and disposal operations of MDAS would be performed within this response action as described for Surface MEC/MPPEH Removal.

4.2 Alternative Description

The following four RA alternatives were developed for FI857a MRS by combining the GRAs summarized in **Section 4.1**:

5. No Action,
6. LUCs,
7. Surface Removal of MEC/MPPEH Combined with LUCs, and
8. Surface and Subsurface Removal of MEC/MPPEH.

A description of each of these alternatives is provided below

4.2.1 Alternative 1 - No Action

The No Action alternative involves no action to be performed under current or future land-use scenarios. No RA would be performed at the site, and no institutional controls such as warning

signs or land use restrictions are included in the No Action alternative. No cost will be associated with this alternative. This alternative is included as a baseline comparison for other alternatives.

Table 4-1 Potentially Applicable MEC Technologies and Process Options at FI857a MRS

General Response Action	Remedial Technology	Process Option
No Action	None	None
LUCss	Access Restrictions - Administrative Controls	Zoning, Planning and/or Deed Restrictions
		Educational Awareness Program
		UXO Escort/Construction Support
	Access Restrictions - Engineering/Physical Controls	Fencing
		Signage
Surface MEC/MPPEH Removal	Detection	Analog Metal Detectors
	Removal	Manual Removal Methods (Shovels, Hand Equipment)
	Disposal	MPPEH Inspections
		Demolition (MEC/MDEH)
		Manual Demilitarization (If Required)
		MDAS Disposal (Recycling)
Subsurface MEC/MPPEH Removal	Detection	Digital Metal Detectors
	Removal	Manual Removal Methods (Shovels, Hand Equipment)
		Mechanical Methods (Earth Moving Machinery)
	Disposal	MPPEH Inspections
		Demolition (MEC/MDEH)
		Manual Demilitarization (If Required)
		MDAS Disposal (recycling)

4.2.2 Alternative 2 - Land Use Controls

The LUCs alternative includes engineering controls (e.g., fencing and warning signage) and institutional controls (e.g., military orders preventing access to the MRS). Based on the suspected presence of MEC/MPPEH at FI857a MRS, the site's proximity to populated areas, and

the relative ease of access for Base personnel and residents, engineering controls including physical barriers and signage would be required. As part of this alternative, fencing would be placed along the perimeter of the site and frequent signage would be put in place. The fencing would be constructed of 7-foot high chain link topped with barbed wire and would be constructed to restrict access to entire site. Signs identifying the area as having a MEC hazard would be placed every 100 ft along the fence line. Intrusive work would be required during fence installation; therefore, MEC avoidance would be required. An estimated 919 linear ft of fence and 10 warning signs would be installed as part of this alternative. If Holloman AFB transfers the land associated with the FI857a MRS, then LUCss including restrictions and a description of hazards present at the MRS would need to be incorporated into any real property documents necessary for transferring ownership from Holloman AFB.

4.2.3 Alternative 3 – Surface Removal of MEC/MPPEH Combined with LUCs

The instrument-aided removal of all visible MEC/MPPEH would be performed in this alternative. The hand-held magnetic locators would be utilized during this effort. The use of metal detectors for surface clearance would not be warranted since non-ferrous munitions are not suspected to be present on the site Following the completion of the surface clearance, brush clearing would be conducted across the entire area of the MRS. Brush clearing would be performed using hand or powered tools such as machetes, brush hooks, or powered circular saw type weed cutters. Recovered MEC/MPPEH would be handled, stored, destroyed, and demilitarized in accordance with the guidance set forth in the DDESB-approved ESS developed for the FI857a MRS. Discovered MEC/MPPEH (determined as MDEH) would be detonated on-site, and all remaining MD and other metallic cultural debris items would be moved to a central location and shipped to a recycling facility for disposal. Range related features would be removed except for the large range related structures that would be left in place.

Surface soil samples would be collected from areas containing isolated locations of confirmed MEC/MPPEH and in areas of significant amounts of MD using composite soil sampling techniques to determine the presence or absence of MC contamination (metals and explosives). In addition, MC soil sampling would be performed before and after BIPs and consolidated shots. The NMED has recently revised its risk based Soil Screening Levels (SSLs) (NMED, 2012). USEPA also publishes Regional Screening Levels (RSLs) (USEPA, 2013). The more conservative of these two values (SSL and RSL) would be used as the risk-based screening level to determine whether MC contamination exists.

LUCs would be implemented upon completion of surface MEC/MPPEH removal to minimize potential exposure to potential subsurface MEC/MPPEH and to increase public awareness of the historical use and the potential for encountering MEC/MPPEH. LUCs would be comprised of educational and awareness programs for Base personnel and visitors that include but are not limited to:

- Notations of the suspected presence of subsurface MEC/MPPEH in the Base Real Property records, in the Installation General Plan, and in the Base Geographic Information System land management system (Geobase) as well as written materials designed to raise community understanding and awareness of the hazards associated with subsurface MEC;
- Signs that warn the users of the former range of areas where they may encounter subsurface MEC.

- Already implemented dig permits at Holloman AFB prohibiting digging without construction support by UXO personnel would remain in place.

4.2.4 Alternative 4 - Surface and Subsurface Removal of MEC/MPPEH

This alternative includes 100% surface removal of MEC/MPPEH and removal of the following subsurface anomalies:

- Those that show characteristics of burial pits and
- All individual geophysical anomalies above the established threshold based on the MRS background noise determined by an IVS/GSV.

In no case will any excavations and removals exceed 10 feet. In addition, if perimeter anomalies are found or if surface clearance and/or intrusive investigation results indicate the MEC/MPPEH presence beyond the MRS boundary, FPM will extend surface clearance and DGM investigation to determine the extent of contamination.

The MRS would undergo a 100 percent (%) surface clearance as outlined for Alternative 3 and a 100% Digital Geophysical Mapping (DGM) coverage using magnetometer G-858 coupled with the Real-Time Kinematic Global Positioning System. The suspected munition items for FI857a MRS are grenades and M38 practice bombs. Both the M38 bomb and hand grenade are composed of ferrous metal components which makes both electromagnetic induction sensors (EM61) and magnetometers (G-858) potentially appropriate for the subsurface clearance. However, since FI857a MRS had not been used as a bombing range, the anticipated MEC/MPPEH in the subsurface of the site could have been buried on site at any depth. In general, G-858 is used for detection of munitions located at greater depths; therefore, G-858 would be used for detection of subsurface anomalies.

All DGM anomalies identified for intrusive investigation would be removed using both manual removal techniques (e.g., shovels, hand equipment) and earth moving machinery. Recovered MEC/MPPEH would be handled, stored, destroyed, and demilitarized in accordance with the guidance set forth in the DDESB-approved ESS developed for the FI857a MRS. The excavated MEC for which the risk of movement beyond immediate vicinity of discovery is not considered acceptable would be BIP. MEC for which the risk of movement has been determined to be acceptable either within a current working sector or at an establish demolition ground would be disposed by consolidated.

Surface and subsurface soil samples would be collected from areas containing isolated locations of confirmed MEC/MPPEH and in areas with significant amounts of MD using composite soil sampling techniques to determine the presence or absence of MC contamination (explosives and metals). In addition, MC soil sampling would be performed before and after BIPs and consolidated shots. The SSLs (NMED, 2012) and RSL (USEPA, 2013) would be deployed to determine whether MC contamination exists, as outlined for Alternative 3.

4.3 Evaluation Criteria

This section provides evaluation of 4 alternatives using the effectiveness, implementability, and cost criteria set forth in the NCP and the USEPA guidance for conducting EE/CAs (USEPA, 1993). The following sections provide a discussion of the pertinent evaluation criteria for each alternative.

Effectiveness

The effectiveness of a technology refers to its capability of removing the specific items in the volumes required, the degree to which the technology achieves the RAO, and the reliability and performance of the technology over time, including protection of human health and the environment, compliance with ARARs to the extent practical, long-term effectiveness and permanence, reduction in explosive safety hazard, and short-term effectiveness. As explained in **Section 3.3**, the RAO for FI857a MRS is to implement measures that will minimize MEC hazards which may contain energetic materials that pose a potential explosive safety hazard to human health and the environment. Levels of effectiveness were assessed based upon the number of effectiveness criteria that would be satisfied by each alternative. Effectiveness criteria include: protection of human health, protection of workers during implementation, compliance with chemical-, location-, and action- specific ARARs, short-term effectiveness, long-term effectiveness, and reduction in the toxicity, mobility, or volume (TMV) of contaminants.

Implementability

The ease of implementation of a technology refers to the availability of commercial services to support it, the constructability of the technology under specific site conditions, and the acceptability of the technology to all parties involved (regulators, public, owner, etc.), including technical feasibility, administrative feasibility, availability of services, support agency acceptance, and community acceptance. Levels of implementability were assessed based upon the number of implementability criteria satisfied by each alternative. Implementability criteria include: technical feasibility, administrative feasibility, and community and regulatory acceptance.

Cost

For the detailed cost analysis of alternatives, the expenditures required to complete each alternative were estimated in terms of capital costs and Post Removal Site Control (PRSC) cost. Capital costs include costs to complete initial RA activities. The PRSC costs include annual operation and maintenance for 30 years and periodic costs to perform Five-Year Reviews for 30 years. By combining the different costs associated with each alternative, a present-worth calculation for each alternative can be made for comparison. For the purposes of the cost estimate summaries (**Appendix A**), Remedial Action Cost Engineering and Requirements (RACER) was utilized to develop alternative costs. RACER is an environmental remediation/corrective action cost-estimating system developed for DoD cost-estimating use.

4.4 Individual Analysis of Alternatives

4.4.1 Alternative 1 – No Action

Effectiveness

Alternative 1 provides no additional protection to human health and the environment. Potential MEC/MPPEH would remain onsite, which would potentially expose authorized personnel/workers and Base residents to explosive safety hazards associated with MEC/MPPEH. In addition this alternative would not protect the environment from future releases of explosive-related contaminants. No risk reduction will be accomplished through this alternative.

Action-specific ARARs do not apply to this alternative. Alternative 1 does not provide any short term effectiveness at FI857a MRS as it does not limit or eliminate risks to human health and the

environment. Alternative 1 does not provide any long-term effectiveness. Since no RA is performed for Alternative 1, there is no reduction in the TMV of contaminants.

Implementability

Alternative 1 is the No Action alternative; therefore, implementability does not apply. Alternative 1 is not protective of human and ecological receptors; therefore it would not be accepted by regulators.

Cost

The total estimated cost for Alternative 1 is $0. There are no capital or PRSC costs, contingencies, or professional or technical services associated with this alternative.

4.4.2 Alternative 2 – Land Use Controls

Effectiveness

Alternative 2 provides a limited level of protection to human health and the environment at the FI857a MRS. This alternative would reduce the explosive safety risk to humans by inhibiting access to MEC/MPPEH that would remain in place; however, engineering controls cannot eliminate the potential for human exposure because of intended or unintended breeches of the installed barrier. No potential environmental benefits are realized from this alternative because munitions items would remain in place.

As with any MEC site, Alternative 2 does have worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working in areas with live munitions. All personnel working in the area will be led by UXO personnel who will provide MEC avoidance support. Establishing the engineering controls would involve intrusive activities during installation, therefore the area must be free of subsurface MEC/MPPEH prior to working in that immediate area. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-related work activities.

MEC left in place does not conflict with the ability to comply with potential action- specific ARARs, therefore, Alternative 2 is in compliance with ARARs.

Alternative 2 is effective in the short term by providing physical barriers and signage for receptor access to restricted areas. Alternative 2 provides limited long-term effectiveness. Engineering controls cannot eliminate the long term risks to human health. Fencing and signage can be compromised by trespassers, and weather and the receptors would in turn have access to restricted areas. Alternative 2 does not include the removal of on-site MEC/MPPEH; therefore the risk to human health is high if engineering controls are compromised. Long term and extensive operation and maintenance would be required to maintain fencing and signs in good repair.

Since no RA will be performed for Alternative 2, there will be no reduction in the TMV of contaminants.

Implementability

This alternative is technically feasible, administratively feasible, and services and materials necessary to implement the LUCs are readily available in the local community. This alternative is considered technically feasible because the action is achievable using readily available MEC

avoidance support services and tools. Possible constraints to implementing the LUCs would be extreme weather conditions. In the case of extreme weather conditions, the installation of the fence and warning signage would be temporarily postponed. This alternative is considered administratively feasible because there are no foreseeable obstacles to implement LUCs. There are no permits, waivers, easements, or right-of-way agreements necessary to install fence and warning signage for the MRS. All equipment, personnel, and services necessary to implement Alternative 2 are available in the vicinity of Holloman AFB.

Alternative 2 provides an adequate level of protection to human health as long as LUCs are enforced. Since this alternative will not address the removal of the hazard it is unlikely that the regulators will accept this alternative.

Cost

The total estimated cost for Alternative 2 is $381,276 (**Appendix A**). Alternative 2 includes capital costs ($45,397) for developing and implementing LUCs including institutional restrictions and engineering controls. Engineering controls include installation of fencing and warning signs. PRSC costs associated with this alternative ($335,879) include annual operation and maintenance for 30 years and periodic costs to perform Five-Year Reviews for 30 years.

4.4.3 Alternative 3 – Surface Removal of MEC/MPPEH Combined with LUCs

Effectiveness

Alternative 3 provides the moderate level of protection to human health and the environment within FI857a MRS. Authorized and unauthorized personnel accessing the site would be protected from potential MEC/MPPEH items currently on the surface and the potential release of explosive related contamination will be reduced because the MEC/MPPEH items will be removed and disposed of, as necessary. An explosive hazard that may still exist in this area due to the potential presence of subsurface MEC would be addressed through LUCs.

Alternative 3 has worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working with/around potentially live munitions. All personnel involved with the MEC/MPPEH removal would be qualified to work on a site contaminated with MEC/MPPEH and must have documented proof of qualifications. All applicable safety requirements would be followed for handling, storage, and demolition/demilitarization. To protect both the site workers and visitors to the site (authorized and unauthorized), areas where the removal is taking place would have exclusion zones established for explosive safety purposes. Only authorized personnel would be allowed in the exclusion zone during the normal working hours, however, authorized visitors would be allowed in the exclusion zone under conditions specified in the DDESB-approved ESS. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-related work activities. The methodologies to safely perform these activities would be described in the Site-Specific NTCRA WP and the Health and Safety Plan (HASP).

For Alternative 3, surface MEC/MPPEH would be removed and destroyed and all activities conducted in a manner consistent with applicable ARARs.

Alternative 3 is effective in the short term by minimizing the explosive safety risk of MEC/MPPEH by permanently removing the items from the ground surface. Alternative 3 would be effective in eliminating surface MEC/MPPEH hazards from the FI857a site. The removal of MEC/MPPEH from ground surface would eliminate exposure to potential receptors. Long-term

operation and maintenance would be required and periodic site inspections would need to be performed to identify and mitigate subsurface MEC/MPPEH that exposed at the surface.

Alternative 3 provides reduction of TMV since the surface MEC/MPPEH that are encountered during the NTCRA will be either BIP or transported to the MRS Safe Disposal Area (SDA) for demolition. Additional residuals include trace amounts of metals and potential residual explosives. An evaluation of the concentrations of these residuals following a MEC detonation would be performed.

Implementability

Alternative 3 employs technologies that have been used in full-scale applications; therefore it is technically and administratively feasible. MEC/MPPEH removal support services and tools are readily available through a number of commercial contractors.

Alternative 3 provides the moderate level of protection to human health and the environment among the four alternatives. MEC/MPPEH currently on the surface would be removed and disposed of, as necessary, and the remaining subsurface MEC/MPPEH will be addressed through LUCs. However, since this MRS is fairly small (0,8 acres), the subsurface clearance of the site will be cost-effective and will remove the need for LUCs and their maintenance for 30 years. Therefore, it is unlikely that the regulators will accept this alternative.

Cost

The total estimated cost for Alternative 3 is $454,936 (**Appendix A**). Alternative 3 includes capital costs ($22,495) for performing the surface clearance across 0.8 acres as well as developing and implementing LUCs (institutional and engineering controls). Engineering controls include installation of warning signs. PRSC costs associated with this alternative ($432,441) include annual operation and maintenance for 30 years, periodic costs to perform surface sweeps of the 10% of the MRS every five years, and Five-Year Reviews for 30 years.

4.4.4 Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH

Effectiveness

Alternative 4 provides the highest level of protection to human health and the environment within FI857a MRS. Authorized and unauthorized personnel accessing the site would be protected from MEC/MPPEH items currently on the surface/subsurface and the potential release of explosive related contamination will be minimized because the surface and subsurface MEC/MPPEH items will be removed and disposed of.

Alternative 4 has worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working with/around potentially live munitions. All personnel involved with the MEC/MPPEH removal would be qualified to work on a site contaminated with MEC/MPPEH and would have documented proof of qualifications. All applicable safety requirements would be followed for handling, storage, and demolition/demilitarization. To protect both the site workers and visitors to the site (authorized and unauthorized), areas where the removal is taking place would have exclusion zones established for explosive safety purposes. Only authorized personnel would be allowed in the exclusion zone during the normal working hours, however, authorized visitors would be allowed in the exclusion zone under conditions specified in the DDESB-approved ESS. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-

related work activities. The methodologies to safely perform these activities would be described in the Site-Specific NTCRA WP and the HASP.

For Alternative 4, surface and subsurface MEC/MPPEH would be removed and destroyed and all activities conducted in a manner consistent with applicable ARARs.

Alternative 4 is effective in the short term by minimizing the explosive safety risk of MEC/MPPEH by permanently removing the items from the ground surface/subsurface. Alternative 4 is effective in the long-term by minimizing the explosive safety hazard by permanently removing MEC/MPPEH from the ground surface and subsurface.

Alternative 4 provides reduction of TMV since the MEC/MPPEH that are encountered during the NTCRA will be either BIP or transported to the MRS SDA for demolition. Additional residuals include trace amounts of metals and potential residual explosives. An evaluation of the concentrations of these residuals will be performed.

Implementability

The removal of surface and subsurface MEC/MPPEH from the FI857a MRS is technically and administratively implementable. MEC removal support services and tools are readily available through a number of commercial contractors.

Alternative 4 provides the highest level of protection to human health and the environment among the four alternatives and will result in the site closeout and unrestricted land use at FI857a. Therefore, the regulatory agencies are likely to consider the Alternative 4 as the most acceptable alternative at the FI857a MRS.

Cost

The total estimated cost for Alternative 4 is $132,645 (**Appendix A**). Alternative 4 includes capital costs ($132,645) for performing surface clearance across 0.8 acres, 100% DGM coverage of the site, excavation of all anomalies above the established threshold, demolition of MEC, and offsite disposal of MDAS. Since this alternative will result in site closeout, no PRSC costs are associated with this alternative.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section presents a comparative analysis of RA alternatives for the FI857a MRS. In order to rank the alternatives, each alternative was ranked numerically from 1 to 3 for each criterion. The No Action alternative was rated as Not Applicable (NA). The alternative that was determined to be the best alternative when assessed with the criterion, received a numerical ranking of 1. The second best alternative received a numerical ranking of 2, and so forth. Once the numerical ranking was determined for the three criteria (effectiveness, implementability, and cost) the overall score was determined by adding up the individual numerical rankings for each alternative. An alternative ranked "3" for effectiveness, "1" for implementability, and "3" for cost would have an overall score of "7". The overall scores were used to arrange the alternatives in rank order, with the lowest score being ranked the highest.

5.1 Effectiveness

Table 5-1 provides the ranking of effectiveness criteria of the four alternatives. Alternative 1 does not achieve the RAO. Alternative 2, 3, and 4 have been developed because they were able to achieve RAO identified in **Section 3.0**. If the RAO is achieved, then human health and the environment are protected. Workers can be protected during implementation of all three alternatives using standard personal protective equipment and MEC detecting devices and procedures. The explosive safety risk to the human health will be minimized through the removal of MEC contamination, which, if left in place, could also potentially serve as a source of chemical environmental contamination. Therefore, Alternative 4 is more protective of the human health and the environment than Alternatives 2 and 3 because it directly addresses the explosive hazard through removing MEC/MPPEH from both surface and subsurface of the site.

All three alternatives can comply with the action-specific ARARs, which apply to the implementation of the alternatives. The subsurface RA will adhere to all regulations regarding environmentally sensitive locations, excavations, detonations, and explosives transportation, use, and storage. Therefore, subsurface removal meets more ARARs than a surface clearance or LUCs. Surface removal meets more ARARs than LUCs.

For the short term effectiveness, the LUCs alternative is ranked best because it reduces risk upon implementation, requires little time to implement, and has minimal adverse effects on the public and the environment. The surface removal alternative is ranked second best as it reduces risk upon implementation, requires less time and effort to implement than subsurface removal, and results in few public and environmental impacts. The subsurface removal alternative is ranked third because it requires more planning and has more of an impact on the environment.

For the long-term effectiveness, the subsurface removal alternative is ranked best because it would eliminate any buried MEC/MPPEH in the area. For the same reason Alternative 4 is ranked best for the reduction of TMV.

As shown in **Table 5-1**, Alternative 4 is ranked best in terms of effectiveness.

5.2 Implementability

All of the alternatives are technically and administratively feasible. Implementing Alternative 2 would be easier than implementing any of the other alternatives, from both an administrative and a technical feasibility perspective. In addition, Alternative 2 could be accomplished in a relatively shorter length of time than that required to implement an RA.

Table 5-1 Effectiveness Criteria Evaluation

Alternative	Protection of Human Health	Protection of Workers	Compliance with ARARs	Short-Term	Long-Term	Reduction of TMV	Overall Score	Rank
Alternative 1 No Action	NA	NA	NA	NA	NA	NA	NA	NA
Alternative 2 LUCs	3	1	3	1	3	3	14	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	1	2	2	2	2	11	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	1	1	3	1	1	8	**1**

From technical and administrative perspectives, implementation of a subsurface removal is the least feasible. Unlike surface removal, a subsurface removal requires excavation equipment (in addition to specially trained and qualified personnel and a means of MEC disposal, which is required for all RAs). WPs and removal reports are more difficult to document. The subsurface removal alternative generally requires more logistical and management support than the surface removal alternative and it would take more time and effort to implement than surface removal.

Considering the high MEC/MPPEH risk level, it was determined that the regulatory agencies and community are likely to consider the subsurface removal alternative as the most acceptable alternative in this area. Therefore, the subsurface removal alternative is ranked best in terms of state agency and community acceptance. Surface removal is ranked second, as state agencies and community are likely to be less enthusiastic about a clearance that does not address subsurface risks. LUCs are ranked third, as state agencies and community are likely to prefer a response action that addresses removal of the hazards.

As shown in **Table 5-2,** all three alternatives have the same rank in terms of implementability.

5.3 Cost

The present-worth costs of each of the alternatives are summarized in **Table 5-3**. The detailed cost breakdown for each alternative is provided in **Appendix A**. As shown in **Table 5-3**, Alternative 4 is ranked best in terms of cost.

5.4 Overall Ranking of Alternatives

The overall ranking of the different alternatives in terms of their effectiveness, implementability, and cost is presented in **Table 5-4**. Alternative 4 has the best overall ranking and is recommended alternative.

Table 5-2 Implementability Criteria Evaluation

Alternative	Technical Feasibility	Admin Feasibility	Regulatory Acceptance	Community Acceptance	Overall Score	Rank
Alternative 1 No Action	NA	NA	NA	NA	NA	NA
Alternative 2 LUCs	1	1	3	3	8	**1**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	2	2	2	8	**1**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	3	3	1	1	8	**1**

Table 5-3 Cost Criteria Evaluation

Alternative	Total Project Duration (Years)	Capital Cost	Total O&M Cost	Total Present Cost of Alternative	Rank
Alternative 1 No Action	NA	NA	NA	NA	NA
Alternative 2 LUCs	30	$45,397	$335,879	381,276	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	30	$22,495	$432,441	454,936	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	$132,645	$0	132,645	**1**

Table 5-4 Alternatives Evaluation

Alternative	Effectiveness Rank	Implementability Rank	Cost Rank	Overall Score	Overall Rank
Alternative 1 No Action	NA	NA	NA	NA	NA
Alternative 2 LUCs	3	1	3	7	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	1	2	5	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	1	1	3	**1**

6.0 RECOMMENDATIONS

This EE/CA presents the selected RA alternative for the MEC/MPPEH hazards at the FI857a MRS at Holloman AFB in Otero County, New Mexico, developed in accordance with CERCLA as amended and consistent with the NCP. This decision is based on the information gathered during the previous investigations completed at the site and included in the Administrative Record for the site. The action recommended for this site is Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH, which will achieve the RAO with a higher certainty of success and is consistent with what is anticipated to be overall final remedy for the site. This alternative addresses the explosive safety issues associated with MEC/MPPEH, while the other alternatives leave them in place by varying degrees with no means to mitigate the hazard. Additionally, Alternative 4 provides the greatest protection of human health and the environment and long term effectiveness while being less expensive to implement than the other alternatives. Implementation of this alternative will permit site closeout which means that no restrictions on future land use are needed for this site and no further restoration funds are required to be expended at FI857a MRS. Conditions at the site meet the USEPA 40 CFR § 300.415(b)(2)(vi) - threat of fire or explosion - criterion for initiating an RA. The total project cost, if approved, is estimated to be $132,645 with no PRSC costs.

6.1 Public Participation

Following completion of the EE/CA, community relations and administrative record activities necessary for all RAs will be performed.

According to Section 300.415(m) of the NCP, the Lead Agency (USAF) will conduct the following community relations activities:

- Designate a community relations spokesperson,
- Establish the information repository,
- Conduct community interviews,
- Prepare Community Relations Plan, and
- Issue public notice in the Alamogordo Daily News of availability of the EE/CA.

According to Section 300.820 of the NCP, the Lead Agency will conduct the following administrative record requirements:

- Establish the administrative record file,
- Publish public notice of the availability of the administrative record file,
- Hold a public comment period,
- Develop written responses to significant public comments, and
- Complete the administrative record file after selecting the response.

Written responses to significant comments will be summarized in an Action Memorandum and will be included in the Administrative Record.

6.2 Removal Action Schedule

The general completion time frames for activities associated with the NTCRA at the FI857a MRS are summarized in **Table 6-1**.

Table 6-1 Removal Action Schedule

EE/CA (preparation, review, and approval)	15 November 2013 to 6 October 2014
Action Memorandum (with public comment period)	16 September 2014 to 4 June 2015
Explosives Safety Submission	1 October 2013 to2 September 2014
NTCRA WP (preparation, review, and approval)	1 May 2015 to 19 January 2016
Fieldwork	20 January 2016 to 2 February 2016
After Action Report	9 March 2016 to 25 November 2016
Site Closeout	26 November 2016 to 4 July 2018

7.0 REFERENCES

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USACE. 2009d. DID Number MMRP-09-005: Accident Prevention Plan. 19 August.

USACE. 2009e. DID Number MMRP-09-010: EE/CA, RI, and FS Reports. 19 August.

USACE. 2009f. DID Number MMRP-09-011: Accident/Incident Reports. 19 August.

USACE. 2009g. DID Number MMRP-09-012: Personnel Qualifications Certification Letter. 19 August.

Appendix A
Removal Action Alternatives Cost Estimates

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Alternative 1
No Action

This page is intentionally left blank.

There is no cost associated with Alternative 1.

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Alternative 2
Land Use Controls

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

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Phase Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator

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Phase Cost Detail Report
(with Markups)

Agency/Org./Office: FPM
Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

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Phase Cost Detail Report
(with Markups)

Phase:

Phase Type: Operations & Maintenance
Phase Name: Fencing and LUC/ICs-Alt2
Description:

Start Date: October, 2014
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
MEC Institutional Controls	Yes	100	0

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Phase Cost Detail Report
(with Markups)

Technology	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
ADMINISTRATIVE LAND USE CONTROLS	$147,518							$97,857	$245,375
(100% Prime)		$0	$0	$70,942	$10,831	$0	$16,084		
MEC Institutional Controls	$30,913							$14,484	$45,397
(100% Prime)		$0	$0	$7,200	$2,931	$0	$4,353		
Total Phase Cost	$178,431	$0	$0	$78,142	$13,762	$0	$20,437	$112,341	$290,772
						Escalation			$90,504
						Escalated Phase Cost			$381,276

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Phase Cost Detail Report
(with Markups)

Markup Template

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

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Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator
Agency/Org./Office: FPM

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Phase Technology Cost Detail Report
(with Markups)

Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

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Phase Technology Cost Detail Report
(with Markups)

Phase:

Phase Type: Operations & Maintenance
Phase Name: Fencing and LUC/ICs-Alt2
Description:

Start Date: October, 2014
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
MEC Institutional Controls	Yes	100	0

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Phase Technology Cost Detail Report
(with Markups)

Technology: ADMINISTRATIVE LAND USE CONTROLS

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040934	UXO Technician II	4.00	HR	0.00	51.46	0.00	0.00	$205.84	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	800.00	$2,400.00	☑	☐
33220102	Project Manager	2.00	HR	0.00	193.20	0.00	0.00	$386.39	☐	☑
33220106	Staff Engineer	16.00	HR	0.00	186.89	0.00	0.00	$2,990.24	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220112	Field Technician	4.00	HR	0.00	115.90	0.00	0.00	$463.60	☐	☑
33220114	Word Processing/Clerical	2.00	HR	0.00	81.71	0.00	0.00	$163.42	☐	☑
33220115	Draftsman/CADD	2.00	HR	0.00	89.68	0.00	0.00	$179.36	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	355.57	0.00	0.00	0.00	$355.57	☑	☑

Total Element Cost	**$8,179.18**
Total 1st Year Technology Cost	**$8,179.18**

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Phase Technology Cost Detail Report (with Markups)

Technology: MEC Institutional Controls

Element: Implementation

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	12.00	DAY	0.00	0.00	0.00	63.64	$763.69	☐	☑
33010202	Per Diem (per person)	12.00	DAY	0.00	0.00	0.00	123.00	$1,476.00	☑	☐
33040927	UXO Senior Scientist	98.00	HR	0.00	120.59	0.00	0.00	$11,817.38	☐	☑
33240101	Other Direct Costs	1.00	LS	118.17	0.00	0.00	0.00	$118.17	☑	☑

Total Element Cost **$14,175.25**

Element: Engineering Controls

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
18040105	Boundary Fence, 5' Galvanized	919.00	LF	17.54	12.58	2.74	0.00	$30,201.89	☐	☑
18040501	Hazardous Waste Signing	10.00	EA	63.89	38.07	0.00	0.00	$1,019.63	☐	☑

Total Element Cost **$31,221.52**

Total 1st Year Technology Cost **$45,396.77**

Total Phase Cost **$53,575.95**

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Alternative 3
Surface Removal of MEC/MPPEH Combined with LUCs

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

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Phase Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator

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Phase Cost Detail Report
(with Markups)

Agency/Org./Office: FPM
Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

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Phase Cost Detail Report
(with Markups)

Phase:

Phase Type: Remedial Action
Phase Name: Surface Clearance- Alt 3
Description:

Approach: Ex Situ
Start Date: October, 2014
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Site Characterization & Removal Assessment	Yes	100	0
2015 SURFACE SWEEP	Yes	100	0
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
MEC Institutional Controls	Yes	100	0
2020 SURFACE SWEEP	Yes	100	0
2025 SURFACE SWEEP	Yes	100	0
2030 SURFACE SWEEP	Yes	100	0
2035 SURFACE SWEEP	Yes	100	0
2040 SURFACE SWEEP	Yes	100	0
2045 SURFACE SWEEP	Yes	100	0

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Phase Cost Detail Report
(with Markups)

Technology	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
MEC Site Characterization & Removal Assessment	$12,153							$3,448	$15,601
(100% Prime)		$0	$0	$1,644	$726	$0	$1,078		
2015 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
ADMINISTRATIVE LAND USE CONTROLS	$147,518							$97,857	$245,375
(100% Prime)		$0	$0	$70,942	$10,831	$0	$16,084		
MEC Institutional Controls	$4,859							$2,035	$6,894
(100% Prime)		$0	$0	$995	$419	$0	$622		
2020 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
2025 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
2030 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
2035 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		

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Phase Cost Detail Report
(with Markups)

Technology	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
2040 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
2045 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
Total Phase Cost	$201,773	$0	$0	$97,157	$15,795	$0	$23,456	$136,408	$338,181
						Escalation			$116,758
						Escalated Phase Cost			$454,936

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Phase Cost Detail Report
(with Markups)

Markup Template

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

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Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

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Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator
Agency/Org./Office: FPM

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Phase Technology Cost Detail Report
(with Markups)

Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

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Phase Technology Cost Detail Report
(with Markups)

Phase:

Phase Type: Remedial Action
Phase Name: Surface Clearance- Alt 3
Description:

Approach: Ex Situ
Start Date: October, 2014
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Site Characterization & Removal Assessment	Yes	100	0
2015 SURFACE SWEEP	Yes	100	0
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
MEC Institutional Controls	Yes	100	0
2020 SURFACE SWEEP	Yes	100	0
2025 SURFACE SWEEP	Yes	100	0
2030 SURFACE SWEEP	Yes	100	0
2035 SURFACE SWEEP	Yes	100	0
2040 SURFACE SWEEP	Yes	100	0
2045 SURFACE SWEEP	Yes	100	0

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Phase Technology Cost Detail Report (with Markups)

Technology: MEC Site Characterization & Removal Assessment

Element: Site Characterization

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010202	Per Diem (per person)	14.00	DAY	0.00	0.00	0.00	123.00	$1,722.00	☑	☐
33021530	Differential GPS Unit Rental	1.00	MO	95.35	0.00	0.00	0.00	$95.35	☐	☑
33040223	Ordnance Locator, Schoenstedt, Model GA-72CD, weekly rental	7.00	WK	0.00	0.00	0.00	146.10	$1,022.68	☐	☑
33040651	4 X 4 Truck- Rental/Lease	11.00	DAY	0.00	0.00	110.31	0.00	$1,213.46	☐	☑
33040921	Senior UXO Supervisor (SUXOS)	10.00	HR	0.00	77.16	0.00	0.00	$771.60	☐	☑
33040923	UXO Project Manager	10.00	HR	0.00	100.91	0.00	0.00	$1,009.10	☐	☑
33040930	UXO QC Specialist	10.00	HR	0.00	71.05	0.00	0.00	$710.52	☐	☑
33040931	UXO Safety Officer	10.00	HR	0.00	70.21	0.00	0.00	$702.13	☐	☑
33040934	UXO Technician II	60.00	HR	0.00	51.46	0.00	0.00	$3,087.59	☐	☑
33040935	UXO Technician III (UXO Supervisor)	10.00	HR	0.00	61.74	0.00	0.00	$617.44	☐	☑
33041001	16oz Standard TNT Booster	10.00	EA	0.56	0.00	0.00	0.00	$5.57	☐	☑
33041002	50 gr/ft Det -Cord (1000 ft roll)	2.00	EA	794.36	0.00	0.00	0.00	$1,588.72	☐	☑
33041004	12 ft Lead Primadet Non-Electric Detonators	5.00	EA	9.53	0.00	0.00	0.00	$47.66	☐	☑
33041101	Airfare	4.00	LS	0.00	0.00	0.00	750.00	$3,000.00	☑	☐
33240101	Other Direct Costs	1.00	LS	7.49	0.00	0.00	0.00	$7.49	☑	☑

Total Element Cost	**$15,601.33**
Total 1st Year Technology Cost	**$15,601.33**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2015 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: ADMINISTRATIVE LAND USE CONTROLS

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040934	UXO Technician II	4.00	HR	0.00	51.46	0.00	0.00	$205.84	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	800.00	$2,400.00	☑	☐
33220102	Project Manager	2.00	HR	0.00	193.20	0.00	0.00	$386.39	☐	☑
33220106	Staff Engineer	16.00	HR	0.00	186.89	0.00	0.00	$2,990.24	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220112	Field Technician	4.00	HR	0.00	115.90	0.00	0.00	$463.60	☐	☑
33220114	Word Processing/Clerical	2.00	HR	0.00	81.71	0.00	0.00	$163.42	☐	☑
33220115	Draftsman/CADD	2.00	HR	0.00	89.68	0.00	0.00	$179.36	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	355.57	0.00	0.00	0.00	$355.57	☑	☑

Total Element Cost	**$8,179.18**
Total 1st Year Technology Cost	**$8,179.18**

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Phase Technology Cost Detail Report
(with Markups)

Technology: MEC Institutional Controls

Element: Implementation

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	5.00	DAY	0.00	0.00	0.00	63.64	$318.20	☐	☑
33010202	Per Diem (per person)	5.00	DAY	0.00	0.00	0.00	123.00	$615.00	☑	☐
33040927	UXO Senior Scientist	40.00	HR	0.00	120.59	0.00	0.00	$4,823.42	☐	☑
33240101	Other Direct Costs	1.00	LS	118.17	0.00	0.00	0.00	$118.17	☑	☑

Total Element Cost **$5,874.80**

Element: Engineering Controls

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
18040501	Hazardous Waste Signing	10.00	EA	63.89	38.07	0.00	0.00	$1,019.63	☐	☑

Total Element Cost **$1,019.63**

Total 1st Year Technology Cost **$6,894.43**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2020 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2025 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2030 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2035 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2040 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2045 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**
Total Phase Cost	**$100,984.55**

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Alternative 4
Surface and Subsurface Removal of MEC/MPPEH

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

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Phase Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator

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Phase Cost Detail Report
(with Markups)

Agency/Org./Office: FPM
Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

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Phase Cost Detail Report
(with Markups)

Phase:

Phase Type: Study
Phase Name: Surface and Subsurface Clearance - Alt4
Description:

Start Date: December, 2015
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Removal Action	Yes	100	0

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Phase Cost Detail Report
(with Markups)

Technology	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
MEC Removal Action (100% Prime)	$88,043	$0	$0	$16,825	$6,910	$0	$10,261	$33,997	$122,040
Total Phase Cost	$88,043	$0	$0	$16,825	$6,910	$0	$10,261	$33,997	$122,040
						Escalation			$10,605
						Escalated Phase Cost			$132,645

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Phase Cost Detail Report
(with Markups)

Markup Template

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

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Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

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Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator
Agency/Org./Office: FPM

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Phase Technology Cost Detail Report
(with Markups)

Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Phase:

Phase Type: Study
Phase Name: Surface and Subsurface Clearance - Alt4
Description:

Start Date: December, 2015
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Removal Action	Yes	100	0

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Phase Technology Cost Detail Report (with Markups)

Technology: MEC Removal Action

Element: Vegetation Removal

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
17010401	Chipping brush, light brush	1.00	ACR	0.00	1,391.69	537.06	0.00	$1,928.75	☐	☑
33010202	Per Diem (per person)	1.00	DAY	0.00	0.00	0.00	123.00	$123.00	☑	☐
33040935	UXO Technician III (UXO Supervisor)	10.00	HR	0.00	61.74	0.00	0.00	$617.44	☐	☑

Total Element Cost **$2,669.19**

Element: UXO Mapping

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010202	Per Diem (per person)	13.00	DAY	0.00	0.00	0.00	123.00	$1,599.00	☑	☐
33021530	Differential GPS Unit Rental	2.00	MO	95.35	0.00	0.00	0.00	$190.70	☐	☑
33040210	Geonics EM-61 Metal Locator, Towed (Weekly Rental)	1.00	WK	0.00	0.00	0.00	602.73	$602.73	☐	☑
33040223	Ordnance Locator, Schoenstedt, Model GA-72CD, weekly rental	7.00	WK	0.00	0.00	0.00	146.10	$1,022.68	☐	☑
33040230	Geonics EM-61 Metal Locator, Hand Held (Weekly Rental)	1.00	WK	0.00	0.00	0.00	485.20	$485.20	☐	☑
33040651	4 X 4 Truck- Rental/Lease	6.00	DAY	0.00	0.00	110.31	0.00	$661.89	☐	☑
33040653	All Terrain Vehicle (ATV) - Rental/Lease	1.00	DAY	299.18	0.00	0.00	0.00	$299.18	☐	☑
33040934	UXO Technician II	60.00	HR	0.00	51.46	0.00	0.00	$3,087.59	☐	☑
33040935	UXO Technician III (UXO Supervisor)	20.00	HR	0.00	61.74	0.00	0.00	$1,234.88	☐	☑

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Phase Technology Cost Detail Report (with Markups)

Element: UXO Mapping

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33040936	Geophysicist (UXO)	20.00	HR	0.00	77.71	0.00	0.00	$1,554.14	☐	☑
33041101	Airfare	10.00	LS	750.00	0.00	0.00	0.00	$7,500.00	☑	☐
33240101	Other Direct Costs	1.00	LS	1,045.27	0.00	0.00	0.00	$1,045.27	☑	☑
					Total Element Cost			**$19,283.26**		

Element: UXO Removal

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010202	Per Diem (per person)	23.00	DAY	0.00	0.00	0.00	123.00	$2,829.00	☑	☐
33040223	Ordnance Locator, Schoenstedt, Model GA-72CD, weekly rental	4.00	WK	0.00	0.00	0.00	146.10	$584.39	☐	☑
33040646	Backhoe - Rental/Lease	4.00	DAY	0.00	0.00	332.41	0.00	$1,329.63	☐	☑
33040651	4 X 4 Truck- Rental/Lease	7.00	DAY	0.00	0.00	110.31	0.00	$772.20	☐	☑
33040934	UXO Technician II	120.00	HR	0.00	51.46	0.00	0.00	$6,175.18	☐	☑
33040935	UXO Technician III (UXO Supervisor)	20.00	HR	0.00	61.74	0.00	0.00	$1,234.88	☐	☑
33041001	16oz Standard TNT Booster	4.00	EA	0.56	0.00	0.00	0.00	$2.23	☐	☑
33041002	50 gr/ft Det -Cord (1000 ft roll)	1.00	EA	794.36	0.00	0.00	0.00	$794.36	☐	☑
33041004	12 ft Lead Primadet Non-Electric Detonators	2.00	EA	9.53	0.00	0.00	0.00	$19.06	☐	☑
33240101	Other Direct Costs	1.00	LS	552.90	0.00	0.00	0.00	$552.90	☑	☑
					Total Element Cost			**$14,293.83**		

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Phase Technology Cost Detail Report (with Markups)

Element: Site Management

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010202	Per Diem (per person)	28.00	DAY	0.00	0.00	0.00	123.00	$3,444.00	☑	☐
33040651	4 X 4 Truck- Rental/Lease	28.00	DAY	0.00	0.00	110.31	0.00	$3,088.81	☐	☑
33040921	Senior UXO Supervisor (SUXOS)	40.00	HR	0.00	77.16	0.00	0.00	$3,086.42	☐	☑
33040923	UXO Project Manager	40.00	HR	0.00	100.91	0.00	0.00	$4,036.39	☐	☑
33040930	UXO QC Specialist	40.00	HR	0.00	71.05	0.00	0.00	$2,842.10	☐	☑
33040931	UXO Safety Officer	40.00	HR	0.00	70.21	0.00	0.00	$2,808.53	☐	☑
33041101	Airfare	4.00	LS	750.00	0.00	0.00	0.00	$3,000.00	☑	☐
				Total Element Cost				**$22,306.24**		

Element: Stakeholder Involvement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33040923	UXO Project Manager	12.00	HR	0.00	100.91	0.00	0.00	$1,210.92	☐	☑
33040935	UXO Technician III (UXO Supervisor)	12.00	HR	0.00	61.74	0.00	0.00	$740.93	☐	☑
33041302	Site Specific Workplan (Moderate Complexity)	1.00	EA	155.60	22,597.37	0.00	0.00	$22,752.96	☐	☑
33041305	Explosive Safety Submission (Moderate Complexity)	1.00	EA	311.19	10,491.28	0.00	0.00	$10,802.48	☐	☑
33041314	UXO Removal Report (Moderate Complexity)	1.00	EA	311.19	27,668.51	0.00	0.00	$27,979.70	☐	☑
				Total Element Cost				**$63,486.99**		
				Total 1st Year Technology Cost				**$122,039.51**		

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Phase Technology Cost Detail Report
(with Markups)

Total Phase Cost	**$122,039.51**

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FINAL

REMEDIAL INVESTIGATION WORK PLAN

RR869a DEBRIS FIELD MRS

HOLLOMAN AIR FORCE BASE
NEW MEXICO

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for:

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Ave., Suite 163
Joint Base San Antonio Lackland AFB, Texas 78236-9853

October 2014

Prepared by:

FPM Remediations, Inc.

584 Phoenix Drive
Rome, NY 13441

URS **Group, Inc.**
7720 N 16th Street, Suite 100
Phoenix, AZ 85020-4493

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RR869a Debris Field MRS

Remedial Investigation

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Site:

RR869a Debris Field
Holloman Air Force Base
New Mexico

Author: _____
Peter Corigliano

Title: Site Lead
Date: _____

Submitted to:
Mr. Chuck Hendrickson
USEPA, Region 6 (6PD-F)
1445 Ross Ave, Suite 1200
Dallas, TX 75202-2733

Reviewer: _____
Maureen Whalen CG, CPG, PMP

Title: Project Manager
Date: _____

Prepared for:

Air Force Civil Engineer Center (AFCEC)
2261 Hughes Ave., Suite 163
Joint Base San Antonio Lackland AFB,
Texas 78236-9853

Reviewer: _____
DeAnna Rothhaupt

Title: Holloman AFB Environmental Chief
Date: _____

Prepared by:

FPM Remediations, Inc.
584 Phoenix Drive, Rome, NY 13441

October 2014

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LIST OF ABBREVIATIONS AND ACRONYMS

%	percent
°F	Degrees Fahrenheit
AAAF	Alamogordo Army Air Field
AF	Air Force
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFI	Air Force Instruction
AFJI	Air Force Joint Instruction
AFMAN	Air Force Manual
AR	Army Regulation
ASCII	American Standard Code for Information Interchange
BIP	Blow-In-Place
bgs	belowground surface
BSP	Blind Seeding Program
CFR	Code of Federal Regulations
CHE	Chemical Hazard Evaluation
cm	centimeter
COPC	Contaminant of Potential Concern
COR	Contracting Officer's Representative
CSA	Courtesy Storage Agreement
CSE	Comprehensive Site Evaluation
CSM	Conceptual Site Model
DA	Department of the Army
DoD, DD	Department of Defense
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DID	Data Item Description
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DMM	Discarded Military Munitions
DQCR	Daily QC Report
DQO	Data Quality Objective
EcoSSL	Ecological Soil Screening Level
EHE	Explosives Hazard Evaluation
EM	Engineering Manual
EM61	EM61-MK2
EMI	Electromagnetic Induction
EOD	Explosive Ordnance Disposal
EPP	Environmental Protection Plan
ERA	Ecological Risk Assessment
ESQD	Explosives Safety Quantity Distance
ESRI	Environmental Sciences Research Institute
ESS	Explosive Safety Submission
EZ	Exclusion Zone
FCR	Field Change Request

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

FPM	FPM Remediations, Inc.
ft	feet
GIP	Geophysical Investigation Plan
GIS	Geographical Information System
GLONASS	Global Navigation Satellite System
GPO	Geophysical Prove-Out
GSV	Geophysical System Verification
G-858	Geometrics Cesium Vapor Magnetometer G-858
HA	Hazard Assessment
HDR	HDR Environmental, Operations and Construction, Inc.
HFD	Hazardous Fragmentation Distance
HHE	Human Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System
HASP	Health and Safety Plan
HSTT	High Speed Test Track
Hz	Hertz
IAW	in accordance with
ID	Identification
IDW	Investigative-Derived Waste
in	inches
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
ISO	Industry Standard Object
IVS	Instrument Verification Strip
kg	kilogram
kHz	kilo Hertz
LANL	Los Alamos National Laboratory
m	meter
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
MEC HA	Munitions and Explosives of Concern Hazard Assessment
MGFD	Munition with the Greatest Fragmentation Distance
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MSA	Munitions Storage Area
MSD	Minimum Separation Distance
ms	milliseconds

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

NAD83	North American Datum 1983
NFA	No Further Action
NEW	Net Explosive Weight
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NRHP	National Register of Historic Places
nT	nanoTesla
NTCRA	Non-Time-Critical Removal Action
OE	Ordnance and Explosives
OSHA	Occupational Safety and Health Administration
PBR	Performance-Based Remediation
PC	Personal Computer
PDA	Personal Digital Assistant
PDT	Project Delivery Team
PM	Project Manager
PMP	Project Management Plan
POC	Points of Contact
PPE	Personal Protective Equipment
ppm	parts per million
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
Q-D	Quality Distance
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RPM	Remedial Project Manager
RRD	Range Related Debris
RSL	Regional Screening Levels
RTK-GPS	Real-Time Kinematic Global Positioning System
SARA	Superfund Amendments and Reauthorization Act
Schonstedt	Schonstedt GA-52Cx
SDA	Safe Disposal Area
Shaw	Shaw Environmental, Inc.
SKY	Sky Research, Inc.
SLERA	Screening-Level Ecological Risk Assessment
SNR	Signal to Noise Ratio
SOO	Statement of Objectives
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SUXOS	Senior UXO Supervisor
TDS	Total Dissolved Solids
TNT	trinitrotoluene
TP	Technical Paper
TSD	Team Separation Distance
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

URS	URS Group, Inc.
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USAESCH	U.S. Army Engineering Support Center, Huntsville
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
UXO I	UXO Technician I
UXO II	UXO Technician II
UXO III	UXO Technician III
UXOQCS	UXO QC Specialist
UXOSO	UXO Safety Officer
VSP	Visual Sample Plan
WP	Work Plan
WSMR	White Sands Missile Range
WWII	World War II

1.0 INTRODUCTION

This Remedial Investigation (RI) Work Plan (WP) describes the work elements, technical approach, and safety guidance to conduct an RI at one Military Munitions Response Program (MMRP) Munitions Response Site (MRS) at Holloman Air Force Base (AFB) located in south-central New Mexico in Otero County. The MRS requiring the RI is the Debris Field (RR869a).

1.1 Project Authorization

The investigation is being performed in support of the United States Air Force (USAF) MMRP at Holloman AFB. The MMRP was created by Congress in 2001 under the Defense Environmental Restoration Program (DERP) as established by Section 211 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and is codified in Sections 2701-2710 of Title 10 of the United States Code (U.S.C.). The Department of Defense (DoD) has established the MMRP under the DERP to address DoD sites with Unexploded Ordnance (UXO), Discarded Military Munitions (DMM), and Munitions Constituents (MC) located on current and former military installations.

The USAF is the lead agency for this RI. Participation of and cooperation with federal, state, and local authorities and the local public will be solicited for the duration of this activity and for all environmental restoration activities at Holloman AFB. Participation of these entities is required for the environmental restoration process and aids in ensuring the protection of human health and the environment. Federal, state, and local authorities will have input into the actions implemented at Holloman AFB through planning meetings, plan review, and the public comment process. Concerns of the federal, state, and local authorities will be solicited and provisions of federal, state, and local regulations will be given full consideration for all actions taken at Holloman AFB.

This RI WP is being completed by the FPM Remediations, Inc. (FPM) Team, under FPM's Air Force Civil Engineering Center (AFCEC) Contract FA8903-13-C-0008, to support the USAF MMRP. The Statement of Objectives (SOO) for the Performance-Based Remediation (PBR) at Holloman AFB is included in **Appendix A**.

1.2 Project Purpose and Scope

The purpose of this RI is to provide site data of sufficient quantity and quality to close existing data gaps at the RR869a Debris Field MRS. Geophysical investigation was not performed at the site, and therefore, there is no information regarding the distribution of subsurface anomaly density. Intrusive investigation is not planned for the RI field activities, since FPM intends to remove all detected subsurface anomalies above the established threshold based on site-specific data from the MRS during a follow-on Non-Time-Critical Removal Action (NTCRA). However, if the RI Digital Geophysical Mapping (DGM) results indicate that 100 percent (%) removal of subsurface anomalies during NTCRA is not a feasible option (more than 1000 DGM anomalies), intrusive investigation will be performed during this RI to characterize the nature and extent of Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH) and MC within the MRS in order to focus follow-on NTCRA on MEC and/or MC delineated areas.

Specific project tasks will include: (1) Site visits; (2) Preparation of technical planning documents including an Explosives Safety Submission (ESS) and RI WP; (3) RI field activities

including surface clearance, DGM, intrusive investigations (if required) and MC sampling, and (4) preparation of deliverables such as RI Report.

1.3 Summary of Technical Approach

A summary of the technical approach is presented below. The detailed technical approach is presented in Field Investigation Plan (**Section 3**).

(1) Surface Clearance and brush clearing (if required) – 100% surface clearance will be performed across the MRS. The purpose of the surface clearance is to remove surface hazards (MEC or MPPEH) and eliminate sources of DGM signal interference.

(2) Grid-Based DGM – 100% DGM coverage will be conducted utilizing:

- Geometrics Cesium Vapor Marine Magnetometer G-858 (G-858) at RR869a. The magnetic system will be comprised of two (2) or more G-858 sensors separated horizontally 0.6 meters (m) in order to increase the productivity of data collection. The detection capabilities of magnetometers are not anticipated to be impacted by site geology. However, if the capabilities of the magnetometers are impacted by site conditions, Electromagnetic Induction (EMI) sensor EM61-MK2 (EM61) will be used for DGM data collection."

(3) Geophysical data analysis and preparation of an anomaly table.

(4) If deemed feasible, all anomalies from the anomaly table will be excavated during the follow-on NTCRA (intrusive activities are not planned for this RI). However, if 100% removal of subsurface anomalies is not a reasonable option for NTCRA (more than 1000 DGM anomalies), one of the following approaches will be implemented during this RI:

- Anomalies will be ranked using the advanced technology (MetalMapper), and all targets not classified as high confidence non-targets of interest will be excavated during NTCRA.
- Visual Sample Plan (VSP) statistical module will be used to provide 95% confidence of MEC/MPPEH potential at the site. This approach includes intrusive investigation of randomly selected anomalies during this RI.

1.4 Work Plan Organization

This RI WP has been organized as follows:

Section 1: Introduction - describes the project authorization, project purpose and scope, site location, setting, and current and future land uses.

Section 2: Technical Management Plan - identifies the project objectives, organization schedule and deliverables, reporting and public relations support, and identifies key project personnel and their roles.

Section 3: Field Investigation Plan - describes the methodology and procedures to be followed for the field investigation.

Section 4: Quality Control Plan (QCP) - describes the standard processes that will be used to monitor, inspect, and control daily activities to ensure quality performance, processes to correct quality issues, Quality Control (QC) to contract deliverables, and QC reporting requirements.

Section 5: Explosives Management Plan - provides the details for management of explosives-related operations conducted at the MRS.

Section 6: Environmental Protection Plan (EPP) - provides the approach, methods, and operational procedures to be employed to protect the natural environment during field activities.

Section 7: References - provides a list of references used to develop this RI/FS WP.

Appendix A: The Statement of Objectives - provides a copy of the SOO for the PBR at Holloman AFB.

Appendix B: Health and Safety Plan (HASP) – outlines the level of personal protection and safe operating guidelines.

Appendix C: Points of Contact - identifies Points of Contact (POC) for the RI.

Appendix D: Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) - includes Standard Operating Procedures (SOPs) that will be used during RI field activities for MC sampling and a MC Sampling and Analysis Plan prepared in accordance with (IAW) the UFP-QAPP.

Appendix E: Contractor Forms - provides copies of the field forms that will be used during the RI field activities.

Appendix F: ESS - provides safety criteria for planning and siting explosives operations.

Appendix G: Contractor Personnel Qualification Certification Letter – certifies that key UXO personnel meet training and experience requirements.

Appendix H: Project Schedule - provides detailed project schedule.

1.5 Site Location

Holloman AFB is located in south-central New Mexico, 7 miles west of the city of Alamogordo in Otero County (**Figure 1-1**). It is adjacent to the White Sands Missile Range (WSMR). A portion of the Base to the south is bordered by Route 70, which also runs roughly north-south and parallel to the eastern boundary of the Base. Holloman AFB occupies approximately 50,763 acres of land. It is contiguous to the much larger (2.2 million acre) WSMR, and located in the eastern portion of the WSMR. The southern portion of Holloman AFB contains the flight line, composed of a series of runways running north-south, east-west, and northeast southwest. The Main Base is located at the southeast corner of the installation, where Route 70 borders the site. The Main Base contains housing and administrative buildings. The West Area and the North Area refer to the improved areas around the original airfield (southeastern triangle formed by the runways). High Speed Test Track (HSTT) runs north-south and is located northwest of the airfield. The track is the world's longest of its kind at 9.5 miles and has been used for an array of missile testing for decades and is still in use today. Access to Holloman AFB requires admittance through the security gate and there is a fence around the installation.

1.5.1 Installation Mission and History

Holloman AFB began nine months after the U.S. entered World War II (WWII), and was an integral facility in the early stages of the U.S. space program throughout the Cold War. On 6 February 1942, construction began on an extensive bombing and gunnery range later known as the Alamogordo Bombing and Gunnery Range. On 10 August 1942, the Alamogordo Army Air

Field (AAAF) was officially established. Because the facility was initially intended to be used by Great Britain as part of their WWII British Training Program for bomber crews, the Base was designed after Royal Air Force bases. The first atomic bomb was detonated at the Trinity Site in the northwest corner of the Alamogordo Bombing and Gunnery Range (now the WSMR) on 16 July 1945. In 1946, as more lands became available within the Tularosa Basin, the AAAF was reassigned to be a missile development facility. With the creation of the USAF as a separate service, the facility came under the direction of the Air Materiel Command, which decided that the facility would be used to conduct guided missile programs. On 13 January 1948, the Base was renamed Holloman AFB, after Col. George V. Holloman, an early pioneer in guided missile development.

To support the Holloman mission of developing guided missiles, the Army Ordnance Corps built White Sands Proving Grounds at about this time. The combination of the White Sands Proving Grounds and Alamogordo Bombing Range was 100 miles long and 40 miles wide. On 1 September 1952, the two ranges were combined to form the Integrated White Sands Range. From 1952 to 1970, missile development and testing at White Sands included the Snark Matador, Mace, Falcon, Aerobee, JB-2 Loon, and Firebee missiles. High speed sled tests, high altitude balloon projects, and Aeromedical Field Laboratory experiments were also conducted. Testing activities included the Central Inertial Guidance Test Facility and the Radar Target Scatter Test Facility.

In 1972, the Base was taken over by Tactical Air Command and became primarily a fighter base with some continued developmental testing. On 15 November 1991, command responsibility was transferred from the 833rd Air Division to the 49th Wing. Today, the 49th Wing provides leadership to the installation. Two projects begun during the Cold War era continue on the Base: the HSTT and the Primate Research Lab (both considered tenant organizations)

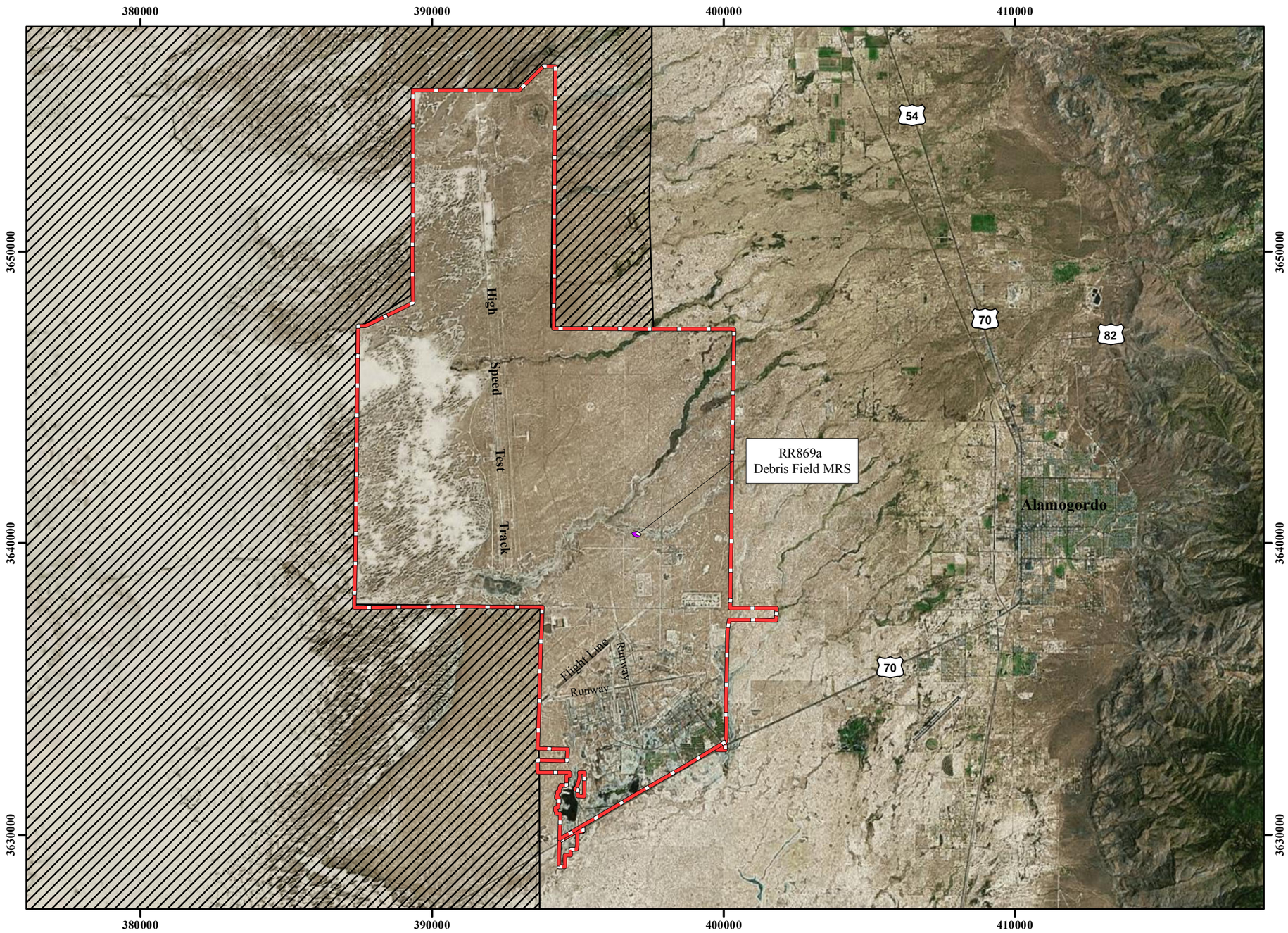
1.5.2 RR869a Debris Field MRS Site Description

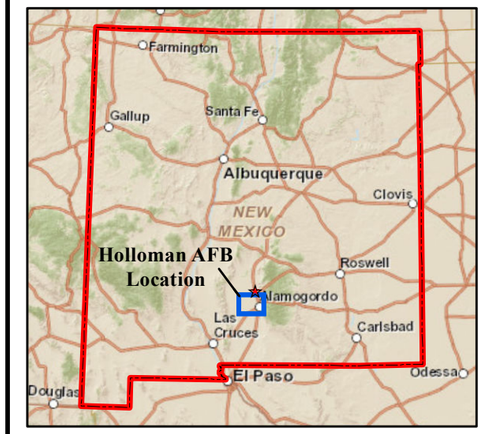
The RR869a Debris Field MRS is a 3.5-acre site located in the south-central portion of the Base north of Munitions Storage Buildings 1197 and 1198 (**Figure 1-1**). The site is located south of Ritas Draw. Initially the site was identified as 3.6-acre Munitions Response Area (MRA) 869; however, due to overlapping boundaries with Installation Restoration Program (IRP) Site OT-04 the Comprehensive Site Evaluation (CSE) Phase II investigation (HDR Environmental, Operations and Construction, Inc. [HDR], 2013) recommended splitting the MRA 869 into two MRSs. The Debris Field (RR869) MRS (0.1 acres) is comprised of the overlapping portion with IRP Site OT-04, which was investigated under the IRP and is therefore ineligible under the MMRP and the Debris Field (RR869a) MRS, consisting of the remaining 3.5 acres and will be the only MRS addressed during this RI.

Exact historical munitions use at the MRA 869 are unknown, however during previous investigations, debris consistent with a possible missile/drone crash were observed along with 5-inch rocket motor fragments, small arms projectiles, small amounts of clay target debris, possible 2.75-inch rocket launcher debris, one expended hand grenade fuze, and squibs, one of which was complete and treated as MEC.

Based on previous investigation results the following may be found at the site:

- 2.75-inch rocket,
- 5-inch rocket,





Legend

White Sands Missile Range

Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 1-1

Holloman Air Force Base Location

NOTES:
Revision Date: 8/13/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 12,000 feet

0 1,850 3,700 Meters

0 6,000 12,000 Feet

N W E S

FPM Remediations, Inc.

2014

Path: C:\Projects\New Mexico\GIS\RR869\Figure 1-1 Site_RR869A.mxd

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- Hand grenades,
- Electric squibs, and
- Small arms ammunition: 12, 16, and 20 gauge shot shells, 5.56mm, 7.62mm, and .50 caliber.

1.5.3 Climate

Holloman AFB is located in a semi-arid region within the northern portion of the Chihuahuan Desert. Its climate resembles other semi-arid regions with warm to hot summer days, cool nights, and mild winters. Monthly mean high temperatures range from 55 degrees Fahrenheit (°F) in January to 93.6°F in August. Monthly mean low temperatures range from 29°F in January to 66°F in July. Evapotranspiration is usually high due to dry air, large daily solar radiation totals, seasonally high winds, and warm temperatures. Seasonal fluctuation in precipitation rates is a result of prevailing wind directions, which can bring in frontal storms from the north or the Pacific or Caribbean cyclonic systems. Holloman AFB averages 13.20 inches (in) of annual rainfall. Nearly half of this amount falls within the months of July through September, known as the summer monsoons. Monsoon thunderstorms are generally short in duration and high in intensity. Occurrences are highly variable from year to year and one or two short-term events may contain a large percentage of the net annual precipitation.

1.5.4 Topography

Holloman AFB lies within the Tularosa basin of south-central New Mexico. This area is part of the Mexican Highland section of the Basin and Range physiographic province and is characterized by fault block mountains interspersed with low desert plains and basins. The Base lies on relatively flat alluvial plains below the Sacramento Mountains. These plains are bordered to the west by the White Sands dune field. Elevations range from 4,000 to 4,250 feet (ft) above mean sea level (Sky Research, Inc. [SKY], 2011).

The topography of the RR869a Debris Field MRS consists of heavily sloping terrain with gorges and gullies.

1.5.5 Soils

The soils on Holloman AFB are basin fill deposits formed primarily from alluvial and eolian processes. All soils have a high gypsum and salt content, primarily due to the eastern migration of gypsum sands from WSMR and White Sands National Monument. Alluvial floodplains on the eastern and southern portions of the Base are basin fill deposits from the western slope of the Sacramento Mountains. Subsoils, or undersoils, are formed from sediments of Lake Otero, a Pleistocene lake formed during a climatic cycle of increased moisture. During periods of low precipitation, this large lake, reaching a depth of several hundred feet, would contract and leave salt and gypsum evaporates. Holloman AFB has three primary soil types: several associations and complexes of Holloman, Gypsum Land, and Yesum soils, located in the flats; Dune Land, found in the White Sands dunes; and Mead silty clay loam soil, found in the alluvial floodplains (including most jurisdictional wetlands). None of the soil types are very productive, due to high gypsum and salt content, and all are highly subject to both wind and water erosion when the vegetation is sparse or the soil is exposed.

1.5.6 Geology

Holloman AFB is located in the Tularosa Basin, a downfaulted, closed, intermountain basin located in the southern portion of the Rio Grande Rift. The Tularosa Basin is a bolson, which is a basin with no surface drainage outlet, in which sediments are carried by surface water into the closed basin and deposited (Bhate, 2007). The Tularosa Basin is thought to have formed approximately 35 million years ago as a result of faulting, with the most recent formational activity having occurred as recently as 10,000 years ago. Basin fill of the Tularosa Basin is derived from the erosion of the uplifted material and fluvial deposits from the Rio Grande River. The Basin fill consists of unconsolidated coarse- to fine-grained alluvial fan deposits along the rims of the basin that are gradational toward the basin into finer-grained alluvial, fluvial, and lacustrine deposits. Evaporite materials, such as selenite, are present. Prominent local physiographic features include the Sacramento Mountains to the east, San Andres Mountains, and White Sands National Monument to the west (49th FW, 2009). The Tularosa Basin was formed as a structural trough during the Middle to Late Cenozoic era. Alluvial fill deposition includes sand, gravel, and clay in alluvial fans along the basin margins and extensive lake, alluvial, and evaporate deposits within the interior basin.

1.5.7 Hydrogeology

Streams sustained by groundwater discharge within the basin include Salt Creek and Malpais Spring. It is estimated that the groundwater resources of the Tularosa Basin contain over 100 million-acre feet of brackish groundwater. A wide range of water chemistries including sodium chloride, carbonate, and sulfate-based brine waters exist in the basin and water with salinity from 1,000 parts per million (ppm) Total Dissolved Solids (TDS), approximate to fresh water, to over 20,000 ppm TDS, approximate to sea water, can be found within the basin. The predominance of groundwater occurs as an unconfined aquifer in the unconsolidated deposits of the central basin. The primary source of groundwater recharge is percolation of rainwater and a minor contribution from stream run-off along the western edge of the Sacramento Mountains. Beneath Holloman AFB, groundwater ranges from 5 ft to 50 ft belowground surface (bgs). Groundwater flow is generally toward the southwest with localized influences from the variations in Base topography with shallower groundwater found on the southern end of the Base (SKY, 2011).

1.5.8 Hydrology

The only permanent water in the Tularosa Basin is found in small streams between Alamogordo and Three Rivers, New Mexico. There are no perennial streams within Holloman AFB or in the nearby surrounding landscape; however, a set of perennial pools exist within the Base. They are the final one-third of the Lost River, a set of pools near the confluence of Ritas and Malone Draws, and the Salt Lakes just south of the Lost River and Camera Pad Road Pond. The Rio Grande, located west of the San Andres Mountains, and the Pecos River, east of the Sacramento Mountains, are the closest perennial rivers in the region. There are at least nine prominent east-west drainages that receive intermittent flows during seasonal thunderstorms. The largest of these drainages is the Lost River drainage system, including alone Draw, Carter Draw, and Ritas Draw. According to the Integrated Natural Resources Management Plan (INRMP), approximately 650 ft. on either side of the middle of the Ritas Draw is a wetland buffer zone. Prior to extensive management of the surface topography and construction of U. S. Highway 70/82, Dillard Draw emptied into the Main Base, creating a network of flats and playas including

what are now Lake Holloman, Stinky Playa, and Pond G. Construction activities have disrupted the natural flow of this wetland ecosystem (SKY, 2011).

A portion of the MRS boundary comingles with the wetland buffer zone associated with Ritas Draw.

1.5.9 Vegetation

The vegetation of Holloman AFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca also occur. Sensitive species that currently receive no federal protection include lichen (A. clauzadeana), proposed for rare and endangered listing and the grama grass cactus, included due to its former candidate status (SKY, 2011).

Vegetation in the vicinity of the RR869a Debris Field MRS is consistent with desert scrubland.

1.5.10 Ecological Profile

No federally listed species covered under the Endangered Species Act currently reside at Holloman AFB. Several federally listed species, however, have been observed at the Base in the past. Mountain plover (proposed federally threatened) nested at Lake Holloman during the 1980s. Brown pelicans (recently delisted) are occasionally observed at Lake Holloman and the constructed wetlands. Peregrine falcons (recently delisted) regularly forage at Lake Holloman. Five other sensitive species currently receive no federal protection: a lichen (*A. clauzadeana*), proposed for rare and endangered listing; the grama grass cactus, included due to its former candidate status; the White Sands pupfish, a state-endangered species; the western burrowing owl, a species of concern; and the western snowy plover, also a species of concern.

The White Sands Desert Pupfish is a federal species of concern and a threatened species in the state of New Mexico (New Mexico Department of Game and Fish [NMDGF], 2012). According to the INRMP, potential White Sands Pupfish (*Cyprinodon tularosa*) habitat exists in a portion of the RR869a Debris Field MRS. The MRS is slightly within the wetland buffer zone, and as such appropriate measures will be taken to ensure that there are no negative impacts to the species and habitat. Management of this species falls under the jurisdiction of the New Mexico Department of Game and Fish. Potential habitat on Holloman AFB includes all stream channels of the Lost River, White Sands Missile Range, and a corridor 660 ft wide extending 330 ft from either side of the center of the stream channel (HDR, 2013). White Sands Pupfish habitat also includes any other areas where they are found or transplanted by mutual agreement of all signatories as well as a 330 ft buffer around the said habitat as demonstrated in the previous delineations, with the exception of the four isolated populations of trans-located fish formerly located in experimental ponds near Lake Holloman on Holloman AFB and any future exceptions under mutual agreement. No other threatened or endangered species habitat exists within the RR869a Debris Field MRS boundary.

1.5.11 Building, Structures and Utilities Near/Within MRS

The RR869a Debris Field MRS is unused and characterized by open space with vegetation consistent with desert scrubland. A portion of the MRS boundary is shared with IRP Site OT-04; however, this site is fenced off from the MRS. There are 100 buildings located within a 2-mile radius of the RR869a Debris Field MRS. Operational mission support, recreational, and buildings that support the flight line are located to the south of the RR869a Debris Field MRS

within a 4-mile radius (HDR, 2013). No known utilities are known to exist on/near the location of the Debris Field.

1.6 Previous Investigations

Previous investigations performed at the Debris Field MRA 869 included:

- Modified CSE Phase I (Shaw Environmental, Inc. [Shaw], 2010), and
- CSE Phase II (HDR, 2013).

1.6.1 Modified CSE Phase I

Modified CSE Phase I was completed in 2010. Prior to the start of the CSE Phase I, no MRAs had been discovered at Holloman AFB and it was believed that there was a low probability of a significant number of MRAs being found at Holloman AFB. Therefore, the USAF has modified the CSE Phase I process by deferring some actions typically performed in a Phase I, to the CSE Phase II, if a Phase II is required. For this Modified CSE Phase I, it was determined that a Conceptual Site Model (CSM) and Munitions Response Site Prioritization Protocol (MRSPP) and Hazard Ranking System (HRS) scoring elements were not required. The activities performed during the CSE Phase I included identification and review of data repositories located both on and off the installation, interviews with Base personnel, and visual surveys.

Modified CSE Phase I Results

The Modified CSE Phase I was performed to characterize the site; evaluate actual or potential release(s) of hazardous substance(s), pollutant(s), or contaminant(s) to migration/exposure pathways (groundwater, soil, and air) from MRAs; and evaluate associated targets of concern (Shaw, 2010).

During the Modified CSE Phase I field survey activities, debris was observed along the southern slope of Ritas Draw, north of Munitions Storage Buildings 1197 and 1198. Upon further examination, debris consistent with a possible missile/drone crash was observed. Additional munitions debris (MD) observed at the site included fragments of 5-inch rocket motors (Shaw, 2010).

During the field investigation, no structural features were observed. The field team observed potential high explosive fragments and MD consistent with a missile or drone crash site.

Recommendations for the CSE Phase II included surface soil and subsurface soil sampling to assess if MC has been released to the environment at the Debris Field.

1.6.2 CSE Phase II

A CSE Phase II investigation was performed at MRA 869. The field activities included:

- Visual surveying to identify MEC or MEC-related items and/or features,

The sites were prioritized for further munitions response actions, based on relative risk, using the MRSPP scoring system. The MRS Priority is determined by selecting the highest rating from the Explosives Hazard Evaluation (EHE), Chemical Hazard Evaluation (CHE), and Human Health Hazard Evaluation (HHE) modules and ranges from 1 to 8. Priority 1 and 8 indicate the highest and the lowest potential hazards, respectively. Only a site with a chemical warfare hazard can receive an MRS Priority of 1.

CSE Phase II Results

The CSE Phase II field investigation occurred from October 2011 to March 2012.

During the field investigation visual survey transects were completed at the Debris Field MRA. Metal scrap was observed throughout the area. Small arms-related debris consisted of one .50 cal projectile and sparse clay target debris. The field team observed various items that were identified as rocket launcher and possible rocket debris including 2.75-inch launcher debris and possible 5-inch rocket debris among other unidentifiable items. These items were documented as MD. One expended hand grenade fuze was also observed. Expended electric squibs were observed, along with one squib with a single intact charge. Holloman Explosive Ordnance Disposal (EOD) was notified of the intact squib and collected the item for disposal. No other MEC items were discovered. No craters indicative of a target area were identified.

Sampling was not conducted during the CSE Phase II because no potential sources of MC were found during MRA surveys. Any risk at this MRA is expected to be similar to background conditions. The unfired squib round identified, are typically used to initiate an aircraft counter measure device and are considered a low explosive hazard. Squibs are not considered high explosive and the quantities of explosives in the items are not high enough in concentration to pose an explosives hazard; therefore sampling for explosives was not justified during this investigation. **Figure 1-2** shows the CSE Phase II Identified items and visual reconnaissance transects.

The results from the CSE Phase II were also used to modify the investigated MRA boundary resulting in two MRSs (as shown and previously discussed). The RR869 Debris Field MRS (0.1 acres) was investigated as part of OT-04 under the IRP and is therefore ineligible under the MMRP. The RR869a Debris Field MRS, consists of 3.5 acres and will be the only MRS addressed during this RI.

The RR869a Debris Field MRS obtained an MRSPP score of 5 and was recommended for further munitions response action. Due to RR869 Debris Field MRS being ineligible for the MMRP it was not scored using the MRSPP.

1.7 Conceptual Site Model

1.7.1 MEC Exposure Pathway Analysis

MEC Exposure Pathway Analysis for the RR869a Debris Field MRS is shown in **Figure 1-3**. Munitions-related activities that have occurred at both sites are the primary source of the potentially explosive MEC. Based on CSE Phase II results, potential for MEC at RR869a Debris Field MRS was found in the form of MD associated with 2.75-inch rockets, 5-inch rockets, squibs, and hand grenade fuzes, as well as unidentified MD.

The impacted medium considered for MEC exposure at RR869a Debris Field MRS is both surface and subsurface soil.

A variety of naturally occurring processes may alter the condition of the land at the site resulting in a potentially explosive subsurface item being exposed at the surface and becoming more accessible to contact with people or the environment. These processes may include frost heave, flooding and erosion. A variety of intrusive activities by people also may alter the condition of the land at the site in a manner that a subsurface MEC item may become exposed at the surface. These may include construction activities that involve excavation.

The RR869a Debris Field MRS is accessible by human receptors, including Base personnel, and contractors; and may be accessible to trespassers. Thus, exposure pathways are shown to be complete for all of these receptor categories for MEC on the soil surface (**Figure 1-3**). MEC exposure pathways are shown to be potentially complete for MEC in the subsurface for authorized Base personnel and contractor human scenario. Trespassers are typically unlikely to engage in soil disturbing activities.

Biota are generally not considered when evaluating MEC risk because, risk to biotic receptors is usually evaluated at the population level. Though an individual ecological receptor may experience a negative affect from encountering MEC, MEC does not pose risk to biotic populations unless a large area of habitat were to be destroyed, for example, by a large detonation. Since the CSE Phase II did not discover craters or MD items capable of damaging large areas of habitat, MEC exposure pathways to biota are shown as incomplete (**Figure 1-3**).

1.7.2 MC Exposure Pathway Analysis

MC Exposure Pathway Analysis for RR869a Debris Field MRS is shown in **Figure 1-4**.

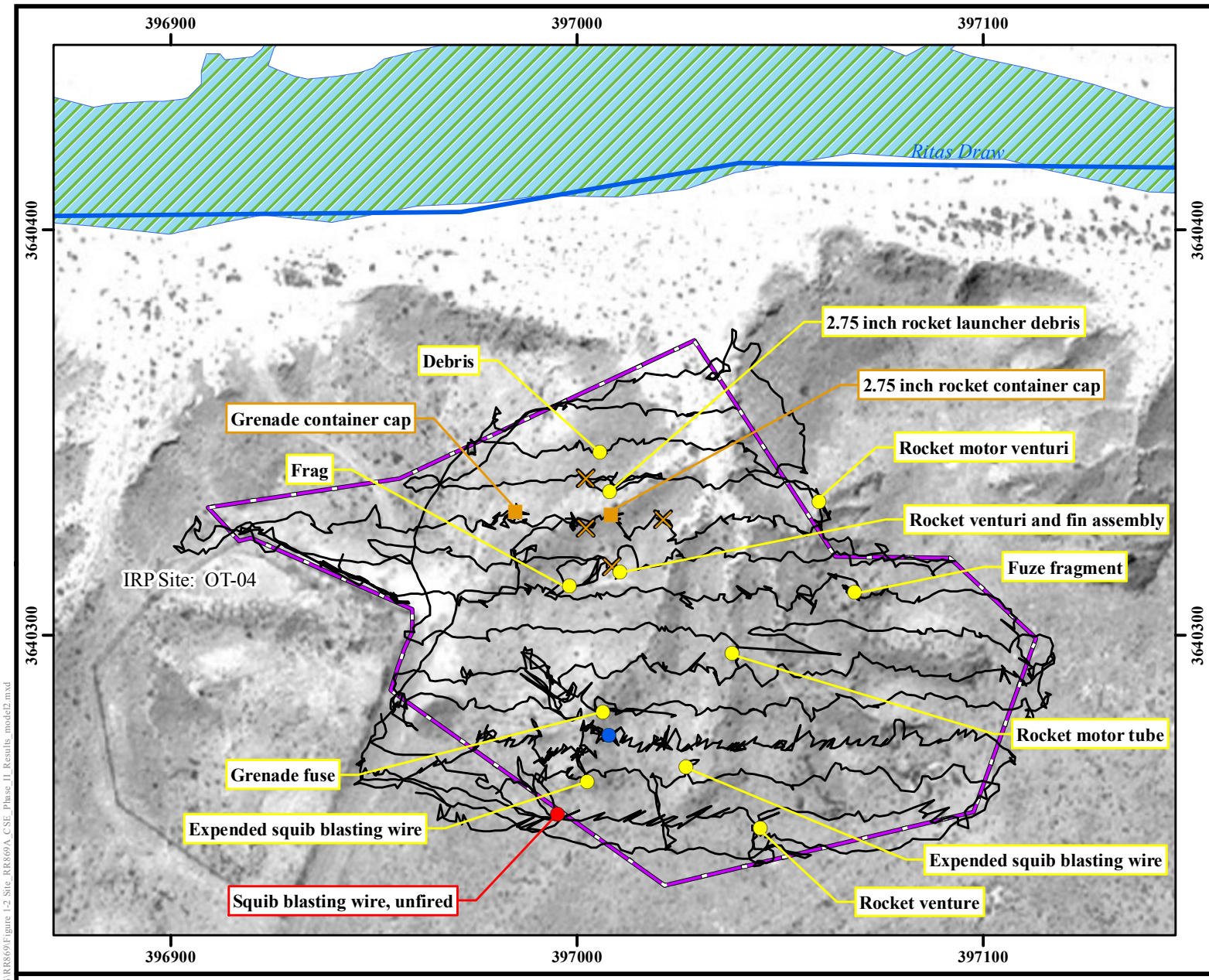
In general, migration pathways involve movement via air, water, soil, and the interfaces between these media. Based on the types of releases and the characteristics of MC /Contaminants of Potential Concern (COPCs), the fate and transport of contaminants at Holloman AFB is expected to occur mainly in the terrestrial environment, but there is potential for migration by aquatic and atmospheric pathways as well.

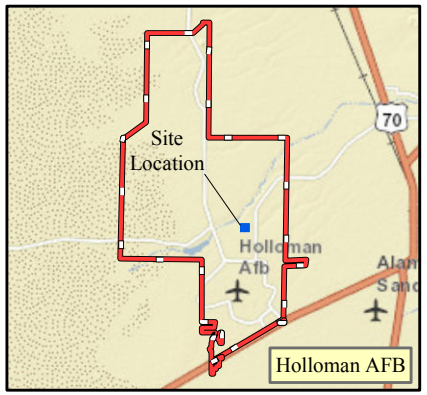
In the terrestrial environment, if the contaminant is released to soil, it may volatilize, adhere to the soil by sorption, leach into the groundwater with precipitation, or degrade due to chemical (abiotic) or biological (biotic) processes. If the contaminant is volatilized from soil, it may be released to the atmosphere or migrate to groundwater. Constituents that are dissolved in groundwater may eventually be transported to a surface aquatic environment.

In the atmospheric environment, contaminants may exist as vapors or as suspended particulate matter. The transport of contaminants relies mostly on wind currents, and continues until the contaminants are returned to the earth by wet or dry deposition. Degradation of organic compounds in the atmosphere can occur due to direct photolysis, reaction with other chemicals, or reaction with photochemically generated hydroxyl radicals. Based upon the data collected during CSE Phase II activities, transport of MC/COPCs via the atmospheric environment is unlikely at Holloman AFB and therefore at the RR869a Debris Field MRS as well.

Human Receptors at the RR869a Debris Field MRS include authorized Base personnel, contractors, and possibly trespassers (current and future). The exposure pathways include direct (or incidental) ingestion of soil (surface and subsurface), dermal contact with soil, and inhalation of volatiles and fugitive dusts from contaminated soil. For RR869a, exposure pathways are shown to be potentially complete for all of the aforementioned human receptor categories for MC at surface (**Figure 1-4**). The exposure pathways are shown to be potentially complete for MC in the subsurface for all human scenarios except trespassers (current and future), which are unlikely to engage in soil disturbing activities.

Ecological receptors the MRS include terrestrial invertebrates, plants, and terrestrial birds, mammals, and reptiles. MC exposure pathways to biota are shown as potentially complete at both the surface and subsurface for MC.





Legend

- Munitions and Explosives Of Concern (MEC)
- Munitions Debris
- Clay Target Debris
- Small Arms Debris: Projectile
- Range-Related Debris
- Stream
- CSE Phase II Visual Survey Transects
- Wetlands
- RR869a
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 1-2

RR869a Debris Field MRS
CSE Phase II Findings

NOTES:
1. SR859 MRS boundary based on CSE Phase II findings.
2. HHSL - Human Health Screening Level
3. Revision Date: 8/13/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
False Easting: 500,000.0000
Central Meridian: -105.0000
Latitude Of Origin: 0.0000
Horizontal Datum: North American 1983
False Northing: 0.0000
Scale Factor: 0.9996
Units: Meter

1 inch = 120 feet
0 18 36 Meters
0 60 120 Feet

N W E S

FPM Remediations, Inc.

2014

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Figure 1-3
MEC Exposure Pathway Analysis

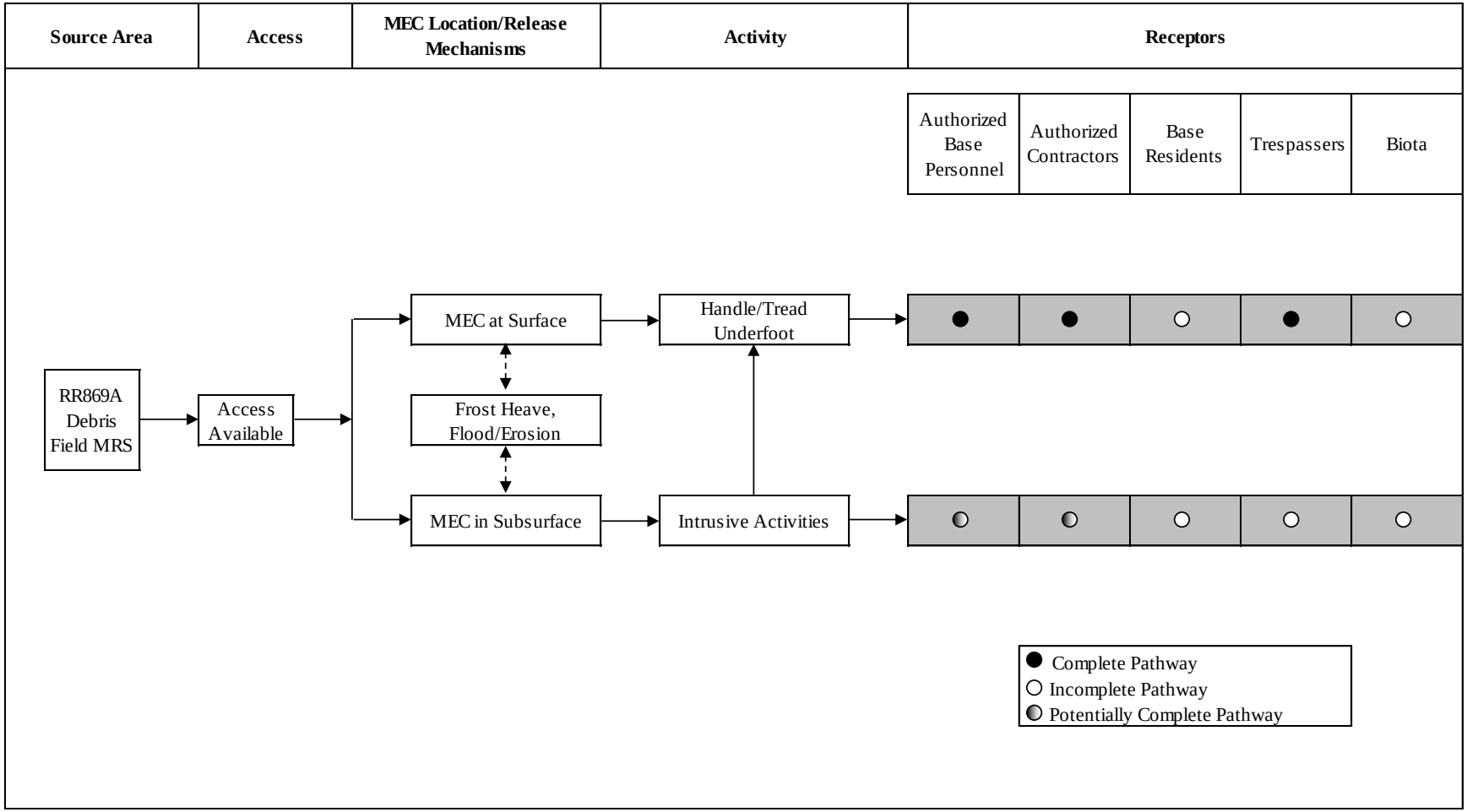

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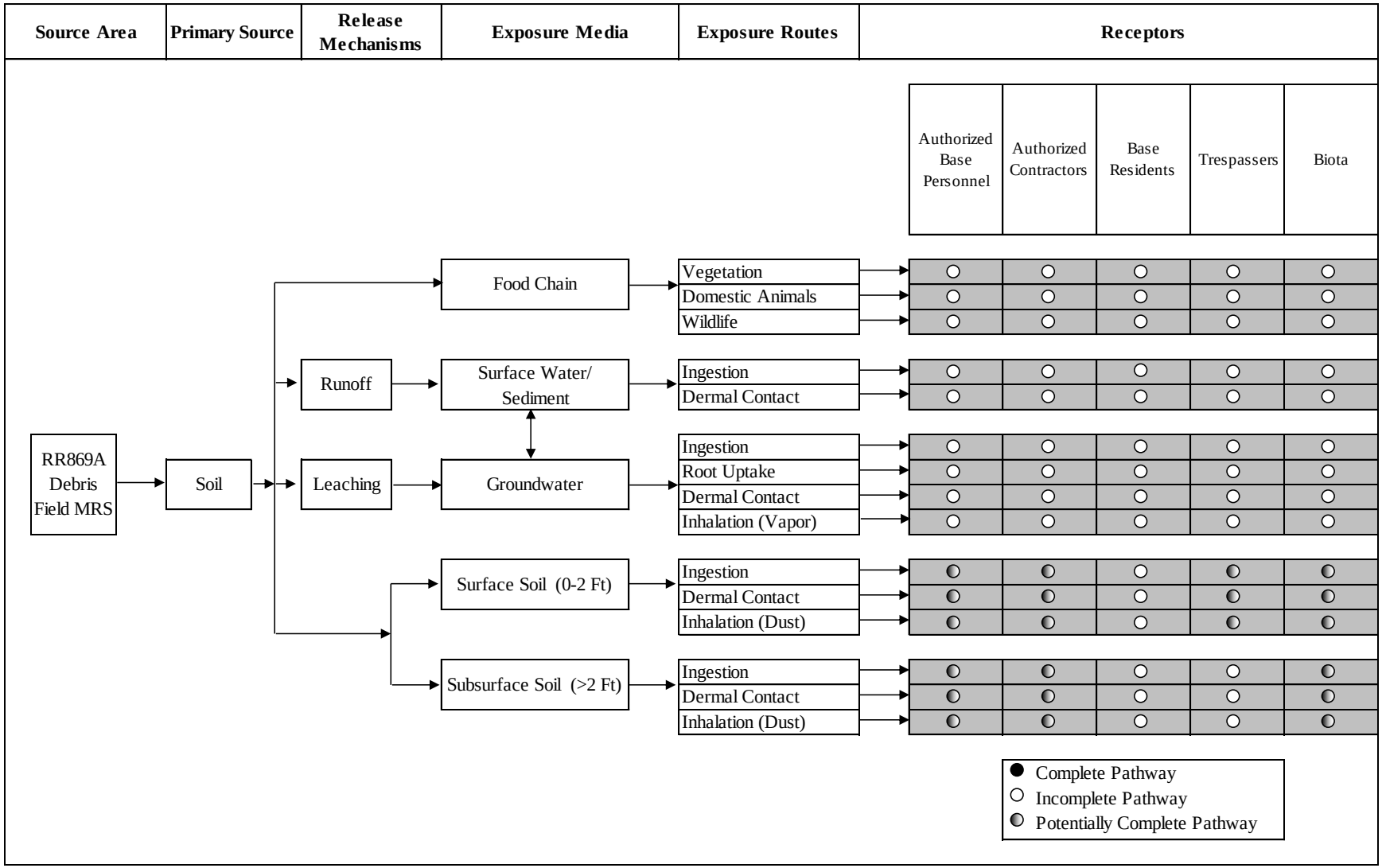
Figure 1-4
MC Exposure Pathway Analysis



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There is no present-day human exposure to groundwater at Holloman AFB. The aquifer below Holloman AFB is an unconfined sole source brackish aquifer, with an average depth to groundwater of 5 ft. to 50 ft. bgs. Groundwater flow beneath the installation generally occurs from the northeast to the southwest, and depths to groundwater tend to be shallowest toward the main installation. Depending on future land use, there is a possibility that groundwater supply wells could be put in place for domestic and/or industrial uses, though the high total dissolved solids in the aquifer indicates that the water would likely need pretreatment before it was considered potable. Therefore, exposure pathways are shown to be incomplete for MC in ground water for all receptors at the MRS.

1.8 Current and Future Land Uses

1.8.1 RR869a Debris Field MRS

The RR869a Debris Field MRS is currently unused open space and no known changes to the future land use have been indicated. The site is located north of gate IP-11, which is secured with a combination lock. There is no fencing or other controls associated with the site; however, access to Holloman AFB requires admittance through the security gate and there is a fence around the installation. Therefore, access to the MRS is restricted for the general public, but is open to Base personnel and contractors.

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2.0 TECHNICAL MANAGEMENT PLAN

For the RI process to be successful, close coordination and cooperation between the stakeholders, community regulators, and technical support personnel must occur. The following sections describe the technical management approach for the RI characterization activities. The Technical Management Plan details the organizational structure roles and functions of the project management approach methods and operational procedures that will be used during the RI.

2.1 Project Objectives

The objectives of the RI are to:

- Achieve 100% DGM coverage of the RR869a Debris Field MRS and identify the number of subsurface anomalies for the follow-on NTCRA.
- Evaluate feasibility of 100% removal of all subsurface anomalies during NTCRA. If deemed feasible (less than 1000 DGM anomalies), the RI Report will be completed. If not, anomalies will be either ranked using the MetalMapper or VSP statistical module will be used to provide 95% confidence of MEC/MPPEH potential on the sites.
- Achieve concurrence from regulators and stakeholders on the selected approach.

2.2 Project Organization

The RI for the RR869a MRS will be completed by FPM using subcontractors as needed. A project team organization chart, illustrating the relationships of key project personnel for the RI is provided in **Figure 2-1**. Close coordination will be maintained with the project delivery team (PDT) consisting of AFCEC, Holloman AFB, New Mexico Environment Department (NMED), and United State Environmental Protection Agency (USEPA) Region 6.

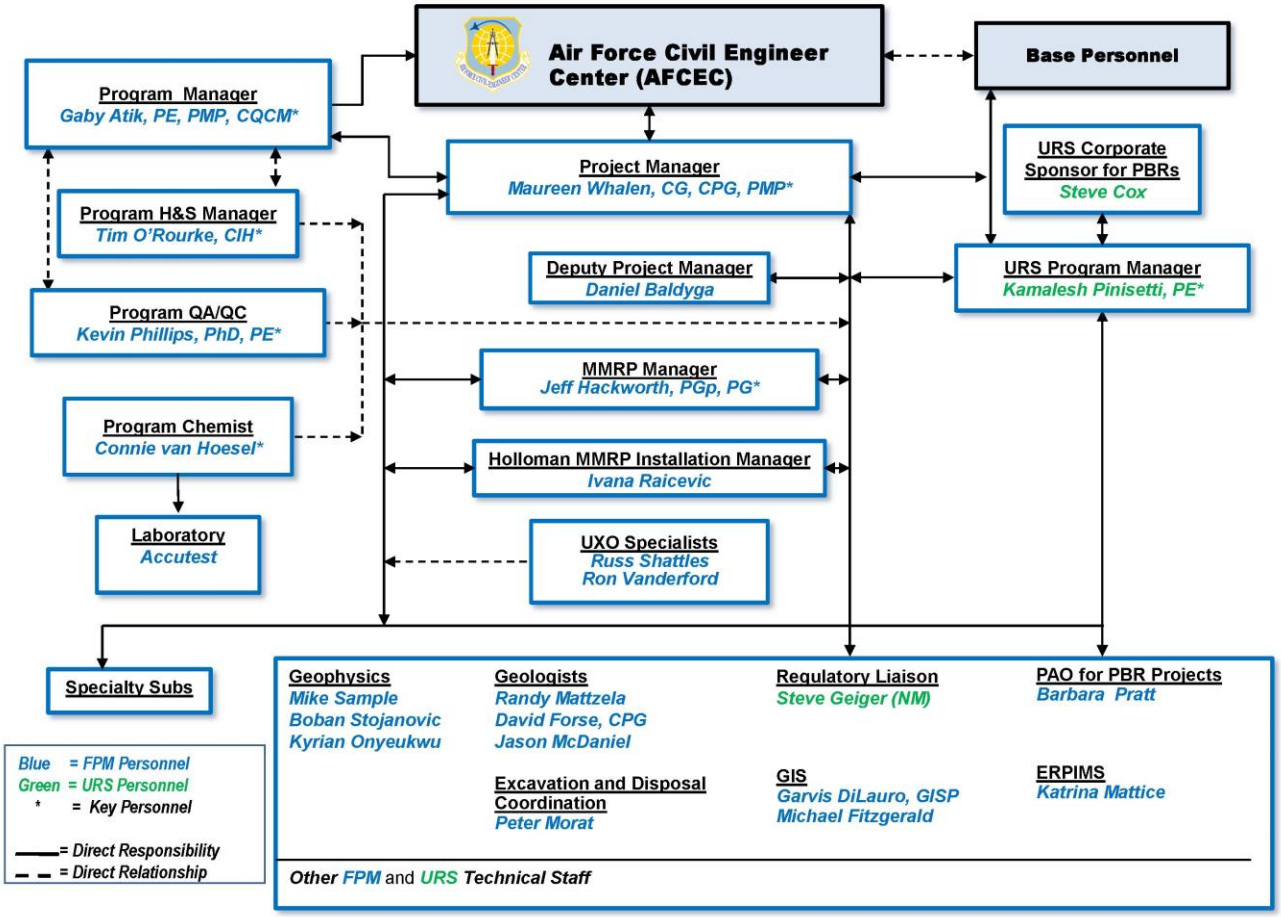
2.3 Contractor Personnel

The FPM project team will consist of personnel experienced in MEC/MPPEH and MC investigations. Key contractor project team members will include a Program Manager, Project Manager (PM), MMRP Manager, Munitions Response Safety and QC Managers and Program Chemist. Key field personnel and project staff will include a Senior UXO Supervisor (SUXOS), a dual-hat UXO Safety Officer (UXOSO)/UXOQC Specialist (UXOQCS), UXO technicians, Project Geophysicists/Scientists, MC sampling personnel, and chemists. Authorization documentation for UXO personnel will be available at the site for inspection or verification, as required. Data evaluation and reporting will require the efforts of chemists and human and ecological risk assessors. The roles and responsibilities of contractor project personnel are detailed below.

2.3.1 Project Manager

The FPM PM will be responsible for monitoring the overall progress of the project, reviewing monthly progress reports, and checking that necessary resources are available to the MMRP Manager. The PM will also maintain close communication with the AFCEC/Holloman AFB to assess their satisfaction during performance on this contract.

Figure 2-1 Project Organization Chart



2.3.2 MMRP Manager

The MMRP Manager will have authority to do the following:

- Assign key personnel and take corrective action for unacceptable performance,
- Reviewing and approving all project deliverables,
- Reporting to the PM on budget, technical, schedule, and quality issues,
- Approving labor charges, subcontractor invoices, and other direct cost expenditures,
- Coordinating daily work and ensuring technical quality of all activities,
- Supervising and overseeing all field activities, and
- Stop, amend, or curtail work for quality, health and safety, regulatory, or operational deficiencies.

2.3.3 MMRP Installation Manager

The MMRP Installation Manager is responsible for implementing the project such that technical, financial, and scheduling objectives are successfully completed and reports directly to the MMRP Manager. The MMRP Installation Manager has the authority to commit the resources necessary to meet project objectives and requirements. The MMRP Installation Manager will be responsible for the following:

- Serving as the POC for management/technical direction of RI tasks,
- Executing tasks to meet scope, schedule and budget constraints,
- Selecting and directing technical personnel on the task,
- Preparing schedule, and monthly progress input to the PM,
- Reviewing and approving all project deliverables, and
- Supervising and overseeing subcontractors.

2.3.4 Senior Unexploded Ordnance Supervisor

The SUXOS will meet applicable requirements of Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP), Minimum Qualifications for UXO Technicians and Personnel 18 (DDESB, 2004). The SUXOS reports directly to the FPM UXO Operations Manager and will confirm that field personnel conduct MEC operations at the site IAW the RI WP and in a systematic manner using proven operating methods and techniques. Typical responsibilities include:

- Planning, coordinating, and supervising explosives operations,
- Coordinating on-site field activities with the MMRP Installation Manager (e.g., intrusive investigations) to minimize impacts to productivity and to confirm compliance with the MMRP sites HASP (**Appendix B**),
- Directly interfacing with and relaying safety and health concerns to the MMRP Manager,
- Managing on-site manpower and equipment necessary to safely conduct the tasks associated with the field investigation,
- Preparing and submitting a detailed daily accounting of activities performed each workday, and
- Performing a final inspection of MPPEH and certifying it to be free of any explosive hazard.

2.3.5 Unexploded Ordnance Safety Officer/ Quality Control Specialist

The UXOSO/QCS will serve a dual role as the project UXOSO and UXOQCS. The UXOSO/QCS will meet applicable requirements of DDESB TP18 (DDESB, 2004) for both the UXOSO and UXOQCS. The UXOSO/QCS is responsible for implementing and enforcing the safety and health requirements listed in the MMRP sites HASP. The UXOSO/QCS is also responsible for implementing and enforcing the UFP-QAPP and verifying elements of the RI WP. The UXOSO/QCS reports to the FPM UXO Safety/QC Manager and responsibilities include, but are not limited to:

Safety Responsibilities

- Evaluating MEC and explosives operational risks, hazards, and safety requirements,
- Conducting the UXO safety briefings for project and visiting personnel,
- Conducting and documenting daily safety inspections and weekly safety audits,
- Developing and implementing corrective action plans to eliminate or mitigate hazards,
- Monitoring compliance with the safety measures contained in the HASP and associated documents during field activities,
- Confirming the proper use of Personal Protective Equipment (PPE) IAW the requirements of the HASP,
- Establishing and verifying compliance with site-specific safety requirements,
- Implementing health and safety training and medical surveillance monitoring,
- Investigating and documenting injuries, illnesses, accidents, incidents, and near-misses,
- Establishing and maintaining Minimum Separation Distances (MSDs) during field operations IAW the DDESB-approved ESS, and
- Stopping work if health and/or safety are jeopardized or compromised.

QC Responsibilities

- Verifying compliance with MMRP-related DoD publications, AFCEC and Holloman AFB documents, as well as local, state, and federal statutes and codes,
- Conducting QC final acceptance sampling inspections,
- Checking for defective or damaged equipment,
- Verifying appropriate personnel are being utilized during field investigation activities, maintaining inspection and surveillance documentation (e.g., QC reports, equipment standardization results and equipment maintenance results, and nonconformance and corrective action documents),
- Performing and documenting daily inspections/surveillances of job site activities on a Daily QC Report (DQCR) form,
- Verifying that required equipment tests and checks have been performed and that inspection and standardization results comply with specifications, and
- Issuing a stop work order for unsafe or for any major quality nonconforming conditions.

2.3.6 Program Chemist/Chemical Quality Control Manager

The Program Chemist reports directly to the FPM PM and will be responsible for execution of the MC characterization. The Program Chemist will be responsible for the development of the site-specific UFP-QAPP. In addition, the Program Chemist will conduct the data evaluation and validation efforts on all chemical analyses. Additional duties include:

- Serving as the primary POC for technical coordination of the Environmental/MC sampling and analyses program,

- Developing and monitoring implementation of the Chemical QC Plans and UFP-QAPP for environmental/MC sampling,
- Developing and insuring compliance with chemical Data Quality Objectives (DQOs),
- Directing the analytical laboratory coordination during sampling activities,
- Reviewing and validating laboratory analytical data IAW the UFP-QAPP, United States Army Corps of Engineers (USACE) Data Quality Evaluation Guidance (if applicable), DoD Quality Systems Manual, and the USEPA National Functional Guidelines,
- Preparing data validation reports and QC Summary Reports for documentation of compliance with DQOs,
- Evaluating data completeness and usability with respect to DQOs,
- Preparing data usability reports,
- Performing field audits to evaluate compliance with the UFP-QAPP and field sampling protocols, and
- Participating in laboratory audits.

2.3.7 Quality Control Geophysicist

The QC Geophysicist will provide QC oversight of the geophysical effort. This individual shall have a degree in geophysics, geology, geological engineering, or a closely related field, and shall have a minimum of 5 years of directly related geophysical experience such as data collection, processing, and interpretation sufficient to provide oversight of the geophysical processes and quality of results. The QC Geophysicist reports to the MMRP Manager and will be responsible for:

- Developing and implementing the geophysics QC program,
- Developing daily QC databases,
- Developing QC figures,
- Developing summary tables to include all positional and production QC data,
- Reprocessing 10% of the production data,
- Posting all raw and production QC data to SharePoint, and
- Reviewing Instrument Verification Strip (IVS) and Blind Seeding Program (BSP) results.

2.3.8 Project Geophysicist

The Project Geophysicist has overall responsibility for design, implementation, and management of all geophysical investigations required for the work effort, but may not be on-site full time. This individual shall have a degree in geophysics, geology, geological engineering, or a closely related field, and shall have a minimum of 5 years of directly related geophysical experience. The Project Geophysicist will report directly to the MMRP Installation Manager. The Project Geophysicist will assist in providing solutions to geophysical problems encountered in the field in order to meet the required geophysical objectives of the project. The Project Geophysicist for

this project meets the requirements of Data Item Description (DID) Number OE-025.02, Personnel/Work Standards (USACE, 2004). Typical responsibilities include:

- Recommending experienced and qualified personnel and maintaining the geophysical staff throughout the project. Coordinating field teams and support personnel to ensure consistency of performance and meeting established schedules,
- Providing technical leadership in the disciplines of geophysics, statistics, and QC and Quality Assurance (QA) of the geophysical data. Using experienced personnel to process and assess the quality of the Real-Time Kinematic Global Positioning System (RTK-GPS) and Differential Global Positioning System (DGPS) data,
- Establishing a list of equipment, computers, materials, and supplies necessary to perform the task,
- Developing and implementing the Geophysical System Verification (GSV),
- Monitoring technical performance of team members,
- Performing technical reviews of all deliverables,
- Approving contributions to any technical deliverable for any work element,
- Serving as the primary point-of-contact for technical coordination of project geophysical requirements,
- Reporting to the MMRP Manager on budget, technical, schedule, and quality issues relating to geophysics, and
- Coordinating daily work and verifying technical quality of geophysical activities.

2.3.9 Site Geophysicist

The Site Geophysicist will be on site at all times and is required to oversee the day-to-day operations of the site geophysical investigations. This individual shall have a degree in geophysics, geology, geological engineering, or a closely related field. The Site Geophysicist will be assigned when field work commences. The Site Geophysicist for this project meets the requirements of DID OE-025.02 (USACE, 2004). The specific responsibilities of the Site Geophysicist include the following:

- Scheduling field crew activities in concert with the Project Geophysicist,
- Ensures the entire geophysical team attends the Daily "Tailgate" Safety Briefing each day,
- Coordinate all field activities with the SUXOS,
- Coordinate all QC/QA checks with the UXOQCS,
- Adhere to Team Separation Distances at the Site,
- Observe the “Buddy System” safety rule,
- Establishing and maintaining communications with team personnel, UXOSO; SUXOS; UXO Team Leader,
- Maintaining data acquisition-related paperwork and ensuring its accuracy,

- Coordinating and directing activities of all personnel on the geophysical field team, including setting and enforcing the schedules required to achieve the goals for each day's activities,
- Supervising geophysical field operations and related surveying activities, including directing field team activities,
- Logging all activities at the geophysical survey site in the field logbook and maintaining relevant files,
- Ensuring that all materials needed at the survey site are in stock (e.g., geophysical equipment, writing materials, tape, markers, etc.),
- Planning the field data acquisition schedule for the next day with the Project Geophysicist,
- Checking sites to be surveyed and access routes in advance of data acquisition activities,
- Reporting the level of effort expended to the Project Geophysicist on a daily basis,
- Downloading data at the processing center on a daily basis,
- Performing daily repeatability checks at the specified area for all geophysical instrumentation and DGPS instruments,
- Analyzing current field procedures on a daily basis and refining approaches to improve the efficiency and/or quality of the data based on site-specific survey conditions,
- Inventory all rental equipment to determine that all necessary items have been received and that the equipment is in working order, and
- Record and maintain an inventory of all geophysical equipment on site. The document should include all serial numbers of the geophysical equipment.

The authority of the Site Geophysicist includes shutting down geophysical operations on site to prevent compromising technical quality.

2.3.10 UXO Technician III/Team Leader

UXO Technician III (UXO III) will meet all applicable requirements of DDESB TP18 (DDESB, 2004) and will report directly to the SUXOS. The UXO III will supervise a project team performing work on this project and may also serve in the capacity of Demolition Supervisor during demolition and explosive demilitarization operations. This individual will meet all applicable requirements of DDESB TP-18. Typical responsibilities include:

- Supervising the team to which he/she is assigned,
- Providing the MEC subject matter expertise to ensure the team's safety and the project's quality,
- Ensuring the team's actions are accomplished safely and efficiently,
- Maintaining a field logbook related to the team's operations,
- Implementing the work, safety and quality plans for this project,
- Supervising the conduct of all on-site evaluations directly related to MEC operations,

- Being familiar with the duties of all assigned personnel and being able to perform all of the functions enumerated for UXO Technicians I and II, and
- If assigned as a Demolition Supervisor during demolition operations, the UXO Technician III is also responsible for:
    - Ensuring all personnel are familiar with the nature of the materials, hazards, and precautions,
    - Coordinating with the SUXOS to ensure all notifications are completed prior to demolition, and
    - Along with the SUXOS and UXOSO/UXOQCS, being present and in direct control during all on-site disposal operations.

2.3.11 UXO Technician II

UXO Technician II (UXO II) personnel will meet all applicable requirements of DDESB TP 18 (DDESB, 2004) and will report to the UXO III/Team Leader for field operations. This individual will meet all requirements of DDESB TP-18. The UXO II is responsible for performing daily operations as directed by the SUXOS. The UXO II responsibilities include, but are not limited to:

- Provide avoidance techniques for field collection procedures to identify contaminated soil,
- Prepare an on-site holding area to temporary store MEC that has an acceptable risk of movement,
- Investigate anomalies to confirm the presence of MEC or MD,
- Conduct explosive demolition operations to dispose of MEC items,
- Supervise and mentor UXO Tech I personnel during all field operations,
- Transport UXO that has been determined Safe to Move,
- Escort personnel who are not directly involved in UXO-related operations, but have activities to perform within exclusion areas,
- Inspect MPPEH for the presence of explosive safety hazards, and
- Be capable of performing all activities of a UXO Technician I.

2.3.12 UXO Technician I

UXO Technician I (UXO I) personnel will meet all applicable requirements of DDESB TP18 (DDESB, 2004) and will report to the UXO III/Team Leader. The UXO I will be responsible for performing daily operations as directed by the SUXOS. The UXO I responsibilities include but are not limited to:

- Reconnoiter and classify UXO and DMM,
- Identify all types of military munitions,
- Excavate subsurface UXO and DMM,

- Perform demolition operations,
- Operate personnel decontamination stations,
- Assist in the inspection of MPPEH for the presence of explosive hazards, and
- Construct UXO-related protective works.

2.3.13 Team Subcontractors

URS Group, Inc. (URS) has been selected as a team subcontractor to perform various reach-back services. URS has significant experience in performing RI and has teamed with FPM over the past eight years on numerous DoD contracts and task orders.

Accutest Laboratories Southeast, Inc. of Florida has been selected as the analytical laboratory to support this project. Accutest Laboratories Southeast, Inc. holds DoD Environmental Laboratory Accreditation Program.

2.4 Project Communication and Reporting

The operational and administrative lines of communication for the RI are identified in **Figure 2-1**. To assure consistency throughout the project, the FPM PM will be the primary POC between the stakeholders and project personnel. The FPM MMRP Installation Manager will provide AFCEC/Holloman AFB with monthly project status reports to communicate activities completed during the month, difficulties encountered, corrective actions taken, activities planned for the next month, and updates to the project schedule. POC information for the RR869a Debris Field MRS RI is included in **Appendix C**.

2.5 Project Deliverables

The major project deliverables include:

- Project Management Plan (PMP) – Submitted in Draft and Final versions to the AFCEC and Holloman AFB for review.
- UFP-QAPP – Submitted in a Draft version to the AFCEC and Holloman AFB for review and finalization.
- ESS – Submitted in Draft and Final versions to the AFCEC and Holloman AFB for review, including 49th Wing, the Air Force Safety Center, and DDESB.
- RI WP – Submitted in Draft, Draft-Final, and Final versions to the AFCEC and Holloman AFB, and Draft Final and Final versions to the regulatory agencies for review.
- RI Report – Submitted in Draft, Draft-Final, and Final versions to the AFCEC and Holloman AFB, and Draft-Final and Final versions to the regulatory agencies for review.

2.6 Project Schedule

The project schedule is presented in **Table 2-1**. FPM will update the project schedule each month and report schedule changes in monthly progress reports submitted to the AFCEC PM and Holloman AFB throughout the project duration.

Table 2-1
Project Schedule

Activity	Date
Final RI WP	October 2014
RI Fieldwork	November 2014 to December 2014
Draft RI Report	January 2015
Final RI Report	August 2015

2.7 Periodic Reporting

2.7.1 Progress Reports

FPM will submit monthly progress reports to, and host a monthly teleconference with the AFCEC and Holloman AFB. Additionally, FPM will prepare weekly progress reports during field activities.

2.7.2 Daily Site Reports

A daily site report will be included as part of the RI Report. The Daily Site Report will include:

- A concise summary of daily activities
- Personnel on-site
- Ordnance or ordnance related material encountered
- Changed conditions, delays or conflicts encountered
- A consolidation and summary of daily events of significance
- Deviations from the planned activities and procedures

2.7.3 Daily Quality Control Reports

The information included in DQCR is described in detail in the QCP (**Section 4.0**). During each day of field work, FPM will complete a DQCR that includes the following information:

- Contract information (e.g., Agency, PM, Contract Number, Task Order Number, etc.)
- A description of the definable feature work completed
- What phase of control that definable feature of work is in
- UXOSO/QCS inspections conducted (if applicable)
- Site weather conditions
- List of subcontractor work performed (if applicable)
- A description of any visitors to the site
- Materials received
- Quality management information pertaining to field activities

FPM will submit DQCRs to the AFCEC PM and Holloman AFB as required or requested. DQCRs will be included in the RI Report.

2.8 Project Public Relations Support

All public participation will be coordinated through the Contracting Officer's Representative (COR) for AFCEC approval. FPM will provide the necessary support to initiate, schedule, and address all public participation aspects of the project (e.g., preparation of briefings, presentations, fact sheets, newsletters, public notices). The FPM Public Affairs Lead is Barbara Pratt.

2.9 Subcontractor Management

It is anticipated that subcontractors and vendors will be enlisted for the following services:

- UXO Technicians personnel reach-back
- MC sample laboratory analyses
- Providing donor explosives for MEC demolition

Prior to subcontract work being performed, FPM will negotiate and prepare a subcontract that will identify the scope of services and detail necessary and appropriate terms and conditions. Subcontractor procurement will follow Federal Acquisition Regulation requirements. Once the subcontract is executed, FPM will perform periodic reviews to verify that contractual requirements and milestones are being met. The PM will manage unresolved issues or conflicts that may impact the schedule or budget.

2.10 Management of Field Operations

Prior to beginning field activities, the MMRP Manager will coordinate support with Holloman AFB. This will include providing access to the MRS (gate keys/combinations). Field operations that will be completed as part of the RI include:

- Site delineation,
- Surface clearance,
- DGM,
- Intrusive investigation if required (i.e., target anomaly selection and reacquisition and excavation of target anomalies potentially representing MEC).
- MC sampling at MEC/MPPEH locations,
- MPPEH inspection process, and
- MEC disposal.

SOPs for the various MC sampling field activities were developed IAW the requirements of UFP-QAPP (**Appendix D**) and procedures for intrusive investigation (if required) are provided in Intrusive Investigation Plan (**Section 3.6)**. Compliance with procedures will support the collection of representative and comparable data. The MMRP Manager will ensure that the MEC/MPPEH investigation (overseen by SUXOS) and MC sampling activities (overseen by MC Task Lead) are completed IAW the HASP, and ESS. The UXOSO/QCS will verify that work being performed on site is IAW approved plans, procedures, and guidance documents. The

UXOQCS will complete field audits, as needed, to verify that field operations are being completed IAW the RI WP and applicable guidance documents. FPM will maximize sustainable opportunities (e.g., combining field activities in ways that reduce waste generation, conserve resources, and minimize land and ecosystem disturbance).

3.0 FIELD INVESTIGATION PLAN

3.1 Overall Approach to Munitions Response Activities

This section provides a description of the overall RI approach for the RR869a Debris Field MRS, establishes DQOs, and describes data collection and utilization.

3.1.1 Project Goals

The goal of the RI is to provide DGM data (100% coverage) to close existing data gaps at the MRS. Since FPM intends to remove all detected subsurface anomalies from the MRS during the follow-on NTCRA, intrusive investigation is not planned for the RI field activities. However, if this removal is not a feasible option for NTCRA (more than 1000 DGM anomalies), one of the following approaches will be implemented during this RI:

(1) Anomalies will be ranked using the advanced technology (MetalMapper) to classify the sources of geophysical anomalies as "targets-of-interest" or non-hazardous items that may remain in the ground. Potential targets of interest will be excavated during the follow-on NTCRA.

(2) VSP statistical module will be used to provide 95% confidence of MEC/MPPEH potential on the sites. Using this module, a portion of the site where no MEC is identified during the intrusive activities will be recommended for No Further Action (NFA) (unlimited use/unlimited exposure), while the remaining portion of the site will become the subject of the follow-on NTCRA.

The RI goals include:

- Accurately locating and recording geophysical anomalies,
- Properly analyzing and interpreting the geophysical data, and if required
- Properly documenting the intrusive findings.

Residual MC contamination will be assessed through a biased sampling program for explosives. Surface and subsurface soil samples (if intrusive investigation is performed) will be collected using composite sampling at locations where MEC/MPPEH items are identified as well as in areas with significant amounts of MD. In addition, The CSE Phase II data indicates only minor undocumented usage of small arms at this site and does not indicate a potential lead or PAH concern. However, if during the RI a significant amount of shotgun shells and/or clay target debris is found sampling for related contaminat of concern (lead and PAH) will be conducted. MC sampling will be IAW the procedures outlined in the site-specific UFP-QAPP (**Appendix D**).

3.1.2 Data Quality Objectives

The DQO Process is a systematic planning tool that defines the performance criteria that will be used to establish the final data collection design as well as to determine acceptable quantitative criteria on the quality and quantity of the data to be collected. The DQO Process will be followed for the RR869a Debris Field MRS to identify the type, number, location, and physical quantity of samples and data, as well as the QC and QA activities that will ensure that sampling design and measurement errors are managed sufficiently to meet the performance and acceptance criteria specified in the DQOs.

3.1.2.1 Data Quality Objectives Process Overview

As identified in Guidance for Systematic Planning Using the Data Quality Objective Process (USEPA, 2006), the steps of the DQO development process include:

1. State the problem – Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.
2. Identify the Decision – Identify what questions the study will attempt to resolve, and what actions may result.
3. Identify the Inputs to the Decision – Identify the information that need to be obtained and the measurement that needs to be taken to resolve the decision statement.
4. Define the study boundaries – Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.
5. Develop a Decision Rule – Define the statistical parameter of interest, specify the action level, and integrate the previous DQO outputs into a statement that describes the logical basis for choosing the alternative actions.
6. Specify Tolerable Limits on Decision Errors – Define the decision maker's tolerable error rates based on a consideration of the consequences of making incorrect decision.
7. Optimize the Design – Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets DQOs.

The above process will be implemented to identify data needed to support decisions at the MRS. The DQO development process (USEPA, 2006) as it applies to the RR869a Debris Field MRS described below.

3.1.2.2 Problem Statement

Historical site activities within the RR869a Debris Field MRS resulted in the potential presence of MEC/MPPEH which poses an immediate threat to the users of these sites (e.g., Base personnel and contractors). The evidence collected during the CSE Phase II at the MRS is not sufficient to characterize the site since a geophysical survey was not performed. In addition, there was no intrusive investigation of geophysical anomalies, and therefore, no information regarding the type of subsurface anomalies (non-munitions metal scrap *vs*. munitions related). As a result of this data gap, an RI investigation is needed to provide DGM data for the follow-on NTCRA during which all detected subsurface anomalies above the established threshold based on site-specific data will be removed, or if the removal of all subsurface anomalies is not a feasible option, to provide information for full characterization (nature and extent of MEC and MC), so that the follow-on removal action can be performed at contaminated portions of the MRS.

3.1.2.3 Decision Identification

The goal of the RI is to collect data such that the following decisions can be made regarding the MRS:

- Do the geophysical survey data indicate that 100% removal of subsurface anomalies is a feasible option?

- If yes, then an intrusive investigation of subsurface anomalies will not be performed during the RI. All anomalies will be excavated during the follow-on NTCRA.
- If no, based on the features of DGM data, one of the two approaches will be applied:
    1. If the majority of DGM anomalies represent isolated targets, advanced classification technology will be applied to rank the anomalies and determine whether signals are likely to arise from a munition or another source. Anomalies identified as non-targets of interest may remain in the ground. All remaining anomalies will be intrusively investigated during the follow-on NTCRA.
    2. If there are frequent overlaps of DGM signals (more than 20% of all anomalies), VSP software will be used to determine the required number of intrusive digs that will indicate 95% confidence factor of the MEC potential on site. This approach includes intrusive investigation of randomly selected anomalies during this RI.

- Whether surface clearance and intrusive investigation (if performed) results indicate the presence of MEC/MPPEH at the MRS?
    - If yes, then a MEC Hazard Assessment (HA) is required to evaluate the potential explosive hazard.
    - If surface clearance and intrusive investigation results show that there are portions of the MRS where MEC/MD is not present, recommend NFA for these portions and acreage reduction for the MRS.
- If MEC/MPPEH is found during the surface clearance and/or intrusive investigation (if performed), environmental samples will be collected at MEC/MPPEH locations to determine the presence or absence of explosives and metals. If MC is present above screening levels and is attributable to MEC/MPPEH, does it pose an unacceptable risk?
    - If yes, then a Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) may be prepared for those analytes exceeding screening levels
    - If no, then recommend NFA for MC.
- If significant amount of shotgun shells and/or clay target debris is found, soil samples from 0 to 3ft bgs will be collected for metals (lead) and PAH analysis to determine the presence of contamination, as follows:
    - If the concentration of metals and/or PAHs in soil exceed the screening levels, the HHRA and ERA may be prepared for those analytes exceeding screening levels.
    - If the concentrations of metals and/or PAHs in soil are less than the respective screening levels, then it will be determined that no further remedial action is required.

3.1.2.4 Inputs to the Decisions

The following information and data are needed to make the decisions specified above if the intrusive investigation is included in the RI efforts:

- Historical information for the munitions that may have been used at the MRS.

- Locations, types, and depths of MEC and/or MPPEH observed.
- Results of the intrusive investigations (if performed) to verify anomalies detected during the geophysical surveys. Applicable data include:
  - The number, location, and magnitude of anomalies.
  - Results of dig and verification of the anomalies indicating whether MEC/MPPEH was present, the depth and orientation of discovered objects, and to the extent possible, what type of MEC/MPPEH was found.
- MC concentrations for samples collected during the RI.
- Results of the HHRA and ERA.

Only the first bullet applies if the intrusive investigation is not part of the RI activities.

3.1.2.5 Study Boundaries and Field Limitations

The study area for the RR869a Debris Field MRS includes all acreage located within the respective MRS boundary (**Figure 1-2**). The MRS does contain heavily sloping terrain with gorges and gullies. As previously described, Ritas Draw, located to the north of the MRS has an associated wetland buffer zone. Any sampling activity in the northern portion of the MRS will follow only after approval of any required dig permit. There are no cultural/archaeological features associated with the MRS.

3.1.2.6 Tolerance Limits on Decision Errors

The following analysis is provided for the case intrusive investigation that is performed during the RI. False positives result when an anomaly is detected at a given location, declared as a significant DGM anomaly to be intrusively investigated or otherwise posted to a dig sheet, and no source for the anomaly is identified in the field.

False positives can be a result of low threshold selection for anomalies (i.e., conservative anomaly picking), spikes in the data not successfully removed during processing (e.g., instrument jolts resulting from terrain), and heterogeneities in the subsurface (e.g., highly-ferrous soils). False positives are unavoidable and do not affect the data quality in terms of removing MEC items from the subsurface. The performance goal with respect to false positives is to minimize their occurrences while maintaining the same MEC identification rates.

The consequences of false positive measurements may overestimate the presence of potential MEC. The probability of making an incorrect decision using the collected data, which may contain sampling design or measurement errors, can be controlled by following the procedures in the Geophysical Investigation Plan (GIP) presented in **Section 3.4**. Data quality evaluation procedures and determination of usability are defined in the QCP (**Section 4.0**.)

For the DGM surveys at the MRS, a false positive goal of no more than 15% will be established on this project, IAW USACE DID MMRP-09-004 (USACE, 2009a). False positives will be minimized to the extent possible through the use of the best available geophysical practices executed by the geophysical field team and data analyst. False positives will be documented in the database so that the 15% false positive metric can be monitored. Exceeding 15% false positives will result in a re-evaluation of the detection methods, data, and project QC. QA targets chosen below the selection criteria will not be considered a false positive. A Corrective Action Report, if appropriate, will be provided explaining the root cause for the excessive false

positive rate. Additional corrective actions may be performed as deemed necessary for false positives less than 15%.

A false negative is the omission of any item meeting target selection criteria from being selected as a target. Target selection criteria are discussed in **Section 3.4.6.2**. FPM will implement a rigorous QC program to ensure no false negatives occur during the RI (there are no tolerance limits on false negative occurrence). This includes initial and daily geophysical equipment QC checks, static and positional accuracy tests for RTK-GPS, IVS and blind seeding program, QC reprocessing of 10 % of initially processed geophysical data, and QC inspection of minimum of 10% of the areas intrusively investigated. All QC tests including their tolerance limits are discussed in detail in **Section 4.0.**"

The results of QA/QC efforts during sample collection and analysis, in combination with professional judgment, will be used to evaluate the usability of chemical data for making decisions. Acceptable limits for the MC sampling include analytical method reporting and/or detection limits that are sufficiently low to meet applicable human health regulatory screening criteria. Analytical method detection limits, reporting limits, and QC acceptance criteria are specified in the UFP-QAPP (**Appendix D**).

3.1.2.7 Design Optimization

The data collection design presented in this RI WP is based on the proposed actions and evaluation of existing data. Initial DGM survey results and field observations will be assessed to optimize the follow-on approaches. The project team will have opportunities to provide input through regular project updates during data collection activities, analysis of data, and preparation of reports.

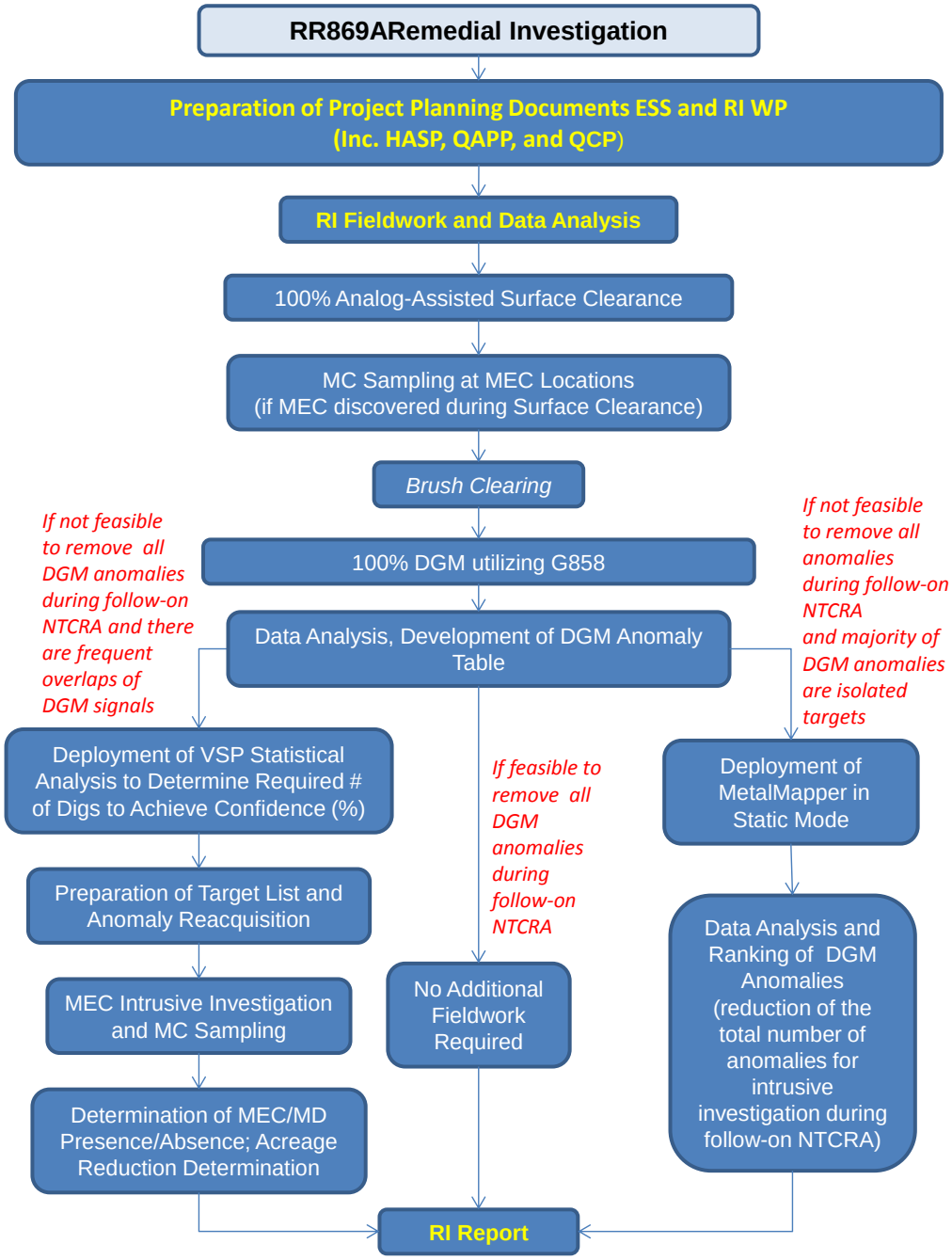
3.1.3 Investigative Approach

Based on the history of the MRS and the lack of investigative data, a phased approach is planned for the RI field investigation that is comprised of:

- 100% analog-assisted surface clearance,
- Brush Clearing if necessary,
- DGM survey utilizing the G-858 magnetic sensors,
- Data analysis, anomaly/target selection,
    - If required, deployment of MetalMapper in static mode and ranking of DGM anomalies or development of dig-sheet lists using the VSP statistical analysis (if VSP is used, intrusive investigation of randomly selected DGM targets will be performed).
- Characterizing MPPEH as either Material Documented as an Explosive Hazard (MDEH) or Material Documented as Safe (MDAS),
- Removing and storing material determined to be MDEH and MDAS in separate storage locations,
- MEC/MDEH Demolition,
- Offsite Disposal of MDAS, and
- MC sampling.

Figure 3-1 illustrates in more detail the phased technical approach to be implemented at both sites.

Figure 3-1 Technical Approach RR869a Debris Field MRS



3.1.1 Data Incorporation into Project Reports

3.1.1.1 Remedial Investigation Report

The results of the geophysical investigation, intrusive investigations (if performed), and MC sampling, will be evaluated and included in the project Geographical Information System (GIS) and the RI Report. The GIS database will be managed and updated as new information becomes available.

3.1.2 Non-Time-Critical Removal Action

Upon completion of the RI process, FPM plans on implementing a NTCRA to mitigate risk associated with subsurface MEC/MPPEH. An Engineering Evaluation/Cost Analysis and Action Memorandum will be prepared and submitted to project stakeholders. The document will contain a description of the site and existing MEC hazards, current land use activities, and previous actions that have taken place to address the MEC hazard. The Action Memorandum will also include an endangerment determination with the following statement: "There is a

significant possibility that an individual may encounter MEC hazards at this site, and that these hazards may cause injury or death to individuals who encounter the hazards if not addressed through the response action described in the Action Memorandum."

3.2 Surface Clearance

One hundred percent detector-aided surface clearance will be conducted prior to the geophysical survey at the RR869a Debris Field MRS. The purpose of the surface clearance is to:

1. Remove surface hazards (MEC/MPPEH) and debris that could pose a safety hazard to personnel and/or equipment from grid footprints and,
2. Eliminate sources of DGM signal interference that could obscure subsurface anomalies and thus reduce the effectiveness of the DGM surveys to detect and map subsurface targets.

3.2.1 Equipment

Geophysical instrumentation will be used by FPM's UXO team to help identify the lateral and vertical extent of potential MEC/MPPEH exposed at the surface. The UXO team will use hand-held magnetic locators as their primary instrumentation. Based on site-specific field conditions and the potential for encountering non-ferrous MPPEH at the site, FPM will also use hand-held EMI metal detectors during the survey to supplement information from the hand-held magnetic locators. The position of the surface clearance team will be recorded using a sub-meter DGPS. All field team members will be equipped with a geophysical sensor and DGPS.

3.2.1.1 Schonstedt GA-52Cx Magnetometer

The Schonstedt GA-52Cx magnetometer (Schonstedt) is a hand-held unit that will be used during the surface clearance survey. The Schonstedt detects changes in the Earth's ambient magnetic field caused by ferrous metal. The technology uses two fluxgate magnetometers, aligned and mounted a fixed distance apart, to detect changes in the Earth's ambient magnetic field caused by ferrous metal or disturbances in soil conditions. An audio signal is provided to the operator who uses changes in the audio signal to pinpoint the location of the ferrous metal item. The detection capability of the Schonstedt varies according to the local conditions, the size

of the object, and the skill of the operator. However, detection of a medium-sized target (e.g., 75- millimeter [mm] projectile) is generally limited to a maximum depth of 1.0 m.

3.2.1.2 White's EM DFX 300 Metal Detector

The White's DFX 300 metal detector is a hand-held analog electromagnetic system that will be used during surface clearance work as needed. The DFX 300 has multi-frequency capability and uses operating frequencies of 3 and 15 kilo Hertz (kHz), or both at the same time for enhanced target discrimination. An audio signal is provided to the operator who uses changes in the audio signal and a liquid crystal visual display to pinpoint the location of the metal item. The White's DFX 300 is capable of detecting both ferrous and non-ferrous metals. The detection capability of the instrument varies according to the local conditions, the size, orientation, and depth of the object, and the skill of the operator. The DFX 300 will be used during the surface clearance to detect nonferrous metal objects that could pose a physical hazard to personnel during DGM activities.

3.2.1.3 Navigational and Positioning Equipment

Trimble® GPS Pathfinder® ProXRT Trimble

A real-time DGPS Trimble® GPS Pathfinder® ProXRT or equivalent will be used to determine the positions of analog geophysical instruments used for surface clearance. The Trimble® GPS Pathfinder® ProXRT can achieve decimeter accuracy by combining H-Star™ technology, OmniSTAR support, and Global Navigation Satellite System (GLONASS) support on top of dual frequency GPS. Installing the GLONASS option on the GPS Pathfinder ProXRT receiver increases the number of satellites available for tracking. The increased number of observed satellites is especially useful in conditions with limited sky visibility (i.e., densely vegetated areas, closed canopies, etc.). Tracking GLONASS satellites as well as GPS satellites can also improve productivity by reducing the time required to achieve decimeter or sub foot accuracy, either in real-time or after post processing. Positional data will be sampled and recorded at 1 sample per second.

3.2.1.4 Surface Clearance Equipment Verification

The UXO III (Team Leader) will be responsible for verifying all instrumentation is in proper working order at the start of each day. The Schonstedt magnetic locators, handheld electromagnetic metal detectors and the DGPS will be checked throughout the day for adequate battery charge. Extra batteries will be carried with the surface clearance field team at all times.

The instruments will be tested each morning at the same IVS where DGM equipment will be tested using a series of metallic Industry Standard Objects (ISOs) (surrogates for munitions, see **Section 3.4.4** for more details). Any "failure to detect" occurrences will result in that specific instrument being replaced by a properly functioning instrument of the same type. All IVS results will be documented in the Field Activity Daily Log form (**Appendix E**).

3.2.2 Personnel

Two UXO IIIs, one UXO II, and two UXO Is will perform surface clearance under the direct supervision of the SUXOS and dual-hat UXOSO/UXOQCS. All team members will be familiar with the RI WP, HASP, ESS, and site history prior to commencement of fieldwork. All UXO technicians will meet or exceed the qualification requirements specified in DDESB TP 18 (DDESB, 2004). Typical personnel responsibilities are described in detail in **Section 2.0**.

3.2.3 Surface Clearance Procedures

Surface clearance/removals will be conducted within the entire area (3.5 acres) of the MRS. It will be performed across grids (**Figure 3-2**) that will be staked-out during the preparation of the sites. Surface clearance work across grids will be conducted by UXO technicians, sweeping side by side, with magnetometers. Lanes will be established by pulling fiberglass measuring tapes or ropes from grid node to grid node. Each member of the sweep crew will perform detector assisted visual inspection following a lane. UXO qualified personnel will flag, identify, and record the location of discovered MEC/MPPEH with DGPS. The SUXOS will determine if the item is MEC and if it can be safely moved to the established MRS Safe Disposal Area (SDA). The potential SDA locations will be determined and approved prior to commencing field operations. If the UXO item is determined to be unsafe to move, FPM will conduct a Blow-in-Place (BIP) operation IAW procedures described in the approved ESS. In addition, MD and non-MEC related materials, will be collected, segregated (i.e., Munitions Debris separated from non-MD related materials) and temporarily stored for final processing and disposition.

3.2.4 Munitions with the Greatest Fragmentation Distance

For the RR869a Debris Field MRS, the 5-inch Mk10 Rocket Motor (potential 5-inch rocket motor debris was identified in previous investigations) is the Munition with the Greatest Fragmentation Distance (MGFD); for the MRS.

3.2.5 Minimum Separation Distances

Prior to the start of intrusive activities, the SUXOS and UXOSO will verify that the area around the MRS is clear of all nonessential personnel. MSDs will be established and maintained around each MRS during intrusive activities. The MSDs are dependent on the MGFD as listed in **Table 3-1.**

Table 3-1 Minimum Separation Distances

MRS	MEC	MSD (feet)						
		For Unintentional Detonations			For Intentional Detonations			
		Hazardous Fragmentation Distance (HFD)		K40[1] TSD	Without EC: Larger of MFD-H or K328[2]	Using Sandbag Mitigation (Single Item)		Water Mitigation
		Without EC	With EC			Single Layer	Double Layer	
RR869a	5-inch Mk 10 Rocket Motor	428	Not Permitted	115	1874	Not Permitted	Not Permitted	Not Permitted

Notes:

1. K40 also referred as "team separation distance (TSD)" - The allowable blast overpressure distance for unintentional detonations of non-fragmenting munitions.
2. K328 - The allowable blast overpressure distance or MSD for a planned detonation of non-fragmenting munitions.

If MEC with a greater fragmentation than the established MGFD (**Table 3-1**) is encountered, the MSD will be adjusted IAW DDESB TP 16 Methodologies for Calculating Primary Fragment Characteristics (DDESB 2013a), operations will continue, and an amendment to the ESS

submitted for approval (a copy of this document will be available on site). Explosives Safety Quantity Distance (ESQD) arcs will be adjusted accordingly.

3.2.6 Material Potentially Presenting an Explosive Hazard Inspection Process

Material recovered from the MRSs will be inspected, re-inspected, and certified free of explosives hazards by at least two UXO-qualified personnel IAW Chapter I, Section 11, Engineering Manual (EM) 385-1-97 (USACE, 2008a) with Change 1, 17 May 2013; DoD Instruction 4140.62 (DoD, 2008b) with Change 1, 19 February 2014; and Chapter 14, EM 1110-1-4009 (USACE, 2010a). MPPEH will be categorized as one of the following:

- **MDEH**– The explosive hazards are known or suspected and documented. These items will be disposed of by detonation IAW the ESS (**Appendix F**).
- **MDAS** – Not presenting an explosive hazard, and consequently safe for unrestricted transfer or release. This is no longer considered MPPEH and is reclassified accordingly. Once certified as MDAS, the material will be reclassified as MD, RRD, or other debris. MD classified material will be segregated, containerized, and secured until final disposition. MD will be documented on a Department of Defense (DD) Form 1348-1A (**Section 3.6.6.1**). A log book entry and pictures will be completed documenting the inspection.

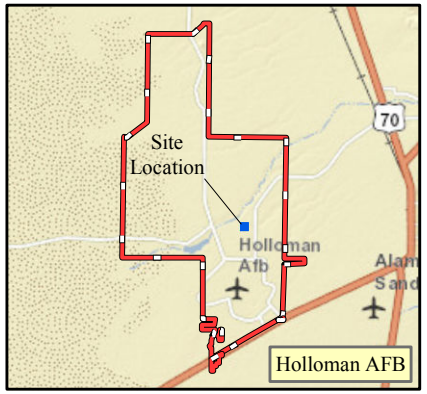
3.2.6.1 DD Form 1348-1A

Upon completion of removal activities, the contractor will complete a DD Form 1348-1A as the turn-in documentation for MD. The contractor will certify that 100% of the MD is properly inspected, provide a 100% re-inspection, and declare that all materials are free of explosive hazards by qualified UXO personnel. The following statement shall be signed and dated by the SUXOS and verified/signed by the UXOSO/QCS.

"This certifies and verifies that the material listed has been 100% inspected and, to the best of our knowledge and belief, is free of explosive hazards, engine fluids, illuminating dials, and other visible liquid hazardous toxic or radiological waste materials."

3.2.7 Munitions and Explosives of Concern Disposition

FPM maintains a Bureau of Alcohol, Tobacco, & Firearms Type 33 Federal Explosives License (FEL), No. 6-NY-00986, which authorizes site UXO personnel to purchase, receive and use donor explosives to dispose of MEC/MDEH. MEC/MDEH will be disposed of on a daily basis using appropriate engineering controls. The Base Command Post and EOD will be notified of MEC/MDEH disposal activities and will, in turn, notify Fire and Emergency Medical Technician for stand-by. If demolition operations cannot be conducted at the time the item is located, the item will be secured in place with sand bags and security will be provided 24 hours a day until disposal of the item can be achieved. Prior to explosive operations, the UXOSO will ensure that appropriate MSDs for non-essential and essential personnel are properly established and maintained IAW the approved ESS. The SUXOS will ensure that the explosive materials used are appropriate for the operations performed. All MEC/MDEH disposal activities will be conducted by qualified UXO personnel IAW DDESB TP-18 (DDESB, 2004), and any applicable state or local regulations. At a minimum, the demolition operations team will consist of a minimum of three UXO-qualified personnel, including the UXOSO, a UXO III acting as Demolition Supervisor, and a UXO Technician II or UXO Technician I. These operations will



Legend

- 100% DGM Coverage Grid (100ft X 100ft)
- RR869a MRS
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 3-2

DGM Grid System
RR869a Debris Field MRS

NOTES:
1. SR859 MRS boundary based on CSE Phase II findings.
2. HHSL - Human Health Screening Level
3. Revision Date: 8/7/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
False Easting: 500,000.0000
Central Meridian: -105.0000
Latitude Of Origin: 0.0000
Horizontal Datum: North American 1983
False Northing: 0.0000
Scale Factor: 0.9996
Units: Meter

1 inch = 120 feet

0 18 36 Meters

0 60 120 Feet

N W E S

FPM Remediations, Inc.

Path: C:\Projects\New Mexico\GIS\RR869\Figure 3-2_Site_RR869A_DGM_Grid.mxd

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be performed under the direction and supervision of the SUXOS. In the unlikely event that an accidental detonation or the emergency occurs, the emergency contingency plan in the HASP will be followed. The UXOSO will be the primary contact and will coordinate all emergency activities.

All explosive operations will follow the procedures outlined in AFMAN 91-201 (AFMAN, 2011) EM 385-1-1 (USACE, 2011), EM 385-1-97 (USACE, 2010b), Department of the Army (DA) TM I 60A-1-1-31, EOD Procedures/General Information on EOD Disposal Procedures (DA, 2008). Munitions that are encountered during the RI will be either BIP or transported to the MRS SDA. The FPM SUXOS will determine which method is the most appropriate. If BIP is deemed to be the most appropriate, FPM will implement applicable and necessary engineering controls (i.e., use of sandbags or water) for mitigation of fragmentation and blast effects due to intentional detonation of munitions IAW HNC-ED-CS-S-98-7, Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions (USACE, 1998b) and HNC-ED-CS-5-00-3, Use of Water for Mitigation of Fragmentation and Blast Effect due to Intentional Detonation of Munitions (USACE, 2000) for all demolition shots. Demolition shots will be fired during daylight hours. The exceptions to the BIP requirement are when the SUXOS determines the risk associated with movement is acceptable and movement is necessary for the efficiency of either the activities being conducted, or protection of people, property, or critical assets. In such cases, the SUXOS may evaluate the munitions and authorize its movement within the MRS to the approved SDA for securing and destruction either individually or as part of a consolidated shot. It is assumed that all DMM will be transported to the SDA for disposal. Live MEC/UXO will not be stored for any length of time.

If determined acceptable to move by the SUXOS, consolidating multiple MEC/MDEH may be anticipated for this project. Consolidated MEC/MDEH disposal operations will be conducted IAW: AFMAN 91-201 (AFMAN, 2011), DDESB Memorandum Approval of Minimum Separation Distance to Non-Essential Personnel When Using DDESB-Approved Consolidated Shot Method (September 25, 2009) (DDESB, 2009b); DA TM 60A-1-1-31, (DA, 2008); USACE Engineering Pamphlet (EP) 1110-1-17 Establishing a Temporary Open Burn (OB) and Open Detonation (OD) Site for Conventional Ordnance and Explosive Projects (USACE, 1999); and the unnumbered U.S. Army Engineering Support Center, Huntsville (USAESCH) publication entitled “Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites” (August 1998) (USAESCH, 1998). Consolidated shots shall be initiated in such a manner that detonation of all munitions items is simultaneous.

3.3 Brush Clearing

Following the completion of the surface clearance, brush clearing will be conducted in the MRS where vegetation may hamper the collection of DGM data. Brush clearing will be performed mechanically using a forestry mower/mulcher or its equivalent and/or by using hand or powered tools such as machetes, brush hooks, or powered circular saw type weed cutters.

3.4 Geophysical Investigation Plan

This GIP describes the project requirements for all activities related to geophysical operations and those tasks that rely on geophysical data and interpretations. The plan also explains how the proposed methods and procedures will be tailored to anticipated site conditions, technical requirements, applicable safety and security regulations, and strategies. This GIP follows the guidelines specified in USACE DID Number MMRP-09-004, Geophysics (USACE, 2009a).

3.4.1 Geophysical Data Quality Objectives

The geophysical DQOs are based on USACE EM 1110-1-4009 Military Munitions Response Actions (USACE, 2010a). The geophysical DQOs establish acceptance criteria concerning sensor performance, navigation accuracy, data density, data processing standards, and anomaly selection criteria to meet the minimum goals for the investigation. These criteria are listed in detail in **Section 4.3.5**. Metrics will be confirmed or appropriately adjusted based on the results of the GSV.

3.4.2 Geophysical Investigation Approach

FPM's geophysical team will perform 100% DGM coverage survey at the MRS. G-858 sensors will be deployed at the RR869a MRS, for geophysical data collection. However, in the case capabilities of magnetometers are impacted by site conditions, EMI sensor EM61 will be used for DGM data collection. DGM data will be collected in a grid configuration with nominal line spacing of 0.6 m for G-858 to facilitate 100% coverage. Prior to conducting the survey, grid corner coordinates will be exported from the GIS system for location in the field. Grid-based data will be reviewed in GIS, overlain on the survey grid layout, and QC inspected to verify the quality of the data. The sensor positioning at the MRS will be accomplished using the RTK-GPS.The USACE DID Number MMRP-09-004 (USACE, 2009a) shall be used in association with EM-1110-1-4009 (USACE, 2010a) Chapters 6-9 as guidance for DGM operations.

The use of G-858 as a primary MEC/MPPEH detection tool at the RR869a Debris Field MRS is based on the types of munitions found at this site during the CSE Phase I and II. In general, the magnetometer represents a more robust system for detecting and mapping munitions of interest at greater depths. The magnetic system that will be employed at the MRS will be comprised of two or more G-858 sensors separated horizontally by 0.6 m in order to increase the productivity of data collection.

3.4.3 Equipment

3.4.3.1 Geometrics G-858 Cesium Vapor Magnetometer

The G-858 is used for detecting and mapping ferrous metallic objects by measuring the net strength of the total magnetic field simultaneously within two optically pumped cesium vapor sensors. The total magnetic field includes the Earth's geomagnetic field [approximately 48,466 nanoTeslas (nT) at Holloman AFB location] and any anomaly generated from nearby ferromagnetic material. The G-858 is comprised of a belt-mounted display and logging console connected to two cesium sensors mounted on a hand-held counterbalanced staff. The console contains electronics to acquire magnetic field data with position and displays them on a liquid crystal display screen for review and edit. The G-858 consists of three items: (1) a photon emitter containing a cesium light emitter (lamp); (2) an absorption chamber containing cesium vapor and a "buffer gas" through which the emitted photons pass; and (3) a photon detector, arranged in that order. Essentially, when the sensor encounters a perturbation (quantum energy) from a local magnetic source (e.g., 60-mm ordnance), this energy may hit one of the cesium atoms and cause it to jump into a new energy state, which may, in turn, absorb a photon from the cesium emitter. If this is the case, it will cause a decrease in the number of photons reaching the detector and this decrease can be easily recorded as a measure of the magnetic anomaly.

A magnetic base station consisting of a single G-858 sensor and microprocessor console will be established in an area away from vehicle or pedestrian traffic, and clear of surface and subsurface

cultural interference (e.g., metallic debris, fencing, and utilities). The base station console will be time-synchronized with the mobile field system console daily. The base station data will be later used to correct for diurnal variations in the Earth's magnetic field during the time of the G-858 surveys.

3.4.3.2 Electromagnetic System (Contingency Plan)

The Geonics EM61 is a high-resolution time-domain electromagnetic system that can detect electrically conductive objects. The basic elements of an electromagnetic sensor are a transmit coil and a receive coil. A current pulse running through the transmit coil creates the primary electromagnetic field. Changes in this primary field set up eddy currents in the object, under the sensor. The eddy currents produce a secondary or induced electromagnetic field emanating from the object. This induced electromagnetic field is associated with the decay of eddy currents in metal objects near the sensor and is measured by the receiver coil, the output signal being proportional to the rate of change of the electromagnetic flux through the receiver coil. The receiver is timed to measure the signal within four time gates (216, 336, 660, and 1,266 microseconds) after the current pulse in the transmitter loop is completed. The four time gates allow discrimination between different types of targets based on the time-decay rate of the response. A measurable response in milliVolts (mV) implies that a metal object is present, and the profile of that response can be used to estimate the object's size. The EM61 can record up to 12 records per second with four time gates per record.

An EM61 system consists of a pair of 0.5- by 1.0-m coils. The lower coil is both a transmitter and receiver and the upper coil is exclusively a receiver coil. The lower coil is located 0.42 m above the ground surface for optimal data collection using the standard wheel mode, and the upper coil is 0.30 m above the lower coil. The EM61 is fully equipped for simultaneous logging of GPS and electromagnetic data.

3.4.3.3 Real-Time Kinematic Global Positioning System

A Trimble R8 RTK-GPS will be utilized as the positioning system used during the DGM data collection. The RTK-GPS is a dual frequency system that utilizes a code-based measurement technique. The system is equipped with on-the-fly ambiguity resolution which allows receivers to collect high-quality solutions very quickly and without complicated initialization procedures. The RTK-GPS base station will be set up based on benchmarks established by U.S. National Geodetic Survey or another suitable control point established by a licensed surveyor.

3.4.3.4 Integration of Geophysical and RTK-GPS Data

Geophysical survey data linked with RTK-GPS will provide real-time positional control. The data will be acquired by linking the RTK-GPS to the G-858 console (2 sensors) or to the to the field Personal Computer (PC) computer (for system comprised of more than 2 sensors). An RS-232 data cable will serve as the communication bridge between the RTK-GPS and the respective data logger. Positional data will be sampled and recorded at a rate of 1 sample per second or 1 Hz. The RTK-GPS will be configured to output a National Marine Electronics Association (NIMA) data string utilizing the Global Positioning System Fixed Data format to the geophysical data logger.

Geophysical survey data linked with RTK-GPS will provide real-time positional control. The data will be acquired by linking the RTK-GPS to the G-858 console. An RS-232 data cable will serve as the communication bridge between the DGPS and the data logger. Positional data will

be sampled and recorded at a rate of 1 sample per second or 1 Hz. The Trimble® GPS Pathfinder® ProXRT will be configured to output a National Marine Electronics Association data string utilizing the Global Positioning System Fixed Data format to the geophysical data logger.

3.4.4 Geophysical System Verification

A GSV (Nelson *et al*., 2009a) will be used to confirm that the geophysical detection system is functioning properly and will provide ongoing monitoring of production work to verify the surveys are being performed correctly. A GSV includes an initial instrument demonstration, identification of background noise levels, daily QC checks, and a BSP. This physics-based verification of sensor performance originates from a large database of Geophysical Prove-Out (GPOs) executed on a variety of site conditions and a better understanding of the capabilities and limitations of common geophysical detection systems over the years, as well as development of reliable models for the signals expected from common sensors. The GSV is effective because the sensor that will be used in the survey (G-858 or EM61[contingency plan]) obey well-defined basic physics principles. The USACE-accepted GSV is generally intended to replace the empirical GPO previously used to verify performance of geophysical systems under controlled conditions near the work site. The GSV is not intended to replace current QC practices; it will be added to existing DGM QC and QA procedures.

The GSV is comprised of two main elements: an IVS and a BSP. Both an IVS and a BSP will be utilized during the RI at the MRS to verify the performance of the geophysical system.

3.4.4.1 Instrument Verification Strip

The objectives of the IVS are to verify that the geophysical detection system is operating as designed, to capture levels of background noise due to site conditions on a daily basis, and to streamline daily QC checks. The IVS can be performed using the responses from ISOs (surrogates for munitions) described in **Table 3-2** due to the G-858 responses of different targets scale in a well-defined, calculable way (Nelson et al., 2009b).

Table 3-2 ISOs Characterized for Use as Munitions Surrogates

Item	Nominal Pipe Size	Outside Diameter	Length	Part Number*	ASTM Specification
Small ISO	1”	1.315” (33 mm)	4” (102 mm)	44615K466	A53/A773
Medium ISO	2”	2.375” (60 mm)	8” (204 mm)	44615K529	A53/A773
Large ISO	4”	4.500” 115 mm	12” (306 mm)	44615K137	A53/A773
* Part number from the McMaster-Carr catalog					

IVS for G-8585

The IVS for G-858 will be composed of four (4) linear tracks 24 m in length. Two large ISOs will be emplaced at a depth of 7 x the diameter in two different orientations (perpendicular and parallel to the Earth's magnetic field). In addition, two ISOs will be 12 m apart which will provide site-specific noise measurements during data collection at the IVS. The chosen depth will ensure a high signal to noise ratio (SNR) on the sensor measurements (in general, an SNR of 3 to 5 is required for reliable detection).

IVS for EMK61

The IVS for EM61 will be composed of four (4) linear tracks 30 m in length (Figure 3.5). Six (6) ISOs (three [3] of each, medium and small) will be emplaced at two (2) different depths measured to the center of the items (depth of 5 x, and 3 x the diameter for medium and small ISOs, respectively) and three different orientations (vertical, horizontal across track, and horizontal along track). In addition, the ISOs will be emplaced with a spacing of 5 m which will also provide a site-specific noise measurement during the strip. The physics characteristics of the chosen ISOs will be sufficiently similar to the targets of interest such that they can be detected and used to verify that the system is operating properly. The two (2) depths are chosen to ensure a high SNR on the sensor measurements. The location and depth of the IVS items will be measured at the middle and the depth measured to the center of the items, respectively, to a precision of ±0.02 m.

3.4.4.2 IVS Data Collection Procedures

The IVS location will be identified on the first day of operation and will be chosen to represent typical soils, geology and vegetation. A background DGM survey will be performed at the location to verify the area chosen is free of anomalies. If the test strip's location is cluttered with buried metal items, the area will be cleared of those items and the background DGM test repeated, or another location will be selected for establishing the IVS, and the process repeated. Once the DGM background data are determined to be suitable for constructing the IVS, the ISOs will be buried along one line and their depth and location measured to the center and at the middle of the items, respectively, recorded to a precision of ±0.02 m.

The IVS protocol for the first day for the G-858 (EM61, contingency plan) sensor will include the following:

- One line of data will be collected with the sensor passing directly over top of the items. This will provide the peak signal measurements to confirm sensor operation.
- Two additional lines of data will be collected, the first offset from the center by half the planned line spacing and the second by the full line spacing in the same direction. This will provide confirmation that the line spacing is sufficiently close to detect the targets of interest.
- A line of data will be collected offset from the center by the planned line spacing in the other direction. The three lines of data collected as prescribed for field data collection can be used to produce a two-dimensional map to confirm geolocation accuracy in both directions and check for latencies in the data.
- A line of data will be collected offset from the IVS to measure site noise.

The noise measurements will be made along line that is more than 6 m for G-858 (2m for EM61 [contingency plan]), far from the buried targets so that their signals do not contaminate the measured noise background. This line will not contain discrete anomalies or non-representative terrain or geology that will affect the instrument. Noise measurements will determine whether targets of interest can be detected reliably to their depth of interest under the site conditions.

In addition, the survey crew will be required to survey the test strip at the beginning and end of each day. This will be a simplified survey, two passes in opposite directions over the line of emplaced targets to confirm sensor operation and one pass over the line for noise measurement. Continuous noise monitoring throughout the production data will indicate whether the conclusions from the IVS measurements will apply throughout the site. Note if multiple sensors are utilized for surveys, the above described procedures for the first day and all fieldwork days will be followed for each sensor.

3.4.4.3 Blind Seeding Program

A BSP will be performed as an integral part of the GSV. The main purpose of the BSP is to provide ongoing confirmation that targets of interest can be detected and recovered. In order to serve as an effective QC procedure, the BSP includes placement of known objects at surveyed locations that are blind to the survey, data processing, and anomaly resolution teams at sufficient frequency that they are useful for daily quality checks under the actual conditions of the site. Seed items must be available, affordable, well characterized, and representative of the items of interest at the site. They should be planted such that measured signals for known objects are within the expected detectable range of the sensors, and further that the signals are detectable above measured site noise.

For the BSP at the MRS, the number of small and medium ISOs emplaced in grids will depend on the production rate and will be chosen so that at least one seed is encountered per DGM crew per day. The planned locations for seeds will be flexible so that they may be emplaced safely. Anomaly avoidance will be practiced in the burying of seeds, and all procedures will be in compliance with relevant safety guidelines. The depth for small and medium ISOs will be ~3 times and ~ 5 times their diameter, respectively. All depths will be defined based on center to the object. All buried ISOs will have vertical orientation.

3.4.4.4 GSV Results

Since the response as a function of depth and orientation has not been published for the G-858, the FPM DGM team will build a database during the first day of surveying at the IVS which will define the boundaries for magnetic response of the ISOs. The database will be developed based on the measured results from two (2) large ISOs. The depth, orientation and distance between ISOs are specified in **Section 3.4.4.1**. Magnetic data will be collected using two or more sensors along the central line. This data collection will be repeated five (5) times for each sensor. We will take the average of the total field resulting from all repeated measurements over the IVS to determine the range of responses for the item (average ± 20%). In this manner, the geophysics team can provide a quantitative verification that the magnetic system is working properly.

Comparison of the IVS results to FPM's database (or to published results for EM61 [contingency plan]) will provide the following information:

- Whether the targets of interest are detectable to the depth of interest in the presence of the measured survey noise, and

- Whether the data are being collected correctly.

For the BSP, for each grid that contains a seed, the QC geophysicist will determine whether the seed(s) made it to the target list. If so, the QC geophysicist will ensure that the location accuracy is within contract specifications and, after the anomaly has been dug, make sure that the correct item (or items if this was a stacked seed) is recovered. If the seed is not on the target list, the QC geophysicist will begin a root cause analysis. Questions to be asked include:

- Is there a geophysical signal at the seed location that should have been picked?
- Is there an anomaly but is it below the selected threshold?
- Is there an anomaly remaining that was below a shallower anomaly (stacked seed)?
- Is there a sensor location issue?

The failure to detect a seed target will allow a project team to recognize if problems exist and undertake corrective action while still in the field.

3.4.5 General Field Procedures

Procedures will be followed to help facilitate the collection of accurate and reliable geophysical data. Most important is the proper operation and function of the geophysical instruments, and proper function of the positioning equipment. Tests will be conducted daily to assess those functions. The QC procedures will include allowing the equipment a proper warm-up period of a minimum 15 minutes as well as completing static, spike, relaxation, cable shake, personnel, latency, and positioning tests to ensure accuracy and repeatability of collected field data. All of these QC tests are summarized in **Sections 4.4.1.1** and **4.4.1.2**. Failed components will be repaired or replaced. QC checks will be recorded electronically, and included as part of the geophysical data deliverable. A separate Geosoft Database including all of the IVS results will be maintained. The main elements and general sequence of the field procedures are:

- The geophysical team will be familiar with the RI WP.
- Shape files and points of interest will already be uploaded into the DGPS and RTK-GPS controller so that the field operator will be able to see his/her position and the corresponding background in real time.
- Visual checking of the instruments for possible mechanical damage will be performed, and the team will check that the batteries are charged.
- Geophysical and navigational instruments will be set up.
- Both the RTK-GPS and DGPS will be checked for proper functioning and positional accuracy tested at a known control point(s).
- After warming up equipment, opening QC tests will be conducted.
- The results of QC tests will be written on daily QC forms (**Appendix E**).
- If QC tests are checked as “Pass,” the operator may begin with the IVS.
- If the results of the IVS are within the predicted bounds identified in the initial IVS testing results, the operator may begin data collection.

- Data collection, with obstacles and deviations from planned survey path will be documented and recorded in the field log (**Appendix E**).

Two or more G-858 sensors will be mounted horizontally, with a nominal sensor separation of 0.6 m, and nominal height of approximately 0.25 m above the ground surface.

A magnetic base station consisting of a single G-858 sensor and microprocessor console will be established in an area away from vehicle or pedestrian traffic, and clear of surface and subsurface cultural interference (e.g., metallic debris, fencing, and utilities). The base station console will be time-synchronized with the mobile field system console daily. The base station data will be later used to correct for diurnal variations in the Earth's magnetic field during the time of the G-858 surveys.

If EM61 is used for data collection (contingency plan), data will be collected along survey lines spaced 0.5 m apart using either a single coil, wheeled, man portable system or multi-coil towed array. The coils of the EM61 will be oriented with the long axis perpendicular to the direction of travel. Data will be recorded using a Juniper Allegro data logger.

The average velocity of data collection is 1 meter per second (1m/s). Using a collection rate of 10 Hz, the sampling interval will be approximately one reading per 0.01 m. This data density provides adequate coverage to satisfy the project DQOs, and the performance standard of 98% of the collected data being less than 0.25 m apart will be met.

The geophysical sensor will be coupled with an RTK-GPS for real-time sensor positioning. The RTK-GPS base station will be set up based on benchmarks established by U.S. National Geodetic Survey or a licensed surveyor. A Trimble R8 Rover will be interfaced with the data logger to record positional data coincident with instrument readings. Correction data will be radio transmitted from the base station to the R8 rover. The GPS readings will be recorded at a rate of 1 Hz. The positional information will be logged in the Projected Coordinate System; North American Datum 1983 (NAD83), Universal Transverse Mercator (UTM) Zone 13 North and recorded in meters.

- Subsequent to collecting data, both the closing QC tests and IVS will be performed.
- Results will be written on the QC form (**Appendix E**).
- At the end of the day all instruments and cables will be visually checked.
- All batteries will be recharged.
- DGM production data will be downloaded, backed up, and sent to the data processor.
- Daily IVS and QC data will be sent to the QC Geophysicist.

3.4.6 Geophysical Data Processing and Analysis

3.4.6.1 G-858

The G-858 and positional data will be processed and interpreted using Geometrics MagMap 2000 and Geosoft Oasis Montaj®. The data will be processed and interpreted as appropriate to meet QA/QC requirements. Subsequent to data acquisition, all field data will be downloaded to a PC and backed up daily to an external hard drive or equivalent as well as electronically transmitted to our San Antonio office server for back up to a central server.

The overall-processing stream for G-858 data will be accomplished using the following steps:

- Raw binary geophysical data will be downloaded from the magnetic system to a PC.
- Raw G-858 binary geophysical data will be converted to Geosoft *.xyz files in Geometrics MagMap.
- Positional offset correction for sensors will be performed.
- The initial QC checks will be conducted to verify that personal and shake tests passed.
- Geophysical sensor data will be evaluated for spikes, gaps, and sensor failure.
- Heading corrections will be applied (using results obtained from QC octant test).
- Analyzing the noise spectra using different filters (e.g., low pass, non-linear, Euler or Werner deconvolution and Wiener optimal filter) may be utilized to alleviate possible effects of magnetic soil and other cultural ferromagnetic sources.
- Positional and sensor data sets will be merged.
- A demedian filter will be applied to the geophysical data to remove sensor drift, regional trend, and level the data to a zero baseline (a 150-point average will be used for the magnetic data).
- The total field analytic signal will be gridded using a minimum curvature gridding function with a 0.09-m cell size.
- Data will be displayed on the maps in gridded format as 2-dimensional polynomial function displayed using a color scheme where the response to the object shows up as an isolated feature or "anomaly" above the background level.

All processing steps will be documented so that results can be checked and procedures verified.

3.4.6.2 EM61 (Contingency Plan)

Geophysical sensor and positional data will be processed and interpreted using Geonics DAT61MK2, and Geosoft Oasis Montaj®. The overall-processing stream for EM61 data will be accomplished using the following steps:

- Raw binary geophysical data will be downloaded from the EM61 data logger to a PC
- Data spikes will be removed.
- The geometry of geophysical system and GPS will be included in the data.
- Data will be converted to Geosoft *.xyz files and imported in Oasis Montaj.
- The following initial QC checks of the data will be performed to verify the quality and/or identify substandard values:
  1) The QC forms will be checked for personal and shake tests
  2) The latency correction will be calculated using latency test
  3) Data will be checked for spikes
  4) It will be verified whether the data are within the expected range.

- The static/standard test will be evaluated for QC compliance.
- The data will be latency and drift corrected. Only the GPS data with quality factor 4 will be used, and when possible the remaining data will be interpolated. All data falling below required positioning standards will be recollected.
- The noise level will be checked using the fourth differential.
- Different filters (e.g., low pass, non-linear, Euler or Werner deconvolution and Wiener optimal filter) may be utilized to help alleviate the effect of the soil and cultural EM sources.
- A dynamic background will be calculated based on three (3) standard deviations and the production data will be sub-set to include only those data that satisfy normal decay Channel 1 > Channel 2 > Channel 3 > Channel 4.
- Drift corrections will be performed using demedian correction.
- The sum of all channels will be calculated.
- The channel 2 or the sum of all channels will be gridded using a minimum curvature gridding function with a 0.10-m cell size and 0.4-m blanking distance.
- Gridded data will be plotted and non-systematic lag correction will be performed if needed.
- Maps will be made and data will be displayed in gridded format as 2-dimensional polynomial function using a color scheme where the response to the object shows up as an isolated feature or "anomaly" above the background level.

All processing steps will be documented so that results can be checked and procedures verified

3.4.6.3 Target Selection

The most common, standard approach to select anomalies is referred to as “threshold picking.” Often these approaches are applied in a simple manner and base anomaly selections are performed using the automated tools described below. However, recommended approaches use either a more sophisticated method to detect and select anomalies, or a phased approach to first detect above-background measurements and then quantify one or more anomaly characteristics to select anomalies onto dig lists based on multiple criteria.

The targets will be picked using the following steps:

- Magnetic anomalies that have large magnetic footprints will be selected from the final analytic signal grid and magnetic residual total field grid utilizing a 1-pass smoothing (Hanning).
- If EM61 is used for DGM data collection (contingency plan), EM anomalies will be selected from the gridded data (filtered channel 2 or sum of all channels) utilizing a peak-picking algorithm (Blakely test) and using a 1-pass smoothing (Hanning) filter.
- A grid value cutoff level (threshold) for the G-858 (or EM61 [contingency plan]) will be determined in agreement with MRS-specific requirements.

- The locations of all known cultural features recorded during the survey will be plotted on the same map as the data. All anomalies that are in close proximity to those features will be masked and excluded from target selection. Note FPM will coordinate with the HAFB Restoration Project Manager to temporarily remove the portion of the fence bordering the RR869a MRS to avoid fence interference during both the G-858 data collection and reacquisition of targets selected for intrusive investigation
- Additional targets will be manually selected from the portion of the data with the signal strength that is within 5% of the required threshold. Analysis of the anomaly footprint (i.e., anomaly size), and shape and time decay of these anomalies will be used for this target selection as well.

3.4.7 QC Control

All QC aspects of the GIP discussed in this section were developed IAW DID MMRP-09-004 (USACE 2009a) and EM 1110-1-4009 (Chapter 9) (USACE 2010a) requirements and are described in detail in **Section 4.0**.

QC inspections/surveillance points to be performed during the IVS include area selection, seed item placement and survey, repeat data, and static position test QC checks. All IVS QC actions will be reviewed and confirmed by the QC Geophysicist.

QC inspections/surveillance points performed as part of the geophysical investigation include equipment maintenance, instrument standardizations checks, battery strength checks, positioning accuracy test, warm-up test, personnel check, cable shake test, static test, standard instrument response test, static system relaxation test, latency test, repeatability test, along line measurement spacing, processed data checks, database checks, anomaly selection, and anomaly reacquisition. All geophysical investigation QC actions will be reviewed and confirmed by the QC Geophysicist.

QC inspections/surveillance points performed as part of the target anomaly verification include checks to verify that the UXO team resolved the target anomalies. Verification of target anomalies includes determination of:

- Anomaly Type (e.g., UXO, DMM, MD, Range Related Debris (RRD), Other Debris, False Positive, No Dig/Utility).
- Anomaly Description and quantity (e.g., 1 rebar, 5 nails, wire, MK3, Projectile 75 mm).
- Object Depth to Top.
- Estimated Object Weight (kilogram [kg]).
- Estimated Object Dimensions (Length/Width/Thickness)
- Physical Condition of MEC (Intact, Broken Open, Filler Visible)

Verification of the target anomalies will be performed by the Field Geophysicist/UXO technician and reviewed by the Project Geophysicist/SUXOS.

3.4.7.1 Final Processed Data Format and Storage

The Final Processed Data will be produced and presented in American Standard Code for Information Interchange (ASCII) formatted files and native Geosoft format (.GDB). Final

processed data is defined as data that represents, to the best of FPM's ability, the true anomaly amplitude that exists at each anomaly location measured by the geophysical system. Final processed data will have all corrections applied needed to correct for positioning offsets, instrument bias (including instrument latency), instrument drift and diurnal magnetic variations (magnetic method). Advanced processed data is defined as Final Processed data that has been subjected to additional advanced processing techniques and was used in the anomaly selection process. All corrections and processing steps will be documented. Metadata for final processed and advanced processed data will include UTM zone and coordinate units, and descriptions and units of all "z" values, which are the data associated with each measurement event. All measurement events will have a time stamp. Unprocessed, interim-processed, final processed, and advanced processed (if used) "z" values shall be included in a single file. Data file size will be limited to 100 megabytes or less, and the file length will be limited to 600,000 lines or less. Each data file will be logically and sequentially named so that the file name can be easily correlated with the project-specific naming conventions.

3.4.7.2 Map Formats

For submittals, maps will be provided in editable Geosoft form and map images (.map) will be provided in image format (.jpeg) for viewing and include grid (.grd) files. Maps will include the following basic map features in addition to other necessary site information.

Selected anomalies and known features will be marked with symbols on the map. Map scales will be even multiples of the base units presented in the map. Map sizes will be designed to fit standard printer or plotter sizes. Grid ticks or grid lines will be visible and labeled.

The title block will include the figure number, map title, and sub-title and location of the information being presented. Objects/symbols shown on the map will be identified in a legend. A map scale bar, coordinate system, and north arrow will be included. Color scale bars will use a color scheme that clearly differentiates between anomalies and background readings. Background values will be plotted in white or gray. A classic "cold to hot" color scale will be used with negative values plotted in blue and high positive values plotted in red or pink. The range of values will be "fixed" so that the same color scale is utilized across the site.

Additional project information provided in boxes will include at a minimum the following information:

- Client,
- Project,
- Contractor,
- Map approver, and
- Date created.

3.5 Geospatial Information and Electronic Submittals

The Geospatial Information and Electronic Submittals Plan details the site-specific survey, mapping, aerial photography, computer-aided drafting and design/GIS, and electronic submittals required for the RI.

3.5.1 Control Points

Survey points will be tied to an established network of monuments with horizontal and vertical control of "Class I, Third Order" or better. Horizontal control will be based on the metric system and referenced to the NAD83 and the UTM Grid System. Surveying and mapping requirements will meet the minimum standards set forth in USACE EM 1110-1-1004, Geodetic and Control Surveying (USACE, 2002). Newly established control points and recovered monuments will be of a permanent nature for recoverability during future phases of work within the same project. Control points will be iron or steel pins, concrete monuments, or other permanently constructed points. Installation of control points and monuments will meet minimum standards set forth in USACE EM 1110-1-1002, Survey Markers and Monumentation (USACE, 1990a).

3.5.2 Geographic Information System Incorporation

Spatial data created as part of the RI will be submitted in an Environmental Sciences Research Institute (ESRI)-compliant format (shape files, coverage's, or geodatabase). Supporting tabular data will be submitted in either Microsoft® Excel or Access format.

3.5.3 Computer Files and Digital Data Sets

Final document files (e.g., reports and associated figures and tables) generated will be submitted in PC-compatible Microsoft Office 2000® or higher software and in Adobe Portable Document Format. Final GIS data generated will be submitted in non-proprietary spatial data transfer standard format at the close of the project, as well as in the ESRI shape file format.

3.6 Fieldwork Contingencies

The fieldwork contingencies include two additional approaches if the removal of all DGM anomalies detected during the RI is not a feasible option for the follow-on NTCRA:

(1) VSP statistical module will be used to provide 95% confidence of MEC/MPPEH potential on the site. This approach includes the dig sheet development (VSP-derived number of randomly selected anomalies for intrusive investigation), reacquisition of targets selected for intrusive investigation, and intrusive investigation of these targets. The acreage reduction determination for the MRS will be performed based on intrusive investigation. All DGM anomalies detected at the remaining portion of the site will be intrusively investigated during the follow-on NTCRA.

(2) Deployment of the MetalMapper for ranking of the RI DGM anomalies to classify sources of geophysical anomalies as targets of interest or non-hazardous items. This approach will provide the reduction of the total number of anomalies for intrusive investigation during the follow-on NTCRA.

3.6.1 Dig Sheet Development

The Anomaly, Dig Selection & Intrusive Results Tables will be submitted digitally in a Microsoft Access Database IAW DID MMRP-09-004-Attachment B (USACE 2009a). The Dig Sheets will include all anomalies from the Anomaly Table that have been selected for intrusive investigation.

The initial number of targets that need to be intrusively investigated will be determined using the "Anomaly Verification Sampling" Statistical Analysis module of the VSP software. This module works as follows. If there are N anomalies in anomaly table, we will make an

assumption that *M* out of these *N* anomalies are MEC. Then, if we pick *n* anomalies at random without replacement out of *N*, this statistics will give the probability P (*m*) that exactly *m* out of *n* anomalies are MEC. This probability is given by

$$P(m) = \frac{\dfrac{M!}{(M-m)!}\dfrac{(N-M)!}{(N-M-n+m)!(n-m)!}}{\dfrac{N!}{(N-n)!n!}}$$

Once the number of anomalies that need to be initially excavated is established, targets for intrusive investigation will be randomly selected from the anomaly table to be representative of that particular area. Depending on the dig results in the field, the initial assumptions will be adjusted (i.e., the iterative approach will be applied until the final dig list is completed). The final dig list will indicate that, after excavating a specific number of targets, a 95% confidence level of MEC potential on site has been achieved.

3.6.2 Anomaly Reacquisition

G-858

Anomaly reacquisition for G-858 will be conducted using the following procedures:

- The Project Geophysicist will use the final dig list of target locations to generate a target relocation table. The table will include each target's maximum and minimum values of total magnetic field ($\Delta B = B_{max} - B_{min}$) to help facilitate target relocation in the field.
- The Project Geophysicist will transmit the target relocation table to the Site Geophysicist, and the targets will be relocated using the RTK-GPS.
- After locating the target, the geophysicist will use the G-858 to locate the two peaks of the dipole. If the dipole is symmetric, the flag will be placed at the mid-point between two peaks. If the dipole is asymmetric (the dominating peak is usually positive), the flag will be placed closer to that peak. Finally, the direction between the flag and position determined with DGPS as well as its distance will be recorded.

An example of Anomaly Reacquisition Table for the G-858 is provided in **Appendix E**.

EM61 (Contingency Plan)

Anomaly reacquisition for EM61 will be conducted using the following procedures:

- The target lists will be given to a Site Geophysicist who will relocate the targets using RTK-GPS.
- After locating the target, the geophysicist will use the EM61 to locate the peak of the response. He/she will pass over the anomaly in two (2) perpendicular directions to locate the response peak as accurately as possible. However, the EM61 readings will be recorded while passing in the direction parallel to data collection since the best correlation can be achieved with the previous data collection. Then, the flag will be placed at determined position.
- The search radius will be up to ~1.5 meters around the anomaly identified during data collection. If multiple peaks are identified at the time of anomaly reacquisition, those

locations will be flagged in the field and the results documented on the reacquisition target list.

- Finally, the direction between the flag and position determined with RTK-GPS, and its distance, will be recorded.

An example of Anomaly Reacquisition Table for both G-858 and EM61 is provided in **Appendix E.**

3.6.3 Intrusive Investigation Plan

Intrusive activities (if performed) will be completed IAW the RI WP, and DDESB-approved ESS. All excavation operations will be conducted IAW Air Force (AF) guidance document Air Force Manual (AFMAN) 91-201 (AFMAN, 2011), USACE EM 385-1-1 Safety and Health Requirements Manual (USACE, 2011), USACE EM 385-1-97 Explosives Safety and Health Requirements Manual (USACE, 2010b) and Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1926 Subpart P.

3.6.3.1 Target Anomaly Sampling Locations

UXO personnel will excavate subsurface geophysical targets identified as a result of the DGM surveys and data evaluation efforts, and picked for excavation using the RI DQO methodology. Therefore, MEC/MPPEH sampling locations will be generally along the same paths that the geophysical investigation teams used to collect the subsurface data. During the field activities, revised field maps will be generated that illustrates the actual paths taken with anomaly points picked form MEC/MPPEH sampling for use by field crews and QC personnel.

3.6.3.2 Target Anomaly Investigation Procedures

A UXO excavation team will perform intrusive investigation. Intrusive activities will not begin until the UXOSO has given a safety briefing, the UXO Team Leader has given a site-specific safety briefing to their team, communications are established with the field command post, and all non-essential personnel are evacuated from the area outside the specified MSDs.

Exclusion Zones (EZs) will be established IAW the approved ESS during MEC operations. The establishment of EZs may require posting of security watches, or physical marking of the zone to confirm that non-essential personnel do not enter. Essential personnel and authorized visitors as defined in AFMAN 91-201 (AFMAN, 2011) will be allowed within the EZ. If non-essential or unauthorized personnel enter the area, intrusive investigations will cease.

If intrusive investigations must occur within the Hazardous Fragmentation Distance (HFD) listed in **Table 3-1**, appropriate and applicable engineering controls will be used. If engineering controls cannot be implemented, any public roadways within the HFD areas will be evacuated and/or roadways blocked to prevent non-essential personnel from entering during intrusive investigations of the anomalies.

Hand excavation will be the primary intrusive method, and will be performed using hand trowels or shovels. Schonstedt magnetometers will be used to assist the team in determining the location and orientation of the anomaly item. The UXO team personnel excavating an anomaly shall initially remove no more than a 6-inch layer of soil at the location of the anomaly. A visual and electronic search of the excavation shall then be made. This process shall be repeated until the audible signal from the instrument indicates the object is close to the surface of the excavation. Once this determination has been made, soil will be removed by hand until the anomaly is

located. Heavy equipment may be used in some areas where appropriate, including areas of very dense anomalies or if large, heavy items are discovered. It will be used to remove the immediate overburden from atop anomalies. Heavy equipment will not come in contact with the target anomaly. The intrusive anomaly investigation team will refine and pin-point each excavation location utilizing hand-held detectors (magnetometer and/or electromagnetic). Prior to excavations, each work area will be evaluated for underground utilities by the SUXOS and the UXOSO.

If the subsurface contact proves to be non-MEC, the item will be removed and the excavation rechecked by the UXO technician using the Schonstedt magnetometer. If the hole is "clean," (i.e., negligible response with Schonstedt) it will be refilled and tamped. If the subsurface contact is MEC, procedures developed in the ESS will be implemented. To verify all source items are investigated, the area within a diameter of 1 m centered on the target location will be checked by the UXO technician using a Schonstedt to verify no other metallic items exist within this area. This is required since the primary geophysical anomaly (target) could mask additional anomalies. All access/excavation/detonation holes will be backfilled with the soils excavated from the hole.

3.6.3.3 Accountability and Records Management

The UXO dig team will record results and dispositions of geophysical targets electronically, utilizing handheld Personal Digital Assistant (PDAs). Data recorded in each PDA will be downloaded daily by the Project Geophysicist/Data Manager and compared with specific geophysical data characteristics contained in the overall dig sheets to better refine the dig process as the RI progresses. Detailed records will be made of all MEC items encountered during the RI activities. This record will include the nomenclature (if applicable) type, approximate weight, depth, orientation, condition, and location of the item indicated. Excavated anomaly attributes will also be added to the project GIS database. The UXOQC will review the accuracy of the project GIS database.

The example of an Intrusive Results Table is provided in **Appendix E**.

3.6.3.4 Material Potentially Presenting an Explosive Hazard Inspection Process

The MPPEH inspection process is described in **Section 3.2.6.**

3.6.3.5 Personnel Qualifications

UXO personnel qualifications are presented in **Section 2.0**.

3.6.3.6 Munitions and Explosives of Concern Disposition

Disposition of MEC/MDEH items is described in **Section 3.2.7**.

3.6.4 Geometrics' Metal Mapper

The MetalMapper will be used during this RI to rank DGM anomalies if:

1. Removal of all anomalies detected using G-858 is not a feasible option for the follow-on NTCRA; and
2. Majority of detected anomalies represent isolated targets.

3.6.4.1 Description

The MetalMapper is an advanced electromagnetic induction (EMI) system configured for the detection and characterization of UXO. This technology represents a significant departure from existing commercially available EMI instruments for UXO detection. Although the MetalMapper can be used in the survey or mapping mode for target detection, it's most important application is for use as a system for "Cued-ID" target characterization. In the cued ID mode, data are acquired at one or more locations in close proximity to the target. Precision static measurements at these locations permit the calculation of the target characteristics. For isolated targets, a measurement at a single field point suffices. These target characteristics are then used to generate a prioritized dig list that identifies each target as either one that needs to be removed or one that is non-hazardous.

This system uses time domain electromagnetic principles to induce electrical currents in buried metallic objects and then measure the effects of those currents in receivers on the surface. It has three (3) orthogonal transmitter coils. Each is approximately 1 m x 1 m in size. One coil is oriented horizontally (Z coil) to generate vertical fields and the two other coils (X and Y) are mounted vertically orthogonal to each other. The Z coil is the only coil that is required during dynamic data acquisition. The X coil measure the electromagnetic fields in the "cross-line" direction or along the direction of travel and the Y coil is oriented to measure "in-line (perpendicular to direction of travel) electromagnetic fields. Each coil has a coil with 10 turns in order to generate the signals. Within the box containing the horizontal coil are seven (7) receiver cubes, each one containing three (3) orthogonal coils to measure the fields resulting in twenty one (21) different receiver coils. The receiver coils are oriented in the same manner as the transmitter coils. The transmitter coils are powered using a bi-polar half duty cycle and the time decay of the subsurface currents (transients) are measured during time off of the transmitter coils. The transmitter coils are activated in sequence and measurements are recorded in all 21 receiver coils, for a measurement where all transmitter coils are used, this will result in 63 different electromagnetic transients being recorded.

The system can be operated in static and dynamic mode. Static measurements are acquired when the system is stationary over a known target. It acquires the data over 8.328 milliseconds (ms) using all three transmitter coils. The other default measurement type is dynamic acquisition. This is intended for use while towing the MetalMapper over an area. In this mode only the Z coil is used and the decay is measured over .924 ms with only a single stack.

The MetalMapper will be operated in static measurement mode. The measurements will be performed in close proximity of all targets previously detected using the G-858 magnetic system. Precision static measurements at these locations will provide the calculation of target characteristics. First, target location and number will be loaded after which the data will be acquired. The acquisition of the data will be controlled by changing different parameters such as number and length of decays and transmitter coils used. The initial measurements will be made with the data constantly sampled at 250 kHz. This is significantly more information than required for analysis, and therefore, the data will be averaged over a window. Since the measured field falls off rapidly, data points will be sampled linearly in log time, so that the data will appear evenly spaced in a logarithmic scale. The same procedure will be repeated for all other targets detected in a particular grid.

3.6.4.2 Data processing and Library Based Classification

MetalMapper files will be directly imported to Geosoft Oasis Montaj using GX. The procedure for processing MetalMapper data in Oasis is as follows:

- Flag Identifications (IDs) will be imported onto Oasis target database
- MetalMapper data will be imported into Site Database
- MetalMapper data will be inverted
- Anomaly graphic will be made
- Comparison of polarization to UXO library will be made to look for targets of interest. Comparison will be made by ordnance type and by closest match.
- Classification will be performed using a rule-based approach

All processed anomalies will be separated in four (4) groups:

1. Likely non-targets of interest (non-hazardous, may remain in the ground),
2. Targets of interest,
3. Cannot decide (targets with axially symmetric response that do not match known munitions).
4. Cannot analyze ((lack of data due to a sensor-specific data gap, inversion fails to converge, and inversion produces unphysical parameters). Because no useful information regarding the nature of these targets can be extracted from the measured data, they must be treated as potential targets of interest.

Targets from the last three groups will be intrusively investigated during the follow-on NTCRA.

3.7 Munitions Constituents Sampling and Analysis

Based on historical information and previous investigations (**Section 1.6**), MEC/MPPEH items may be discovered at the RR869a Debris Field MRS. The objective of the MC sampling is to determine the presence or absence of MC contamination associated with such items and if present establish the contamination's extent. In addition, The CSE Phase II data indicates only minor undocumented usage of small arms at this site and does not indicate a potential lead or PAH concern. However, if during the RI a significant amount of shotgun shells and/or clay target debris is found sampling for related contaminant of concern (lead and PAH) will be conducted.

Soil samples will be collected using composite sampling at locations of identified MEC/MPPEH as well as in areas with significant amounts of MD. The sampling depths will be determined based in part upon the depth of MEC/MPPEH found during the intrusive investigation (if performed). MEC/MPPEH surface finds will result in only surface soil being collected because any resulting MC are expected to be close to the surface if soil is undisturbed. Conversely, subsurface MEC/MPPEH finds will result in subsurface soil being collected at the same location and depth of MEC/MPPEH and analyzed for MC. Note: Since the overall remedial objective for the RR869a MRS is a Site Closeout, MC soil sampling will be performed at locations of MEC items representing a low explosives hazard such as squib.

Sampling activities will be conducted with the support of a UXO escort providing MEC and anomaly avoidance IAW USACE EP 75-1-2, UXO Support during Hazardous, Toxic, and Radioactive Waste and Construction Activities (USACE, 2007). The sampling requirements, procedures, and chemical analyses are described below and in the UFP-QAPP (**Appendix D**). QA/QC procedures for the various sampling methods are also described in the UFP-QAPP (**Appendix D**). The NMED has recently revised its risk based Soil Screening Levels (SSLs) (NMED, 2012a). USEPA also publishes Regional Screening Levels (RSLs) (USEPA, 2014). The SSLs or RSLs as well as NMED approved Basewide background levels (NMED, 2012b) are employed to determine whether MC contamination exists. The project screening standards are summarized in **Table 3-3**.

3.7.1 Areas with Isolated Locations of Confirmed MEC

Surface and subsurface soil samples will be collected from areas containing isolated locations of confirmed MEC/MPPEH as well as in areas with significant amounts of MD using composite soil sampling techniques as described below. The samples will be submitted for laboratory analysis using USEPA Method 8330A for explosives and USEPA Method 6010C for metals (aluminum, antimony, chromium, copper, iron, lead, and zinc). The samples will be analyzed to determine if MCs have been released to the environment.

Composite soil samples will be collected using a seven-point “spoke and hub” method, in which six sub-samples are collected from a wheel shaped layout of two ft in diameter and a seventh sub-sample collected from the center of the wheel.

The procedure for sample collection is as follows:

- The intended sample location is laid out and recorded in the field log book. Prior to sample collection, don clean nitrile gloves and do not allow disposable sampling equipment to come in contact with potential sources of contamination.
- At each of the seven sub-samples locations, dig down approximately 6 inches using a disposable polyethylene scoop. The radius from the center sub-sample should be approximately 1 foot from the center sample.
- The soil from each sampling location is placed into a decontaminated stainless steel bowl or disposable polyethylene bag. The samples are then homogenized by hand mixing with a decontaminated stainless steel spoon or disposable polyethylene scoop until the sample color is homogenous.
- Once the composite sample is collected, the location will be documented and photographed; and GPS coordinates will be recorded.
- Once collected, the sample will be containerized as per the analytical laboratories requirements, labeled as specified in the SOP for Sample Handling, Documentation, and Tracking and placed in a cooler chilled to a maximum temperature of 4°C.
- The team will set aside a portion of the sample to use in logging a description of the soil characteristics (using the Unified Soil Classification System) in the field logbook.

Table 3-3 Soil Screening Levels

Analyte	Holloman AFB Soil Background Levels[a] (mg/kg)	Human Health Residential Soil Screening Value (mg/kg)			Ecological soil Screening Values (mg/kg)	
		USEPA RSLs[b]	New Mexico SSLs[c]	Recommended HH Soil Screening Values	LANL Ecological Benchmark[d]	Recommended Eco Screening Value
Nitroaromatics and Nitramines						
1,3-Dinitrobenzene	NA	0.62	NA	0.62	0.073	0.073
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	NA	15	NA	15	10	10
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	NA	15	NA	15	3.6	3.6
2,4-Dinitrotoluene	NA	1.7	15.7	1.7	2.5	2.5
2,6-Dinitrotoluene	NA	0.36	61.1	0.36	1.8	1.8
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	NA	6.0	58.2	6.0	7.5	7.5
Nitrobenzene	NA	5.1	53.5	5.1	1.31 +	1.31
Nitroglycerin (NG)	NA	0.62	6.11	0.62	71	71
2-Nitrotoluene (o-Nitrotoluene)	NA	3.2	29.1	3.2	9.9	9.9
3-Nitrotoluene (m-Nitrotoluene)	NA	0.62	7.82	0.62	12	12
4-Nitrotoluene (p-Nitrotoluene)	NA	25	244	25	22	22
Octahydro- 1,3,5,7-tetranitro- 1,3,5,7-tetra (HMX)	NA	380	3,910	380	27	27
Pentaerythritol tetranitrate (PETN)	NA	12	NA	12	100	100
1,3,5-Trinitrobenzene (sym-TNB)	NA	220	NA	220	6.6	6.6
2,4,6,-Trinitrotoluene (TNT)	NA	3.6	39.1	3.6	6.4	6.4
Trinitrophenylmethylnitramine (Tetryl)	NA	12	244	12	0.99	0.99
3,5-Dinitroaniline	NA	NA	NA	NA	NA	NA
Metals						
Aluminum	13,722	7,700	78,000	13,722[a]	NA	13,722[a]
Antimony	1.6	3.1	31.3	3.1	0.05	0.05

Analyte	Holloman AFB Soil Background Levels[a] (mg/kg)	Human Health Residential Soil Screening Value (mg/kg)			Ecological soil Screening Values (mg/kg)	
		USEPA RSLs[b]	New Mexico SSLs[c]	Recommended HH Soil Screening Values	LANL Ecological Benchmark[d]	Recommended Eco Screening Value
Chromium	25	12,000	1,170,00	12,000	28	28
Copper	13	310	3,130	310	15	15
Iron	23,049	5,500	54,800	23,049[a]	NA	23,049[a]
Lead	10.9	400	400	400	14	14
Zinc	54.6	2,300	23,500	2,300	48	48

Notes
HH = Human Health
LANL = Los Alamos National Laboratory
mg/kg = milligram per kilogram
NA = No value available
a – (NVB, 2011). Final Basewide Background Study Report Holloman Air Force Base, New Mexico.
b – (USEPA, 2014). Regional Screening Levels
c – (NMED, 2012). New Mexico Soil Screening Levels.
http://www.nmenv.state.nm.us/HWB/documents/NMED_RA_Guidance_for_SI_and_Remediation_Feb_2012_.pdf
d – Unless otherwise noted, the ecological screening value in this column represents the Ecological Screening Level (ESL) for soil developed by Los Alamos National Laboratory., (LANL, 2011). Ecological Screening Levels. Los Alamos National Laboratory Eco Database. U.S. Department of Energy.
+ No LANL ESL available for nitrobenzene. Soil screening level will be taken from: (USEPA, 2003). USEPA, Region V, Resource Conservation Recovery Act (RCRA) Ecological Screening Levels.
http://www.epa.gov/reg5rcra/ca/ESL.pdf.
e – USEPA Ecological Soil Screening Levels (EcoSSL) values were used preferentially over other sources of ecological soil screening values. If no EcoSSL was available, soil screening benchmarks developed by LANL will be selected for the ecological screening value.

3.7.2 PAH Sampling

Soil samples for PAH analysis will be collected using the seven-point "spoke and hub" composite sampling method following procedures described in the field SOPs presented in **Appendix D**. The number of soil samples collected will be dependent on the number of significant shotgun shells and/or clay target debris finds. We estimate that approximately 10 composite samples will be required at the RR869a Debris Field MRS. However, if no significant shotgun shells and/or clay target debris finds are located then soil sampling will not occur. The soil samples will be analyzed for metals (by USEPA 6010C) and for PAHs (by USEPA 8270D SIM) to determine if contamination posing a potential threat to human health and/or ecological environment is present.

3.8 Investigative-Derived Waste

This Investigative-Derived Waste (IDW) Plan describes procedures for handling and disposing of IDW generated during the RI field activities. This plan is applicable to IDW generated during MC sampling and does not apply to MEC/MDEH or MD.

Planned MC sampling activities include soil sampling using disposable sampling equipment, such as disposable polyethylene scoops. Sampling is not anticipated to generate IDW. PPE and other disposable sampling equipment will be bagged and temporarily staged for off-site disposal

IAW USEPA regulations. Sampling personnel will follow local and state protocols, as well as stakeholder guidance, in determining the proper disposal of PPE.

If site information necessitates the sampling of additional matrices and utilizing alternative sampling approaches, a change to this document will be completed detailing the IDW anticipated and procedures and protocols required for disposal.

3.9 Risk Characterization and Analysis

Following field work, a qualitative evaluation of explosive hazards for the RR869a Debris Field MRS will be performed. A MEC HA will be utilized for the MRS. Potential risk associated with the MRS will also be evaluated by conducting a MC HHRA and ERA. Site-specific preliminary CSMs were developed for the MRS as part of this RI WP. These CSMs serve as a starting point for the RI WP and were developed using site-specific information. The preliminary CSMs for both MEC and MC exposure pathway analyses are shown on **Figures 1-3** and **1-4**. These preliminary CSMs will be refined for the RI pending the outcome of the surface clearance, geophysical investigation, intrusive investigation, and MC sampling results.

3.9.1 Munitions and Explosives of Concern Hazard Assessment

This MEC HA ranks potential explosive hazards to human receptors at sites where MEC was identified during the RI. The MEC HA is a systematic approach to assess the potential acute explosive hazards at an MRS given current site conditions and under various cleanup or land use control alternatives. The qualitative HA technique presented here follows the USAF MEC Hazard Assessment Tool (MHAT) (USAF, 2011), which provides an assessment of the acute explosive hazards associated with remaining MEC at an MRS by analyzing site-specific conditions and human issues that affect the likelihood that a MEC accident will occur. The MEC HA method focuses on hazards to human receptors and does not directly address environmental or ecological concerns that might be associated with MEC. The process for conducting the MEC HA is described in the MEC HA interim guidance document (EPA, 2008) and the tool used to perform the calculations developed by the USAF and described in the MHAT user's guide (USAF, 2011).

Hazard Assessment Framework

The MEC HA was structured around three major components of potential explosive hazard incidents:

- Severity – the potential consequences of the effect on a human receptor should a MEC item detonate;
- Accessibility – the likelihood that a human receptor will be able to come in contact with a MEC item; and
- Sensitivity – the likelihood that a MEC item will detonate if a human receptor interacts with it.

Each of these three components was assessed by input factors collected from historical site information and field data collection. Each input factor has multiple categories, each of which is associated with a numeric score that reflects the relative contributions of the different input factors to the MEC HA. The factors are entered into the USAF MHAT. **Table 3-4** shows the input factor maximum scores and resulting weights.

These results should not be considered quantitative measures of explosive hazard; instead, the output places an MRS within one of four hazard levels (highest potential to low potential explosive hazard conditions).

3.9.2 Baseline Human Health Risk Assessment

The general approach for the screening level HHRA, involves comparison of maximum detected MC values with conservative screening levels. The more conservative of the USEPA RSLs or NMED SSLs is used for the HHRA (see **Table 3-3**). If the background level (NMED, 2012b) is higher of both NMED SSL and USEPA RSL, the background level will be used for HHRA. The residential screening values represent the most conservative unrestricted future land use, so they will be applied regardless of applicable exposure scenarios to protect all possible current and future exposure scenarios.

The receptors to be evaluated include base personnel, authorized contractors, residents, visitors, and trespassers. The primary MC exposure pathways for human receptors are through subsurface soil and surface soil. Future land use is anticipated to remain consistent with current land use. Therefore, potential receptors should remain the same.

Table 3-4 Input Factors, Maximum Scores, and Resulting Weights

Explosive Hazard Component	Input Factor	Maximum Scores	Weights
Severity	Energetic Material Type	100	10%
	Location of Additional Human Receptors	30	3%
	Component total	130	13%
Accessibility	Site Accessibility	80	8%
	Total Contact Hours	120	12%
	Amount of MEC	180	18%
	Minimum MEC Depth/Maximum Intrusive Depth	240	24%
	Migration Potential	30	3%
	Component total	650	65%
Sensitivity	MEC Classification	180	18%
	MEC Size	40	4%
	Component total	220	22%
Total Score		1,000	100%

3.9.3 Screening-Level Ecological Risk Assessment

A Screening Level ERA (SLERA) will be completed to assess potential adverse impacts on current or future ecological receptors exposed to MC in soil at Holloman AFB MRAs. The assessment endpoints for the SLERA are the protection of local populations and communities of

plants, mammals, birds, and soil invertebrates from adverse impacts from explosive MC in soil. A SLERA will be prepared IAW the USEPA's Ecological Risk Assessment Guidance for Superfund (ERAGS) (USEPA, 1997). The SLERA will include screening-level problem formulation/ecological effects evaluation and screening-level preliminary exposure estimates/risk calculation components. The SLERA will also take into consideration available Basewide background levels for constituents in soil (NMED, 2012b).

The primary exposure pathways for ecological receptors are through the food chain, surface soil, and subsurface soil.

3.9.4 Munitions Response Site Prioritization Protocol

FPM will update the MRSPP and assign the MRS an updated relative priority for response activities based on the results of the RI analysis and considering various factors related to safety and environmental hazards. The MRSPP will be applied IAW 32 CFR Part 179 and the guidance provided in the DoD MRSPP Primer (DoD, 2007). FPM will assign a MRSPP rating ranging from 1 to 8 to each MRS. The priority will be determined by selecting the highest rating amongst the EHE and HHE modules.

4.0 QUALITY CONTROL PLAN

The QCP presented in this chapter addresses the QC procedures to be followed during the completion of MEC/MPPEH-related activities during the RI at the RR869a Debris Field MRS. The QCP describes the way in which FPM will produce the deliverables, and the step-by-step approach that will be taken to ensure the quality of the services and the products derived from those services. The FPM QC process ensures that the training, actions, procedures, and tools support every employee according to the requirements and in such manner that the environment is protected and the impact of the project activities is minimized. The QCP adheres to the requirements specified in MMRP industry standard guidance documents published by DoD, DDESB, and USACE.

The overall objectives of this QCP are to identify and implement quality requirements to ensure that overall project activities are accomplished using an acceptable level of internal controls and review procedures. The intent of such controls is to eliminate conflicts, errors, and omissions and ensure the technical accuracy of all deliverables. Specifically, this plan:

- Identifies the specific project QC objectives for the associated RI project elements.
- Identifies the RI project QC organization and defines each individual's respective authority, responsibilities, and qualifications.
- Defines RI project documentation management and control, communications, and recordkeeping procedures.
- Establishes comprehensive evaluation of correct application of methods, adequacy of basic data and assumptions, correctness of calculations, and compliance with guidance, standards, regulations and laws.
- Describes procedures for the management of deficiencies, nonconforming conditions.
- Defines procedures for RI project submittals and recordkeeping.

4.1 Quality Assurance

QA will be monitored by the USAF. The USAF will evaluate field activities to verify that the approved RI WP is being followed and that the projects DQOs are being met.

4.2 Project Personnel Qualifications

Project personnel will be qualified to perform their assigned jobs IAW DDESB TP 18 (DDESB, 2004). Each employee will have a file at the project site which will include copies of necessary licenses, permits, training records, certificates of qualifications, and resumes that support the employee's placement and position. The UXOQCS will verify that project personnel have the required certifications to complete their assigned role on the project. Personnel minimum qualifications are described in detail in Technical Management Plan (**Section 2.0**).

4.2.1 Explosive Ordnance Disposal, Unexploded Ordnance Certifications, and Training Requirements

FPM will ensure that only qualified and properly trained personnel are assigned to positions on project sites. Prior to mobilization of personnel, FPM will ensure that training required by OSHA 29 CFR 1910.120, has been completed for all personnel assigned to the project. In addition, prior to the start of operations all personnel will receive the following as a minimum:

- Familiarization with the WP and its policies and procedures.
- HASP/Activity Hazard Analysis/SOP orientation.
- PPE training.
- Environmental considerations peculiar to the operations on the project site.
- Instruction and training on equipment usage and safe work practices.
- Daily safety training outlining the day's activities.

Training is conducted by the SUXOS or dual-hat UXOSO/UXOQCS, and records of attendance are maintained on site. Certificates of Training will be issued when applicable. The UXOSO/UXOQCS will have a monitoring program in place to identify when project personnel require refresher training and he will be responsible for reviewing EOD/UXO certifications.

4.2.2 Health and Safety Training

Health and safety requirements for project personnel have been established IAW the OSHA 1910.120 requirements for hazardous waste site works. Training certifications for field project personnel will be maintained on site by the UXOSO/UXOQCS. Project personnel training requirements are discussed in greater detail in the MMRP sites HASP (**Appendix B).**

4.3 Quality Program

4.3.1 Contract Submittal Quality Control Process

Documents required under this contract will be developed and maintained by a project team consisting of the PM, Program Chemist/Chemical Quality Control Manager, QC Geophysicist, and UXOQCS. These team members will contribute their corporate knowledge and experience to the documents to ensure technical quality. **Table 4-1** provides a summary matrix of project personnel QC responsibilities and associated submittals.

Comments on submitted documents will be directed by project personnel to the appropriate subject matter expert for resolution. Changes to final WP will be submitted to the PM immediately upon approval. The PM will be responsible for ensuring that the changes are posted to the hard copy on file and that all field personnel are made aware of the changes.

4.3.2 View and Acceptance of the Quality Control Program

The QCP will be reviewed and approved by the PM. After completion of the management review, the QCP will be submitted to the AF for review and acceptance prior to starting operational field activities. Revisions to the QCP will be reviewed and approved in the same manner as the original plan.

4.3.3 Review and Approval of Quality Control Plan Implementation and Project Procedures

The UXOSO/QCS has the authority and responsibility to verify that the QCP has been implemented for project activities. The Project Procedures presented in this RI WP will be reviewed by the UXOSO/QCS, SUXOS, Program Chemist/Chemical Quality Control Manager, QC Geophysicist, Project Geophysicist, the Installation Manager, the MMRP Manager, and the PM.

Table 4-1 Quality Control Submittal Register

Project Personnel	QC Responsibilities	Associated Submittals
Project Manager	Review and approve	All project deliverables
Program Chemist/Chemical Quality Control Manager	Develop and implement Chemical QC Plan and UFP-QAPP for environmental/MC sampling	Chemical QC Plan
		UFP-QAPP for environmental/MC sampling
	Develop and ensure compliance with chemical DQOs	Daily Chemical QC Report
		Chemical QC Summary Report
		Data Validation Reports
QC Geophysicist	Develop and implement the Geophysics QC Program	Geophysics QC Program
	Review and verify compliance with geophysical DQOs	Daily QC database updates
		QC figures
		Summary table of positional and production QC data
		Post raw and production QC data to SharePoint website
UXOQCS	Perform and document QC inspections/surveillances	Daily and Weekly QC Reports
	Perform and document nonconformance and corrective actions	Nonconformance and Corrective Action Reports

4.3.4 QC Management Philosophy

The Management Philosophy addresses the contractor's commitment to quality through QC Program which includes Quality Production, Internal Quality Checks and Reviews, and Technical Review.

The Quality Production includes a specific number of activities i.e., definable features of work, that are the major categories of work to be performed and form the framework for the QC approach for the project.

The internal quality checks and reviews will include a comprehensive evaluation of:

- Correct application of methods.
- Adequacy of basic data and assumptions.
- Correctness of calculations.
- Completeness of documentation.
- Compliance with guidance, standards, regulations, and laws.

The Technical Review will ensure that:

- The concepts, assumptions, features, methods, analyses, and details are appropriate, fully coordinated, and correct.
- An appropriate range of feasible alternatives was evaluated.
- The problems, opportunities, and issues are properly defined and scoped.
- The analytical methods used are appropriate and yield reliable results.
- The results and recommendations are reasonable, within policy guidelines, and supported by the presentation.
- Any deviations from policy, guidance, and standards are appropriately identified and have been properly approved.
- The products meet the customers' needs.

4.3.5 Three-Phase Control Process

The UXOSO/UXOQCS and QC Geophysicist will verify compliance with project requirements through implementation of the three-phase control process (Engineer Regulation 1180-1-6, Contracts-Construction Quality Management (USACE, 1995) and EP 715-1-2, A Guide to Effective Contractor Quality Control (USACE, 1990b). This process checks that project activities comply with the approved plans and procedures. Elements of the three-phase control process are: (1) preparatory phase, (2) initial phase, and (3) follow-up phase. Each control phase is important for obtaining a quality product. However, the preparatory and initial phases are particularly valuable in preventing problems. Production work is not to be performed on a definable feature of work until successful preparatory and initial phase inspections have been completed and documented. The specific QC monitoring requirements for the definable features of work are listed in **Table 4-2**.

4.3.5.1 Preparatory Phase

The preparatory phase, as it applies to a definable feature of work, commences with actions in advance of production work. The preparatory phase includes review and approval of plans, specifications, SOPs, and other applicable documents, and to verify that equipment and personnel are in place before work starts. This inspection phase is conducted with the people responsible for performing each definable feature of work checking that personnel know what is expected and understand their role. The Installation Manager, UXOQCS, and QC Geophysicist are responsible for conducting and verifying that all preparatory actions required prior to conduction work have been accomplished.

4.3.5.2 Initial Phase

The initial control of each definable feature of work is performed when a work process begins. The purpose of the inspection is to:

- Verify that the work to be performed will be in compliance with procedures and contract specifications.
- Verify that equipment and personnel on site meet the requirements established during the preparatory phase.
- Review acceptable level of workmanship for site personnel who will be conducting the definable feature of work.
- Review the preparatory phase inspection report.
- Resolve any differences of interpretation.

Table 4-2 Definable Features of Work and Quality Control Actions

Definable Feature of Work	Inspection/ Surveillance Point	Attribute	QC Action (performed or confirmed by)	Sampling Frequency	Acceptance Criteria
Prepare Plans	Draft/Final	Not Applicable (N/A)	Internal independent technical review (technical staff)	N/A	N/A
Pre-Mobilization	Readiness review	Capture lessons learned	Three-phase control (QC Geophysicist/ UXOQCS)	N/A	N/A
IVS Establishment	Area selection	Minimal background noise	Review pre-seed Survey (QC Geophysicist/ UXOQCS)	Pre-survey	Low background readings
	Seed item placement survey	Survey accuracy	Review survey data (QC Geophysicist/ UXOQCS)	All items in IVS	x, y = 2 cm z = 5 cm
	Repeat data	Amplitude and positional accuracy	Review data (QC Geophysicist)	Once for all equipment infield	±20% of the ISO response obtained by FPM (G-858); within predicted bounds (EM61 [contingency plan]) and ±25 cm positional accuracy along line of data collected directly over the seed items

Mobilization	Post mobilization	Capture lessons learned	Three-phase control (QC Geophysicist/ UXOQCS)	N/A	N/A
Detector-aided Surface Clearance	Grids completed and turned over by Operations	No remaining hazards in the detector-aided surface cleared areas	Three-phase control (UXOQCS)	Minimum 10%of cleared surface areas	No MEC, MPPEH, and metallic items
Geophysical Investigation	Static noise levels, cable shake and personnel tests	Background noise	Review static responses (QC Geophysicist)	Twice Daily	Background: Peak to peak variation ≤ 1nT (G-858) and ≤ 2.5 mV for Channels 2,3,and 4 and ≤4 mV for Channel 1(EM61 [contingency plan])
Geophysical Investigation Geophysical Investigation (continued)	IVS	Response to known ISO, location of known ISO	Review Results (QC Geophysicist)	Twice Daily	±20% of the ISO response obtained by FPM (G-858); within predicted bounds (EM61 [contingency plan]);and ±25 cm positional accuracy along line of data collected directly over the seed items
	Anomaly selection	Anomalies chosen by data interpreter	Identify target anomalies (QC Geophysicist)	10% of data to be reanalyzed	No more than 5% anomaly selection differences at or above the minimum response threshold
Geophysical Investigation (continued) Blind Seeding Program	Along line measurement spacing	Distance between data points	Measure data Density (QC Geophysicist)	By dataset	98% ≤ 25 cm along line
	Anomaly reacquisition	Reacquire anomaly within critical radius	Review reacquire data (QC Geophysicist)	All selected anomalies	90% of all items within 1 m
	Target anomaly locations determined to be resolved by operations	Target anomaly excavation location resolution IAW project requirements	Conduct verification of a minimum of10% of target Anomaly locations (transect and grid) solved by Operations (UXOQCS)	As operational target anomaly excavation locations are completed	Target anomaly location is resolved IAW project target anomaly requirements

	Blind seed locations	Amplitude and positional accuracy	Review data (QC Geophysicist/UX OQCS)	All blind seeds	All blind seeds detected and all blind seeds recovered
MEC/MDEH Disposal	Pre- and post-MEC/MDEH disposal operations	Safety and quality of MEC/MDEH disposals	Three-Phase Control to include final QC acceptance inspections at each MEC/MDEH disposal location (UXOQCS)	Before and after every MEC/MDEH disposal operation	No MEC/explosive hazards remain at disposal locations
MPPEH Certification	Throughout	Documentation of explosives safety status prior to transfer	Three-phase control to include a final random sampling inspection of the segregated MDAS (UXOSO/QCS)	Continuous	MPPEH inspection process is IAW (DoD 2008b);certified MDAS does not contain or have the potential to contain energetic material

The initial phase is first documented UXOQCS field compliance inspection for a definable feature of work. Initial phase inspections may be repeated when acceptable levels of quality are not demonstrated or at the discretion of the UXOQCS or QC Geophysicist. The UXOQCS or QC Geophysicist (if applicable) will verify that corrective action has been completed and is appropriate to prevent recurrence of the condition. When corrective action cannot be completed in a timely manner or the root cause is not known, immediate corrective action that fixes the deficiency may be taken and verified, and work continued pending root cause analysis and more appropriate corrective action.

4.3.5.3 Follow-up Phase

Follow-up phase inspections are performed after a work process has begun and periodically throughout the work process. Following completion of RI fieldwork, a final inspection will be conducted as part of the Follow-Up Phase. The purpose of the inspection is to evaluate whether the process is being completed IAW agreed upon standards and to evaluate whether the level of quality meets QC acceptance criteria. The UXOQCS and QC Geophysicist are responsible for monitoring work processes and verifying continued compliance with RI WP and QC criteria requirements. Deficiencies identified during follow-up phase inspections will be documented and corrective action taken. The UXOQCS or QC Geophysicist will verify that corrective action has been completed and is appropriate to prevent recurrence of the condition. When corrective action cannot be completed in a timely manner or the root cause is not known, immediate corrective action that fixes the deficiency may be taken and verified, and work continued pending root cause analysis and more appropriate corrective action.

4.3.6 Documentation

Project documents are required to be kept up-to-date and available where the work is being performed. The WP and standard FPM procedures and documents are to be prepared, maintained up-to-date, and made available to project team members. All documents will be maintained in the project files and available in hardcopy version and electronically on the project's SharePoint/Folders website. Project team members will have access to the SharePoint website.

4.3.6.1 Project Logbooks

Project logbooks, consisting of bound books with hard covers and sequentially numbered pages, will be maintained on a daily basis by each of the field team leaders in charge of a specific task. These logbooks will contain detailed record of all activities related to specific field tasks and specific references to other field documents used on a daily basis. The front of each logbook shows the project name, logbook number, and the dates of use.

4.3.7 Document Preparation, Review, and Approval

The project documentation will conform to the following requirements:

- Documents and associated revisions defining technical, management, and QC requirements will include the job number and unique control number for verifying implementation.
- Each technical, management, and quality document will indicate the preparer, reviewer, approver, purpose of issue, and revision status.
- Changes to the previously issued document will be identified either within the document or in an appropriate attachment.
- Documents and associated revisions are reviewed by personnel who are:
  - Responsible for implementation,
  - Qualified by experience, education, or training to provide a critical review,
  - Responsible for checking that the document does not contain information or direction that conflicts with documents of superior authority or other documents that relate to the same work or subject, and
  - Participants in the original review and approval, unless designated otherwise.

4.3.7.1 Field Change Request Form

Periodic changes to procedures can be issued through the implementation of Field Change Request (FCR) forms. Field team members assigned to perform or supervise a task that recognizes the necessity for a change in the task procedures are responsible for initiating, completing, and submitting the FCR for review and approval of appropriate field changes. The FCR process includes review and approval of the recommended change by the site senior UXO staff, QC Geophysicist (if applicable for geophysical task), Program Chemist/Chemical QC Manager (if applicable for Environmental/QC sampling task), PM, and appropriate COR prior to process alteration in the field and incorporation into a revised WP element. The AF may ask that the FCR be reviewed by appropriate regulatory personnel if it is deemed to be a significant change to a process or overall Scope of Work. FCRs should be approved or disapproved in no

more than one week. When an FCR is approved, changes to procedures will be reviewed with project personnel during the morning meeting/safety briefing prior to implementation. FCRs will be numbered sequentially and will be maintained in the project files on site.

4.3.7.2 Training Records

Training Records will be maintained by the PM. These records will contain any licenses, permits, certificates, or other qualifying data, to include:

- Date and nature of training
- Personnel attending and instructor(s)
- Signature of instructor and SUXOS or UXOSO

4.3.7.3 Daily Field Activity Reports

All field activities affecting QC will be performed IAW documented procedures identified in the WP or applicable guidance. During all field activities, FPM may use any or all of the following reporting forms and additional forms and reporting media as necessary:

- Daily Health and Safety Meeting Report,
- DQCR,
- Site Safety Tailgate Meeting Log,
- Nonconformance and Corrective Action Form,
- Health and Safety Compliance Inspection,
- Site Visitors Logs, and
- QA Audit Checklist.

4.3.7.4 Daily Quality Control Reports

DQCRs shall be maintained in the project files for inclusion in the final report. The UXOQCS shall prepare a DQCR including, as a minimum, the following information:

- Preparer (name and signature)
- Date
- The criteria for and results of any inspection, surveillance, or review performed (attach inspection or surveillance forms as applicable)
- The results of any review of submittals or other items
- The results of QC inspections of grids
- Any significant issues or open items

The UXOQCS will maintain a field logbook of all inspection and testing activities. This daily logbook will be used in preparing the recurring reports and deliverables and the project report. Additionally, the UXOQCS or QC Geophysicist will conduct random surveillance of documents in the field and for field office use to validate that the most current documents are in place and being implemented.

4.3.7.5 Site Safety Tailgate Meeting Log

Site Safety Tailgate Meeting Logs shall be maintained in the project files for inclusion in the final report. The UXOSO shall prepare a log including, as a minimum, the following information:

- Preparer (name and signature)
- Date
- Weather conditions, discussion of any incidents, accidents, or significant site events that may impact safety, and stopping work due to safety issues
- Signatures of all project personnel and visitors acknowledging that they have participated in a safety briefing

4.3.7.6 MEC and Anomaly Excavation Records

The MEC and anomaly records are used to record data on anomaly excavations and MEC encountered. An example of Dig Selections and the Intrusive Results Table is provided in **Appendix E.**

4.3.7.7 Visitor Documentation

Visitors on site during RI activities will be required to log in and off the site. The UXOSO will verify that visitors to the site have received a briefing by the UXOSO and/or SUXOS of the site activities scheduled the day of the visit, the health and safety issues associated with those activities, areas of the site that are off-limits, whether visitors have the required PPE, and that visitors are briefed and understand the established danger warning system used on site by project. All visitors to the site will be required to sign in with the UXOSO and receive the health and safety briefing. New project personnel and subcontractors must review the HASP and receive site-specific training. All visitors must be escorted by project personnel. The UXOSO will document the visitor briefing and maintain the documentation onsite for the duration of the project.

4.4 Quality Control Surveillance

QC surveillance is an ongoing process that will take place throughout the project on a daily basis. Surveillance is the process of monitoring and verifying the status of procedures, methods, conditions, products, processes, and services and the analysis of records in relation to requirements to confirm that the requirements for quality are met. Surveillance will be conducted on a scheduled or unscheduled basis and is conducted as part of the follow-up inspection process of the three-phase control system. **Table 4-2** presents the project's definable features of work with associated QC actions for project activities, except MC sampling activities covered in the UFP-QAPP (**Appendix D**) including the frequency of the inspection and the party responsible for performing the activity. The UXOQCS and/or QC Geophysicist will conduct surveillance to collect objective evidence to document and report conditions observed. Daily QC surveillance of program activities and processes will be performed to evaluate completion of required activities and their effectiveness. QC surveillance activities will be documented on the DQCR and will be part of the project records.

4.4.1 Geophysical Quality Control

The QC Geophysicist will be responsible for overseeing and documenting QC performed with respect to the digital geophysical surveys. QC of the field data will include checks and reviews of the digital data deliverable. Specific checks will include data completeness, quality, WP QC criteria compliance, and format. Data that have not undergone QC checks will not be delivered to the AF unless by mutual agreement. In that case, a statement of limitations will be included with the data deliverable indicating that QC checks have not been completed for the subject data.

4.4.1.1 Initial Geophysical Equipment QC Checks

The following checks will be completed at least once at the beginning of the DGM activities. These tests will be performed at each IVS location.

1. **Six Line Test.** This test will be performed in the same area as that planned for the IVS. The test will be conducted over the same line each time the test is performed. Data from the first two passes will be collected at a normal walking speed (1m/s) with no objects buried. Next, one ISO will be buried in the vertical orientation (at the same location where this ISO is planned for the IVS) and data will be collected along this line with two additional passes at a normal walking speed (1m/s), and one pass each at slow and fast walking speeds. Repeatability of response amplitude, positional accuracy, and latency will be evaluated. The acceptance criteria are ±20% for repeatability of amplitude response and ±25 cm for positional accuracy. Comparison of noise levels between the three acquisition speeds will also be performed.
2. **Pull Away Test.** This test demonstrates the effects of navigational equipment and/or vehicles used to tow sensors or arrays. With the instrument collecting data in a static (background) test, navigational equipment is positioned as that would be in the field survey and pulled slowly away from the sensor to gauge any differences in response. This must be performed twice: once with the navigational equipment power off, the second with the equipment power on. A simple direct current shift may be observed when the equipment is in normal operating position, compared to values when it is distant; however, this is easily removed from the data. If excessive noise is noted, steps will be taken to identify the source and correct the problem.
3. **Octant Test (magnetometer only).** An octant test will be used to document the effect that heading (direction of travel) can have on the magnetometer. The test will be designed to document the differences in sensor readings based on heading and determine whether a heading correction should be warranted. The sensors will be moved from a central point to compass headings of 45, 90, 135, 180, 225, 270, 315, and 360° and deviations in amplitude will be noted. The documented heading error will be used for post-processing correction.
4. **Azimuthal Test (magnetometer only).** The Azimuthal test will be used to optimize sensor orientation and avoid magnetometer sensor “dead zones”. The test will document the differences in sensor readings based on orientation with respect to Earth’s magnetic field. Sensor response will be evaluated in a variety of horizontal and vertical orientations. The sensor will be rotated horizontally and deviations in amplitude will be noted at 45, 90, 135, 180, 225, 270, 315, and 360°. The optimum sensor orientation will

be evaluated by rotating the sensor vertically 360° and noting deviations in amplitude. The acceptance criterion is the maximum SNR that detects the smallest target object.

4.4.1.2 Daily Quality Checks

The following daily QC checks will be performed at the IVS location. The minimum frequency for each daily QC test is defined in **Table 4-2**. Additional follow-on QC checks (warm-up, cable shake, personnel, and static background) will be performed following transportation of the instrument/operator to the site, and prior to each data collection session.

1. **Positional Accuracy.** This test will be conducted to verify the proper set-up and functioning of the RTK-GPS base station. Prior to data collection, coordinates are measured at an established control point to record any offset. Acceptance criteria are ±2.5 cm from the established coordinates for the point. The horizontal RTK-GPS accuracy for static tests is 5cm.
2. **Equipment/Electronics Warm-Up**. Equipment/electronics warm-up will be conducted at power-up to minimize sensor drift due to thermal stabilization. The manufacturer's instructions for equipment startup will be followed and at least 15 minutes of warm-up will be performed for the G-858. If instrument readings fail to stabilize within the recommended warm-up period, an additional five minutes of warm-up will occur. If data instability persists, troubleshooting procedures will be initiated. If the data instability cannot be resolved the equipment will be replaced.
3. **Null Instrument (EM61 only, contingency plan))**. The instrument will be nulled at the start of each day's activities following equipment warm-up and prior data collection. Nulling the instrument corrects for previous instrument drift and normalizing background values by adjusting the signal response for each time gate to 0 mV.
4. **Vibration Test (Cable Shake).** This test, also known as a cable shake, will be used to identify shorting cables and problematic connectors. Cables will be shaken for a minimum of five seconds with the instrument held in a static position. If shorts are found, the associated cables and/or connectors will be replaced immediately. The vibration test will be repeated once repairs are complete. Acceptance criteria include absence of data spikes in the data profile during the test. If data spikes persist, troubleshooting procedures will be initiated. If the data spike cannot be resolved the equipment will be replaced.
5. **Personnel Test.** This test will be conducted on survey personnel to confirm that potential interference sources (e.g., pocket knives, pens, buckles, steel-toed boots, cell phones, and portable radios) have been removed from their bodies. Personnel who will be performing the surveys or who will be coming in close proximity to the survey equipment will approach the sensor and have the instrument operator monitor and record the results. An acceptance criterion ≤ 3 nT for the G-858 and ≤ 2.5 mV on Channel 2 for the EM61 (contingency plan) will be used.
6. **Static Background Test.** This test will be performed to quantify instrument background readings or electronic drift and locate potential interference spikes in the time-domain. A minimum of 3 minutes of static background data will be collected after instrument warm-up. The instrument operator will monitor readings to confirm stability. For the static

background test acceptance criteria will be ≤ 1 nT for the G-858 and ≤ 2 mV peak to peak on Channels 2, 3, and 4 and ≤ 4 mV on Channel 1 for the EM61 (contingency plan).

7. **IVS Test.** This test will be performed to determine impulse response and repeatability of the instrument to find ISO items, the ability to locate these items accurately, and also verify consistency in background noise levels during mapping. Each IVS track, background and seeded, will be mapped in each direction at the normal data collection pace. Acceptance criteria include meeting ±20% for response amplitude of ISO items for data repeatability, and ±25 cm for positional accuracy along line of data collected directly over the seed items.
8. **Latency Test.** This test measures repeatability of instrument response while moving, and it will be performed to determine the instrument response to a standard object. For this test, a standard item (ISO) is temporarily emplaced in the vertical orientation at a known location along the background track of the IVS area. The G-858 (EM61, contingency plan) will pass over the standard item two times in opposite directions. The obtained results will be compared to determine the difference in the location of the standard. The time difference will be used during the data processing to correct data positions in a process referred to as latency correction.

4.4.1.3 Data Quality Checks

The Site Geophysicist/geophysical technician will monitor the sensor performance during the QC tests. Any observed failure to meet acceptance criteria will result in immediate corrective action. The operator will check the instrument to determine the cause of the failure and if possible make repairs (tighten or replace cables, replace battery, etc.). The QC tests are repeated and the results monitored. Continued failure to meet acceptance criteria will result in immediate notification of the Site Geophysicist and removal of the faulty instrument from service until repairs can be completed.

During the processing of field data, the Site Geophysicist will review the individual data profiles to identify abnormal spikes in the measured data for larger than usual fluctuations in the background noise level. The QC Geophysicist will review QC issues and will determine whether the data are useable or the grid/area should be resurveyed. The QC Geophysicist will also assess the root cause of the problem and make recommendations for corrective actions.

4.4.1.4 Independent Geophysical QC Reprocessing

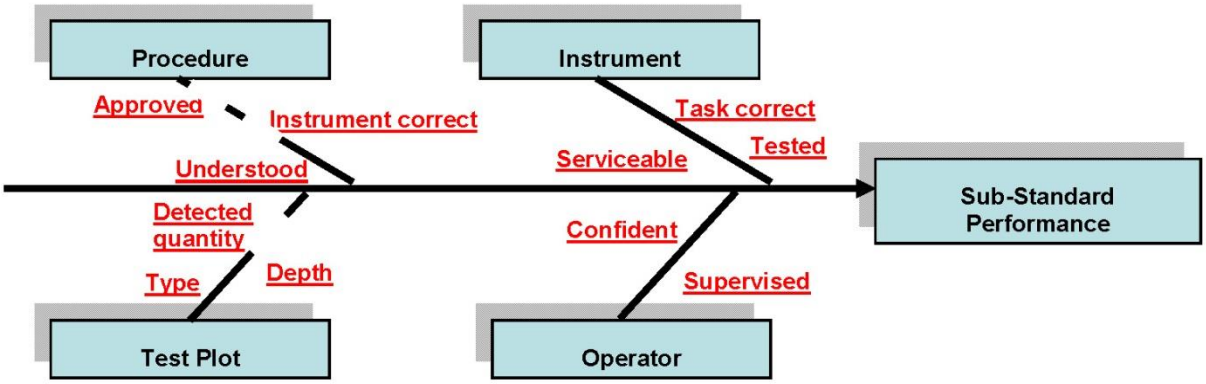
Once the initial geophysical anomaly analysis and interpretation is completed, the data and initial dig sheet will be delivered to an independent QC geophysicist for QC reprocessing. At a minimum, 10% of the data will be reprocessed. This reprocessing will be performed using the same procedure as the initial processing including all processes from preprocessing to target picking. If any target additions or deletions in reprocessing occur, the independent QC Geophysicist will work with the Project Geophysicist to perform a root cause analysis and implement corrective actions.

4.4.1.5 Root Cause Analysis

Any portion of the process or analysis not consistent with the DQO is considered a quality failure. The QC Geophysicist will conduct a Root Cause Analysis to determine if the failure is the result of the process, procedures, equipment and/or personnel and to what extent of previously performed work may have been affected by the failure. The QC Geophysicist will

provide his findings to the PM, and SUXOS with suggested or required corrective actions. Once approved by management, the team will implement the corrective actions. All target reacquisition and intrusive QC measures will be documented, with copies sent to appropriate personnel for review and inclusion into other documents as deemed necessary. **Figure 4-1** illustrates the flow of the root cause and effect process that the QC Geophysicist will use to determine failure causes.

Figure 4-1 Root Cause and Effect Process



4.5 Equipment Maintenance and Checks

Tools, instruments, and equipment deployed to the project site will be properly maintained and calibrated (as necessary) IAW the instrument manufacturer specifications, standard industry practice. This applies to equipment used in the field for activities that have an impact on quality, including geophysical instruments, communication equipment, vehicles/machinery, environmental monitoring equipment, and PPE. Rulers, tape measures, levels, and other such devices will not be standardized if normal commercial equipment provides adequate accuracy, but must be maintained in good working condition. Equipment will be visually checked for damage prior to use. Preventative maintenance on equipment will be performed on a regular basis according to the manufacturers operating instructions or recommendations. Critical spare parts will be kept on hand to minimize downtime, particularly batteries for GPS, radio, and geophysical equipment. Maintenance activities will be recorded in field logbooks. The quality of geophysical data sets is dependent on the operational capabilities of the equipment used. By manufacturer's design, these instruments are calibrated at the time of manufacture and do not require field calibration. Manufacturer's manuals will be maintained on site for reference. To check that equipment is fully capable and will perform IAW the manufacturer's specifications, pre-operational and post-operational checks will be performed daily. Following these checks, equipment that is found unsuitable will be immediately removed from service. These checks will provide QC data indicating the proper functionality of the instruments. The UXOQCS or QC Geophysicist will verify these actions using the three-phase control process and QC surveillance.

4.6 UXO Quality Control

The UXOQCS will perform a QC inspection of a minimum of 10% of the areas cleared. For QC inspections, the UXOQCS will use a Schonstedt GA-52 Cx. Any unexcavated anomaly identified by the UXOQCS will trigger an analysis of the process to determine the cause of the

anomaly detection failure by the UXO Team. The anomaly will be addressed for identification and removal, if appropriate. Additionally, the UXOQCS will conduct inspections of recovered MD scrap, and any material or item potentially presenting an explosive hazard, to ensure there are no explosive components or hazards.

If a detection failure is identified, the UXOQCS will conduct a Root Cause Analysis to determine if the failure is the result of the process, procedures, equipment and/or personnel. A Root Cause Analysis may include, but not limited to the following actions:

- Careful evaluation, recovery, and destruction of MEC/UXO.
- Certification of the identification and disposition of each anomaly excavated.
- Review of representative dig sheet data.
- Field evaluation of the site QC operations.

The UXOQCS will provide his findings to the MMRP Manager and SUXOS with suggested corrective actions. Once approved by management, the UXO Team will implement the corrective actions. The Root Cause Analysis and corrective actions will be attached to the weekly report. A QC discovery of any isolated MEC item outside the physical area cleared will not be considered a QC failure.. QC failures will be documented, reported, and corrective actions taken.

4.7 Nonconformance and Deficiency Identification

Nonconformance identification assumes recognition of circumstances that prevent a work process to control output from conforming to the contract requirements. Project personnel have the responsibility, as part of their normal work duties, to promptly identify and report conditions adverse to quality. An identified nonconformance will be identified, documented, investigated and corrected.

A deficiency is a condition that can be corrected quickly by standard methods during normal course of work. A deficiency usually is not systematic in nature. It will be the responsibility of project personnel to identify deficiencies and notify their supervisor or manager as soon as the conditions are identified. Determination of deficiencies will be supported with objective evidence.

4.8 Audit Procedures

The audit process involves identifying, documenting, and reporting non-conformances or deficiencies, initiating corrective actions through appropriate channels, and conducting a compliance review.

4.8.1 Internal Audit Process

The internal audit procedures include the following:

- Audit of Environmental/MC sampling and analyses program activities performed by the Program Chemist/Chemical Quality Control Manager,
- Audit of geophysical procedures performed by QC Geophysicist,
- Audit inspections of geophysical equipment performance, operating and maintenance records, equipment testing records, equipment QC checks, geophysical data acquisition,

dig location selection, anomaly reacquisition, result corrections performed by the QC Geophysicist and UXOQCS,

- Audit inspections of dig sheets and the UXO database, in conjunction with the 10% QC checks of each grid performed by the UXOQCS,
- Reporting of any suspected technical non-conformances or deficiencies performed by field teams, and
- Follow-up audits to verify that QA procedures are maintained throughout the investigation.

Internal audits will be completed at the beginning, middle, and end of the project and, all results will be reported to the PM. When the audit is completed, the original records generated for all audits will be retained within the central projects files. Records will include audit reports, written replies, the record of completion of corrective action, and documents associated with the conduct of audits, which support audit findings and corrective actions, as appropriate.

4.8.2 External Audit Process

The AF may conduct the external audits of the MEC activities at any time during the field operations. These audits may or may not be announced and will be completed according to field activity information presented in this RI WP and SOPs. The external field audit process can include (but not limited to):

- GSV development,
- Equipment testing and performance requirements,
- Geophysical data acquisition, reacquisition,
- Anomaly selection and verification,
- "Dig" locations, intrusive sampling locations,
- MEC activity documentation and electronic data file management.

4.9 Corrective Actions

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or QC nonconforming condition which can affect data quality. Corrective action can occur during field activities, laboratory analyses, and during the data review and validation. Field activity discrepancies will be discussed with the SUXOS who will document the discrepancy in the field log book. The SUXOS will then inform the QA/QC Manager and MMRP Manager. The MMRP Manager will define the required corrective action. The SUXOS and/or field manager will document the corrective action in the field log book and will instruct field personnel on the implementation of the corrective action. It will be the responsibility of the UXOQC to ensure that the corrective action is properly implemented. A copy of the corrective action documentation will be provided to the MMRP Manager on the same day the corrective measure is implemented. This will enable the PM to include the corrective action in the monthly project status report.

The MMRP Manager will document major discrepancies and discuss a recommended corrective action with the field team. Corrective actions for major discrepancies can be defined as

measures that change the number of samples collected, change previously selected sampling locations, and impact the project quality objectives. The UXOQC will be responsible for ensuring that the corrective action is properly implemented and documented. The QA/QC Manager will review non-conformances to determine if trends adverse to quality are developing, and proposing and implementing long-term corrective action to prevent recurrence of any nonconformance trends.

4.10 Lessons Learned

The objective of the lessons learned is to capture and share experience or recognized potential problems or better business practices to:

- Prevent the recurrence of repetitive design/execution deficiency
- Clarify interpretation of regulations and standards
- Reduce the potential for mistakes in high risk/probability areas of concern
- Pass on information specific to an installation or project
- Promote a good work practice that should be ingrained for repeat application
- To promote efficient and cost-effective business practice

This process is designed to identify nonconforming conditions. As required by this program, actions will be taken to correct nonconformance and to prevent their recurrence. These conditions will be assessed to determine if they are systematic or unique occurrences. After informal review and discussion by the project team, those conditions that might aid other projects will be written up as lessons learned, describing the original condition and results, changes made, and the resultant improvements. If no changes were made, but in hindsight should have been, this information will be detailed. Lessons learned will be discussed in the final RI Report. All personnel are encouraged to continuously review their processes and suggest changes that improve the process, provide benefits, or improve project efficiency, safety, and quality. These suggestions can be either formally submitted (written memo to project leadership) or informally through verbal discussions at project meetings.

4.11 Stop Work Authority

When a condition is identified that is adverse to quality and/or safety, the dual hat UXOQCS and/or QC Geophysicist have the authority to stop work until the condition is resolved. The decision to stop work pending corrective action should not be taken lightly.

A stop work request may be issued for a portion of a process, which would allow as much work as possible to continue, thus limiting the impact of the stop work request on areas not affected by the condition. The UXOQCS will immediately notify SUXOS, MMRP Manager, and PM, and document the stop work request.

In the event the SUXOS and MMRP Manager do not agree with the stop work request, the PM will have the final decision making authority.

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5.0 EXPLOSIVES MANAGEMENT PLAN

An Explosives Management Plan has been prepared IAW AFMAN 91-201 Explosives Safety Standards and DID MMRP-09-002, Explosives Management Plan (USACE, 2009b) describing the procedures to be used by UXO personnel to purchase, receive, use, store, transport, issue, and report the loss of explosives utilized during RI. All personnel involved with explosives will be trained and qualified in the tasks to be performed and will comply with all federal, state, and local laws as required. The procedures will be performed IAW following regulations:

- DoD 4145.26-M, Contractor's Safety Manual for Ammunition and Explosives
- DoD 6055.09-M, DoD Ammunition and Explosives Safety Standards (DoD, 2008a)
- Applicable Sections of the Department of Transportation, 49 CFR Parts 100-199
- Army Regulation (AR) 385-64, Ammunition and Explosives Safety (AR, 2011)
- AR 190-11, Physical Security of Arms, Ammunition and Explosives (AR, 2006)
- USACE EM 385-1-97, Explosives Safety and Health Requirements Manual (USACE, 2010b)
- USACE EM 385-1-1, Safety and Health Requirements Manual (USACE, 2011)
- BATFE Publication 5400.7, Federal Explosives Laws and Regulations

5.1 Personnel and Explosives Limits

All explosives operations will be designed to ensure compliance with the *Cardinal Principle of Explosives Safety*: "Expose the minimum number of people to the minimum amount of explosives for the minimum amount of time." The authorized Net Explosive Weight (NEW) and Hazard classification/Division will be clearly posted on each cubicle, magazine, or pad where explosives are stored, maintained, inspected, or handled. Personnel limits for the operations being conducted at each explosives operating location will be clearly posted. Posted limits will distinguish between supervisors, workers, and casuals and be included in written procedures.

5.2 Handling Explosives and Movement Precautions

Only trained personnel under the supervision of an individual who understands the hazards and risks involved in the operation will be handling explosives. The following guidance will be used for handling explosives:

- Detonators, Initiators, squibs, and other such electrically or mechanically initiated devices will be handled in protective containers. The container designated to prevent item-to item contact will be used.
- Bale hooks will not be used to handle explosives.
- Munitions will not be tumbled, dragged, dropped or thrown.
- Conveyors, chutes, hand trucks, or forklifts will not be used in atmospheres and locations where they can create hazards. Sections of roller conveyors used to move explosives will be interlocked and supported.
- Boxes containing explosives will not be used to support conveyors.

5.3 Licenses and Permits

FPM maintains a BATFE Type 33 FEL, No. 6-NY-00986, which authorizes site UXO personnel to order and use donor explosives to dispose of MEC/MDEH.

5.4 Acquisition

MEC items will be disposed of by the use of donor explosives. Wesco will be FPM's explosives vendor. Explosives will be delivered on a pre-arranged schedule based on the Holloman AFB Munitions Storage Area (MSA) (known as the 49th MXS) operations tempo. All security and access procedures will be arranged by FPM's SUXOS and coordinated with the MSA and Base security. USAF security (or contract security as directed by Holloman AFB Security Police) will escort the delivery vehicle to the MSA and provide all directions to the driver. The FPM SUXOS or his/her designated representative will be on site to inspect and sign for all explosives. All personnel handling explosives will be listed on FPM's most current BATFE Notice of Clearance.

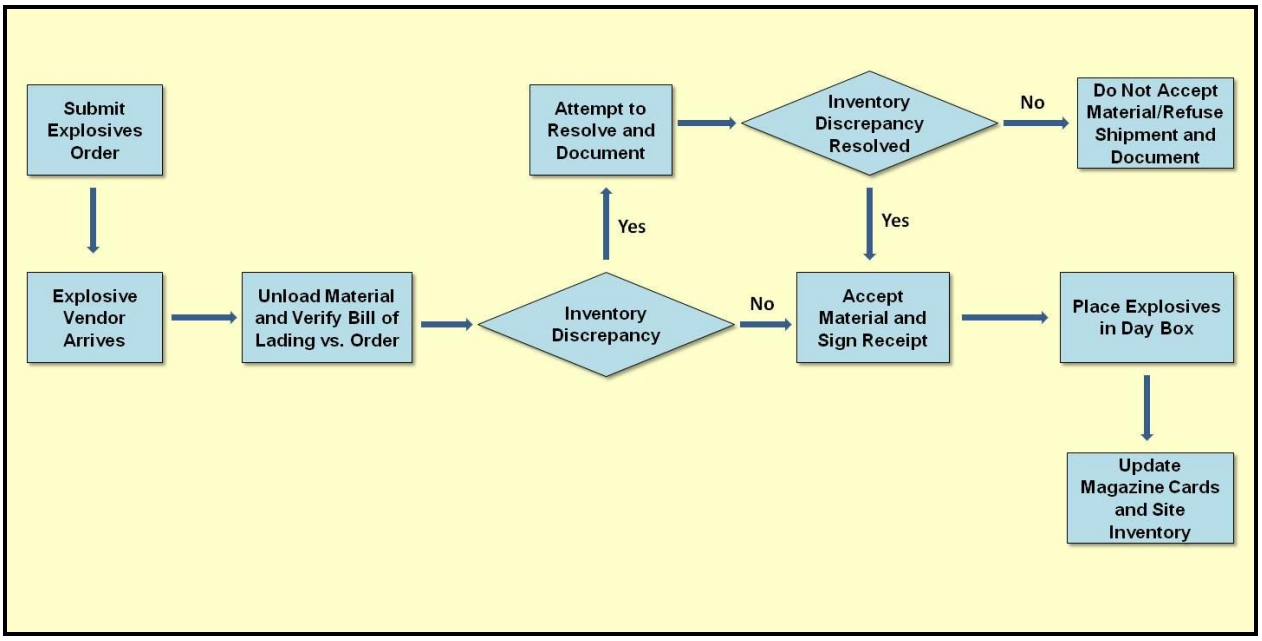
5.5 Initial Receipt of Explosives

The licensed commercial explosives vendor is responsible for permits and documentation required by federal, state, and local regulations regarding the transportation of explosives to the location where FPM will take custody of the explosives. Only the SUXOS may sign for explosives received from the vendor. The following procedures will be adhered to upon initial receipt of explosive materials (see **Figure5-1**):

- Upon arrival at the site, the SUXOS will escort the vendor/supplier to a designated area for loading/unloading.
- An individual authorized to receive the explosives will compare the explosives delivery record to the actual quantity delivered prior to accepting custody for the explosives.
- Once the quantity has been confirmed, the explosive delivery record will be signed and the explosives transferred to and stored in the MSA.
- All material introduced or removed from the MSA will be entered on stack cards and explosive records will be updated.
- If it is determined that there is a discrepancy between the quantity delivered and quantity shipped, the following will occur:
  - Notify the UXOSO.
  - Do not accept shipment.
  - Contact the Shipper immediately to resolve the discrepancy.

Note: If the discrepancy cannot be resolved within 24 hours, the SUXOS will notify the Local Law Enforcement Agency, FPM Program H&S Manager, and FPM MMRP Manager.

Figure 5-1 Receipt of Explosive Material Process



5.6 Explosives Storage Magazine

A Courtesy Storage Agreement (CSA) is signed between FPM and the Holloman AFB MSA to allow courtesy storage of up to 100 pounds NEW of donor explosives in properly cited DDESB-approved facilities. The Holloman AFB MSA will assign specific munitions storage bunkers for FPM's use and provide FPM the CSA with required signatures at the time of mobilization.

5.7 Transportation

Transportation of explosives and MEC will be conducted IAW Title 49, CFR when specifically prescribed, AFMAN 91-201 (AFMAN, 2011), Defense Transportation Regulation 4500.9R Part 2, 2008, and Air Force Joint Instruction (AFJI) 24-210, Packaging of Hazardous Material (AFJI, 2010), as well as IAW New Mexico laws for transportation of explosives and other dangerous articles. The transportation of explosives to locations requiring demolition operations will be conducted in the following manner:

- Explosives acceptable for transportation will have an assigned hazard classification.
- Packaging of explosives will comply with Title 49, CFR, Parts 171-179, and 29 CFR1926.902.
- Vehicles will have a safety inspection performed prior to loading explosives.
- Any vehicle found or suspected to be in a hazardous condition will be moved to an area isolated from other locations by the proper Q-D, unless it is more hazardous to move the vehicle.
- Vehicles will be equipped with a first aid kit and a minimum of two (2) each 2A:10BC rated fire extinguishers.
- Transport vehicles will be equipped with wood lined bed to ensure a non-sparking surface.

- Vehicles will be placarded during the transport of explosives as outlined in Subpart F of Title 49, CFR, Part 172.
- It will be ensured that lifting devices on vehicles or handling equipment have a serviceable mechanism designed to prevent sudden dropping of the load in event of power failure.
- It will be ensured that explosives loaded on all types of vehicles and handling equipment are stable and protected by an effective restraining system before movement.
- The safest possible primary and alternate explosive movement routes will be designated to cover all phases of movement.
- Vehicles will be refueled before the explosives are loaded and at least 100 ft from structures or sites containing explosives.
- Speeds will be kept to 20 miles per hour or less, depending on road conditions.
- Radio communications will be maintained with the UXOSO.
- All incoming motor vehicles carrying hazard class 1 explosives and other hazard class items that carry an explosives compatibility group will be inspected at a designated inspection station by a representative of the commander before further routing on Base.

5.8 Receipt Procedures

Prior to accepting any explosives, the procedures outlined above in the initial receipt procedures will be accomplished. The FPM SUXOS is authorized to purchase, receive, access, issue, transport, and use explosives for this project. Any other project personnel who will have access, issue, transportation, and use authority for explosives on this project will be annotated on the approved user list, which will be maintained within the explosive management records. Upon completion of each demolition operation, an ammunition consumption report will be completed. Upon expenditure of all explosives, the authorized person will certify in writing that the explosives were used for their intended purpose.

5.9 Inventory

Once donor explosives are stored, the USAF will maintain control of all items. Access to explosives will be coordinated with the Holloman AFB MSA and the FPM SUXOS. A mandatory monthly inspection of all donor explosives will be conducted as per CSA. Weekly inventories will be conducted by FPM, unless the Holloman AFB MSA operations tempo prevents it.

5.10 Reporting Lost or Stolen Explosives

Loss or theft of explosives will be reported as stated in 27 CFR on Commerce in Explosives. If it is confirmed that ordnance or explosives are missing, then the SUXOS will contact the Contracting Officer immediately by telephone and in writing within 24 hours.

5.11 Return to Storage of Non-Exploded Explosives

All explosives ordered and received will be consumed.

5.12 Disposal of Remaining Explosives

All explosives ordered and received will be consumed during the disposal operations.

6.0 ENVIRONMENTAL PROTECTION PLAN

This EPP has been developed IAW Air Force Instruction (AFI) 32-7064 (AFI, 2004), INRMP (Holloman AFB, 1999), and AFCEC MMRP Integration with Cultural Resource Management (AFCEC, 2011) and complies with the requirements of the National Environmental Policy Act and its implementing regulations. This EPP describes the approach, methods, and procedures that will be employed to reduce adverse impacts to the natural environment during RI field activities.

FPM has incorporated site-specific Green and Sustainable Remediation practices into the RI project planning approach to reduce the footprint of RI related activities. Our approach includes:

- Sequencing the execution of like events such that the number of mobilizations is reduced.
- Utilizing the base's recycling center.
- Utilizing reusable items during sampling where practical in place of disposable alternatives.
- Incorporating, if feasible, work trucks and equipment powered by biodiesel or alternative fuels.
- Utilizing electronic media, including email, web-based communication tools, and videoconferencing, where practicable and where in compliance with the contract, to communicate among stakeholders and reduce the use of paper and number of energy-intensive trips.

Prior to the start of RI field activities FPM will coordinate with the installation office of Natural Resources, the Cultural Resources Manager, the MMRP Remedial PM (RPM), and appropriate Federal and State authorities to agree upon strategy(s) to minimize, or if possible avoid, any adverse impacts to site resources. Potential site resources and mitigation procedures to avoid or lessen the adverse impacts from the geophysical investigations, intrusive activities and MC sampling, are identified below.

6.1 Potential Site Resources

No National Register of Historic Places (NRHP) eligible cultural sites are identified within the boundaries of the MRS. FPM will coordinate all operations within affected areas of the MRS with the HAFB Natural Resources office. FPM will also coordinate all brush clearing activities with the HAFB Natural Resources office.

6.1.1 Water Resources

The only permanent water in the Tularosa Basin is found in small streams between Alamogordo and Three Rivers, New Mexico. There are no perennial streams within Holloman AFB or in the nearby surrounding landscape; however, a set of perennial pools exist within the Base. They are the final one-third of the Lost River, a set of pools near the confluence of Ritas and Malone Draws, and the Salt Lakes just south of the Lost River and Camera Pad Road Pond. The Rio Grande, located west of the San Andres Mountains, and the Pecos River, east of the Sacramento Mountains, are the closest perennial rivers in the region.

6.1.2 Wetlands

There are at least nine prominent east-west drainages that receive intermittent flows during seasonal thunderstorms. The largest of these drainages is the Lost River drainage system, including Malone Draw, Carter Draw, and Ritas Draw. Prior to extensive management of the surface topography and construction of U.S. Highway 70/82, Dillard Draw emptied into the Main Base, creating a network of flats and playas including what are now Lake Holloman, Stinky Playa, and Pond G. Construction activities have disrupted the natural flow of this wetland ecosystem (SKY, 2011).

6.1.3 Vegetation

The vegetation of Holloman AFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca also occur. Sensitive species that currently receive no federal protection include lichen (A. clauzadeana), proposed for rare and endangered listing and the grama grass cactus, included due to its former candidate status (SKY, 2011). The vegetation within the MRS is characteristic of desert scrub communities. No sensitive plant species have been identified within the MRS.

6.1.4 Fish and Wildlife

Considering its relatively small size, Holloman AFB provides a relatively large diversity of habitats for aquatic and terrestrial species. Throughout the Tularosa Basin suitable wildlife habitat is limited due to ranching, farming, and urban and rural development. Within this patchwork, wildlife is typically left to survive in increasingly smaller pockets of native habitat further fragmented by roads and fences (Holloman AFB, 1999).

New Mexico has one of the most diverse mammalian faunas in North America, with eighty-nine taxa described from New Mexico, ten of which are holotypes from Otero County. The most common mammals at Holloman AFB are various rodents and the Black-tailed jackrabbit (Lepus californicus), found ubiquitously in the Great Basin Desert Scrub habitats in New Mexico. The Main Base and Boles Wells Well Field have small colonies of bats that forage for insects at the numerous playas, wetlands and riparian habitats. Bats on Holloman AFB roost in abandoned and inhabited buildings. The bats identified on Holloman are: the Pallid bat (Antrozous pallidus pallidus), Small-footed myotis (Myotis ciliolabrum melanorhinus), California myotis (Myotis californicus), and Spotted bat (Euderma maculatum). Surveys conducted within habitats at the periphery of the dune found fourteen species of rodents. The Ord's Kangeroo Rat (Dipodomys ordii), Desert Pocket Mouse (Chaetodipus penicillatus) and Plains Pocket Mouse (Perognathus flavescens gypsi) were found primarily within the dunes and others were found equally distributed or too few were captured to determine the habitat affinity.

The kit fox (Vulpes macrotis neomexicanus) inhabits the marginal and interior dunes of the White Sands (Bison-M). These foxes prey on rodents, especially kangaroo rats, within the duneland; their ranges may extend approx. 3 km (1.9 miles) from their dens. The mountain lion (Felis concolor) occupies broken and mountainous country from the Pecos River west and

commonly occurs within the San Andres and Oscura Mountains west of Holloman AFB. Mountain lion scat was found within Holloman AFB in 1994, near the confluence of Malone and Ritas Draws. Mule deer (Odocoileus hemionus) and porcupine (Erethizon dorsatum) have been observed near the Boles Wells Wellfield facilities. Porcupines are common in most habitat types and are occasionally observed on WSMR from grasslands and shrublands to higher elevation

woodlands; no observations have been made on the Main Base. The oryx (Oryx gazella), a non-native, introduced game animal is currently a resident of the Base. Oryx range into most habitats found within Holloman AFB and consume the dominant plant types, e.g. mesa dropseed and alkali sacaton. The Texas horned lizard, formerly a Category 2 species for federal listing as endangered or threatened, was reclassified February 28, 1996 as a Species of Concern (Department of Interior 1996). The Texas horned lizard appears to be abundant on Holloman AFB and was found within the major plant community types on both the Main Base and Boles Wells Water System Annex.

The White Sands pupfish (Cyprinodon tularosa) is endemic to the Tularosa Basin, with two naturally- occurring populations at Malpais Spring and Salt Creek within WSMR and two introduced populations at Mound Springs at WSMR and Lost River within Holloman AFB.

6.1.5 Migratory Birds

At least 230 bird species have been confirmed at Holloman AFB. A substantial proportion of these, including grebes, herons, ducks, sandpipers, waders, gulls, and terns, were detected at the Holloman wetlands. A reasonably large number of species in the family Emberizidae (including warblers, towhees, sparrows, and blackbirds) was detected, especially considering the virtual absence of riparian or forested areas with permanent water. These species are usually seen primarily near the wetlands, and to a lesser extent during surveys of grassland habitats. Also detected on grassland surveys were nine species of sparrows and other typical grassland species such as Swainson's Hawk, Prairie Falcon, Eastern and Western Meadowlark, Scaled Quail, four species of wren, and three thrasher species (Holloman AFB, 1999).

The majority of species detected during surveys at cinetheodolite missile towers were residents (23), followed by long-distance migrants (20) or short-distance migrants (5) that breed or winter on Holloman. Similarly, the majority of grassland species detected during surveys were residents (23), followed by stopover migrants (15), winter residents (9), and migrant breeders (5, Mehlhop et al. 1998b). In contrast, the numbers of bird species and individuals at the wetlands peak during spring and fall migration, and there are few resident or breeding wetland species.

Several sensitive bird species occur in wetland habitats at Holloman. The Interior Least Tern (Sterna antillarum athalassos) is federally and state endangered and is a rare vagrant at the wetlands. The Peregrine Falcon (Falco peregrinus), an occasional migrant, is federally and state endangered. The White-faced Ibis (Plegadis chihi) is a federal species of concern observed regularly on migration. Another federal species of concern, the Western Snowy Plover (Charadrius alexandrines nivosus) breeds in relatively small numbers on Stinky Playa and Lagoon G and is fairly abundant during migration. The Bald Eagle (Haliaetus leucocephalus), federally listed as threatened, and the Neotropic Cormorant (Phalacrocorax brasilianus), state endangered group 2, are potential visitors to the Holloman Wetlands complex, but to date neither has been observed there.

In grassland habitats, the most common sensitive bird species is the Western Burrowing Owl (Athene cunicularia hypugaea). This federal species of concern is a common year-round resident and successful breeder. The Ferruginous Hawk (Buteo regalis) is a federal species of concern. Only one individual was detected during raptor surveys in 1994-95. Baird's sparrows (Ammodramus bairdii) occur in relatively undisturbed grasslands and are rarely reported in New Mexico. Only one incidental sighting has occurred on Holloman, and none was detected during surveys targeted at the species (unpublished Baird's Sparrow report). A former category 2

species, Baird's sparrows now have no federal or state status. The Northern Aplomado Falcon (Falco femoralis septenrionalis) is a federally and state endangered species that has not been detected on Holloman. Finally, one state endangered group 1 species, the Common Ground Dove (Columbina passerina) is a potential shrubland inhabitant but has not been observed at Holloman.

6.1.6 Endangered and Threatened Species

No federally listed species covered under the Endangered Species Act currently reside at Holloman AFB. Several federally listed species, however, have been observed at the Base in the past. Mountain plover (proposed federally threatened) nested at Lake Holloman during the 1980s. Brown pelicans (recently delisted) are occasionally observed at Lake Holloman and the constructed wetlands. Peregrine falcons (recently delisted) regularly forage at Lake Holloman (Holloman AFB, 1999).

The White Sands Pupfish (Cyprinodon tularosa), is considered a Federal Species of Concern (formerly a Federal Category 2 species) and is listed by the State of New Mexico as 'threatened'. This species is managed under the jurisdiction of the NMDGF (NMDGF, 2012). Potential habitat on Holloman AFB includes all stream channels of Malone Draw and Lost River on Holloman AFB, WSNM, and WSMR, and a corridor 200 meters (660 feet) wide, extending 100 meters (330 feet) from either side of the center of the stream channel. It also includes any other areas where White Sands pupfish are found or transplanted by mutual agreement of all signatories as well as a 100 meter (330 foot) buffer around said habitat as demonstrated in the previous delineations, with the exception of the four isolated populations of translocated fish formerly located in the experimental ponds near Lake Holloman on Holloman AFB and any future exceptions under mutual agreement with WSMR, Holloman AFB, WSNM, USFWS, and the NMDGF and the party or parties seeking such exceptions (WSMR, 2006). Four other sensitive species currently receive no federal protection: a lichen (A. clauzadeana), proposed for rare and endangered listing; the grama grass cactus, included due to its former candidate status; the western burrowing owl, a species of concern; and the western snowy plover, also a species of concern.

6.1.7 Cultural and Archaeological Resources

The National Historic Preservation Act requires the federal government to consider the effects of undertakings to historic properties. Cultural/ historical resource sites present at Holloman AFB include two Cold War era missile development facilities, the Missile Test Stand Area (MTSA) and the Able 51 Area; and a WWII era turret gunner training facility, the Jeep Target Area. All three areas are considered eligible for listing on the NRHP (Sale et al., 1996). No cultural or archaeological resources have been identified at the RR869a MRS.

6.2 Mitigation Procedures

6.2.1 Coordination with the Installation Natural Resources Office

FPM will maintain close coordination with the installation office of Natural Resources, the Cultural Resources Manager, the MMRP RPM, and appropriate Federal and State authorities throughout RI field activities. If site-specific conditions change or additional resources are identified, FPM will work closely with installation office of Natural Resources, the Cultural Resources Manager, the MMRP RPM, and appropriate Federal and State authorities to come to

an agreement on the proper path forward. Addition conservation measure and/or revisions to mitigation procedures may be incorporated into field activities, as necessary.

6.2.2 Waste Disposal

Soil removed during intrusive investigations will be placed as close to the excavation as reasonable during excavation activities. When complete, the soil will be returned to the excavation. While arrangements for MD removal will be made prior to the start of field activities, MD determined to be safe may be temporarily stored at a secured location (to be determined on-site).

Solid waste generated during field activities will be collected daily and placed in proper trash receptacles off-site. FPM will arrange for removal of solid waste including pin flags, wooden stakes, and other material used. MDAS will be disposed offsite and recycled.

6.2.3 Dust and Emission Control

It is anticipated that planned field activities will generate little or no fugitive dust emissions. Airborne dust resulting from the use of heavy equipment will be monitored. If necessary, water will be used to control dust.

6.2.4 Spill Prevention and Control

Minimal amounts of chemicals will be brought on-site during the field activities. Field vehicle refueling will be completed at commercial off-site facilities. Field procedures will focus on minimizing or preventing spills during field activities.

Fuel or other liquid spills from on-site vehicles, if any, will be contained and the impacted soil removed, characterized, and disposed of at an off-site facility as appropriate. MC sample preservatives, if used, will be provided in sample containers by the laboratory to minimize the on-site handling of acids or other chemicals. Additional spill control and prevention details are discussed in the MMRP sites HASP (**Appendix B**).

6.2.5 Storage Areas and Temporary Facilities

If needed, temporary storage areas within a secured area with restricted to authorized personnel will be established. Temporary storage areas will be locked and/or secured to prevent disturbance by trespassers or vandals.

6.2.6 Access Routes

FPM will use established roadways (dirt or paved) to the greatest extent possible to gain access to the sites. Field personnel will confine motorized traffic to established access routes to reduce potential impacts to surface topography and vegetation.

6.2.7 Vegetation Removal

Vegetation may be cut to facilitate the use of geophysical instruments and other work. Vegetation will be cut no closer than six inches to the ground. It is not anticipated that any trees will be disturbed by RI field activities.

6.2.8 Water Run-On and Run-Off Control

Excavation activities will not disturb the local drainage patterns. Excavated soils will be used to backfill the excavations and manually graded to site contours.

6.2.9 Equipment Decontamination and Disposal

If necessary, equipment will be decontaminated IAW the Equipment and Personnel Decontamination SOP provided in the UFP-QAPP (**Appendix D**), during field activities.

Planned MC sampling activities include surface soil sampling using disposable sampling equipment, such as disposable polyethylene scoops and bottles. Surface soil sampling is not anticipated to generate IDW. PPE and other disposable sampling equipment will be bagged and temporarily staged for off-site disposal IAW USEPA and NMED regulations. Sampling personnel will follow local and state protocols, as well as stakeholder guidance, in determining the proper disposal of PPE.

If site information necessitates the sampling of additional matrices and utilizing alternative sampling approaches, a FCR will be completed detailing the alternative sampling approaches, the IDW anticipated and procedures and protocols required for disposal.

6.2.10 Minimizing Disturbance

FPM will make all reasonable efforts to avoid disturbances to any natural and cultural resources encountered during RI field activities. Procedures for minimizing areas of disturbance include such measures as:

- Driving on established roads as much as possible;
- Limiting vehicle trips in areas without roads; and
- Replacing soil into holes that result from intrusive excavation.

FPM will utilize pertinent restoration efforts to ensure that disturbed areas are restored to pre-investigation conditions.

6.2.11 Post-Activity Clean-Up

All project materials, solid wastes, and MDAS will be removed from the project site at the conclusion of field activities prior to leaving the site. Excavations will be backfilled with the displaced soil and/or imported backfill, and re-graded as best as possible to its prior contours. IDW will be disposed of on routine basis, following the procedures described in **Section 3.8** and IAW the Investigation-Derived Waste SOP provided in the UFP-QAPP (**Appendix D**).

6.2.12 Air Monitoring Plan

The necessity for air monitoring is not anticipated at the work sites. Should on-site conditions warrant, air monitoring will be conducted IAW procedures defined in the MMRP sites HASP (**Appendix B**).

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Appendix A

Statement of Objectives

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The following Statement of Objectives is an excerpt from the contract documents and only pages applicable to the statement are included (i.e., pages 171 through 211 of the total 281 pages).

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STATEMENT OF OBJECTIVES (SOO)

FOR

PERFORMANCE-BASED REMEDIATION (PBR)

AT

CANNON AFB, NEW MEXICO
HOLLOMAN AFB, NEW MEXICO
KIRTLAND AFB, NEW MEXICO &
LUKE AFB, ARIZONA

CONTRACT NUMBER: FA8903-13-C-0008

18 September 2013

1.0 SCOPE

This requirement is for environmental remediation activities at Cannon Air Force Base (AFB), New Mexico, Holloman AFB, New Mexico, Kirtland AFB, New Mexico, and Luke AFB, Arizona. This Statement of Objectives (SOO) defines the scope of a full range of construction and engineering activities necessary for investigation, design, remedial action, remedial construction, and environmental remediation activities to achieve minimum performance objectives and stretch goals and support progress to Site Closeout (SC) at eighty-five (85) Installation Restoration Program (IRP) sites, and twenty-one (21) Military Munitions Response Program (MMRP) sites in the Performance Based Remediation (PBR) contract.

1.1 Introduction

Cannon AFB

Cannon AFB is home to the 27th Special Operations Wing of the Air Force Special Operations Command. Cannon AFB is located in Curry County, New Mexico, situated approximately eight miles west of the City of Clovis. The base is situated on 3,789 acres (5.9 square miles) of federally-owned land. Off-base facilities include the currently active Melrose Air Force Range (formerly Melrose Bombing Range), located about 24 miles west-southwest of the base on approximately 60,010 acres.

Cannon AFB is regulated by the U.S. Environmental Protection Agency, Region 6 (EPA) and the New Mexico Environment Department (NMED) Hazardous Waste Board (HWB). Cannon has an active Resource Conservation and Recovery Act (RCRA) permit # NM7572124454. It is not on the National Priorities List (NPL).

Holloman AFB

Holloman AFB is located six miles (10 km) southwest of the central business district of Alamogordo, New Mexico. Holloman AFB occupies approximately 60,000 acres and was first established in 1942 as Alamogordo Army Air Field (AAF) flying primarily B-17s, B-24s, and B-29s. In 1947, it became the primary site for the testing and development of un-manned aircraft, guided missiles, and other research programs. In 1968, the 49th Tactical Fighter Wing arrived at HAFB and has conducted fighter aircraft training and operations. Holloman AFB has also served as the German Air Force's Tactical Training Center since 1996.

Corrective action is regulated by the Holloman AFB RCRA Permit # NM6572124422-2. The Corrective Action Modules and guidance documents, supporting corrective action, are provided by the NMED HWB.

Kirtland AFB

Kirtland AFB is located in Bernalillo County, in central New Mexico, southeast of and adjacent to the City of Albuquerque. The approximate area of the base is 52,287 acres. Environmental

remediation is being conducted pursuant to RCRA. Regulatory enforcement authority is the NMED HWB. Kirtland AFB has a RCRA Hazardous Waste Permit #NM9570024423.

At Kirtland AFB, project stakeholders may include, but not be limited to, the Air Force, US Army Corp of Engineers (USACE), Kirtland AFB, Air National Guard, New Mexico Environment Division (NMED) Hazardous Waste Board (HWB), the City of Albuquerque and Albuquerque Bernalillo County Water Utility Authority, Veteran's Administration Medical Center, and private landowners. The required level of involvement may differ from site to site and the Contractor will be responsible for obtaining comments with appropriate approval or concurrence on project deliverables consistent with applicable regulatory drivers and agreements for each site.

Luke AFB

Luke AFB covers approximately 4,000 acres west of the Phoenix metropolitan area in Glendale, Arizona. Construction of the facility began on March 29, 1941. Although only a few essential buildings had been completed, training of the first class of pilots began on June 6, 1941. Luke Air Force Base is the largest and only active-duty F-16 Fighting Falcon training base in the world with more than 200 F-16s assigned. The host command at Luke is the 56th Fighter Wing (56 FW), under Air Education and Training Command's 19th Air Force.

The eastern portion of Luke AFB currently consists of a variety of light industrial facilities, office buildings occupied by administrative and community services, Base barracks, and outdoor recreation centers. The central and western portions of Luke AFB include the runways; open space; and aircraft operation, training, and maintenance facilities. Base residential housing and commercial areas are located to the east of Luke AFB across Litchfield Park Road. The base population includes about 7,500 military members and 15,000 family members. With about 80,000 retired military members living in greater Phoenix, the base services a total population of more than 100,000 people.

On August 30, 1990, EPA placed Luke AFB on the NPL. On September 27, 1990, the USEPA, Arizona Department of Environmental Quality (ADEQ), Arizona Department of Water Resources (ADWR), and USAF signed the Federal Facility Agreement (FFA) to establish the procedural framework for conducting the required environmental investigations at Luke AFB. The OU-2 ROD was signed in 1994 and listed Luke AFB as a Federal Superfund site. The OU-1 ROD was signed on September 1999. The signing of the FFA marked the official beginning of the Comprehensive Environmental Restoration, Compensation and Liability Act (CERCLA) investigation of the Base.

1.2 General PBR Scope and Requirements

The Contractor shall perform all the necessary environmental construction and engineering activities as required to achieve the performance objectives of this SOO.

Enclosure 1 lists the sites included in the scope of this contract.

The Air Force (AF) is required to implement remedies as necessary to protect human health and the environment. The intent of the PBR initiative is to maximize the number of SCs or advance sites as close to SC as practicable during the Period of Performance (POP) in a cost effective manner. It is desirable to the AF that Life-Cycle Costs (LCC) be reduced. The AF is interested in substantial reduction of long-term environmental liabilities and life-cycle costs through accelerated achievement of SC and optimization of environmental restoration activities for all sites included in this contract while complying with applicable federal, state and local laws and regulations; and applicable base-specific orders, agreements, or rules. General performance objectives pursuant to the AFAF's overarching goals are listed below in order of priority and defined in Enclosure 4:

1) Achieve SC during the POP.

2) For any site not achieving SC during the POP, achieve, in order of priority,
   a. Response Complete (RC)
   b. Remedy in Place (RIP)
   c. The furthest objective within the regulatory structure for each site (e.g. Decision Document (DD), Preliminary Assessment/Site Inspection (PA/SI), etc.)

3) The Contractor shall develop an Optimized Exit Strategy (OES) for sites identified in Table 1 of this SOO that have an approved DD prior to, or during the POP, but do not achieve SC. The Contractor shall describe the strategy in an OES Plan to achieve the following objectives:
   - Maintain compliance with all DDs and plans (currently in place or to be approved) until no longer required or an alternate approach is approved.
   - Correct Five-Year Review deficiencies where identified as no longer protective of human health and the environment at all sites.
     - The next Five-Year Review for Kirtland AFB is scheduled in 2015.
     - The next Five-Year Review for Cannon AFB is scheduled in 2017.
     - The Five-Year Review for Holloman AFB is scheduled in 2017.
     - The Five-Year Review for Luke AFB is scheduled in 2017.
   - Apply innovative technologies to minimize the cost and period of operating, monitoring and treatment.
   - Improve the understanding of the Conceptual Site Model (CSM), existing systems, and contamination sources to support optimization.
   - Provide an analysis of alternatives for each site to aggressively accelerate treatment and progress to expedite SC. Alternatives shall include engineering cost estimates, conceptual designs, and a business case analysis.
   - Develop performance indicators, decision criteria, and objectives consistent with the performance model described below that will be used to optimize remedial efficiency, quantify how the response is progressing and demonstrate when the objective has been reached. The following are the minimum required OES deliverables: an OES Plan shall be delivered within one year from either date of award or exercise of the option of the SubCLIN whichever is applicable. An OES Implementation

Completion Report shall be delivered upon completion of the implementation of the optimization efforts in the approved OES Plan, and one of the final milestones shall be an OES Effectiveness Report:

- The OES Effectiveness Report shall include:
  a) Documentation of what remedial strategies were implemented, what remains to be implemented, and any modifications to the OES arising from performance to date.
  b) A realistic schedule to achieve SC or RC after the POP (the Contractor shall identify which performance objective is the optimal endpoint). For sites with an indeterminate project completion date, a schedule for 30 years including the POP is required.
  c) The remaining definable and measurable milestones after the POP.

4) For all sites listed in Table 1 of this SOO that have an approved DD prior to or during the POP and are not being proposed to SC during the POP, the Contractor shall develop performance models that describe the expected course of the remediation process (i.e. how conditions are expected to change over time as measured using appropriate performance indicators from the current state until the performance objective is achieved). For all sites being proposed to SC during the POP, the work planning documents are expected to contain the performance model. The Contractor shall provide monitoring reports that demonstrate whether or not the remedial approach is performing in accordance with the performance model. For purposes of reporting Contractor progress and status, these conditions shall be quantified by performance indicators relevant to the proposed remedial approach. A performance model is a graphic representation of a performance indicator value over time until a performance objective is achieved. Several indicators may be needed to adequately reflect performance. The Contractor shall report the actual remedy performance compared to projected performance. The Contractor shall ensure consistency and continuity of information regarding performance (between the Project Management Plan (PMP), Integrated Master Schedule (IMS)/Milestone Payment Schedule (MPS), and OES plan.

Within the construct of the goals and objectives above, the minimum performance objectives and specific performance objectives to be achieved for each site during the POP for this contract effort are outlined in Tables 1 and 2 of this SOO. If the Contractor anticipates the ability to achieve a stretch goal during the POP, the Contractor is encouraged to propose that stretch goal, which will then become the requirement of this contract (applicable to sites in Table 1 of this SOO only).

The Contractor shall specify the performance objective to include at least the minimum objective as listed for sites in Table 1 of this SOO, and the specific performance objectives for sites in Table 2 of this SOO (with no stretch goal proposed) and date they intend to achieve it for each site within the POP. Contractors shall explain why the selected performance objective (including the minimum performance objective if that is what is proposed) is an optimum solution for the Government. It should be noted that the AF reserves the right not to exercise all options not awarded at the time of contract award.

Table 1: Minimum Performance Objectives and Standards

Minimum Performance Objectives	Minimum Performance Standards
All Sites	
Approved Project Management Plan (PMP): • Draft Preliminary PMP within 30 calendar days of contract award. • Final Preliminary PMP within 14 calendar days of receipt of COR comments on the drafts. • Updated Final PMP expected approximately 4.5 years after the Final Preliminary PMP. • Time-phased updates, submitted annually (at minimum) or more frequently, as appropriate to maintain accuracy and completeness.	Air Force approval through the Contracting Officer's Representative (COR).
Provide support (supplying documents to independent reviewers and participation in meetings/interviews) for Five-Year Reviews required for all site(s) identified in the contract for the duration of the contract. Correct any remedy or site deficiencies noted in Five-Year Reviews.	Air Force approval through the COR and Regulator approval (e.g., formal documentation accepting correction of deficiencies).

Beginning at Notice to Proceed (NTP), or upon achievement of RIP or RC, or any performance objective that is not SC, conduct, as appropriate, RA-O and/or LTM and develop an OES to achieve SC and implement the elements of the approved strategy that fall within the POP. RA-O/LTM and implementation of the OES shall continue through the duration of the POP or 1) until no longer required based on Air Force and regulatory concurrence that SC has been achieved, or 2) AF and regulators have approved implementation of an alternate approach.	AF approval through the COR for RA-O/LTM reports and Regulatory approval as required (e.g., formal documentation accepting the RA-O/LTM report). AF approval through the COR for OES Plan and OES Effectiveness Report And approval of Regulatory required documents.
Minimum Performance Objectives	***Minimum Performance Standards***
Site Specific	
Achieve RFI within specified timeframe (CY) as noted below for the following site: **<u>Kirtland AFB:</u>** **<u>01/2017</u>** • CG570: EOD Hill Upon achievement of RFI, perform any necessary RA-O/LTM at the above sites for the duration of the contract or until achievement of SC, whichever comes first. Note**: Dates for sites not awarded within the base award are subject to change depending on when they are awarded.	Air Force approval through the COR and Regulator approval (e.g., written confirmation of acceptance of documentation demonstrating RIP). Maintain all ongoing RA-O, O&M, and/or LTM activities at the following sites until SC is achieved or the required activities are replaced in accordance with the newly approved exit strategy.

Achieve RC within specified timeframe (CY) as noted below for the following site: **Cannon AFB:** **01/2019** • TU504: Hospital Abandoned UST Upon achievement of RC, perform any necessary LTM at the above sites for the duration of the contract or until achievement of SC, whichever comes first. Note**: Dates for sites not awarded within the base award are subject to change depending on when they are awarded.	Air Force approval through the COR and Regulator approval (e.g., written confirmation of acceptance of documentation demonstrating RC).
Achieve RC within specified timeframe (CY) as noted below for the following sites: **Holloman AFB:** **05/2018** • ML866: Former Bombing Range **09/2018** • SR867: Possible Firing Range **01/2019** • OW967: SWMU 20 (Within T-38 Site) • OW968: SWMU 19 (Within T-38 Site) • SS059, SS524: T-38 Test Cell (SWMU 229) Upon achievement of RC, perform any necessary LTM at the above sites for the duration of the contract or until achievement of SC, whichever comes first. Note**: Dates for sites not awarded within the base award are subject to change depending on when they are awarded.	Air Force approval through the COR and Regulator approval (e.g., written confirmation of acceptance of documentation demonstrating RC).

Achieve RC within specified timeframe (CY) as noted below for the following sites: **Kirtland AFB:** **11/2016** • ML125: Field Firing Range • AL120: Proximity Fuze Range • PT123: Tijeras Small Arms Range • DA130: Arroyo Del Coyote Demolition Area **08/2023** • ST105: TCE and Nitrate Contaminated Groundwater Upon achievement of RC, perform any necessary LTM at the above sites for the duration of the contract or until achievement of SC, whichever comes first. Note**: Dates for sites not awarded within the base award are subject to change depending on when they are awarded.	Air Force approval through the COR and Regulator approval (e.g., written confirmation of acceptance of documentation demonstrating RC).
Achieve Site Closeout (SC) within specified timeframe (CY) as noted below for the following sites: **Cannon AFB:** **04/2018** • TU502: Former Gas Stations USTs • TU503: Base Support/ Operations Generator Former UST • TU505: Flight line Generator USTs **08/2016** • TS835: Former Skeet Range (VCA) **08/2017** • AT109: SWMU 109, FT-C109	AF approval through the COR and Regulator approval (e.g. written regulator confirmation of acceptance of SC documentation for unrestricted use).

Cannon AFB continued:

11/2017

- FT006: Fire Training Area No. 1
- SD015: AGE drainage ditch
- MY031: AGE maintenance shop pad
- SW127/128: Oil/water Separator

12/2017

- TU071: Recovered JP-4 Fuel Tank No. 390
- AT110: FT-C110: SWMU 110
- SW111: Unlined Pit (used with SWMU 109)
- SW112: Oil/water separator No. 2336
- TU126: Inactive Underground Storage Tank 3

10/2018

- SW006: POL Tank No. 129
- SD-012: Stormwater Collection Point South Playa (SWMU 85)
- SD017: Old entomology rinse area
- SD020: NE Stormwater Drainage Area (SWMU 95)
- SD022: Storm water drainage & retention pond on GC
- DP036: MWR Body Shop
- WL102: Wastewater treatment effluent discharge
- SS501: Former AGE Dispatch Facility spills

02/2021

- FL070: Oil/water separator & leach field 326
- TA129: Waste Oil Storage Facility 244-formerly AOC I
- SS507: POL Yard Refueling Area
- DA508: Surface Disposal Area

Note**: Dates for sites not awarded within the base award are subject to change depending on when they are awarded.

Achieve Site Closeout (SC) within specified timeframe (CY) as noted below for the following sites: **Holloman AFB:** **12/2014** • SS013: Sodium Arsenite Spill Site • OT014: Former Entomology Shop Area • OT032: Former Primate Research Area Sewer Lines • SS067: Spill & Sand Blasting Residuals Area **09/2015** • RW042: Radioactive Waste Disposal Area **09/2016** • TU503: Building 221 • TU506: Building 901 • TU508: Building 298 • TU515: Building 889 • TU518: UST 7003 **09/2018** • SD027: PAD 9 Washrack Area, RAD Waste • OT037: Early Missile Testing Site • OT038: Test Sled Maintenance Area • SS065: Test Cell Surface Spill • SS069: Flight line Fuel Spill Area • TS851: Former Skeet Range • XU853: Missile Test Stands Area • XU854: Able 51 Area • FI857: Former Bunker • SR858: Former Small Arms Range • SR863: 1000 Inch Range **01/2020** • RR869: Debris Field **Holloman AFB continued:**	AF approval through the COR and Regulator approval (e.g. written regulator confirmation of acceptance of SC documentation for unrestricted use).

03/2020 • TU904: Building 1194 • SR864: Poorman Range **05/2020** • SR859: Former Skeet Range 2 • TS862: Jeep Target Area Skeet Range • ML865: Ballistics Rain Field **02/2021** • SS018: Chromic Acid Spill Site **09/2021** • SS017: BX Gas Station Fuel Leak **12/2022** • DP030: Grease Trap Disposal Pits, • SD033: Cooking Grease Disposal Trench **06/2023** • OD20K: 20,000 Pound Open Detonation Unit Note**: Dates for sites not awarded within the base award are subject to change depending on when they are awarded.	
Achieve Site Closeout (SC) within specified timeframe (CY) as noted below for the following sites: **Kirtland AFB:** **01/2017** • OT572: Building 5700-1 **02/2017** • OT573: Asphalt Dump Area **04/2017** • SS575: Transient Alert Pad **11/2017**	AF approval through the COR and Regulator approval (e.g. written regulator confirmation of acceptance of SC documentation for unrestricted use).

• CW571: Zia Park **09/2018** • TG100: Bomb Target • AL120A: Proximity Fuze Range • AL120B: Proximity Fuze Range **06/2020** • PL567: UST058 **09/2021** • WP026: Base Sewage Lagoons & Golf Course Pond **08/2022** • ST070E: Oil/Water Separator (ST-219) Note**: Dates for sites not awarded within the base award are subject to change depending on when they are awarded.	
Achieve Site Closeout (SC) within specified timeframe (CY) as noted below for the following sites: **<u>Luke AFB:</u>** **<u>03/2015</u>** • FT007: North Fire-Training Area (West) **<u>01/2016</u>** • DP013: Drainage Ditch Disposal Area **<u>02/2016</u>** • ST018: Facility 993 • DP023: Surface impoundment west of Facility 993 **<u>Luke AFB continued:</u>** **<u>12/2016</u>** • FT007E: North Fire-Training Area (East)	AF approval through the COR and Regulator approval (e.g. written regulator confirmation of acceptance of SC documentation for unrestricted use).

• SD020: Oil/Water Separator Canal and Earth Fissures **11/2019** • RW002: Low-Level Radioactive Waste Burial Site **03/2020** • SD038: Southwest Oil/Water Separator at the Auto Hobby Shop **04/2023** • TU044: Leaking Underground Storage Tank at remote Waterdog Recreational Area Note**: Dates for sites not awarded within the base award are subject to change depending on when they are awarded.	
Develop an OES to achieve SC and implement the elements of the approved strategy that fall within the POP for the following sites: Cannon AFB: • LF002: Landfill No. 2[1] • SW002: Recovered tank no. 108[1] • LF003: Landfill No. 3[1] • LF004: Landfill No. 4[1] • SW004: Recovered tank no. 121[1] • LF005: Landfill No. 5, cell 3[1] • LF025: Landfill No. 25, Concrete rubble pile[1] • SI101: Wastewater Treatment System – lagoons 1 & 2 [1] Holloman AFB: • LF029: Old Army Landfill • SS039: Missile Fuel Spill Area, Groundwater ***only*** Kirtland AFB: • LF001: Landfill No.1[1] • LF002: Landfill No. 2[1] • LF008: Landfill No. 4, 5 & 6[1]	Air Force approval of optimized exit strategy and Regulator concurrence with Air Force approved reports confirming implementation of the strategy (e.g. written confirmation of acceptance of documentation). Maintain all ongoing RA-O, O&M, and/or LTM activities at the following sites until SC is achieved or the required activities are replaced in accordance with the newly approved exit strategy. [1] O&M and Long Term Management (preventive and corrective maintenance) at these sites will begin in 1st Quarter 2014 (December 2013).

Luke AFB • LF003: Outboard Runway Landfill • LF014: Old Salvage Yard Burial Site • LF025: Northwest Landfill	

Table 2: Performance Objectives (These are the only performance objectives – for sites in Table 2, no higher stretch goal is desired or should be proposed.)

Site Specific	
Conduct Long Term Management (LTM) at the following sites: Luke AFB • SS042: Bulk Fuels Storage Area Implementation of LTM shall continue through the duration of the POP or until no longer required based on Air Force and regulatory concurrence that SC has been achieved.	Air Force approval through the COR and Regulatory approval (e.g. written confirmation of implementation of LTM (e.g. Land Use Controls, Institutional Controls, etc.)).

This SOO and enclosures listed below include general requirements of the project to meet the AF objectives:

- Enclosure 1 – Site List
- Enclosure 2 – Key Documents
- Enclosure 3 – Government Furnished Equipment (GFE)/Government Furnished Property (GFP)
- Enclosure 4 – Acronyms and Definitions
- Enclosure 5 –Format For Metadata and .pdf Documents

The Contractor shall function as an integral team member in support of the Air Force Civil Engineer Center (AFCEC) mission, to include the sharing of information with other AFCEC contractors and AF personnel, and cooperation with community stakeholders, regulators, and other Government entities.

Requirements for efficient management of this contract include, but are not limited to, the submission of accurate, on-time, quality contract deliverables and timely identification and solution of impediments to successful project execution. Technical requirements include, but are not limited to, early involvement in the process to allow for the development of the most cost-effective and technically sound approach or solution. AFCEC will rely on the Contractor's expertise in recognizing and addressing problematic issues and successful execution of this contract. The Contractor shall perform all work in accordance with federal, state, and local statutes and regulations. The Contractor shall also comply with base regulations. Remedies

shall conform to environmental permits, decision document requirements, or other legal requirements.

2.0 APPLICABLE DOCUMENTS

The Contractor shall identify and comply with all applicable federal, state, and local statutes; AF/Military/ instructions, manuals, handbooks, regulations, guidance, and policy letters (including AF policy and guidance for IRP, CRP, and MMRP); Executive Orders (EOs); American Society for Testing and Materials (ASTM); American Petroleum Institute (API) Codes; National Association of Corrosions Engineers (NACE); National Fire Protection (NFPA); Steel Structures and Painting Counsel (SSPC); National Electrical Code (NEC); Uniform Fire Code (UFC); and International Building Code (IBC) including all changes and amendments in effect on the date of issuance of this contract. It is the Contractor's responsibility to identify and comply with all applicable requirements. In addition, the Contractor shall refer to the current versions of the Department of Defense (DoD) Policy and Guidelines for Acquisitions Involving Environmental Sampling or Testing and The United States AF Construction Management Implementation Guide.

The Contractor shall identify and comply with all applicable documents for the bases including Records of Decision (RODs), ROD Amendments, Explanation of Significant Differences (ESDs), RCRA Permits and subsequent modifications, Risk Evaluation Corrective Action Program (RECAP) documents, the Endangered Species Act, other Decision Documents, Deeds, and conveyance notices. Key base-specific documents are listed in Enclosure 2.

The Contractor is solely responsible for reviewing all publicly available information and forming their independent, professional conclusions/interpretation of site conditions and requirements to meet the objectives of this contract. The information provided in this SOO is not intended as a substitute for complete analysis of technical data available, nor is it intended to be a guide on how the Contractor should address achievement of the performance objectives.

3.0 GOVERNMENT FURNISHED INFORMATION, EQUIPMENT, AND PROPERTY (GFI, GFE, GFP)

Government Furnished Information is listed in Enclosure 3, GFE/GFP. The AF believes that documentation provided with the solicitation represents the most recent and appropriate documentation available for the Installation and sites identified in this contract. However, if there is a conflict between this information and other site documentation (the existing reports), the Contractor is solely responsible for reviewing all available information and forming their independent, professional conclusions/interpretation of site conditions and requirements to ahieve the performance objectives of this contract. Specific documents may be made available following a request to the Contracting Officer (CO), if the documentation can be distributed in a timely manner. Electronic format is not guaranteed.

The Contractor shall properly account for and manage all new and existing GFE and/or GFP procured and utilized at the bases in accordance with the applicable Federal Acquisition Regulation (FAR). Lists of GFE/GFP are provided in Enclosure 3:

Cannon AFB, NM:

- Soil Vapor Extraction System Design and Construction is composed of one (1) SVE well and two (2) vapor monitoring wells that are plumbed to an SVE system which is connected to moisture separator, particulate filter, a blower, monitoring instrumentation, and GAC containers. The system is housed in a shed. The SVE system and all the related components can be explained in detail within Section 3 of the Interim Corrective Measures, Construction Summary Report, SWMU ST-70 (Former ST-219), April 2009.

Holloman AFB, NM:

- Currently there are no remedial systems at Holloman AFB.
- Should remedial systems be required, the AF will provide electricity and water but the Contractor is required to provide the connections and installations.

Kirtland AFB, NM:

- Currently there are no remedial systems at Kirtland AFB.
- Should remedial systems be required, the AF will provide electricity and water but the Contractor is required to provide the connections and installations.

Luke AFB, AZ:

- Currently there are no remedial systems at Luke AFB or at Waterdog Recreational Area.
- Should remedial systems be required, the AF will provide electricity and water but the Contractor is required to provide the connections and installations.
- Contractor should note that NO utilities are available at the remote Waterdog site. Contractor will have to make arrangements, from start to finish, for any and all utilities necessary for any planned activities at this site.

Remediation systems may or may not be listed as GFE and/or GFP. The Contractor is responsible for providing all other supplies and equipment, not already installed and not listed in Enclosure 3, required to achieve the performance objectives of this contract. All AF owned property used for remediation purposes must be maintained by the Contractor in accordance with applicable maintenance requirements. The Contractor is responsible for proper return or disposal of excess or unserviceable equipment or materials as required during the duration of this contract. Prior to disposal of excess or unserviceable equipment listed in Enclosure 3, the Contractor shall coordinate activities with the CO for disposition instructions.

4.0 MANAGEMENT, PLANNING, AND REPORTING REQUIREMENTS

The Contractor shall implement a full range of construction and engineering activities as required to meet objectives of this contract and in accordance with all applicable base, regulatory, and site requirements. The Contractor shall supply all labor, equipment, and

materials necessary to accomplish the work. The Contractor shall perform management and planning functions, including performance measurement and fund status reporting.

4.1 Milestone Payment Schedule (MPS)

Milestone payments shall be based on the completion of definable and measurable steps, which are considered integral and necessary to the achievement of the stated performance objectives. Completion of milestones shall demonstrate payment is appropriate and warranted. AF approval of the documentation supporting the completion of the milestone is required for payment (for example, AF approval of Draft Remedial Investigation report, AF acceptance that interim and final performance goals per approved performance models have been achieved.) Where regulatory acceptance/concurrence is required for this documentation, AF acceptance of the milestone will occur following regulatory acceptance/concurrence of the documentation (for example, EPA approval of Draft Record of Decision). For milestones where regulatory acceptance/concurrence is required and regulatory acceptance/concurrence cannot be obtained, the AF will evaluate the Contractor's documents to determine if they are legally and technically acceptable to warrant payment for achieving that milestone.

The Contractor's proposed MPS may require restructure of Contract Line Item Number (CLIN)/SubCLINs, if necessary, to align with projected available funding prior to award; however the MPS is not final with award of the contract. Changes made to the MPS prior to award are used to finalize the SubCLINs description and amount. Award of the contract does not equate to final acceptance of the MPS. The MPS shall be included as part of the PMP. The MPS will be negotiated during development of the PMP and may require additional changes. The Contractor shall submit the MPS in an electronic format consistent/compatible with the AFCEC SharePoint website, **e-DASH**. Final decisions regarding the adequacy of milestone and deliverable completion resides solely with the COR. The COR will take into consideration the appropriate acceptance and/or concurrence of necessary site remediation documentation by regulators, consistent with applicable regulatory drivers of this SOO.

Management and overhead type costs (program/project management, monthly reporting, mobilization costs, etc.) do not provide measureable program advancement and are not appropriate milestone payments. These costs/expenses should be allocated into site, site grouping, or Operable Unit (OU)-related milestone payments that provide demonstrable value to the program. Milestones shall not represent a "progress" payment or a monthly payment for level of effort expended. Completing site mobilization/demobilization (unless exempted by CO), accomplishment of field activities, or submittal of a monthly status or Operations and Maintenance (O&M) reports are examples of unacceptable milestone payments.

The first deliverable milestone required in the MPS is the Opening Phase PMP. The PMP deliverable milestone shall be contract inclusive. The Contractor shall not allocate costs to specific sites or include indirect costs associated with sites. Upon determination of bona fide need, a second PMP SubCLIN for the Closing phase may be exercised. Both PMPs shall be updated annually or as necessary to remain current with the approved execution strategy.

The Contractor shall complete an MPS and identify milestone payments, and the associated payment schedule on a site by site basis. The Contractor may also propose logical groupings of sites or OUs for milestone payment purposes where an approach provides greater efficiency for the program; however, a SubCLIN involving multiple sites shall identify milestones by individual sites in order to support AF reporting requirements. Table 2 of this SOO includes the specific performance objectives (with no stretch goal proposed). Achievement of the awarded performance objective for Table 1 and Table 2 sites of this SOO shall be the final payment milestone for each SubCLIN. Potential CLIN and SubCLINs are described in the CLIN/MPS/IMS Guidance.

The number of milestone payments per site should be limited to a reasonable amount based on the scope and anticipated duration to achieve the performance objective at the site. The Contractor is limited to one invoice submitted to AFCEC per month. The invoice must itemize the milestone payments for each site or grouping associated with the invoice.

If the Contractor has to continue working beyond the performance objective date to achieve a final milestone (applies to SubCLIN dates only) the Contractor shall submit a period of performance extension request to the CO at least 60 days prior to the expiration date of the Sub-CLIN. However, the Contractor shall not perform work after the funding associated with the milestone cancels. Specifically, completion of activities on an individual SubCLIN cannot exceed 30 days prior to the end of the fiscal year; five years from the date of exercising of the SubCLIN. However, the Contractor will not receive payment until milestones are achieved in accordance with the MPS. The Contractor may receive a negative past performance rating for delay in achievement of the impacted performance objectives.

4.2 Project Management Plan (PMP)

The Contractor shall develop and maintain a detailed PMP. The PMP shall include the Technical Approach, IMS, and MPS, prepared as part of the Contractor's proposal. In addition, the PMP shall specify the resources required for the planning, execution, control, and completion of the stated performance objectives. At a minimum, the PMP shall include the following sections: technical approach, performance objectives in accordance with the SOO, draft Performance Models, organization and integration of the project team, schedule management and project controls, transitional activities, risk management, SubCLIN management, quality management, health and safety management, project communications and stakeholders, procurement management, and security management. The PMP should identify the project's resources and project tasks corresponding to the SubCLINs for this contract.

In order to align with the availability and expiration of Government funds, the Contractor shall prepare two versions of the PMP. The initial (or opening phase) PMP will govern activities from award to the midpoint of the PoP. The closing phase PMP will govern activities from the midpoint of the PoP the end of the PoP and will be funded approximately 4.5 years from contract award or upon CO determination of bona fide need.

The first draft of the opening phase PMP shall be due within 30 calendar days of contract award and subsequent revisions shall be subject to AF review and approval. The revised version of the opening phase PMP shall be due within 14 calendar days from receipt of AF comments. The PMP shall be updated annually, or as necessary, throughout the contract to remain current with the approved execution strategy. The Final Preliminary PMP, annual updates, and the Final PMP shall be submitted in an electronic format consistent/compatible with the AFCEC SharePoint website, **e-DASH.**

The first draft of the closing phase PMP shall be due within 30 calendar days of SubCLIN award. The closing phase PMP will be a logical follow-on of the final version of the opening phase PMP. The revised version of the closing phase PMP shall be due within 14 calendar days from receipt of AF comments. The PMP shall be updated annually, or as necessary, throughout the contract to remain current with the approved execution strategy.

The final milestone for the opening phase PMP SubCLIN shall be a Project Status Summary and for the Closing phase PMP SubCLIN shall be a Project Closeout Summary.

The Project Status Summary and Project Closeout Summary shall include summaries of the following: progress on achievement of objectives, progress on achievement of milestones including performance models, schedule achievements or delays, issues and risks, and other project indicators as required by the CO or COR. In addition, the Project Closeout Summary shall include required information to support closeout of the contract as defined by the CO and COR.

4.3 Project Web Site

The Contractor shall maintain a document repository for all PBR documents to include, but not limited to information on meetings, documents submitted, SubCLIN details, milestone status as agreed to in the PMP; current topics associated with the PBR, basic PBR statistics and objectives, stakeholder Point of Contact (POC) information; calendar of events, meetings milestones; laboratory results and reports, 3D conceptual models; groundwater reports, analysis, studies; links to administrative records/information repository records and to associated appropriate reference documents- state and federal policy guidance; and key performance indicator tracking.

The repository is intended to be a single access point repository for all PBR documentation. It shall be accessible to all stakeholders during the life of the PBC. The Contractor shall provide notifications to the COR, CO, and Base POC at the time data is included in the repository. At close-out, all repository documents will be transferred to DVD media and delivered to the AF, and placed on the AFCEC contractor drop-zone website (address provided under separate cover).

4.4 Schedule and Planning Requirements – Integrated Master Schedule (IMS)

The Contractor shall prepare and submit an IMS for approval that includes activities and milestones at a detailed level and presents sequenced events for completion of the proposed

performance objectives within the time designated and any critical path items that may affect ability to meet the schedule. The Contractor shall include and identify all performance milestones and payments consistent with the approved MPS. Sites associated with each milestone/task shall be noted in the schedules using the Site IDs and referencing all site aliases noted in Table 1 and Table 2 of this SOO and SubCLINs. The schedule shall be provided in initial hardcopy and subsequently in electronic format consistent/compatible with AF software, currently Microsoft™ Project and in Adobe Acrobat portable document file (.pdf), Microsoft Excel, and any other formats required upon request. Updated and revised schedules shall be submitted electronically to the AFCEC SharePoint website with monthly status reports with changes clearly identified by the Contractor.

4.5 Cost and Status Reporting

The Contractor shall prepare and submit a monthly Contractor's Progress, Status, and Management Report (CPSMR). The CPSMR shall be used to review and evaluate the overall progress of the project, along with any existing or potential problem areas. The report shall be prepared in a format coordinated with the COR. The CPSMR shall also be used to indicate whether efforts for each site are on target for meeting the Contractor's proposed performance objective.

The CPSMR shall include a summary of the events that occurred during the reporting period, discussion of performance, identification of problems, proposed solutions, corrective actions taken, outstanding issues, and payments made toward the MPS to date.

The Contractor is required to report monthly, quarterly and yearly metrics. The reporting format will be via the Contractor's PBR website and AFCEC's SharePoint website, e-DASH. The Contractor will be required to upload the following reports:

- Monthly: % expensed, % complete, and % on time addressing each SubCLIN for an AF dashboard roll-up.

- Quarterly: Performance indicators (PIs) associated with each site, for an AF dashboard roll-up. Examples for consideration include:
    - Mass loading rate
    - Volumetric loading rate
    - Mass removal rate
    - Cumulative mass removed
    - Unit cost
    - Cumulative cost
    - Variable operating cost
    - Mass flux
    - Energy consumption rate
    - Greenhouse gas emission rate
    - Decay rate
    - Reaction rate

- Center of mass
- Disturbances
- Water consumption rate
- Percent time pump and treat systems are operating
- gallons of GW treated;
- qty/pounds of contaminant removed from water;
- qty/pounds of contaminant removed from soil;
- energy saved using energy saving techniques compared to std approach;
- qty/pounds of recycled material;
- acreage returned for beneficial/mission use;
- Number of sites to SC, LTM, RC, RIP, RI, NFA, NFRAP, OES, of total anticipated for this PBR (i.e. 3/7 SC, 2/9 NFA, 5/15 NFRAP, 2/42 OES)

- Yearly: Data in support of the Annual Report to Congress as applicable, to include, but not be limited to the following:
  - gallons of GW treated;
  - qty/pounds of contaminant removed from water;
  - qty/ pounds of contaminant removed from soil;
  - energy saved using energy saving techniques compared to std approach;
  - qty/ pounds of recycled material;
  - acreage returned for beneficial/mission use;
  - Number of sites to SC, LTM, RC, RIP, RI, NFA, NFRAP, OES, of total anticipated for this PBR (i.e.: 3/7 SC, 2/9 NFA, 5/15 NFRAP, 2/42 OES)

The Contractor shall provide the cost for reporting the data as a separate line item in the CPSMR.

The AF will use approved performance indicators and models, in addition to the PMP to establish and execute a surveillance plan. The Surveillance Plan will highlight key quality control activities or events. The COR will use the Surveillance Plan to determine when AF (COR and/or CO) surveillance activities can be conducted to assess progress toward and/or verify completion of payment milestones. The AF will communicate surveillance activities internally and with the Contractor. Current guidance on how the AF will develop and implement surveillance will be provided in the Surveillance Plan.

4.6 Meeting and Conference Requirements

4.6.1 Meeting/Teleconference Support

The Contractor shall participate in post-award meetings and Project Management Review (PMR) meetings or teleconferences with the AF, as necessary to achieve the performance objectives in this SOO. The Contractor shall coordinate meetings; provide logistical support (e.g., facilities, audio/visual); present materials and lead technical discussions. The Contractor shall prepare, and submit for AF review and concurrence, any presentation materials and agendas for meetings. The Contractor shall prepare minutes for all meetings attended.

The Contractor also shall attend and/or support meetings and teleconferences to discuss technical or regulatory issues and project progress and status with the AF and regulatory agency representatives as required, including applicable meetings such as Restoration Advisory Board (RAB) meetings, partnering, Tier 1, Tier II meetings and teleconferences. Monthly teleconferences shall also be required to discuss in detail progress and any technical or management issues. Also other periodic meetings/teleconferences shall be required, as necessary. However, the frequency of meetings may change based on the status of the environmental restoration program. The AF will be present for all technical and public meetings with the regulatory agencies. The Contractor shall clearly identify themselves as "Contractors" in all situations involving stakeholders. The Contractor shall prepare, and submit for AF review and concurrence, any presentation materials and agendas for meetings. Travel to/from the Base and to other CONUS locations for such purposes as meeting attendance, briefings and/or presentations may be required in support of this remedial action. These activities are considered incidental to the effort required and shall not be included for separate milestone payments.

The Contractor shall notify the AF (Installation) prior to any contact with a regulatory agency.

4.6.2 Public Meetings and Hearings

The Contractor shall support all community involvement requirements to meet CERCLA, RCRA, and other regulatory requirements including public meetings, public notices, RAB meetings, Technical Working Group, Community Advisory Group meetings, public comment periods, and responsiveness summary preparation. The frequency of meetings listed below may change based on the status of the environmental restoration program.

Cannon AFB: An active RAB is in place with meetings held semi-annually.

Holloman AFB: There is currently no active RAB.

Kirtland AFB: There is no RAB; but Kirtland AFB does have a Citizens Advisory Board (CAB). A Community Relations Plan has been developed and implemented for Kirtland AFB and is included in the Basewide Work Plan (Tetra Tech, 2004). Restoration contractors at Kirtland AFB support the CAB meetings by developing information, make briefings regarding project status of all sites, and prepare meeting minutes. The CAB meetings are quarterly. Additional semi-annual meetings are conducted with DOE and the contractors provide the same support. Kirtland AFB also has quarterly leadership meetings which require contractor support.

Luke AFB: There is currently no active RAB, as it was dissolved after the majority of the sites were de-listed.

The Contractor shall attend teleconferences as necessary with the assigned Public Affairs Officer (PAO) to ensure the PAO is fully aware of all ongoing activities, public outreach status, compliance with applicable regulations, and potential issues that might impact the AF and its public image in accordance with Clause H029, Implementation of Disclosure of Information. The Contractor shall notify the Base POC before any contact with the PAO.

Examples of types of Public Affairs requirements include the presentation of technical information and logistical support (e.g., advertising, audio-visual, handouts, report(s), recordings, verbatim transcripts, poster boards, slides, synopses, etc.) for events and/or meetings in support of the Government's position. All reports and other information generated under this contract shall become the property of the Government, and distribution to any other source by the Contractor is prohibited unless authorized by the COR.

The Contractor shall research, coordinate and provide responses for short-notice internal and external requests for information such as congressional inquiries and media requests as requested by the PAO or other applicable action officers. These inquiries require the Contractor to provide the AF factual and responsive information within 48 hours of request.

4.7 Contractor Documentation

The Contractor shall create and maintain a Master Document List (MDL) that includes all documents, whether the document is a deliverable or not, which are prepared during the course of this contract. The MDL and its documents shall be maintained in libraries readily available for submittal to the Government. The Contractor shall maintain the project documents for the duration of this contract and transfer custody to the AF within 90 calendar days prior to POP expiration.

The Contractor shall also provide documentation monthly to maintain the installation's existing administrative record in accordance with established procedures. Refer to "Enclosure 5 – "Format for Meta Data and .pdf Documents" for format guidance when providing documents.

4.8 Spatial Data (Map) Requirements

The Contractor shall not establish new Geographic Information System (GIS) systems.

In furtherance of the environmental construction or restoration effort, the Contractor shall provide geospatial data and map(s) of installation features (historical, existing, or planned) altered or constructed as required to achieve the performance objectives of this contract.

Source data and product data remain the property of the United States Government. The Contractor may be required to explain and demonstrate the company's process for protecting all geospatial data, including but not limited to, geometry, attributes, metadata, topologies, and relational database schemas and operations used in association with this SOO. Further information about security and nondisclosure requirements should be obtained from the installation Geospatial Integration Office (GIO).

The Contractor shall provide data to update the GIS and/or computer-aided design and drafting (CADD) files, as required to achieve the performance objectives of this contract. Source data and product data remain the property of the United States Government.

The Contractor shall also ensure that GIS data is submitted in a format compatible with the AF GeoBase program, as outlined in the AF GeoBase Strategic Plan. The Contractor shall consult with each Base POC and/or installation GIO office to ensure CADD and GIS data is compatible with each installation's requirements.

4.9 Notification Requirements

The Contractor is required to notify the CO, COR, and Base POC of critical issues that may affect the contract performance and/or human health and the environment. The types of issues that require notification include, but are not limited to, health risks, spills, Notices of Violation (NOVs) (received or anticipated), changes in critical personnel, and finding unanticipated unexploded ordnance (UXO) or chemical warfare materiel (CWM). As an example, if unanticipated UXO were discovered during field activities, the Contractor would be required to immediately stop work, report the discovery to the Base POC, CO and COR, and implement the appropriate safety precautions. Field activities could not continue until clearance was received from the CO. On critical issues, verbal notification should be made immediately, followed by written notification as soon as practical.

4.10 Permits

The Contractor shall develop, coordinate, apply, comply with, and/or modify all federal, state, local, and other applicable environmental permits, access agreements, easements, licenses, and certificates required to achieve the performance objectives of this contract as detailed in 4.10.1 and 4.10.2. Generally the AF will sign all easement agreements and modifications and/or renewals of new or existing permits, licenses, and certificates required under this contract. The Contractor shall maintain a library of these documents at the Contractor's site office as well as the corporate facility handling this contract. The Contractor shall comply with all applicable permit conditions.

4.10.1 Environmental Permits

Pursuant to CERCLA (42 U.S.C. 9621(e)), no federal, state, or local permits shall be required for onsite removal or remedial actions. The Contractor must consult with the AF prior to obtaining environmental permits for onsite CERCLA activities. For non-CERCLA restoration sites, the Contractor shall assist the AF to comply with all applicable permit conditions, including payment of permit fees. If the Contractor has any question whether a particular permit may or may not be required, the Contractor shall consult with the AF prior to obtaining the permit. The Contractor shall be responsible for reviewing, and responding to site-specific underground utility locating systems request tickets, or other dig permit requests, requiring the identification of subsurface appurtenances and utilities associated with the remediation systems included in this contract. If the Contractor obtains environmental permits, it is responsible for implementing and paying for them. Utility location ticket requests will be sent to the Contractor and the Contractor will be required to review, respond, and address all location requirements in accordance with state law and regulations. The Contractor shall maintain all records pertaining to location requests.

4.10.2 Rights of Access to Non-AF Real Property

The Contractor shall prepare documents using AF provided templates to satisfy the performance objectives of this contract.

4.11 Photo Documentation

The Contractor shall prepare digital photographic documentation, as required to achieve the performance objectives of this contract. The Contractor shall include photographic documentation of site(s) and building(s) under investigation, field activities, and sample locations. The Contractor shall upload all photographs to the Contractor Deliverables Upload Tool (CDUT). Photography of any kind shall be coordinated through the COR and/or Base POC.

4.12 Remote and/or Austere Sites

The Contractor will be required to perform work as specified at Waterdog Recreational Area at Luke AFB (Site TU044) which is considered to be a remote and/or austere location. The Contractor shall be responsible for all personnel, security, supplies, equipment, and infrastructure (including, but not limited to, potable water, utility systems, housing, dining, transportation, and medical care) when there are no facilities and services available. This shall include providing these facilities and services to a limited number of government personnel or other contractor personnel (such as Title II personnel) present or visiting to oversee or assess the work.

4.13 Site Access Badges

The Contractor shall obtain and monitor assigned security badges and Common Access Cards (CACs) (used by both prime contractor and subcontractor personnel) for the duration of this contract. All security badges, CACs and/or passes shall be returned to the Base POC upon expiration of the badge/ CAC, upon completion of the project, or when possession of the badge/ CAC is no longer necessary (e.g., upon removal of contractor personnel from specific projects).

Additional access or security requirements/limitations that may impact scheduling are provided below. Advance coordination for site access is required as follows: for example the contractor will be required to obtain a flightline badge, escorts, secret clearance, etc.), and time requirements for coordination, etc.

Kirtland AFB: Kirtland Underground Munitions and Maintenance Storage Complex (KUMMSC), has separate security restrictions but no restoration work is expected in the area.

Whenever intrusive activities are conducted at the Environmental Restoration Program (ERP) sites, the Contractor must complete Base Civil Engineering Clearance Requests (AF [AF] IMT 103) and Base Civil Engineer Work Requests (AF IMT 332) and shall obtain approval from the Contracting Officer. The Contractor shall coordinate all such work with Installation maintenance personnel prior to performing work. Contractors on environmental sites are

required to perform their own utility checks based on Installation-supplied utility maps. The Contractor shall comply with all Installation- or site-specific time and procedural requirements (federal, state, and local) described in the permits obtained.

4.14 Worksite Activities and Coordination

4.14.1 Coordination of Activities

The Contractor shall coordinate worksite activities with all applicable personnel to ensure the protection of human health and the environment; the prevention of damage to property, utilities, materials, supplies, and equipment; and the avoidance of work interruptions. The Contractor shall provide physical security to work areas by furnishing security equipment and personnel. The Contractor shall perform emergency response to situations arising from project activities. The Contractor shall perform emergency repairs to facilities, systems, improvements, or utilities damaged in the course of executing the contract requirements. The Contractor shall comply with all local, state, federal and military law and guidance covering security activities. The Contractor shall comply with Occupational Safety and Health Administration (OSHA) safety and health regulations and local safety office requirements. The Contractor is required to provide the CO copies of any OSHA report(s) submitted during the duration of the contract.

4.14.2 Radiological Waste, Hazardous Material and Hazardous Waste Permitting and Reporting

The Contractor shall handle all radiological waste, hazardous materials and waste in accordance with applicable federal, state, local, and base requirements. The Contractor shall provide all radiological waste, hazardous materials use and hazardous waste disposal documentation to the COR and/or Base POC, and shall register with the Hazardous Materials Pharmacy program (if available) at the installation to ensure appropriate and efficient tracking of the Contractor's hazardous material purchases, inventories, use, and releases such as required by the Emergency Planning and Community Right-to-Know Act (EPCRA), Executive Orders, or any installation reporting requirements.

The Contractor shall also comply with federal, state, local, and base requirements for any task involving the transportation of radiological waste, hazardous wastes and/or contaminated materials to off-site treatment, storage and/or disposal facilities. This includes 40 Code of Federal Regulations (CFR) 260, 49 CFR 172, 173, 178, 179 and all other applicable local, state, and federal transportation regulations.

5.0 CHEMISTRY REQUIREMENTS

The Contractor shall be responsible for the quality of all required chemistry services performed. The Contractor shall ensure that all chemistry-related tasks are conducted in accordance with the project-specific Work Plan (WP). The Contractor shall identify a Program Chemist as key personnel in the project WP. The Program Chemist will act as a POC on all chemistry-related issues and shall be responsible for ensuring that all Data Quality Objectives (DQOs) are met.

5.1 Quality Assurance

The Contractor shall develop project-specific DQOs designed to ensure data of adequate quality are collected to support project decisions. DQOs shall be developed in accordance with local, state, and federal regulations, such as USEPA QA/G4, Guidance for the DQO Process (most recent version) and documented in the project WP.

All field sampling and laboratory services shall be conducted in accordance with the approved project WP. Samples shall not be submitted for analysis until the WP is approved. The Contractor shall ensure that all requirements specified in the project WP are met. If not met, the Contractor may be required to re-accomplish sampling at the Contractor's expense. The Contractor shall conduct audits, administer an AFCEC-approved performance evaluation sample program, verify and validate data, and perform corrective actions in accordance with the project WP. The Contractor shall submit results of audits and performance evaluation samples to the COR.

5.2 Laboratory Selection

The Contractor shall select a laboratory that is accredited under the DoD Environmental Laboratory Accreditation Program (ELAP). The Contractor shall ensure that the selected laboratory meets all state and federal requirements, including state certification where appropriate. The laboratory shall also have analytical capabilities sufficient for the methods specified in the WP and adequate throughput capacity to handle the project's analytical workload during all field activities.

The Contractor may establish an on-site laboratory at the project site if determined necessary by the Contractor. However, on-site test laboratory(ies) shall also be accredited under the DoD ELAP and meet all state and federal requirements, including state certification where appropriate.

By submission of an offer, the Contractor represents that analytical testing in support of the restoration program will be performed by laboratories accredited in accordance with the DoD Environmental Laboratory Accreditation Program (ELAP). Additional information regarding ELAP can be found at the Navy Labs website (address provided under separate cover).

Questions regarding the ELAP shall be submitted to the AFCEC Chemistry Mailbox (address provided under separate cover).

5.3 Analytical Data Management

The Contractor shall ensure that all hard copy and electronic data deliverables supplied by the laboratory are complete and adequate to support the quality and usability of the data. Raw data packages shall be submitted to the COR and Base POC upon request. Data packages shall include all information required to re-create the analysis, including correspondence with the

laboratory regarding exceeding quality assurance/quality control (QA/QC) measurements and documentation of corrective actions. The Contractor shall meet Environmental Resources Program Information Management System (ERPIMS) data deliverable requirements as currently required by AFCEC as detailed in Section 8.3.

5.4 Record Keeping

The Contractor shall create and maintain in one location written (in bound, numbered logbook) and electronic records sufficient to recreate each sampling, analytical, testing and monitoring event, and shall make these records available to the Government upon request. The Contractor shall maintain records of, and derived from, all activities outlined in the appropriate portion of the Quality Program Plan (QPP) supporting the generation of these sampling and analysis records. The Contractor shall also retain written calculations using information obtained from sampling, analysis monitoring, and testing activities, to include all raw data. All information shall be provided to the Government upon request.

6.0 PLANS AND REPORTS

6.1 Quality Program Plans (QPP)

The Contractor shall prepare, for AFCEC review and approval, project-specific QPPs for this contract. The project-specific QPP shall describe the work that will be accomplished at a site, or group of sites. The Contractor shall implement, maintain, and comply with the approved project-specific QPP. The Contractor may elect to write a generic (basewide) QPP to address common project information and procedures. Project-specific QPPs may reference the generic QPP as applicable. Additional information on the UFP-QAPP can be found on the AFCEC Chemistry website (to be provided under separate cover).

The QPP shall include the WP and the Health and Safety Plan (HSP) (as required by 29 CFR 1910.120). WPs requiring sampling and analysis shall be written in the UFP-QAPP format (i.e., worksheets). The QPP shall also include the Construction Quality Plan (CQP), as appropriate. Project DQOs shall be fully described as required to achieve the performance objectives of this contract. The Contractor may utilize existing plans (e.g., site-specific or basewide groundwater monitoring plans) in their entirety or prepare updates, revisions, or addenda to the existing plans, with AFCEC approval, in lieu of developing new plans. However, use of any existing plans may still require revision to meet the UFP-QAPP format. For new sampling and analysis/data collection efforts, a new work plan shall be written in the UFP-QAPP format.

6.2 Technical Plans and Reports

The Contractor shall provide technical plans, explosive safety documents, and reports, as well as various other deliverables. The Contractor shall complete these documents according to the most appropriate industry standard.

Deliverables are required under this contract to demonstrate that performance objectives and milestones are being met and that payment is appropriate. Most documents must be submitted for initial AF review followed by submittal to one or more regulatory agencies. Document Review Process Guidance provided outlines a generic document review process for this contract. The Contractor shall ascertain the number of copies required for delivery to all relevant parties. Regulatory Agency review times will be based on the agency reviewing the document, complexity of the deliverable, and work load of the technical review team. Legally binding documents such as reports, correspondence, NFA documents, regulatory closure documents, RODs, or other decision documents shall be signed by the AF and not the Contractor.

The Contractor shall submit all plans, reports, and other deliverable documents in, Draft, Draft Final, and/or Final versions as appropriate for that specific document. Not all documents will require submittal of all versions. The Contractor shall provide multiple versions of the following documents:

- **Cannon AFB**: Documents: Two (2) hardcopies and two (2) CD's of all draft documents; four (4) hardcopies and CDs of all Draft Final and Final documents.
- **Holloman AFB**: Documents: Two (2) hardcopies and two (2) CD's of all draft documents; four (4) hardcopies and CDs of all Draft Final and Final documents.
- **Kirtland AFB**: Documents: One (1) hardcopy and 1 CD of all draft documents; three (3) hardcopies and three (3) CDs of all Draft Final and Final documents.
- **Luke AFB**: Documents: Five (5) hardcopies and five (5) CD's of all draft documents; five (5) hardcopies and CDs of all Draft Final and Final documents. Add two (2) each for all 5 year reviews.
- AFCEE COR and Program Management Office (PMO) POC: one (1) CD of Drafts, Draft Final, and Final documents.

The Contractor shall upload all documents to the AFCEC Contractor Deliverables Upload Tool (CDUT), link to be provided upon award. The deliverables required for this contract shall be proposed by the Contractor and will be included in the Contractor's MPS.

7.0 SITE WORK

The Contractor shall perform site preparation, incidental characterization and field investigation, conservation, demolition, and restoration of sites as required to achieve the performance objectives of this contract.

7.1 Conservation

Activities shall be planned and implemented in a manner that protects existing site utilities, structures, surface features, service operations, monitoring and other types of wells, and the general site environment. This includes the protection of prehistoric and/or historic sites identified in the base Integrated Cultural Resources Management Plan; endangered/threatened wildlife species and their potential habitats; exemplary natural areas as defined in the base Integrated Natural Resources Management Plan; and trees, shrubs and other vegetation not in the

affected zone from dust damage, soil compaction, and physical contact with machines and equipment. Work activities shall be coordinated with the AFCEC COR and Base POCs (Cultural Resources POCs, the Natural Resources POCs, Base Operating Support POCs) to ensure compliance with these requirements. If appropriate, the Contractor shall conserve uncontaminated topsoil by removal, storage, or redistribution. All reasonable measures shall be taken to minimize and suppress fugitive emissions of dust, vapors, and other site materials during site work. All fill materials shall be non-contaminated with the proper documentation to demonstrate as such. The Contractor shall conduct all operations and activities with the intent of reducing the amount of pollution generated. Specific areas to be focused on are generation of solid waste, use of hazardous materials, use of ozone depleting chemicals, generation of hazardous waste, and use of energy and water. During site work the Contractor shall plan, construct, operate, maintain, optimize, and decommission systems necessary to control storm water run-on and run-off; and transport surface water drainage to a treatment plant, discharge location, or any other appropriate destination.

Cannon AFB: There are no identified natural or cultural resource issues nor are there any threatened & endangered species listed at the base.

Holloman AFB: There are no significant cultural or natural resource management issues with the exception of a sensitive habitat at the SS039 Missile Fuel Spill Area site.

Kirtland AFB: There are endangered species, cultural resources and/or natural resource issues that could affect some of the sites at Kirtland AFB. The Burrowing owl is a resident endangered species; however this may have more impact on restoration work at MMRP sites as opposed to the IRP sites. No significant cultural resource issues were identified. Kirtland AFB has a Natural and Cultural Resource Management Plan (NCRMP) in place.

Luke AFB: No endangered species were reported at Luke AFB. Cultural resource clearance is needed before any work can be performed at certain areas of Luke AFB for all areas south of Super Sabre Street. The need for endangered species or cultural clearance will be evaluated prior to conducting intrusive site field activities.

As the metropolitan Phoenix area is a federal non-attainment area for particulate matter, Luke AFB operates within a very stringent dust-control environment. Contractor shall be responsible for obtaining, implementing, and complying with all required dust-control permits.

7.2 Demobilization

The Contractor shall decontaminate equipment and facilities prior to leaving the site(s), decommission facilities as necessary, and fully restore the site(s) as close as possible to pre-construction conditions. The Contractor shall remove any temporary facilities and implement erosion control measures such as seeding, mulch, sodding, and erosion control fabrics; restore roads, structures and utilities; and plant trees, shrubbery, grasses and other vegetation. The Contractor shall document and report on activities and train Government personnel to perform required maintenance, as requested.

7.3 Site Characterization

The Contractor shall perform work including, but not limited to, field investigation and sampling/analysis that characterizes environmental conditions incidental to and as required to achieve the performance objectives of this contract. The Contractor shall identify specific site characterization activities proposed to achieve the performance objectives.

7.4 Site Preparation

The Contractor shall perform site work as necessary to prepare sites for construction activities. Security and access controls shall be implemented to prevent unauthorized entry to sites and to protect wildlife from site exposure. The Contractor shall survey existing utilities to determine adequacy and need for modifications to support site activities. The Contractor shall obtain appropriate approvals and shall construct connections or new systems for electrical power, water, sewer, gas distribution, telephone, and other utilities, as required, to achieve the performance objectives of this contract. Additionally, the provision and cost of utility metering devices associated with implementation of existing and proposed remedies, including installation of individual meters for necessary utilities, is the responsibility of the Contractor. The Contractor shall meter all utilities consumption on a monthly basis.

Cannon AFB: Contractor must follow base rules but must make connections themselves. Exception is that final electrical hookup to be performed by Cannon AFB personnel. Metering is not required for operation.

Holloman AFB: Contractor to supply electric meter and reimburse base, must connect to water, sewer and electric by contract.

Kirtland AFB: Contractor must follow base rules but must make connections themselves. Exception is that final electrical hookup to be performed by Kirtland personnel. Metering is not required for operation.

Luke AFB: For Luke the Contractor will pay to connect to utilities and will be charged at reasonable market rates. No utilities available at Waterdog Recreational Annex. Contractor will need to be self sufficient at that location.

7.5 Demolition

Any demolition activities shall be ancillary to other requirements. The Contractor shall demolish facilities, systems, and other improvements as required in this contract. The Contractor shall conduct demolition efforts in conjunction with such activities as new environmental remedial system construction and site clearing if required to achieve the performance objectives of this contract. The Contractor shall perform surveys as part of demolition efforts.

8.0 ENVIRONMENTAL REQUIREMENTS

The Contractor shall perform a full range of activities to meet environmental engineering and construction requirements to achieve the performance objectives of this contract. Requirements may include, but are not limited to, completion of conceptual design(s), construction, implementation, demolition, and emergency response as related to environmental engineering and construction tasks.

The Contractor shall execute environmental restoration, pollution prevention, compliance, conservation, design, and construction projects. The Contractor shall evaluate, complete, and modify designs as necessary, and plan, install, construct, test, and decommission any site as required to achieve the performance objectives of this contract. The Contractor shall document all activities as stated herein.

The Contractor shall perform incidental support such as designing, planning, programming, scoping, studying, investigating, evaluating, and consulting on environmental engineering and construction efforts. The Contractor shall also provide training to Government and other contractor personnel regarding the O&M of equipment, systems, and facilities during equipment shakedown periods. The Contractor shall perform O&M of equipment, systems, and facilities prior to acceptance by the Government.

The Contractor shall implement Environmental Management System (EMS) principles in accordance to contractor requirements of AF Instruction (AFI) 32-7001 (*Environmental Management*), to include Green and Sustainable Remediation (GSR) techniques, to the extent practicable while ensuring protection of human health and the environment. EMS and GSR are defined in Enclosure 4. An EMS follows the Plan-Do-Check-Act cycle and considers the environmental impact of investigative and remedial activities during the remedy selection process as well as operation and maintenance of the remediation activity. The Contractor shall incorporate an EMS approach into all environmental restoration projects, evaluating activities and selecting a remedy, product, and/or service that minimizes the environmental impact from the remedy, yet provides the maximum environmental benefit to the cleanup over the entire life of the remedial project. The Contractor shall mitigate, minimize, or otherwise manage the potential environmental impacts from all remediation activities. Contractors working on AF installations must complete an initial EMS awareness-level training and integrate EMS training with other required contractor orientation and training when possible.

8.1 Performance-Based Remediation (PBR)

The Contractor shall perform a full range of activities to meet all PBR requirements. PBR requirements may include investigation, design, construction, remedial action, O&M, optimization of LTM, and Remedial Process Optimization (RPO).

This contract involves a PBR approach, where desired outcomes of the work are identified without specifying the methods or technologies to be used. Under such efforts, the contracted work is performed with a focus on results. This PBR contract enables the Contractor to select

actions best suited to the site requirements, ensures that best management practices and best available technologies are employed, and focuses on continual improvement by applying an EMS approach.

8.1.1 Scope Discussion and Limits

The scope of this contract is to perform environmental restoration services for the sites listed in Enclosure 1 and assume contractual liability and responsibility for achieving the Contractor's proposed performance objectives. The AF is statutorily responsible for all sites listed in Enclosure 1. This scope includes all known contaminants linked to the specific sites (thus, to include contaminants on, under, or emanating from the specific sites) without regard to quantity (e.g., plume size, concentrations, etc.).

The Contractor shall be responsible for:

a) The provision and cost of metering the utilities associated with the implementation of remedies for each installation is identified in Section 7.4.
b) Well abandonment with AF and Regulatory acceptance (if required) that the well is no longer necessary.
c) Reviewing all documents/deliverables before they are submitted to the base. The Contractor should establish a quality control/quality assurance review process to ensure documents/deliverables do not contain typos, formatting issues, contradictory information in tables and text, etc.
d) Well Maintenance such as redevelopment on an annual basis, well pad repair, and re-surveying latitude, longitude, and elevation, if deemed necessary by any of the stakeholders.

The Contractor shall not be responsible for:

a) Reasonably unanticipated contaminants at sites identified in Enclosure 1 (e.g., previously undetected mercury within a trichloroethene [TCE] plume); however, Contractors would be responsible for reasonably anticipated contaminants such as vinyl chloride in a TCE plume.
b) Remediation or treatment of emerging contaminants unless otherwise specified.
c) Regulatory changes (i.e., reduction in MCL levels).
d) Unknown sites (e.g., sites not identified in Enclosure 1).
e) Execution of modification of deeds or other real property documentation unless otherwise specified.

8.1.2 Transition of Work

Activities will transition to this contract upon completion of the current Contractor's field support and/or final deliverable on sites noted in the table below. The Contractor must ramp-up management of this contract quickly upon award to ensure seamless operations of existing systems and no lapses in service.

Base/Site No.	Contract/Contractor (POP End)	Existing Task Order Final Deliverable/Outcome
Cannon AFB		
RS-C103, LF002, SW002 (TU/US-C002), SW004 (TU/US-C004), FT006, SW006 (TU/US-C006), AT010 (FT-C110), SD012 (SWMU 85), SD-12 (Storm-water collection point S.Playa), SD015, SD_20, NE Storm-water drainage area (SWMU 95), MY031, TU/US-C071, FT-C109, WL-C102, SW111 (FT-C111), SW112 (FT-C112), TU/US-C126, SW127 (OW-C127), and TA/AS-C129	FA8903-09-D-8580, TO 0013 /Shaw/31Dec13	Achieve ISM and AF Approved Draft RFI or RC for all sites not achieving SC (CAC without Controls)
Holloman AFB		
TU/US-C500, TU/US-C501, TU/US-C503, TU/US-C504, TU/US-C505, TU/US-C506, TU/US-C508, , TU/US-C513, and TU/US-C518	AFCEE WERC09 Midwestern Region FY11 PBR FA8903-09-D-8580, TO 0013 /Shaw/31Dec13	Achieve ISM and Draft RFI within 16 months from NTP (31 Dec 2012)
SS059, SS524	W912PP-09-D003, DO 0008/Bhate/3Jul15	ACM
Kirtland AFB		
CW571, OT572, OT573, and SS575	AFCEE WERC09 Midwestern Region FY11 PBR FA8903-09-D-8580, 0013/ Shaw/31Dec13	Achieve ISM and Draft RFI by Jan13.
ST070E	AFCEE ECOS FA8903-10-D-8594, 0049/Bhate/12Oct13	Quarterly SVE Operation Reports/ Annual Characterization and SVE

Base/Site No.	Contract/Contractor (POP End)	Existing Task Order Final Deliverable/Outcome
		Optimization Report
LF001, LF002, and LF008	AFCEE ECOS FA8903-10-D-8596, 0076/HGL/29Aug13	Monthly Landfill 1, 2 and 8 Inspection Report/ M&M Annual Report
Luke AFB		
RW002, ST018 & SS042	contract currently being negotiated, (Stell Environmental/Arcadis), Ft. Worth District ACOE	One year of annual monitoring conducted in May 2013 with report to follow

8.2 Environmental Construction

8.2.1 Completion of Conceptual Design

A conceptual design (typically 10–30% design) for environmental projects may be provided to the Contractor for completion of the design and then construction. This work may be provided in phases. The Contractor is accountable for all aspects of the final design under federal, state, and applicable local laws. All completed designs shall be signed and sealed in accordance with all applicable requirements. The Contractor shall complete project working drawings and the various plans and schedules, including a construction schedule, and obtain submittal approvals and permits. Working drawings and specifications shall comply with codes, laws, and the request for proposal requirements. The working drawings shall be submitted for AF review. The Contractor shall implement, coordinate, and execute all regulatory reviews, shall ensure technical adequacy of the final design, and shall provide quality control of all phases of the contract.

8.2.2 Study Effort Incidental to Remedy or Corrective Action

The Contractor may engage in supplemental study work in pursuit of a remedy or corrective action. This may include, but is not limited to (1) performing bench-scale and pilot-scale studies of remediation technology, and (2) drafting new decision documents (e.g., ROD Amendment, ESD, RCRA Permit modification).

8.2.3 Construction

The Contractor shall perform construction, restoration, and demolition of utilities, real property systems, and infrastructure in support of environmental restoration requirements as required to achieve the performance objectives of this contract. Construction and demolition activities shall be in conformance with local and AF standards and regulations to include base specific regulations. The Contractor shall erect or install support buildings, equipment enclosures, and storage facilities for construction materials and contaminated material awaiting disposal as permitted by the base.

8.2.4 Pre-Final Inspection

The Contractor shall conduct a pre-final walk through inspection and publish the pre-final inspection findings in a pre-final inspection report.

8.2.5 Final Inspection

The Contractor shall conduct a final inspection and publish the findings in a final inspection report. The inspection shall concentrate on the items identified at the pre-final inspection and recorded in the pre-final report. The final inspection report shall (1) certify that all items of the design have been implemented and that the construction is complete; (2) include a record of "signed and sealed" as-built drawings and specifications verifying that all development standards have been met. At the final inspection, the Contractor shall present a completed DD Form 1354, Transfer and Acceptance of Real Property to the Base Civil Engineer (BCE) or other appropriate organization for signature and acceptance.

8.2.6 Delivery and Warranty

The Contractor shall complete all inspection and commissioning requirements prior to final inspection. The warranty shall be issued in accordance with FAR 52.246-21. Extended warranties offered by the Contractor and its subcontractors or suppliers may be accepted at the Government's discretion. The Contractor shall provide system O&M manuals and parts list to the Government, and train maintenance personnel in system operations prior to delivery to the Government.

8.3 Environmental Resources Program Information Management System (ERPIMS)

The Contractor shall comply with the ERPIMS data deliverable requirements for all field-derived data/information supported by ERPIMS data structure including, but not limited to, sampling data, relevant QA/QC data, lithology, groundwater, monitoring well location, well construction, well maintenance, and/or abandonment information. After receipt of the contract, the Contractor shall submit an ERPIMS Data Submission Schedule within 30 days of award to establish the projected framework for ERPIMS data submissions. The Contractor shall record and enter field and laboratory data and submit this data as specified in the latest ERPIMS Data Loading Handbook (DLH) using the latest version of the ERPIMS software utility (ERPTools). ERPIMS data submissions are required within 90 days of sample collection unless a written waiver or extension is obtained from the CO in coordination with AFCEC Environmental Restoration Branch Chief. The AFCEC website (address provided under separate cover) offers the latest DLH, ERPTools client software, ERPIMS policy, ERPIMS Help Desk contact info, data submission requirements, ERPTools training schedules, and more. Data submissions shall be error-free, pass all validation checks and fully comply with the ERPIMS DLH. The Contractor shall ensure that any required corrections are accomplished within both the contract POP and before funding expiration. The preferred procedure is for laboratories to use ERPTools to input/submit chemistry data for initial validation, import and submission by the Prime Contractor. ERPTools training is available to prime and laboratory contractors. All PBR

milestones that include analytical sampling shall include successful ERPIMS loading of all relevant ERPMIS data elements into the production database as a minimum acceptance criterion.

8.4 Innovative and Proven Technologies

The Contractor shall, to the extent reasonably practical, plan, design, construct, operate, monitor, and decommission innovative environmental remediation, monitoring, and other technologies as required to achieve the performance objectives of this contract. The AF seeks technologies and methodologies that are innovative, sustainable and cost-effective that will lead to accelerated closure of environmental sites. Information on innovative technologies and methodologies available to the Contractor as well as resources to additional sources and information of other innovative approaches is available at AFCEC technology transfer website (address provided under separate cover).

8.5 Operations and Maintenance

The Contractor shall perform RA-O/O&M requirements at specified locations. The Contractor shall be responsible for the operation, maintenance, monitoring, optimization, and evaluation of in-place environmental systems throughout their active life. This shall include all materials required to replace any exhaustible process materials required to operate and maintain the individual processes specified in the system O&M manuals and equipment manufacturer specifications. The Contractor shall provide system O&M manuals and parts list to the Government, and train maintenance personnel in system operations prior to the end of the POP. The Contractor shall ensure that the operation of the environmental system is optimal and effective at achieving system goals.

The Contractor shall review installed equipment and prepare databases of equipment/systems with information such as scheduled maintenance, compatibility with existing systems, vendor sources, and warranty expiration dates for all systems installed at sites that will not achieve SC by the end of the POP.

The Contractor shall perform studies to monitor and evaluate the remedial process as required to achieve the performance objectives of this contract. The Contractor shall plan, design, construct, and implement RPO to ensure effectiveness and efficiency of the remedial process based upon the Contractor's proposed technical approach for achieving the performance objectives of this contract.

In accordance with AF policy, the Contractor shall support (e.g., supplying documents to independent reviewers and participation in meetings/interviews) Five-Year Reviews of all remedial actions, including non-CERCLA cleanup actions using the EPA guidance document Comprehensive Five-Year Review Guidance, OSWER No 9355.7-03B-P, June 2001. The Contractor shall also be responsible for implementing recommendations presented in the Five-Year Reviews.

The Contractor shall update questionnaires for the Environmental Decision Information Tracking Tool (EDITT) System Inventory module and Performance Tracking Tool (PTT). The questionnaires require fiscal year O&M data for each remediation system and/or monitoring program included in this contract; due by November 30 of each calendar year. The Contractor shall also update questionnaires for the EDITT Decision Document Inventory module with information on major decisions (e.g., decision document, site closure, and no further action) within three weeks of a change in status. The data will be entered in accordance with instructions in the current version of the EDITT Quick Start Guide (website address provided under separate cover). Examples of the questionnaires for each technology found in EDITT appear as an appendix in the Quick Start Guide.

8.6 Ordnance Removal and Support

Within the context of the MMRP or the Environmental Restoration Program, the Contractor shall remove, render inert, destroy, recycle, and dispose of used or fired munitions, UXO, and other explosive devices and materials as required, to achieve the performance objectives of this contract. The Contractor shall perform associated investigative work if required to achieve the performance objectives in this contract. Ordnance may contain or be within the proximity of chemical, biological, and radiological materials and wastes. The Contractor shall prepare, as required, an Explosive Siting Plan, Explosives Safety Submission, Chemical Safety Submission and obtain AF Safety Center and DoD Explosive Safety Board approval before any response actions are taken. For removal of UXO, other ordnance, and MC contamination associated with all sites such as, bombing ranges, ranges containing MEC, small arms, skeet, and practice ranges, etc., it may be necessary to further investigate subsurface anomalies, perform MC remedial actions, conduct surface and subsurface MEC/UXO removals and shall be the responsibility of the Contractor. Coordination with the Base's Explosive Ordnance Disposal (EOD) office is required prior to any specific response. However, the Contractor shall be responsible for and perform investigations and plan response actions to remove, transport, and dispose of UXO, munitions related debris, scrap material, etc. and munitions residue from exploded ordnance. Clearance must be performed prior to using intrusive equipment. Detection and identification may require applying innovative and proven technologies. Documentation shall include generation of a digital geophysical record and data inputs to GIS, and well as written reports of activities.

The Contractor is prohibited from off-setting contract cost or invoice cost upon receipt of proceeds generated through recycling commodity sales. 100% of all commodity sales proceeds must be returned to the government. Cash payments are prohibited.

8.7 Presumptive and Other Remedies

The Contractor shall implement remedial actions and other cleanup or response actions as required to achieve the performance objectives of this contract.

8.7.1 Requirements

The Contractor shall obtain concurrence for remedial actions with appropriate agencies in coordination with the COR and Base POC. In support of the remedy, the Contractor shall be required to do some or all of the following:

- Conduct all remediation activities within context of the installation Environmental Policy, as contractually required by the installation EMS, incorporating the significant aspects identified by the installation as applicable to remediation activity(ies)
- Incorporate GSR into the approach as practicable (see Section 8.0)
- Determine and/or confirm natural and anthropogenic background levels of contaminant of concern (COC)
- Determine contaminant fate and transport, and hydrogeologic properties
- Perform groundwater modeling, and perform any other modeling or technical analysis in support of multi-media requirements
- Analyze and convert existing groundwater monitoring wells for use as appropriate
- Perform field investigations, risk assessments, and risk mitigation
- Report on activities, modify designs and specification plans, and provide documentation
- Conduct tests to evaluate the effectiveness of the technologies utilized and maintain optimum system performance
- Develop O&M manuals for new and modified systems and components

8.7.2 Regulatory Site Closure

Regulatory Site Closure is necessary but is not sufficient to achieve SC. Site Closure for this contract is defined in Enclosure 4. Regulatory Site Closure as described in the paragraph below is a component of the achieving the SC milestone.

In support of remedial actions, the Contractor shall close sites in accordance with all applicable local, state, and federal regulations. The Contractor shall prepare the closure reports and other applicable documents and provide any supporting documentation and data required by the regulatory agencies upon approval by the COR. The Contractor may be required to conduct additional investigation, remediation, and/or provide appropriate documentation to satisfy closure requirements. Closure will be considered complete upon receipt of signed regulatory and AF concurrence.

Wells and remediation systems shall be decommissioned in accordance with all applicable federal, state, and local regulations and the location restored to a condition compatible with the surrounding area. Wells may include, but are not limited to, extraction wells, injection wells, monitoring wells (single and multiple completion), and piezometers. Remediation systems may include, but are not limited to, equipment, tanks, fencing, enclosures, piping, conduit, concrete slabs, and asphalt paving. Underground system piping and conduit may be abandoned in place provided the piping is properly decontaminated to the satisfaction of the AF in a manner that will preclude future AF financial liability. The Contractor shall obtain approval from the AF and regulator, if applicable, prior to decommissioning any wells and systems.

8.8 Radiological and Hazardous Waste Removal and Support

The Contractor shall remove, render inert, destroy, recycle, and dispose of hazardous and/or radiological wastes and materials and provide all hazardous materials use and hazardous and/or radiological waste disposal documentation to the COR and/or Base POC or designated alternate. An AF representative will sign all hazardous and/or radiological material waste manifests. The Contractor shall perform associated investigative work as required.

9.0 POINTS OF CONTACT

POCs will be specified upon contract award.

10.0 ABBREVIATIONS, ACRONYMS, and TERMS

Refer to Enclosure 4 "Acronyms and Definitions" for the abbreviations, acronyms, and commonly used terms.

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Appendix B
Health and Safety Plan

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The Health and Safety Plan is on a parallel review track and is awaiting AFCEC approval.

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Appendix C
Points of Contact

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POINTS OF CONTACT

MMRP REMEDIAL INVESTIGATION
RR869a DEBRIS FIELD MRS

HOLLOMAN AIR FORCE BASE
Contract Number FA8903-13-C-0008

Name	Role	Email Address	Organization	Phone Number
Naomi Alvarado	CO	Naomi.alvarado@us.af.mil	772 ESS/PKB	210-395-8151
Rita Leal	Contract Specialist	Rita.Leal@us.af.mil	772 ESS/PKB	210-395-8228
DeAnna Rothhaupt	RPM	Deanna.rothhaupt@us.af.mil	49 CES/CEA	575-572-3931
Brian Renaghan	COR	brian.renaghan@us.af.mil	AFCEC/CZRX	210-395-8581
Layi Oyelowo	Alt COR	Layi.oyelowo@us.af.mil	AFCEC/CZRX	210-395-8567
H. Don Ficklen	AFCEC/CZRW – Program Manager - Restoration Program Office	holmes.ficklen@us.af.mil	AFCEC/CZRX	210-395-8577
Laquita Joy Lozano	AFCEC Contractor Support	laquita.lozano.ctr@us.af.mil	AFCEC/CZR	210-395-8573
David Rizzuto	Holloman AFB Contractor Support	David.rizzuto@holloman.af.mil	USAF	575-572-5395
DJ Davis	Holloman AFB Contractor Support	Darrell.Davis@holloman.af.mil	USAF	575-572-3931
John Kieling, Chief	NMED Project Manager	John.kieling@state.nm.us	NMED	505-827-1603
Chuck Hendrickson	USEPA Region 6 Project Manager		USEPA	214-665-2196
Gaby Atik	FPM Program Manager	g.atik@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x202
Maureen Whalen	FPM Project Manager	m.whalen@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x216
Daniel Baldyga	FPM Deputy Project Manager	d.baldyga@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x207
Kamalesh Pinisetti	URS Program Manager	Kamalesh.pinisetti@urs.com	URS Corporation	602-317-5204
Jeff Hackworth	FPM MMRP Manager	j.hackworth@fpm-remediations.com	FPM Remediations, Inc	210-495-7744
Ivana Raicevic	FPM MMRP Installation Manager	i.raicevic@fpm-remediations.com	FPM Remediations, Inc	210-495-7744
Russell Shattles	FPM UXO Services Manager	r.shattles@fpm-remediations.com	FPM Remediations, Inc	678-920-8315
Katrina Mattice	FPM ERPIMS	k.mattice@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x212
Connie Van Hoesel	FPM Program Chemist	c.vanhoesel@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x250
Jean Dent-Smith	Accutest Laboratories Project Manager	jeans@accutest.com	Accutest Laboratories	407-425-6700

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Appendix D
Uniform Federal Policy-Quality Assurance Project Plan

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FINAL

UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN

for

RR869a DEBRIS FIELD MRS

HOLLOMAN AIR FORCE BASE NEW MEXICO

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Ave., Suite 163
Joint Base San Antonio Lackland, Texas 78236-9853

October 2014

Prepared by:

FPM Remediations, Inc.

584 Phoenix Drive
Rome, NY 13441

URS **Group, Inc.**
7720 N 16th Street, Suite 100
Phoenix, AZ 85020-4493

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UFP-QAPP for RR869a Debris Field MRS

Remedial Investigation

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with (IAW) a system designed to assure that qualified personnel gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Site:

RR869a Debris Field MRS
Holloman Air Force Base
New Mexico

Submitted to:
Mr. Chuck Hendrickson
USEPA, Region 6 (6PD-F)
1445 Ross Ave, Suite 1200
Dallas, TX 75202-2733

Prepared for:

Air Force Civil Engineer Center (AFCEC)
2261 Hughes Ave., Suite 163
Joint Base San Antonio - Lackland,
Texas 78236-9853

Prepared by:

FPM Remediations, Inc.
584 Phoenix Drive, Rome, NY 13441

October 2014

Author: _____
Peter Corigliano

Title: Site Lead
Date: _____

Reviewer: _____
Maureen Whalen PG, CPG, PMP

Title: Project Manager
Date: _____

Reviewer: _____
DeAnna Rothhaupt

Title: Holloman AFB Environmental Chief
Date: _____

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LIST OF ABBREVIATIONS AND ACRONYMS

%	percent
%R	%Recovery; also Accuracy
°C	degrees Celsius
A	error for analytical
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
CAS	Chemical Abstracts Service
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
CO	Contracting Officer
CoC	Chain of Custody
COR	Contracting Officer Representative
CSE	Comprehensive Site Evaluation
CSM	Conceptual Site Model
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DL	Detection Limit
DoD	Department of Defense
DQCRs	Daily Quality Control Reports
DQI	Data Quality Indicator
DQO	Data Quality Objective
EE/CA	Engineering Evaluation/Cost Analysis
ERPIMS	Environmental Restoration Program Information Management System
FPM	FPM Remediations, Inc.
GPS	Global Positioning System
H&S	Health and Safety
HDR	HDR Environmental, Operations and Construction, Inc.
IAW	in accordance with
ICAL	Initial Calibration
ICP	Inductively Coupled Plasma
ICS	Interference Check Solutions
ICV	Initial Calibration Verification
IDL	Instrument Detection Limit
IRP	Installation Restoration Program
JBSA-Lackland	Joint Base San Antonio - Lackland
LCS	Laboratory Control Sample
LOD	Limit of Detection
LOQ	Limit of Quantitation
MB	method blank
MC	munitions constituents
MD	munitions debris
MDEH	Material Documented as an Explosive Hazard
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
mg/kg	milligram(s) per kilogram

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS	Matrix Spike
MSD	Matrix Spike Duplicate
N/A	Not Applicable
NA	Not Available
NFA	No Further Action
NMED	New Mexico Environment Department
No.	Number
NTCRA	Non-Time-Critical Removal Action
PAH	polynuclear aromatic hydrocarbon
PBR	Performance Based Remediation
PDS	Post Digestion Spike
PE	Performance Evaluation
PGM	Program Manager
PM	Project Manager
PMP	Project Management Plan
POC	point of contact
PT	Proficiency Testing
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RI	Remedial Investigation
RL	Reporting Limit
RPD	Relative Percent Difference; also Precision
RPM	Restoration Program Manager
RSD	relative standard deviation
RTK-GPS	Real-Time Kinematic Global Positioning System
S	error for sampling
Shaw	Shaw Environmental, Inc.
Sky	Sky Research, Inc.
SOP	Standard Operating Procedure
SPLP	Synthetic Precipitation Leaching Procedure
TCLP	Toxicity Characteristic Leaching Procedure
TO	Task Order
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
VSP	Visual Sample Plan
WP	Work Plan

Introduction

This Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) has been prepared in support of a Remedial Investigation (RI) for the RR869a Debris Field Munition Response Site (MRS) at Holloman Air Force Base (AFB). The primary purpose of this document is to present the field sampling plan for the RI at the site, and will be used in conjunction with the Site Specific Work Plan (WP) for this MRS. Holloman AFB is located in south-central New Mexico, about seven miles west of the city of Alamogordo in Otero County, New Mexico (**Figure 1**). Holloman AFB occupies approximately 50,763 acres of land. Historically, the Base was used for the testing and development of unmanned aircraft, guided missiles, and other research programs. Holloman AFB is home to the 49th Wing, who provides leadership to the Installation. It has also served as the German Air Force's Tactical Training Center since 1996. The southern portion of Holloman AFB contains the flight line, composed of a series of runways running north-south, east-west, and northeast southwest. The Main Base is located at the southeast corner of the Installation, where Route 70 borders the site. The Main Base contains housing and administrative buildings.

The Debris Field Munitions Response Area (MRA) 869 is located in the south-central portion of the Base north of Munitions Storage Buildings 1197 and 1198. The area is located on the southern bank of Ritas Draw. Exact historical munitions use at the MRA 869 is unknown. During Comprehensive Site Evaluation (CSE) Phase II performed at this area, debris consistent with a possible missile/drone crash were observed along with 5-inch rocket motor fragments, small arms projectiles, small amounts of clay target debris, possible 2.75-inch rocket launcher debris, one expended hand grenade fuze, and squibs, one of which was complete and treated as Munitions and Explosives of Concern (MEC). Due to overlapping boundaries of MRA 869 with Installation Restoration Program (IRP) Site OT-04 this MRA has been split into two MRSs at the conclusion of the CSE Phase II: The Debris Field (RR869) MRS consisting of 0.1 acres and currently addressed under the IRP (therefore ineligible for the Military Munitions Response Program [MMRP]), and the Debris Field (RR869a) MRS consisting of 3.5 acres. The RR869a MRS will nbe investigated during this RI. The site is currently unused and vegetation is consistent with desert scrubland. No facilities exist within the MRS.

FPM Remediations, Inc. (FPM) has been contracted by the Air Force Civil Engineer Center (AFCEC) under Contract FA8903-13-C-0008 to conduct Performance Based Remediation (PBR), in compliance with United States Environmental Protection Agency (USEPA) and New Mexico Environment Department (NMED) regulatory requirements, at Holloman AFB. The scope of work to be completed for this project is summarized in **Table 1-1** and described in greater detail in the RI WP.

This document has been prepared in conjunction with the tasks described in the New Mexico – Arizona Group PBR Project Management Plan (PMP) (FPM, 2013) and the RI WP (FPM, 2014).

Table 1-1
Holloman AFB RR869a Debris Field MRS Scope of Work

Work Element	Monitoring Matrix	Preliminary Site Chemical of Concern	Site Objective
RI – Field Activities (Sampling)	Soil	munitions constituents (MC) metals and explosives	Complete data collection necessary to characterize the site for follow-on Non-Time-Critical Removal Action (NTCRA)

QAPP Worksheet #1 & #2 – Title and Approval Page

1. Project Identifying Information

    a. Site name/project name: Debris Field MRS, Holloman AFB/PBR RI WP/UFP-QAPP

    b. Site location/number:

    Debris Field MRS – RR869a MRS

    c. Contract/work assignment number: FA8903-13-C-0008; Task Order (TO): Not Applicable (N/A)

2. Lead Organization

    a. Lead Organization Project Manager (PM):

    _____ _____

    Stephanie Ramon Date
    Contracting Officer's Representative (COR) AFCEC
    Environmental Center of Excellence Restoration
    - Execution (CZRX)

    b. Lead Organization Quality Manager:

    _____ _____

    Layi Oyelowo Date
    AFCEC/CZRX Contracting Officer (CO) Alternate

3. Federal Regulatory Agency:

    _____ _____

    Chuck Hendrickson, PM Date
    USEPA Region 6

4. Other stakeholders:

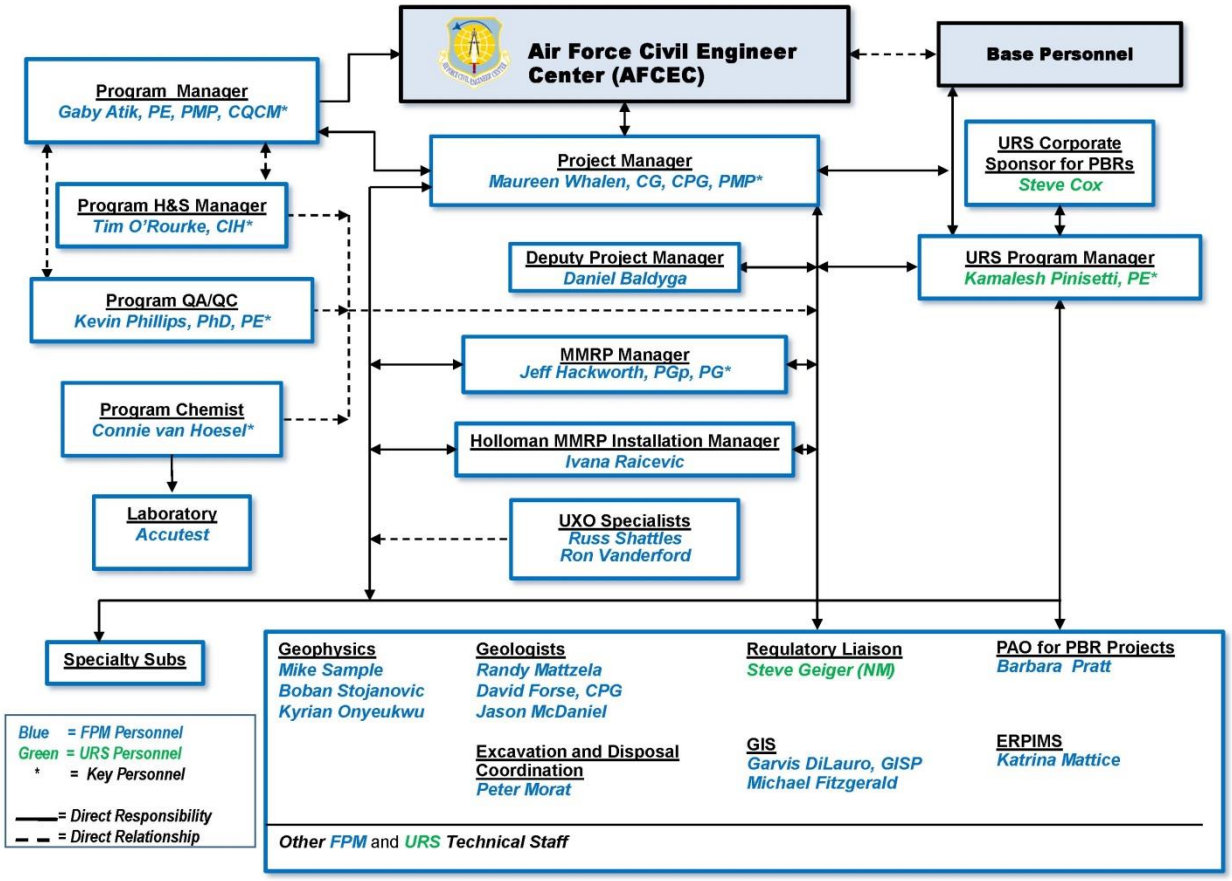
    _____ _____

    DeAnna Rothhaupt, 49 Civil Engineer Squadron (CES) Date
    Civil Environmental and Infrastructure Engineering
    (CEIER) Environmental Chief Restoration Program Manager (RPM)

5. Plans and Reports from previous investigations relevant to this project:

Date	Title	Site
2006	Basewide Background Study Report, Holloman Air Force Base, NM.	MRA 869
2010	Final Report - Modified Comprehensive Site Evaluation Phase I, Holloman Air Force Base, New Mexico	MRA 869
2011	Holloman Air Force Base, New Mexico – Comprehensive Site Evaluation Phase II Final Work Plan, Military Munitions Response Program.	MRA 869
2012	Comprehensive Site Evaluation Phase II, Holloman Air Force Base, New Mexico, Final Work Plan.	MRA 869
2013	Final Report - Comprehensive Site Evaluation Phase II, Holloman Air Force Base, NM.	MRA 869

QAPP Worksheet #3 & #5 – Project Organization and QAPP Distribution



Peter Corigliano will be serving as FPM's Team Lead for the RR869a Debris Field MRS.

QAPP recipients' contact information is provided below:

QAPP Recipients	Title	Organization / Address	Telephone Number (No.)	E-mail Address
Naomi Alvarado	CO	772 Enterprise Sourcing Squadron/Environmental Contracting (ESS/PKB) /2261 Hughes Ave., Suite 163, Joint Base San Antonio Lackland (JBSA-Lackland), Texas 78236-9856	210-395-8151	Naomi.alvarado@us.af.mil
Stephanie Ramon	COR	AFCEC/CZRX/2261 Hughes Ave., Suite 155, (JBSA Lackland), Texas 78236-9856	210-395-8628	Stephanie.ramon.1@us.af.mil
Layi Oyelowo	AFCEC COR Alternate	AFCEC/CZRX/2261 Hughes Ave., Suite 155, (JBSA Lackland), Texas 78236-9856	210-395-8567	Layi.oyelowo@us.af.mil
Rita Leal	Contract Specialist	772 ESS/PKB/2261 Hughes Ave., Suite 163, (JBSA Lackland), Texas 78236-9856	210-395-8228	Rita.leal@us.af.mil
DeAnna Rothhaupt	49 Civil Engineer Squadron (CES)/Civil Environmental and Infrastructure Engineering (CEIER) – Environmental Chief – RPM	49 CES/CEIER/550 Tabosa Ave Holloman AFB, NM 8830	575-572-3931	Deanna.rothhaupt@us.af.mil
David Rizzuto	Holloman AF Contractor Support	United States Air Force (USAF)/550 Tabosa Ave Holloman AFB, NM 8830	575-572-5395	David.rizzuto@holloman.af.mil
DJ Davis	Holloman AF Contractor Support	USAF/550 Tabosa Ave Holloman AFB, NM 8830	575-572-3931	Darrell.Davis@holloman.af.mil

QAPP Recipients	Title	Organization / Address	Telephone Number (No.)	E-mail Address
Chuck Hendrickson	USEPA Region 6 PM	USEPA, Region 6 (6PD-F) / 1445 Ross Ave, Suite 1200, Dallas, TX 75202-2750	214-665-2196	
Gaby Atik PE	Program Manager (PGM)	FPM/584 Phoenix Drive, Rome NY, 13441	315-336-7721	g.atik@fpm-remediations.com
Maureen Whalen PG, CPG, PMP	PM	FPM/584 Phoenix Drive, Rome, NY 13441	315-336-7721	m.whalen@fpm-remediations.com
Jeff Hackworth PG	MMRP Manager	FPM/5811 University Heights BLVD., Suite 101, San Antonio, TX 78249	210-495-7744	j.hackworth@fpm-remediations.com
Ivana Raicevic, PhD.	Holloman AFB MMRP Installation Manager	FPM/5811 University Heights BLVD., Suite 101, San Antonio, TX 78249	210-495-7744	i.raicevic@fpm-remediations.com
Jean Dent-Smith	Accutest Laboratories PM	4405 Vineland Road Suite C-15 Orlando, FL 32811	407-425-6700	jeans@accutest.com

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QAPP Worksheet #4, #7, & #8 – Personnel Qualifications and Sign-Off Sheet

Organization: AFCEC

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Naomi Alvarado	CO			
Stephanie Ramon	AFCEC/CZRX – COR			

Organization: Holloman AFB

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
DeAnna Rothhaupt	Holloman AFB RPM			

Organization: FPM

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Gaby Atik PE	PGM	B.S.C.E., Master in Engineering. Engineering Management / Environmental Systems, 20+ years of environmental experience.		
Kevin Phillips Ph.D., PE	QA / Quality Control (QC) Officer	Ph.D. Environmental Engineering, M.S. Hydrodynamics, B.C.E., Civil Engineering. 30+ years of experience	Licensed Professional Engineer in New York, New Jersey, Pennsylvania, Connecticut, Maryland, Massachusetts, Alabama, and Texas	

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Maureen Whalen PG, CPG, PMP	PM	M.S. Quaternary Studies, B.S. Geology. CPG, PG, PMP. 20 + years of environmental experience		
Jeff Hackworth, PGp, PG	MMRP PM	B.S. Geophysics PG 26+ years of environmental experience	Registered Geophysicist: California Registered Professional Geologist: Tennessee	
Tim O'Rourke, CIH	Health and Safety (H&S) Manager	Certified Industrial Hygienist 15 years' experience		
Connie van Hoesel	Program Chemist/Chemical QC Manager	M.S. Environmental Engineering, B.A. Chemistry, 12 years' experience		
RI Field Team [1]	RI Field Team Personnel	Various	H&S Training per 29 Code of Federal Regulations (CFR) 1910.120 Tailgate meeting to discuss daily plans and procedures	

Organization: Laboratory

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Jean Dent-Smith	Accutest Laboratory Inc. PM		Accutest Laboratory is a Department of Defense (DoD) Accredited laboratory. Accreditation certificate is provided in **Appendix B**.	

1 All sampling personnel will be trained using sampling techniques described in the Standard Operating Procedures (SOPs) (**Appendix A**). All field personnel (including sub-contractors) certifications will be electronically retained by FPM for review.

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QAPP Worksheet #6 – Communication Pathways

Communication Drivers	Organization	Name	Contact Info	Procedure (Timing, pathways, etc.)
Point of contact (POC) with USEPA Region 6	Holloman AFB RPM	DeAnna Rothhaupt	575-572-3931	Ms. Rothhaupt is the Holloman AFB RPM.
	AFCEC/CZRX - COR	Stephanie Ramon	210-395-8628	Ms. Ramon is the AFCEC COR PM.
	AFCEC/CZRX – COR/Alternative	Layi Oyelowo	210-395-8567	Mr. Oyelowo is the alternate POC to Stephanie Ramon.
Overall Project Management	AFCEC/CZRX - COR	Stephanie Ramon	210-395-8628	Ms. Ramon is the AFCEC COR PM.
Program and Project Activities and Issues	FPM PGM	Gaby Atik PE	315-336-7721	Is the primary interface with AFCEC and ensures performance objectives are met.
Manages Project; Project activities; WP and/or QAPP Changes	FPM PM/Holloman AFB	Maureen Whalen PG, CPG, PMP	315-336-7721	Overall responsibility of the project. Supervises field sampling activities. Reports to AFCEC and Holloman AFB within three days of the change. Once approved, the UFP-QAPP recipients will receive a copy of the change.
Daily Field Progress Reports	Holloman AFB MMRP Installation Manager	Ivana Raicevic, PhD	210-495-7744	Supervises field sampling and Operation and Maintenance activities. Authors status and completion reports. Reports to PM and/or AFCEC and Holloman AFB within three days of the change. Once approved, the UFP-QAPP recipients will receive a copy of the change.
Sampling and Remediation Activities	Holloman AFB MMRP Installation Manager	Ivana Raicevic, PhD	210-495-7744	Responsible for all sampling and remediation activities to assure goals are attained. Reports to AFCEC and Holloman AFB daily during field efforts.

Communication Drivers	Responsible Entity	Name	Phone No.	Procedure (Timing, pathways, etc.)
Project QA /QC	QA/QC Officer	Kevin Phillips PhD., PE	631-737-6200	Will determine corrective action for field, data interpretation, and reporting issues
Reporting Lab Data Quality Issues	Chemical QC Manager	Connie van Hoesel	315-336-7721	Will determine corrective action for lab data quality issues
Field and Analytical Corrective Actions	Chemical QC Manager	Connie van Hoesel	315-336-7721	Will determine corrective action for field and analytical issues
Release of Analytical Data	Chemical QC Manager	Connie van Hoesel	315-336-7721	No analytical data can be released until it has been reviewed by the Chemical QC Manager and data validation has been completed.
QAPP Amendments	AFCEC/CZRX - COR	Stephanie Ramon	210-395-8628	Any major changes to the QAPP must be approved by Stephanie Ramon before the changes can be implemented.

QAPP Worksheet #9 – Project Planning Session Summary

No site-specific planning sessions have been held to date, however one will be planned two weeks after the document is submitted for review. Two meetings have been held discussing PBR contract objectives.

1) Holloman AFB Kick-off Meeting - 29 October 2013 and

2) AFCEC-FPM Kick-off Meeting – 5 November 2013.

If any meetings are held with USEPA Region 6, AFCEC, and/or Holloman AFB regarding scoping and/or elements specifically relating to this UFP-QAPP, this worksheet will be revised accordingly.

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QAPP Worksheet #10 – Conceptual Site Model

Site Background

RR869a Debris Field MRS was identified during previous investigations as containing potential sources for MEC/MPPEH and associated MC (e.g. metals and explosives). The approximately 3.5-acre RR869a Debris Field MRS is located in the south-central portion of the Base north of Munitions Storage Buildings 1197 and 1198. The site is located on the southern bank of Ritas Draw and north of gate IP-11. Exact historical munitions use at the MRS is unknown.

Previous Investigations

The Debris Field MRA 869 has been investigated in a CSE Phase I (Shaw Environmental, Inc. [Shaw], 2010) and a CSE Phase II (United States Army Corps of Engineers [USACE] and HDR, 2013) under the USAF MMRP.

Modified Comprehensive Site Evaluation Phase I - 2010 – Modified CSE Phase I was completed in 2010. Prior to the start of the CSE Phase I, no MRAs had been discovered at Holloman AFB and it was believed that there was a low probability of a significant number of MRAs being found at Holloman AFB. Therefore, the USAF has modified the CSE Phase I process by deferring some actions typically performed in a Phase I, to the CSE Phase II, if a Phase II is required. For this Modified CSE Phase I, it was determined that a Conceptual Site Model (CSM) and Munitions Response Site Prioritization Protocol and Hazard Ranking System scoring elements were not required. The activities performed during the CSE Phase I included identification and review of data repositories located both on and off the Installation, interviews with Base personnel, and visual surveys.

During the Modified CSE Phase I field survey activities, debris was observed in the MRA along the southern slope of Ritas Draw, north of Munitions Storage Buildings 1197 and 1198. Upon further examination, debris consistent with a possible missile/drone crash was observed. Additional munitions debris (MD) observed at the area included fragments of 5 inch rocket motors (Shaw, 2010).

During the field investigation, no structural features were observed. The field team observed potential high explosive fragments and MD consistent with a missile or drone crash site. No MC samples were collected.

Comprehensive Site Evaluation Phase II - 2013 – A CSE Phase II was completed in 2012, and involved the compilation and evaluation of information relating to the possible contamination of environmental media from MC related to historic munitions related activities at identified MRAs at Holloman AFB. Activities included visual reconnaissance surveys and the sampling and analysis of surface and/or subsurface soil determine if MC, hazardous substances, pollutants and contaminants, or other constituents have been released into the environment.

During the field investigation visual survey transects were completed at the Debris Field MRA 869. Metal scrap was observed throughout the area. Small arms-related debris consisted of one .50 caliber projectile and sparse clay target debris. The field team observed various items that were identified as rocket launcher and possible rocket debris including 2.75-inch launcher debris and possible 5-inch rocket debris among other unidentifiable items. These items were documented as MD. One expended hand grenade fuze was also observed. Expended electric squibs were observed, along with one squib with a single intact charge. Holloman Explosive

Ordnance Disposal was notified of the intact squib and collected the item for disposal. No other MEC items were discovered. No craters indicative of a target area were identified.

Sampling was not conducted during the CSE Phase II because no potential sources of MC were found during site surveys. Any risk at this site is expected to be similar to background conditions. The unfired squib round identified, are typically used to initiate an aircraft counter measure device and are considered a low explosive hazard. Squibs are not considered high explosives and the quantities of explosives in the items are not high enough in concentration to pose an explosives hazard; therefore sampling for explosives was not justified during this investigation.

The MRA 869 was spilt into two MRSs at the conclusion of the CSE Phase II: The RR869 Debris Field MRS (0.1 acres) and the RR869a Debris Field MRS (3.5 acres). The RR869 MRS is currently investigated under the IRP and is therefore ineligible under the MMRP. The RR869a Debris Field MRS will be the only MRS addressed during this RI.

The RR869a Debris Field MRS obtained a Munitions Response Site Prioritization Protocol (MRSPP) score of 5 at the conclusion of the CSE Phase II and was recommended for further munitions response action.

Site Models

The RR869a MRS consists primarily of desert scrubland with heavily sloping terrain with gorges and gullies. The CSM is a description of a site and its environment based on existing knowledge. It describes contaminated sources, possible receptors, and the interactions that link them. The CSM evolves through an iterative process of data collection and actions. Current CSMs for MEC and MC are included in **Section 1.7** of the RI WP. The CSM will continue to be refined through the RI.

QAPP Worksheet #11 – Project/Data Quality Objectives (DQOs)

1. State the Problem

If confirmed MEC/ (MPPEH classified as Material Documented as an Explosive Hazard [MDEH] and/or areas with significant amounts of MD are identified during the RI at the RR869a Debris Field MRS, what is the nature and extent of associated MC, explosives (1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 2-Nitrotoluene; 3,5-Dinitroaniline; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; 4-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl) and metals (aluminum, antimony, chromium, copper, iron, lead, and zinc)? Is further action necessary to address residual concentrations of MC associated with MEC/MPPEH (explosives and metals) that may pose a threat to HH.

The CSE Phase II data indicates only minor undocumented usage of small arms at this site and does not indicate a potential lead or PAH concern. However, if during the RI a significant amount of shotgun shells and/or clay target debris is found, what is the nature and extent of associated contaminants, metals (lead) and PAHs? Is further action necessary to address residual concentrations of metals (lead) and PAHs that may pose a threat to human health or is no further action (NFA) appropriate?

2. Identify the Goals of the Study

The goal of the RI study is to provide Digital Geophysical Mapping (DGM) data (100 percent (%) coverage) to close existing data gaps regarding the distribution of subsurface anomaly density at both MRSs. Intrusive investigation is not planned for the RI field activities, since FPM intends to remove all detected subsurface anomalies above the established threshold from the MRS during the follow-on NTCRA. However, if the RI DGM results indicate that 100 % removal of subsurface anomalies during NTCRA is not a feasible option, one of the two following approaches will be applied:

(1) Anomalies will be ranked using the advanced technology (MetalMapper) to classify the sources of geophysical anomalies as “targets-of-interest” or non-hazardous items that may remain in the ground. Potential targets of interest will be excavated during the follow-on NTCRA.

(2) Visual Sample Plan (VSP) statistical module will be used to provide 95% confidence of MEC potential on the sites. Intrusive investigation of selected anomalies will be performed during the RI.

The goal of MC sampling portion of the RI study is to provide information regarding MC (explosives and metals) associated with MEC/MDEH finds. If intrusive investigation is not performed during the RI, only surface MC sampling will be conducted. Subsurface MC samples will be conducted as part of the follow-on NTCRA but not the RI phase. However, MC samples will be collected from both surface and subsurface during the RI phase, if intrusive investigation is performed during this phase (VSP option).

3. Identify Information Inputs

Surface and subsurface soil (if intrusive investigation is performed) samples will be collected at confirmed MEC/MDEH locations and in areas of significant amounts of MD to evaluate potential impacts to the media from associated MC. The soil samples will be analyzed at an off-

site laboratory (Accutest Laboratories, Inc.) for explosives (1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 2-Nitrotoluene; 3,5-Dinitroaniline; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; 4-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl) (by USEPA SW-846 Method 8330A) and metals (aluminum, antimony, chromium, copper, iron, lead, and zinc) (by USEPA SW-846 Method 6010C). The depth of a specific soil sample will depend on the depth of the associated MEC/MPPEH find.

If a significant amount of shotgun shells and/or clay target debris is found, samples will be collected to evaluate potential impacts to the media from associated contaminants, metals (lead) and PAHs. The soil samples will be analyzed at an off-site laboratory (Accutest Laboratories, Inc.) for metals (lead) (by USEPA SW-846 Method 6010C) and PAHs (USEPA SW-846 Method 8270D).

4. Define the Boundaries of the Study

The boundary of the study is the boundary of the RR869a MRS. Sampling for MC associated with MEC/MDEH (explosives [1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 2-Nitrotoluene; 3,5-Dinitroaniline; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; 4-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl] and metals [aluminum, antimony, chromium, copper, iron, lead, and zinc]) will occur at the specific locations and depths where MEC/MPPEH items, if any, are identified. If necessary sampling for contaminants associated with small arms usage, metals (lead) and PAHs will occur at the specific locations where a significant amount of shotgun shells and/or clay target debris is found.

5. Develop the Analytical Approach

The following decision rules will be utilized to link potential results with conclusions or future actions.

Decision Rule 1. If MEC/MDEH is found during the surface clearance and/or intrusive investigation, environmental samples will be collected at the MEC/MDEH locations to determine the presence or absence of MC (explosives and metals) in soil. In addition, soil samples will be collected before and after any Blow-In-Place and consolidated shot operations. In addition, MC sampling will be performed at locations of significant amounts of MD.

Decision Rule 2. Soil samples collected for explosives (1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 2-Nitrotoluene; 3,5-Dinitroaniline; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; 4-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl) and metals (aluminum, antimony, chromium, copper, iron, lead, and zinc) associated with MEC/MPPEH analysis will be evaluated to determine the presence of contamination, as follows:

- ***If*** explosives and/or metals are detected above the Limit of Detection (LOD) (see **Worksheet #15**) in a sample, ***then*** it will be determined that the corresponding compound is present and included as a detect in the existing analytical dataset for the site (see Decision Rule 3).

- ***If*** explosives and/or metals are not detected above the LOD (see **Worksheet #15**) in a sample, ***then*** it will be determined that the compound is not present and included as a non-detect in the existing analytical dataset for the site (see Decision Rule 3).

Decision Rule 3. The site will be reassessed based on the existing dataset (comprised of historical and new data) to determine if further action is necessary, as follows:

- ***If*** the concentrations of explosives and/or metals in soil exceed the project action limits (see **Worksheet #15**), ***then*** it will be determined that further remedial action for MC in soil may be required.
- ***If*** project action limits for an analyte are not available (NA), ***then*** determination of the necessity for further action will be discussed quantitatively.
- ***If*** the concentrations of explosives and/or metals in soil are less than the respective project action limits (see **Worksheet #15**), ***then*** it will be determined that no further remedial action for MC is appropriate.

Decision Rule 4. If significant amount of shotgun shells and/or clay target debris is found, soil samples from 0 to 3ft bgs will be collected for metals (lead) and PAH analysis to determine the presence of contamination, as follows:

- ***If*** metals and/or PAHs are detected above the LOD (see **Worksheet #15**) in a sample, ***then*** it will be determined that the corresponding compound is present and included as a detect in the existing analytical dataset for the site (see Decision Rule 2).
- ***If*** metals and/or PAHs are not detected above the LOD (see **Worksheet #15**) in a sample, ***then*** it will be determined that the compound is not present and included as a non-detect in the existing analytical dataset for the site (see Decision Rule 2).

Decision Rule 5. The site will be reassessed based on the existing dataset (comprised of historical and new data) to determine if further action is necessary, as follows:

- ***If*** the concentrations of metals and/or PAHs in soil are less than the respective project action limits (see **Worksheet #15**), ***then*** it will be determined that no further remedial action is accepted.
- ***If*** the concentrations of metals and/or PAHs in soil exceed the project action limits (see Worksheet #15), ***then*** it will be determined that further remedial action for MC in soil may be required.

6. Specify Performance or Acceptance Criteria

Sample analytical results will be compared to the project action limits as shown in **Worksheet #15**. **Worksheet #37** describes the usability assessment of the data. Decision errors include data quality and usability. To ensure the quality of the data, all data will be reviewed, verified, and validated IAW this QAPP. To ensure usability of laboratory data, appropriate laboratory methods have been selected to provide the necessary laboratory DLs. Acceptance criteria for the analytical data are listed in **Worksheet #28**.

7. Develop the Detailed Plan for Obtaining Data

The sampling design and rationale are presented in **Worksheet #17**. The details of the Geophysical Investigation Plan and Intrusive Investigation Contingencies are presented in RI **WP Sections 3.4** and **3.6**, respectively. **Worksheets #16, #17**, and **#18** describe the details of the soil sampling. **Worksheets #19, #20, #24-28**, and **#30** will specify soil sampling analysis design requirements.

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	**Soil**	**Data qualifier definitions and full data review/validation criteria are listed in Tables 12-2 and 12-3.**			
Analytical Group	**Metals**				
Conc. Level	**Low**				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1 and No. 2	SW-846 6010C/ LAB SOP# MET104/ MET100	Precision – Lab	Relative Percent Difference (RPD) <10%	Matrix spike/Matrix spike duplicate (MS/MSD) and/or Laboratory Control Sample (LCS)/ LCS Duplicate Proficiency Testing (PT) Sample	A
			Refer to Worksheet #24	Calibration – Initial and Continuing	
		Precision – Field/ Laboratory	If both the parent and duplicate values are > 5x Limit of Quantification (LOQ), then 20% RPD for aqueous samples, 30% for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field Duplicates	S&A

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1 and No. 2 (Continued)	SW-846 6010C/ LAB SOP# MET104/ MET100 (Continued)	Accuracy/Bias	See **Table 12-1**	Interference Check Sample, LCS, MS, and Post Digestion Spike (PDS), if applicable	A
			Refer to Worksheet #24	Calibration – Initial and Continuing	
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks (MBs)	A
				Equipment blanks	S&A
		Representative ness	Holding time compliance per 40 CFR 136 and/or method	Holding time	A
		Quantitation Limit	LOQ > LOD LOD & LOQ must be verified quarterly.	Standard that is at or below the LOQ as the lowest point on the calibration curve.	A
		Sensitivity	Sample results will be reported to the DL.	Sample results that are less than the LOQ, but greater than the DL, will be reported with a **J**-flag. Quarterly LOD verification.	A
		Completeness	90 and 95% for soil	Data Completeness Check	S&A

[1]Reference No. from QAPP **Worksheet #21**

[2]Reference No. from QAPP **Worksheet #23**

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	**Soil**	**Data qualifier definitions and full data review/validation criteria are listed in Tables 12-2 and 12-4.**			
Analytical Group	**Metals**				
Conc. Level	**Low**				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**DQIs**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1 and No. 2	SW-846 8330A/ LAB SOP# GC016 / OP019	Bias Contamination Precision - Overall	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <1/2 Lab Reporting Limit (RL).	Field Blank/Equipment Blank	S
			All Target Compounds; see Table 12-1 for analyte specific RPD criteria.	Field Duplicates	S&A
		Accuracy/Bias Contamination	<1/2 Lab RL.	MBs	A
		Accuracy/Method Bias in ideal matrix	%Recovery (%R) = (Calculated Value/True Value) *100%	LCS	A
		Bias Contamination	%R = (Calculated Value - Sample Value/True Value) *100%	MS	A

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1 and No. 2 (Continued)	SW-846 8330A/ LAB SOP# GC016 / OP019 (Continued)	Precision and Accuracy	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	MS Duplicate (MSD)	A
		Precision and Accuracy	%R = (Calculated Value/True Value) *100%	Surrogate Spike	A

[1] Reference No. from QAPP **Worksheet #21**

[2] Reference No. from QAPP **Worksheet #23**

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	**Soil**	**Data qualifier definitions, and full data review/validation criteria are listed in Tables 12-2 through 12-5**			
Analytical Group	**PAHs**				
Conc. Level	**Low to High**				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1 and No. 2	USEPA 8270D by Selected Ion Monitoring (SIM)/SOP MS008 USEPA SPLP 1312/SOP OP042	Precision – Lab	RPD <30%	MS/MSD, LCS/LCSD, and/or PT Sample	A
			Refer to **Worksheet #24**	Calibration – Initial and Continuing	
		Precision – Field/ Laboratory	If both the parent and duplicate values are > 5x limit of quantification (LOQ), then 20% RPD for aqueous samples, 30% for soil. If either the parent or duplicate value is < 5X the LOQ, then the difference between the parent and duplicate must be < 2X the LOQ.	Field Duplicates	S&A

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1 and No. 2 (continued)	USEPA 8270D by Selected Ion Monitoring (SIM)/SOP MS008 USEPA SPLP 1312/SOP OP042 (continued)	Accuracy/Bias	See Table 12-1	Interference Check Sample, LCS, MS, and post digestion spike (PDS), if applicable	A
			Refer to Worksheet #24	Calibration – Initial and Continuing	
		Accuracy/Bias Contamination	No target compounds > ½ LOQ	Method blanks	A
				Equipment blanks	S&A
		Representativeness	Holding time compliance per 40 CFR 136 and/or method	Holding time	A
		Quantitation Limit	LOQ > LOD LOD & LOQ must be verified quarterly.	Standard that is at or below the LOQ as the lowest point on the calibration curve.	A

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1 and No. 2 (continued)	USEPA 8270D by Selected Ion Monitoring (SIM)/SOP MS008 USEPA SPLP 1312/SOP OP042 (continued)	Sensitivity	Sample results will be reported to the DL.	Sample results that are less than the LOQ, but greater than the DL, will be reported with a **J**-flag. Quarterly LOD verification.	A
		Completeness	90 and 95% for soil	Data Completeness Check	S&A

[1] Reference No. from QAPP **Worksheet #21**

[2] Reference No. from QAPP **Worksheet #23**

Table 12-1
Accuracy and Precision Criteria for Chemical Analysis

Spiking Compound	Accuracy (%R) Soil	Precision (RPD) Soil
METALS		
Aluminum	80-120	20
Antimony	80-120	20
Chromium	80-120	20
Copper	80-120	20
Iron	80-120	20
Lead	80-120	20
Zinc	80-120	20
EXPLOSIVES		
1,3,5-Trinitrobenzene	81-133	19
1,3-Dinitrobenzene	80-125	15
2,4,6-Trinitrotoluene	69-124	18
2,4-Dinitrotoluene	80-130	20
2,6-Dinitrotoluene	75-143	22
2-Amino-4,6-dinitrotoluene	79-122	20
2-Nitrotoluene	84-126	21
3-Nitrotoluene	84-129	21
4-Amino-2,6-dinitrotoluene	76-124	23
4-Nitrotoluene	83-132	25
HMX	64-159	17
Nitrobenzene	77-139	17
Nitroglycerin	73-121	15
PETN	74-140	16
RDX	78-120	16
Tetryl	63-135	25
3,5-Dinitroaniline	79-117	18
PAHs		
Acenapthene	45 - 110	30
Acenaphthylene	45 - 105	30
Benzo(a)anthracene	50 - 110	30
Benzo(a)pyrene	50 - 110	30
Benzo(b)fluoranthene	45 - 115	30
Benzo(g,h,i)perylene	40 - 125	30
Benzo(k)fluoranthene	45 - 125	30
Chrysene	55 - 110	30
Dibenz(a,h)anthracene	40 - 125	30
Fluoranthene	55 - 115	30
Fluorene	50 - 110	30
Indeno(1,2,3-cd)pyrene	40 - 120	30
2-Methylnaphthalene	45 - 105	30

Spiking Compound			Accuracy (%R) Soil	Precision (RPD) Soil
Naphthalene	40 - 105	30		
Phenanthrene	50 - 110	30		
Pyrene	45 - 125	30		

Table 12-2
Data Qualifier Definitions

Qualifier	Description
J	Estimated. The analyte was positively identified; the quantitation is an estimation due to discrepancies in meeting certain analyte-specific QC criteria, or the concentration is less than the sample quantitation limit.
UJ	The analyte was not detected. The result is estimated due to discrepancies in meeting certain analyte-specific QC criteria.
M	Matrix effect: The result is estimated due to a matrix effect.
B	Blank contamination. The analyte was found in the sample at a concentration similar to that observed in a blank.
R	Rejected. The data are rejected due to deficiencies in meeting QC criteria and may not be used for decision-making.

Table 12-3
Data Review/Validation Criteria for USEPA Method 6010C

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOD verification checks shall be performed.	See DoD Quality Systems Manual (QSM) v 4.2. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat DL determination and LOD verification check at higher level and set LOD.	LOD is 2-3x the DL (for a single-analyte standard) or greater than 1-4x the DL (for a multi-analyte standard).	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOQ verification checks shall be performed.	See DoD QSM v 4.2. LOQ must be set within the calibration range prior to sample analysis.	N/A	N/A	N/A
Instrument Detection Limit (IDL) study (Inductively Coupled Plasma [ICP] only)	At initial set-up and after significant change	DLs established shall be $\leq$ LOD	N/A	Samples cannot be analyzed without an IDL.	Apply **R**-flag to data without a valid IDL study

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Linear dynamic range or high-level check standard (ICP only)	Every 6 months	Within ±10% of true value	N/A	N/A	N/A
Holding time	Every sample	Soil samples: 6 months	Contact FPM as to additional measures to be taken.	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.
Sample temperature	None	N/A	Contact FPM for additional measures to be taken.	N/A	N/A
Initial calibration for all analytes (ICAL) ICP: minimum one high standard and a blank	Daily ICAL prior to sample analysis	$r \geq 0.995$	Correct problem then repeat ICAL	Problem must be corrected. No samples may be run until ICAL has passed.	Apply **R**-flag to data without a valid ICAL

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Second source calibration verification (ICV)	Once after each ICAL, prior to sample analysis	Value of second source for all analytes within ± 10% of expected value (initial source)	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flag to data without second source verification
Continuing Calibration verification (CCV)	After every 10 samples and at the end of the analysis sequence.	ICP: All analytes within ± 10% of expected value from ICAL.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **R**-flag to data with CCV outside criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Low-level calibration check standard	Daily, after one-point ICAL.	Within + 20% of true value.	Correct problem, then reanalyze.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **R**-flag to data with low-level calibration check standard outside criteria.
MB, Equipment Blank	One per preparatory batch, one per sampling day	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Calibration blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence	No analytes detected > LOD	Correct problem. If required, reprep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination.
Interference check solutions (ICS) (ICP only)	At the beginning of an analytical run	ICS-A: Absolute value of concentration for all nonspiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes). ICS-AB: Within ± 20% of expected value.	Terminate analysis; locate and correct problem; reanalyze ICS.	No samples may be analyzed without a valid ICS	Apply **R**-flag to data with ICS outside criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LCS	One per preparatory batch	QC acceptance criteria specified in UFP-QAPP Table 12-1.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (ICP Metals %R<60%, Hg %R < 50%): Apply **J**-flag to detects and **R**-flag to nondetects.
Dilution test (ICP only)	Each preparatory batch or when a new or unusual matrix is encountered	Fivefold dilution must agree within ± 10% of the original determination.	ICP: Perform PDS addition.	Only applicable for samples with concentrations > 50X LOQ (6010B)	Apply **J**-flag to analytes in parent sample outside criteria
PDS (ICP only)	When dilution test fails or analyte concentration in all samples < 50X LOD	75-125%	See flagging criteria.	The spike addition should produce a level between 10-100X LOQ	Apply **J**-flag to analytes in parent sample outside criteria

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MS/MSD	One per preparatory batch per matrix	QC acceptance criteria specified in UFP-QAPP Table 12-1.	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. No data flagging if native concentrations are > 4X spiking amount	For the specific analyte(s) in the parent sample, apply **M**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data.
Laboratory sample duplicate	One per preparatory batch per matrix (if MS/MSD is not performed)	RPD ≤ 20% (sample and sample duplicate)	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	Data shall be evaluated to determine the source of difference.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met.
Field Duplicate	One per 10 field samples	See UFP-QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2)	N/A	N/A	Apply **J**-flag to detects and **UJ**-flag to nondetects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Results reported between DL and LOQ	N/A	N/A	N/A	N/A	Apply **J**-flag to all results between DL and LOQ.

Table 12-4
Data Review/Validation Criteria for USEPA Method 8330A

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOD verification checks shall be performed.	See DOD QSM v 4.2. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat DL determination and LOD verification check at higher level and set LOD.	LOD is 2-3x the DL (for a single-analyte standard) or greater than 1-4x the DL (for a multi-analyte standard).	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOQ verification checks shall be performed.	See DOD QSM v 4.2. LOQ must be set within the calibration range prior to sample analysis.	N/A	N/A	N/A
Holding time	Every sample	Soil samples: 14 days to extract, 40 days to analysis	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Sample temperature	Every cooler	4±2 degrees Celsius (°C)	Contact FPM as to additional measures to be taken.	None	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects.
					Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to nondetects.
Soil grinding blank	Between each sample.	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (e.g., ground and subsampled) and analyzed in the same manner as a field sample. Grinding blanks can be analyzed individually or composited. No target analytes detected great	All blank results must be reported and the affected samples must be flagged accordingly if blank criteria are not met.	None	If the composite grinding blank exceeds the acceptance criteria, apply **U**-flag to analytes detected in field samples < 5X blank contamination associated with the grinding composite. If any individual grinding blank is found to exceed the acceptance criteria

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Soil sample triplicate	At the subsampling step, one sample per batch. Cannot be performed on any type of blank sample.	Three 10 g subsamples are taken from a sample expected to contain the highest levels of explosives within the Quantitation Range of the method. The relative standard deviation (RSD) for results above the RL must not exceed 20%.	Corrective action must be taken if this criterion is not met (e.g., the grinding process should be investigated to ensure that the samples are being reduced to a sufficiently small particle size).	None	Apply **J**-flag if corrective action does not solve problem and no sample available.
Minimum five point ICAL for all analytes	Minimum of 5 calibration standards with the lowest standard concentration at or below the RL. Once calibration curve or line is generated, the lowest calibration standard must be re-analyzed.	The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear regression is used, $r \geq 0.995$.	Correct problem then repeat ICAL	None	Apply **R**-flag to data without a valid ICAL

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Second source calibration verification	Once after each ICAL	Value of second source for all analytes within ± 20% of expected value (initial source)	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flags to data without second source verification.
CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All analytes within ± 20% of expected value form ICAL	Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification	If %D for an individual analyte is > 20%, no samples may be analyzed until the problem has been corrected	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to nondetects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MB, equipment blank	One per preparatory batch, one per sampling day	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination.
LCS	One per preparatory batch	QC acceptance criteria specified in UFP-QAPP Table 12-1.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	LCS should contain all analytes to be reported, including surrogates	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30%): Apply **J**-flag to detects and **R**-flag to nondetects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MS/MSD	One per preparatory batch per matrix	QC acceptance criteria specified in UFP-QAPP Table 12-1.	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	For the specific analyte(s) in the parent sample, apply **M**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data.
Laboratory sample duplicate	One per preparatory batch per matrix (if MS/MSD is not performed)	RPD $\leq$ 30% (sample and sample duplicate)	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met.	Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Surrogate spike	All field and QC samples	QC acceptance criteria specified in UFP-QAPP Table 12-2.	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Analytes identified in UFP-QAPP Table 12-2	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects.
Confirmation of positive results (second column or detector)	All positive results (exceeding the LOD) must be confirmed	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%	NA	Report the higher of two confirmed results unless overlapping peaks are causing erroneously high results, then report the non-affected result and document in the case narrative.	Apply **J**-flag if RPD >40%. Apply **U**-flag if primary result not confirmed.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Results reported between DL and LOQ	N/A	N/A	N/A	N/A	Apply **J**-flag to all results between DL and LOQ.
Field Duplicate	One per 10 field samples	See UFP-QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2)	NA	NA	Apply **J**-flag to detects and **UJ**-flag to nondetects.

Table 12-5

Data Review/Validation Criteria for USEPA Method 8270D SIM

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOD verification checks shall be performed.	See DoD QSM v 4.2. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat detection limit determination and LOD verification check at higher level and set LOD.	LOD is 2-3x the detection limit (for a single-analyte standard) or greater than 1-4x the detection limit (for a multi-analyte standard).	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOQ verification checks shall be performed.	See DoD QSM v 4.2. LOQ must be set within the calibration range prior to sample analysis.	N/A	N/A	N/A
Holding time	Every sample	Soil VOCs: 48 hours until frozen by laboratory (< -7°C), 14 days to analysis. Soil SVOCs: 14 days to extract, 40 days to analysis.	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to nondetects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to nondetects to samples > 2X holding time criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Sample temperature	Every cooler	4±2 °C	Contact FPM as to additional measures to be taken.	None	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to nondetects. VOC samples received at temperature > 10°C, **R**-flag all results.
Sample preservation	Every sample	Sample preservation requirements not met (e.g., pH >2, headspace in VOA vials, etc.)	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to nondetects.
Tuning	Prior to calibration and every 12 hours during sample analysis	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Problem must be corrected. No samples may be accepted without a valid tune.	Apply **R**-flag to data without a valid tune
Breakdown check (DDT method 8270C only)	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 20% for DDT.	Correct problem then repeat breakdown check		Apply **R**-flag to data analyzed if DDT degradation is not met.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Minimum five point ICAL for all analytes	ICAL prior to sample analysis	1. Average response factor (RF) for SPCCs: VOCs - ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane, ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050	Correct problem then repeat initial calibration	Problem must be corrected. No samples may be run until ICAL has passed	Apply **R**-flag to data without a valid ICAL
		2. RSD for RFs for CCCs: VOCs and SVOCs ≤ 30% and one option below;			Apply **R**-flag to data without a valid ICAL
		Option 1: RSD for each analyte ≤ 15%			
		Option 2: linear least squares regression r ≥ 0.995			
		Option 3: non-linear regression - coefficient of determination (COD) r^2 ≥ 0.99 (6 points shall be used for second order, 7 points shall be used for third order)			

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Second source calibration verification	Once after each ICAL	Value of second source for all analytes within ± 20% of expected value (initial source)	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration.	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flag to data without second source verification.
Evaluation of relative retention times (RRTs)	Each sample	RRT of each target analyte in each calibration standard within ± 0.06 RRT units.	Correct problem, then rerun ICAL	Laboratories may update the retention times based on the CCV to account for minor performance fluctuations or after routine system maintenance.	Apply **R**-flag to data outside retention time window
Manual Integration	All	Acceptance by FPM Chemist	Provide justification for each instance of manual integration	Laboratory will provide chromatograms before and after each manual integration	Apply **R**-flag to all compounds with improper integration

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
CV	Daily, before sample analysis, and every 12 hours of analysis time.	Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane, ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050			Apply **J**-flag to detects and **UJ**-flag to nondetects if average RF not met
		% Difference/Drift (%D) for all target compounds and surrogates: VOCs and SVOCs ≤ 20%D (Note: D ≤ difference when using RFs or drift when using least squares regression or non-linear calibration.)	Correct problem, then rerun CV. If that fails, repeat ICAL. Reanalyze all samples since last acceptable CCV.	Problem must be corrected. No results may be reported without a valid CCV. Flagging criteria is only appropriate in cases where the samples cannot be reanalyzed.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **R**-flag to nondetects

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Internal standards verification	In all field samples and standards	Retention time ± 30 seconds from retention time of the midpoint standard in the CV Extracted ion current profile (EICP) area within - 50% to + 100% of ICAL midpoint standard	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	Sample results are not acceptable without a valid IS verification.	If corrective action fails in field samples, apply **J**-flag to detects and **UJ**-flag to nondetects to analytes with IS recoveries between 30%-50% or > 150%. Apply **R**-flag to samples with IS recoveries < 30%.
Method blank, Equipment blank, Trip blank (VOCs only)	One per preparatory batch, one per sampling day, one per storage cooler	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit.	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination (<10X for common laboratory contaminants).

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LCS	One per preparatory batch	QC acceptance criteria specified in UFP-QAPP Table 12-1.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<30%): Apply **J**-flag to detects and **R**-flag to nondetects.
MS/MSD	One per preparatory batch per matrix	QC acceptance criteria specified in UFP-QAPP Tables 12-1.	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	For the specific analyte(s) in the parent sample, apply **M**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Laboratory sample duplicate	One per preparatory batch per matrix (if MS/MSD is not performed)	RPD ≤ 30% (sample and sample duplicate)	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met.	Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met.
Surrogate spike	All field and QC samples	QC acceptance criteria specified in UFP-QAPP Table 12-2.	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Analytes identified in UFP-QAPP Table 12-6.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to nondetects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to nondetects. For SVOCs, no qualification when only one surrogate is outside QC criteria.
Results reported between DL and LOQ	N/A	N/A	N/A	N/A	Appy **J**-flag to all results between DL and LOQ.
Field Duplicate	One per 10 field samples	See UFP-QAPP **Worksheet #12** (UFP-QAPP Manual Section 2.6.2).	N/A	N/A	Appy **J**-flag to detects and **UJ**-flag to nondetects.

QAPP Worksheet #13 – Secondary Data Uses and Limitations

Data Type	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Soil Data	Holloman Air Force Base, Comprehensive Site Evaluation Phase II Report, September 2013 (USACE)	USACE and HDR. Historic maps, records, and various documents relating to historic site use, CSE Phase I information, soil sample collection and contamination delineation.	To assess potential areas of contamination and focus data collection activities in specific site areas where contamination is most likely.	Secondary data may not meet all DQOs, and, therefore, may not be able to be used without limitation.

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QAPP Worksheet #14 and #16 – Project Tasks & Schedule

Summary of Project Tasks

Sampling Tasks (Performed by FPM)**:**

- Specific discussion of the sampling approach and sampling design and rationale is provided in **Worksheet #17**.
- Soil sampling will assess the absence or presence of MC contamination at the RR869a Debris Field MRS. Sample locations will be surveyed using either Real-Time Kinematic Global Positioning System (RTK-GPS) or Differential Global Positioning System (DGPS) equipment.
- Samples will be collected using the field SOPs attached as **Appendix A** of this UFP-QAPP.

Analysis Tasks:

- Accutest will analyze samples for metals using USEPA SW-846 Method 6010C for the following metals (aluminum, antimony, chromium, copper, iron, lead, and zinc).
- Accutest will analyze samples using USEPA SW-846 Method 8330A for the following explosives : 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 2-Nitrotoluene; 3-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; 4-Nitrotoluene; HMX; Nitrobenzene; RDX; Tetryl, Nitroglycerin, PETN, and 3, 5-Dinitroaniline.
- If necessary, Accutest Laboratories, Inc. will analyze samples for PAHs using USEPA SW-846 Method 8270S SIM

QC Tasks – All Projects:

1. MS/MSDs will be collected at an approximate frequency of 5%.
2. Duplicates will be collected at a rate of 10% and analyzed by Accutest Laboratories to assess field and laboratory precision.
3. Equipment blanks will be collected from each type of non-disposable, decontaminated sampling device.
4. Laboratory performance evaluation (PE) samples will be collected at each site to assess the laboratory's ability to provide defensible data of a known quality.
5. Data validation will be conducted on 100% of all analytical data collected.

Summary of Project Tasks

Secondary Data – All Projects: Previously collected data will be evaluated. Secondary data may not meet all DQOs, and, therefore, may not be able to be used without limitation. See **Worksheet #13**.
Data Management Tasks – All Projects: Data will be delivered in an Environmental Restoration Program Information Management System (ERPIMS) database compatible format after data verification/ validation have been performed and data qualifiers have been added.
Waste Management Tasks – All Projects: 1. It is not anticipated that MC sampling activities will generate IDW. Planned MC sampling activites will be performed using disposable sampling equipment, such as disposable polyethylene acoops and bottles. PPE and other disposable sampling equipment will be bagged and temporarily staged for off-site disposal IAW USEPA and NMED regulations. Sampling personnel will follow local and state protocols, as well as stakeholder guidance, in determining the proper disposal of PPE.
Documentation and Records – All Projects: 1. All field documentation will be recorded in indelible ink in bound field books. These will summarize all daily field activities, weather conditions, personnel present, visitors, etc. All samples collected will be documented as to their location, which will be measured using either RTK-GPS or DGPS equipment. Each day's samples and associated field measurements shall be recorded on field sampling forms. Chain of Custody (CoC) forms, bills of lading, air bills, and sample logs will be prepared and retained for each sample. 2. A copy of the final WP and UFP-QAPP will be retained in central project file (electronically on a server) and in print form in the onsite office.
Data Packages – All Projects: Accutest Laboratories will complete analytical data packages IAW the AFCEC approved forms or similar and will provide ERPIMS X file.

Summary of Project Tasks

Assessment / Audit Tasks – All projects: Field Sample Collection and Documentation Audits: to be determined.
Data Review Tasks – All projects 1. For the samples, Accutest Laboratories will verify that all data are complete for samples received. All data package deliverable requirements will be met. Data will be 100% verified by FPM IAW this UFP-QAPP. A data verification report will be prepared for each lab work order (lab data package). 2. Verified and validated data and all related field logbooks/notes/records will be reviewed to assess total measurement error and determine overall usability of the data for project purposes. Data limitations will be determined and data will be compared to Project Quality Objectives and required Action Limits. Corrective Action will be completed as necessary. Final validated data are placed in the ERPIMS database, with any necessary qualifiers and tables, charts and graphs generated.

Project Schedule/Timeline Table

Activity	Date
Final RI WP	October 2014
RI Fieldwork	October 2014 to November 2014
Draft RI Report	December 2014
Final RI Report	July 2015

Appendix H of the RI WP presents the complete detailed project schedule.

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QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: Metals (SW-846 Method 6010C)
Concentration Level: Low

Analyte	Chemical Abstracts Service No.	Holloman AFB Soil Background Levels[1] (mg/kg)	USEPA Screening Levels[2] Residential Soil (milligrams per kilogram [mg/kg])	NMED Hazardous Waste Bureau Residential Soil SSL (mg/kg)[3]	LANL Ecological Benchmark (mg/kg)[4]	Achievable Laboratory Limits[5]		
						LOD (mg/kg)	LOQ (mg/kg)	Method Detection Limit (MDL) (mg/kg)
Aluminum	7429-90-50	13,722	7,700	78,000	NA	1.25	10	1
Antimony	7440-36-0	1.6	3.1	31.3	0.05	0.1	0.5	0.08
Chromium	16065-83-1	25	12,000	117,000	28	0.1	0.2	0.09
Copper	7440-50-8	13	310	3,130	12	0.1	1.25	0.09
Iron	7439-89-6	23,049	5,500	54,800	NA	5	15	3.5
Lead	7439-92-1	10.9	400	400	14	0.1	1	0.055
Zinc	7440-66-6	54.6	2,300	23,500	48	0.25	1	0.15

Notes:

NA Not Available

(1) Approved Background Levels NMED Memo (NMED, 2012b)

(2) May 2014 USEPA Regional Residential Screening Levels.

(3) New Mexico Soil Screening level February 2012 (updated June 2012)

(4) Los Alamos National Laboratory ECORISK Database Release 3.1, October, 2012, no effect ESL

(5) Achievable LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method.

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: Explosives (SW-846 Method 8330A)
Concentration Level: Low

Analyte	Chemical Abstracts Service No.	Holloman AFB Soil Background Levels[1] (mg/kg)	USEPA Screening Levels[2] Residential Soil (mg/kg)	NMED Hazardous Waste Bureau Residential Soil SSL (mg/kg)[3]	LANL Ecological Benchmark (mg/kg)[4]	Achievable Laboratory Limits[5]		
						LOD (mg/kg)	LOQ (mg/kg)	MDL (mg/kg)
1,3,5-Trinitrobenzene	99-35-4	NA	220	NA	6.6	0.10	0.20	0.08
1,3-Dinitrobenzene	99-65-0	NA	0.62	NA	0.073	0.10	0.20	0.08
2,4,6,-Trinitrotoluene	118-96-7	NA	3.6	39.1	6.4	0.10	0.20	0.08
2,4-Dinitrotoluene	121-14-2	NA	1.7	15.7	2.5	0.10	0.20	0.08
2,6-Dinitrotoluene	606-20-2	NA	0.36	61.1	1.8	0.10	0.20	0.08
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	15	NA	10	0.10	0.20	0.08
2-Nitrotoluene	88-72-2	NA	3.2	29.1	9.9	0.10	0.20	0.08
3-Nitrotoluene	99-08-1	NA	0.62	7.82	12	0.10	0.20	0.08
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	15	NA	3.6	0.10	0.20	0.08
4-Nitrotoluene	99-99-0	NA	25	244	22	0.10	0.20	0.08
HMX	2691-41-0	NA	380	3,910	27	0.10	0.20	0.08
Nitrobenzene	98-95-3	NA	5.1	53.5	1.31[+]	0.10	0.20	0.08
RDX	121-82-4	NA	6.0	58.2	7.5	0.10	0.20	0.08
Tetryl	479-45-8	NA	12	244	0.99	0.10	0.20	0.08

Analyte	Chemical Abstracts Service No.	Holloman AFB Soil Background Levels[1] (mg/kg)	USEPA Screening Levels[2] Residential Soil (mg/kg)	NMED Hazardous Waste Bureau Residential Soil SSL (mg/kg)[3]	LANL Ecological Benchmark (mg/kg)[4]	Achievable Laboratory Limits[5]		
						LOD (mg/kg)	LOQ (mg/kg)	MDL (mg/kg)
3,5-Dinitroaniline	618-87-1	NA	NA	NA	NA	0.10	0.20	0.08
Nitroglycerin	55-63-0	NA	0.62	6.11	71	1.0	2.0	0.5
PETN	78-11-5	NA	12	NA	100	1.0	2.0	0.5

Notes:

+ No LANL ESL available. Soil screening level taken from USEPA, Region V, Resource Conservation Recovery Act Ecological Screening Levels (USEPA, 2003)

NA Not Available

(1) Approved Background Levels NMED Memo (NMED, 2012b)

(2) May 2014 USEPA Regional Residential Screening Levels.

(3) New Mexico Soil Screening level February 2012 (updated June 2012)

(4) Los Alamos National Laboratory ECORISK Database Release 3.1, October, 2012, no effect ESL

(5) Achievable LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: PAHs (SW-846 Method 8270D SIM)
Concentration Level: Low

Analyte	Chemical Abstracts Service No.	Holloman AFB Soil Background Levels[1] (mg/kg)	USEPA Screening Levels[2] Residential Soil (mg/kg)	NMED Hazardous Waste Bureau Residential Soil SSL (mg/kg)[3]	LANL Ecological Benchmark (mg/kg)[4]	Achievable Laboratory Limits[5]		
						LOD (mg/kg)	LOQ (mg/kg)	MDL (mg/kg)
Acenaphthene	83-32-9	NA	350	3,440	0.25	0.067	0.13	0.053
Acenaphthylene	208-96-8	NA	NA	NA	120	0.067	0.13	0.053
Benzo(a)anthracene	56-55-3	NA	0.15	1.48	0.8	0.013	0.027	0.0067
Benzo(a)pyrene	50-32-8	NA	0.015	0.48	53	0.013	0.027	0.0067
Benzo(b)fluoranthene	205-99-2	NA	0.15	1.48	18	0.013	0.027	0.0067
Benzo(g,h,i)perylene	191-24-2	NA	NA	NA	24	0.013	0.027	0.0067
Benzo(k)fluoranthene	207-08-9	NA	1.5	14.8	62	0.013	0.027	0.0067
Chrysene	218-01-9	NA	15	148	2.4	0.013	0.027	0.0067
Dibenz(a,h)anthracene	53-70-3	NA	0.015	0.148	12	0.013	0.027	0.0067
Fluoranthene	206-44-0	NA	230	2,290	10	0.067	0.130	0.033
Fluorene	86-73-7	NA	230	2,290	3.7	0.067	0.130	0.053
Indeno(1,2,3-cd)pyrene	193-39-5	NA	0.15	1.48	62	0.013	0.027	0.0067
2-methylnaphthalene	91-57-6	NA	23	NA	16	0.067	0.130	0.053
Naphthalene	91-20-3	NA	3.8	43.0	1	0.067	0.130	0.053
Phenanthrene	85-01-8	NA	NA	1,830	5.5	0.067	0.130	0.033
Pyrene	129-00-0	NA	170	1,720	10	0.067	0.130	0.033

Notes:

+ No LANL ESL available. Soil screening level taken from USEPA, Region V, Resource Conservation Recovery Act Ecological Screening Levels (USEPA, 2003)

NA Not Available

(1) Approved Background Levels NMED Memo (NMED, 2012b)

(2) May 2014 USEPA Regional Residential Screening Levels.

(3) New Mexico Soil Screening level February 2012 (updated June 2012)

(4) Los Alamos National Laboratory ECORISK Database Release 3.1, October, 2012, no effect ESL

(5) Achievable LODs and LOQs are limits that an individual laboratory can achieve when performing a specific analytical method

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QAPP Worksheet #17 – Sampling Design and Rationale

The Holloman AFB and RR869a Debris Field MRS Locations are shown on **Figures 1** and **2**, respectively. Field activities will consist of MEC/MPPEH surface clearance, DGM, MEC/MPPEH intrusive investigations (if applicable), and MC sampling. Sampling activities at the MRS will include soil sampling at confirmed MEC/MPPEH locations and in areas with significant amounts of MD and could occur anywhere within the MRS. Specific details of the MC sampling design and rationale are provided below.

Soil sampling will be conducted at the MRS to determine the nature and extent of MC contamination associated with MEC/MPPEH. Representative soil samples will be collected from locations with confirmed MEC/MPPEH and in areas with significant amounts of MD. Note: Since the overall remedial objective for the RR869a MRS is a Site Closeout, MC soil sampling will be performed at locations of MEC finds representing a low explosives hazard such as squib.

Soil samples will be collected using the seven-point "spoke and hub" composite sampling method following procedures described in the field SOPs presented in **Appendix A**. The sampling depths will be determined based in part upon the depth of MEC/MDEH found during the intrusive investigation (if performed). MEC/MDEH surface finds will result in only surface soil being collected due to any resulting MC are expected to be close to the surface if soil is undisturbed. Conversely, MEC/MDEH subsurface finds will result in subsurface soil being collected at the same location and depth of the identified MEC/MDEH item and analyzed for MC. The number of soil samples collected will be dependent on the number of MEC/MDEH finds. We estimate that approximately 10 composite samples will be required at the RR869a Debris Field MRS. However, if no MEC/MDEH is found then MC sampling will not occur. The soil samples will be analyzed for explosives (by USEPA Methods 8330A and metals by USEPA 6010C) to determine if contamination posing a potential threat to human health and/or ecological environment is present. Results will be used to determine remedial options for impacted areas at the site. Remedial options will be evaluated in an Engineering Evaluation/Cost Analysis (EE/CA).

The CSE Phase II data indicates only minor undocumented usage of small arms at this site and does not indicate a potential lead or PAH concern. However, if during the RI a significant amount of shotgun shells and/or clay target debris is found, soil samples will be collected to determine the nature and extent of any associated contaminants, metals (lead) and PAHs. Soil samples will be collected using the seven-point "spoke and hub" composite sampling method following procedures described in the field SOPs presented in **Appendix A**. The number of soil samples collected will be dependent on the number of significant shotgun shells and/or clay target debris finds. We estimate that approximately 10 composite samples will be required at the RR869a Debris Field MRS. However, if no significant shotgun shells and/or clay target debris finds are located then soil sampling will not occur. The soil samples will be analyzed for metals (by USEPA 6010C) and for PAHs (by USEPA 8270D SIM) to determine if contamination posing a potential threat to human health and/or ecological environment is present.

Additional site specific details for the geophysical and intrusive investigations and MC sampling and analysis plans are provided in the RI WP. All field parameter measurements will be documented in the daily QC reports (DQCRs) issued as part of the Investigation/Sampling Reports.

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QAPP Worksheet #18 – Sampling Locations and Methods

Sampling Location	Matrix	Depth (inches)	Analytical Group	Concentration Level	No. of Samples	Sampling SOP Reference[1]	Rationale for Sampling Location
RR869a	Soil	Determined based on the depth of MEC/MDEH finds	Metals and Explosives	Low	10[2]	SOP No. 1 and No. 2	To determine the vertical and areal extent of contamination (see Worksheet #17)

[1] PT and split samples will be collected as specified by AFCEC.
[2] We estimate that approximately 10 seven-point "spoke and hub" composite samples will be required at the RR869a Debris Field MRS. However, if more MEC/MDEH is found, MC sampling will occur at each MEC/MDEH find location..
[3] We estimate that approximately 10 seven-point "spoke and hub" composite samples will be required at the RR869a Debris Field MRS. However, if more are needed then sufficient samples will be collected to characterize the extent of any contamination. If no significant shotgun shells and/or clay target debris finds are located then no sampling will occur.

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QAPP Worksheet #19 & #30 – Sample Containers, Preservation, and Hold Times

Laboratory: Accutest Laboratories, Inc., 4405 Vineland Road, Suite C-15 Orlando, FL 32811, Jean Dent-Smith jeans@accutest.com, 407-425-6700.
List any required accreditations/certifications: DoD Environmental Laboratory Accreditation Program accreditation, compliant with the most recently published version of the DoD QSM Version 4.2.

Backup-up Laboratory: None

Sample Delivery Method: FedEx

Data Package Turnaround: 20 Days

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Sample Size[2]	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[3] (preparation / analysis)
Soil	Metals – ICP/CVAA	SW-846 6010C/ MET104/MET100	5 grams	(2)-8 ounce jar	None specified per Ch.3 of SW-846	6 months
Soil	Nitroaromatics	SW-846 8330A/ OP019/GC016	2 grams	(2)-8 ounce jar	Cool 4°C	14 days to extraction / 40 days for analysis
Soil	PAH	SW-846 8270D SIM/ MS008/OP007	30 grams	2)-Zip Lock Bag	Cool 4°	14 days to extraction / 40 days for analysis

Notes
[1] Refer to the Analytical SOP References table (**Worksheet #23**).
[2] The minimum sample size is based on analysis allowing for sufficient sample for reanalysis. Additional volume is needed for the laboratory MS/MSD sample analysis.
[3] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

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QAPP Worksheet #20 – Field QC Summary

Matrix	Analytical Group	No. of Field Samples[1]	No. of Field Duplicate Samples[2]	No. of MS/MSDs[3]	No. of Field Blanks	No. of Equipment Blanks[5]	No. of Blanks (Trip)[4]	No. of PT Samples	Total No. of Analyses	
Soil	Metals and Explosives	10	1	1	0	10	0	As specified by AFCEC	22	
Soil	Metals (lead) and PAHs	10	1	1	1	0	0	10	As specified by AFCEC	23
								20		46
									Total	66

[1] Specify the appropriate reference letter or No. from the Analytical SOP References table (**Worksheet #23**).
[2] The No. of samples collected may vary depending on field conditions.
[3] Total Numbers of Field Duplicate Samples will meet project goal of 10%.
[4] Total MS/MSD Samples will meet project goal of 5%.
[5] Trip blank samples are not required for coolers containing metals and polynuclear aromatic hydrocarbon (PAH) samples.
[6] Equipment blanks will be collected from non-disposable decontaminated sampling devices at a rate of 1 per day of field sampling.

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QAPP Worksheet #21 – Field SOPs

SOPs are located in **Appendix A**.

Reference No.[1]	Title, Revision Date and / or No.	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP No. 1	Surface and Near Surface Soil Sampling	FPM	Grab/hand auger	N	Includes descriptions and procedures for surface soil sampling.
SOP No. 2	Sub-Surface Soil Sampling	FPM	Hand Auger or Direct Push Rig	N	Includes descriptions and procedures for sub-surface soil sampling.
SOP No. 3	Sediment Sampling	FPM	Grab/hand auger	N	Includes descriptions and procedures for sediment sampling.
SOP No. 4	Surface Water Sampling	FPM	Grab	N	Includes descriptions and procedures for surface water sampling.
SOP No. 5	Sample Handling, Documentation, and Tracking	FPM	N/A	N	Includes sample packaging, shipping, and CoC requirements.
SOP No. 6	Decontamination	FPM	N/A	N	Includes descriptions and procedures for decontamination of personnel and equipment.
SOP No. 7	Global Positioning System (GPS) Measurements	FPM	GPS units	N	Includes description and procedures for marking data points using GPS units.
SOP No. 8	Equipment Calibration	FPM	Various field parameter measuring equipment	N	Includes descriptions and procedures or calibrating field parameter measuring equipment.

Notes:
[1] – FPM SOPs are not project specific; as such the SOP document may include SOPs that are not relevant to the immediate project and/or tasks.

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QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment[1]	Calibration Activity	SOP Reference[2]	Responsible Person	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action
Trimble XRT2 and Nomad DGPS	No daily calibration activity. Initial receiver settings are programmed by manufacturer	SOP No. 7.	Field personnel	Verify real-time location with base map on receiver and determine accuracy	Observe displayed location and actual location.	Daily	Within 0.5 feet if static.	Manufacturer service
Trimble R8 RTK-GPS with TSC2 controller and R7 receiver/base station.	No daily calibration activity. Initial receiver settings are programmed by manufacturer	SOP No. 7.	Field personnel	Verify real-time location with base map on receiver and determine accuracy	Observe displayed location and actual location.	Daily	Within 25 cm.	Manufacturer service

[1] Only field equipment associated with sampling activities are listed in this work sheet. The field equipment, calibration, maintenance, testing, and inspections associated with other activities (DGM, surface clearance, subsurface removal, etc.) are defined in the WP.

[2] The Project Sampling SOP References table is found on **Worksheet #21**.

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QAPP Worksheet #23 – Analytical SOP's

Laboratory SOPs are located in **Appendix B**.

SOP Reference No.	Title, Revision Date, and / or No.	Definitive or Screening Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project Work? (Y/N)
MET100	Metals by ICP, Aug 2013	Definitive	Soil/ Metals – ICP 6010C	Trace 6000 Series	No
MET104	Digestion of Soils for ICP Analysis, Aug 2013	Definitive	Soil/ Prep Method Metals – ICP SW-846 3050B	SCP Science	No
GC016	Analysis of Nitroaromatics and Nitramines by HPLC, Dual DAD, Sep 2013	Definitive	Soil/ Explosives SW-846 8330A	HP1100, Dual DAD	No
OP019	SOP for the Extraction of Nitroaromatics/Nitramines from Solid Samples, Sep 2013	Definitive	Soil/ Explosives SW-846 8330A	Sonic Disruptor	No
OP007	Extraction of Semi-volatile Organics (BNAs) from Solid Samples, Aug 2013	Definitive	Soil/Prep Method	Sonic Disruptor	No
MS008	Analysis of Semi-volatile Organics by method 8270D SIM, Aug 2013	Definitive	Semi-volatiles SW-846 8270D SIM	HP6890/5973, HP6890/5975	No

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QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person	SOP[1]
Thermo ICAP 6000 Series	Metals, SW-846 6010C	ICAL daily	ICAL %RSD <5%, or Correlation coefficient R>0.995 ICV and CCV %D <10%	Instrument maintenance, nebulizer cleaning, torch inspection, standard inspection, recalibration	Laboratory Analyst	MET100
HP1110, Dual DAD	SW-846 8330A, 5-points minimum	Major maintenance (per method) or second consecutive failure of opening CCV warrants recalibration	ICAL %RSD <20%, or Correlation coefficient R>0.995 ICAL Verification, CCV %D <15%	Instrument maintenance, leak check, Lamp test, pump test, standard inspection, recalibration	Laboratory Analyst	GC016
HP6890/5973 HP6890/5975	Semi volatiles, SW-846 8270D SIM, 5 points minimum	Major maintenance (per method) or second consecutive failure of opening CCV warrants recalibration	ICAL %RSD <20%, or Correlation coefficient R>0.995; Meet minimum RF as per method.	ICAL %RSD <20%, or Correlation coefficient R>0.995; Meet minimum RF as per method.	Laboratory Analyst	MS008

[1] The Analytical SOP References table is found on **Worksheet #23**.

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QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP[1]
Trace 6000 Series	Torch, nebulizer, spray chamber, auto sampler, pump tubing maintenance.	SW-846 6010C	Check connections, flush lines, clean nebulizer	Frequency determined by instrument remaining in calibration and free of interference – MET100	Passing calibration	Reconnect sample pathways, recalibrate, reanalyze affected samples	Laboratory Analyst	MET100
HP 1110 Dual DAD	Needle, needle seat, column filters, guard columns, pump piston seals, mobile phase filters	SW-846 8330A	Leak test, injection needle and needle seat inspection, filter inspection, lamp test as needed	Need for maintenance determined by passing calibration and chromatography – see GC016	Passing CCV	Column back flush, guard columns replacement, lamp replacement (as needed)	Laboratory Analyst	GC016

HP5890/5973 HP6890/5975	Injector port, column maintenance, source cleaning	SW-846 8270D SIM	Leak test, column and injector port inspection, source insulator integrity	Need for maintenance determined by passing calibration and Decafluorotriphenylphosphine (DFTPP) – see MS008	Passing DFTPP and CCV, passing Internal Standard response	Column clipping and/or reconditioning, seal and liners replacement, filaments and insulators as needed	Laboratory Analyst	MS008

[1] The Analytical SOP References table is found on **Worksheet #23**. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis.

QAPP Worksheet #26 & #27 – Sample Handling, Custody, and Disposal

Sampling Organization: FPM

Laboratory: Accutest Laboratories, Inc.

Method of sample delivery: FedEx

Number of days from reporting until sample disposal: 60

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Labeling	FPM, Field Personnel	SOPs # 1, 2, and 5
Chain-of-Custody Form Completion	FPM, Field Team Leader	SOP #5
Packaging	FPM, Field Personnel	SOP #5
Shipping Coordination	FPM Site Lead/ FPM Field Personnel	SOP #5
Sample Receipt, Inspection, & Log-in	Accutest Laboratories Inc., Randy Shields	Accutest Laboratories Inc., SOPs GC016, OP019, MS008, OP007, MET100, and MET104
Sample Custody and Storage	Accutest Laboratories Inc., Randy Shields	Accutest Laboratories Inc., SOPs GC016, OP019, MS008, OP007, MET100, and MET104
Sample Disposal	Accutest Laboratories Inc., Randy Shields	Accutest Laboratories Inc., SOPs GC016, OP019, MS008, OP007, MET100, and MET104

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QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix		Soil				
Analytical Group		ICP Metals				
Analytical Method / SOP Reference		SW-846 6010C/ LAB SOP# Met100				
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
MB	1 per extraction batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples nondetect – report without qualification 2. Samples >10X contamination level – report with qualification 3. Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	<1/2 RL

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS	1 per extraction batch	%R = (Calculated Value/True Value) *100%; 80%<%R<120%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples nondetect – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%R = (Calculated Value/True Value) *100%; 80%<%R<120%
MS	1 per 20 samples or one for each extraction batch	%R = (Calculated Value - Sample Value/True Value) *100%: 80%≤%R≤120%	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix.	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value - Sample Value/True Value) *100%: 80%≤%R≤120%

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MSD	1 per 20 samples or one for each extraction batch	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	See above	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2
Serial Dilution Test	Each preparatory batch or when a new or unusual matrix is encountered	Five-fold dilution must agree within ± 10% of the original determination.	Perform PDS addition. Flagging criteria are not appropriate.	Analyst	Precision (field samples)	Five-fold dilution must agree within ± 10% of the original determination. Only applicable for samples with concentrations >50x LOQ for ICP.

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
PDS addition	When dilution test fails or analyte concentration in all samples <50x MDL	Recovery within 75-125% of expected result. The spike addition should produce a level between 10x to 100x LOQ.	Run samples by method of standard additions or apply J-flag to all sample results (for same matrix) for specific analyte(s) for all samples associated with the post-digestion spike addition.	Analyst	Accuracy	Recovery within 75-125% of expected result. The spike addition should produce a level between 10x to 100x LOQ.

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix		Soil				
Analytical Group		Explosives				
Analytical Method / SOP Reference		SW-846 8330A/ LAB SOP# GC016				
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Responsible Person (s)**	**DQI**	**Measurement Performance Criteria**
MB	1 per extraction batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples nondetect – report without qualification 2. Samples >10X contamination level – report with qualification 3. Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	<1/2 RL

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action	Responsible Person (s)	DQI	Measurement Performance Criteria
LCS	1 per extraction batch	%R = (Calculated Value/True Value) *100%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples nondetect – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%R = (Calculated Value/True Value) *100%
MS	1 per 20 samples or one for each extraction batch	%R = (Calculated Value - Sample Value/True Value) *100%	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix. The project Chemist will be contacted and a decision will be made to either report the data as is with a notation in the analytical narrative or if the samples should be re-extract and re-analyzed.	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value - Sample Value/True Value) *100%

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action	Responsible Person (s)	DQI	Measurement Performance Criteria
MSD	1 per 20 samples or one for each extraction batch	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	See above	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2
Surrogate Spikes	Every sample	%R = (Calculated Value/True Value) *100%	Reason for poor recoveries is investigated and eliminated before further analytical activities. Corrective actions are: 1. High bias, samples nondetect – report without qualification. 2. Low bias – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Individual sample preparation efficiency control	%R = (Calculated Value/True Value) *100%

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix	Soil					
Analytical Group	PAHs					
Analytical Method / SOP Reference	SW-846 8270D SIM/ LAB SOP# MS008					
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Responsible Person (s)**	**DQI**	**Measurement Performance Criteria**
MB	1 per extraction batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples nondetect – report without qualification 2. Samples >10X contamination level – report with qualification 3. Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	<1/2 RL

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action	Responsible Person (s)	DQI	Measurement Performance Criteria
LCS	1 per extraction batch	%R = (Calculated Value/True Value) *100%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples nondetect – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%R = (Calculated Value/True Value) *100%
MS	1 per 20 samples or one for each extraction batch	%R = (Calculated Value - Sample Value/True Value) *100%	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix. The project Chemist will be contacted and a decision will be made to either report the data as is with a notation in the analytical narrative or if the samples should be re-extract and re-analyzed.	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value - Sample Value/True Value) *100%

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action	Responsible Person (s)	DQI	Measurement Performance Criteria
MSD	1 per 20 samples or one for each extraction batch	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	See above	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2
Surrogate Spikes	Every sample	%R = (Calculated Value/True Value) *100%	Reason for poor recoveries is investigated and eliminated before further analytical activities. Corrective actions are: 1. High bias, samples nondetect – report without qualification. 2. Low bias – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Individual sample preparation efficiency control	%R = (Calculated Value/True Value) *100%

QC Sample	Frequency / No.	Method / SOP QC Acceptance Limits	Corrective Action	Responsible Person (s)	DQI	Measurement Performance Criteria
Internal standards (IS)	Every sample	IS Area = -50% to +100% of CCV	If failure is due to instrument performance issues, the problem must be identified, corrected, and the sample must be re-analyzed. If no instrument problem is found the sample must be re-analyzed. If upon re-analysis the responses are still not within limits, the problem may be considered sample matrix interference	Analyst	Instrument sensitivity control	Detector Stability

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QAPP Worksheet #29 – Project Documents and Records

Sample Collection and Field Records:

Record	Generation	Verification	Storage location/archival
Field logbook and data collection sheets	FPM Field Team Leader	FPM Site Manager, Ivana Raicevic	Project file and Electronic Storage, FPM office
CoC forms	FPM Field Staff	FPM Site Manager, Ivana Raicevic and Accutest Laboratories Inc., Randy Shields	Project file and Electronic storage, FPM office and Accutest permanent project records folder
Contractor Daily QC Reports	FPM Field Team Leader	FPM Site Manager, Ivana Raicevic	Electronic storage in project files, FPM office
Air bills	FPM Field Staff and Shipper (FedEx)	FPM Field Team Leader	Project file, FPM office
Deviations	FPM Field Team Leader and FPM Site Manager, Ivana Raicevic	FPM PM	Project file and Electronic Storage, FPM office
Corrective Action Reports	FPM PM, Maureen Whalen	COR	Project file, FPM office
Correspondence	Various	N/A	Electronic storage in project files, FPM office

Project Assessments:

Record	Generation	Verification	Storage location/archival
Field audit checklists	FPM Site Manager, Ivana Raicevic	FPM PM, Maureen Whalen	Project file, FPM office
Data verification checklists	FPM Chemical QC Manager, Connie van Hoesel	FPM Site Manager, Ivana Raicevic and FPM PM, Maureen Whalen	
Data validation report			
Data usability assessment report			

Laboratory Records

Record	Generation	Verification	Storage location/archival
Shipping Receipt or Freight Bill	Accutest Laboratories Inc., Randy Shields	Accutest PM, Jean Dent-Smith	Initially stored in Accutest permanent project records folder; after job completion & invoicing, stored in ERPIMS
Sample Receiving Checklist			
Condition Upon Receipt Anomaly Form			
Priority form			
CoC form	FPM Field staff	Accutest Sample Receiving personnel, Randy Shields	Stored in Accutest permanent project records folder and in the Project file and Electronic Storage at FPM's office
Internal CoC Report	Accutest Laboratories Inc., Randy Shields	Accutest PM, Jean Dent-Smith	Accutest electronic storage and ERPIMS.
Raw data files	Accutest analytical personnel, Mark Erstling (Organics), Dave Metzgar (Metals)		
Final analytical report			

Record	Generation	Verification	Storage location/archival
Other vital records (*e.g.*, instrument maintenance records, QA records)	Accutest	Accutest	Accutest Warehouse

Laboratory Data Deliverables

Record	Metals	Explosives	SVOCs
Narrative	x	x	x
CoC	x	x	x
Summary Results	x	x	x
QC Results	x	x	x

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QAPP Worksheets #31, #32, & #33 – Assessments and Corrective Action

Assessments:

Assessment Type	Responsible Party & Organization	Number/ Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Review field documentation (log book, field forms, chain-of-custody forms, etc.)	Maureen Whalen PG, CPG, PMP, FPM	As work progresses	Within 24 hours of finding deficiency	Review of corrected documentation	24 hours after notification
Field sampling audit	QA/QC Officer, or PM, FPM	Once at start of sampling	Within 2 days of the start of sampling	E-mail and/or phone log	Within 2 days of finding deficiency
Internal laboratory assessment	Accutest QA Manager	Once per project	Within 5 days of sample analysis	Documented in the lab report	2 weeks
External AFCEC laboratory audit PE	AFCEC	Once per sampling event	Within 7 days of analysis	AFCEC Report on Laboratory Assessment	4 weeks

QAPP Worksheets #31, #32, & #33 – Assessments and Corrective Action

Assessment Response and Corrective Action:

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Review Field Documents (Logbooks, Sampling Logs, and CoC forms)	Marked up copy of document	Maureen Whalen PM, FPM	Within 24 hours of finding deficiency	Review of corrected documentation	Field Team Leader, FPM, and Maureen Whalen PG, CPG, PMP, FPM	24 hours after notification
Field Sampling Audit	E-mail or verbal report to detail the deviation from QAPP	Maureen Whalen, PM, FPM	Within 2 days of the start of sampling	E-mail and/or phone log	Field Team Leader, FPM, and Maureen Whalen PG, CPG, PMP, FPM	2 days
Internal Laboratory Assessment	Lab Report to detail project deviations	Accutest PM	Within 5 days of sample analysis	Documented in the lab report	Accutest QA Manager	2 weeks
External AFCEC Laboratory Assessment	AFCEC findings of Laboratory project deviations	Project Chemist, FPM and Accutest Laboratory Manager	Within 7 days of analysis	AFCEC Report on Laboratory Assessment	Maureen Whalen PG, CPG, PMP, FPM, AFCEC, and Accutest Laboratory	4 weeks

QAPP Worksheet #34 – Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (Conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	x	
2	Contract	x	
3	Field SOPs	x	
4	Laboratory SOPs	x	
Field Records			
5	Field log books	x	x
6	Equipment calibration records	x	x
7	Chain-of-custody forms	x	x
8	Geophysics reports	x	x
9	Relevant correspondence	x	x
10	Field audit reports	x	x
11	Field corrective action reports	x	x
Analytical Data Package			
12	Cover sheet (laboratory identifying information)	x	x
13	Case narrative	x	x
14	Internal laboratory chain-of-custody	x	x
15	Sample receipt records	x	x
16	Sample chronology	x	x
17	Communication records	x	x
18	LOD/LOQ establishment and verification	x	x
19	Standards traceability	x	x
20	Instrument calibration records	x	x
21	Definition of laboratory qualifiers	x	x
22	Results reporting forms	x	x
23	QC sample results	x	x
24	Corrective action reports	x	x

Item	Description	Verification (completeness)	Validation (Conformance to specifications)
25	Raw data	x	x
26	Electronic data deliverable	x	x

Only verification and validation inputs associated with sampling activities are listed in this work sheet. Verification and validation inputs associated with other activities (DGM, surface clearance, subsurface removal, etc.) are defined in the WP.

QAPP Worksheet #35 – Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field log book	QAPP, Field SOP	Verify that records are present and complete for each day of field activities. Verify that all planned samples including QC samples were collected and that sample collection locations are documented. Verify that changes or exceptions were documented and reported.	Daily – Site Manager At conclusion of field activities – Project QA Manager
Chain-of-custody forms	QAPP, Field SOP	Verify the completeness of chain-of-custody forms. Examine entries for consistency with the field logbook. Verify that the required volume of sample has been collected. Verify that sample identifications and analytes are correct and legible. Verify that all required signatures and dates are present.	Daily – Field team leader At conclusion of sampling event – Site Manager and PM
Laboratory deliverable	QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Compare the data package with the chain-of-custody forms to verify that results were provided for the correct analytes for all the collected samples. Check the sample receipt records to ensure sample condition upon receipt was noted. Review the narrative to ensure that all QC exceptions are described	Before sending to FPM – Laboratory QA Manager Upon receipt – Chemical Project QA Manager
Audit Reports, Corrective Action Reports	QAPP	Verify that all planned audits were conducted. Examine any audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	Project QA Manager

Only verification processes associated with sampling activities are listed in this work sheet. The verification processes associated with other activities (DGM, surface clearance, subsurface removal, etc.) are defined in the WP.

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QAPP Worksheet #36 – Data Validation Procedures

Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator
Soil	Metals, explosives, and PAHs	Low-to-high	DoD QSM 4.2	Connie van Hoesel, Project Chemist, FPM
Soil	Metals, explosives, and PAHs	Low-to-high	QAPP **Worksheets #12, #15** and **#24**. QAPP **Tables 12-1** through **12-45**	Connie van Hoesel, Project Chemist, FPM

Only validation processes associated with sampling activities are listed in this work sheet. The validation processes associated with other activities (DGM, surface clearance, subsurface removal, etc.) are defined in the WP.

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QAPP Worksheet #37 – Data Usability Assessment

A complete (100%) data review will be performed on the samples collected during the sampling event. The review will consist of verification and validation based on completeness and compliance checks of sample receipt conditions and both sample-related and instrument-related QC results, as addressed in **Worksheet #12**. Any flags that limit the usability of the data shall be applied to all associated samples; flags are listed in **Table 12-2**. The Data Usability Assessment will be performed by FPM personnel. Connie van Hoesel, FPM Chemical QC Coordinator will be responsible for information in the Usability Assessment. Note that the Data Usability Assessment will be conducted on verified/validated data. After the Data Usability Assessment has been performed, data deemed appropriate for decision-making purposes will be used to assess contaminant extents at sites at Holloman AFB. The results of the Data Usability Assessment will be presented in the RI Report. The following items will be assessed and conclusions drawn based on their results.

Precision: Results of field duplicates will be presented separately in tabular format for each sample pair when results are reported above the LOD. For each field duplicate pair, the results will be assessed as stated in **Tables 12-3**, **12-4, and 12-5**. MS/MSD RPDs are calculated by the laboratory and those with RPDs outside the criteria established in **Table 12-1** will be listed in tabular form in the data verification report. A discussion will follow summarizing the results of the laboratory precision. Any conclusions about the precision of the analyses will be drawn and any limitations on the use of the data will be described.

Accuracy/Bias Contamination: Results for all laboratory MBs will be evaluated and analytes detected in these blanks will be listed in tabular form in the data verification report. Laboratory data will be qualified based on the criteria listed in **Tables 12-3**,**12-4 and 12-5**. A discussion will follow summarizing the results of the laboratory accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

Overall Accuracy/Bias: Results for all LCS, surrogate and MS/MSD recoveries that are outside evaluation criteria will be presented in tabular format in the data verification reports. The results will be checked versus those listed in **Table 12-1**. A discussion will follow summarizing the overall accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

Performance Evaluation: PE samples will be evaluated and if discrepancies are discovered they will be investigated and the effect on field sample results will be determined and discussed with FPM, Accutest, and AFCEC. A discussion of PE sample results will be included with QC sample discussion and aid in data defensibility. If results from PE samples are outside the expected values, an investigation will be completed to determine the source of the discrepancy. A corrective action report will be prepared to document the results of the investigation and to address whether re-sampling or reanalysis is required. If the cause is determined to also affect all samples that were collected, then an evaluation of the reliability of the field sample results will be made and reported in the data usability assessment and RI Report.

Representativeness: Representativeness is a qualitative measure of the degree to which data accurately and precisely represent a characteristic of a population, and is mainly addressed in the sample design. A measure of representativeness can also be obtained by assessing holding times

and blank data. Any conclusions about the representativeness of the samples will be drawn and any limitations on the use of the data will be described.

Comparability: IAW this UFP-QAPP the data are comparable when collection techniques, measurement method and reporting procedures are the same for each data set.

Completeness: A completeness check will be performed on all data generated by the laboratory. Completeness criteria are presented on **Worksheet #12**. Completeness will be calculated as the No. of data points for each analyte that is deemed useable (not rejected) divided by the total No. of data points for each analyte. A discussion will follow summarizing the results of the calculation of data completeness. Any conclusions about the completeness of the data will be drawn and any limitations on the use of the data will be described. Data completeness addresses only those samples that are collected and only data that is analyzed by the laboratory.

Graphics: Figures and maps will be prepared showing the site specific sampling locations and results.

Reconciliation: Each of the measurement performance criteria listed in **Worksheet #12** will be examined to determine if the objective was met. Each analysis will be evaluated separately in terms of the major impacts observed from the data verification/validation, DQIs and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Usability of the data will be based on the quality assessment. After establishing the usability of the data, it will be determined if the DQO was met and if project action limits were met. The final report will include a summary of all points that comprised the reconciliation of each objective. Any conclusions or limitations on the usability of any of the data will be described.

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FIGURES

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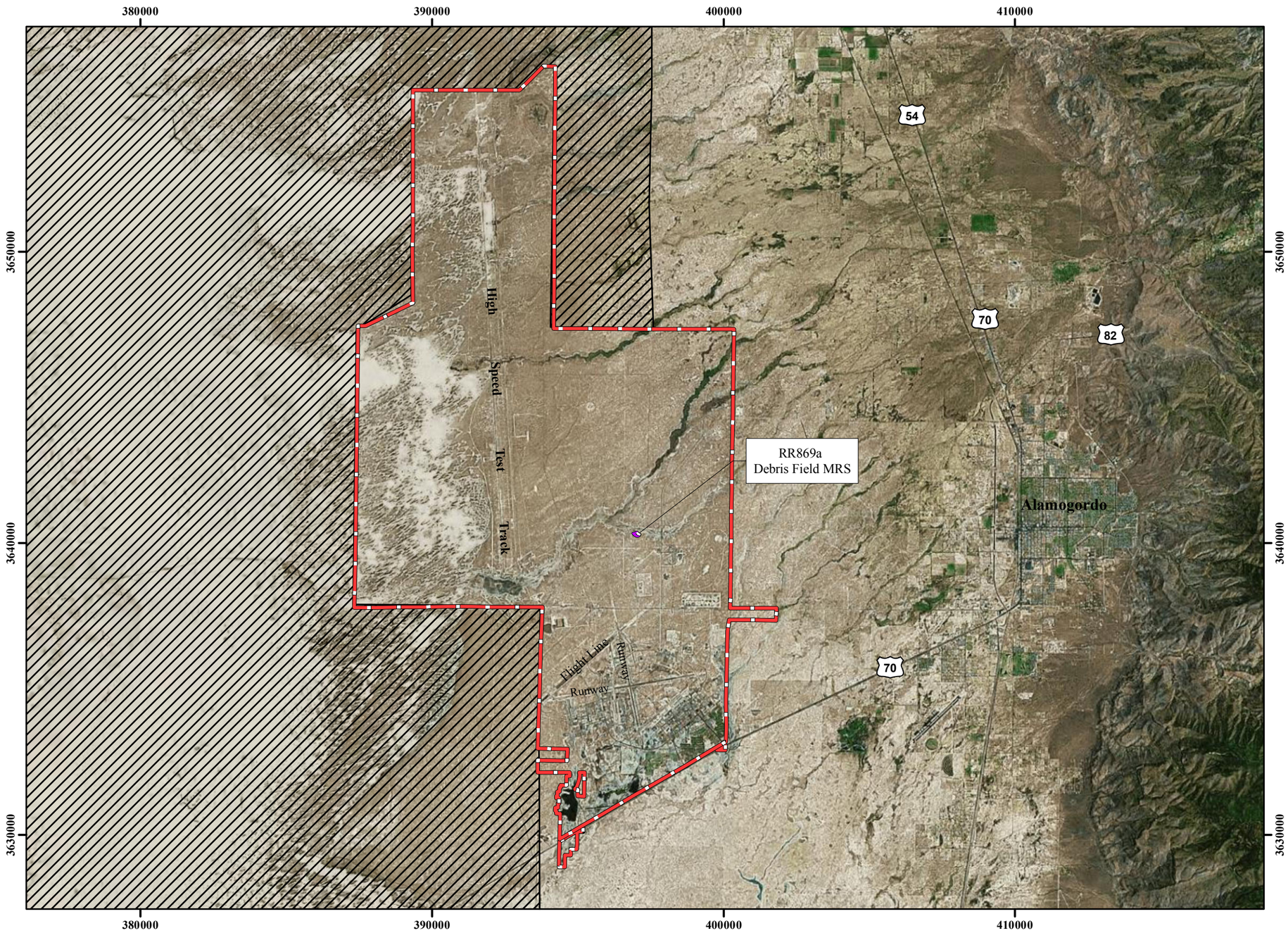

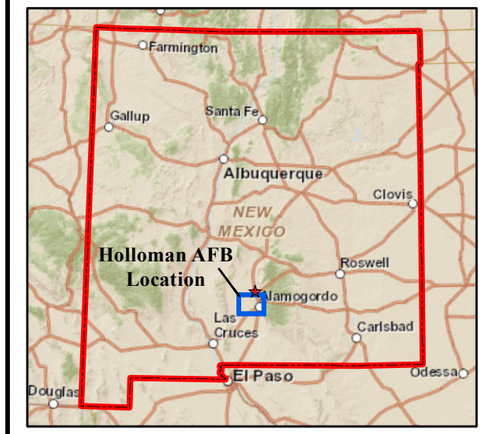

Legend

White Sands Missile Range

Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 1

Holloman Air Force Base Location

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 8/13/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 12,000 feet

0 1,850 3,700 Meters

0 6,000 12,000 Feet

N W E S

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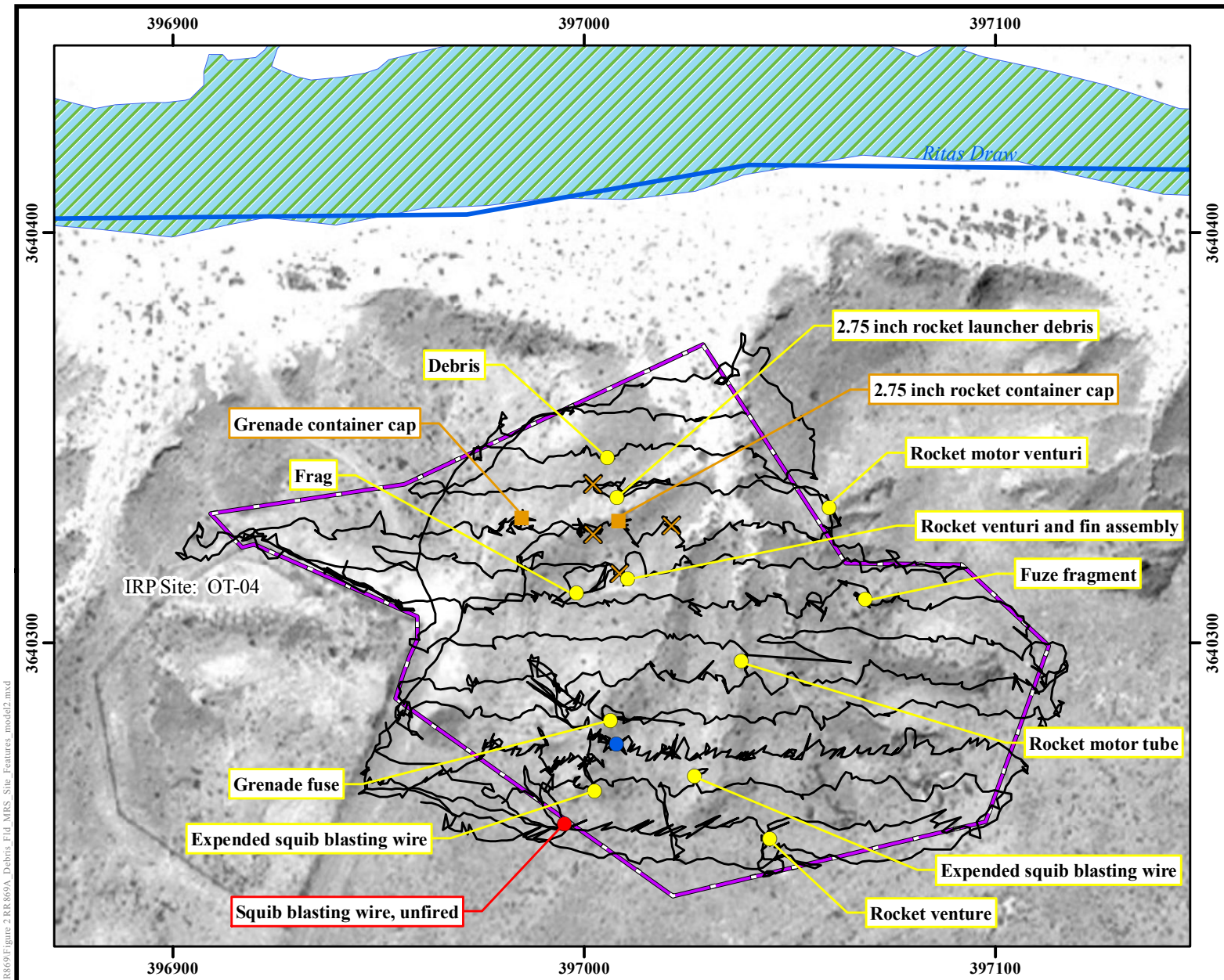

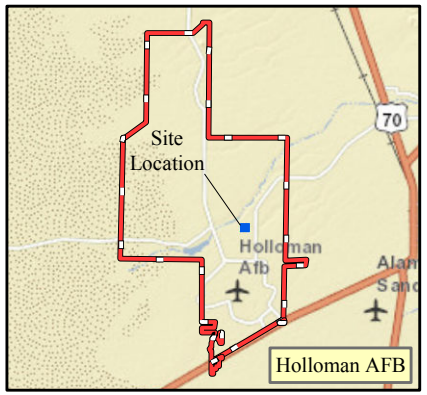

Legend

- Munitions and Explosives Of Concern (MEC)
- Munitions Debris
- Clay Target Debris
- Small Arms Debris: Projectile
- Range-Related Debris
- Stream
- CSE Phase II Visual Survey Transects
- Wetlands
- RR869a
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM
AFCEC

FIGURE 2

RR869a Debris Field MRS
CSE Phase II Findings

FPM Remediations, Inc.

2014

NOTES:
1. SR859 MRS boundary based on CSE Phase II findings.
2. HHSL - Human Health Screening Level
3. Revision Date: 8/13/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

1 inch = 120 feet

0 18 36 Meters

0 60 120 Feet

N W E S

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APPENDIX A

Field Standing Operating Procedures

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1.0 SOP NO. 1 – SURFACE AND NEAR SURFACE SOIL SAMPLING

1.1 PURPOSE AND SCOPE

The purpose of this document is to define the Standard Operating Procedure (SOP) for collecting soil samples at Holloman Air Force Base (AFB) using hand tools. This SOP describes the equipment, field procedures, and Quality Assurance/Quality Control (QA/QC) procedures implemented for sample collection.

This SOP is intended to be used together with the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) and other appropriate SOPs. Health and safety procedures and equipment for the investigation are detailed in the project Health and Safety Plan (HASP).

Applicable SOPs are listed below:

- SOP No. 3 – Sample Handling, Documentation, and Tracking
- SOP No. 4 – Equipment and Personnel Decontamination
- SOP No. 5 – Global Positioning System (GPS) Measurements
- SOP No. 6 – Permits and Clearances
- SOP No. 8 – Investigation-Derived Waste

1.2 EQUIPMENT AND MATERIALS LIST

The following equipment and materials should be on site for soil sampling:

- Stainless steel hand auger or hand trowel
- Surveyor's stakes and flags
- Pick
- Field logbook
- Sample Collection Field Sheets
- Nitrile gloves
- Hard plastic disposable tools (i.e., polyethylene [PE] scoop)
- Sample containers
- Sample container labels
- Label tape (clear)
- Disposable sealed zip-type PE bag
- Paper towels
- Digital camera
- 100 foot hand tape
- Waterproof and permanent marking pens
- Plastic sheeting
- Trash bags
- Cooler with sufficient ice to maintain a temperature of 4°C
- Appropriate health and safety equipment, as specified in the HASP

- Appropriate decontamination supplies, as specified in SOP No. 4

Other materials and equipment may be needed based on field conditions.

1.3 LOCATING THE SAMPLING POINTS

Sampling locations will be determined in the field. At the time of locating each sampling point, the sampling point identification will be entered in the field logbook and the GPS coordinates recorded. Information concerning nearby landmarks, or other information that will help to re-locate the point in the future will be recorded. The sample locations will be marked using surveyor's stakes and flags (or lath), and the flags (or lath) will be labeled using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations into site landmarks if available (such as foundations). If the surveyor's stake is offset from the sample location, the offset will be noted on the field map or field logbook.

1.4 SURFACE AND NEAR SURFACE SOIL DISCRETE SAMPLING PROCEDURES

Discrete samples consist of soil collected for chemical analysis from a single location. Sampling sites will be located and marked using surveying stakes or flags. Discrete surface soil and subsurface soil samples will be collected as follows:

- At each location, clear an area approximately 12 inches in diameter of surface vegetation and debris from the vicinity where a sample is to be collected.
- Use a decontaminated stainless steel spoon or disposable spoon to collect the surface soil to a depth interval of 0 to 2 inches. A steel pick may be used as needed to loosen the soil prior to sampling.
- Use a decontaminated hand auger or direct push technology to collect the shallow soil from a depth of 2 inches to 3 feet below ground surface (bgs). When proper sample depth is reached, remove the cuttings from the borehole while keeping the core intact.
- To the extent possible, eliminate gravel size or larger particles or debris based on visual observation.
- Immediately fill the appropriate sample containers. Label and handle the containers as specified in SOP No. 3, Sample Handling, Documentation, and Tracking.
- Decontaminate the sampling equipment in accordance with SOP No. 4, Equipment and Personnel Decontamination.
- Once the sample is collected, the location will be documented and photographed; and GPS coordinates will be recorded.

1.5 INCREMENTAL SAMPLING PROCEDURES

The goal of Increment Sampling (IS) is to obtain an unbiased and reproducible estimate of the average concentration of analytes through the collection of soil sample increments distributed evenly throughout the decision unit/sampling area. Ideally, the target weight of an IS sample is

approximately 1 kilogram (kg) and is comprised of 30 (minimum) to 100 increments within the decision unit. IS samples will be collected as follows:

- Determine the appropriate size of the decision unit to fit the investigation objective. Decision unit size recommendations range from 33-ft x 33-ft to 165-ft x 165-ft and consist of 30 increments to 100 increments, respectively. The location and size of individual decision units are to be based on previous investigations, visual evidence of Munitions and explosives of concern (MEC) or Munitions Debris (MD), and/or type of MEC present.
- Using survey flags, delineate a decision unit boundary at each corner of the selected area. Note that the size and shape of the decision unit will be largely determined by the terrain features and the data quality objectives set forth in the UFP-QAPP.
- Once the boundary of the decision unit is defined, place nine flags at evenly spaced intervals along two opposite sides of the decision unit to define 10 lanes. Flags can then be used to fill in the remaining sides to create a visual sub-grid pattern. Additional flags can be placed within the interior of the decision unit if visual obstructions impede the visualization of evenly spaced increments throughout.
- With 100 increments established throughout the grid area, IS locations can then be selected. For 50-increment samples, every other flag will act as a sampling location. For 33-increment samples, every third flag will act as a sampling location. This pattern can be adjusted to satisfy the desired quantity of increments, as needed.
- Working in a team of two, one person will collect each increment while the other holds the sample container (clean plastic bag) and keeps track of the number of increments collected. The increments are sampled in a snake-like pattern from one corner of the decision unit to the corner adjacent to the starting corner.
- For the collection of QA/QC samples, the replicate samples should be collected from a sub-grid collection point offset from the original starting position and followed in the same snake-like pattern walked during the collection of the primary sample.
- Recommended sampling depths range from 1 inch to 4 inches at each increment location and are based on the overall depth distribution of anticipated analytes. The diameter of the sampling tool and the volume collected at each increment location will need to be adjusted to satisfy the 1 kg sample mass as it pertains to the selected quantity of increments in each decision unit.
- Once collected, the sample will be containerized as per the analytical laboratories requirements and labeled as specified in SOP No. 5, Sample Handling, Documentation, and Tracking.
- Once the sample collection is completed, the location will be documented and photographed; and GPS coordinates will be recorded at each of the four corners of the decision unit.

1.6 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All

QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

1.6.1 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. The initial sample containers for a particular parameter or set of parameters will be filled first, and then the duplicate sample containers for the same parameter(s) will be filled, and so on until all necessary sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. Duplicate samples will be blind to the laboratory. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

1.6.2 Matrix Spike and Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the chain of custody (COC) form and on the containers. It may be necessary to increase the sample volume for samples where the MS/MSD designation is to be made. If additional volume is necessary, the additional sample container will be filled immediately after the initial sample. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

1.7 SAMPLE HANDLING

Sample containers, preservatives and analysis are specified in Worksheet #19. Samples will also be labeled and handled as described in SOP No. 3, Sample Handling, Documentation, and Tracking.

1.8 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the activities concluded and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets.

1.8.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sampling location. Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location (and depths)
- Date and time of sampling

- Person(s) performing sampling
- Type of sample (grab or composite)
- Color (describe), odor (describe)
- Sample description
- Sample identification number
- Analyses required
- Number of sample bottles taken for each analyses
- Preservation of samples, if any
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sample quality.

1.8.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field logbook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Locations, depths, and sample station numbers
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information
- Calculations, if required.

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2.0 SOP NO. 2 - SUB-SURFACE SOIL SAMPLING

2.1 PURPOSE AND SCOPE

This SOP describes the equipment, materials, field procedures, and documentation procedures for collecting sub-surface soil samples using direct push or auger methods for soil characterization and chemical analysis.

Health and safety procedures and equipment to be used during soil sampling are described in a separate HASP. These SOPs are intended to be used with the UFP-QAPP and with other SOPs listed below:

- SOP No. 3 - Sample Handling, Documentation, and Tracking
- SOP No. 4 - Equipment and Personnel Decontamination
- SOP No. 6 – Permits and Clearances
- SOP No. 7 – Equipment Calibration
- SOP No. 8 – Investigation-Derived Waste

2.2 EQUIPMENT AND MATERIALS LIST

One of the following drilling equipment:

- Direct push rig (e.g., Geoprobe® rig or similar) with appropriate drilling and sampling tools (sub-surface soil)
- Hollow Stem Auger Kit and electric drill
- Hand Auger

The following equipment and materials should be on site for sub-surface soil sampling regardless of the drilling equipment used:

- Photoionization Detector (PID) (with 10.2 eV lamp)
- Weighted tape measure and ruler with 0.01-foot increments
- Surveyor's stakes and flags
- Field logbook
- Drilling Log form
- Sample Collection Field Form
- Stainless-steel bowl and spoon
- Sample containers
- Sample container labels
- Label tape (clear)
- Ziploc® bags
- Paper towels
- Digital Camera
- Waterproof and permanent marking pens
- Plastic sheeting

- Trash bags
- Ice chest with ice
- Appropriate health and safety equipment, as specified in the HASP
- Appropriate decontamination supplies, as specified in SOP No. 4
- Granular bentonite and potable water

2.3 LOCATING THE SAMPLING POINTS

The facilities designated for sampling are shown on figures provided in the UFP-QAPP (Worksheet #17). The approximate soil sampling locations will be identified on site figures before field work commences. The exact soil sampling locations will be determined in the field. Sampling coordinates will be mapped on the front of the Drilling Log in the Location Sketch/Comments Area. The sampling locations will be defined in the investigation specific work plan (WP) similar to previous investigation and long term monitoring locations.

When each soil sampling location is identified in the field, the sampling point identification will be entered in the field logbook and on the Drilling Log. Include any information concerning nearby landmarks, or other information that will help to re-locate the point in the future. Mark the sample locations using surveyor's stakes and flags, and label the flag using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations to site landmarks (such as foundations) if available. If the surveyor's stake is offset from the sample location, the offset will be noted on the field map and the field logbook.

2.4 SOIL SAMPLING PROCEDURES

Direct push samples will be collected using a dual tube sampling system or a discrete interval, piston-type sampler (Geoprobe®, MacroCore®, or equivalent). With a dual tube system, the outer rods remain in the ground while the inner rod and sample liner are extracted to retrieve a soil sample from the desired interval. Soil samples may be collected continuously throughout the depth of the direct push boring or from discrete intervals. The direct push rods will be decontaminated between boring locations, but not between samples at the same boring since a new acetate liner is used for each sample.

With a piston-type sampler, a four-foot or five-foot-long stainless steel sampler with an acetate liner is advanced to the top of the desired sampling interval. The sampler is closed to soil during advancement of the sampler to the desired sampling interval. When the top of the desired sampling interval is reached, a piston rod inside the sampler is unlocked through the drill rods, and the sampler is advanced to the bottom of the sampling interval. The sampler and all drill rods are then removed from the ground, and the acetate liner is removed from the piston sampler. Aside from the cutting shoe, the soil sampler never comes in contact with the soil sample. The cutting shoe is decontaminated after each sample is collected, and a new acetate liner is used for every sample interval. The outer sampling barrel is decontaminated after each boring is completed. The sampling will be documented in the field logbook and drill log.

With a hand auger or hollow stem auger kit, the auger head will be advanced manually to the depth. Auger extensions will be used when sampling at depths exceeding 4 feet. Once the desired depth is achieved, the auger is removed for sample collection as described below. Following collection, the hand auger or hollow stem auger kit will be decontaminated. When using manual samplers, the sampling will be documented in the field logbook and Soil/Sediment sampling form.

At each sampling location, the sampler will be advanced by a combination of hydraulic vertical pressure and percussion hammering. Once the target depth is achieved, the sample will be withdrawn and the liner filled with the soil sample is retrieved.

The following procedures will be followed once the soil sample has been retrieved:

- Don a clean pair of nitrile gloves.
- Cut acetate sleeve to provide access to the soil sample (direct push sampling only).
- Measure the recovery. Record the sampling interval and recovery on the drilling log.
- Remove soil smear from the outside of the acetate sleeve and examine the sample, with particular attention for visible evidence of staining, odors, or other evidence of contamination. Record the soil description on the Drilling Log or Soil/Sediment Sampling Form.
- Conduct PID screening of the soil. The soil with the highest PID levels will be collected for a sample.
- The soil from the sampling interval will be removed from the liner and homogenized in a stainless-steel bowl. Once the soil has been homogenized, fill the appropriate sample containers as specified in the UFP - QAPP (Worksheet #19). Record the sample interval and analysis requested on the Drilling Log or Soil/Sediment Sampling Form and the COC.
- Label, store, transport, and document the samples (depending on the use of the sample) according to SOP No. 3. The parameters for analysis and preservation are specified in UFP QAPP Worksheet #19.
- If no other samples will be collected from the boring, abandon the boring by backfilling the hole with hydrated granular bentonite. Pour the granular bentonite down the hole in approximate 1-foot to 2-foot lifts, and then pour approximately 0.5 gallon of potable water down the hole to hydrate the bentonite. Continue this from the bottom of the hole to the surface.

2.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

2.5.1 Field Blanks

Field blanks are QC samples collected to evaluate potential external contamination of samples and will consist of trip, ambient, and equipment blanks. The sample collection coordinator or the project QA/QC coordinator will designate these blanks. The blanks will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples.

A trip blank serves as a check on sample contamination originating from the container or sample transport. A trip blank consists of a volatile organic analysis (VOA) vial which was filled with VOA-free water at the lab, transported to the site, kept in the same cooler as the normal samples throughout the entire sampling day, and shipped back to the laboratory with the normal samples. One trip blank will be sent with each cooler containing water samples for volatile organic analyses.

The ambient blank serves as a check on sample contamination originating from ambient air during volatile organic compounds (VOCs) sample collection. An ambient blank consists of an empty VOA vial which is filled in the field with VOA free water. While pouring the sample, the water is given ample contact with ambient air conditions. The ambient blank is typically collected at the sampling location that potentially exhibits the largest ambient influence (near a busy road, airfield, etc.).

The equipment blank serves as a check on sample contamination originating from sampling equipment reuse during sample collection. The equipment blank consists of a set of sample bottles identical to the normal sample, which is filled with lab-grade water that is flushed over a decontaminated, reusable piece of equipment.

2.5.2 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. All sampling containers will be filled in the following order: volatile or gaseous analyses first, then semi-volatile organic compounds (SVOCs), including polynuclear aromatic hydrocarbons (PAHs); metals; mercury; cyanide; total organic carbon; anions; other remaining analytes (no specific order). The initial sample containers will be filled first, and then the duplicate sample containers for the same parameter(s) and so on until all sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

2.5.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) analyses are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the COC form and on the containers. It may be necessary to increase the sample volume for MS/MSD samples. If

additional volume is necessary, the additional sample containers will be filled in the identical fashion as described above in the duplicate sample section. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

2.6 FIELD DOCUMENTATION

Field documentation for sub-surface soil sampling includes field logbooks and field forms. The most important aspect of field documentation is thorough, organized, and accurate record keeping. Two forms are used in the field during sub-surface soil sampling. These forms include the Drill Log and the Soil/Sediment Sampling Form. Each form is described in **Section 2.6.2**. An important factor of record keeping is the proper preservation and storage of all field documentation. To preserve the field documentation, the field notes and field forms are scanned and the electronic record of the field notes is stored in the project folder and backed up on additional hard drives to prevent data loss.

Additional forms including Health and Safety Meeting forms, Health and Safety Inspection forms, and COCs used during the sampling event are detailed in SOP No. 3.

2.6.1 Field Logbook

All information pertinent to soil sampling and not documented on the field forms will be recorded in a bound field logbook with consecutively numbered pages. The field logbook notes will be recorded in indelible ink. The field logbooks notes are entered to create an accurate record of the work performed so that the sampling activity can be reconstructed without relying on the memory of field personnel. Information documented in the field logbook may include information on date of notes, weather conditions, field personnel, site, mobilization, work performed including location and time, etc. After each day, field notes are reviewed by the field team leader or site responsible person for accuracy. Refer to SOP No. 3 for detailed procedures regarding documentation in the field logbook.

2.6.2 Field Forms

<u>Drill Log</u>

The Drilling Log contains the following minimum information:

- Project name and number
- Contractor company, field personnel
- Boring Identifier
- Drilling subcontractor company and name of drilling personnel
- Site Identifier
- Brand and model of drill rig
- Sizes and types of drilling and sampling equipment

- Surface elevation (if available, this may be entered later after the survey)
- Date drilling started and finished
- Overburden thickness, depth drilled into rock, and total depth of hole
- Depth to water during drilling and depth to water after drilling with elapsed time
- Number of geotechnical samples, type of samples, and core boxes (if cores are saved)
- Number of chemical samples and requested analyses
- Signature of field geologist who completed the Drilling Log field form
- Field sketch showing the boring location
- Sampling interval and measured sample recovery.
- A description of the recovered soil sample in accordance with the Unified Soil Classification method for unconsolidated geologic materials. The descriptions should include origin, grain size, sorting, texture, structure, bedding, color, moisture content, and consistency.
- Sample Identifier
- Sample Collection Time
- As applicable, field screening results, geotechnical samples, chemical samples, and blow counts (split-spoon sampling only).
- As applicable, record pertinent observations (such as odors, staining, colors, changes in drill rod advancement, chatter, water, etc.) in the "Remarks" column.
- If portions of the Drilling Log are not applicable (e.g., if samples are not collected for chemical analysis or if cores are not collected, etc.) record an "NA" in the appropriate location on the form.
- Bore hole abandonment (method of abandonment)

Soil/Sediment Sampling Form

The Soil/Sediment Sampling Form contains the following minimum information:

- Field personnel
- Project name and number
- Site Identifier
- Sample Location Identifier
- Sizes and types of sampling equipment
- Date of sample
- Sampling depth.
- A description of the recovered soil sample. The descriptions should include origin, grain size, texture, structure, color, and odor.
- Comments or Observations
- Sample Identifier
- Sample Collection Time

3.0 SOP NO. 3 – SAMPLE HANDLING, DOCUMENTATION, AND TRACKING

3.1 PURPOSE AND SCOPE

This SOP describes the procedures for sample handling, documentation, and tracking. This SOP is intended to be used with the UFP-QAPP, and with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling

3.2 SAMPLE IDENTIFICATION

The sampling locations, sample types, and naming conventions will be established prior to field activities for each sample to be collected. On-site personnel will obtain assistance in defining any special sampling requirements from the FPM Project Manager or designated Task Manager. Each sample will have a discrete, alpha-numeric sample identification (ID). A unique sample ID is needed to track each of the samples collected for analysis during the life of this project. In addition, the sample IDs will be used in the database to identify and retrieve the analytical results received from the laboratory. Each sample ID will be assigned at the time of sampling.

Sample ID

The sample ID will be designated as follows: Site Code, Sample Type and Sampling Location Indicator, Sample Location Number, Sample Depth Identifier, and Sample Type Qualifier.

Site Code

The first segment consists of two to five alphanumeric characters that designate the site code. Examples of site codes include:

- SR864 for Poorman Range
- ML865 for Ballistics Rain Field

For a soil sample designated “SR864SO0101A”, “SR864” indicates the sample is collected from the Ballistics Rain Field site.

Sample Type and Sampling Location Indicator

The second segment consists of one or two alphanumeric characters that indicate the sample type and sampling location indicator. Sample types are as shown below:

SO Surface Soil (0 to 2 inches)
SS Subsurface Soil (2 inches or greater)

For a soil sample designated "SR864SO0101A", "SO" indicates the sample is collected from surface soil.

Sample Location Number

The two-digit number following the sample indicator completes the identification of the sampling location at a specific site.

For a soil sample designated "SR864SO0101A", "01" indicates the sample is collected from sampling location 1.

Sample Depth Identifier

The fourth segment consists of two numerical characters that will be used to identify the depth in feet below top of inner casing in wells and feet bgs for soil samples.

For a soil sample designated "SR864SO0101A", "01" indicates the sample is collected 1 foot bgs.

Sample Type Qualifier

The fifth segment is one or two alphabetic characters used to designate the type of sample. The first letter denotes the round of sampling completed (e.g., "A" for first quarterly sampling round, "B" for second quarterly sampling round, etc.). The sample types will be identified by the second character as listed below:

- A = Primary sample
- B = Primary sample
- C = Field duplicate groundwater sample
- D = Matrix Spike Duplicate (MSD)
- E = Equipment blank
- F = Ambient blank
- R = Trip blank
- S = Matrix Spike (MS)

The letter A or B appearing at the end of a sample number indicates that the sample is a primary sample. These letters will be selected randomly to mask the predominance of primary samples over QA/QC samples. This system was devised to minimize the likelihood that the laboratory personnel can distinguish the primary samples from the QA/QC samples using the sample identification.

3.3 SAMPLE LABELS

Sample labels will be filled out as completely as possible by a designated member of the sampling team prior to beginning field sampling activities each day. All sample labels will be

filled out using waterproof ink. At a minimum, each label will contain the following information:

- Sampler's company affiliation
- Site location
- Sample ID
- Date and time of sample collection
- Analyses required
- Method of preservation (if any) used
- Sample matrix (i.e., soil, groundwater, surface water)
- Sampler's signature or initials

3.4 SAMPLE HANDLING PROCEDURES

This section discusses proper sample containers, preservatives, and handling and shipping procedures. The UFP-QAPP summarizes the information contained in this section and also includes the sample holding times for each analyte.

3.4.1 Sample Containers

Certified, commercially clean sample containers will be obtained from the contract analytical lab. The contract laboratory will label the containers to indicate the type of sample to be collected. Required preservatives will be prepared and placed in the containers at the laboratory prior to shipment to the site. Appropriate sample containers for the specific analyses required will be listed in the UFP-QAPP.

3.4.2 Sample Preservation

Sample preservation efforts will commence at the time of sample collection and will continue until analyses are performed. Samples will be stored on ice at 4°C in coolers immediately following collection. The ice will be double bagged in plastic storage bags. Additional sample preservation requirements are listed in the UFP-QAPP. Chemical preservatives, if necessary, will be added to the sample containers by the laboratory prior to shipment to the field, unless otherwise specified in the UFP-QAPP.

3.4.3 Sample Handling and Shipping

The sample containers will be wiped clean of all sample residue and then wrapped in protective packing material (bubble wrap) and taped. Samples will be double-bagged with plastic bags and then placed upright in an iced cooler. Additional packing material will be placed around the samples as necessary to protect them from damage and to keep them upright. A COC form will accompany each cooler. The COC will be placed in a plastic bag and attached to the inside lid of the cooler. The cooler lid will be taped closed with a custody seal.

Coolers will be hand delivered or shipped by overnight express carrier to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific

holding times. This may require daily shipment of samples with short holding times. The condition of all samples as received and temperature of all coolers will be reported by the laboratory.

3.4.4 Holding Times and Analyses

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest and stability factors, and preservative (if any) used. Allowable holding times are listed in the UFP-QAPP.

3.5 SAMPLE DOCUMENTATION AND TRACKING

This section describes documentation required in the field notes, on the sample collection field sheets, on the daily QC reports, and on the sample COC forms.

3.5.1 Field Logbook

All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions that are initialed and dated. Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook for a particular site. A site-specific logging procedure will be developed to include sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel. The logbooks will be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become a part of the final project file.

The following information (as applicable) shall be recorded in the field log book:

- Sampler’s printed name and signature
- Names of other field personnel (FPM and any FPM subcontractors) and site visitors
- Date (month, day, year)
- General weather conditions
- Time and location of sampling (including approximate distance to adjacent landmarks if possible)
- Level of personal protective equipment (PPE) used
- Brief description of sampling method with references to appropriate SOPs and WP
- Sample ID (includes location and matrix)
- Any QA/QC sample
- Number and volume of sample containers and requested analysis
- Sample handling and preservation
- Results of any field measurements, equipment used, and equipment calibration information
- Decontamination information
- Brief discussion of any field decisions, unusual conditions, problems encountered and corrective action taken, and/or changes required by field conditions

- Signature and date by person responsible for writing the field notes

3.5.2 Daily Quality Control Report

Each sampling crew will also maintain DQCRs to supplement the information recorded in the field logbook. DQCRs will be maintained by members of the field sampling team and cross-checked for completeness at the end of each day by the sampling team members and/or Field Manager. They will be signed and dated by individuals making entries and initials by the reviewer upon completion. Copies of the DQCR will be forwarded to the QA Officer for review. The DQCR will include the following information:

- Project name
- Project number
- Personnel on site
- Visitor on site
- Subcontractors on site
- Equipment on site
- Weather conditions
- Field work performed
- Quality control and health and safety activities
- Problem, down time, and standby time
- Name and title of person completing the DQCR

3.5.3 Sample Chain of Custody

During field sampling activities, traceability of the sample must be maintained from the time that the samples are collected until laboratory data are issued. Initial information concerning collection of the samples will be recorded in the field logbook as described above. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. The COC form used in the field is a one-page form.

The sampler will be responsible for initiating and filling out the COC form. The sampler will sign the COC when the sampler relinquishes the samples to anyone else. One COC form will be completed for each cooler of samples collected daily. The COC will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times

- Method of shipment
- Shipping air bill number (if appropriate)

The person responsible for delivery of the samples to the laboratory will sign the COC form, and retain a copy of the COC form, document the method of shipment, and send the original and the second copy of the COC form with the samples. Upon receipt at the laboratory, the person receiving the samples will sign the COC form and return the second copy to the FPM Chemical Quality Control Coordinator. Copies of the COC forms documenting custody changes and all custody documentation will be received and kept in the central files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original COC will be sent by the laboratory to the FPM Chemical Quality Control Coordinator to be incorporated into the central files.

4.0 SOP NO. 4 – EQUIPMENT AND PERSONNEL DECONTAMINATION

4.1 PURPOSE AND SCOPE

This SOP describes the equipment, materials, field procedures, and documentation procedures for decontaminating sampling equipment and personnel. Health and safety procedures and equipment to be used during soil sampling are described in a separate HASP. The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling
- SOP No. 8 – Investigation-Derived Waste

The overall objective of an environmental sampling program is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., all non-disposable equipment that will come in direct contact with samples) and field support equipment (e.g., drill rigs, vehicles) is, therefore, required prior to, between, and after uses to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

4.2 EQUIPMENT AND MATERIALS LIST

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot water – high-pressure sprayer
- Sponges or paper towels
- Alconox detergent (or equivalent)
- Potable tap water or distilled water
- Laboratory-grade de-ionized water
- Garden-type water sprayers
- Appropriate Health and Safety equipment (i.e., nitrile gloves, safety glasses, etc.)
- Appropriate containers for Investigative Derived Waste (IDW)

4.3 DECONTAMINATION PROCEDURES

Site activities should be conducted with the general goal of preventing the contamination of personnel and equipment. However, some type of decontamination will always be required on site. A sample personnel decontamination will use remote sampling techniques, bag monitoring instruments, avoid contact with obvious contamination, and employ dust suppression methods as necessary to reduce the probability of becoming set-up guideline and a sample decontamination equipment and supplies list are included in the HASP.

4.3.1 Decontamination Solutions

A decontamination solution should be capable of removing, or converting to a harmless substance, the contaminant of concern without harming the object being decontaminated. The preferred solution is a mixture of detergent and water, which is a relatively safe option compared to chemical decontaminants. A solution recommended for decontaminating consists of 1 to 1.5 tablespoons of Alconox per gallon of warm water. Skin should be decontaminated by washing with hand soap and water. The decontamination solution must be changed when it no longer foams or when it becomes extremely dirty. Rinse water must be changed when it becomes discolored, begins to foam, or when the decontamination solution cannot be removed.

4.3.2 Personnel Decontamination

A temporary personnel decontamination line will be set up in the Contamination Reduction Zone, which is outside of the Exclusion Zone where intrusive work is being performed. If contamination is not encountered, a dry decontamination station may be established which consists of an area where disposable PPE can be donned and discarded. It is anticipated that all work at the Holloman AFB will be completed in Level D.

4.3.3 Sampling Equipment Decontamination

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the HASP.
- Gross contamination on equipment will be scraped off at the sampling or construction site.
- Equipment that cannot be damaged by water will be placed in a wash tub containing Alconox or low-sudsing non-phosphate detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by a de-ionized or distilled water rinse.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with de-ionized or distilled water. Care will be taken to prevent equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately after

decontamination, the equipment will be covered or wrapped in plastic sheeting, foil, or heavy-duty trash bags to minimize potential contact with contaminants.

4.3.4 Equipment Leaving the Site

Vehicles used for activities in non-contaminated areas shall be cleaned on an as-needed basis, as determined by the unexploded Ordnance (UXO) Site Safety Officer/QC Supervisor (UXOSO/QCS), using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles leaving the area.

4.3.5 Responsible Authority

Decontamination operations at each hazardous waste site shall be supervised by the UXOSO/QCS. The UXOSO/QCS is responsible for ensuring that all personnel follow decontamination procedures and that all contaminated equipment is adequately decontaminated. The UXOSO/QCS is also responsible for maintaining the decontamination zone and managing the wastes generated from the decontamination process.

4.3.6 Investigation Derived Waste

Liquid wastewater from decontamination will be removed from the site and properly disposal of. Solid waste, including sample liners and PPE, will be removed from the site and properly disposed of as well.

4.4 EMERGENCY DECONTAMINATION

Emergency decontamination procedures should be followed if necessary to prevent the loss of life or severe injury. In the case of threat to life, decontamination should be delayed until the victim is stabilized; however, decontamination should always be performed first, when practical, if it can be done without interfering with essential lifesaving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life. During an emergency, provisions must also be made for protecting medical personnel and disposing of contaminated clothing or equipment.

4.5 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination will include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions
- IDW handling

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5.0 SOP NO. 5 - GLOBAL POSITIONING SYSTEM MEASUREMENTS

5.1 PURPOSE AND SCOPE

This SOP provides technical guidance and methods that will be used to perform GPS measurements at the field site.

GPS surveying at the field site is used to record:

- Locations of MEC or MD
- Excavation footprints
- Sampling locations
- Injection locations
- Other surface and subsurface feature locations and elevations

The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Soil Sampling

5.2 PERSONNEL QUALIFICATIONS

GPS measurements at the field site will be performed by qualified field personnel. All personnel engaged in recording GPS measurements will be knowledgeable and experienced in methods and equipment use.

5.3 GPS SURVEYING

GPS equipment capable of achieving measurement precision of equal to or less than the specified accuracy without correction will be used. GPS equipment should collect data such that post-processing of spatial data can be performed to increase measurement precision, if needed. The equipment will be operated in accordance with manufacturer's specification, operations manual, and generally accepted surveying practices.

Surveying equipment will be field-verified each day before beginning surveying by establishing the coordinates of a known location (ie, temporary benchmark) using the GPS unit. The benchmark identification (or description) and measured coordinates will be recorded in the survey logbook.

5.3.1 Survey Points

GPS equipment will be used to record the grid corner and center-point coordinates, that will be marked for future reference during the investigation. GPS will be used to record other pertinent site feature data, for example the location of MEC or MD and anthropogenic material, if encountered. Prior to collecting the center-point sampling location coordinates, each location will be marked with a survey flag. The sample location ID will be recorded on each survey flag.

Sample locations will be measured from the center of the grid cell or grab location. For each GPS location recorded an identifier and the coordinates will be stored in the data logger.

If the coordinates at a survey location cannot be determined due to the presence of tree cover or other obstacles which prohibit adequate signal reception, coordinates will be obtained at a minimum of two alternate locations (offsets) close to the original survey location. The distance and bearing from each of the alternate locations to the original survey location will then be determined using a measuring tape and compass.

5.3.2 Coordinate Systems

It is assumed all GPS measurements will be recorded using the projected Universal Transverse Mercator (UTM) coordinate system and the World Geodetic System 1984 (WGS84) datum. The grid will be referenced to known National Geodetic Survey (NGS) benchmarks, if possible.

5.3.3 Required Accuracy

At a minimum, surveyed location coordinates will be determined to an accuracy of ±0.5 foot. Vertical elevations measured by GPS are suspect due to limited system accuracy. Accuracy will be assessed using the FGDC Geospatial Positioning Accuracy Standards. Data may be post-processed to increase accuracy, if required.

5.4 DOCUMENTATION

The field team is responsible for documenting all survey measurements. A complete and accurate record correlating the sample IDs to the instrument assigned stations IDs will be kept in the field logbook. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets as applicable. Upon completion of each day's fieldwork, the electronic record will be downloaded from the instrument, correlated with the sample IDs, and uploaded into the project database.

6.0 SOP NO. 6 - PERMITS AND CLEARANCES

6.1 PURPOSE AND SCOPE

This document defines the SOP for obtaining all permits and clearances required for work at Holloman AFB. Permits and clearances are required for entrance onto the Base to complete fieldwork, for Base security, and to locate underground utilities for intrusive fieldwork. Additional permits may be required to access restricted areas. All required permits and clearances will be verified with Holloman AFB personnel. The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling

6.2 CONTRACTOR BADGES, VEHICLE PASSES, AND CAMERA PASS

6.2.1 Contractor Badges

A daily pass must be obtained from the visitor's center at the gate. The Holloman AFB Remedial Project Manager will be notified in advance of the list of contractor and subcontractor employees that will be entering the Base prior to arriving at the gate. Security personnel will issue daily passes to contractor and subcontractor employees. These passes are per vehicle and are issued for those employees riding in that vehicle. Once the pass is issued, the personnel listed on a single pass must stay together. All personnel entering the Base must present a valid driver's license to Base security once arriving on base. Vehicle registration and proof of insurance are required to obtain a Base pass. Contractor's passes are the property of the United States (U.S.) Air Force and will be returned to the Base Security Office when no longer needed. The pass will be kept with the contractor at all times while on Base property.

6.2.2 Vehicle Passes

All vehicles that enter the Base must be registered at the Base Security Office, and obtain and display a contractor pass\vehicle permit tag from Base Security. The registrant will furnish the vehicle registration, proof of insurance, rental agreement (if applicable), and valid driver's license. Vehicle passes serve as contractor badges and are issued on a daily basis only. Vehicle/contractor passes must be displayed (taped) on the lower corner of the windshield on the driver's side of the vehicle.

6.2.3 Photography

A camera pass is not required for taking any photographs on Base. However, contractors and subcontractors are not to photograph aircraft or other potentially sensitive items. Photography

will be limited to the site and site features, documentation of field activities, and field personnel. **At no time will personnel take pictures of the aircraft or maintenance bays.**

6.3 UTILITY CLEARANCES

Digging permits will be obtained for all machine-driven intrusive activities prior to initiating the work, in accordance with Part VII of Chapter 8 of Revised Statute Title 40. Digging permits are obtained by:

The planned drilling or digging areas at each site will be marked with white paint, tape or flagging. White is the only color allowed for marking excavations and borings.

A call will be placed to the statewide utility hotline New Mexico One Call at (800) 321-2537. The street address and the nearest street intersection along with a call-back telephone number will be provided. In addition, New Mexico One Call may request a faxed copy of a site map if multiple drilling locations require utility locates. Notice shall be given and will include a specific location request for excavation or demolition work to be performed at least forty-eight hours, but not more than one hundred twenty hours, excluding weekends and holidays, in advance of actual work commencement.

A utility locate request requires the name, address, and telephone number of the person filing the notice of intent, and, if different, the person responsible for the excavation or demolition, the starting date, anticipated duration, and description of the specific type of excavation or demolition operation to be conducted, the specific location of the proposed excavation or demolition and a statement as to whether directional boring or explosives are to be used. If the excavation or demolition is part of a larger project, the notice shall be confined to the actual area of proposed excavation or demolition that will occur during the ten-day time period under RS40:1749.14(C).

A Base Civil Engineering Work Clearance Request (AF Form 103) will be completed for each planned drilling or digging area and it will be provided to the Base Restoration Project Manager for signature and processing.

Await a return of the completed AF Form 103 to the Base Restoration Project Manager. A site meeting may be required in order to clarify the locations for intrusive work.

Permits are valid for a period of 10 days once approval has been given. If the work at the site is not initiated or completed within the 10 day period, the clearance process must be repeated starting with step number 1 above.

6.4 NOTICE TO AIRMEN (NOTAM)

NOTAMs for drilling, well installation, well sampling or other work activities on or near the Holloman AFB Flightline (i.e., parking ramp, between runways, revetments, etc.) will be

coordinated through FPM who will submit the NOTAMs to Base Operations for publishing. It is not anticipated that contractors will be required to work on or near the flightline.

6.5 FLIGHTLINE DRIVING PERMIT

Currently, access to the flightline requires escort to be provided by the Holloman AFB Restoration Project Manager. It is not anticipated that contractors will need flightline driver passes or badges.

6.6 HOT WORK PERMIT

A hot work permit is required for all work utilizing an open flame, including but not limited to, welding, cutting torch use, and kerosene-fired steam cleaners. A hot work permit must be obtained from the Holloman AFB Fire Department prior to the initiation of permit required activities. The Fire Department non-emergency phone number to call to obtain a hot work permit is **(575)-572-7228**.

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7.0 SOP NO. 7 - EQUIPMENT CALIBRATION

7.1 PURPOSE AND SCOPE

This SOP describes the procedures for equipment calibration and documentation. This SOP is intended to be used with the UFP-QAPP and with other SOPs listed below:

- SOP No. 2 – Subsurface Soil Sampling

7.2 EQUIPMENT AND MATERIALS LIST

The following section provides a list of equipment that may be needed to perform equipment calibration.

Horiba U-22 and Horiba U-52:

- Horiba U-22
- Horiba U-52
- Auto calibration solution pH 4
- Calibration cup
- Calibration log for Horibas

YSI 556

- YSI 556
- Calibration cup
- Calibration log for YSI
- DI water
- Conductivity solution (1.413 µS/cm)
- pH 4 solution
- pH 7 solution
- ORP solution (240 mV)
- PID, miniRAE
- Tedlar bag
- Isobutylene (100 ppm)
- Calibration log for PID

7.3 EQUIPMENT CALIBRATION PROCEDURES

The following provides the procedures for the calibration of the Horiba U-22 and U-52, YSI 556, and PID miniRAE.

Horiba U-22:

- Turn on Horiba.
- Place probe in auto calibration solution (pH 4.00).
- Press Cal button.
- Press Ent button, calibration begins.
- END appears when calibration is complete.
- Press MEAS button and collect pH reading.
- The acceptable pH range is 3.96 to 4.04.
- If any errors appear, refer to Horiba U-22 manual.

Horiba U-52:

- Turn on Horiba.
- Place probe in auto calibration solution (pH 4.00).
- Press Cal button.
- Press Ent button, calibration begins when the parameters on screen start to blink.
- When parameters stop blinking, calibration is complete.
- Collect pH reading.
- The acceptable pH range is 3.96 to 4.04.
- If any errors appear, refer to Horiba U-52 manual.

YSI 556:

- Turn on YSI 556.
- Press ESC which will lead to main menu.
- Scroll to Calibrate and press ENT.
- Scroll to DO, press enter, scroll to DO%
- Enter barometric pressure.
- Place probe in DI water (in calibration cup) and loosely tighten probe to calibration cup.
- Press enter, and then enter again.
- DO% is instantly calibrated.
- Acceptable range is 95% to 105%.
- Press ESC to return to calibration menu.
- Scroll to Conductivity, press enter, scroll to Conductivity in list and press enter
- Enter standard, 1.413 µs/cm.
- Fill calibration cup with conductivity solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- Conductivity is instantly calibrated.
- Acceptable range is 1.408 to 1.418 µs/cm.
- Press ESC to return to calibration menu.
- Scroll to pH, press enter, scroll to 2-point calibration and press enter

- Enter 1st standard, 4.00.
- Fill calibration cup with pH 4.00 solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- pH is instantly calibrated.
- Acceptable range is 3.95 to 4.05.
- Press enter.
- Enter 2nd standard, 7.00.
- Fill calibration cup with pH 7.00 solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- pH is instantly calibrated.
- Acceptable range is 6.95 to 7.05.
- Press ESC to return to calibration menu.
- Scroll to ORP, press enter
- Enter standard, 240 mV.
- Fill calibration cup with ORP solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- Conductivity is instantly calibrated.
- Acceptable range is 235 to 245 mV.
- If any errors appear, refer to YSI 556 manual.

PID miniRAE:

Zero Calibration

- Turn on PID to Zero Calibration menu.
- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.
- Zero calibration starts.
- When Zero calibration is complete, you see this message: Zeroing is done!, Reading = 0.000 ppm.

Span Calibration

- Turn on PID to Scan Calibration menu.
- The span gas is first be filled into a Tedlar bag.
- Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.
- Press [Y/+] to enter Span calibration.
- Turn on your span calibration gas.
- Press [Y/+] to initiate calibration.

- Span calibration starts and displays this message: Calibrating...
- When Span calibration is complete, you see this message: Span 1 is done!, Reading = 100.0 ppm.

Per the Mini RAE manual, there is no set range of what is allowed above or below 100 ppm. The Manual simply states that the "reading should be very close to the span gas value".

7.4 DOCUMENTATION:

Documentation for equipment calibration forms which are included in the DQCRs. The calibration forms include:

- Equipment model and number
- Date
- Calibration personnel
- Standard calibration values
- Scan gas concentration for PID calibration
- Standard calibration solution parameters for water quality

8.0 SOP NO. 8 - INVESTIGATION-DERIVED WASTE

8.1 PURPOSE AND SCOPE

This document defines the SOP for the handling and disposal of investigation-derived waste (IDW) at Holloman AFB. IDW will include soil cuttings, decontamination fluids, well purge water, and personal protective equipment (PPE). These procedures are intended to be used with the WP or WP addenda as well as the applicable SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Soil Sampling
- SOP No. 4 - Equipment and Personnel Decontamination
- SOP No. 7 – Equipment Calibration

8.2 EQUIPMENT LIST

The following equipment is required for handling IDW:

- Department of Transportation (DOT)-approved 55-gallon drums
- Photoionization Detector (PID) (10.2 eV lamp considered appropriate for most applications)
- Sampling equipment and sample containers [for Toxicity Characteristic Leaching Procedure (TCLP) sampling, if applicable]

8.3 FIELD PROCEDURES

8.3.1 IDW Handling

Soil cuttings from different borings at the same site will be combined in the same drum, but soil from different sites will be kept separate. If headspace results or visual or olfactory observations indicate potentially highly contaminated materials, cuttings from individual soil borings will be containerized separately from cuttings from other borings at the same site.

Fluids from heavy equipment and small tool equipment decontamination will be containerized for characterization. No fluids will be discharged directly into waterways or drainages leaving the site. All IDW determined to be characteristically hazardous will be disposed off-site using a licensed waste disposal firm.

PPE used during investigation activities (including nitrile gloves, paper towels, etc.) is expected to have minimal contamination, and will not be required to be containerized. All PPE will be treated as solid waste and will be placed in plastic trash bags and disposed of on site at a trash receptacle or dumpster identified by Holloman AFB personnel. Well materials from abandoned wells will be pulled from the ground, scraped clean, and disposed of as solid waste on Base.

Disposable sampling equipment, such as bailers, PE tubing, Terra Core soil samplers, etc., will also be discarded as solid waste.

8.3.2 Waste Storage

All IDW required to be containerized will be stored in 55-gallon drums. The drums will be marked with the following information:

- Installation identification (i.e., Holloman AFB)
- Site name and number
- Type of IDW (i.e., soil cuttings, purge water, decontamination fluids)
- Boring number(s) or sampling location number (s)
- Date(s) of accumulation
- Name and phone number of Holloman AFB contact (to be provided by Holloman AFB Restoration Project Manager at start of field activities)

All containerized IDW will be stored on site at a designated storage area identified by Holloman AFB personnel until the need for off-site disposal has been made, as described in the following subsection.

All water containerized as IDW will be stored in 55-gallon drums and will be transported to the central staging area for off-site disposal by a licensed waste disposal firm.

8.3.3 Determination of Disposal

All IDW that is determined to not be disposable on-Base will be properly disposed of at a licensed off-Base facility. The analytical results from the field sampling activities will be used to indicate the contamination levels of IDW from each site to determine an appropriate disposal facility. If analytical results indicate none or minimal contamination, IDW will disposed of off-site or at a location on base identified by the Holloman Restoration Project Manager.

If results indicate that IDW from a given site may be characteristically hazardous, a sample of containerized IDW will be collected and analyzed for the appropriate waste characteristic using the TCLP. Analytical test results will be compared to TCLP threshold criteria to determine if the material is characteristically hazardous. Characteristically hazardous IDW will be properly manifested and shipped to a licensed off-Base Subtitle C disposal facility. **A representative of Holloman AFB will sign all manifests for IDW shipped off site.**

Attachment 1 Field Forms

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SOIL / SEDIMENT SAMPLING FORM

Project: _____ Sampled by: _____

Site and Site Code (**SITEID**): _____

Sampling Location ID. (**LOCID**): _____

Date (**LOGDATE**): _____ Time: _____

FIELD OBSERVATIONS:

Sample Depth or Interval	Material Description/ Color

Comments/Observations:

_____

_____

_____

_____

Sample Time: _____ Sample ID: _____

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Equipment Calibration Log

Instrument Name: _____

Model Number: _____

Date	First Standard Concentration	First Standard Reading	Second Standard Concentration	Second Standard Reading	Comments

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WASTE INVENTORY TRACKING FORM

LOCATION : _____

PROJECT NAME:_____

ACTIVITIES: _____

Date Waste Generated	Activity Generating Waste (borehole # / well #)	Description of Waste	Field Evidence of Contamination	Estimated Volume	Type of Container (storage ID#)	Location of Container	Waste Characterization	Comments

Note: Describe whether soil or water samples have been collected for waste characterization, include date, if known.

Signature: _____

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Appendix B

Laboratory Certifications and Standard Operating Procedures

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LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 **Certificate Number L2229**

Accutest Laboratories Southeast, Inc.

4405 Vineland Road, Suite C-15
Orlando FL 32811

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: December 15, 2015

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 29th of January 2013

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

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LABORATORY ACCREDITATION BUREAU

Certificate # L2229

Scope of Accreditation For Accutest Laboratories Southeast, Inc.

4405 Vineland Road, Suite C-15
Orlando, FL 32811
Svetlana Izosimova, Ph.D., QA Officer
407-425-6700

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Accutest Laboratories Southeast, Inc. to perform the following tests:

Accreditation granted through: December 15, 2015

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8011	1,2-Dibromoethane (EDB)
GC	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC	EPA 8015C	Diesel range organics (DRO)
GC	EPA 8015C	Oil Range Organics (ORO)
GC	EPA 8015C	Gasoline range organics (GRO)
GC	EPA 8015C	Ethanol
GC	EPA 8015C	2-Ethoxyethanol
GC	EPA 8015C	Isobutyl alcohol (2-Methyl-1-propanol)
GC	EPA 8015C	Isopropyl alcohol (2-Propanol)
GC	EPA 8015C	Methanol
GC	EPA 8015C	n-Butyl alcohol
GC	EPA 8015C	n-Propanol
GC	EPA 8015D	Diesel range organics (DRO)
GC	EPA 8015D	Oil Range Organics (ORO)
GC	EPA 8015D	Gasoline range organics (GRO)
GC	EPA 8015D	Ethanol
GC	EPA 8015D	2-Ethoxyethanol
GC	EPA 8015D	Isobutyl alcohol (2-Methyl-1-propanol)
GC	EPA 8015D	Isopropyl alcohol (2-Propanol)
GC	EPA 8015D	Methanol
GC	EPA 8015D	n-Butyl alcohol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8015D	n-Propanol
GC	EPA 8021B	Benzene
GC	EPA 8021B	Ethylbenzene
GC	EPA 8021B	Chlorobenzene
GC	EPA 8021B	Toluene
GC	EPA 8021B	1,2-Dichlorobenzene
GC	EPA 8021B	1,3-Dichlorobenzene
GC	EPA 8021B	1,4-Dichlorobenzene
GC	EPA 8021B	m-Xylene
GC	EPA 8021B	p-Xylene
GC	EPA 8021B	o-Xylene
GC	EPA 8021B	Methyl-tert-Butyl Ether
GC	EPA 8081B	4 4`-DDD
GC	EPA 8081B	4 4`-DDE
GC	EPA 8081B	4 4`-DDT
GC	EPA 8081B	Aldrin
GC	EPA 8081B	Chlordane (tech.)
GC	EPA 8081B	Dieldrin
GC	EPA 8081B	Endosulfan I
GC	EPA 8081B	Endosulfan II
GC	EPA 8081B	Endosulfan sulfate
GC	EPA 8081B	Endrin
GC	EPA 8081B	Endrin aldehyde
GC	EPA 8081B	Endrin ketone
GC	EPA 8081B	Heptachlor
GC	EPA 8081B	Heptachlor epoxide
GC	EPA 8081B	Methoxychlor
GC	EPA 8081B	Toxaphene (Chlorinated camphene)
GC	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC	EPA 8081B	alpha-Chlordane
GC	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC	EPA 8081B	delta-BHC
GC	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC	EPA 8081B	gamma-Chlordane
GC	EPA 8082A	Aroclor-1016 (PCB-1016)
GC	EPA 8082A	Aroclor-1221 (PCB-1221)
GC	EPA 8082A	Aroclor-1232 (PCB-1232)
GC	EPA 8082A	Aroclor-1242 (PCB-1242)
GC	EPA 8082A	Aroclor-1248 (PCB-1248)
GC	EPA 8082A	Aroclor-1254 (PCB-1254)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8082A	Aroclor-1260 (PCB-1260)
GC	EPA 8082A	Aroclor-1262 (PCB-1262)
GC	EPA 8082A	Aroclor-1268 (PCB-1268)
GC	EPA 8082A	2,4'-diCB bz8
GC	EPA 8082A	2,2',5-trCB bz18
GC	EPA 8082A	2,4,4'-trCB bz28
GC	EPA 8082A	2,2',3,5'-teCB bz44
GC	EPA 8082A	2,2',4,5'-teCB bz49
GC	EPA 8082A	2,2',5,5'-teCB bz52
GC	EPA 8082A	2,3'4,4'-teCB bz66
GC	EPA 8082A	3,3',4,4'-teCB bz77
GC	EPA 8082A	3,4,4',5-teCB bz81
GC	EPA 8082A	2,2',3,4,5'-peCB bz87
GC	EPA 8082A	2,2',3,4',5-peCB bz90
GC	EPA 8082A	2,2',4,5,5'-peCB bz101
GC	EPA 8082A	2,3,3',4,4'-peCB bz105
GC	EPA 8082A	2,3',4,4',5-peCB bz118
GC	EPA 8082A	2',3,4,4',5-peCB bz123
GC	EPA 8082A	3,3',4,4',5-peCB bz126
GC	EPA 8082A	2,2',3,3',4,4'-hxCB bz128
GC	EPA 8082A	2,2',3,4,4',5'-hxCB bz138
GC	EPA 8082A	2,2',3,5,5',6-hxCB bz151
GC	EPA 8082A	2,2',4,4',5,5'-hxCB bz153
GC	EPA 8082A	2,3,3',4,4',5-hxCB bz156
GC	EPA 8082A	2,3,3',4,4',5'-hxCB bz157
GC	EPA 8082A	2,3',4,4',5,5'-hxCB bz167
GC	EPA 8082A	3,3',4,4',5,5'-hxCB bz169
GC	EPA 8082A	2,2',3,3',4,4',5-hpCB bz170
GC	EPA 8082A	2,2',3,4,4',5,5'-hpCB bz180
GC	EPA 8082A	2,2',3,4,4',5',6-hpCB bz183
GC	EPA 8082A	2,2',3,4,4',6,6'-hpCB bz184
GC	EPA 8082A	2,2',3,4',5,5',6-hpCB bz187
GC	EPA 8082A	2,3,3',4,4',5,5'-hpCB bz189
GC	EPA 8082A	2,2',3,3',4,4',5,6-ocCB bz195
GC	EPA 8082A	2,2',3,3',4,4',5,5',6-noCB bz206
GC	EPA 8082A	Decachlorobiphenyl bz209
GC	EPA 8091	2 4-Dinitrotoluene (2 4-DNT)
GC	EPA 8091	2 6-Dinitrotoluene (2 6-DNT)
GC	EPA 8141B	Azinphos-methyl (Guthion)
GC	EPA 8141B	Bolstar (Sulprofos)
GC	EPA 8141B	Carbophenothion

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8141B	Chlorpyrifos
GC	EPA 8141B	Coumaphos
GC	EPA 8141B	Demeton-o
GC	EPA 8141B	Demeton-s
GC	EPA 8141B	Diazinon
GC	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC	EPA 8141B	Dimethoate
GC	EPA 8141B	Disulfoton
GC	EPA 8141B	EPN
GC	EPA 8141B	Ethion
GC	EPA 8141B	Ethoprop
GC	EPA 8141B	Famphur
GC	EPA 8141B	Fensulfothion
GC	EPA 8141B	Fenthion
GC	EPA 8141B	Malathion
GC	EPA 8141B	Merphos
GC	EPA 8141B	Methyl parathion (Parathion methyl)
GC	EPA 8141B	Mevinphos
GC	EPA 8141B	Monocrotophos
GC	EPA 8141B	Naled
GC	EPA 8141B	Parathion ethyl
GC	EPA 8141B	Phorate
GC	EPA 8141B	Ronnel
GC	EPA 8141B	Stirofos
GC	EPA 8141B	Sulfotepp
GC	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC	EPA 8141B	Thionazin (Zinophos)
GC	EPA 8141B	Tokuthion (Prothiophos)
GC	EPA 8141B	Trichloronate
GC	EPA 8141B	o o o-Triethyl phosphorothioate
GC	EPA 8151A	2 4 5-T
GC	EPA 8151A	2 4-D
GC	EPA 8151A	2 4-DB
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	Dichloroprop (Dichlorprop)
GC	EPA 8151A	Dinoseb (2-sec-butyl-4 6-dinitrophenol DNBP)
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Silvex (2 4 5-TP)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	RSK-175	Acetylene
GC	RSK-175	Methane
GC	RSK-175	Ethane
GC	RSK-175	Ethene
GC	RSK-175	Propane
GC	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC	MA-EPH	Diesel range organics (DRO)
GC	MA-VPH	Gasoline range organics (GRO)
GC	OA-1	Gasoline range organics (GRO)
GC	OA-2	Diesel range organics (DRO)
GC	TN-EPH	Diesel range organics (DRO)
GC	TN-GRO	Gasoline range organics (GRO)
GC	WI-DRO	Diesel range organics (DRO)
GC	AK-101	Gasoline range organics (GRO)
GC	AK-102	Diesel range organics (DRO)
GC	OK-GRO	Gasoline range organics (GRO)
GC	OK-DRO	Diesel range organics (DRO)
GC	TX 1005	Petroleum range organics
GC	TX 1005	Extractable petroleum hydrocarbans
GC/MS	EPA 8260B	1 1 1 2-Tetrachloroethane
GC/MS	EPA 8260B	1 1 1-Trichloroethane
GC/MS	EPA 8260B	1 1 2 2-Tetrachloroethane
GC/MS	EPA 8260B	1 1 2-Trichloroethane
GC/MS	EPA 8260B	1 1-Dichloroethane
GC/MS	EPA 8260B	1 1-Dichloroethylene
GC/MS	EPA 8260B	1 1-Dichloropropene
GC/MS	EPA 8260B	1 2 3-Trichlorobenzene
GC/MS	EPA 8260B	1 2 3-Trichloropropane
GC/MS	EPA 8260B	1 2 4-Trichlorobenzene
GC/MS	EPA 8260B	1 2 4-Trimethylbenzene
GC/MS	EPA 8260B	1 2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1 2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B	1 2-Dichlorobenzene
GC/MS	EPA 8260B	1 2-Dichloroethane
GC/MS	EPA 8260B	1 2-Dichloropropane
GC/MS	EPA 8260B	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B	1 3 5-Trimethylbenzene
GC/MS	EPA 8260B	1 3-Dichlorobenzene
GC/MS	EPA 8260B	1 3-Dichloropropane
GC/MS	EPA 8260B	1 4-Dichlorobenzene
GC/MS	EPA 8260B	1-Chlorohexane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	2 2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone
GC/MS	EPA 8260B	2-Nitropropane
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein (Propenal)
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Benzyl Chloride
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Carbon disulfide
GC/MS	EPA 8260B	Carbon tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Cyclohexanone
GC/MS	EPA 8260B	Di-isopropylether (DIPE)
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane
GC/MS	EPA 8260B	Diethyl ether
GC/MS	EPA 8260B	Ethanol
GC/MS	EPA 8260B	Ethyl acetate
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Ethylene Oxide
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane (Methyl iodide)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B	Isopropylbenzene
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B	Methylene chloride
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	Pentachloroethane
GC/MS	EPA 8260B	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	T-amylmethylether (TAME)
GC/MS	EPA 8260B	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B	Trichlorofluoromethane
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl chloride
GC/MS	EPA 8260B	Xylene (total)
GC/MS	EPA 8260B	m,p-Xylene
GC/MS	EPA 8260B	o-Xylene
GC/MS	EPA 8260B	cis-1 2-Dichloroethylene
GC/MS	EPA 8260B	cis-1 3-Dichloropropene
GC/MS	EPA 8260B	cis-1 4-Dichloro-2-butene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Dioxane
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	tert-Butyl alcohol
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	trans-1 2-Dichloroethylene
GC/MS	EPA 8260B	trans-1 3-Dichloropropylene
GC/MS	EPA 8260B	trans-1 4-Dichloro-2-butene
GC/MS	EPA 8260B	Ethyl tert-butyl alcohol
GC/MS	EPA 8260B	Isopropyl ether
GC/MS	EPA 8260B	tert-Amyl alcohol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	tert-Butyl formate
GC/MS	EPA 8260B	1 1 2-Trichloro-1 2 2-trifluoroethane
GC/MS	EPA 8260C	1 1 1 2-Tetrachloroethane
GC/MS	EPA 8260C	1 1 1-Trichloroethane
GC/MS	EPA 8260C	1 1 2 2-Tetrachloroethane
GC/MS	EPA 8260C	1 1 2-Trichloroethane
GC/MS	EPA 8260C	1 1-Dichloroethane
GC/MS	EPA 8260C	1 1-Dichloroethylene
GC/MS	EPA 8260C	1 1-Dichloropropene
GC/MS	EPA 8260C	1 2 3-Trichlorobenzene
GC/MS	EPA 8260C	1 2 3-Trichloropropane
GC/MS	EPA 8260C	1 2 4-Trichlorobenzene
GC/MS	EPA 8260C	1 2 4-Trimethylbenzene
GC/MS	EPA 8260C	1 2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260C	1 2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260C	1 2-Dichlorobenzene
GC/MS	EPA 8260C	1 2-Dichloroethane
GC/MS	EPA 8260C	1 2-Dichloropropane
GC/MS	EPA 8260C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260C	1 3 5-Trimethylbenzene
GC/MS	EPA 8260C	1 3-Dichlorobenzene
GC/MS	EPA 8260C	1 3-Dichloropropane
GC/MS	EPA 8260C	1 4-Dichlorobenzene
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 8260C	2 2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein (Propenal)
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl Chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloroprene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	Di-isopropylether (DIPE)
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethanol
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl Acetate
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Hexane
GC/MS	EPA 8260C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl Acetate
GC/MS	EPA 8260C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	T-amylmethylether (TAME)
GC/MS	EPA 8260C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260C	Tetrahydrofuran

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	Xylene (total)
GC/MS	EPA 8260C	m,p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	cis-1 2-Dichloroethylene
GC/MS	EPA 8260C	cis-1 3-Dichloropropene
GC/MS	EPA 8260C	cis-1 4-Dichloro-2-butene
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	p-Dioxane
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	trans-1 2-Dichloroethylene
GC/MS	EPA 8260C	trans-1 3-Dichloropropylene
GC/MS	EPA 8260C	trans-1 4-Dichloro-2-butene
GC/MS	EPA 8260C	Ethyl tert-butyl alcohol
GC/MS	EPA 8260C	Isopropyl ether
GC/MS	EPA 8260C	tert-Amyl alcohol
GC/MS	EPA 8260C	tert-Butyl formate
GC/MS	EPA 8260C	1 1 2-Trichloro-1 2 2-trifluoroethane
GC/MS	EPA 8270D	1 2 4 5-Tetrachlorobenzene
GC/MS	EPA 8270D	1 2 4-Trichlorobenzene
GC/MS	EPA 8270D	1 2-Dichlorobenzene
GC/MS	EPA 8270D	1 2-Diphenylhydrazine
GC/MS	EPA 8270D	1 3 5-Trinitrobenzene (1 3 5-TNB)
GC/MS	EPA 8270D	1 3-Dichlorobenzene
GC/MS	EPA 8270D	1 3-Dinitrobenzene (1 3-DNB)
GC/MS	EPA 8270D	1 4-Dichlorobenzene
GC/MS	EPA 8270D	1 4-Dithiane
GC/MS	EPA 8270D	1 4-Oxathiane
GC/MS	EPA 8270D	1 4-Naphthoquinone
GC/MS	EPA 8270D	1 4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D	1-Methylnaphthalene (added to method at FDEP request)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2 3 4 6-Tetrachlorophenol
GC/MS	EPA 8270D	2 4 5-Trichlorophenol
GC/MS	EPA 8270D	2 4 6-Trichlorophenol
GC/MS	EPA 8270D	2 4-Dichlorophenol
GC/MS	EPA 8270D	2 4-Dimethylphenol
GC/MS	EPA 8270D	2 4-Dinitrophenol
GC/MS	EPA 8270D	2 4-Dinitrotoluene (2 4-DNT)
GC/MS	EPA 8270D	2 6-Dichlorophenol
GC/MS	EPA 8270D	2 6-Dinitrotoluene (2 6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4 6-dinitrophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3 3`-Dichlorobenzidine
GC/MS	EPA 8270D	3 3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3-Methylphenol (m-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4 4’-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7 12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g h i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	Dibenz(a h)anthracene
GC/MS	EPA 8270D	Dibenz(a j)acridine
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1 2 3-cd)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloronitrobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	a-a-Dimethylphenethylamine
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2 2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	o o o-Triethyl phosphorothioate
GC/MS	EPA 8270D	1 4-Dioxane (1 4-Diethyleneoxide)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Biphenyl
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Simazine
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g h i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenz(a h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1 2 3-cd)pyrene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 610	1-Methylnaphthalene
HPLC	EPA 610	2-Methylnaphthalene
HPLC	EPA 610	Acenaphthene
HPLC	EPA 610	Acenaphthylene
HPLC	EPA 610	Anthracene
HPLC	EPA 610	Benzo(a)anthracene
HPLC	EPA 610	Benzo(a)pyrene
HPLC	EPA 610	Benzo(b)fluoranthene
HPLC	EPA 610	Benzo(g h i)perylene
HPLC	EPA 610	Benzo(k)fluoranthene
HPLC	EPA 610	Chrysene
HPLC	EPA 610	Dibenz(a h)anthracene
HPLC	EPA 610	Fluoranthene
HPLC	EPA 610	Fluorene
HPLC	EPA 610	Indeno(1 2 3-cd)pyrene
HPLC	EPA 610	Naphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 610	Phenanthrene
HPLC	EPA 610	Pyrene
HPLC	EPA 8330A	1 3 5-Trinitrobenzene (1 3 5-TNB)
HPLC	EPA 8330A	1 3-Dinitrobenzene (1 3-DNB)
HPLC	EPA 8330A	2 2’, 6 6’-Tetranitro-4 4’-azoxytoluene
HPLC	EPA 8330A	2 4 6-Trinitrotoluene (2 4 6-TNT)
HPLC	EPA 8330A	2 4-Dinitrotoluene (2 4-DNT)
HPLC	EPA 8330A	2 6-Dinitrotoluene (2 6-DNT)
HPLC	EPA 8330A	2-Amino-4 6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	3 5-Dinitroaniline
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	4-Amino-2 6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	Nitroglycerin
HPLC	EPA 8330A	Octahydro-1 3 5 7-tetranitro-1 3 5 7-tetrazocine (HMX)
HPLC	EPA 8330A	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	RDX (hexahydro-1 3 5-trinitro-1 3 5-triazine)
HPLC	EPA 8330A	Tetryl (methyl-2 4 6-trinitrophenylnitramine)
HPLC	EPA 8330A	2-amino-6-Nitrotoluene
HPLC	EPA 8330A	4-amino-2-Nitrotoluene
HPLC	EPA 8330A	2-amino-4-Nitrotoluene
HPLC	EPA 8330A	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A	DNX
HPLC	EPA 8330A	MNX
HPLC	EPA 8330A	TNX
HPLC	EPA 8330B	1 3 5-Trinitrobenzene (1 3 5-TNB)
HPLC	EPA 8330B	1 3-Dinitrobenzene (1 3-DNB)
HPLC	EPA 8330B	2 4 6-Trinitrotoluene (2 4 6-TNT)
HPLC	EPA 8330B	2 4-Dinitrotoluene (2 4-DNT)
HPLC	EPA 8330B	2 6-Dinitrotoluene (2 6-DNT)
HPLC	EPA 8330B	2-Amino-4 6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3 5-Dinitroaniline
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Amino-2 6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330B	Octahydro-1 3 5 7-tetranitro-1 3 5 7-tetrazocine (HMX)
HPLC	EPA 8330B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330B	RDX (hexahydro-1 3 5-trinitro-1 3 5-triazine)
HPLC	EPA 8330B	Tetryl (methyl-2 4 6-trinitrophenylnitramine)
HPLC	EPA 8330B	2-amino-6-Nitrotoluene
HPLC	EPA 8330B	4-amino-2-Nitrotoluene
HPLC	EPA 8330B	2-amino-4-Nitrotoluene
HPLC	EPA 8330B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8332	PETN
HPLC	EPA 8332	Nitroglycerin
LC/MS/MS	EPA 6850	Perchlorate
ICP	EPA 6010C	Aluminum
ICP	EPA 6010C	Antimony
ICP	EPA 6010C	Arsenic
ICP	EPA 6010C	Barium
ICP	EPA 6010C	Beryllium
ICP	EPA 6010C	Cadmium
ICP	EPA 6010C	Calcium
ICP	EPA 6010C	Chromium
ICP	EPA 6010C	Cobalt
ICP	EPA 6010C	Copper
ICP	EPA 6010C	Iron
ICP	EPA 6010C	Lead
ICP	EPA 6010C	Magnesium
ICP	EPA 6010C	Manganese
ICP	EPA 6010C	Molybdenum
ICP	EPA 6010C	Nickel
ICP	EPA 6010C	Potassium
ICP	EPA 6010C	Selenium
ICP	EPA 6010C	Silver
ICP	EPA 6010C	Sodium
ICP	EPA 6010C	Strontium
ICP	EPA 6010C	Thallium
ICP	EPA 6010C	Tin
ICP	EPA 6010C	Titanium
ICP	EPA 6010C	Vanadium
ICP	EPA 6010C	Zinc

Non-Potable Water		
Technology	**Method**	**Analyte**
CVAA	EPA 7470A	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium
UV/VIS	EPA 9012B	Cyanide, automated colorimetry with off-line distillation
IC	EPA 300	Bromide
IC	EPA 300	Chloride
IC	EPA 300	Fluoride
IC	EPA 300	Nitrate
IC	EPA 300	Nitrite
IC	EPA 300	Sulfate
IC	EPA 300	Total nitrate-nitrite
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Automated Colorimetry	EPA 353.2	Nitrate
Automated Colorimetry	EPA 353.2	Nitrite
Automated Colorimetry	EPA 353.2	Nitrate+Nitrite
Manual Colorimetry	EPA 365.3	Orthophosphate
Titrimetric	SM 2320B, 19th ed	Alkalinity, Total
Titrimetric	SM 4500 S^2-F, 20th ed.	Sulfide, Iodometric
Manual Colorimetry	SM 4500 NO2-B, 19th ed.	Nitrite as N,
Manual Colorimetry	SM 4500 NO3-E, 19th ed.	Nitrate as N,
Manual Colorimetry	SM 4500 NO3-E, 19th ed.	Nitrite+Nitrate,
Calculation	SM 4500 NO3-E, SM 4500 NO2-B, 19th ed.	Nitrate, calculation
Gravimetric Methods	EPA 1664A	Oil and Grease
Gravimetric Methods	EPA 9070A	Oil and Grease
Gravimetric Methods	SM2540B	Total Residue (Total Solids)
Gravimetric Methods	SM2540C	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM2540D	Non-Filterable Residue (Total Suspended Solids)
Electrometric Methods	SM4500H+B	Hydrogen Ion (pH)
Electrometric Methods	EPA 9040C	Hydrogen Ion (pH)
Combustion	EPA 9060A	Total Organic Carbon
Waste Characterization	SW-846 Chapter 7	Reactive Cyanide and Reactive Sulfide

Non-Potable Water		
Technology	**Method**	**Analyte**
Ignitability	EPA 1110A	Flash Point
Waste Characterization	SW-846 Chapter 7	Reactive Cyanide
Waste Characterization	SW-846 Chapter 7	Reactive Sulfide
Preparation	**Method**	**Type**
EPA 8011	EPA 8011	Microextraction
EPA 5030B	EPA 8015D/C	GRO, OA-1, TN-VPH, MA-VPH, Purge and Trap, aqueous
MA-EPH	MA-EPH	Diesel Range Organic, Liquid-liquid extraction and fractionation
EPA 3510C	EPA 8015D/C	DRO/ORO, FL-PRO, OA-2, TN-EPH, WI-DRO Liquid-Liquid Extraction
EPA 3510C	EPA 8015D/C	Non-Halogenated Organics (Alcohols), direct inject
EPA 5030B	EPA 8021B	Aromatic VOC, Purge and Trap, aqueous
EPA 3510C	EPA 8081B	Chlorinated Pesticides, Liquid-Liquid Extraction
EPA 3510C	EPA 8082A	PCBs and Congeners, Liquid-Liquid Extraction
EPA 3510C	EPA 8091	Nitroaromatics, Liquid-Liquid Extraction
EPA 3510C	EPA 8141B	Organophosphorus Pesticides, Liquid-Liquid Extraction
EPA 3535A	EPA 8141B	Organophosphorus Pesticides, Solid Phase Extraction
EPA 8151A	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
EPA 5030B	EPA 8260B/C	VOC by GC/MS, Purge and Trap, aqueous
EPA 3510C	EPA 8270D	BNA Extractables by GC/MS, Liquid-Liquid Extraction
EPA 3510C	EPA 8310	PAH, Liquid-Liquid Extraction
EPA 610	EPA 610	PAH, Liquid-Liquid Extraction
EPA 3535A	EPA 8330A/B	Explosives, Solid Phase Extraction
EPA 3535A	EPA 8332	Explosives, Solid Phase Extraction
Lachat MicroDistillation	EPA 9012B	Cyanide, Lachat MicroDistillation proprietary method, aqueous
EPA 3010A	EPA 6010C	Metals by ICP, Acid Digestion, aqueous
EPA 7470A	EPA 7470A	Hg by CVAA, digestion, aqueous

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8011	1,2-Dibromoethane (EDB)
GC	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC	EPA 8015C	Diesel range organics (DRO)
GC	EPA 8015C	Oil Range Organics (ORO)
GC	EPA 8015C	Gasoline range organics (GRO)
GC	EPA 8015C	Ethanol
GC	EPA 8015C	2-Ethoxyethanol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8015C	Isobutyl alcohol (2-Methyl-1-propanol)
GC	EPA 8015C	Isopropyl alcohol (2-Propanol)
GC	EPA 8015C	Methanol
GC	EPA 8015C	n-Butyl alcohol
GC	EPA 8015C	n-Propanol
GC	EPA 8015D	Diesel range organics (DRO)
GC	EPA 8015D	Oil Range Organics (ORO)
GC	EPA 8015D	Gasoline range organics (GRO)
GC	EPA 8015D	Ethanol
GC	EPA 8015D	2-Ethoxyethanol
GC	EPA 8015D	Isobutyl alcohol (2-Methyl-1-propanol)
GC	EPA 8015D	Isopropyl alcohol (2-Propanol)
GC	EPA 8015D	Methanol
GC	EPA 8015D	n-Butyl alcohol
GC	EPA 8015D	n-Propanol
GC	EPA 8081B	4 4`-DDD
GC	EPA 8081B	4 4`-DDE
GC	EPA 8081B	4 4`-DDT
GC	EPA 8081B	Aldrin
GC	EPA 8081B	Chlordane (tech.)
GC	EPA 8081B	Dieldrin
GC	EPA 8081B	Endosulfan I
GC	EPA 8081B	Endosulfan II
GC	EPA 8081B	Endosulfan sulfate
GC	EPA 8081B	Endrin
GC	EPA 8081B	Endrin aldehyde
GC	EPA 8081B	Endrin ketone
GC	EPA 8081B	Heptachlor
GC	EPA 8081B	Heptachlor epoxide
GC	EPA 8081B	Methoxychlor
GC	EPA 8081B	Toxaphene (Chlorinated camphene)
GC	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC	EPA 8081B	alpha-Chlordane
GC	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC	EPA 8081B	delta-BHC
GC	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC	EPA 8081B	gamma-Chlordane
GC	EPA 8082A	Aroclor-1016 (PCB-1016)
GC	EPA 8082A	Aroclor-1221 (PCB-1221)
GC	EPA 8082A	Aroclor-1232 (PCB-1232)
GC	EPA 8082A	Aroclor-1242 (PCB-1242)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8082A	Aroclor-1248 (PCB-1248)
GC	EPA 8082A	Aroclor-1254 (PCB-1254)
GC	EPA 8082A	Aroclor-1260 (PCB-1260)
GC	EPA 8082A	Aroclor-1262 (PCB-1262)
GC	EPA 8082A	Aroclor-1268 (PCB-1268)
GC	EPA 8082A	2,4'-diCB bz8
GC	EPA 8082A	2,2',5-trCB bz18
GC	EPA 8082A	2,4,4'-trCB bz28
GC	EPA 8082A	2,2',3,5'-teCB bz44
GC	EPA 8082A	2,2',4,5'-teCB bz49
GC	EPA 8082A	2,2',5,5'-teCB bz52
GC	EPA 8082A	2,3'4,4'-teCB bz66
GC	EPA 8082A	3,3',4,4'-teCB bz77
GC	EPA 8082A	3,4,4',5-teCB bz81
GC	EPA 8082A	2,2',3,4,5'-peCB bz87
GC	EPA 8082A	2,2',3,4',5-peCB bz90
GC	EPA 8082A	2,2',4,5,5'-peCB bz101
GC	EPA 8082A	2,3,3',4,4'-peCB bz105
GC	EPA 8082A	2,3',4,4',5-peCB bz118
GC	EPA 8082A	2',3,4,4',5-peCB bz123
GC	EPA 8082A	3,3',4,4',5-peCB bz126
GC	EPA 8082A	2,2',3,3',4,4'-hxCB bz128
GC	EPA 8082A	2,2',3,4,4',5'-hxCB bz138
GC	EPA 8082A	2,2',3,5,5',6-hxCB bz151
GC	EPA 8082A	2,2',4,4',5,5'-hxCB bz153
GC	EPA 8082A	2,3,3',4,4',5-hxCB bz156
GC	EPA 8082A	2,3,3',4,4',5'-hxCB bz157
GC	EPA 8082A	2,3',4,4',5,5'-hxCB bz167
GC	EPA 8082A	3,3',4,4',5,5'-hxCB bz169
GC	EPA 8082A	2,2',3,3',4,4',5-hpCB bz170
GC	EPA 8082A	2,2',3,4,4',5,5'-hpCB bz180
GC	EPA 8082A	2,2',3,4,4',5',6-hpCB bz183
GC	EPA 8082A	2,2',3,4,4',6,6'-hpCB bz184
GC	EPA 8082A	2,2',3,4',5,5',6-hpCB bz187
GC	EPA 8082A	2,3,3',4,4',5,5'-hpCB bz189
GC	EPA 8082A	2,2',3,3',4,4',5,6-ocCB bz195
GC	EPA 8082A	2,2',3,3',4,4',5,5',6-noCB bz206
GC	EPA 8082A	Decachlorobiphenyl bz209
GC	EPA 8141B	Azinphos-methyl (Guthion)
GC	EPA 8141B	Bolstar (Sulprofos)
GC	EPA 8141B	Carbophenothion

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8141B	Chlorpyrifos
GC	EPA 8141B	Coumaphos
GC	EPA 8141B	Demeton-o
GC	EPA 8141B	Demeton-s
GC	EPA 8141B	Diazinon
GC	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC	EPA 8141B	Dimethoate
GC	EPA 8141B	Disulfoton
GC	EPA 8141B	EPN
GC	EPA 8141B	Ethion
GC	EPA 8141B	Ethoprop
GC	EPA 8141B	Famphur
GC	EPA 8141B	Fensulfothion
GC	EPA 8141B	Fenthion
GC	EPA 8141B	Malathion
GC	EPA 8141B	Merphos
GC	EPA 8141B	Methyl parathion (Parathion methyl)
GC	EPA 8141B	Mevinphos
GC	EPA 8141B	Monocrotophos
GC	EPA 8141B	Naled
GC	EPA 8141B	Parathion ethyl
GC	EPA 8141B	Phorate
GC	EPA 8141B	Ronnel
GC	EPA 8141B	Stirofos
GC	EPA 8141B	Sulfotepp
GC	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC	EPA 8141B	Thionazin (Zinophos)
GC	EPA 8141B	Tokuthion (Prothiophos)
GC	EPA 8141B	Trichloronate
GC	EPA 8141B	o o o-Triethyl phosphorothioate
GC	EPA 8151A	2 4 5-T
GC	EPA 8151A	2 4-D
GC	EPA 8151A	2 4-DB
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	Dichloroprop (Dichlorprop)
GC	EPA 8151A	Dinoseb (2-sec-butyl-4 6-dinitrophenol DNBP)
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Silvex (2 4 5-TP)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC	MA-EPH	Diesel range organics (DRO)
GC	MA-VPH	Gasoline range organics (GRO)
GC	OA-1	Gasoline range organics (GRO)
GC	OA-2	Diesel range organics (DRO)
GC	TN-EPH	Diesel range organics (DRO)
GC	TN-GRO	Gasoline range organics (GRO)
GC	AK-101	Gasoline range organics (GRO)
GC	AK-102	Diesel range organics (DRO)
GC	AK-103	Residual Oil range organics (RPO)
GC	OK GRO	Gasoline range organics (GRO)
GC	OK DRO	Diesel range organics (DRO)
GC	TX 1005	Petroleum range organics
GC	TX 1005	Extractable petroleum hydrocarbons
GC/MS	EPA 8260B	1 1 1 2-Tetrachloroethane
GC/MS	EPA 8260B	1 1 1-Trichloroethane
GC/MS	EPA 8260B	1 1 2 2-Tetrachloroethane
GC/MS	EPA 8260B	1 1 2-Trichloroethane
GC/MS	EPA 8260B	1 1-Dichloroethane
GC/MS	EPA 8260B	1 1-Dichloroethylene
GC/MS	EPA 8260B	1 1-Dichloropropene
GC/MS	EPA 8260B	1 2 3-Trichlorobenzene
GC/MS	EPA 8260B	1 2 3-Trichloropropane
GC/MS	EPA 8260B	1 2 4-Trichlorobenzene
GC/MS	EPA 8260B	1 2 4-Trimethylbenzene
GC/MS	EPA 8260B	1 2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1 2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B	1 2-Dichlorobenzene
GC/MS	EPA 8260B	1 2-Dichloroethane
GC/MS	EPA 8260B	1 2-Dichloropropane
GC/MS	EPA 8260B	1 2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B	1 3 5-Trimethylbenzene
GC/MS	EPA 8260B	1 3-Dichlorobenzene
GC/MS	EPA 8260B	1 3-Dichloropropane
GC/MS	EPA 8260B	1 4-Dichlorobenzene
GC/MS	EPA 8260B	1-Chlorohexane
GC/MS	EPA 8260B	2 2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	2-Nitropropane
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein (Propenal)
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Benzyl chloride
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Carbon disulfide
GC/MS	EPA 8260B	Carbon tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Cyclohexanone
GC/MS	EPA 8260B	Di-isopropylether (DIPE)
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane
GC/MS	EPA 8260B	Diethyl ether
GC/MS	EPA 8260B	Ethanol
GC/MS	EPA 8260B	Ethyl acetate
GC/MS	EPA 8260B	Ethylene oxide
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B	Isopropylbenzene
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl bromide (Bromomethane)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B	Methylene chloride
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	Pentachloroethane
GC/MS	EPA 8260B	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	T-amylmethylether (TAME)
GC/MS	EPA 8260B	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B	Trichlorofluoromethane
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl chloride
GC/MS	EPA 8260B	Xylene (total)
GC/MS	EPA 8260B	m,p-Xylene
GC/MS	EPA 8260B	o-Xylene
GC/MS	EPA 8260B	cis-1 2-Dichloroethylene
GC/MS	EPA 8260B	cis-1 3-Dichloropropene
GC/MS	EPA 8260B	cis-1 4-Dichloro-2-butene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Dioxane
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	tert-Butyl alcohol
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	trans-1 2-Dichloroethylene
GC/MS	EPA 8260B	trans-1 3-Dichloropropylene
GC/MS	EPA 8260B	trans-1 4-Dichloro-2-butene
GC/MS	EPA 8260B	Ethyl tert-butyl alcohol
GC/MS	EPA 8260B	Isopropyl ether
GC/MS	EPA 8260B	tert-Amyl alcohol
GC/MS	EPA 8260B	tert-Butyl formate
GC/MS	EPA 8260B	1 1 2-Trichloro-1 2 2-trifluoroethane
GC/MS	EPA 8260C	1 1 1 2-Tetrachloroethane
GC/MS	EPA 8260C	1 1 1-Trichloroethane
GC/MS	EPA 8260C	1 1 2 2-Tetrachloroethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1 1 2-Trichloroethane
GC/MS	EPA 8260C	1 1-Dichloroethane
GC/MS	EPA 8260C	1 1-Dichloroethylene
GC/MS	EPA 8260C	1 1-Dichloropropene
GC/MS	EPA 8260C	1 2 3-Trichlorobenzene
GC/MS	EPA 8260C	1 2 3-Trichloropropane
GC/MS	EPA 8260C	1 2 4-Trichlorobenzene
GC/MS	EPA 8260C	1 2 4-Trimethylbenzene
GC/MS	EPA 8260C	1 2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260C	1 2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260C	1 2-Dichlorobenzene
GC/MS	EPA 8260C	1 2-Dichloroethane
GC/MS	EPA 8260C	1 2-Dichloropropane
GC/MS	EPA 8260C	1 2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260C	1 3 5-Trimethylbenzene
GC/MS	EPA 8260C	1 3-Dichlorobenzene
GC/MS	EPA 8260C	1 3-Dichloropropane
GC/MS	EPA 8260C	1 4-Dichlorobenzene
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 8260C	2 2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein (Propenal)
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloroprene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	Di-isopropylether (DIPE)
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethanol
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylene oxide
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Hexane
GC/MS	EPA 8260C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl Acetate
GC/MS	EPA 8260C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	T-amylmethylether (TAME)
GC/MS	EPA 8260C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Xylene (total)
GC/MS	EPA 8260C	m,p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	cis-1 2-Dichloroethylene
GC/MS	EPA 8260C	cis-1 3-Dichloropropene
GC/MS	EPA 8260C	cis-1 4-Dichloro-2-butene
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	p-Dioxane
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	trans-1 2-Dichloroethylene
GC/MS	EPA 8260C	trans-1 3-Dichloropropylene
GC/MS	EPA 8260C	trans-1 4-Dichloro-2-butene
GC/MS	EPA 8260C	Ethyl tert-butyl alcohol
GC/MS	EPA 8260C	tert-Amyl alcohol
GC/MS	EPA 8260C	tert-Butyl formate
GC/MS	EPA 8260C	1 1 2-Trichloro-1 2 2-trifluoroethane
GC/MS	EPA 8270D	1 2 4 5-Tetrachlorobenzene
GC/MS	EPA 8270D	1 2 4-Trichlorobenzene
GC/MS	EPA 8270D	1 2-Dichlorobenzene
GC/MS	EPA 8270D	1 2-Diphenylhydrazine
GC/MS	EPA 8270D	1 3 5-Trinitrobenzene (1 3 5-TNB)
GC/MS	EPA 8270D	1 3-Dichlorobenzene
GC/MS	EPA 8270D	1 3-Dinitrobenzene (1 3-DNB)
GC/MS	EPA 8270D	1 4-Dichlorobenzene
GC/MS	EPA 8270D	1 4-Dithiane
GC/MS	EPA 8270D	1 4-Oxathiane
GC/MS	EPA 8270D	1 4-Naphthoquinone
GC/MS	EPA 8270D	1 4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D	1-Methylnaphthalene (added to method at FDEP request)
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2 3 4 6-Tetrachlorophenol
GC/MS	EPA 8270D	2 4 5-Trichlorophenol
GC/MS	EPA 8270D	2 4 6-Trichlorophenol
GC/MS	EPA 8270D	2 4-Dichlorophenol
GC/MS	EPA 8270D	2 4-Dimethylphenol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	2 4-Dinitrophenol
GC/MS	EPA 8270D	2 4-Dinitrotoluene (2 4-DNT)
GC/MS	EPA 8270D	2 6-Dichlorophenol
GC/MS	EPA 8270D	2 6-Dinitrotoluene (2 6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4 6-dinitrophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3 3`-Dichlorobenzidine
GC/MS	EPA 8270D	3 3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3-Methylphenol (m-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4 4’-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7 12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Benzo(g h i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	Dibenz(a h)anthracene
GC/MS	EPA 8270D	Dibenz(a j)acridine
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1 2 3-cd)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Pyrene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	a-a-Dimethylphenethylamine
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2 2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	o o o-Triethyl phosphorothioate
GC/MS	EPA 8270D	1 4-Dioxane (1 4-Diethyleneoxide)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Biphenyl
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Atrazine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Simazine
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g h i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenz(a h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1 2 3-cd)pyrene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A	1 3 5-Trinitrobenzene (1 3 5-TNB)
HPLC	EPA 8330A	1 3-Dinitrobenzene (1 3-DNB)
HPLC	EPA 8330A	2 2’, 6 6’-Tetranitro-4 4’-azoxytoluene
HPLC	EPA 8330A	2 4 6-Trinitrotoluene (2 4 6-TNT)
HPLC	EPA 8330A	2 4-Dinitrotoluene (2 4-DNT)
HPLC	EPA 8330A	2 6-Dinitrotoluene (2 6-DNT)
HPLC	EPA 8330A	2-Amino-4 6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	3 5-Dinitroaniline
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	4-Amino-2 6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	Nitroglycerin
HPLC	EPA 8330A	Octahydro-1 3 5 7-tetranitro-1 3 5 7-tetrazocine (HMX)
HPLC	EPA 8330A	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	RDX (hexahydro-1 3 5-trinitro-1 3 5-triazine)
HPLC	EPA 8330A	Tetryl (methyl-2 4 6-trinitrophenylnitramine)
HPLC	EPA 8330A	Nitroglycerin
HPLC	EPA 8330A	2-amino-6-Nitrotoluene
HPLC	EPA 8330A	4-amino-2-Nitrotoluene
HPLC	EPA 8330A	2-amino-4-Nitrotoluene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A	DNX
HPLC	EPA 8330A	MNX
HPLC	EPA 8330A	TNX
HPLC	EPA 8330B	1 3 5-Trinitrobenzene (1 3 5-TNB)
HPLC	EPA 8330B	1 3-Dinitrobenzene (1 3-DNB)
HPLC	EPA 8330B	2 4 6-Trinitrotoluene (2 4 6-TNT)
HPLC	EPA 8330B	2 4-Dinitrotoluene (2 4-DNT)
HPLC	EPA 8330B	2 6-Dinitrotoluene (2 6-DNT)
HPLC	EPA 8330B	2-Amino-4 6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3 5-Dinitroaniline
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Amino-2 6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	Octahydro-1 3 5 7-tetranitro-1 3 5 7-tetrazocine (HMX)
HPLC	EPA 8330B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330B	RDX (hexahydro-1 3 5-trinitro-1 3 5-triazine)
HPLC	EPA 8330B	Tetryl (methyl-2 4 6-trinitrophenylnitramine)
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-amino-6-Nitrotoluene
HPLC	EPA 8330B	4-amino-2-Nitrotoluene
HPLC	EPA 8330B	2-amino-4-Nitrotoluene
HPLC	EPA 8330B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8332	PETN
HPLC	EPA 8332	Nitroglycerin
LC/MS/MS	EPA 6850	Perchlorate
ICP	EPA 6010C	Aluminum
ICP	EPA 6010C	Antimony
ICP	EPA 6010C	Arsenic
ICP	EPA 6010C	Barium
ICP	EPA 6010C	Beryllium
ICP	EPA 6010C	Cadmium
ICP	EPA 6010C	Calcium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010C	Chromium
ICP	EPA 6010C	Cobalt
ICP	EPA 6010C	Copper
ICP	EPA 6010C	Iron
ICP	EPA 6010C	Lead
ICP	EPA 6010C	Magnesium
ICP	EPA 6010C	Manganese
ICP	EPA 6010C	Molybdenum
ICP	EPA 6010C	Nickel
ICP	EPA 6010C	Potassium
ICP	EPA 6010C	Selenium
ICP	EPA 6010C	Silver
ICP	EPA 6010C	Sodium
ICP	EPA 6010C	Strontium
ICP	EPA 6010C	Thallium
ICP	EPA 6010C	Tin
ICP	EPA 6010C	Titanium
ICP	EPA 6010C	Vanadium
ICP	EPA 6010C	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium
UV/VIS	EPA 9012B	Cyanide, automated colorimetry with off-line distillation
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Gravimetric Methods	EPA 9071B	Oil and Grease
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Combustion	EPA 9060A	Total Organic Carbon
TCLP Extraction	EPA 1311	TCLP
SPLP Extraction	EPA 1312	SPLP
Waste Characterization	EPA 1110A	Corrosivity Towards Steel
Waste Characterization	SW-846 Chapter 7	Reactive Cyanide and Reactive Sulfide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Ignitability	EPA 1110A	Flash Point
Waste Characterization	SW-846 Chapter 7	Reactive Cyanide
Waste Characterization	SW-846 Chapter 7	Reactive Sulfide
Preparation	**Method**	**Type**
EPA 8011	EPA 8011	Microextraction
EPA 5035	EPA 8015D/C	GRO, OA-1, TN-GRO, MA-VPH, Purge and Trap, solid
EPA 5035A	EPA 8015D/C	GRO, OA-1, TN-GRO, MA-VPH, Purge and Trap, solid
MA-EPH	MA-EPH	Diesel Range Organic, Ultrasonic extraction and fractionation
EPA 3550C	EPA 8015D/C	DRO/ORO, FL-PRO, OA-2, TN-EPH, WI-DRO Ultrasonic Extraction
EPA 3546	EPA 8015 C/D	Diesel and Oil range organics (DRO/ORO), Microwave Extraction
EPA 3546	EPA 8081 B	Chlorinated Pesticides, Microwave Extraction
EPA 3546	EPA 8082A	PCBs, Ultrasonic Extraction
EPA 3546	EPA 8151A	Chlorinated Herbicides, Microwave Extraction
EPA 3546	EPA 8141B	Organophosphorus Pesticides, Microwave Extraction
EPA 3550C	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct inject , DI water leach
EPA 3550C	EPA 8081B	Chlorinated Pesticides, Ultrasonic Extraction
EPA 3550C	EPA 8082A	PCBs and Congeners, Ultrasonic Extraction
EPA 3550C	EPA 8141B	Organophosphorus Pesticides, Ultrasonic Extraction
EPA 8151A	EPA 8151A	Chlorinated Herbicides, Ultrasonic Extraction
EPA 5035	EPA 8260B,C	VOC by GC/MS, Purge and Trap, solid
EPA 5035A	EPA 8260B,C	VOC by GC/MS, Purge and Trap, solid
EPA 5030B	EPA 8260B,C	VOC by GC/MS, Purge and Trap, TCLP Extracts
EPA 3550C	EPA 8270D	BNA Extractables by GC/MS, Ultrasonic Extraction
EPA 3550C	EPA 8310	PAH, Ultrasonic Extraction
EPA 8330A EPA8332	EPA 8330A EPA 8332	Explosives, Ultrasonic Extraction
EPA 8330B	EPA 8330B	Explosives, Shaker Table Extraction
EPA 3010A	EPA 6010C	Metals by ICP, Acid Digestion, TCLP extracts

LABORATORY ACCREDITATION BUREAU

Certificate # L2229

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
EPA 3050B	EPA 6010C	Metals by ICP, Acid Digestion, solid
EPA 7470A	EPA 7470A	Hg by CVAA, TCLP extracts
EPA 7471B	EPA 7471B	Hg by CVAA, solid
EPA 3060A	EPA 7196A	Cr6+, Alkaline Digestion
Lachat MicroDistillation	EPA 9012B	Cyanide, Lachat MicroDistillation proprietary method, solids
EPA 3580A	EPA 8081B; EPA 8141B EPA 8082A; EPA 8270D EPA 8015D/C	Waste Dilution, Extractables
EPA 3585	EPA 8260B/D EPA 8015D/C	Waste Dilution for Volatile Organics
EPA 3510C	EPA 8081B; EPA 8270D EPA 8151A	TCLP parameters

Notes:

1) This laboratory offers commercial testing service.

Approved by: _____ Date: January 29, 2013

R. Douglas Leonard
Chief Technical Officer

Issued: 1/29/13

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Quality Systems Manual

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_____
Harry Behzadi, Ph.D., VP Southeast Operations

_____
Norman D. Farmer, Regional Technical Director

_____
Rick Watkins, Laboratory Manager, Technical Director

_____
Svetlana Izosimova, Ph.D., Quality Assurance Officer

Accutest Laboratories Southeast, Inc.
4405 Vineland Road, Suite C-15
Orlando, Florida 32811
407.425.6700
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INTRODUCTION

The Accutest Laboratories Southeast, Inc. (Accutest SE) Quality Assurance Program, detailed in this plan, has been designed to meet the quality program requirements of the National Environmental Laboratories Accreditation Conference (TNI), DoD QSM Ver 4.2, 2010 and ISO 17025. The plan establishes the framework for documenting the requirements of the quality processes regularly practiced by the Laboratory. The Quality Assurance Officer is responsible for changes to the Quality Assurance Program, which are appended to the LQSM as they occur. The plan is reviewed annually for compliance purposes by the Laboratory Director and Technical Director and edited if necessary. Changes that are incorporated into the plan are summarized in the plan introduction. Changes to the plan are communicated to the general staff in a meeting conducted by the Quality Assurance Officer following the plan's approval.

The Accutest SE plan is supported by standard operating procedures (SOPs), which provide specific operational instructions on the execution of each quality element and assure that compliance with the requirements of the plan are achieved. Accutest SE employees are responsible for knowing the requirements of the SOPs and applying them in the daily execution of their duties. These documents are updated as changes occur and the staff is trained to apply the changes.

At Accutest, we believe that satisfying client requirements and providing a product that meets or exceeds the standards of the industry is the key to a good business relationship. However, client satisfaction cannot be guaranteed unless there is a system that assures the product consistently meets its design requirements and is adequately documented to assure that all procedural steps are executed and are traceable.

This plan has been designed to assure that this goal is consistently achieved and the Accutest product withstands the rigors of scrutiny that are routinely applied to analytical data and the processes that support its generation.

Accutest Laboratories Southeast is a permanent location facility and is part of Accutest Laboratories, Inc.

Summary of Changes
Accutest SE Quality System Manual –October 2012

Section	Description	Page #
Title Page	new revision number	Title
OrgChart	Lillian Torres replaced with Angel Rivera as WetChem supervisor; removed Paul Konnik from Sales.	8
1	Management commitment ro constant process improvement spelled out	5
16	Complete rewrite with detail and hierarchy of non-conforming products	63
App II	DoD certified methods specified in both TNI and non-TNI tables Added Perchlorate, Nitrate/Nitrite, 1,4-Dioxane,	80-83
App IV	Added 2 MS SOPs and 1 Sample Management SOP	99-101

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1.0 QUALITY POLICY

1.1 *Accutest Mission*:

Accutest Laboratories provides analytical services to commercial and government clients in support of environmental monitoring and remedial activities as requested. The Laboratory's mission is dedicated to providing reliable data that satisfies clients requirements as explained in the following: "Provide easy access, high quality, analytical support to commercial and government clients which meet or exceeds data quality objectives and provides them with the data needed to satisfy regulatory requirements and/or make confident decisions on the effectiveness of remedial activities."

These services are provided impartially and are not influenced by undue commercial or financial pressures, which might impact the staff's technical judgment. Coincidentally, Accutest does not engage in activities that endanger the trust in our independent judgment and integrity in relation to the testing activities performed.

1.2 *Policy Statement*:

The management and staff of Accutest Laboratories share the responsibility for product quality and continually strive for its systematic improvement. Accordingly, Accutest's quality assurance program is designed to assure that all processes and procedures, which are components of environmental data production, meet established industry requirements, are adequately documented from a procedural and data traceability perspective, and are consistently executed by the staff. It also assures that analytical data of known quality, meeting the quality objectives of the analytical method in use and the data user's requirements, is consistently produced in the laboratory. This assurance enables the data user to make rational, confident, cost-effective decisions on the assessment and resolution of environmental issues.

The laboratory Quality System also provides the management staff with data quality and operational feedback information. This enables them to determine if the laboratory is achieving the established quality and operational standards, which are dictated by the client or established by regulation, such as TNI, ISO 17025 or DoD QSM. The information provided to management, through the QA program, is used to assess operational performance from a quality perspective and to perform corrective action as necessary.

All employees of Accutest Laboratories participating in environmental testing receive quality system training and are responsible for knowing and complying with the system requirements. The entire staff shares Accutest's commitment to good professional practice.

Harry Behzadi, Ph.D.
VP Southeast Operations

2.0 ORGANIZATION

2.1 ***Organizational Entity***. Accutest Laboratories, Inc. is a testing laboratory founded in 1956 and registered as a New Jersey Corporation. In 2007 the laboratory has changed ownership to Accutest Holdings, Inc. Operations, staff and physical locations were not affected by the change. The laboratory headquarters are located in Dayton, New Jersey where it has conducted business since 1987. Satellite laboratories are maintained in Marlborough, Massachusetts; Orlando, Florida; San Jose, California; Denver, Colorado; Lafayette, Louisiana; and Houston, Texas.

2.2 *Management Responsibilities*

Requirement: Each laboratory facility will have an established chain of command. The duties and responsibilities of the management staff are linked to the President/CEO of Accutest Laboratories who establishes the agenda for all company activities.

President/CEO. Primarily responsible for all operations and business activities. Delegates authority to laboratory directors, general managers, and quality assurance director to conduct day-to-day operations and execute quality assurance duties. Each of the individual operational entities (New Jersey, Massachusetts, Florida,, Texas, California, Colorado, and Louisiana) reports to the President/CEO.

Corporate Quality Assurance Director. Responsible for design, oversight, and facilitation of all quality assurance activities established by the Quality Program. Directly reports to the President/CEO.

Vice President Operations/Laboratory Director. There is a Laboratory Director assigned to each of the following operational entities: New Jersey, Massachusetts Florida, Louisiana, and West (Texas, California, and Colorado). The Laboratory Director executes day-to-day responsibility for laboratory operations including technical aspects of production activities and associated logistical procedures. Directly reports to the President/CEO.

Quality Assurance Officer *(on location).* Responsible for oversight, implementation and facilitation of all quality assurance activities established by the Quality Program. Directly reports to the Laboratory Director. Also exchanges information with and submits laboratory performance data (PE scores, audit reports, accreditation changes, etc.) to Corporate QA Director. Takes program directions from Corporate QA Director.

Technical Director. Responsible for oversight and implementation of technical aspects of production activities in the environmental testing laboratory. In the event that the technical director, quality assurance director, or laboratory manager is absent for a period of time that exceeds 15 consecutive calendar days, the designated appointees shall temporarily perform the technical director, quality assurance director, or laboratory manager's job function. If this absence exceeds 65 consecutive calendar days, the Accreditation Body(ies), including DoD ELAP, is to be notified in writing.

Current list of appointed deputies located in restricted access controlled document directory

Department Managers. Executes day-to-day responsibility for specific laboratory areas including technical aspects of production activities and associated logistical procedures. Directly report to the Laboratory Director.

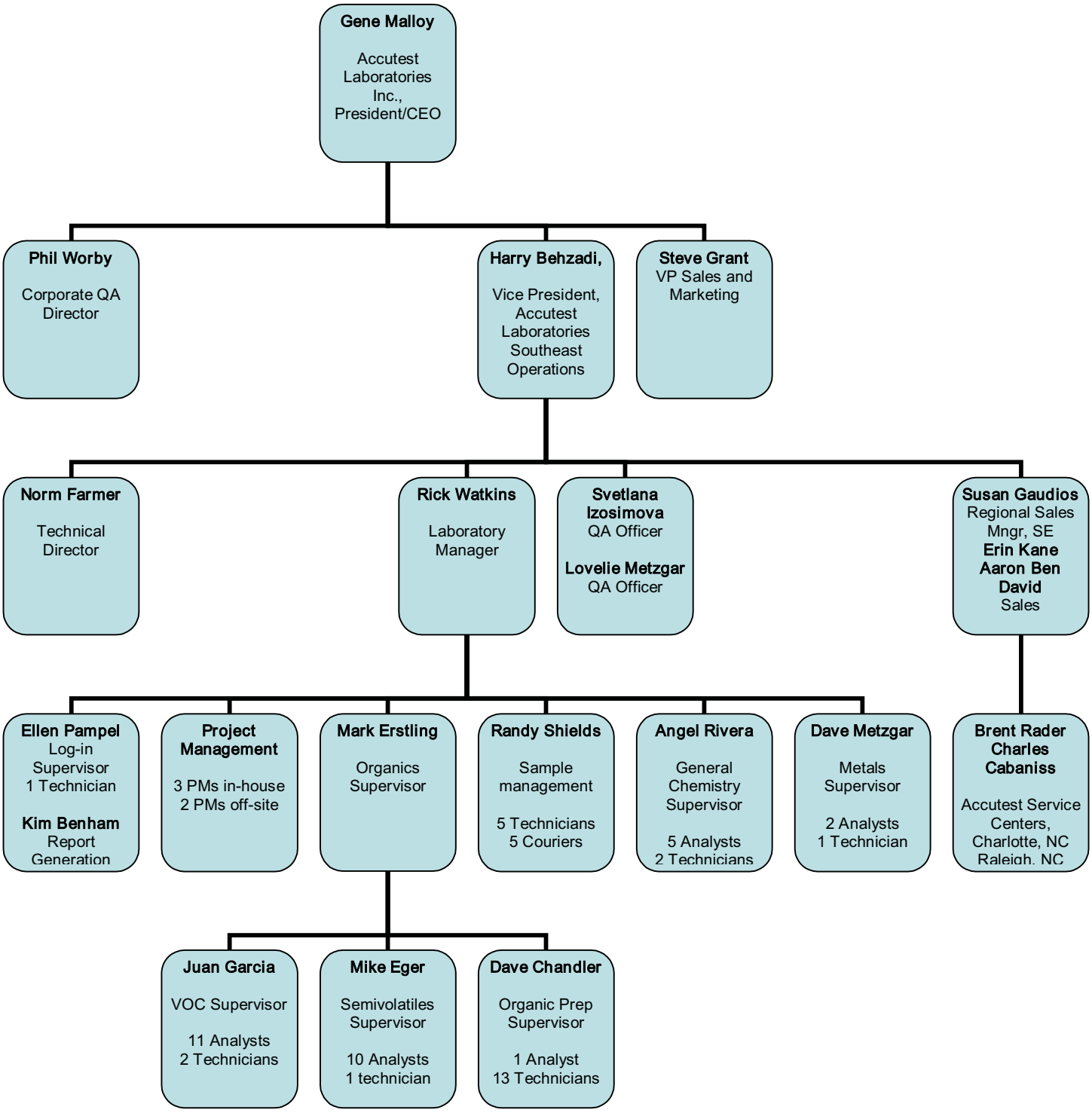
Section Supervisors. Executes day-to-day responsibility for specific laboratory units including technical aspects of production activities and associated logistical procedures. Directly report to the Department Manager.

2.3 *Chain of Command*

The responsibility for managing all aspects of the Company's operation is delegated to specific individuals, who have been assigned the authority to act in the absence of the senior staff. These individuals are identified in the following Chain of Command:

Harry Behzadi, Ph.D., VP, Southeast Operations
Norm Farmer, Technical Director (Operations and IT)
Rick Watkins, Laboratory Manager (Operations)
Heather Wandrey, Project Manager (Client Services)

Accutest Laboratories Southeast Organizational Chart



3.0 QUALITY RESPONSIBILITIES OF THE MANAGEMENT TEAM

3.1 ***Requirement***: Each member of the management team has a defined responsibility for the Quality Program. Program implementation and operation is designated as an operational management responsibility. Program design and implementation is designated as a Quality Assurance Responsibility.

President/CEO*:* Primary responsibility for all quality activities. Delegates program responsibility to the Quality Assurance Director. Serves as the primary alternate in the absence of the Quality Assurance Director. Has the ultimate responsibility for implementation of the Quality Program.

Vice President Operations/Laboratory Director*.* Responsible for implementing and operating the Quality Program in all laboratory areas. Responsible for the design and implementation of corrective action for defective processes. Has the authority to delegate Quality Program implementation responsibilities.

Corporate Quality Assurance Director*.* Responsible for design, implementation support, training, and monitoring of the quality system. Identifies product, process, or operational defects using statistical monitoring tools and processes audits for elimination via corrective action. Empowered with the authority to halt production if warranted by quality problems. Monitors implemented corrective actions for compliance.

Quality Assurance Officer *(on location).* Responsible for design support, implementation support, and monitoring support of the quality system. Training personnel in various aspects of quality system. Conducts audits and product reviews to identify product, process, or operational defects using statistical monitoring tools and processes audits for elimination via corrective action. Empowered with the authority to halt production if warranted by quality problems. Monitors implemented corrective actions for compliance.

Technical Director. Responsible for oversight and implementation of technical aspects of Quality System as they are integrated into method applications and employed to assess analytical controls on daily basis. The Technical Director reviews and acknowledges the technical feasibility of proposed quality system involving technical applications.

Department Managers*.* Responsible for applying the requirements of the Quality Program in their section and assuring subordinate supervisors and staff apply all program requirements. Initiates, designs, documents, and implements corrective action for quality deficiencies.

Group Leaders*.* Responsible for applying the requirements of the Quality Program to their operation and assuring the staff applies all program requirements. Initiates, designs, documents, and implements corrective action for quality deficiencies.

Bench Analysts. Responsible for applying the requirements of the Quality Program to the analyses they perform, evaluating QC data and initiating corrective action for quality control deficiencies within their control. Implements global corrective action as directed by superiors.

3.2 *Program Authority*:

Authority for program implementation on corporate level originates with the President/CEO who bears ultimate responsibility for program design, implementation, and enforcement of requirements. This authority and responsibility is delegated to the Director of Quality Assurance who performs quality functions independently without the encumbrances or biases created by operational or production responsibilities to ensure an honest, independent assessment of quality issues.

Laboratory Director and Quality Assurance Officer mirror this authority on location.

3.3 *Data Integrity Policy*:

The Accutest Data Integrity Policy reflects a comprehensive, systematic approach for assuring that data produced by the laboratory accurately reflects the outcome of the tests performed on field samples and has been produced in a bias free environment by ethical professionals. The policy includes a commitment to technical ethics, staff training in ethics and data integrity, an individual attestation to data integrity and procedures for evaluating data integrity. Senior management assumes the responsibility for assuring compliance with all technical ethics elements and operation of all data integrity procedures. The staff is responsible for compliance with the ethical code of conduct and for practicing data integrity procedures.

The Accutest Data Integrity Policy is as follows:

"Accutest Laboratories is committed to producing data that meets the data integrity requirements of the environmental regulatory community. This commitment is demonstrated through the application of a comprehensive data integrity program that includes ethics and data integrity training, data integrity evaluation procedures, staff participation and management oversight. Adherence to the specifications of the program assures that data provided to our clients is of the highest possible integrity and can be used for decision making processes with high confidence."

Data Integrity Responsibilities

Management. Senior management retains oversight responsibility for the data integrity program and retains ultimate responsibility for execution of the data integrity program elements. Senior management is responsible for providing the resources required to conduct ethics training and operate data integrity evaluation procedures. They also include responsibility for creating an environment of trust among the staff and being the lead advocate for promoting the data integrity policy and the importance of technical ethics.

Staff. The staff is responsible for adhering to the company ethics policy as they perform their duties and responsibilities associated with sample analysis and reporting. By executing this responsibility, data produced by Accutest Laboratories retains its high integrity characteristics and withstands the rigors of all data integrity checks.

The staff is also responsible for adhering to all laboratory requirements pertaining to manual data edits, data transcription and data traceability. These include the application of approved manual peak integration and documentation procedures. It also includes establishing traceability for all manual results calculations and data edits.

Ethics Statement. The Accutest ethics statement reflects the standards that are expected for businesses that provide environmental services to regulated entities and regulatory agencies on a commercial basis. The Ethics Policy is comprised of key elements that are essential to organizations that perform chemical analysis for a fee. As such, it focuses on elements related to personal, technical and business activities.

Accutest Laboratories provides analytical chemistry services on environmental matters to the regulated community. The data the company produces provides the foundation for determining the risk presented by a chemical pollutant to human health and the environment. The environmental industry is dependent upon the accurate portrayal of environmental chemistry data. This process is reliant upon a high level of scientific and personal ethics.

It is essential to the Company that each employee understands the ethical and quality standards required to work in this industry. Accordingly, Accutest has adopted a code of ethics, which each employee is expected to adhere to as follows:

- Perform chemical and microbiological analysis using accepted scientific practices and principles.
- Perform tasks in an honest, principled and incorruptible manner inspiring peers & subordinates.
- Maintain professional integrity as an individual.
- Provide services in a confidential, honest, and forthright manner.
- Produce results that are accurate and defensible.

- Report data without any considerations of self-interest.

- Comply with all pertinent laws and regulations associated with assigned tasks and responsibilities.

Data Integrity Procedures.

Four key elements comprise the Accutest data integrity system:
1) data integrity training,
2) signed data integrity documentation for all laboratory employees,
3) in-depth, periodic monitoring of data integrity, and
4) data integrity procedure documentation.
Procedures have been implemented for conducting data integrity training and for documenting that employees conform to the Accutest Data Integrity and Ethics policy.

The data integrity program consists of routine data integrity evaluation and documentation procedures to periodically monitor and document data integrity. These procedures are documented in SOPs. SOPs are approved and reviewed annually following the procedures employed for all Accutest SOPs. Documentation associated with data integrity evaluations is maintained on file and is available for review.

Data Integrity Training, .Accutest employees receive technical ethics training during new employee orientation. Employees are also required to attend annual ethics refreshment training and sign an ethical conduct agreement annually, which verifies their understanding of Accutest's technical ethics policy and their ethical responsibilities. The agreement is refreshed annually and appended to each individual's training file.

The training focuses on the reasons for technical ethic training, explains the impact of data fraud on human health and the environment, and illustrates the consequences of criminal fraud on businesses and individual careers. Multiple examples of prohibited practices are reviewed and discussed. Accutest's ethics policy and code of ethics are reviewed and explained for each new employee. Employees receive Accutest's technical ethics brochure for further review.

Training on department-specific data integrity procedures are conducted by individual departments for groups involved in data operations. These include procedures for manual chromatographic peak integration, standards traceability, etc.

Data Integrity Training Documentation. Records of all data integrity training are maintained in individual training folders. Attendance at all training sessions is documented and appended to the training file.

Accutest Data Integrity and Ethical Conduct Agreement. All employees are required to sign a Data Integrity and Ethical Conduct Agreement annually. This document is archived in individual training files, which are retained for duration of employment.

The Data Integrity and Ethical Conduct Agreement is as follows:

I. *I understand the high ethical standards required of me with regard to the duties I perform and the data I report in connection with my employment at Accutest Laboratories.*

II. *I have received formal instruction on the code of ethics that has been adapted by Accutest Laboratories and agree to comply with these requirements.*

III. *I have received formal instruction on the elements of Accutest Laboratories' Data Integrity Policy and have been informed of the following specific procedures:*

   a. *Routine data integrity monitoring is conducted on sample data, which may include an evaluation of the data I produce,*

   b. *Formal procedures for the confidential reporting of data integrity issues are available, which can be used by any employee,*

   c. *A data integrity investigation is conducted when data issues are identified that may negatively impact data integrity.*

IV. *I am aware that data fraud is a punishable crime that may include fines and/or imprisonment upon conviction.*

V. *I also agree to the following:*

   a. *I shall not intentionally report data values, which are not the actual values observed or measured.*

   b. *I shall not intentionally modify data values unless the modification can be technically justified through a measurable analytical process.*

   c. *I shall not intentionally report dates and times of data analysis that are not the true and actual times the data analysis was conducted.*

   d. *I shall not condone any accidental or intentional reporting of inauthentic data by other employees and immediately report it's occurrence to my superiors.*

   e. *I shall immediately report any accidental reporting of inauthentic data by myself to my superiors.*

Data Integrity Monitoring. Several documented procedures are employed for performing data integrity monitoring. These include regular data review procedures by supervisory and management staff (Section 12.7), supervisory review and approval of manual integrations and periodic reviews of data audit trails from the LIMS and all computer controlled analysis.

Data Review. All data produced by the laboratory undergoes several levels of review, which includes two levels of management review. Detected data anomalies that appear to be related to data integrity issues are isolated for further investigation. The investigation is conducted following the procedures described in this section.

Manual Peak Integration Review and Approval. Routine data review procedures for all chromatographic processes includes a review of all manual chromatographic peak integrations. This review is performed by the management staff and consists of a review of the machine integration compared to the manual integration. Manual integrations, which have been performed in accordance with Accutest's manual peak integration procedures are approved for further processing and release. Manual integrations which are not performed to Accutest's specifications are set aside for corrective action, which may include analyst retraining or further investigation as necessary.

Data Audit Trail Review. Data integrity audits are comprehensive data package audits that include a review of raw data, process logbooks, processed data reports and data audit trails from individual instruments and LIMS. Data audit trails, which record all electronic data activities, are available for the majority of computerized methodology and the laboratory information management system (LIMS). These audit trails are periodically reviewed to determine if interventions performed by technical staff constitute an appropriate action. The review is performed on a recently completed job and includes interviews with the staff that performed the analysis. Findings indicative of inappropriate interventions or data integrity issues are investigated to determine the cause and the extent of the anomaly.

Confidential Reporting Of Data Integrity Issues. Data integrity concerns may be raised by any individual to their supervisor. Employees with data integrity concerns should always discuss those concerns with their immediate supervisors as a first step unless the employee is concerned with the confidentiality of disclosing data integrity issues or is uncomfortable discussing the issue with their immediate supervisors. The supervisor makes an initial assessment of the situation to determine if the concern is related to a data integrity violation. Those issues that appear to be violations are documented by the supervisor and referred to the QA Officer (local) for investigation.

Documented procedures for the confidential reporting of data integrity issues in the laboratory are part of the data integrity policy. These procedures assure that laboratory staff can privately discuss ethical issues or report items of ethical concern without fears of repercussions with senior staff.

Employees with data integrity concerns that they consider to be confidential are directed to the Corporate Human Resources Manager in Dayton, New Jersey. The HR Manager acts as a conduit to arrange a private discussion between the employee and the Corporate QA Director or a local QA Officer.

During the employee - QA discussion, the QA representative evaluates the situation presented by the employee to determine if the issue is a data integrity concern or a legitimate practice. If the practice is legitimate, the QA representative clarifies the

process for the employee to assure understanding. If the situation appears to be a data integrity concern, the QA representative initiates a Data Integrity Investigation following the procedures specified in SOPs QA038-QA041.

Data Integrity Investigations. Follow-up investigations are conducted for all reported instances of ethical concern related to data integrity. Investigations are performed in a confidential manner by senior management according to a documented procedure. The outcome of the investigation is documented and reported to the company president who has the ultimate responsibility for determining the final course of action in the matter. Investigation documentation includes corrective action records, client notification information and disciplinary action outcomes, which is archived for a period of five years.

The investigations are conducted by the senior staff and supervisory personnel from the affected area. The investigation team includes the Laboratory Director and the Quality Assurance Officer. Investigations are conducted in a confidential manner until it is completed and resolved.

The investigation includes a review of the primary information in question by the investigations team. The team performs a review of associated data and similar historical data to determine if patterns exist. Interviews are conducted with key staff to determine the reasons for the observed practices.

Following data compilation, the investigations team reviews all information to formulate a consensus conclusion. The investigation results are documented along with the recommended course of action.

Corrective Action, Client Notification & Discipline. Investigations that reveal systematic data integrity issues will go through corrective action for resolution and disposition (Section 13). If the investigation indicates that an impact to data has occurred and the defective data has been released to clients, client notification procedures will be initiated following the steps in Section 17.6.

In all cases of data integrity violations, some level of disciplinary action will be conducted on the responsible individual. The level of discipline will be consistent with the violation and may range from retraining and/or verbal reprimand to termination.

4.0 JOB DESCRIPTIONS OF KEY STAFF

4.1 ***Requirement***: Descriptions of key positions within the organization must be defined to ensure that clients and staff understand duties and the responsibilities of the management staff and the reporting relationships between positions.

President/Chief Executive Officer. Responsible for all laboratory operations and business activities. Establishes the company mission and objectives in response to business needs. Direct supervision of the Vice President of Operations, each laboratory director, client services, management information systems, and quality assurance.

Vice President, Operations/Laboratory Director. Reports to the company president. Establishes regional laboratory operations strategy and business development. Authorized to enter into contractual agreements on Company's behalf.

Director, Quality Assurance. Reports to the company president. Establishes the company quality agenda, develops quality procedures, provides assistance to operations on quality procedure implementation, coordinates all quality control activities monitors the quality system and provides quality system feedback to management to be used for process improvement.

Vice President, Information Technlogies Reports to the company president. Develops the MIS software and hardware agenda. Provides system strategies to compliment company objectives. Maintains all software and hardware used for data handling.

Client Services, Sales, Account Manager(s). Reports to the company president. Establishes and maintains communications between clients and the laboratory pertaining to client requirements which are related to sample analysis and data deliverables. Initiates client orders and supervises sample login operations.

Quality Assurance Officer *(on location)*. Reports to the Laboratory Director. Develops quality procedures, provides assistance to operations on quality procedure implementation, coordinates all quality control activities, monitors the quality system, and provides quality system feedback to management to be used for process improvement. In the event of prolonged absence QAO also designated a Deputy Technical Director, unless otherwise specified by internal memo from Laboratory Director.

Manager Client Services *(on location)*. Reports to the Laboratory Director. Establishes and maintains communications between clients and the laboratory pertaining to client requirements which are related to sample analysis and data deliverables. Initiates client orders and supervises sample login operations.

Technical Director (On Location). Reports to the laboratory director. Establishes laboratory operations strategy. Direct supervision of organic chemistry and inorganic

chemistry. Directs the operations, preparation and instrumental analysis. Responsible for following Quality Program requirements. Assumes operational responsibilities of Lab Director in his absence.

Laboratory Manager. Reports to the Laboratory Director. Directs the day-to day operations of entire laboratory, direct supervision of organic chemistry, inorganic chemistry, field services, and sample management.
Oversees daily work schedule as developed by respective departments. Supervises method implementation. Responsible for following Quality Program requirements. Maintains laboratory instrumentation in an operable condition.

Supervisors, Shipping and Receiving Departments. Reports to the Laboratory Manager. Develops, maintains and executes all procedures required for transport and receipt of samples, verification of preservation, and chain of custody documentation. Responsible for maintaining and documenting secure storage, delivery of samples to laboratory units on request, and disposal following completion of all analytical procedures.

Supervisor, Wet Chemistry. Reports to the Laboratory Manager. Directs the operations of the wet chemistry group. Establishes and executes daily work schedule. Supervises method implementation, application, and data production. Supervises the analysis of samples for wet chemistry parameters using valid, documented methodology. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Responsible for following Quality Program requirements.

Supervisor, Metals. Reports to the Laboratory Manager. Directs the operations of the metals group. Establishes and executes daily work schedule. Supervises method implementation, application, and data production. Supervises the analysis of samples for metallic elements using valid, documented methodology. Documents all procedures and data production activities. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Responsible for following Quality Program requirements

Supervisor, Organic Preparation. Reports to the Laboratory Manager. Directs the operations of the sample preparation group. Establishes and executes daily work schedule. Supervises method implementation, and application. Supervises the preparation of samples for organic compounds using valid, documented methodology. Documents all procedures and data production activities. Maintains laboratory equipment in an operable condition. Reviews records for compliance to quality and methodological requirements. Responsible for following Quality Program requirements.

Volatile and Semivolatie Supervisors, Organics. Reports to the Laboratory Manager. Directs the operations of the respective organics group. Establishes and executes daily work schedule. Supervises method implementation, application, and data production. Supervises the analysis of samples for organic compounds using valid, documented methodology. Documents all procedures and data production

activities. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Responsible for following Quality Program requirements

Report Generation Supervisor. Reports to Laboratory Manager. Oversees report generation and fulfillment of client specifications as applied to data deliverables. Responsible for data delivery in timely manner.

Detailed Job descriptions of lab personnel are found in training folders

4.2 *Employee Screening, Orientation, and Training*.

All potential laboratory employees are screened and interviewed by human resources and technical staff prior to their hire. The pre-screen process includes a review of their qualifications including education, training and work experience to verify that they have adequate skills to perform the tasks of the job. Minimum qualifications for non-technical personnel require High School diploma (couriers also shall posses clean driving record), technical personnel must also demonstrate basic laboratory experience, such as balance and syringe use, aseptic practices, etc. College-level science coursework is favored.

Newly hired employees receive orientation training beginning the first day of employment by the Company. Orientation training consists of initial health and safety training and a detailed review of the personal protection policies, technical ethics training and data integrity procedures and quality assurance program training (including Company's goals, objectives, mission, and vision).

All technical staff receives training to develop and demonstrate proficiency for the methods they perform. New analysts work under supervision until the supervisory staff is satisfied that a thorough understanding of the method is apparent. Organics/Inorganics analysts are required to demonstrate method proficiency through a precision and accuracy study. Data from the study is compared to method acceptance limits. If the data is unacceptable, additional training is required. The analyst must also demonstrate the ability to produce acceptable data through the analysis of an independently prepared proficiency sample.

Proficiency is demonstrated annually. Data from initial and continuing proficiency demonstration is archived in the individual's training folder. In the instance where analyte can not be spiked in the clean matrix, such as TSS or pH, the results of an external Performance Evaluation (PE) sample may be used to document analyst's proficiency.

Minimum training required for administrative staff consists of laboratory safety and ethical conduct.

4.3 ***Training Documentation***. The QA Officer prepares a training file for every new employee. All information related to qualifications, experience, external training courses, and education are placed into the file. Verification documentation for

orientation, health & safety, quality assurance, and ethics training is also included in the file.

Additional training documentation is added to the file as it occurs. This includes data for initial and continuing demonstrations of proficiency, performance evaluation study data and notes and attendance lists from group training sessions.

The Quality Assurance Department maintains the employee training database. This database is a comprehensive inventory of training documentation for each individual employee. The database enables supervisors to obtain current status information on training data for individual employees on a job specific basis. It also enables the management staff to identify training documentation in need of completion.

Employee specific database records are created by human resources on the date of hire. Data base fields for job specific requirements such as SOP documentation of understanding and annual demonstration of analytical capability are automatically generated when the supervisor assigns a job responsibility. Employees acknowledge that their SOP responsibilities have been satisfied using a secure electronic process, which updates the database record. Reports are produced which summarize the qualifications of individual employees or departments.

5.0 SIGNATORY APPROVALS

Requirement: Procedures are required for establishing the traceability of data and documents. The procedure consists of a signature hierarchy, indicating levels of authorization for signature approvals of data and information within the organization. Signature authority is granted for approval of specific actions based on positional hierarchy within the organization and knowledge of the operation that requires signature approval. A log of signatures and initials of all employees is maintained for cross-referencing purposes.

5.1 *Signature Hierarchy*.

President/Chief Executive Officer. Authorization for contracts and binding agreements with outside parties. Approval of final reports, quality assurance policy, SOPs, project specific QAPs, data review and approval in lieu of technical managers. Contract signature authority resides with Company Officers only, which include the President/CEO, CFO and VP Administration.

Vice President, Operations/Laboratory Director. Approval of final reports and quality assurance policy in the absence of the President. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers. Technical policy.

Technical Director (on location): Approval of final reports and quality assurance policy in the absence of the Laboratory Director. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers. Technical policy review. In the event of prolonged absence refer to list of approved deputies – sec 2.2.

Director, Quality Assurance. Approval of final reports and quality assurance policy in the absence of the President. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers.

Quality Assurance Officer (on location). Approval of final reports and quality assurance policy in the absence of the Laboratory Director. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers. In the event of prolonged absence refer to list or appointed deputies – see sec. 2.2.

Manager, Sample Management. Initiation of laboratory sample custody and acceptance of all samples. Approval of department policies and procedures. Department specific supplies purchase. Waste manifesting and disposal.

Project Manager, Client Services. QAP and sampling and analysis plan approval. Project specific contracts, pricing, and price modification agreements. Approval and acceptance of incoming work, Client services policy.

Supervisors, Technical Departments. Methodology and department specific QAPs. Data review and approval, department specific supplies purchase. Technical approval of SOPs.

Supervisors, Technical Departments. Data review approval, purchasing of expendable supplies.

5.2 ***Signature Requirements***. All laboratory activities related to sample custody and generation or release of data must be approved using either initials or signatures. The individual, who applies his signature or initial to an activity or document, is authorized to do so within the limits assigned to them by their supervisor. All signatures and initials must be applied in a readable format that can be cross-referenced to the signatures and initials log if necessary.

5.3 ***Signature and Initials Log***. The QA Officer maintains a signature and initials log. New Employee signatures and initials are appended to the log on the first day of employment. Signature of individuals no longer employed by the company are retained.

6.0 DOCUMENTATION and DOCUMENT CONTROL

Requirement: Document control policies have been established which specify that any document used as an information source or for recording analytical or quality control information must be managed using defined document control procedures. Accordingly, policies and procedures required for the control, protection, and storage of any information related to the production of analytical data and the operation of the quality system to assure its integrity and traceability have been established and implemented in the laboratory. The system contains sufficient controls for managing, archiving and reconstructing all process steps, which contributed to the generation of an analytical test result. Using this system, an audit trail for reported data can be produced, establishing complete traceability for the result.

6.1 Administrative Records.

The Quality Assurance Officer manages Administrative (non-analytical) records. These records consist of electronic documents that are retained in a limited access electronic directory, which are released to the technical staff upon specific request.

Form Generation & Control. The Quality Assurance Officer approves all forms used as either stand-alone documents or in logbooks to ensure their traceability. Forms are generated as computer files only and maintained in a limited access master directory. Access to the electronic forms and applications is granted to QA Officer, Laboratory Manager and Technical Director(s) (local and regional). Approved forms must display the date of current revision and initials of person who revised the form. Modifications to existing forms are approved by QA, obsolete forms moved to archive directory and retained for minimum of five years.

New forms must include Accutest SE identification and appropriate spaces for signatures of approvals and dates. Further design specifications are the responsibility of the originating department.

Technical staff is required to complete all forms to the maximum extent possible. If information for a specific item is unavailable, the analyst is required to cross out the information block. The staff is also required to cross out the uncompleted portions of a logbook or logbook form if the day's analysis does not fill the entire page of the form.

Logbook Control. All laboratory logbooks are controlled documents that are comprised of approved forms used to document specific processes. Logbook control is maintained by QA staff.

New logs are numbered and issued to a specific individual who is assigned responsibility for the log. Supervisor performs periodical review of the logbooks. Old logs are returned to QA for entry into the document archive system where they are retained for minimum of five (5) years. Laboratory staff may hold a maximum of two consecutively dated logbooks of the same type in the laboratory, not including the most recently issued book to simplify review of recently completed analysis.

Controlled Documents. Key laboratory documents are designated for controlled document status to assure that identities of individuals receiving copies and the number of copies that have been distributed are known. Controlled status simplifies document updates and **retrieval** of outdated documents. Control is maintained through a document numbering procedure and document control logbook designating the individual receiving the controlled document. Document control is also maintained by pre-designating the numbers of official copies of documents that are placed into circulation within the laboratory.

Quality Systems Manual (QSM). All QSMs are assigned a number prior to distribution. The QSMs are distributed as controlled documents i.e. ones that will be collected back and replaced with next version (documents distributed to the Accutest Inc. staff). QSMs distributed to outside entities are considered tracked documents – since there is no possibility of collecting them back and ensuring that current revision is in use. These situation include bid submissions, client requests, etc. These copies are watermarked as "Uncontrolled Documents" The control/tracking number, date of distribution, and identity of the individual receiving the document are recorded in the document control spreadsheet. QA staff maintains tracking spreadsheet. The numbering system is continuous.

Standard Operating Procedures (SOPs). SOPs are maintained by pre-designating the numbers of official copies of documents that are placed into circulation within the laboratory. Official documents are printed and placed into the appropriate laboratory section as follows:

Sample Management: One copy for the sample receiving file
Bottle preparation area – One copy for shipping area
Organics Laboratories: One for the affected laboratory area.
Inorganics Laboratories: One for the affected laboratory area.

The original, signed copy of the SOP is maintained in the master SOP binder by the QA staff.

Documents are controlled using an "Official Copy" stamp in red ink. Additional copies could be issued to individuals for training purposes. Distribution is documented on SOP cover page. Superceded copies collection is conducted accordingly to cover page distribution list.

SOPs distributed to clients as part of bid submission, pre-audit evaluation, etc. are watermarked as "Proprietary Information".

Quick reference cards: These documents are compiled for lab staff convenience and are based on current SOP revision and/or recent regulatory updates. These one- or two-sided documents are footnoted with reference to SOP/regulatory standard, stamped with "Official Copy" stamp in red ink and laminated for durability. *Use of these quick references does not substitute reading and acknowledging the parent SOP.*

Operators' Manuals are considered controlled documents and stored in appropriate departments.

6.2 ***Technical Records***. All records related to the analysis of samples and the production of analytical results are archived in secure document storage or on electronic media and contain sufficient detail to produce an audit trail, which re-creates the analytical result. These records include information related to the original client request, bottle order, sample login and custody, storage, sample preparation, analysis, data review and data reporting.

Records that can not be maintained on electronic media are considered irretrievable records, segregated into separate secured storage and access controlled with access log maintained by QA Staff. Examples of such records are employee training files, obsolete SOPs and acknowledgement form originals, training files, logbooks, etc.

Each department involved in this process maintains controlled documents, which enable them to maintain records of critical information relevant to their department's process.

6.3 ***Quality Assurance Directory.*** All Quality Assurance documentation and quality control limit data is stored in a restricted QA directory on the network server. The directory has been designated as read only. The QA staff, technical director and the laboratory manager have write capability in this directory. Information on this directory is backed-up daily.

This directory contains all current and archived Quality System Manuals, SOPs, control limits, MDL studies, precision and accuracy data, internal and external audit reports, official forms, Health and Safety materials, PT scores, State Certifications and metrics calibration information.

6.4 ***Analytical Records***. All data related to the analysis of field samples are retained as either paper or electronic records that can be retrieved to compile a traceable audit trail for any reported result. All information is linked to the client job and sample number, which serves as a reference for all sample related information tracking.

Critical times in the life of the sample from collection through analysis to disposal are documented. This includes date and time of collection, receipt by the laboratory, preparation times and dates, analysis times and dates and data reporting information. Analysis times are calculated in hours for methods where holding time is specified in hours (≤72 hours).

Sample preparation information is recorded in a separate controlled logbook or on controlled forms in three-ring binder. It includes sample identification numbers, types of analysis, preparation and cleanup methods, sample weights and volumes, reagent lot numbers and volumes and any other information pertinent to the preparation procedure.

Information related to the identification of the instrument used for analysis is permanently attached to the electronic record. The record includes an electronic data file that indicates all instrument conditions employed for the analysis, including the type of analysis conducted. The analyst's identification is electronically attached to the record. The instrument tuning and calibration data is electronically linked to the sample or linked though paper logs, which were used in the documentation of the analysis. Quality control and performance criteria are permanently linked to the paper archive or electronic file.

Paper records for the identity, receipt, preparation and evaluation of all standards and reagents used in the analysis are documented in prepared records and maintained in controlled documents or files. Lot number information linking these materials to the analysis performed is recorded in the logbooks associated with the samples in which they were used.

Manual calculations or peak integrations that were performed during the data review are retained as paper or electronically generated PDF documents and included as part of the electronic archive. Signatures for data review are retained on paper or as electronic stamps on PDF versions of the paper record for the permanent electronic file.

6.5 ***Confidential Business Information (CBI).*** Operational documents including SOPs, Quality Manuals, personnel information, internal operations statistics, and laboratory audit reports are considered confidential business information. Strict controls are placed on the release of this information to outside parties.

Release of CBI to outside parties or organizations may be authorized upon execution of a confidentiality agreement between Accutest and the receiving organization or individual. CBI information release is authorized for third party auditors and commercial clients in electronic mode as Adobe Acrobat .PDF format only.

6.6 ***Software Change Documentation & Control.*** Changes to software are documented as text within the code of the program undergoing change. Documentation includes a description of the change, reason for change and the date the change was placed into effect. Documentation indicating the adequacy of the change is prepared following the evaluation by the user who requested the change.

6.7 ***Report and Data Archiving***. Accutest Laboratories maintains electronic image file copies of original reports in archive for a minimum period of five (5) years. After five years, the files are automatically discarded unless contractual arrangements exist which dictate different requirements. Client specific data retention practices are employed for government organizations such as the Department of Defense Agencies and MA DEP that require a retention period of ten (10) years, as well as commercial clients upon contractual requirements agreement.

Complete date and time stamped client reports are generated from LIMS using the source documents archived on Document server. These source documents are maintained on document server and backed up to primary and clone tapes. Accutest

archives the original report (organized by job number) and the organic and inorganic support data. Organic support data is archived according to instrument batch numbers. All organics data is backed up to the tape or archive drive via Networker Backup software and/or AccuBack backup software. Data from the archive drive is then written to tape at periodic intervals.

Wet chemistry support data is archived by analytical batch (GN…). Metals support data is archived by instrument batch (MA…). Metals digestion data is archived as digestion logbooks.

The reports generation group electronically scans completed reports and stores them by job number on the document server. The document server is backed up daily to a digital tape. Copies of these files remain active on the document server for easy review access. The digital tapes remain in secure storage for the remainder of the archive period.

6.8 ***Training***. Ongoing training ensures competence of all relevant personnel. At the minimum personnel should possess knowledge of the technology used in the testing, general requirements expressed in legislature and industry standards, and understand the significance of deviations with regard to approved procedures. The company maintains a training record for all employees that documents that they have received instruction on administrative and technical tasks that are required for the job they perform. Training records for individuals employed by the company are retained for a period of five years following their termination of employment.

Training File Origination. The Quality Assurance Officer (QAO) initiates training files. Quality Assurance officer retains the responsibility for the maintenance and tracking of all training related documentation in the file. The file is begun on the first day of employment. Information required for the file includes a copy of the individual's most current resume, detailing work experience and a copy of any college diplomas or transcript(s). Information added on the first day includes documentation of health and safety training and a signed Ethics and Data Integrity agreement. These two constitute minimal necessary training for Project Management and Administrative staff. Training documentation, training requirements, analyst proficiency information and other training related support documentation is tracked using a customized database application. Database extracts provide an itemized listing of specific training requirements by job function. Training status summaries for individual analysts portray dates of completion for job specific training requirements.

Technical Training. The supervisor of each new employee is responsible for developing a training plan for each new employee. The supervisor updates the outline, adding signatures and dates as training elements are completed at regular frequency. Supporting documentation, such as precision and accuracy studies, which demonstrate analyst capability for a specific test, are added as completed. When analyte can not be spiked, such as pH or TSS, external PE sample is purchased and analyzed. Where no external PE sample is available, sample duplicates must be successfully analyzed. Method review records are retained where analysis of duplicates is not possible. Employees and supervisors verify documentation of

understanding (DOU) for all assigned standard operating procedures in the training database. Certificates or diplomas for any off-site training are added to the file.

7.0 REFERENCE STANDARD TRACEABILITY

Requirement: Documented procedures, which establish traceability between any measured value and a national reference standard, must be in place in the laboratory. All metric measurements must be traceable to NIST reference weights or thermometers that are calibrated on a regular schedule. All chemicals used for calibration of a quantitative process must be traceable to an NIST reference that is documented by the vendor using a certificate of traceability. The laboratory maintains a documentation system that establishes the traceability links. The procedures for verifying and documenting traceability must be documented in standard operating procedures.

7.1 *Traceability of Metric Measurements - Thermometers*. Accutest uses NIST-traceable thermometers to calibrate commercially purchased working laboratory thermometers prior to their use in the laboratory and annually thereafter for liquid in glass thermometers or quarterly for electronic temperature measuring devices. If necessary, these working thermometers are assigned correction factors that are determined during their calibration using an NIST-traceable thermometer as the standard. The correction factor is documented in a thermometer log and on a tag attached to the working thermometer. Both original observation and corrected measurement are recorded in the temperature log. The NIST-traceable reference thermometer is checked for accuracy by an outside vendor minimum every five (5) years following the specifications for NIST-traceable thermometer calibration verification detailed in the United States Environmental Protection Agency's "Manual for the Certification of Laboratories Analyzing Drinking Water", Fifth Edition, January 2005. Currently the NIST thermometer is verified by outside vendor on triennial basis due to contract-specific requirements. Calibration log and Certificate(s) of calibration are maintained on file with QAO.

7.2 *Traceability of Metric Measurements – Calibration Weights*. Accutest uses calibrated weights, which are traceable to NIST standard weights to calibrate all balances used in the laboratory. Balances must be calibrated to specific tolerances within the intended use range of the balance. Calibration checks are required on each day of use. If the tolerance criteria are not achieved, corrective action specified in the balance calibration SOP must be applied before the balance can be used for laboratory measurements. All weights are recalibrated by outside vendor every five years following the specifications for weight calibration verification detailed in the United States Environmental Protection Agency's "Manual for the Certification of Laboratories Analyzing Drinking Water", Fifth Edition, January 2005. Certificate(s) of calibration are maintained on file with QAO. Balances are inspected and maintained by professional service technicians annually. Certificate(s) of inspection are maintained with QAO.

7.3 *Traceability of Chemical Standards and Reagents*. All chemicals and reagents, with the exception of bulk dry Na2SO4 and solvents purchased as reference standards for use in method calibration must establish traceability to NIST referenced material through a traceability certificate (Certificate of Analysis, CoA). Process links are

established that enable a calibration standard solution to be traced to its NIST reference certificate. Solvents, acids and other supplies are being tested to verify their suitability for the analytical process.

7.4 ***Assignment Of Reagent and Standard Expiration Dates.*** Expiration date information for all purchased standards and reagents is provided to Accutest with all prepared standard solutions and unstable reagents as a condition of purchase. Neat materials and inorganic reagents are not required to be purchased with expiration dates. Certified prepared solutions are labeled with the expiration date provided by the manufacturer. In-house prepared solutions are assigned expiration dates that are consistent with the method that employs their use unless documented experience indicates that an alternate date can be applied. If alternate expiration dates are employed, their use is documented in the method SOP. Expiration dates for prepared inorganic reagents, which have not exhibited instability, are established at two years form the date of preparation for tracking purposes. All containers shall be labeled with the date of preparation and expiration date clearly indicated.

The earliest expiration date is always the limiting date for assigning expiration dates to prepared solutions. Expiration dates that are later than the expiration date of any derivative solution or material are prohibited.

7.5 ***Documentation of Traceability***. Traceability information is documented in individual logbooks designated for the measurement process in use. The QA Officer maintains calibration documentation for metric references in pertinent folders and logbooks.

Balance calibration verification is documented in logbooks that are assigned to each balance. The individual conducting the verification is required to initial and date all calibration activities. Any defects that occur during verification are also documented along with the corrective action applied and a demonstration of return to control. Annual service and calibration reports and certificates retained on file with QA staff.

Temperature control is documented in logbooks assigned to the equipment being monitored. A verified (see 7.1) thermometer is assigned to each individual item. Measurements are recorded along with date and initials of the individual conducting the measurement on a daily or as used basis. Corrective action, if required, is also documented including the demonstration of return to control.

Initial traceability of chemical standards and reagents is documented via a vendor-supplied certificate (see also 7.3) that includes lot number and expiration date information. Solutions prepared using the vendor supplied chemical standard are documented in logbooks assigned to specific analytical processes. Alternatively, documentation may be entered into the electronic standards and reagent tracking log The documentation includes links to the vendors lot number, an internal lot number, dates of preparation, and the preparer's initials. Standards received without certificate of analysis can not be used for calibration or calibration verification and are rejected.

Supervisors conduct regular reviews of logbooks, which are verified using a word rev'd", signature and date. QA Staff monitors the process and documents it in the same manner.

8.0 TEST PROCEDURES, METHOD REFERENCES, AND REGULATORY PROGRAMS

Requirements: The laboratory must use client specified or regulatory agency approved methods for the analysis of environmental samples. The laboratory maintains a list of active methods, which specifies the type of analysis performed, and cross-references the methods to applicable environmental regulation. Routine procedures used by the laboratory for the execution of a method must be documented in a standard operating procedure. Method performance and sensitivity must be demonstrated annually where required. Defined procedures for the use of method sensitivity for data reporting purposes must be established by the Director of Quality Assurance and used consistently for all data reporting purposes.

8.1 ***Method Selection.*** Accutest employs methods for environmental sample analysis that are consistent with the client's application, which are appropriate and applicable to the project objectives. Accutest informs the client if the method proposed is inappropriate or outdated and suggests alternative approaches.

Accutest employs documented, validated regulatory methods in the absence of a client specification and informs the client of the method selected. These methods are available to the client and other parties as determined by the client. Documented and validated in-house methods may be applied if they are appropriate to the project. The client is informed of the method selection.

8.2 ***Method Validation***. Standard methods from regulatory sources are primarily used for all analysis. Standard methods do not require validation by the laboratory. Non-standard, in-house methods are validated prior to use. Validation is also performed for standard methods applied outside their intended scope of use. Validation is dependent upon the method application and may include analysis of quality control samples to develop precision and accuracy information for the intended use. A final method validation report is generated, which includes all data in the validation study. A statement of adequacy and/or equivalency is included in the report. A copy of the report is archived in the quality assurance directory of the company server.

Non-standard methods are validated prior to use. This includes the validation of modified standard methods to demonstrate comparability with existing methods. Demonstrations and validations are performed and documented prior to incorporating technological enhancements and non-standard methods into existing laboratory methods used for general applications. The demonstration includes method specific requirements for assuring that significant performance differences do not occur when the enhancement is incorporated into the method. Validation is dependent upon method application and may include the analysis of quality control samples to develop precision and accuracy information for intended use.

The study procedures and specifications for demonstrating validation include comparable method sensitivity, calibration response, method precision, method accuracy and field sample consistency for several classes of analytical methods are

detailed in this document. These procedures and specifications may vary depending upon the method and the modification.

8.3 ***Standard Operating Procedures***. Standard operating procedures (SOP) are prepared for routine methods executed by the laboratory and processes related to sample or data handling. The procedures describe the process steps in sufficient detail to enable an individual, who is unfamiliar with the procedure to execute it successfully. SOPs are reviewed annually and edited if necessary. SOPs can be edited on a more frequent basis if systematic errors dictate a need for process change or the originating regulatory agency promulgates a new version of the method. Procedural modifications are indicated using a revision number. SOPs are available for client review at the Accutest facility upon request.

8.4 ***Method Detection Limit Determination and verification***. Annual method detection limit (MDL) studies are performed as appropriate for routine methods used in the laboratory. MDL studies are also performed when there is a change to the method that affects how the method is performed or when an instrumentation change that impacts sensitivity occurs. The procedure used for determining MDLs is described in 40 CFR, Part 136, Appendix B. Studies are performed for each method on water, soil and air matrices for every instrument that is used to perform the method. MDLs are established at the instrument level. The highest MDL of the pooled instrument data is used to establish a laboratory MDL. MDLs are experimentally verified through the analysis of spiked quality control samples at 2-3 times the concentration of the experimental MDL, or 1-4 times for multicomponent methods. The verification is performed on every instrument used to perform the analysis. The quality assurance staff manages the annual MDL determination process and is responsible for retaining MDL data on file. Approved MDLs are appended to the LIMS and used for data reporting purposes. MDL values are used as DL values for DOD projects and verification spiking concentrations are listed ad LOD values.

Methods certified under DOD ELAP requirements must undergo verification procedure on quarterly basis – see DOD QSM 4.2, Gray Box D-13.

8.5 ***Method Reporting Limit.*** The method reporting limit is established at the lowest concentration calibration standard in the calibration curve. The low calibration standard is selected by department managers as the lowest concentration standard that can be used while continuing to meet the calibration linearity criteria of the method being used. The validity of the Method Reporting Limits is confirmed via analysis of a spiked quality control sample at 1 – 2x Method reporting limit concentration. RL values are referred to as LOQ for DOD projects.

By definition, detected analytes at concentrations below the low calibration standard cannot be accurately quantitated and must be qualified accordingly.

Methods certified under DOD ELAP requirements must undergo verification procedure on quarterly basis – see DOD QSM 4.2, Gray Box D-14.

8.6 ***Reporting of Quantitative Data.*** Analytical data for all methods is reported without qualification to the reporting limit established for each method. Data may be reported to MDL depending upon the client's requirements provided that all qualitative identification criteria for the parameter have been satisfied. All parameters reported at concentrations between the reporting limit and MDL are qualified as an estimated concentration.

Measured concentrations of detected analytes that exceed the upper limit of the calibration range are either diluted into the range and reanalyzed or qualified as an estimated value. The only exception to this applies to ICP and ICP/MS analysis, which can be reported to the upper limit of the experimentally determined linear range without qualification.

8.7 ***Estimated Uncertainty.*** A statement of the estimated uncertainty of an analytical measurement accompanies the test result when required. Estimated uncertainty is derived from the performance limits established for spiked samples of similar matrices. The degree of uncertainty is derived from the negative or positive bias for spiked samples accompanying a specific parameter. When the uncertainty estimate is applied to a measured value, the possible quantitative range for that specific parameter at that measured concentration is defined. Well recognized regulatory methods that specify values for the major sources of uncertainty and specify the data reporting format do not require a further estimate of uncertainty.

8.8 ***Precision and Accuracy Studies***. Annual precision and accuracy (P&A) studies, which demonstrate the laboratories ability to generate acceptable date, are performed for all routine methods used in the laboratory. The procedure used for generating P&A data is referenced in the majority of the regulatory methodology in use. The procedure requires quadruplicate analysis of a sample spiked with target analytes at a concentration in the working range of the method. This data may be compiled from a series of existing blank spikes or laboratory control samples. Accuracy (percent recovery) of the replicate analysis is averaged and compared to established method performance limits. Values within method limits indicate an acceptable performance demonstration. (See also Sec 4, Training, Demonstration of capability)

8.9 ***Method Sources, References and Update Mechanism.*** The Quality Assurance Staff maintains a list of active methods used for the analysis of samples. This list includes valid method references such as EPA, American Society of Testing and Materials (ASTM) or Standard Methods designations and the current version and version date.

Updated versions of approved reference methodology are placed into use as changes occur. The Quality Assurance Director informs operations management of changes in method versions as they occur. The operations management staff selects an implementation date. The operations staff is responsible for completing all method requirements prior to the implementation date. This includes modification to SOPs, completion of MDL and precision and accuracy studies and staff training. Documentation of these activities is provided to the QA staff who retains this information on file. The updated method is placed into service on the implementation date and the old version is de-activated.

Multiple versions of selected methods may remain in use to satisfy client specific needs. In these situations, the default method version becomes the most recent version. Client specific needs are communicated to the laboratory staff using method specific analytical codes method, which clearly depict the version to be used. The old method version is maintained as an active method until the specified client no longer requires the use of the older version.

Accutest will not use methodology that represents significant departures from the reference method unless specifically directed by the client. In cases where clients direct the laboratory to use a method modification that represents a significant departure from the reference method, the request will be documented in the project file. The LQSM lists active methods used for the analysis of samples in Table 8.1. This list includes valid method references from sources such as USEPA, ASTM or Standard Methods designations and the current version and version date.

8.10 ***Analytical Capabilities***. Appendix II provides a detailed listing of the methodology employed for the analysis of test samples.

9.0 SAMPLE MANAGEMENT, LOGIN, CUSTODY, STORAGE AND DISPOSAL

Requirement: A system to ensure that client supplied product is adequately evaluated, acknowledged, and secured upon delivery to the laboratory must be practiced by the laboratory. The system must assure that chain of custody is maintained and that sample receipt conditions and preservation status are documented and communicated to the client and internal staff. The login procedure must assign, document, and map the specifications for the analysis of each unique sample to assure that the requested analysis is performed on the correct sample and enables the sample to be tracked throughout the laboratory analytical cycle. The system must include procedures for reconciling defects in sample condition or client provided data, which occur at sample arrival. The system must specify the procedures for proper sample storage, transfer to the laboratory, and disposal after analysis. The system must be documented in a standard operating procedure.

9.1 ***Order Receipt and Entry***. New orders are initiated and processed by the client services group (See Chapter 14, Procedures for Executing Client Specifications). The new order procedure includes mechanisms for providing sampling containers to clients. These containers must meet the size, cleanliness, and preservation specifications for the analysis to be performed.

For new orders, the project manager prepares a bottle request form, which is submitted to sample management department. This form provides critical project details to the sample management staff, which are used to prepare and assemble the sample bottles for shipment to the client prior to sampling.

The bottle order is assembled using bottles that meet USEPA specifications for contaminant-free sample containers. Accutest-SE checks all sample containers for cleanliness. Data are reviewed by both the analyst and sample management technician. Results of bottle analyses are retained for minimum of 5 years.

All preservative solutions are prepared in the laboratory and are checked to assure that they are free of contamination from analytes of interest before being released for use. Sample management department retains a copy of the documentation of in-house contamination checks.

Reagent water for trip and field blanks is poured into appropriately labeled containers. Sample bottleware is labeled with durable labels printed on waterproof printing medium with indelible laser or heat transfer printer ink. All bottles are packed into ice chests with blank chain of custody forms and the original bottle order form. Completed bottle orders are delivered to clients using Accutest couriers or commercial carriers for use in field sample collection.

9.2 ***Sample Receipt and Custody***. Samples are delivered to the laboratory using a variety of mechanisms including Accutest couriers, commercial shippers, and client self-delivery. Documented procedures are followed for arriving samples to assure that

custody and integrity are maintained and that handling and preservation requirements are documented and continued.

Sample custody documentation is initiated when the individual collecting the sample collects field samples. Custody documentation includes all information necessary to provide an unambiguous record of sample collection, sample identification, and sample collection chronology. Initial custody documentation employs either Accutest or client generated custody forms.

Accutest generates a Sample Receipt Confirmation form in situations where the individuals who collected the sample did not generate custody documentation in the field. Accutest SE Project Manager then contacts the client for the CoC information to be faxed or e-mailed from the client to the lab.

Accutest defines sample custody as follows:

- The sample is in the actual custody or possession of the assigned responsible person,
- The sample is in a secure area.

The Accutest facility is defined as a secure facility. Perimeter security has been established, which limits access to authorized individuals only. Visitors enter the facility through the building lobby and must register with the receptionist prior to entering controlled areas. While in the facility, visitors must be accompanied by their hosts at all times. After hours, building access is controlled using a computerized pass-key reader system. This system limits building access to individuals with a pre-assigned authorization status. After hours visitors are not authorized to be in the building. Clients delivering samples after hours must make advanced arrangements through client services and sample management to assure that staff is available to take delivery and maintain custody.

Upon arrival at Accutest, the sample custodian reviews the chain of custody and generates Sample Receipt Confirmation form for the samples received to verify that the information on the form corresponds with the samples delivered. This includes verification that all listed samples are present and properly labeled, checks to verify that samples were transported and received at the required temperature, verification that the sample was received in proper containers, verification that sufficient volume is available to conduct the requested analysis, and a check of individual sample containers to verify test specific preservation requirements including the absence of headspace for volatile compound analysis.

9.3 Sample conditions and other observations are documented on the Sample Receipt Confirmation form by the sample custodian prior to completing acceptance of custody. The sample custodian accepts sample custody upon verification that the custody document is correct. Discrepancies or non-compliant situations are documented, flagged and communicated to the Accutest project manager, who contacts the client

for resolution. The resolution is documented and communicated to sample management for execution.

9.4 ***Laboratory preservation of Improperly preserved field samples.*** Accutest extends every effort to preserve samples which were received without proper field preservation.

Field/Equipment negative controls also receive the same amount of preservation as incorrectly preserved samples, and record made in the preservation logbook.

9.5 ***Sample Tracking Via Status Change.*** An automated, electronic LIMS procedure records sample exchange transactions between departments and changes in analytical status. This system tracks all preparation, analytical, and data reporting procedures to which a sample is subjected while in the possession of the laboratory. Each individual receiving samples must acknowledge the change in custody and operational status in the LIMS. This step is required to maintain an accurate electronic record of sample status, dates of analytical activity, and custody throughout the laboratory.

Sample tracking is initiated at login where all chronological information related to sample collection dates and holding times are entered into the LIMS. This information is entered on an individual sample basis

9.6 ***Sample Acceptance Policy***. Incoming samples must satisfy Accutest's sample acceptance criteria before being logged into the system. Sample acceptance is based on the premise that clients have exercised proper protocols for sample collection. This includes sufficient volume, proper chemical preservation, temperature preservation, sample container sealing and labeling, and appropriate shipping container packing.

The sample management staff will make every attempt to preserve improperly preserved samples upon arrival. However, if preservation is not possible, the samples may be refused unless the client authorizes analysis. No samples will be accepted if holding times have been exceeded or will be exceeded before analysis can take place unless the client authorizes analysis.

Sample acceptance criteria include proper custody and sample labeling documentation. Proper custody documentation includes an entry for all physical samples delivered to the laboratory with an identification code that matches the sample bottle and a date and signature of the individual who collected the sample and delivered them to the laboratory. Labeling is done using durable waterproof labels printed with indelible heat-transfer ink.

Accutest reserves the right to refuse any sample which in its sole and absolute discretion and judgement is hazardous, toxic and poses or may pose a health, safety or environmental risk during handling or processing. The company will not accept samples for analysis using methodology that is not performed by the laboratory or for methods that lab does not hold valid accreditation unless arrangements have been made to have the analysis conducted by a qualified subcontractor.

9.7 ***Assignment of Unique Sample Identification Codes***. Unique identification codes must be assigned to each sample bottle to assure traceability and unambiguously identify the tests to be performed in the laboratory.

The sample identification coding process begins with the assignment of a unique alphanumeric job number. A job is defined as a group of samples received on the same day, from a specific client pertaining to a specific project. A job may consist of groups of samples received over multi-day period. The first character of the job number is an alpha-character that identifies the laboratory facility. The next characters are numeric and sequence by one number with each new job.

Unique sample numbers are assigned to each bottle collected as a discrete entity from a designated sample point. This number begins with the job number and incorporates a second series of numbers beginning at one and continuing chronologically for each point of collection. The test to be performed is clearly identified on the bottle label.

Alpha suffixes may be added to the sample number to identify special designations such as subcontracted tests, in-house QC checks, or re-logs. Multiple sample bottles for a specific analysis are labeled Bottle 1, Bottle 2, etc.

9.8 ***Subcontracted Analysis***. Subcontract laboratories are employed to perform analysis not performed by Accutest. The quality assurance staff evaluates subcontract laboratories to assure their quality processes meet the standards of the environmental laboratory industry prior to engagement. Throughout the subcontract process, Accutest follows established procedures to assure that sample custody is maintained and the data produced by the subcontractor meets established quality criteria.

Accutest network laboratories are considered primary subcontractors.

Subcontracting Procedure. Subcontracting procedures are initiated through several mechanisms, which originate with sample management. Samples for analysis by a subcontractor are logged into the Accutest system using regular login procedures. If subcontract parameters are part of the project or sample management has received subcontracting instructions for a specific project, a copy of the chain of custody is given to the appropriate project manager with the subcontracted parameters highlighted. This procedure triggers the subcontract process at the project management level. The Sample Management supervisor contacts an approved subcontractor to place the subcontract order. Subcontract chain of custody is processed in Sample Management Department and copy is filed with the original CoC. Sample management signs the subcontract chain of custody and ships the sample(s) to the subcontractor. The subcontract COC is filed with the original COC and the request for subcontract. Copies are distributed to the login department, the project manager, and sample management.

Client is verbally notified by Project Manager of the requirement to subcontract to the outside laboratory as soon as need Is identified by the Accutest staff. Client notification

must be verified in writing, i.e. by e-mail. Client notification may take place during the initial project set-up, or at the time of sample receipt and login.

Subcontractor data packages are reviewed by the QA Staff to assess completeness and quality compliance. If completeness defects are detected, the subcontractor is asked to immediately upgrade the data package. If data quality defects are detected, the package is forwarded to the QA staff for further review. The QA staff will pursue a corrective action solution before releasing data to the client.

Approved subcontract data is entered into the laboratory information management system (LIMS) if possible and incorporated into the final report. All subcontract data is footnoted to provide the client with a clear indication of its source. Copies of original subcontract data are always included in the data report whether in hardcopy or PDF file, depending on the data submission requirements.

Subcontract Laboratory Evaluation. The QA staff evaluates subcontract laboratories prior to engagement. As a minimum, the subcontract laboratory must provide Accutest with proof of a valid certification to perform the requested analysis for the venue where they were collected, QC criteria summary (LOD/LOQ, LCS, MS/MSD, %RPD, etc.), copy of the most recent regulatory agency audit report, and a copy of the laboratory's Summary of Qualifications (SOQ). Other beneficial materials are QSM, copies of SOPs used for the subcontracted analysis, a copy of the most recent performance evaluation study for the subcontracted parameter, and copies of the most recent third party accreditor's audit report.

Certification verification must be submitted to Accutest annually. If possible, the QA staff may conduct a site visit to the laboratory to inspect the quality system. Accutest Laboratories Southeast assumes the responsibility for the performance of all subcontractors who have successfully demonstrated their qualifications. When selecting a subcontractor for analysis not performed by Accutest, assure qualifications of the subcontractor through local QA officer.

Qualification process of a subcontract laboratory may be bypassed if the primary client directs Accutest to employ a specific subcontractor

Subcontract Laboratory Database. Accutest Laboratories Inc. maintains centralized database of preferred contractors in order to optimize sample handling and data submission process, as well as obtain competitive priced services of uniform quality throughout the network. Individual Accutest laboratories are assigned "Center of Expertise" status according to unique capabilities.

9.9 ***Sample Storage***. Following sample custody transfer, samples are assigned to various refrigerated storage areas by the sample management staff depending upon the test to be performed and the matrix of the samples. The location (refrigerator and shelf) of each sample is entered into sample location database on the line corresponding to each sample number. Samples remain in storage until the laboratory technician retrieves them into the laboratory for analysis.

Samples for volatile organics analysis are placed in storage in designated refrigerators by the sample management staff and immediately transferred to the organics group control. Sample custody is transferred to the VOC department staff. These samples are segregated according to matrix to limit opportunities for cross contamination to occur.

Organics staff is authorized to retrieve samples from these storage areas for analysis. When analysis is complete, the samples are placed back into storage.

9.10 ***Sample Login***. Following sample custody transfer to the laboratory, the documentation that describes the clients analytical requirements are delivered to the sample login group for coding and entry to the Laboratory Information management System (LIMS). This process translates all information related to collection time, turnaround time, sample analysis, and deliverables into a code which enables client requirements to be electronically distributed to the various departments within the laboratory for scheduling and execution.

The technical staff is alerted to client or project specific requirements through the use of a unique project code that is electronically attached to the job during login. The unique project code directs the technical staff to controlled specifications documents detailing the unique requirements.

9.11 ***Sample Retrieval for Analysis***. It is a responsibility of individual analyst to retrieve samples for analysis. Sample Management employs a program to facilitate sample placement and retrieval. Sample is traced around the laboratory using Status feature of LIMS.

After sample analysis has been completed, the analyst places the sample back into the storage and updates sample status.

9.12 ***Sample Disposal***. Accutest retains all samples under proper storage for a minimum of 30 days following completion of the analysis report. Longer storage periods are accommodated on a client specific basis if required. Samples may also be returned to the client for disposal.

Accutest disposes of all laboratory wastes following the requirements of the Resource Conservation and Recovery Act (RCRA). The Company has obtained and maintains a waste generator identification number, FLR00001263309002 (FLR designates State of Florida).

Sample management generates a sample disposal dump sheet from the LIMS tracking system each week, which lists all samples whose holding period has expired. Data from each sample is compared to the hazardous waste criteria established by the Florida Department of Environmental Protection (FDEP).

Samples containing constituents at concentrations above the criteria are labeled as hazardous and segregated into the following waste categories for disposal as follows:

Chlorinated Waste (Closed Top Steel Drum)- Methylene Chloride

Non-Chlorinated Waste (Closed Top Steel Drum)- Hexane, Methanol, and mixed solvents

Sodium Sulfate/Used Charcoal (Open Top Steel Drum)- Charcoal and paper filters used in the filtering of samples.

Hazardous Flammable Vials (Open Top Polypropylene Drum)- Methylene Chloride, Hexane.

Hazardous Aqueous waste (Closed Top Polypropylene Drum)- High Odor Samples, Lachat Waste.

Non Hazardous Soil (Open Top Steel Drum)- Soils.

Hazardous Solid Waste- (Open Top Steel Drum).

Non-Aqueous/Oil Samples- (Closed Top Steel Drum)

Difference between Open and Closed type of drums is whether it is possible to remove entire lid or just threaded stopper. Drums are closed at all times while in storage.

Non-hazardous aqueous samples are neutralized and collected in HDPP 500 Gal holding tank to be removed by waste company.

Non-hazardous solids are drummed and disposed of by contract waste company. Sample bottles are disposed of as recyclable waste in order to crush the bottles and destroy the labels. VOC vials are crushed on site using PRODEVA glass crusher. Supernatant liquid is siphoned off into the HDPP holding tank and solid residue drummed separately.

Laboratory wastes are collected by waste stream in designated areas throughout the laboratory. Waste streams are consolidated twice a week by the waste custodian and transferred to stream specific drums for disposal through a permitted waste management contractor. Filled, consolidated drums are tested for hazardous characteristics and scheduled for removal from the facility for appropriate disposal based on the laboratory data.

10.0 LABORATORY INSTRUMENTATION AND MEASUREMENT STANDARDS

Requirement: Procedures, which assure that instrumentation is performing to a pre-determined operational standard prior to the analysis of any samples, must be established by the laboratory. In general, these procedures will follow the regulatory agency requirements established in promulgated methodology. The instrumentation selected to perform specified analysis is capable of providing the method-specified uncertainty and sufficient sensitivity of measurement needed. These procedures must be documented and incorporated into the standard operating procedures for the method being executed. ALSE Equipment List attached as Appendix III.

10.1 ***Mass Tuning – Mass Spectrometers***. The mass spectrometer tune and sensitivity must be monitored to assure that the instrument is assigning masses and mass abundances correctly and that the instrument has sufficient sensitivity to detect compounds at low concentrations. This is accomplished by analyzing a specific mass tuning compound at a fixed concentration. If the sensitivity is insufficient to detect the tuning compound, corrective action must be performed prior to the analysis of standards or samples. If the mass assignments or mass abundances do not meet criteria, corrective action must be performed prior to the analysis of standards or samples.

10.2 ***Wavelength Verification – Spectrophotometers***. Spectrophotometer detectors are checked on a regular schedule to verify proper response to the wavelength of light needed for the test in use. If the detector response does not meet specifications, corrective action (detector adjustment or replacement) is performed prior to the analysis of standards or samples.

10.3 ***Inter-element Interference Checks (Metals)***. Inductively Coupled Plasma Emission Spectrophotometers (ICP) are subject to a variety of spectral interferences, which can be minimized or eliminated by applying interfering element correction factors and background correction points. Interfering element correction factors are checked on a specified frequency through the analysis of check samples containing high levels of interfering elements. Analysis of single element interferent solutions is also conducted at a specified frequency.

If the check indicates that the method criteria has not been achieved for any element in the check standard, the analysis is halted and data from the affected samples are not reported. Sample analysis is resumed after corrective action has been performed and the correction factors have been re-calculated.

New interfering element correction factors are calculated and applied whenever the checks indicate that the correction factors are no longer meeting criteria. At a minimum, correction factors are replaced once a year.

10.4 ***Calibration and Calibration Verification***. Many tests require calibration using a series of reference standards to establish the concentration range for performing quantitative analysis. Method specific procedures for calibration are followed prior to any sample analysis.

Calibration is performed using a linear or quadratic regression calculation or calibration factors calculated from the curve. The calibration must meet method specific criteria for linearity or precision. If the criteria are not achieved, corrective action (instrument maintenance or re-calibration) is performed. The instrument must be successfully calibrated before analysis of samples can be conducted.

Initial calibration for metals analysis performed using inductively coupled plasma (ICP) employs the use of two standards and a calibration blank to establish linearity. The calibration blank contains all reagents that are placed into the calibration standard with the exception of the target elements. Valid calibration blanks must not contain any target elements.

Initial calibrations must be initially verified using a single concentration calibration standard from a second source (i.e. separate lot or different provider). The continuing validity of an existing calibration must be regularly verified using a single concentration calibration standard. The response to the standard must meet pre-established criteria that indicate the initial calibration curve remains valid. If the criteria are not achieved corrective action (re-calibration) is performed before any additional samples may be analyzed.

10.5 ***Linear Range Verification and Calibration*** Linear range verification is performed for all ICP instrumentation and select General Chemistry methods. The regulatory program or analytical method specifies the verification frequency. A series of calibration standards are analyzed over a broad concentration range. The data from these analyses are used to determine the valid analytical range for the instrument.

Some methods or analytical programs require a low concentration calibration check to verify that instrument is sufficient to detect target elements at the reporting limit. The analytical method or regulatory program defines the criteria used to evaluate the low concentration calibration check. If the low calibration check fails criteria, corrective action is performed and verified through reanalysis of the low concentration calibration check before continuing with the field sample analysis.

In accordance with TNI standards minimum number of calibration points in the absence of method-specific requirements is two calibration points and a blank.

10.6 ***Retention Time Verification (GC/HPLC/IC)***. Chromatographic retention time windows are developed for all analysis performed using gas chromatographs with conventional detectors. An initial experimental study is performed, which establishes the width of the retention window for each compound. The retention time range of the window defines the time ranges for elution of specified target analytes on the primary and

confirmation columns. Retention time windows are established upon initial calibration, applying the retention time range from the initial study to each target compound. Retention times are regularly confirmed through the analysis of an authentic standard during calibration verification. If the target analytes do not elute within the defined range during calibration verification, the instrument must be recalibrated and new windows defined. New studies are performed when major changes, such as column replacement are made to the chromatographic system.

11.0 INSTRUMENT MAINTENANCE

Requirement. Procedures must be established for equipment maintenance. The procedure may include a maintenance schedule if required or documentation of daily maintenance related activities. All instrument maintenance activities must be documented in instrument specific logbooks. All equipment out of service (both analytical and auxiliary) must be clearly marked "Out of Order".

11.1 ***Routine, Daily Maintenance***. Routine, daily maintenance is required on an instrument specific basis. It is performed each time the instrument is used. Daily maintenance traditionally includes activities to insure a continuation of good analytical performance. In some cases, they include performance checks that indicate whether non-routine maintenance is required. If the performance check indicates a need for higher level maintenance, the equipment is taken out of service until maintenance is performed. Analysis cannot be continued until the performance checks meet established criteria. Document return to control. Daily maintenance is the responsibility of the individual assigned to the instrument used for the analysis he is performing.

11.2 ***Non-routine Maintenance***. Non-routine maintenance is reserved for catastrophic occurrences such as instrument failure. The need for non-routine maintenance is indicated by failures in general operating systems that result in an inability to conduct required performance checks or calibration. Equipment in this category are taken out of service and repaired before attempting further analysis. Analysis cannot continue until the instrument meets all performance check criteria and is capable of being calibrated. Section supervisors are responsible for identifying non-routine maintenance episodes and initiating repair activities to bring the equipment on-line. This may include initiating telephone calls to maintenance contractors if necessary. They are also responsible for documenting all details related to the occurrence and the repair.

11.3 ***Scheduled Maintenance***. Modern laboratory instrumentation rarely requires regular preventative maintenance. Where required, the equipment is placed on a schedule, which dictates when maintenance is required. Examples include annual balance calibration by an independent provider and optical alignment of the ICP. Section supervisors are responsible for initiating scheduled maintenance on equipment that requires scheduled preventative attention. Scheduled maintenance is documented using routine documentation practices.

11.4 ***Maintenance Documentation***. Routine and non-routine maintenance activities are documented in logbooks assigned to instruments and equipment used for analytical measurements. The logbooks contain preprinted forms, which specify the maintenance activities required with each use. Accutest Laboratories Southeast has adopted a problem – action – follow-up format to conduct instrument maintenance. The analyst or supervisor who performs or initiates the maintenance activity is required to check the activity upon its completion, verify complete statement of return to normal conditions and initial the form. Non-routine maintenance (i.e. repairs, upgrades, etc.) is documented as well either electronically via e-mail from the service provider or receipt attached to the maintenance log.

12.0 QUALITY CONTROL PARAMETERS, PROCEDURES, AND CORRECTIVE ACTION

Requirement: All procedures used for test methods must incorporate quality control parameters to monitor elements that are critical to method performance. Each quality parameter includes acceptance criteria that have been established by regulatory agencies for the methods in use. Criteria may also be established through client dictates or through the accumulation and statistical evaluation of internal performance data. Data obtained from these parameters must be evaluated by the analyst, and compared to established method criteria. If the criteria are not achieved, the procedures must specify corrective action and conformation of control before proceeding with sample analysis. QC parameters, procedures, and corrective action must be documented within the standard operating procedures for each method. In the absence of client specific objectives the laboratory must define qualitative objectives for completeness and representativeness of data.

12.1 ***Procedure***. Bench analysts are responsible for methodological quality control and sample specific quality control. Each method specifies the control parameters to be employed for the method in use and the specific procedures for incorporating them into the analysis. These control parameters are analyzed and evaluated with every designated sample group (batch).

The data from each parameter provides the analyst with critical decision making information on method performance. The information is used to determine if corrective action is needed to bring the method or the analysis of a specific sample into compliance. These evaluations are conducted throughout the course of the analysis. Each parameter being indicative of a critical control feature. Failure of a methodological control parameter is indicative of either instrument or batch failure. Failure of a sample control parameter is indicative of control difficulties with a specific sample or samples.

Sample Batch. All samples analyzed in the laboratory are assigned to a designated sample batch, which contains all required quality control samples and a defined maximum number of field samples that are prepared and/or analyzed over a defined time period. The maximum number of investigative and field QC samples in the batch is 20. Accutest has incorporated the NELAP batching policy as the sample-batching standard. This policy incorporates the requirement for blanks and spiked blanks as a time based function as defined by NELAP. The typical batch contains a blank, laboratory control sample (LCS or spiked blank), matrix spike and matrix spike duplicate. Batch documentation includes lot specifications for all reagents and standards used during preparation of the batch.

12.2 ***Methodological Control Parameters and Corrective Action***. Prior to the analysis of field sample the analyst must determine that the method is functioning properly. Specific control parameters indicate whether critical processes meet specified requirements before continuing with the analysis. Method specific control parameters must meet criteria before sample analysis can be conducted. Each of these

parameters is related to processes that are under the control of the laboratory and can be adjusted if out of control.

Method Blank. A method blank is analyzed during the analysis of any field sample. The method blank is defined as a sample. It contains the same standards (internal standards, surrogates, matrix modifiers, etc.) and reagents that are added to the field sample during analysis, with the exception of the sample itself. If the method blank contains target analyte(s) at concentrations that exceed method or client requirements (typically defined as 1/2 RL concentrations), the source of contamination is eliminated before proceeding with sample analysis. Systematic contamination is documented for corrective action and resolved following the established corrective action procedures. In specific cases, contamination detected in the method blank may be acceptable if the concentrations do not exceed regulatory limits or client defined reporting limits.

Laboratory Control Samples (LCS or Spiked Blanks). A laboratory control sample (spiked blank or commercially prepared performance evaluation sample) is analyzed along with field samples to demonstrate that the method accuracy is within acceptable limits. These spike solutions are derived from different sources than the solutions used for method calibration. The performance limits are derived from published method specifications or from statistical controls generated from laboratory method performance data. Spiked blanks are blank matrices (reagent water or clean sand) spiked with the targeted parameters and analyzed using the same method used for samples. Accuracy data is compared to laboratory experimentally derived limits to determine if the method is in control. Laboratory control samples (LCS) are commercially prepared spiked samples in an inert material. Performance criteria for recovery of spiked analytes is pre-established by the commercial entity preparing the sample. This sample is analyzed in the laboratory as an external reference.

Accuracy data is compared to the applicable performance limits. If the spike accuracy exceeds the performance limits, corrective action, as specified in the SOP for the method is performed and verified before continuing with a field sample analysis. In some cases, decisions are made to continue with sample analysis if performance limits are exceeded; provided the unacceptable result has no negative impact on the sample data.

Marginal exceedance (ME) values are calculated for methods containing more than eleven (11) targeted analytes. The ME is calculated as $\pm$ 4 standard deviations about the mean. MEs are considered for multi-analyte methods because of the increased likelihood of LCS failure as the number of analytes in the method increase. The number of allowable MEs is based on the number of target analytes in the method. Analytes that regularly fall into the ME category are treated as systematic problems, which are resolved using established trend monitoring and corrective action procedures. Marginal Exceedances are not applied to parameters that are detected in field samples. Routine corrective action is initiated for all cases where LCS spike accuracy criteria is beyond the established control limits and the parameter is detected in field samples corresponding to the unacceptable LCS.

Blanks and spikes are routinely evaluated before samples are analyzed. However, in situations where sample analysis is performed using an autosampler, they may be evaluated after sample analysis has occurred. If the blanks and spikes do not meet criteria, sample analysis is repeated.

Proficiency Testing. Performance Evaluation (Proficiency Testing) samples (PEs, PTs) are single or double blind samples spiked with know amount of analytes on interest and introduced to the laboratory to assess method performance. PEs may be introduced as double blinds submitted by commercial clients, single or double blinds from regulatory agencies, or internal blinds submitted by the QA group.

A minimum of two single blind studies must be performed each year for every parameter in aqueous and solid matrices for each field of proficiency testing (FOPT) for which the laboratory maintains accreditation. Proficiency Testing samples must be purchased as blinds from an accredited vendor. Data from these studies are provided to the laboratory by the vendor and reported to accrediting agencies. If unsatisfactory performance is noted, corrective action is performed to identify and eliminate any sources of error. A new PT must be analyzed to demonstrate continuing proficiency.

PE samples performed for accrediting agencies or clients, which do not meet performance specifications, require a written summary that documents the corrective action investigation, findings, and corrective action implementation.

Single or double blind PT samples are employed for self-evaluation purposes. Data from these analyses are compared to established performance limits. If the data does not meet performance specifications, the system is evaluated for sources of acute or systematic error. If required, corrective action is performed and verified before initiating or continuing sample analysis.

Trend Analysis for Control Parameters. Accuracy data for selected spiked parameters from the laboratory control sample (LCS) is statistically evaluated daily for trends. Data from selected LCS parameters and surrogates are pooled on a method, matrix, and instrument basis. This data is evaluated by comparison to existing control and warning limits. Trend analysis is performed automatically as follows:

- Any point outside the control limit
- Any three consecutive points between the warning and control limits
- Any eight consecutive points on the same side of the mean
- Any six consecutive points increasing or decreasing

The results of the trend analysis are printed for supervisory evaluation prior to sample analysis. Trends that indicate the potential loss of statistical control are further evaluated to determine the impact on data quality and to determine if corrective action is necessary. If corrective action is indicated, the supervisor informs the analysts of

the corrective actions to be performed. Return to control is demonstrated before analysis resumes.

12.3 ***Sample Control Parameters and Corrective Action***. The analysis of samples can be initiated following a successful demonstration that the method is operating within established controls. Additional controls are incorporated into the analysis of each sample to determine if the method is functioning within established specifications for each individual sample. Sample QC data is evaluated and compared to established performance criteria. If the criteria are not achieved the method or the SOP specifies the corrective action required to continue sample analysis. In many cases, failure to meet QC criteria is a function of sample matrix and cannot be remedied. Each parameter is designed to provide quality feedback on a defined aspect of the sampling and analysis episode.

Duplicates. Duplicate sample analysis is used to measure analytical precision. This can also be equated to laboratory precision for homogenous samples. Precision criteria are method dependent. If precision criteria are not achieved, corrective action or additional action may be required. Recommended action must be completed before sample data can be reported.

Laboratory Control Duplicate, Spikes & Spiked Duplicates. Spikes and spiked duplicates are used to measure analytical precision and accuracy for the sample matrix selected. Precision and accuracy criteria are method dependent. If precision and accuracy criteria are not achieved, corrective action or additional action may be required. Recommended action must be completed before sample data can be reported.

Serial Dilution (Metals). Serial dilutions of metals samples are analyzed to determine if analytical matrix effects may have impacted the reported data. If the value of the serially diluted samples does not agree with the undiluted value within a method-specified range, the sample matrix may be causing interference, which may lead to either a high or low bias. If the serial dilution criterion is not achieved, it must be flagged to indicate possible bias from matrix effects. *Accutest-SE uses this procedure as opposed to post-digestion spike unless contractual obligations absolutely require latter*

Post Digestion Spikes. Digested samples are spiked and analyzed to determine if matrix interferences are creating biases in the results. It may also be used to determine potential interferences per client's specification. Spike concentration is determined as per analytical method. No action is necessary if the post digestion spike is outside of the method criteria, unless a preparation problem is suspected with the spike, in which case the post digestion spike should remade and reanalyzed.

Surrogate Spikes (Organics). Surrogate spikes are organic compounds that are similar in behavior to the target analytes but unlikely to be found in nature. They are added to all quality control and field samples to measure method performance for each individual sample. Surrogate accuracy limits are derived from published method

specifications or by statistical evaluation of laboratory generated surrogate accuracy data. Accuracy data is compared to the applicable performance limits. If the surrogate accuracy exceeds performance limits, corrective action, as specified in the method or SOP is performed before sample data can be reported.

Internal Standards (Organic Methods). Internal standards are retention time and instrument response markers added to every sample to be used as references for quantitation. Their response is compared to reference standards and used to evaluate instrument sensitivity on a sample specific basis. Internal standard retention time is also compared to reference standards to assure that target analytes are capable of being located by their individual relative retention time.

If internal standard response criteria are not achieved, corrective action or additional action may be required. The recommended action must be completed before sample data can be reported.

If the internal standard retention time criteria are not achieved corrective action or additional action may be required. This may include re-calibration and re-analysis. Additional action must be completed before sample data is reported.

Internal Standards (ICP Metals). Internal standards are used on ICP instruments to compensate for variations in response caused by differences in sample matrices. This adjustment is performed automatically during sample analysis. The internal standard response of replicated sample analysis is monitored to detect potential analytical problems. If analytical problems are suspected, then the field samples are reanalyzed.

12.4 ***Laboratory Derived Quality Control Criteria.*** Control criteria for in-house methods and client specific modifications that exceed the scope of published methodology are defined and documented prior to the use of the method. The Quality Assurance staff identifies the responsibility for control criteria needs. Control parameters and criteria, based on best technical judgement are established using input provided by the operations staff. These control parameters and criteria are documented and incorporated into the method.

The laboratory derived criteria are evaluated for technical soundness on spiked samples prior to the use of the method on field samples. The technical evaluation is documented and archived by the Quality Assurance staff.

When sufficient data form the laboratory developed control parameter is accumulated, the data is statistically processed and the experimentally derived control limits are incorporated into the method.

12.5 ***Bench Review & Corrective Action***. The bench chemists are responsible for all QC parameters. Before proceeding with sample analysis, they are required to successfully meet all instrumental QC criteria. They have the authority to perform any necessary corrective action before proceeding with sample analysis. Their authority

includes the responsibility for assuring that departures from documented policies and procedures do not occur.

The bench chemists are also responsible for all sample QC parameters. If the sample QC criteria are not achieved, they are authorized and required to perform the method specified corrective action before reporting sample data.

Data Qualifiers. An alpha character coding system is employed for defining use limitations for reported data. These limitations are applied to analytical data by the analyst to clarify the usefulness of the reported data for data user. Accutest Laboratories Southeast qualifies data in accordance with program-specific requirements, such as State of Florida DEP, AFCEE, etc., and these qualifiers are hard-coded in the LIMS on project level. Definitions of common qualifiers could be found at the bottom of the sample report form.

12.6 ***QA Monitoring***. The QA staff prior to client release conducts a spot review of completed data packages. This review includes an examination of QC data for compliance and trends indicative of systematic difficulties. If non-conformances are detected, the QA staff places an immediate stop on the release of the data and initiates corrective action to rectify the situation. The data package is released when the package becomes compliant with all quality requirements.

If the review reveals trends indicative of systematic problems, QA initiates an investigation to determine the cause. If process defects are detected, a corrective action is implemented and monitored for effectiveness.

Performance Limits. The Technical Director is responsible for compilation and maintenance of all precision and accuracy data used for performance limits. Quality control data for all test methods are accumulated and stored in the laboratory information management system (LIMS). Parameter specific QC data is extracted annually and statically processed to eliminate outliers and develop laboratory specific warning limits and confidence limits. The new limits are reviewed and approved by the supervisory staff prior to their use for data assessment. The new limits are used to evaluate QC data for compliance with method requirements for a period of one year. Laboratory generated limits appear on all data reports unless method specifies hard-coded limits (mostly General Chemistry and Metals)

12.7 ***Data Package Review***. Accutest employs multiple levels of data review to assure that reported data has satisfied all quality control criteria and that client specifications and requirements have been met. Production departments have developed data review procedures which must be conducted before data is released to the client.

Analytical Review. The analyst conducts the primary review of all data. This review begins with a check of all instrument and method quality control and progresses through sample quality control concluding with a check to assure that the client's requirements have been executed. Analyst checks focuses on a review of qualitative

determinations and checks of precision and accuracy data to verify that existing laboratory criteria have been achieved. Checks at this level may include comparisons with project specific criteria if applicable. The analyst has the authority and responsibility to perform corrective action for any out-of-control parameter or nonconformance at this stage of review.

Secondary data reviews are performed at the peer level by analysts who have met the qualification criteria for the method in use. Qualification requirements include a valid demonstration of capability and demonstrated understanding of the method SOP. Section supervisors may perform secondary review in-lieu of a peer review Secondary review is performed on 100% of the data produced by their department. It includes a check of all manual calculations; an accuracy check of manually transcribed data from bench sheets to the LIMS, a check of all method and instrument QC criteria, baseline manipulations (if applicable) and a comparison of the data package to client specified requirements. Also included are checks to assure the appropriate methodology was applied and that all anomalous information was properly flagged for communication in the case narrative. Supervisors have the authority to reject data and initiate re-analysis, corrective action, or reprocessing.

All laboratory data requiring manual entry into LIMS system is double-checked by the analysts performing initial data entry and the section supervisor. Verification of supervisory review is indicated on the raw data summary by the supervisor's initials and date.

Electronic data that is manually edited at the bench by the primary analysts is automatically flagged by the instrument data system indicating an override by the analyst. All manual overrides must be verified and approved by a supervisor who initials and dates all manual changes.

Hard copies of manually integrated chromatographic peaks are printed that clearly depict the manually drawn baseline. The hard copy is reviewed and approved by the reviewer (initialed and dated) and included in the data package of all full tier reports or the archived batch records of commercial report packages.

Electronic data that has been committed to the LIMS can only be edited by a manager or supervisor. These edits may be required if needs for corrections are indicated during the final review. An audit record for all electronic changes in the LIMS is automatically appended to the record.

The group manager performs a tertiary review on a spot check basis. This review includes an evaluation of QC data against acceptance criteria and a check of the data package contents to assure that all analytical requirements and specifications were executed.

Report Generation Review. The report generation group reviews all data and supporting information delivered by the laboratory for completeness and compliance

with client specifications. Missing deliverables are identified and obtained from the laboratory. The group also reviews the completed package to verify that the delivered product complies with all client specifications. Non-analytical defects are corrected before the package is sent to the client.

Project Management/Quality Assurance Review. Spot-check data package reviews are performed by the project manager. Project management reviews focus on project specifications. If the project manager identifies defects in the product prior to release, he initiates immediate corrective action to rectify the situation.

The QA Staff reviews approximately 10% of the data produced. The QA review focuses on all elements of the deliverable including the client's specifications and requirements, analytical quality control, sample custody documentation and sample identification. QA reviews at this step in the production process are geared towards systematic process defects, which require procedural changes to effect a corrective action. However, if defects are identified that can be corrected prior to data release, the QA staff returns the package to the laboratory for corrective action. QA data review cannot be used in lieu of a peer level review or a supervisory review.

Data Reporting. Analytical data is released to clients following secondary departmental review. Data release at this stage of the process is limited to electronic information, which is released to clients through a secure, encrypted, password protected, Internet connection.

Hard copy support data is compiled by the report generation group and assembled into the final report. The report is sent to the client following reviews by report generation, and spot-check by QA staff.

All data reports include specified information, which is required to identify the report and its contents. This information includes a title, name and address of the laboratory, a unique report number, total number of pages in the report, clients name and address, analytical method identification, arriving sample condition, sample and analysis dates, test results with units of measurement, authorized signature of data release, statement of applicability, report reproduction restrictions and TNI requirements certification. Subcontracted data is clearly identified.

In the event of report revision date of the revision, nature of revision and identity of the person revising the report must be clearly stated in the body of the report. Depending on the level of the deliverables it could be either stated in the Case Narrative or Case Narrative generated specifically for this purpose. Case Narrative must state "supercedes all previous reports".

12.8 ***Electronic Data Reduction.*** Raw data from sample analysis is entered into the laboratory information management system (LIMS) using automated processes or manual entry. Final data processing is performed by the LIMS using procedures developed by the Company.

All LIMS programs and internally developed software (including Excel spreadsheets) are tested and validated prior to use to assure that they consistently produce correct results. Validation testing is performed by the Information Technology Staff. The testing procedures are documented in an SOP. Programs are not approved for use until they have demonstrated that they are capable of performing the required calculations.

12.9 ***Representativeness***. Data representativeness is based on the premise that qualitative and quantitative information developed for field samples is characteristic of the sample that was collected by the client and analyzed in the laboratory. The laboratory objective for representativeness defines data as representative if the criteria for all quality parameters associated with the analysis of the sample are achieved.

12.10 ***Comparability***. Analytical data is defined as comparable when data from a sample set analyzed by the laboratory is representatively equivalent to other sample sets analyzed separately regardless of the analytical logistics. The laboratory will achieve 100% comparability for all sample data which meets the criteria for the quality parameters associated with its analysis using the method requested by the client.

13.0 CORRECTIVE ACTION SYSTEM

Requirement. The laboratory must have polices and procedures for correcting defective processes, systematic errors, and quality defects, which enables the staff to systematically improve product quality. The system must include procedures for communicating items requiring corrective action, corrective action tracking procedures, corrective action documentation, monitoring of effectiveness, and reports to management. The system must be documented in a standard operating procedure.

13.1 ***Procedure***. Corrective action is the step that follows the identification of a process defect. The type of defect determines the level of documentation, communication, and training necessary to prevent re-occurrence of the defect or non-conformance.

Routine Corrective Action. Routine corrective action is defined as the procedures used to return out of control analytical systems back to control. This level of corrective action applies to all analytical quality control parameters or analytical system specifications.

Bench analysts have full responsibility and authority for performing routine corrective action. The resolution of defects at this level does not require a procedural change or staff re-training. The analyst is free to continue work once corrective action is complete and the analytical system has been returned to control. Documentation of routine corrective action is limited to bench logbook or maintenance logbook comment.

Process Changes. Corrective actions in this category require procedural modifications. They may be the result of systematic defects identified during audits, the investigation of client inquiries, failed proficiency tests, product defects identified during data review, or method updates. Resolution of defects of this magnitude requires formal identification of the defect, development and documentation of a corrective action plan, and staff training to communicate the procedural change.

Technical Corrective Action. Technical corrective action encompasses routine corrective action performed by bench analysts for out of control systems and corrective actions performed for data produced using out of control systems. Technical corrective action for routine situations is conducted using the procedures detailed above.

Non-routine corrective actions apply to situations where the bench analysts failed to perform routine corrective action before continuing analysis. Supervisors and Department Managers perform corrective action in these situations. Documentation of all non-routine corrective actions is performed using the corrective action system.

Sample re-analysis is conducted if sufficient sample and holding time remain to repeat the analysis using an in-control system. If insufficient sample or holding time remains, the data is processed and qualifiers applied that describe the out of control situation. The occurrence is further documented in the case narrative and in the corrective

action response. The corrective action must include provisions for retraining the analysts who failed to perform routine corrective action.

13.2 ***Documentation & Communication***. Routine corrective actions are documented as part of the analytical record. Notations are made in the comments section of the analytical chronicle or data sheet detailing the nonconformance. Continuation of the analysis indicates that return to control was successful.

Corrective actions for process changes are documented, tracked and monitored for effectiveness. Corrective actions may be initiated by any supervisor or senior staff member by completing the corrective action form in Corrective Action database

The corrective action database is an Access application. The initiator generates the corrective action investigation form, which is documented, tracked, distributed to responsible parties and archived through the application. The application assigns a tracking number initiation data and due date to each corrective action initiated and copies the corrective action form to the corrective action database. The application also distributes an E-mail message containing the form to the responsible parties for resolution.

Corrective Action system employs Deficiency – Root Cause – Immediate Fix – Corrective action approach, further divided into categories of Analytical Error, Omission Error, Random Error, Systemic Error and Training Issue.

The responsible party develops and implements the procedural change. Existing documentation such as SOPs are edited to reflect the change. The affected staff is informed of the procedural change through a formal training session. The training is documented and copies are placed into individual training files. The corrective action form is completed and closed in CA database.

Initial and completed corrective action forms are maintained in the Corrective Action directory. This information is archived daily. Copies of training records describing corrective actions are appended to the involved individuals training files.

Monitoring. The QA Staff monitors the implemented corrective action until it is evident that the corrective action has been effective and the systematic deficiency has been eliminated. The corrective action database is updated by QA to reflect closure of the corrective action. The QA staff also assigns an error code to the corrective action for classification of the type of errors being committed.

If QA determines that the corrective action procedure has not effectively remedied the deficiency, the process continues with a re-initiation of the corrective action. Corrective action continues until the defective process is eliminated. If another procedural change is required, it is treated as a new corrective action, which is documented and monitored using established procedures.

Client Notification. Defective processes, systematic errors, and quality defects, detected during routine audits may have negative impacts on data quality. In some cases, data that has been released to clients may be affected. If defective data has been released for use, Accutest will notify the affected clients of the defect and provide specific details regarding the magnitude of the impact to their data.

14.0 PROCEDURES FOR EXECUTING CLIENT SPECIFICATIONS

Requirement. Systems must be established for evaluating and processing client specifications for routine and non-routine analytical services. The systems must enable the client services staff to identify, evaluate, and document the requested specifications to determine if adequate resources are available to perform the analysis. The system must include procedures for communicating the specifications to the laboratory staff for execution and procedures for verifying the specifications have been executed.

14.1 ***Client Specific Requirements***. The project manager is the primary contact for clients requesting laboratory services. Client specifications are communicated using several mechanisms. The primary source of information is the client's quality assurance project plan (QAPP) which details analytical and quality control specifications for the project. In the absence of a QAPP, projects specifications can also be communicated using contracts, letters of authorization, or letters of agreement, which may be limited to a brief discussion of the analytical requirements and the terms and conditions for the work. These documents may also include pricing information, liabilities, scope of work, in addition to the analytical requirements. QAPPs include detailed analytical requirements and data quality objectives, which supersede those found in the referenced methods. This information is essential to successful project completion.

Laboratory also reviews its Accreditation status to evaluate whether it is possible to accept proposed project. Discrepancies must be resolved before the work commences.

The client services staff provides additional assistance to clients who are unsure of the specifications they need to execute the sampling and analysis requirements of their project. They provide additional support to clients who require assistance in results interpretation as needed, provided they possess the expertise required to render an opinion.

The project manager is responsibility for obtaining project documents, which specify the analytical requirements. Following project management review, copies are distributed to the QA staff and the appropriate departmental managers for review and comment. The original QAPP is numbered with a document control number and filed in a secure location.

14.2 ***Requirements for Non-Standard Analytical Specifications***. Client requirements that specify departures from documented policies, procedures, or standard specifications must be submitted to Accutest in writing. These requirements are reviewed and approved by the technical staff before the project is accepted. Once accepted, the non-standard requirements become analytical specifications, which follow the routine procedure for communicating client specifications. Departures from documented policies, procedures, or standard specifications that do not follow this procedure are not permitted.

Exception Policy: With respect to the quality system, incoming non-conforming product refers to received samples that do not meet requirements of custody documentation, are improperly packaged or stored or are contaminated. An internal non-conformance refers to a problem, caused internally due to improper handling of samples, improper sampling methods, and equipment malfunction or data management errors. The individual who identifies the incoming non-conformance is responsible for notifying the project manager. The project manager resolves the issue with the client. The individual who recognizes an internal non-conformance is responsible for initiating corrective action

Departures from standard practices, policies and specifications are reviewed and approved by Technical Director, QA Officer and by Project Manager of the project affected.

Corrective & Preventative Action: Once a quality problem has been identified, the analytical or review process stops, until the reason is identified. Primary responsibility for identifying the cause of the problem rests with the instrument operator. Other staff may be called on to assist in reaching the root cause. The problem prevention tracking system, using Corrective Action Tracking Records, provides a method to track systemic problems until resolved/removed. The QA Officer is responsible for the record management with respect to the disposition of problems.

Deviations that do not limit themselves to a single department and/or client are cited on Corrective Action Record. This may include but not limited to: sample arrival outside of EPA specified holding time, analysis completion outside of EPA specified holding time (with explanation of the reason), inconsistencies between chain of custody and cooler contents, including labeling errors, improper preservation, etc.

Deviations from analytical methods' SOP's are reported by the Analyst to the Section Leader. Single occurrences warrant completion of Corrective Action Tracking record, repetitive occurrences may indicate that either an additional training session is in order, or the SOP does not reflect proper laboratory practice. Training session is conducted by the Technical Director or by QA Officer. In case where SOP does not reflect current laboratory practice, SOP review and correction process may be initiated.

14.3 ***Evaluation of Resources.*** A resource evaluation is completed prior to accepting projects submitted by clients. The evaluation is initiated by the client services staff receives project requirements (usually in the form of QAPjP) and distributes these requirements to the laboratory departments affected. The specifications are evaluated by the department managers from a scheduling and hardware resources perspective. The project is not accepted unless the department managers have the necessary resources to execute the project according to client specifications.

14.4 ***Documentation***. New projects are initiated using a project set up form, which is completed prior to the start of the project. This form details all of the information needed to correctly enter the specifications for each client sample into the laboratory information management system (LIMS, see example). The form includes data reporting requirements, billing information, data turnaround times, QA level, state of origin, and comments for detailing project specific requirements. The project manager is responsible for obtaining this information from the client and completing the form prior to sample arrival and login.

Sample receipt triggers project creation and the login process. The information on the set-up form is entered into the LIMS immediately prior to logging in the first sample. The set up form may be accompanied by a quotation, which details the analytical product codes and sample matrices. These details are also entered into the LIMS during login.

Special information is distributed to the laboratory supervisors and login department in electronic or hardcopy format upon project setup. All project specific information is retained by the project manager in a secure file. The project manager maintains a personal telephone log, which details conversations with the client regarding the project.

14.5 ***Communication***. A pre-project meeting is held between client services and the operations managers to discuss the specifications described in the QAPjP and/or related documents. Project logistics are discussed and finalized and procedures are developed to assure proper execution of the client's analytical specifications and requirements. Questions, raised in the review meeting, are discussed with the client for resolution. Exceptions to any requirements, if accepted by the client, are documented and incorporated into the QAPjP or project documentation records.

Non-standard specifications for individual clients are documented in the LIMS at the client account level. Once entered into the LIMS, these specifications become memorialized for all projects related to the client account. Upon sample arrival, these specifications are accessed through a terminal or printed as a hard copy and stored in a binder for individuals who require access to the specification. Specifications that are not entered into the LIMS are prohibited unless documented in an interdepartmental memo, which clearly identifies the project, client and effective duration of the specification.

14.6 ***Operational Execution***. A work schedule is prepared for each analytical department on a daily basis. Analytical specifications from recently arrived samples have now been entered into the LIMS database. The database is sorted by analytical due date and holding time, into product specific groups. Samples are scheduled for analysis by due date and holding time. The completed schedule, which is now defined as a work list, is printed. The list contains the client requested product codes and specifications required for the selected sample(s). Special requirements are communicated to the analyst using the comments section or relayed through verbal instructions provided by

the supervisor. The bench analyst assumes full responsibility for performing the analysis according to the specifications printed on the work sheet.

14.7 ***Verification***. Prior to the release of data to the client, laboratory section managers and the report generation staff review the report and compare the completed product to the client specifications documentation to assure that all requirements have been met. Project managers perform a spot check of projects with unique requirements to assure that the work was executed according to specifications.

15.0 CLIENT COMPLAINT RESOLUTION PROCEDURE

Requirement. A system for managing and reconciling client complaints must be implemented in the laboratory. The system must include procedures for documenting client complaints and communicating the complaint to the appropriate department for resolution. The system must also include a quality assurance evaluation to determine if the complaint is related to systematic defects requiring process changes.

15.1 ***Procedure***. Client complaints are communicated to client services representatives, quality assurance staff, or senior management staff for resolution. The individual receiving the complaint retains the responsibility for documentation and communicating the nature of the complaint to the responsible department(s) for resolution. The responsible party addresses the complaint. The resolution is communicated to quality assurance (QA) and the originator for communication to the client. QA reviews the complaint and resolution to determine if systematic defects exist. If systematic defects are present, QA works with the responsible party to develop a corrective action that eliminates the defect.

Documentation. Client's complaints are documented by the client service representative receiving the complaint. A record of the telephone conversation is maintained by client services. Client service staff enters the complaint into Data Challenge database or Client Complaint database, depending on the nature of complaint. These databases are cross-linked with corrective action database – see sec. 13. Complaint is communicated to the production departments concerned via auto e-mail. The complaint resolution is documented in the database by the responsible party and resultant e-mail returned to the originator. QA staff is copied on the correspondence.

15.2 ***Corrective Action***. Responses to Data Challenges/Client Complaints are required from the responsible party. At a minimum, the response addresses the query and provides an explanation to the complaint. Corrective action may focus on the single issue expressed in the complaint. Corrective action may include job case narrative generation, reprocessing of data, editing of the initial report, and re-issue to the client. If the QA review indicates a systematic error, process modification is required. The defective process at the root of the complaint is changed. SOPs are either created or modified to reflect the change. The party responsible for the process implements process changes.

15.3 ***QA Monitoring***. Process changes, implemented to resolve systematic defects, are monitored for effectiveness by QA. If monitoring indicates that the process change has not resolved the defect, QA works with the department management to develop and implement an effective process. If monitoring indicates that the defect has been resolved, monitoring is slowly discontinued. Continued monitoring is incorporated as an element of the annual system audit and annual Management Report (see 18.8).

16.0 CONTROL OF NONCONFORMING PRODUCT

Requirement: Policies and procedures have been developed and implemented that describe the procedures employed by the laboratory when any aspect of sample analysis or data reporting do not conform to established procedures or client specifications. These procedures include steps to ensure that process defects are corrected and affected work is evaluated to assess its impact to the client.

Procedure. Nonconforming product is identified through multiple channels, such as second level analytical data review, routine internal review and audit practices, external auditing or through client inquiry. Responsibility and authority for the management of the non-conforming product directly defined by a nature of a non-conformance. For example, non-conformances resulting from internal and external reviews are evaluated and managed by QA Staff. Corrective Action items are issued and followed to completion and verification that defect is prevented from reoccurring. Non-conformances stemming from client inquiry are managed by Project Management staff with QA staff oversight.
Data associated with out-of compliance QC are evaluated by bench personnel and section supervisors. The analyst has the authority and responsibility to perform corrective action for any out-of-control parameter or nonconformance at this stage of review.
If non-conformances are detected, the QA staff places an immediate stop on the release of the data and initiates corrective action to rectify the situation

Non-conformances and their significance are communicated in case narrative and sample report footnotes. Case narrative comments and sample repot footnotes must state the impact on data quality.

Corrective Action. The outcome of the evaluation dictates the course of action. The type of defect determines the level of documentation, communication, and training necessary to prevent re-occurrence of the defect or non-conformance This may include at a minimum client notification, but may also include corrective action. Immediate corrective action is performed using the SOP-specified procedures. However, additional action may be required including cessation of analysis and withholding and/or recalling data reports. If the evaluation indicates that nonconforming data may have been issued to clients, the client is immediately notified and data may be recalled following the procedures specified in respective SOPs. If work has been stopped because of a nonconformance, the Laboratory Director is the only individual authorized to direct a resumption of analysis.
Nonconformances caused by systematic process defects require retraining of the personnel involved as an element of the corrective action solution. Routine corrective actions are documented as part of the analytical record.

17.0 CONFIDENTIALITY PROTECTION PROCEDURES

Requirements: Policies and procedures are required to protect client data from release to unauthorized parties or accidental release of database information through accidental electronic transmission or illegal intrusion. These policies must be communicated to clients and staff. Electronic systems must be regularly evaluated for effectiveness.

17.1 ***Client Anonymity***. Information related to the Company's clients is granted to employees on a "need to know" basis. An individual's position within the organization defines his "need to know". Individuals with "need to know" status are given password access to systems that contain client identity information and access to documents and document storage areas containing client reports and information. Access to client information by individuals outside of the Company is limited to the client and individuals authorized by the client.

Individuals outside of the Company may obtain client information through subpoena issued by a court of valid jurisdiction. Clients are informed when subpoenas are received ordering the release of their information.

17.2 ***Documents***. Access to client documents is restricted to employees in need to know positions. Copies of all client reports are stored in secure archive with restricted access. Reports and report copies are distributed to individuals who have been authorized by the client to receive them. Documents are not released to third parties without verbally expressed or written permission from the client.

17.3 **Confidential Business Information (CBI).** Operational documents including SOPs, Quality Manuals, personnel information, internal operations statistics, and laboratory audit reports are considered confidential business information. Strict controls are placed on the release of this information to outside parties.

Release of CBI to outside parties or organizations may be authorized upon execution of a confidentiality agreement between Accutest and the receiving organization or individual. CBI information release is authorized for third party auditors and commercial clients in electronic mode as Adobe Acrobat .PDF format only. See also Sec. 6.5.

17.4 ***Electronic Data***.

Database Intrusion. Direct database entry is authorized for employees of Accutest only on a need to know basis. Entry to the database is restricted through a user specific multiple password entry system. Direct access to the database outside of the facility is possible through a VPN connection. A unique password is required for access to the local area network. A second unique password is required to gain access to the database. The staff receives read or write level authorization on a hierarchical privilege basis.

Internet Access. Access to client information is through an HTTP Web application only. It does not contain a mechanism that allows direct access to the database. Clients can gain access to their data only using a series of Accutest assigned accounts, and client specific passwords. The viewable data, which is encrypted during transmission, consists of an extraction of database information only.

Client Accessibility. Accessibility to client data delivered via electronic means follows strict protocols to insure confidentiality. Clients accessing electronic data are assigned a company account. The account profile, which is established by the MIS staff, grants explicit access to explicit information pertaining to the clients project activity. Passwords are assigned on an individual basis within a client account. These accounts can be activated or deactivated by the MIS staff only.

17.5 ***Information Requests***. Client specific data or information is not released to third parties without verbally expressed or written permission from the client. Written permission is required from third parties, who contact the Company directly for the release of information. Verbal requests will be honored only if they are received directly from the client. These requests must be documented in a record of communication maintained by authorized recipient.

17.6 ***Transfer of Records***. Archived data, which has previously been reported and transmitted to clients, is the exclusive property of Accutest Laboratories. In the event of a cessation of business activities due to business failure or sale, The Company's legal staff will be directed to arrange for the final disposition of archived data.

The final disposition of archived data will be accomplished using the approach detailed in the following sequence:

1. All data will be transferred to the new owners for the duration of the required archive period as a condition of sale.

2. If the new owners will not accept the data or the business has failed, letters will be sent to clients listed on the most recent active account roster offering them the option to obtain specific reports (identified by Accutest Job Number) at their own expense.

3. A letter will be sent to the TNI accrediting authority with organizational jurisdiction over the company offering them the option to obtain all unclaimed reports at their own expense.

4. All remaining archived data will be recycled using the most expedient means possible.

18.0 QUALITY AUDITS AND SYSTEM REVIEWS

Requirement: The quality assurance group will conduct regularly scheduled audits of the laboratory to assess compliance with quality system requirements, technical requirements of applied methodology, and adherence to documentation procedures. The information gathered during these audits will be used to provide feedback to senior management and perform corrective action where needed for quality improvement purposes.

18.1 ***Quality Systems Review***. Quality system audits are performed annually by the Quality Assurance Director for the Company President. In this audit, the laboratory is evaluated for compliance with the Laboratory Quality Systems Manual (LQSM) and the quality system standards of the National Environmental Laboratory Accreditation Conference. Findings, which indicate non-compliance or deviation from the LQSM, are flagged for corrective action. Corrective actions require either a return to compliance or a plan change to reflect an improved quality process. The QA Officer is responsible for making and documenting changes to the LQSM. These changes are reviewed by the Laboratory Director and Technical Director prior to the approval of the revised system.

18.2 ***Quality System Audits.*** Quality system audits are conducted to evaluate the effectiveness and laboratory compliance with individual quality system elements. These audits are conducted on an established schedule. Audit findings are documented and communicated to the management staff and entered into the corrective action system for resolution. If necessary, retraining is conducted to assure complete understanding of the system requirements.

18.3 ***Technical Compliance Audits***. Technical compliance audits are performed throughout the year following the established schedule. Selected analytical procedures are evaluated for compliance with standard operating procedures (SOPs) and method requirements. If non-conformances exist, the published method serves as the standard for compliance. SOPs are edited for compliance if the document does not reflect method requirements. Analysts are trained to the new requirements and the process is monitored by quality assurance. Analysts are retrained in method procedures if an evaluation of bench practices indicates non-compliance with SOP requirements.

18.4 ***Documentation Audits***. Documentation audits are conducted periodically. This audit includes a check of measurement processes that require manual documentation and non-analytical logbook review. It also includes checks of data archiving systems and a search to find and remove any inactive versions of SOPs that may still be present in the laboratory and being accessed by the analysts. Non-conformances are corrected on the spot. Procedural modifications are implemented if the evaluation indicates a systematic defect.

18.5 ***Corrective Action Monitoring***. Defects or non-conformances that are identified during client or internal audits are shared with management and entered into CA

database for attention by the responsible party. Audit findings are corrected through process modifications and/or retraining. Once a corrective action has been designed and implemented, it is monitored for compliance on a regular basis by the QA staff. Monitoring of the corrective action continues until satisfactory implementation has been verified.

18.6 ***Preventive Action.*** Laboratory systems or processes, which may be faulty and pose the potential for nonconformances, errors, confusing reports or difficulties establishing traceability may be identified during internal audits. These items are highlighted for systematic change using the corrective action system and managed to resolution using appropriate procedures for corrective action.

18.7 ***Client Notification.*** Defective processes, systematic errors, and quality defects detected during routine audits may have negative impact on data quality. In some cases, data that has been released to the client may be affected. If defective data has been released for use, Accutest will immediately notify the affected clients of the defect and provide specific details regarding the magnitude of the impact to their data.

18.8 ***Management Reports***. Formal reports of all audit activities are prepared for the management staff. These reports are prepared annually. The report details the status of the Quality System

The formal report also addresses the following topics:

- *the suitability of policies and procedures;*
- *reports from managerial and supervisory personnel;*
- *the outcome of recent internal audits;*
- *corrective and preventive actions;*
- *assessments by external bodies;*
- *the results of interlaboratory comparisons or proficiency tests;*
- *changes in the volume and type of the work;*
- *customer feedback;*
- *complaints;*
- *recommendations for improvement;*
- *other relevant factors, such as quality control activities, resources, and staff training.*

19.0 HEALTH AND SAFETY

Requirement. The company operates a formal health and safety program that complies with the requirements of the Occupational Health and Safety Administration. The program consists of key policies and practices that are essential to safe laboratory operation. All employees are required to receive training on the program elements. Job specific training is conducted to assure safe practices for specific tasks. All employees are required to participate in the program, receive initial and annual training, and comply with the program requirements. All plan and program requirements are detailed in the Health and Safety Program Manual.

19.1 Policy. Accutest Laboratories will provide a safe and healthy working environment for its employees and clients while protecting the public and preserving the Company's assets and property. The company will comply with all applicable government regulations pertaining to safety and health in the laboratory and the workplace.

The objective of the Accutest Health and Safety Program is to promote safe work practices that minimize the occurrence of injuries and illness to the staff through proper health and safety training, correct laboratory technique application and the use of engineering controls.

19.2 Responsibilities. The Health and Safety Program assists managers, supervisors and non-supervisory employees in control of hazards and risks to minimize the potential for employee and client injuries, damage to client's property and damage or destruction to Accutest's facility.

The Health and Safety Officer is responsible for implementing the Program's elements and updating its contents as necessary. He also conducts periodic audits to monitor compliance and assess the program's effectiveness and is also responsible for creating and administering safety training for all new and existing employees.

The employee is responsible for following all safety rules established for their protection, the protection of others and the proper use of protective devices provided by the Company. The employee is also expected to comply with the requirements of the program at all times. Department Managers and Supervisors are responsible for ensuring the requirements of the Safety Program are practiced daily. The Company President retains the ultimate responsibility for the program design and implementation.

19.3 Program Elements. The Accutest Health and Safety Program consists of key program elements that compliment the company's health and safety objective. These elements form the essence of the health and safety policy and assure that the objectives of the program are achieved.

Safety Education and Training and Communication. Training is conducted to increase the staff's awareness of laboratory hazards and their knowledge of the safety

practices and procedures required to protect them from those hazards. It is also used to communicate general safety procedures required for safe operation in a chemical laboratory.

Initial health and safety training for new employees is conducted during orientation. The training focuses on the Accutest Safety and Health Program and includes specific training for the hazards that may be associated with the employees' duties. Training is also conducted for all program elements focusing on general, acceptable, laboratory safety procedures. Targeted training is conducted to address hazards or safety procedures that are specific to individual employee's work assignments. All training activities are documented and archived in individual training folders. A health and safety training inventory is maintained in the training database.

Accutest Laboratories Southeast maintains personnel trained in HAZWOPER, DOT and HazMat operations, as well as respirator certified.

Safety Officer. The safety officer provides the employees with an opportunity to express their views and concerns on safety issues in an environment where those concerns will be addressed to ensure that the interests of the company and the well being of the employee are protected. Safety Officer is entrusted with elevating the level of safety awareness among their peers.

Hazard Identification and Communication. The hazard communication program enables employees to readily identify laboratory hazards and the procedures to protect themselves from those hazards. This program complies with OSHA's Hazard Communication Standard, Title 29 Code of Federal Regulations 1910.1200 that requires the company to adopt and adhere to the following key elements:

- Material Safety Data Sheets (MSDS) and/or Safety Data Sheets (SDS) must be available to any employee wishing to view them,
- The Company must maintain a Hazardous Chemicals Inventory (by location), which is updated on an annual basis,
- Containers are properly labeled,
- All employees must be provided with annual Personal Protection, Hazard Communication and Right to Know training,

Chemical Hygiene Plan. The Chemical Hygiene Plan complies with the requirements of the Occupational Safety and Health Administration's Occupational Exposure to Hazardous Chemicals in the Laboratory Standard, 29 CFR 1910.1450. This plan establishes procedures, identifies safety equipment, personal protective equipment, and work practices that protect employees from the potential health hazards presented by hazardous chemicals in the laboratory if properly used and/or applied.

Emergency Action & Evacuation Plan. The Emergency Action and Evacuation Plan details the procedures used to protect and safeguard Accutest's employees and property during emergencies. Emergencies are defined as fires or explosions, gas leaks, building collapse, hazardous material spills, emergencies that immediately threaten life and health, bomb threats and natural disasters such as floods, hurricanes or tornadoes. The plan identifies and assigns responsibility for executing specific roles in situations requiring emergency action.

Lockout/Tagout Plan. Lockout/tagout procedures have been established to assure that laboratory employees and outside contractors take steps to render equipment inoperable and/or safe before conducting maintenance activities. The plan details the procedures for conducting maintenance on equipment that has the potential to unexpectedly energize, start up, or release energy or can be operated unexpectedly or accidentally resulting in serious injury to employees. The plan ensures that employees performing maintenance render the equipment safe through lock out or tag out procedures.

Personal Protection Policy. Policies have been implemented which detail the personal protection requirements for employees. The policy includes specifications regarding engineering controls, personal protective equipment (PPE), hazardous waste, chemical exposures, working with chemicals and safe work practices. Safety requirements specific to processes or equipment are reviewed with the department supervisor or the Health and Safety Officer before beginning operations.

Emergency Preparedness Plan. This plan identifies the actions to be taken by Accutest Laboratory's staff in the event of terrorism or terrorist actions, to ensure the safety of the employees and the facility. The plan describes the building security actions coinciding with the "Alert Condition", designated by the Department of Homeland Security.

Appendix I

Glossary of Terms

GLOSSARY OF TERMS

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accreditation: the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyst: the designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

Audit: a systematic evaluation to determine the conformance to quantitative *and qualitative* specifications of some operational function or activity.

Batch: environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality-system matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.

Blind Sample: a sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Case Narrative: a statement of non-conformances associated with particular data report

Calibration: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.

Calibration Curve: the mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.

Calibration Method: a defined technical procedure for performing a calibration.

Calibration Standard: a substance or reference material used to calibrate an instrument.

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.

Chain of Custody: an unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples.

Clean Air Act: the enabling legislation in 42 U.S.C. 7401 *et seq.*, Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and to enforce them.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund): the enabling legislation in 42 U.S.C. 9601-9675 *et seq.*, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601*et seq.*, to eliminate the health and environmental threats posed by hazardous waste sites.

Confirmation: verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors or, additional cleanup procedures.

Conformance: an affirmative indication or judgement that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

Corrective Action: the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form.

Demonstration of Capability: a procedure to establish the ability of the analyst to generate acceptable accuracy.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Duplicate Analyses: the analyses or measurements of the variable of interest performed identically on two sub-samples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

Federal Water Pollution Control Act (Clean Water Act, CWA): the enabling legislation under 33 U.S.C. 1251 *et seq.*, Public Law 92-50086 Stat. 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance.

Field of Testing: TNI's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an up-dated/improved method are required submit to only that portion of the accreditation process not previously addressed (see TNI, section 1.9ff).

Holding Times (Maximum Allowable Holding Times) the maximum times that samples may be held prior to analysis and still be considered valid or not compromised.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Matrix (or Quality System Matrix): the component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated a potable or potential potable water source. Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake. Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue, Biota: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

Matrix Spike (spiked sample or fortified sample): a sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of Target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): a second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest, which is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

National Institute of Standards and Technology (NIST): an agency of the US Department of Commerce's Technology Administration that is working with EPA, States, TNI, and other public and commercial entities to establish a system under which private sector companies and interested States can be accredited by NIST to provide NIST-traceable proficiency testing (PT) to those laboratories testing drinking water and wastewater.

The NELAC institute (TNI): a voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories.

TNI Standards: the plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the The NELAC Institute.

Performance Audit: the routine comparison of independently obtained *qualitative and quantitative* measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

PT Fields of Testing: TNI's approach to offering proficiency testing by regulatory or environmental program, matrix type, and analyte.

Proficiency Testing: a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.

Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Control: the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users.

Quality Manual: a document stating the management policies, objectives, principles, oganizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

Quantitation Limits: the maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user.

Range: the difference between the minimum and the maximum of a set of values.

Raw Data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

Reagent Blank (method reagent blank or method blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

Replicate Analyses: the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval.

Requirement: denotes a mandatory specification; often designated by the term “shall”.

Resource Conservation and Recovery Act (RCRA): the enabling legislation under 42 USC 321 *et seq.* (1976), that gives EPA the authority to control hazardous waste from the “Cradle-to-grave”, including its generation, transportation, treatment, storage, and disposal.

Safe Drinking Water Act (SDWA): the enabling legislation, 42 USC 300f *et seq.* (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations.

Sample Duplicate: two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis.

Spike: a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: the document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of TNI and meets the approval requirements of TNI procedures and policies.

Toxic Substances Control Act (TSCA): the enabling legislation in 15 USC 2601 *et seq.*, (1976), that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture.

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.

United States Environmental Protection Agency (EPA): the federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends.

Validation: the process of substantiating specified performance criteria.

Verification: confirmation by examination and provision of evidence that specified requirements have been met.
NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Appendix II

Analytical Capabilities

TNI-Accredited Fields of Testing

Method Type	Method Number	Regulatory Program
Organics		
EDB and DBCP	EPA 504.1	Drinking Water
1,4-Dioxane	EPA 522	Drinking Water
Metals		
ICP: General	EPA 200.7, 1994	Drinking Water
Cold Vapor Mercury	EPA 245.1, 1994	Drinking Water
Inorganic WetChem		
Perchlorate by Ion Chromatography	EPA 314.0	Drinking Water
Organics		
EDB and DBCP	EPA 504, SW846 8011**	Non-Potable Water
Volatile Organics	EPA 624, SW846 8260B**	Non-Potable Water
Semi-Volatile Organics	EPA 625, SW846 8270D**	Non-Potable Water
Semi-Volatile Organics	SW846 8270D SIM**	Non-Potable Water
Purgeable Aromatics	EPA 602, SW846 8021A**	Non-Potable Water
Chlorinated Pesticides & PCBs	EPA 608, SW846 8081B**, 8082A**	Non-Potable Water
Poly-Aromatic Hydrocarbons	EPA 610, SW846 8310**	Non-Potable Water
Nitroaromatics	SW846 8091**	Non-Potable Water
Explosives	SW846 8330A**, 8332**	Non-Potable Water
Explosives	SW846 8330B**,	Non-Potable Water
Chlorinated Herbicides	SW846 8151A**	Non-Potable Water
Organophosphorus Pesticides	SW846 8141B**	Non-Potable Water
Perchlorate	SW-846 6850	Non-Potable Water
Dissolved Gases	RSK SOP 147-175**	Non-Potable Water
Alcohols	SW846 8015C,D**	Non-Potable Water
Gasoline Range Organics	SW846 8015C,D**	Non-Potable Water
Diesel Range Organics	SW846 8015C,D**	Non-Potable Water
Total Petroleum Hydrocarbons	FLPRO**	Non-Potable Water
Tennessee EPH	TN-EPH**	Non-Potable Water
Tennessee GRO	TN-GRO**	Non-Potable Water
Wisconsin DRO	WI-DRO**	Non-Potable Water
Petroleum Hydrocarbons	Iowa OA-1**	Non-Potable Water
Petroleum Hydrocarbons	Iowa OA-2**	Non-Potable Water
Volatile Petro. Hydrocarbons	Massachusetts VPH, 2004**	Non-Potable Water

Method Type	Method Number	Regulatory Program
Extractable Petro. Hydrocarbons	Massachusetts EPH, 1998**	Non-Potable Water
Total Petroleum Hydrocarbons	TX-1005**	Non-Potable Water
Acrylamide	SW846 8316	Non-Potable Water
Metals		
ICP: General – EPA WW	EPA 200.7, 1994; SW-846 6010C**	Non-Potable Water
Cold Vapor Mercury – EPA WW	EPA 245.1, 1994; SW-846 7470A**	Non-Potable Water
Inorganic WetChem		
Alkalinity	SM2320B**	Non-Potable Water
CBOD	SM 5210B	Non-Potable Water
COD	SM5220C	Non-Potable Water
BOD	SM5210B	Non-Potable Water
Color, Apparent	SM2120B	Non-Potable Water
Ion Chromatography (Bromide, Fluoride, Chloride, Sulfate, Nitrite, Nitrate,) – Aqueous	EPA 300.0**, SW846 9056A**	Non-Potable Water
Nitrate/Nitrite	EPA 353.2**	Non-Potable Water
Total Kjeldahl Nitrogen	EPA 351.2**	Non-Potable Water
Ammonia	EPA 350.1**	Non-Potable Water
Oil & Grease, Gravimetric – AQ	EPA 1664A**, SW846 9070A**	Non-Potable Water
Orthophosphate	EPA 365.3**	Non-Potable Water
Nitrate	SM 4500NO2-B	Non-Potable Water
pH by electrode (Waters)	SM4500H+B**; SW846 9040C**	Non-Potable Water
Specific Conductance	EPA 120.1	Non-Potable Water
Nitrate-Nitrite	SM 4500 NO3-E	Non-Potable Water
Sulfide	SM4500S=F**	Non-Potable Water
Chloride	SM 4500 Cl-B	Non-Potable Water
Total Dissolved Solids	SM2540C**	Non-Potable Water
Total Organic Carbon	SM5310B**, SW846 9060A**	Non-Potable Water
Total Phosphorus	EPA 365.3	Non-Potable Water
Total Solids	SM2540B**	Non-Potable Water
Total Suspended Solids	SM2540D**	Non-Potable Water
Turbidity	EPA 180.1	Non-Potable Water
Total CN	EPA 335.4, SW846 9012B**	Non-Potable Water
Un-Ionized Ammonia - calculation	FDE SOP10/03/83	Non-Potable Water
Perchlorate	EPA 314	Non-Potable Water
Calcium Hardness by Calculation	SM18 2340B	Non-Potable Water
Hardness, Total by Calculation	SM18 2340B	Non-Potable Water
MBAS (Anionic Surfactants as)	SM5540C	Non-Potable Water

Method Type	Method Number	Regulatory Program
Corrosivity & pH – aqueous	SW846 9040C**	Non-Potable Water
Hexavalent Chromium	SW846 7196A**	Non-Potable Water
Organics		
EDB and DBCP	SW846 8011 Mod**	Solid and Chemical Material
Volatile Organics	SW846 8260B**	Solid and Chemical Material
Semi-Volatile Organics	SW846 8270D**	Solid and Chemical Material
Semi-Volatile Organics	SW846 8270D SIM**	Solid and Chemical Material
Gasoline Range Organics	SW846 8015C,D**	Solid and Chemical Material
Diesel Range Organics	SW846 8015C,D**	Solid and Chemical Material
Alcohols	SW846 8015C,D**	Solid and Chemical Material
Polynuclear-Aromatic Hydrocarbons	SW846 8310**	Solid and Chemical Material
Explosives	SW846 8330A**, 8332**	Solid and Chemical Material
Explosives	SW846 8330B**	Solid and Chemical Material
Organochlorine Pesticides	SW846 8081B**	Solid and Chemical Material
Polychlorinated Biphenyls	SW846 8082A**	Solid and Chemical Material
Chlorinated Herbicides	SW846 8151A**	Solid and Chemical Material
Organophosphorus Pesticides	SW846 8141B**	Solid and Chemical Material
Perchlorate	SW-846 6850	Solid and Chemical Material
Total Petroleum Hydrocarbons	FLPRO**	Solid and Chemical Material
Tennessee EPH	TN-EPH**	Solid and Chemical Material
Tennessee GRO	TN-GRO**	Solid and Chemical Material
Wisconsin DRO	WI-DRO**	Solid and Chemical Material
Petroleum Hydrocarbons	Iowa OA-1**	Solid and Chemical

Method Type	Method Number	Regulatory Program
		Material
Petroleum Hydrocarbons	Iowa OA-2**	Solid and Chemical Material
Volatile Petro. Hydrocarbons	Massachusetts VPH, 2004**	Solid and Chemical Material
Extractable Petro. Hydrocarbons	Massachusetts EPH, 1998**	Solid and Chemical Material
Total Petroleum Hydrocarbons	TX-1005**	Solid and Chemical Material
Acrylamide	SW846 8316	Solid and Chemical Material
Metals		
ICP: General – EPA WW	SW846 6010C**	Solid and Chemical Material
Cold Vapor Mercury – EPA DW	SW846 7471B**	Solid and Chemical Material
Inorganic WetChem		
Ion Chromatography (Bromide, Fluoride, Chloride, Sulfate, Nitrite, Nitrate,) – Aqueous	SW846 9056A**	Solid and Chemical Material
Oil & Grease, Gravimetric – Solid	SW846 9071A**	Solid and Chemical Material
Total CN	SW846 9012B**	Solid and Chemical Material
Total Organic Carbon	SW846 9060A**	Solid and Chemical Material
Ammonia	EPA 350.1	Solid and Chemical Material
Total Kjeldahl Nitrogen	EPA 351.2	Solid and Chemical Material
Total Phosphorus	EPA 365.3	Solid and Chemical Material
Waste Ignitability	SW846 1010A**	Solid and Chemical Material
Hexavalent Chromium/soils	SW846 7196A**	Solid and Chemical Material
Corrosivity & pH – aqueous	SW846 9040C**	Solid and Chemical Material
Corrosivity & pH – solid	SW846 9045D**	Solid and Chemical Material

Method Type	Method Number	Regulatory Program
Cyanide Reactivity	SW846 Chapter 7**	Solid and Chemical Material
Sulfide Reactivity	SW846 Chapter 7**	Solid and Chemical Material
Organics		
Volatile Organics	TO-3	Air and Emissions
Preparation Methods*		
Liquid/Liquid Extraction, Water	SW846 3510C	
Solid Phase Extraction, Water	SW846 3535A	
Solids Extraction by Sonication	SW846 3550B	
Microwave-assisted extraction, solids	SW846 3546	
Acid/Base Partitioning	SW846 3650B	
Sulfur Cleanup of Extracts	SW846 3660B	
Sulfuric Acid Cleanup	SW846 3665A	
Purge & Trap - Aqueous	SW846 5030B	
Purge & Trap – Solids	SW846 5035A	
Total Recoverable Metals Digestion	EPA 200.7	
Non-Pot. Water Digest: ICP	SW846 3010A	
Alkaline Digestion of Soils for Hexavalent Chromium	SW846 3060A	
Digestion of Soils for ICP	SW846 3050B	
TCLP	SW846 1311	
SPLP	SW846 1312	

* Preparation methods are not listed on Primary TNI Accreditation per State of Florida DOH rules. However, for the benefit of other accrediting authorities, these methods are inspected during FDOH visits. Listing of surveyed and approved preparation methods is available from on-site inspection report.
** Methods certified by DoD ELAP

Non-TNI-Accredited Fields of Testing

Method Type	Method Number	Regulatory Program
Organics		
Thiodiglycol	Accutest in-house method (HPLC)	Solid and Chemical Material
N-Nitroso-N-Ethylurea	Accutest in-house method (HPLC)	Solid and Chemical Material
Volatile Petroleum Hydrocarbons	Missouri Gasoline Range Organics	Solid and Chemical Material
Extractable Hydrocarbons	Missouri Diesel Range Organics	Solid and Chemical Material
Extractable Hydrocarbons	Missouri Oil Range Organic	Solid and Chemical Material
Volatile Petroleum Hydrocarbons	Alaska AK-101**	Solid and Chemical Material
Extractable Hydrocarbons	Alaska AK-102**	Solid and Chemical Material
Extractable Hydrocarbons	Alaska AK-103**	Solid and Chemical Material
Volatile Petroleum Hydrocarbons	OK GRO**	Solid and Chemical Material
Extractable Hydrocarbons	OK DRO**	Solid and Chemical Material
Inorganic WetChem		
Oxidation-Reduction Potential	ASTM D1498-76, mod. for solids	Solid and Chemical Material
Percent Ash (dry basis)	ASTM D2974-87, D482-91	Solid and Chemical Material
Grain Size (hydrometer)	ASTM D422-63	Solid and Chemical Material
Sieve Testing	ASTM D422-63	Solid and Chemical Material
Specific Gravity	ASTM D1298-85	Solid and Chemical Material
Acidity	SM2310B	Non-Potable Water
Dissolved Oxygen	EPA 360.1	Non-Potable Water
Mineral Suspended Solids	EPA 160.2/160.4	Non-Potable Water
Organophosphonic Acids	Accutest in-house method (IC)	Solid and Chemical Material

Method Type	Method Number	Regulatory Program
Perchlorate	EPA 314MOD	Solid and Chemical Material
Percent Solids	SM19 2540G	Solid and Chemical Material
Settleable Solids	EPA 160.5	Non-Potable Water
Total Mineral Solids	EPA 160.4	Non-Potable Water
Total Residual Chlorine	EPA 330.5	Non-Potable Water
Total Volatile Solids	EPA 160.4	Non-Potable Water
Volatile Suspended Solids	EPA 160.2/160.4	Non-Potable Water
CÑ Amenable to Chlorination	EPA 335.4	Solid and Chemical Material
Bicarbonate, Carbonate, CO2 - calculation	SM19 4500 CO2D	Non-Potable Water
Ferrous Iron	SM19 3500 FE-D	Non-Potable Water
Salinity - calculation	SM19 2520B	Non-Potable Water
Paint Filter Test	SW846 9095	Solid and Chemical Material
Corrosivity towards steel	SW846 1110	Solid and Chemical Material
Corrosivity & pH – aqueous	SW846 9040C	Solid and Chemical Material

Appendix III

Equipment List

ORGANIC INSTRUMENTATION

Instrument	Model	Location	Serial #	Year
GC/MS	Agilent 5975C MSD/OI 4551/4660	MS-VOA	US11172705	2011
GC/MS	Agilent 5975C MSD/OI 4551/4660	MS-VOA	US11322911	2011
GC/MS	Agilent 5975C MSD/OI 4551/4660	MS-VOA	US10102029	2010
GC/MS	Agilent 5975C MSD/OI 4551/4660	MS-VOA	US83120965	2008
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US71225975	2007
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US62724401	2006
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US53921303	2005
GC/MS	Agilent 5973N MSD/Agilent 7683 AS	SVOC Lab	US40620599	2004
GC/MS	Agilent 5973 MSD/OI 4660/4552 Archon	MS-VOA	US41746628	2004
GC/MS	Agilent 5973 MSD/OI 4660/4552 Archon	MS-VOA	US41746633	2004
GC/MS	Agilent 5973 MSD/OI 4560/4552 Archon	Soil VOA	US21843765	2002
GC/MS	Agilent 5973 MSD/OI 4551/4660	MS-VOA	US21844034	2002
GC/MS	Agilent 5973 MSD/OI 4660/4552 Archon	MS-VOA	US02440350	2000
GC/MS	Agilent 5973 MSD/OI 4560/4552 Archon	MS-VOA	US94240108	1999
GC/MS	Agilent 5973 MSD/Agilent 7683 AS	SVOC Lab	US82311290	1998
GC/MS	Agilent 5973 MSD/Agilent 7683 AS	SVOC Lab	US81211109	1998
GC/MS	Hewlett-Packard 5970 MSD/OI 4560/4552 Archon	Soil VOA	3034A12782	1989
GC/MS	Hewlett-Packard 5970 MSD/OI 4560/4552 Archon	Soil VOA	2905A11904	1987
GC/MS	Hewlett-Packard 5970 MSD/OI 4560/4552 Archon	Soil VOA	2716A10454	1987
GC	Agilent 7890A/Dual ECD/7683B AS	SVOC Lab	CN10842133	2008
GC	Agilent 7890A/Dual FID/7683B AS	SVOC Lab	CN10902149	2009
GC	Agilent 7890A/Dual FID/7683B AS	SVOC Lab	CN10716029	2009
GC	Agilent 7890A/Dual ECD/7683B AS	SVOC Lab	CN10741128	2007

Instrument	Model	Location	Serial #	Year
GC	Agilent 6890/Dual FPD/7683B AS	SVOC Lab	US10643024	2006
GC	Agilent 6890/Dual FID/7683B AS	SVOC Lab	CN10641049	2006
GC	Agilent 6890/Dual ECD/7683B AS	SVOC Lab	CN10641081	2006
GC	Agilent 6890/Dual ECD/7683B AS	SVOC Lab	US10613003	2006
GC	Agilent 6890/PID/PID/OI 4560/4552 Archon	GC VOA	CN10421047	2004
GC	Agilent 6890/PID/FID/ENTECH 7032A-LB	GC VOA	US10239007	2002
GC	Agilent 6890N/Dual FID/HP 7683 AS	SVOC Lab	CN10425061	2004
GC	Agilent 6890N/Dual ECD/HP 7683 AS	SVOC Lab	US10333015	2003
GC	Agilent 6890/Dual ECD/HP 7683 AS	SVOC Lab	US00036916	2000
GC	Agilent 6890/Dual ECD/HP 7683 AS	SVOC Lab	US00028304	1999
GC	Hewlett-Packard 5890/PID/FID/ OI 4560/4552 Archon	GC VOA	3336A60617	1993
GC	Hewlett-Packard 5890/Dual FID/HP 7673 AS	SVOC Lab	3336A59489	1993
GC	Hewlett-Packard 5890/PID/FID/ OI 4560/4552 Archon	GC VOA	3336A51045	1993
GC	Hewlett-Packard 5890/PID/FID/OI 4560/4552 Archon	GC VOA	3203A41646	1992
GC	Hewlett-Packard 5890/PID/FID/OI 4560/4552 Archon (screening instrument)	GC VOA	3223A4267	1992
GC	Hewlett-Packard 5890/Dual FID/HP 7673 AS	SVOC Lab	3126A51085	1991
GC	Hewlett-Packard 5890/PID/FID/ dual MPM 16	Soil VOA	3029A29748	1990
GC	Hewlett-Packard 5890/FID	Soil VOA	2843A20183	1988
GC	Hewlett-Packard 5890/Dual FID	GC VOA	2728A12705	1987
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE91606857	1999
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE23917648	2002
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE01608404	2000
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE40522115	2004
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE03000863	2003

Instrument	Model	Location	Serial #	Year
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE61800775	2006
O-Prep	ESSA LM2-P Ring and Puck mill	Explosives Prep Lab	215090-004	2008
O-prep	Microwave extractor	Organic Prep Lab	MD3482	2010
O-Prep	TurboVap 4 units	Organic Prep Lab		2001
O-Prep	TurboVap 3 units	Organic Prep Lab		2004
O-Prep	TurboVap 1 unit	Organic Prep Lab		2007
O-Prep	Sonicator 2 units	Organic Prep Lab		2004
O-Prep	Sonicator 3 units	Organic Prep Lab		2007
O-Prep	Midi-Vap 2000 Kontes	Organic Prep Lab	479200-2000	2000
Data System	Hewlett-Packard/MS ChemStation	Labwide		1999, with subsequent upgrades

Inorganic Instrumentation

Instrument	Model	Location	Serial #	Year
ICP	Thermo ICAP 6000 Series	Metals Lab	20100903	2010
ICP	Thermo ICAP 6000 Series	Metals Lab	20103825	2010
Mercury Analyzer	Leeman Hydra AA	Metals Lab	HA-2022	2002
Mercury Analyzer	Leeman Hydra AA II	Metals Lab	2004	2012
TOC Analyzer	Shimadzu	WetChem IC room	H51404235007	2004
TOC Analyzer	Shimadzu	WetChem IC room	H51404735099	2010
IC	Dionex IC-2100	WetChem IC room	10110002	2010
IC	Dionex IC-2000	WetChem IC room	04070250	2004
Auto Analyzer	QuickChem 8500 Series	WetChem main room	050500000130	2005
Auto Analyzer	QuickChem 8500 Series 2	WetChem main room	111200001380	2011
Spectrophotometer	Milton-Roy Spectronic 200	WetChem main room	2 units	2000
Digestion block	DigiPrep	WetChem main room	4 units	2005

Centrifuge	CentraCL2	WetChem main room	42613052	2003
MicroDistillation Block	Lachat	WetChem main room	2 units	2005

LIMS		
Instrument	**Model**	**Year**
LIMS	HP True 64	1999

Appendix IV

Certification Summary

Certifying Authority	Certification Program	Registration No.
Alaska	Contaminated Sites	UST-088
Arkansas	Solid/Hazardous Wastes, Non-Potable Water	88-0620
California (NELAP)	Potable Water, Solid/Hazardous Waste	04226CA
Department of Defense (DoD)	Non-Potable Water, Solid and Chemical Materials	L-2229
Florida (NELAP)	Potable, Non-Potable, Solid Waste, UST, Air Toxics	E83510
Georgia	Solid/Hazardous Wastes	Not Applicable
Illinois	Solid/Hazardous Wastes, Non-Potable Water	
Iowa	UST, Solid/Hazardous Wastes, Non-Potable Water	IA366
Kansas (NELAP)	Solid/Hazardous Wastes, Non-Potable Water	E-10327
Kentucky	Underground Storage Tank Program	0065
Louisiana (NELAP)	Solid/Hazardous Wastes	38582
Massachusetts	Non-Potable Water	M-FL946
Mississippi	Potable Water	Not Applicable
Nevada	Non-Potable Water, Solid/Hazardous Wastes	FL009462008A
New Jersey (NELAP)	Solid/Hazardous Wastes, Non-Potable Water	FL002
North Carolina	Solid/Hazardous Wastes, Non-Potable Water	573
Oklahoma	Non-Potable Water, Solid/Hazardous Waste	9959
South Carolina	Solid/Hazardous Wastes, Non-Potable Water	96038001
Texas (NELAP)	Non-Potable Water, Solid/Hazardous Waste	T104704040-08-TX
US Dept. of Agriculture	Foreign Soils Permit	S-56027
Utah (NELAP)	Potable, Non-Potable, Solid/Chemical Materials	FL009462008A
Virginia (NELAP)	Potable, Non-Potable, Solid/Chemical Materials	460177
Washington	Potable, Non-Potable, Solid/Chemical Materials, Air	C2046
Wisconsin	Solid/Hazardous Wastes, Non-Potable Water	399043370

Appendix V

SOP List

SOP #	TITLE
	Organic Preparation Department
OP002	SOP for Glassware Cleaning and Storage
OP003	SOP for Reagent Prep
OP006	SOP for the Extraction of Semi-volatile Organics (BNAs) from Aqueous Samples
OP007	SOP for the Extraction of Semi-volatile Organics (BNAs) from Solid Samples
OP008	SOP for the Extraction of Pesticides/PCBs from Aqueous Samples
OP009	SOP for the Extraction of Pesticides/PCBs from Solid Samples
OP009MW	SOP for the Extraction of Pesticides/PCBs from Solid Samples, microwave
OP010	SOP for the Extraction of Diesel Range Organics (DRO) from Aqueous Samples
OP011	SOP for the Extraction of Diesel Range Organics (DRO) from Solid Samples
OP011MW	SOP for the Extraction of Diesel Range Organics (DRO) from Solid Samples
OP012	SOP for the Extraction of Petroleum Related Organics (FL-PRO) from Aqueous Samples
OP013	SOP for the Extraction of Petroleum Related Organics (FL-PRO) from Solid Samples
OP014	SOP for the Extraction of PAHs from Aqueous Samples (HPLC)
OP015	SOP for the Extraction of PAHs from Solid Samples (HPLC)
OP016	SOP for the Extraction of EDB/DBCP from Aqueous Samples
OP017	SOP for the Extraction of EDB/DBCP from Solid Samples
OP018	SOP for the Extraction of Explosives from Aqueous Samples
OP019	SOP for the Extraction of Explosives from Solid Samples
OP020	SOP for Sample Introduction via SW846-5035
OP021	SOP for Sample Introduction via SW846-5030B
OP022	SOP For The Extraction Of Nitroglycerine And Pentaerythritoltetranitrate (PETN) From Water Samples (HPLC Analysis)
OP023	SOP For The Extraction Of Nitroglycerine And Pentaerythritoltetranitrate (PETN) From Solid Samples (HPLC Analysis)
OP024	Standard Operating Procedure For The Extraction Of Nitroaromatics From Water Samples
OP025	SOP For Sample Preparation For Dissolved Gases In Aqueous Samples
OP026	SOP For The Extraction Of Extractable Petroleum Products (OA-2) From Water Samples
OP027	SOP For The Extraction Of Extractable Petroleum Products (OA-2) From Solid Samples
OP028	SOP For The Extraction Of Diesel And Oil Range Organics From Water Samples
OP029	SOP For The Extraction Of Diesel And Oil Range Organics From Solid Samples
OP030	SOP For The Extraction Of Extractable Petroleum Hydrocarbons From

SOP #	TITLE
	Water Samples (Tennessee EPH)
OP031	SOP For The Extraction Of Extractable Petroleum Hydrocarbons From Solid Samples (Tennessee EPH)
OP032	SOP For The Extraction Of Volatile Petroleum Hydrocarbons From Soil Samples, MA-VPH
OP033	SOP For The Extraction Of PCBs From Wipes
OP034	SOP For The Extraction Of Diesel Range Organics (DRO) From Aqueous Samples WI-DRO
OP035	SOP For The Extraction Of Massachusetts Extractable Petroleum Hydrocarbons From Water Samples
OP036	SOP For The Extraction Of Massachusetts Extractable Petroleum Hydrocarbons From Solid Samples
OP037	SOP For The Extraction Of Chlorinated Herbicides From Water Samples
OP038	SOP For The Extraction Of Chlorinated Herbicides From Soil Samples
OP038MW	SOP For The Extraction Of Chlorinated Herbicides From Soil Samples, microwave
OP039	SOP For The Solid Phase Extraction (SPE) Cartridge Cleanup Of Pesticide Extracts
OP040	SOP For SPLP Leaching Of SVOC And Metals
OP041	SOP For TCLP Leaching Of VOC
OP042	SOP For SPLP Leaching Of SVOC And Metals
OP043	SOP For SPLP Leaching Of VOC
OP044	SOP For The Extraction Of Organophosphorus Pesticides From Water Samples
OP044SP	SOP For The Extraction Of Organophosphorus Pesticides From Water Samples, Solid Phase Extraction
OP045	SOP For The Extraction Of Organophosphorus Pesticides From Soil Samples
OP045MW	SOP For The Extraction Of Organophosphorus Pesticides From Soil Samples, microwave
OP046	SOP for the Extraction of Explosives from Solid Samples, SW-8330B
OP047	SOP for the Extraction of Explosives from Aqueous Samples, SW-8330B
OP048	SOP for the Extraction of PCB Congeners from Aqueous Samples
OP049	SOP for the Extraction of PCB Congeners from Solid Samples
OP050	SOP For The Extraction Of Alaska Extractable Petroleum Hydrocarbons From Water Samples
OP051	SOP For The Extraction Of Alaska Extractable Petroleum Hydrocarbons From Solid Samples
OP052	SOP For The Extraction Of Oklahoma Extractable Petroleum Hydrocarbons From Water Samples
OP053	SOP For The Extraction Of Oklahoma Extractable Petroleum Hydrocarbons From Solid Samples
OP054	SOP For The Extraction Of 1,4-Dioxane From Water Samples
OP055	SOP For The Extraction Of Petroleum Hydrocarbons From Water Samples,

SOP #	TITLE
	TX-1005
OP056	SOP For The Extraction Of Petroleum Hydrocarbons From Solid Samples, TX-1005
OP057	SOP for Sample Introduction via AK-101

Gas Chromatography/ HPLC SOPs

GC002	Analysis Of 1,2-Dibromoethane (EDB) And 1,2-Dibromo-3-Chloropropane (DBCP) By Gas Chromatography, Electron Capture Detector
GC004	Aromatic Volatiles By Gas Chromatography Using PID Detectors EPA 602
GC005	Analysis Of Organochlorine Pesticides By Gas Chromatography, Electron Capture Detector EPA 608
GC006	Analysis Of Polychlorinated Biphenyls By Gas Chromatography, Electron Capture Detector EPA 608
GC007	Analysis Of Polynuclear Aromatic Hydrocarbons By Gas Chromatography, Flame Ionization Detector EPA 610
GC008	Analysis Of Petroleum Range Organics By Gas Chromatography Using Flame Ionization Detector
GC009	Analysis Of 1,2-Dibromoethane (EDB) And 1,2-Dibromo-3-Chloropropane (DBCP) By Gas Chromatography, Electron Capture Detector SW-846 8011
GC010	Analysis Of Gasoline Range Organics By Gas Chromatography Using Flame Ionization Detector
GC011	Analysis Of Diesel Range Organics By Gas Chromatography Using Flame Ionization Detector
GC014	Analysis Of Polychlorinated Biphenyls By Gas Chromatography, Electron Capture Detector SW-846 8082
GC015	Analysis Of Organochlorine Pesticides By Gas Chromatography, Electron Capture Detector SW-846 8081
GC016	Analysis Of Nitroaromatics And Nitramines By HPLC
GC017	Aromatic Volatiles By Gas Chromatography Using PID Detectors SW-8021
GC018	Analysis Of Polynuclear Aromatic Hydrocarbons By HPLC SW-846 8310
GC019	Analysis Of Dissolved Gases By Gas Chromatography, Flame Ionization Detector
GC020	Analysis Of Nitroglycerine And PETN By HPLC
GC021	Analysis Of Volatile Petroleum Hydrocarbons By Gas Chromatography
GC022	Analysis Of Extractable Petroleum Products By Gas Chromatography Using Flame Ionization Detector OA-2
GC023	Analysis Of Diesel And Oil Range Organics By Gas Chromatography Using Flame Ionization Detector
GC024	Analysis Of Petroleum Hydrocarbons By Gas Chromatography Using Flame Ionization Detector (Tennessee EPH)
GC025	Analysis Of Nitroaromatics By Gas Chromatography Using Electron Capture Detector
GC026	Method For Determination Of Volatile Petroleum Hydrocarbons By GC-

SOP #	TITLE
	PID/FID
GC027	Analysis Of Non-Halogenated Organics By Gas Chromatography Using Flame Ionization Detector
GC028	Analysis Of Gasoline Range Organics By Gas Chromatography Using Flame Ionization Detector TDEC GRO
GC029	Analysis Of Diesel Range Organics By Gas Chromatography Using Flame Ionization Detector Wi DRO
GC030	Analysis Of Extractable Petroleum Hydrocarbons By Gas Chromatography Using Flame Ionization Detector MA-EPH
GC031	Analysis Of Chlorinated Herbicides Using GC-ECD
GC032	Analysis Of Organophosphorus Pesticides Using GC-NPD Or FPD
GC033	Air Analysis By GC-PID/FID
GC034	Analysis Of Nitroaromatics, Nitramines And Nitrate Esters By HPLC Method 8330b
GC035	Screening Of Volatile Organics By GC-PID/FID
GC036	Analysis of PCB Congeners by ECD
GC037	Analysis of Diesel and Oil Range Organics by GC/FID, AK-102, AK-103
GC038	Analysis of Gasoline Range Organics by GC/FID, AK-101
GC039	Analysis of Diesel Range Organics by GC/FID, OK-GRO
GC040	Analysis of Gasoline Range Organics by GC/FID, OK-GRO
GC041	Analysis of N-Nitroso-N-Ethylurea by HPLC
GC042	Analysis of Thiodiglycol by HPLC
GC043	Analysis of Acrylamide by HPLC
GC044	Analysis of Petroleum Organics by TX-1005

Mass-Spectrometry SOPs

MS003	Analysis of Volatile Organics by EPA Method 624
MS004	Analysis of Semi-volatile Organics by EPA Method 625
MS005	Analysis of Volatile Organics by EPA Method 8260B
MS006	Analysis of Semi-volatile Organics by EPA Method 8270C
MS008	Analysis of Semi-volatile Organics by EPA Method 8270C SIM
MS009	Analysis of Volatile Organics by GC/MS
MS010	Analysis of Volatile Organics by GC/MS SIM
MS011	Analysis of Semi-volatile Organics by EPA Method 8270D
MS012	Analysis of 1,4-Dioxane by EPA 522
MS013	Analysis of Perchlorate by SW-846 6850

Quality Assurance SOPs

QA001	Preparation, Approval, Distribution & Archiving Of Standard Operating Procedures (SOPs)
QA002	Calibration Of Thermometers
QA003	Personnel Training And Analyst Proficiency

SOP #	TITLE
QA004	Temperature Monitoring
QA005	Calibration Of Analytical Balances
QA006	Eppendorf Pipette Calibration
QA007	Sample Batching Procedure
QA008	Creating New Accounts
QA009	Creating New Projects
QA010	Confidentiality Protection Procedures
QA011	Signature Authority
QA012	Employee Technical Ethics Responsibilities
QA013	Client Complaint Resolution Procedure
QA014	Procedures For The Purchase Of Laboratory Supplies
QA015	Procedures For The Preparation, Distribution, Use And Archiving Of Laboratory Logbooks
QA016	Corrective Action Procedure
QA017	Standards Traceability Documentation Procedure
QA018	Procedure For Login, Management, Handling, And Reporting Of Proficiency Test (Pt) Samples
QA019	Quality System Review
QA020	Procedure For Developing Method Performance Criteria And Experimental Method Detection Limits
QA021	Subcontracting Procedures
QA022	Internal Audit Procedure
QA023	Fume Hood Inspection
QA027	Review Of Inorganics Data
QA028	Review Of Organics Data
QA029	Manual Integration Of Chromatographic Peaks
QA030	Procedure For The Development And Use Of in-house Quality Control Criteria
QA031	Air Quality Monitoring Of Extraction Laboratory
QA032	Routine Maintenance For Major Analytical Instrumentation
QA033	Laboratory Safety
QA034	Sample Homogenizing
QA035	Solvent Testing And Approval
QA036	Data Package Generation
QA037	Deionized Water Quality Control Procedure
QA038	Data Integrity Training Procedure
QA039	Data Integrity Monitoring Procedure
QA040	Procedure For Conducting Data Integrity Investigations
QA041	Procedure For The Confidential Reporting Of Data Integrity Issues
QA042	Basic Calculations For General Chemistry Methods
QA043	Data Qualifier SOP
QA044	Calibration Of Micro-Distillation Tubes
QA045	Estimation of Uncertainty
QA046	Document Control

SOP #	TITLE
QA047	Management of Client Project
QA048	Data Entry for Log-In

General Chemistry SOPs

GNSOP: 101	Acidity (pH 8.2)
GNSOP: 102	Alkalinity, Total (pH 4.5)
GNSOP: 103	Ammonia – Distillation Procedure
GNSOP: 104	Nitrogen, Ammonia
GNSOP: 105	Bicarbonate, Carbonate, Free Carbon Dioxide
GNSOP: 106	Chemical Oxygen Demand
GNSOP: 107	Chloride by Titration
GNSOP: 109	Color, Apparent
GNSOP: 110	Chromium, Hexavalent (Water)
GNSOP: 113	Cyanide Distillation/Aqueous And Solid Samples
GNSOP: 115	Cyanide, Total
GNSOP: 116	Dissolved Oxygen
GNSOP: 121	Ignitability
GNSOP: 122	Anionic Surfactants As MBAS
GNSOP: 123	Nitrogen, Nitrite
GNSOP: 126	Ortho Phosphate
GNSOP: 127	Paint Filter Liquids Test
GNSOP: 128	Phenols Distillation, Soil And Water Samples
GNSOP: 130	Phenols, Total Recoverable
GNSOP: 133	Settleable Solids
GNSOP: 134	Total Suspended Solids (Non Filterable Residue)
GNSOP: 135	Total Dissolved Solids (Total Filterable Residue)
GNSOP: 136	Reactive Sulfide And Reactive Cyanide
GNSOP: 137	pH By Electrode - Water
GNSOP: 140	Sulfide
GNSOP: 144	Total Phosphorus
GNSOP: 145	Turbidity
GNSOP: 147	Winkler Titration For DO Standardization
GNSOP: 161	Percent Solids
GNSOP: 163	Specific Conductance At 25 C.
GNSOP: 166	pH By Electrode – Soil
GNSOP: 167	Biochemical Oxygen Demand (BOD)
GNSOP: 171	Hexachromium In Soils
GNSOP: 179	Corrosivity (Soil pH By Electrode)
GNSOP: 182	Total Kjeldahl Nitrogen
GNSOP: 189	Corrosivity Toward Steel
GNSOP: 190	Total Nitrogen, Organic Nitrogen
GNSOP: 191	Nitrogen, Nitrate
GNSOP: 192	Carbonaceous Biochemical Oxygen Demand (CBOD)

SOP #	TITLE
GNSOP: 193	Oxidation-Reduction Potential
GNSOP: 194	Ferrous Iron
GNSOP: 196	Glassware Cleaning
GNSOP: 197	Anions By Ion Chromatography
GNSOP: 211	Oil & Grease And PHC By 1664
GNSOP: 212	Fractional Organic Carbon
GNSOP: 213	Walkley-Black Total Organic Carbon
GNSOP: 214	Particle Size By Sieve
GNSOP: 215	TOC In Water
GNSOP: 216	Particle Size By Hydrometer
GNSOP: 218	Perchlorate
GNSOP: 219	Bulk Density
GNSOP: 222	Un-Ionized Ammonia Calculation
GNSOP: 224	Hardness By Calculation
GNSOP: 225	Cation Exchange Capacity Of Soils (Sodium Acetate)
GNSOP: 226	TOC In Soil
GNSOP: 227	Oil And Grease – Gravimetric Analysis (Soils)
GNSOP: 228	Anions By Ion Chromatography - IC 2000
GNSOP: 229	Determination Of Nitrocellulose In Water
GNSOP: 230	Determination Of Nitrocellulose In Soil
GNSOP: 231	% Ash
GNSOP: 232	Determination Of Nitrate and Nitrite by Lachat

Metals SOPs

MET 100	Metals By Inductively Coupled Plasma
MET 103	Digestion Of Water Samples For Flame And ICP Analysis
MET 104	Digestion Of Soils For ICP Analysis
MET 105	Cold Vapor Analysis Of Mercury For Soils
MET 106	Cold Vapor Analysis Of Mercury For Water Samples

Sample Management SOPs

SAM101	Sample Receipt And Storage
SAM102	Procedure For Sample Bottle Preparation And Shipment
SAM104	Sample Container Quality Control
SAM108	Sample And Laboratory Waste Disposition
SAM109	Foreign Soil receipt and Handling

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STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF NITROAROMATICS AND NITRAMINES (EXPLOSIVES) FROM SOLID SAMPLES FOR HPLC ANALYSIS

Prepared by: Norm Farmer Date: 08/26/13

Reviewed by: Mike Eger Date: 09/04/13

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TEST NAME: STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF NITROAROMATICS AND NITRAMINES (EXPLOSIVES) FROM SOLID SAMPLES FOR HPLC ANALYSIS

Method: SW846 8330A

Dept: OP

Revised Sections: 3.2.1, 6.1, 7.1-7.3, 7.8-7.10, 7.18 and 9.1.6

1.0 Summary, Scope and Application

1.1 Summary

Solid samples are extracted with acetonitrile in a chilled ultrasonic bath. The extracts are filtered and stored in amber glass vials with Teflon lined screw caps.

1.2 Scope and Application

This procedure is applicable to solid samples, including soils and sediments, submitted for Explosives analysis by HPLC method SW-846 8330A. It is not applicable to samples submitted for Explosives analysis by method SW-846 8330B. For samples that require SW-846 8330B, see SOP 046. Samples for 8330A and 8330B can NOT be batched together.

2.0 Discussion and Comments

This procedure is adapted from SW-846 method 8330A. The method outlined in this SOP is designed for low and high concentration samples. Samples expected to contain high levels of explosives should be screened using method 8510 or 8515. If the samples contain more than 2% explosives, they should not be ground by mortar and pestle.

The HPLC detector is extremely sensitive and will respond to many organic compounds. It is important to minimize extraneous contaminants and carryover by scrupulously cleaning all glassware and by using only high purity reagents. Additionally, all extraction items that come in contact with the sample must be made from glass, stainless steel, wood, or Teflon.

3.0 Preservation and Holding Times

3.1 Preservation

3.1.1 Samples shall be collected in glass jars with Teflon lined caps. 250ml jars are recommended for solid samples.

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3.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be refrigerated at ≤ 6°C until analysis.

3.2 Holding Time

3.2.1 Solid samples must be extracted within 14 days of collection. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.

3.2.2 Extracts should be analyzed as soon as possible, but must be analyzed within 40 days of extraction.

4.0 Definitions

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples that are extracted at the same time.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.7 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

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4.8 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.9 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 Reagents

5.1 Acetonitrile – HPLC grade or equivalent

5.2 Methanol – HPLC grade or equivalent

5.3 Calcium Chloride Solution – prepared by dissolving 5 grams of calcium chloride in one liter of HPLC grade water

5.4 Blank Sand – precleaned to remove contaminants

5.5 Explosives 8330 Surrogate Solution – prepared in acetonitrile at a concentration specified by the HPLC analyst. All surrogate solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.6 Explosives 8330 Spike Solution – prepared in acetonitrile at a concentration specified by the HPLC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

6.0 Glassware and Apparatus

6.1 Aluminum weighing dishes

6.2 16ml amber screw top vials with Teflon lined caps

6.3 Spatula – stainless steel, wooden, or Teflon

6.4 0.5ml or 1.0ml syringes

6.5 Mortar and Pestle – Glass or ceramic

6.6 10.0ml graduated pipette or graduated cyinder

6.7 Desiccator or Drying cabinet

6.8 2.0ml amber glass screw cap vials – caps must have Teflon lined septa

6.9 Ultrasonic water bath capable of running continuously

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6.10 Chiller capable of maintaining the ultrasonic bath temperature at less than 20 ^{o}C

6.11 Hi-Lo Thermometer

6.12 Disposable 3.0ml syringes

6.13 0.45um Teflon syringe filters

6.14 Top loading balance – capable of weighing samples to +/- 0.01 grams

7.0 Procedure

7.1 The extraction of all samples must be documented on a "prep sheet". The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the HPLC analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

7.2 Decant any free liquid from the solid sample. Remove any foreign objects such as twigs, rocks, or metal fragments. Thoroughly mix the sample with a wooden spatula. Samples that are tightly packed or contain obvious layers may need to be transferred to a larger container for proper mixing. Refer to SOP QA034 for more information on sample homogenization.

7.3 Transfer 20 to 50 grams of each sample to the appropriately labeled weighing dish. Use a clean spatula for each sample. Record the sample ID and bottle number on the prep sheet.

7.4 Place the samples in the desiccator or drying cabinet, and allow them to dry at room temperature. Samples must not be heated and should not be exposed to direct sunlight. Samples for this method do not need to be dried to a constant weight; they just need to crumble easily.

7.5 Use a ceramic or glass pestle to grind each sample in the weighing dish. If the sample is difficult to breakup, transfer it to a ceramic or glass mortar for additional grinding. Soil samples that are known to contain high concentrations or explosives should not be ground. They may DETONATE.

7.6 Transfer approximately 2.0 grams of each of the samples to the appropriately labeled amber 16ml vials. Be sure to label the vial cap, because the ultrasonic bath may remove any labels from the sides of the vials. Record the weight to the nearest 0.01 gram on the prep sheet.

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7.7 Transfer approximately 2.0 grams of each of the QC samples to the appropriately labeled vials. This includes the method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD). Use 2.0 grams of clean sand for the MB and BS. Use additional 2.0 gram aliquots of a sample for the MS, MSD, and DUP. Record the sample ID, bottle number, and weight on the prep sheet.

7.8 Using the dedicated spike syringe add 0.5ml of spike solution to the BS, MS, and MSD. Record the spike lot number on the prep sheet.

7.9 Using the dedicated surrogate syringe add 0.5ml of surrogate solution to each of the samples including the QC samples. Record the surrogate lot number on the prep sheet.

7.10 Using a graduated pipette or cylinder, add **4.5ml** of acetonitrile to each of the sample vials, the method blank (MB) and sample duplicate (DUP). Add **4.0ml** of acetonitrile to the BS, MS, and MSD. This will result in **5.0ml** of acetonitrile in each of the vials.

7.11 Put the cap on each vial and shake briefly to mix.

7.12 Place the vials in the rack inside the chilled ultrasonic bath.

7.13 Place the Hi-Lo thermometer probe in the bath. Reset the temperature.

7.14 Sonicate the sample for a minimum of 8 hours, but not more than 18 hours.

7.15 After sonication, remove the vials from the bath and allow them to settle for 30 minutes.

7.16 Record the maximum temperature of the bath on the prep sheet. The temperature should not have exceeded 20 °C. Notify the analyst if this temperature was exceeded.

7.17 Using a disposable 3.0ml syringe, remove 1.0ml of supernatant and combine it with 3.0ml of calcium chloride solution in a 16ml vial. Shake and let stand for 15 minutes. This resultant final volume is equivalent to 20ml.

7.18 Transfer ~3ml of extract to disposable syringe. Attach a Teflon syringe filter to the disposable syringe.

7.19 Filter the extract into an appropriately labeled amber 2.0ml screw cap vial.

CAUTION: WEAR SAFETY GLASSES, THE EXTRACT MAY SPRAY IF THE FILTER CLOGS.

7.20 Store the extracts in the “extract refrigerator” until they are needed for analysis.

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8.0 Quality Assurance and Quality Control

8.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. Samples can not be added to the batch after the sonication procedure has started.

8.2 A method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples.

9.0 Safety and Waste Disposal

9.1 Safety

9.1.1 Safety glasses, gloves and lab coats should be worn when handling samples, standards or solvents.

9.1.2 Avoid grinding samples that may contain high levels of explosives. The grinding action may cause them to DETONATE.

9.1.3 **Hearing protection** must be worn while operating the ultrasonic bath. The high frequency could cause permanent hearing loss.

9.1.4 Avoid touching the ultrasonic bath while it is active. Contact may cause tissue damage.

9.1.5 Avoid touching the chiller probe. Contact may cause tissue damage.

9.1.6 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

9.1.7 Acetonitrile is an inhalation hazard and suspected carcinogen. Use in well ventilated area.

9.2 Waste Disposal

9.2.1 Waste acetonitrile is placed in the “non-chlorinated waste” container.

9.2.2 Extracted soil samples and residual acetonitrile may be poured into the “non-chlorinated waste” container or the entire vial may be lab packed with the “extract waste”.

9.2.3 Waste soil from the homogenizing process should be place in the “soil waste” container. **NOTE:** Waste soil from foreign soils must follow “foreign soil” disposal requirements.

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9.2.4 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining soil samples are transferred to the appropriate drums for disposal.

10.0 References

SW-846 Method 8330A, Rev. 1, 01/98

SW-846 Method 8332, Rev. 0, 12/96

SW-846 Method 8330B, Rev. 2, 10/06

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ANALYSIS OF NITROAROMATICS AND NITRAMINES BY HPLC

Prepared by:	Norm Farmer	Date:	09/07/13
Reviewed by:	Mike Eger	Date:	09/11/13

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TEST NAME: ANALYSIS OF NITROAROMATICS AND NITRAMINES BY HPLC

METHOD REFERENCE: SW846 8330A

DEPT: HPLC

Revised Sections: 6.2, 6.3, 7.1, 7.2.1-7.2.3, 7.3.3, 7.5-7.5.4 and 11.1

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of specific nitroaromatics and nitramines in water and solid matrices utilizing an HPLC equipped with a diode array detector.

1.1.2 The following compounds can be reported by this method:

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	
1,3-Dinitrobenzene	1,3,5-Trinitrobenzene
2,6-Dinitrotoluene	2,4,6-Trinitrotoluene
2,4-Dinitrotoluene	2,4-diamino-6-Nitrotoluene
2-amino-4,6-Dinitrotoluene	2,6-diamino-4-Nitrotoluene
4-amino-2,6-Dinitrotoluene	2-amino-6-Nitrotoluene
Nitrobenzene	2-amino-4-Nitrotoluene
o-Nitrotoluene	4-amino-2-Nitrotoluene
m-Nitrotoluene	2,4-Diaminotoluene
p-Nitrotoluene	2,6-Diaminotoluene
DNX	3,5-Dinitroaniline
MNX	Nitroglycerine
TNX	PETN

*See SOP GC020 for additional information on the analysis of Nitroglycerine and PETN.

1.1.3 The reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. Reporting limits may vary depending on matrix complications and volumes. Reporting limits for this method are in the range of 0.2 to 2.0 ug/l for extracted aqueous samples, 50 ug/l for direct injection aqueous samples, and 200 to 2000 ug/kg for solid samples.

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1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

1.1.5 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.

1.2 Summary

1.2.1 This method is adapted from SW846 Method 8330A and 8332.

1.2.2 Samples are received, stored and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with Accutest SOP OP018 and OP019.

1.2.4 The extracts are analyzed on an HPLC equipped with a diode array detector.

1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in amber glass bottles with Teflon lined caps. One-liter bottles are recommended for aqueous samples and 300ml jars are recommended for solid samples.

2.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be stored at ≤ 6°C until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 7 days of collection.

2.2.2 Solid and waste samples must be extracted within 14 days of collection.

2.2.3 Extracts should be analyzed as soon as possible, but must be analyzed within 40 days of extraction.

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3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.

3.2 Method interferences may be caused by contaminants in solvents, reagents, or glassware. All of these materials must be demonstrated to be free from interferences.

3.3 Tetryl decomposes rapidly in methanol/water solutions, as well as with heat. All aqueous samples expected to contain tetryl should be diluted with acetonitrile prior to filtration and acidified to pH < 3. Samples and extracts should not be exposed to temperatures above room temperature.

3.4 Nitroglycerine and PETN may co-elute with various analytes on the C-18 and RP columns. It may be best to analyze these compounds separately. See SOP GC020 for additional information on the analysis of Nitroglycerine and PETN.

3.5 High levels of 4-amino-2-nitrotoluene may interfere with the surrogate 3,4-dinitrotoluene on the (Zorbax Extend C-18) primary column. In such instances, the surrogate recovery should be calculated from the confirmation column.

3.6 When analyzing the RDX breakdown analytes, TNX may partially coelute with HMX on the primary column and DNX may partially coelute with HMX on the confirmation columns.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

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4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.12 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

5.1 Water – HPLC grade or equivalent

5.2 Acetonitrile – HPLC grade or equivalent

5.3 Methanol – HPLC grade or equivalent

5.4 Calcium chloride solution – prepared by dissolving 5 grams of calcium chloride in 1 liter of HLPC grade water.

5.5 Explosives stock standards – Traceable to Certificate of Analysis

5.6 Surrogate standards – 3,4-Dinitrotoluene

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6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1100

Suitable HPLC equipped with an autosampler, pump, and diode array detector.

Autosampler allows for unattended sample and standard injection throughout the analytical run.

6.2 Data System – Agilent Technologies LC Chemstation rev. A 10.01
Agilent Technologies MS Chemstation rev. DA 00.01

6.2.1 A computer system interfaced to the HPLC that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.2.2 The software should allow for the viewing of the entire UV Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.2.3 Data is archived to a backup server for long term storage.

6.3 Primary Column – Zorbax Extend C-18 3.5u – 4.6mm X 100mm or equivalent

6.4 Confirmation Column– Zorbax Bonus RP (amine bonded C-18) 5u - 4.6mm X 250mm or equivalent

6.5 Gas-tight syringes, syringe filters, and class “A” volumetric glassware for dilutions of standards and extracts.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, and vendor part numbers can be found in the HPLC STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold

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time is reduced to one year or the vendor's expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with acetonitrile. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the explosives are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in 75/25 (v/v) water/acetonitrile. The low standard is at a concentration at or below the RL and the remaining standards define the working range of the detector.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC Conditions

7.2.1 HPLC-BB Conditions - Primary Column – (Extend C-18)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-1.0	78%	22%
1.0-6.0	71%	29%
6.0-27.0	71%	29%
27.0-29.0	78%	22%
29.0-33.0	78%	22%

Column temperature – 43.0 °C

Constant Flow – 2.0 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. The 254-nm wavelength switches to 270-nm just prior to the elution of the nitrotoluenes. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

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7.2.2 HPLC-PP Conditions - Primary Column – (Extend C-18)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-1.0	78%	22%
1.0-6.0	71%	29%
6.0-24.5	71%	29%
24.5-24.6	78%	22%
24.6-29.5	78%	22%

Column temperature – 41.0 °C

Constant Flow – 2.0 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. The 254-nm wavelength switches to 270-nm just prior to the elution of the nitrotoluenes. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.2.3 HPLC-GG/PP Conditions - Confirmation Column – (Bonus RP)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-0.15	38%	62%
0.15-0.85	48%	52%
0.85-19.0	48%	52%
19.0-19.5	38%	62%
19.5-25.0	38%	62%

Column temperature – 20.0 °C

Constant Flow – 0.9 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

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HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3. Sample Preparation

7.3.1 Water Samples (extracted)

A 1000ml aliquot of sample is extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with 3ml of acetonitrile. The final volume is then adjusted to 10ml with reagent water.

7.3.2 Water Samples (direct inject)

A 5ml aliquot of sample is mixed with 5ml of acetonitrile. The extract is filtered through a .45um Teflon syringe filter to remove any particulate.

7.3.3 Solid Samples

A 2-gram aliquot of sample is extracted with acetonitrile utilizing a chilled ultrasonic bath. A 1ml aliquot of extract is mixed with 3ml of calcium chloride solution. The extract is filtered through a .45um Teflon syringe filter to remove any particulate.

7.4. HPLC Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Initial Calibration Procedures

Before samples can be run, the HPLC system must be calibrated, and retention time windows must be determined.

7.4.1.1 External Standard Calibration

A minimum 5-point calibration curve is created for the explosives and surrogates.

Calibration factors (CF) for the explosives and surrogates are determined at each concentration by dividing the area of each compound by the concentration of the standard.

The mean CF and standard deviation of the CF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

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%RSD = (Standard Deviation of CF X 100) / Mean CF

If the %RSD ≤ 20%, linearity through the origin can be assumed and the mean CF can be used to quantitate target analytes in the samples. Alternatively if the %RSD > 20% a calibration curve of response vs. amount can be plotted. If the correlation coefficient (r) is ≥0.995 (r^2 ≥0.990) then the curve can be used to quantitate target analytes in the samples.

7.4.1.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be ≤ 15%. If the ICV does not meet this criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

NOTE: Second source standards may not be available for TNX, DNX, and MNX.

7.4.1.3 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

Retention time windows are crucial to the identification of target compounds. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined

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as ± 3 times the standard deviation of the mean absolute retention time or 0.03 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (surrogates) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations. HPLC retention times tend to shift more than GC retention times.

The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known peaks (standards and surrogates) throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.03 minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential “hits”. The analyst will then review these “hits” and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

7.4.2 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the explosives are prepared at various concentrations; at least one CCV must be below the mid-point of the calibration curve. A continuing calibration standard must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally a CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 15% for each analyte. If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated.

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If the |%D| is greater than 15%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reported. i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed or the data must be qualified.

7.4.3 Sample Extract Analysis

7.4.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV)
QC Extracts
Sample Extracts
CCV Standards

7.4.3.2 One hundred microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.3.3 Tentative identification of an analyte occurs when the peaks from the sample extract fall within the established retention time windows for a calibrated compound.

7.4.3.4 The diode array detector is capable of spectral evaluation; second column confirmation may not be necessary in some instances. Peak spectra can be compared to a spectral library that has been created for the target analytes. However, the UV spectra for some of the analytes are not very unique. **If there is any doubt to the presence of a compound, it must be confirmed on the confirmation column.**

7.4.3.5 If the peaks of interest fall within the retention time windows on the confirmation column, the identification is confirmed. Quantitation of the analyte on the primary and confirmation column should agree within 40%. If the difference is greater than 40% and no obvious reason can be found, the higher result should be reported and flagged as “estimated”; otherwise, the result from the primary column should be reported.

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If doubt over the identity of the analyte exists after primary and confirmation analysis, it may be appropriate to report the analyte as non-detect with an elevated RL and MDL. This should be discussed with the client and documented on the result page.

7.4.3.6 If the compound identification does not confirm, then the result should be reported as ND or "U".

7.4.3.7 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.4.3.8 If peak identification is prevented by the presence of interferences, further cleanup may be required or the extract must be diluted so that the interference does not mask any analytes. Analysis on the confirmation column may also be beneficial.

7.5. Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is

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regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

9.1 Surrogates

9.1.1 3,4-Dinitrotoluene is used as the surrogate standard to monitor the efficiency of the extraction.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

% Recovery = (Sample Amount / Amount Spiked) X 100

The percent recovery must fall within the established control limits for the results to be acceptable.

9.1.2 If the surrogate recovery is not within the established control limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or surrogate solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.1.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.2.3 If no problem is found, re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

9.1.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates

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from both sets of analysis should be reported on the final report.

9.2 Method Blank

9.2.1 The method blank is either de-ionized water or cleaned sand (depending upon sample matrix) to which the surrogate standard has been added. The method blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high level samples. The method blank must be free of any analytes of interest or interferences at ½ the required reporting level to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

9.3.1 The blank spike is either de-ionized water or cleaned sand (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable. The large

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number of analytes in this method presents a substantial probability that a few of the analytes will fall outside of the established control limits. This may not indicate that the system is out of control; therefore, corrective action may not be necessary.

Upper and lower marginal exceedance (ME) limits can be established to determine when corrective action is necessary. A marginal exceedance in the Blank Spike is defined as a recovery being outside of 3 standard deviations but within 4 standard deviations of the mean.

The number of allowable marginal exceedances is based on the number of analytes in the Blank Spike. Marginal Exceedances must be random. If the same analyte exceeds the BS control limits repeatedly, it is an indication of a systematic problem and corrective action must be taken.

The number of allowable marginal exceedances is as follows:

1) 11-30 analytes in BS, 1 analyte allowed in ME range;

2) < 11 analytes in BS, no analytes allowed in ME range

9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.3.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary and the sample results can be reported without qualification.

9.3.2.4 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable.

9.3.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

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9.3.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Matrix Spike and Matrix Spike Duplicate

9.4.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.4.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.4.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are an indication of the sample matrix effects.

9.4.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for each analyte should fall within the established control limits. If more than 33% of the RPDs fall outside of the established control limits,

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the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each explosive in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst}) \times (V_F / V_I) \times DF$

Soil (ug/kg) = $[(CONC_{inst}) \times (V_F / W_I) \times DF]$

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean CF, linear curve, or quadratic curve
DF	=	Dilution Factor
V_F	=	Volume of final extract (ml)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)

Soils are air dried prior to extraction; therefore, %solids is not used in the calculation.

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Wastewater, methanol, and acetonitrile from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

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Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000C Revision 3, March 2003

SW846 Method 8330 Revision 0, September 1994

SW846 Method 8330A Revision 1, January 1998

SW846 Method 3535A Draft Revision 1A, November 1998

SW846 Method 8332 Revision 0, December 1996

SW846 Method 8330B Revision 2, October 2006

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METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

Prepared by:	Dave Metzgar	Date:	08/28/2013
Reviewed by:	Svetlana Izosimova	Date:	09/13/2013

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TEST NAME: METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY

INSTRUMENT: THERMO 6500, SERIAL # 20100903 SSTRACE 1
INSTRUMENT: THERMO 6500, SERIAL # 20103825 SSTRACE 2
AUTOSAMPLER: CETAC 240 POSITION, SERIAL # 031038A520 SSTRACE 1
AUTOSAMPLER: CETAC 240 POSITION, SERIAL # 041048A520 SSTRACE 2

SUGGESTED WAVELENGTH (S): TABLE 2

METHOD REFERENCES: SW846 6010C, EPA 200.7 Rev 4.4 1994

DEPARTMENT: Metals

REVISIONS:
Section 2.0: added pH is checked within metals department
Section 3.0: added detail
Section 5.8: added PCOS and instrument software information
Section 6.6.2: changed “values” to “concentrations” and added detail
Section 6.7: remove references to CRI
Section 7.12: removed reference to CRI
Section 7.13: removed entire section
Section 8.5: removed entire section
Table 6: removed CRI section

1.0 SCOPE AND APPLICATION SUMMARY

1.1 This method is applicable for the determination of metals in water, sludges, sediments, and soils. Elements that can be reported by this method include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Titanium, Thallium, Tin, Vanadium, and Zinc.

1.2 Sample matrices are pretreated following SW846 and EPA methods for digestion of soil, sediment, sludge or water samples. Refer to specific metals department digestion SOP's for more information on digestion techniques.

1.3 This inductively coupled argon plasma optical emission spectrometer (s) (ICP-OES) uses an Echelle optical design and a Charge Injection Device (CID) solid-state detector to provide elemental analysis. Control of the spectrometer is provided by PC based iTEVA software. In the instrument, digested samples are introduced into the Thermo 6500 ICP, passed through a nebulizer and transported to a plasma torch. The element-specific emission spectra are produced by a radio frequency inductively coupled plasma. The spectra are dispersed by a spectrometer, and the intensities of the emission lines are monitored with the solid state detector.

1.4 Reporting limits (RL) are based on the extraction procedure. Reporting limits may vary depending on matrix complications, volumes and by client needs, but the reporting limits must always be verified with a low check which meets the criteria outlined in this SOP. Solid matrices are reported on a dry weight basis. Refer to table 1 of this SOP for Accutest Southeast typical reporting limits. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits.

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1.5 MDLs must be established for all analytes, using a solution spiked at approximately 3 times the estimated detection limit. To determine the MDL values, take seven replicate aliquots of the spiked sample and process through the entire analytical method. The MDL is calculated by multiplying the standard deviation of the replicate analyses by 3.14, which is the student's t value for a 99% confidence level. MDLs must be determined approximately once per year for each matrix and instrument. Please refer to Accutest QA SOP QA020, current version for further information regarding method performance criteria and experimental method detection limits.

1.6 An MDL check standard will be analyzed at the time of the annual MDL study and on a quarterly basis for verification. The concentration of the MDL check standard must be 1x-4x the statistical MDL. The MDL Check Standard is carried through the entire preparation and analytical procedure. This is a qualitative check; therefore, the analyte needs to be detected only. If the analyte is not detected, the concentration of the MDL check standard must be increased to a level where the analyte is detected. This then becomes the current MDL.

1.7 Lower limit of quantitation check sample. The lower limit of quantitation check (LLQC) sample should be analyzed after establishing the lower laboratory reporting limits and on a quarterly basis to demonstrate the desired detection capability. The LLQC sample is carried through the entire preparation and analytical procedure. Lower limits of quantitation are verified when all analytes in the LLQC sample are detected within 20 percent of their true value.

1.8 MDLs are generated for each matrix on both ICP instruments. The higher of the two statistically calculated MDL's is entered into LIMS as the MDL. The verified MDLs are stored in the LIMS and must be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

1.9 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.

1.10 Instrument Detection Limits (IDL). It is suggested that IDL's be completed upon initial instrument installation and whenever instrument conditions have significantly changed. The Instrument Detection Limits (in ug/L) are determined by analyzing 7 replicates of a reagent blank solution on 3 non consecutive days. The IDL is defined as 3 times the average of the standard deviation of the 3 days. Each IDL measurement shall be performed as though it were a separate analytical sample. IDLs shall be determined and reported for each wavelength used in the analysis of the samples.

2.0 PRESERVATION AND BOTTLEWARE

All samples should be preserved with nitric acid to a pH of <2 at the time of collection. All sample pH are checked in sample receiving and within the metals department. Samples that are received with a pH >2 must be preserved to pH <2 and held for 24 hours prior to metals digestion to dissolve any metals that absorb to the container walls. Refer to SOP SAM101, current revision for further instruction. Final pH of TCLP extracts are checked and recorded in Accutest Southeast Extractions Department. Please refer to TCLP (1311) fluid determination logbook and SPLP (1312) fluid determination logbook for further information. TCLP extracts

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received from Accutest Southeast Extractions Department are prepared as soon as possible, no longer than 24 hours from time of receipt. If precipitation is observed during the sample preparation process the sample(s) are immediately re-prepped on dilution until no precipitation is observed. Samples received for dissolved metals analysis should be filtered and preserved to pH<2 within 72 hours of collection. Refer to Accutest Southeast Sample Filtration Logbook for further information.

All soil samples must be stored in a refrigerator at $\leq$ 6°C upon receipt. Refer to SOP SAM101, current revision for further instruction.

All bottleware used by Accutest Southeast is tested for cleanliness prior to shipping to clients. Analysis results must be less than one half the reporting limit to be acceptable. Refer to SOP SAM104, current revision for further instruction.

3.0 HOLDING TIME AND BATCH SIZE

All samples must be prepared and analyzed within 6 months of the date of collection. Refer to appropriate Accutest Southeast digestion SOP, current revision for batch size criteria.

4.0 INTERFERENCES

Several types of interferences can cause inaccuracies in trace metals determinations by ICP. These interferences are discussed below.

4.1 Spectral interferences are caused by overlap of a spectral line from another element, unresolved overlap of molecular band spectra, background contribution from continuous or recombination phenomena, and background contribution from stray light from the line emission of high concentration elements. Corrections for these interferences can be made by using interfering element corrections, by choosing an alternate analytical line, and/or by applying background correction points. The locations selected for the measurement of background intensity will be determined by the complexity of the spectrum adjacent to the wavelength peak. The locations used for routine measurement must be free of off-line spectral interference or adequately corrected to reflect the same change in background intensity as occurs at the wavelength peak.

Note: Refer to section 17.0 of this SOP for further instruction regarding interfering element correction factor generation.

4.2 Physical interferences can be caused by changes in sample viscosity or surface tension, by high acid content in a sample, or by high dissolved solids in a sample. These interferences can be reduced by making sample dilutions.

4.3 Matrix interferences in high solid samples can be overcome by using an internal standard. Yttrium/Indium mix is used for the Thermo 6500 ICP. The concentration must be sufficient for optimum precision but not so high as to alter the salt concentration of the matrix. The element intensity is used by the instrument as an internal standard to ratio the analyte intensity signals for both calibration and quantitation.

4.4 Chemical interferences are not pronounced with ICP due to the high temperature of the plasma, however if they are present, they can be reduced by optimizing the analytical conditions (i.e. power level, torch height, etc.).

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5.0 APPARATUS

5.1 Currently there are two solid state ICPs available for use in the lab. Both are Thermo 6500 ICP units. These units have been optimized to obtain lower detection limits for a wide range of elements. Since they are solid state systems, different lines may be included for elements to obtain the best analytical results. However, the lines which are normally included in the normal analysis program are shown in Table 2.

5.2 Instrument auto samplers. For random access during sample analysis.

5.3 Class A volumetric glassware and pipettes.

5.4 Polypropylene auto sampler tubes.

5.5 Eppendorf Pipette (s) - Pipette (s) are checked for accuracy and to ensure they are in good working condition. Volumes are checked at 100% of maximum volume, the 50% (mid-range) and between 10% and 25% at the low range, whichever constitutes most frequently used volume for a particular pipette. Pipettes are checked within the metals department approximately once per week and stored electronically in the “Eppendorf Calibration Log”. Refer to SOP QA006, current revision for further information regarding pipette calibration.

5.6 Fisher Brand 0.45 micron (um) filter or equivalent. Filter lots are checked for cleanliness through the Method Blank process. All Method Blank analytical results must be less than one half the reporting limit to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated filters must be re-filtered through acceptable filters.

5.7 Fisher Brand disposable 10 ml syringes or equivalent. Syringe lots are checked for cleanliness through the Method Blank process. All Method Blank results must be less than one half the reporting limit to be acceptable, if not , the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated syringes must be re-filtered through acceptable syringes.

5.8 Data System

Microsoft Windows XP Professional Version 2002
Instrument software – Thermo iTEVA version 2.5.0.84

5.8.1 A computer system interfaced to the Thermo 6500 ICP that allows for the continuous acquisition and storage of all data obtained throughout the duration of the analytical run sequence.

5.8.2 Data is archived to a backup server for long term storage.

6.0 REAGENTS

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All chemicals listed below are trace metal grade unless otherwise specified. Refer to Acid Certificate of Analysis logbook for Certificates of Analysis and compliance with the specifications of the grade listed. Accutest Laboratories produces DI water to the specifications for the ASTM Type II standard designation based on the system manufacturer's performance specifications. The DI water is used exclusively for laboratory purposes. De-ionized (DI) water should be used whenever water is required. Refer to SOP QA037, current revision for more information regarding testing and monitoring. Refer to the Metals Department Standard Prep Logbook for the make-up and concentrations of standards and stock solutions being used within this SOP. Some of the information included in the logbook is as follows: standard name, elements in mix, manufacturer, lot number, parent expiration date, acid matrix, stock concentration, volume of standard added, total volume, final prepared concentration, prep date, initials, MET number, and prepared standard expiration date. Standards and prepared reagents must be prepared every 6 months or before stock standard expiration date, whichever comes first. Refer to tables 3 through 7 of this SOP for concentration levels of standards used. Unless otherwise approved, the calibration curve must contain 3 points determined by a blank and a series of standards representing the elements of interest.

6.1 2.5 ppm Yttrium and 10 ppm Indium internal standard, made from ICP quality standard.

6.2 Hydrochloric acid, trace metals grade.

6.3 Nitric Acid, trace metals grade.

6.4 ICP quality standard stock solutions are available from Inorganic Ventures, Spex, Plasma Pure, Ultra, Environmental Express, or equivalent.

6.5 Calibration Standards. These can be made up by diluting the stock solutions to the appropriate concentrations. The calibration standards should be prepared using the same type of acid (s) and at approximately the same concentration as will result in the samples following sample preparation.

6.5.1 For calibration and quantitation an internal standard (Yttrium/Indium) is used to limit nebulization problems. If it is known that the samples contain a significantly different acid matrix, the samples must be diluted so that they are in a similar matrix to the curve. All sample results are referenced to the initial calibration blank (ICB) Internal Standard counts. The criteria is 60-125 percent of the initial calibration blank (ICB) counts. If the internal standard counts fall outside these criteria matrix effects must be suspected and the sample diluted until it meets the criteria or footnoted in LIMS as suspected matrix interference.

6.5.2 Standards must be prepared so that there is minimal spectral interference between analytes.

Note: All Ag stock and intermediate solutions must be stored away from direct sunlight.

6.6 Analytical Quality Control Solutions.

All of the solutions below are prepared by adding either mixed or single element metals solutions to a solution prepared using the same type of acid (s) and at approximately the same concentration as will result in the samples following sample preparation.

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6.6.1 Blank (Calibration, ICB, CCB)

This reagent blank contains Nitric Acid at 3 percent and Hydrochloric Acid at 5 percent.

6.6.2 Initial Calibration Verification solution.

This standard solution must be made from a different source than the calibration curve. The concentrations for each element must be within the range of the calibration curve and should be approximately at the midpoint of the curve. This solution is used to verify the accuracy of the initial calibration. Levels for the ICV standard are shown in Table 4.

6.6.3 Continuing Calibration Verification solution.

The metals concentrations for this standard should be at approximately the mid point of the calibration curve for each element. This standard should be prepared from the same source that is used for the calibration curve. Levels for the CCV standard are shown in Table 5.

6.6.4 Interference Element Check Solutions.

These solutions must be analyzed to check the interfering element correction factors (IEC's) on the ICP instruments. Refer to section 17.0 of this SOP for further information regarding generation of IEC's.

6.6.4.1 ICSA Solution.

The ICSA solution contains only the interfering elements. Levels for the ICSA are shown in Table 9.

6.6.4.2 ICSAB Solution.

The ICSAB solution contains both the interferents and the analytes of interest. Levels for the ICSAB are shown in Table 10.

6.6.4.3 Single element interference check solutions

Prepared as single solutions. Levels for the single element interference solutions are shown in Table 11.

6.7 CRIA Standard Solution (Also referred to as LLCCV)

The CRIA standard contains the elements of interest at levels equal to Accutest Southeast quantitation limits (RL). Please refer to Table 6 for list of elements of interest and concentration levels for the CRIA. If special client reporting limits are requested, then low checks corresponding to those reporting limits must also be analyzed.

6.8 Matrix Spike, Matrix Spike duplicate, and Spike Blank Solution.

This solution is prepared by adding either mixed or single element metals solutions to a solution containing 3 percent nitric acid and 5 percent hydrochloric acid and diluting to a fixed

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final volume with this acid mixture. Spiking solution (s) must be added to the spike blank, matrix spike, and the matrix spike duplicate prior to digestion. Levels for the MS and MSD and Spike Blank standard are shown in Table 7.

6.9 Liquid Argon or Argon Gas. (99.999% purity)

7.0 ANALYTICAL PROCEDURE

Note: Please refer to section 8 of this SOP for further detail on quality control standards. Please refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

7.1 General procedure on how to operate the Thermo 6500 is described below. Refer to the Thermo 6500 operation manual for further details.

7.2 Before starting up the instrument, make sure that the pump tubing is in good condition, the torch assembly, the nebulizer, and the spray chamber are clean, the dehumidifier (if used) is filled with DI water up to the level between Minimum and Maximum, and that there are no leaks in the torch area.

7.3 Turn on the recirculating cooler. Verify that the argon is turned on and there is enough for the entire days analytical run.

7.4 Tighten the pump platens and engage the peristaltic pump. Make sure sample and internal standard solutions are flowing smoothly.

7.5 Put a new solution of acid rinse into the rinse reservoir. The composition of the rinse solution may be periodically changed to minimize sample introduction problems and sample carryover. If internal standard is being used, make sure that sufficient amount of internal standard is prepared for the entire analytical run.

7.6 Start up the instrument following the sequence show below.

7.6.1 Double click the **iTEVA Control Center** Icon on the desktop. Type ***admin*** in User Name field, and then click **OK**.

7.6.2 Once the iTEVA Control Center window is opened, click on **Plasma** Icon at status bar area. Then click on **Instrument Status** to check the interlock indicators (torch compartment, purge gas supply, plasma gas supply, water flow and exhaust should be in green; drain flow and busy should be in gray) and the Optics Temperature. (It should be around 38°C.) Click on the Close box.

7.6.3 Click **Plasma On**. When the plasma is on, click close. Let the instrument warm up for 15 to 20 minutes before starting the analysis. New tubing may take an hour to stabilize.

7.7 Torch Alignment and Auto Peak

7.7.1 If the torch has been cleaned, then the torch alignment procedure must be performed.

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7.7.2 Open the method and then click on **Sequence** tab, then click on **List View** Icon until you reach rack display.

7.7.3 Go to S-6 position (you can assign any position in the rack for torch alignment), then right click to select **Go** to empty sample S:6. (Now, the auto sampler tip moves from Rinse to this position).

7.7.4 Click on **Analysis** tab, then select **Torch Alignment** from Instrument drop down menu. There will be a pop up dialog box present. Click **Run**. Then there will be another dialog pop up box (This is a reminder for Torch Alignment Solution (2 ppm Zn)), click **Ok**. Now, the instrument is initializing an automated torch alignment. It takes about 7 minutes to complete this step. Progress is indicated in the progress bar.

7.7.5 After torch alignment is complete, click **Close**. Click on **Sequence** tab, then followed by **List View** Icon.

7.7.6 Go to Rinse position at rack display, right click to select Go to rinse and let it rinse for approximately 5 minutes.

7.7.7 Perform Auto Peak

7.7.8 It is recommended that the Auto Peak Adjust procedure be performed daily prior to calibration. A standard that contains all of the lines of interest is used and the system automatically makes the appropriate fine adjustments. (High standard solution should be used for this process.)

7.7.9 Click **Sequence** tab, then click on **List View** Icon until the rack is displayed.

7.7.10 Go to S-5 position (you can assign any position in the rack for auto peak adjust), then right click to select **Go** to empty sample S:5. (Now, the auto sampler tip moves from the Rinse position to this position). Click on **Analysis** tab. All elements result is shown in the display area. From Instrument drop down menu, select **Perform Auto Peak**. There will be a pop up dialog box present. Highlight “All Elements”, and then click **Run**. Then there will another pop up dialog box (This is a reminder for Auto Peak Solution), click **Ok**. Now, the instrument is performing auto peak adjust. It takes about 5 minutes to complete this process. The Auto Peak dialog box will show a green check mark in front of “All Elements”, which indicates Auto Peak is complete.

7.8 Open the method and start up the run.

7.8.1 Click on **Analyst** Icon at the workspace. Go to the method and choose Open from the drop down menu. Select the method with the latest revision number.

7.8.2 Go to **Method** tab at the bottom of left hand corner to click on **Automated Output** at the workspace area. Type a filename in Filename field in the data display area (i.e. : SA101010M1, starts with SA, then followed by MM-DD-YY, then M1; M1 indicates the first analytical run for that day, then followed by M2, M3 and so on for the second and third runs.) Click on **Apply To All Sample Types**.

7.8.3 Click on **Sequence** tab at the bottom of left hand corner. From Auto Session drop down menu bar, click on **New Auto sampler** to create a sequence. This will pop up a

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dialog box, then click on **New** and fill in number of samples (i.e.: 100) in the Number of Samples field and the sample I.D. (leave this field empty) in Sample Name field. Type a sequence name (i.e. : SEQ101010M1, starts with SEQ, then MM-DD-YY, then M1; M1 indicates the first analytical run for that day, then followed by M2, M3 and so on for the second and third runs) in the Sequence Name field. Click Ok, then put in "0" as settle time between between sequences, and click **Ok**.

7.8.4 Right click on **Untitled** (Cetac ASX-520 Enviro 5 Named Rack is the rack that is currently used) at the workspace area, click on **Auto-Locate All** to locate all sample positions.

7.8.5 Double click on **Untitled** again, then click on the sequence name (i.e. : SEQ101010M1), on the data display area, type the sequence in Samplename column, dilution factor (if needed) in CorrFact column, check the box in front of Check column, and select an appropriate check table.

7.8.6 Once done with creating sequence, go to **Method** drop down menu and save all changes as **Save As**. There will be a Save a Method dialog box present, go to the save option to check on "Overwrite Method and bump revision number" box, and then click **Ok**.

7.8.7 Go to Sequence tab, click on List View Icon from tool bar, then click on Connect Autosampler to PC and Initialize Icon.

7.8.8 See table 8 for a typical run sequence.

7.9 Calibrate the instrument as outlined below. See table 3 for calibration standards concentrations. This calibration procedure is done a minimum of once every 24 hours. The calibration standards may be included in the auto sampler program or they may be run manually from the **Calibrate Instrument (graduated cylinder)** icon located on the Analyst tab. All curves must be determined from a linear calibration prepared in the normal manner using the established analytical procedure for the instrument. Refer to instrument manual for further detail. Unless otherwise approved, the calibration curve must be determined by a blank and a series of three standards representing the elements of interest. Three exposures will be used with a percent relative standard deviation of less than 5 percent. The resulting correlation coefficient must be $\geq$0.998. If the calibration curves do not meet these criteria, analysis must be terminated, the problem corrected, and instrument re-calibrated. Correlation coefficients, slopes, and y-intercepts for each wavelength are printed and included in each analytical data package.

7.10 After the instrument is properly calibrated, begin by reanalyzing the high standard(s) for each element. The standards can be combined into one solution for this analysis. The analyzed value must be within 5 percent of the true value or that element must be re-calibrated. The High Standard Check shall be used for 200.7 only. After the high standards are analyzed, the ICV check standard shall be run. For the ICV, all elements to be reported must be within 5 percent of the true value for 200.7 and 10 percent of the true value for 6010C. If the ICV fails, analysis shall be terminated, problem corrected, and the instrument re-calibrated.

7.11 After analyzing the ICV, the ICB must be analyzed. The results of the ICB must be less than one half the reporting limit. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a "B" or "V" qualifier, or

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raising the reporting limit for all samples to greater than two times the background concentration.

7.12 Before analyzing any real samples the CRIA (also referred to as LLCCV) must be analyzed. The CRIA contains elements of interest at the reporting limit. The CRIA will be analyzed at the beginning and end of each analytical run. For all elements the results must be within 20 percent of the true value for client specific reporting limits (CRIA Requirement). For all others a 30 percent criterion will be applied. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits (CRIA Requirement). If the initial CRIA fails no samples associated with the failing CRIA can be reported, and the CRIA should be reanalyzed for the failing elements. If the closing CRIA fails the criteria, the samples associated with the CRIA shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the CRIA, or qualifying the results in LIMS.

7.13 Before analyzing any real samples, the interference check standards (ICSA, ICSAB) must be analyzed. For all spiked elements, the analyzed results must be within 20 percent of the true value. For non-spiked elements, the interfering element solutions must be ± the absolute value of the reporting limit for each element. Also, on an as needed basis (i.e.: instrument repair), analyze the single element interference check solutions (SIC). The same criteria as outlined above apply. If the ICSA and/or the ICSAB fall outside this criterion the problem must be corrected and the instrument re-calibrated or data footnoted in LIMS system. If the closing ICSA/ICSAB fails the criteria, the samples associated with the ICSA/ICSAB shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the ICSA/ICSAB, or qualifying the results in LIMS. Refer to section 17.0 of this SOP for Interfering Element Correction (IEC) procedure.

7.14 After the initial analytical quality control has been analyzed, the samples and the preparation batch matrix quality control shall be analyzed. Each sample analysis must be a minimum of 3 readings using at least a 5 second integration time. Between each sample, flush the nebulizer and the solution uptake system with a blank rinse solution for at least 60 seconds or for the required period of time to ensure that analyte memory effects are not occurring.

7.15 Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run. If the CCV solution is not within 10 percent of the true value for method 6010C and 5 percent for method 200.7 (for the initial CCV (ICCV)), the CCV shall be reanalyzed to confirm the initial value. If the CCV is not within criteria after the reanalysis, no samples can be reported in the area bracketed by the failing CCV. Immediately following the analysis of the CCV the CCB shall be analyzed. The results of the CCB must be less than one half the reporting limit for all elements. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a “B” or “V” qualifier, or raising the reporting limit for all samples to greater than two times the background concentration.

7.16 One sample per preparation batch, or whenever matrix interferences are suspected for a batch of samples, a serial dilution (SDL) must be prepared. For the serial dilution, a 1:5 dilution must be made on the sample. The results of the 1:5 dilution shall agree within 10 percent of the true value as long as the sample and the dilution result are greater than 10 times the method detection limit or greater than 50 times the IDL. If the results are outside these criteria then matrix interference should be suspected and the proper footnote entered into LIMS. A post digestion spike (PDS) must be performed if the SDL fails. The PDS must

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recover within ± 20 percent for method SW846-6010C and ± 15 percent for method EPA 200.7. If the PDS is outside these limits then matrix interference must be suspected and the proper footnote entered into LIMS.

7.17 The upper limit of quantitation may exceed the highest concentration calibration point and can be defined as the "linear dynamic" range. Sample results above the linear dynamic range shall be diluted under the linear dynamic range and reanalyzed. Samples following a sample with high concentrations of analyte (s) must be examined for possible carryover. Verification may be done by rinsing the lines with an acid solution and then reanalyzing the sample. A limit check table is built into the autosampler file so that samples exceeding the standardization range are flagged on the raw data.

7.18 After the instrument is optimized and all initial QC has been run, click on **Run Auto-Session** Icon to start the analytical run sequence.

7.18.1 If you need to add or delete samples once the run is started, follow the steps shown below.

7.18.2 Click on **Sequence** tab, then click on **List View** Icon at the tool bar. There is the sequence table shown on the display area.

7.18.3 Click on **Add Samples** Icon. This will pop up a dialog box, and then fill in number of samples that need to be added. Click **Ok**. By doing this, samples will be added to the end of the current sequence without a rack location.

7.18.4 On the Samplename column type in the sample I.D., correction factors, and check tables. **Click on Auto Locate All.**

7.18.5 The added samples will be analyzed at the end of the original sequence run order unless they are assigned a different run order.

7.18.6 Deleting Samples

7.18.7 Click on **Sequence** tab, and then click on **List View** Icon under the sequence display area.

7.18.8 Highlight all samples that need to be deleted and then click on the **Delete Samples** icon.

7.19 When the analysis is completed export the data to LIMS following the procedure outlined below.

7.19.1 Double click on **ePrint** Icon on desktop. There will be a **LEADTOOLS ePRINT** pop up box, click on **Finish Jobs** and **OK** boxes.

7.19.2 Double click the **PDF** Icon on the desktop; the PDF file will be present as Document_#. Right click on that file, select **rename** to change the filename to an assigned analytical run I.D. (i.e.: MA9000). This is the raw data file for MA9000.

7.19.3 Drop the raw data to the **LIMS Data Drop** icon located on the desktop.

7.19.4 By completing the above steps, the raw data (i.e.: MA9000) can be viewed and/or printed from the Raw Data Search function.

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7.19.5 Go to **Analysis** tab, right click on sample header, and select export all samples. A pop up dialog box will come up, type in the analytical run I.D. (i.e.: SA101010M1) and click **Ok**. Go to **Lims Export** folder located on the desktop, right click on analytical run and change extension from .TXT to .ICP. Open the analytical file and make any necessary changes, such as deleting any samples that need to be re-run on dilution. **Save** the file. Drop the data file to the **LIMS Data Drop** icon located on the desktop. This will then send the export file to LIMS for review.

7.20 The data can be evaluated by running an automated data evaluation program, which will help to generate quality control summary pages. Each run must be evaluated as quickly as possible to make sure that all required quality control has been analyzed. With each data package include: cover sheet, copies of all prep sheets, autosampler run sequence, dilution sheets, and raw data. Label each folder with MA#, instrument run I.D., instrument used, and date.

7.21 At the end of the analysis day the ICP must be shutdown using the following sequence.

7.21.1 Place the auto sampler tip in the rinse cup and rinse in a mixed solution of approximately 5 percent nitric acid and 5 percent hydrochloric acid for 10 minutes and then in DI water for 20 minutes.

7.21.2 Turn off the plasma by clicking on the **Plasma** Icon and then by clicking **Plasma Off.**

7.21.3 Close all iTeva programs/windows.

7.21.4 Release the tension on the sample pump platens.

7.21.5 Turn off recirculating chiller.

8.0 QUALITY CONTROL

This section outlines the QA/QC operations necessary to satisfy the analytical requirements for method SW846 6010C. Please refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements. Check with the area supervisor or lab manager for any non compliant quality control for further information.

8.1 High Standard Check.

After the instrument is properly calibrated, the high standard(s) shall be reanalyzed for each element. The analyzed value must be within 5 percent of the true value. If the High Standard falls outside this criteria analysis shall be terminated, problem corrected, and the instrument re-calibrated.

Note: High Standard Check is for method 200.7 only. The standards can be combined into one solution for this analysis.

8.2 Initial Calibration Verification Standard (ICV).

After each calibration, a standard from a different source than the calibration standard shall be analyzed. For the ICV, all elements to be reported must be within 10 percent of the true value for 6010C and within 5 percent for 200.7. If the ICV is outside these

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criteria then the analysis must be terminated, problem corrected, and the instrument re-calibrated.

8.3 Continuing Calibration Blank/Initial Calibration Blank.

Analyze the Initial calibration blank solution at the beginning of each run and the continuing calibration blank after every tenth sample and at the end of the sample run. The ICB/CCB must be less than one half the reporting limit for each element. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a “B” or “V” qualifier, or raising the reporting limit for all samples to greater than two times the background concentration.

8.4 Low Standard Check (CRIA).

The CRIA (also referred to as LLCCV) contains elements of interest at the reporting limit. The CRIA will be analyzed at the beginning and end of each analytical run. For all elements the results must be within 20 percent of the true value for client specific reporting limits (CRIA Requirement). For all others a 30 percent criterion will be applied. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits (CRIA Requirement). If the initial CRIA fails no samples associated with the failing CRIA can be reported, and the CRIA should be reanalyzed for the failing elements. If the closing CRIA fails the criteria, the samples associated with the CRIA shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the CRIA, or qualifying the results in LIMS.

8.5 ICSA and ICSAB and Single Element Interference Solutions

Analyze the ICSA and ICSAB at the beginning and end of each run following the analysis of the CRIA. Also, on an as needed basis (i.e.: instrument repair), analyze the single element interference check solutions (SIC). For all spiked elements, the analyzed results must be within 20 percent of the true value. For non-spiked elements, the interfering element solutions must be $\pm$ the absolute value of the reporting limit for each element. If the ICSA and/or the ICSAB fall outside this criterion the problem must be corrected and the instrument re-calibrated or data footnoted in LIMS system. If the closing ICSA/ICSAB fails the criteria, the samples associated with the ICSA/ICSAB shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the ICSA/ICSAB, or qualifying the results in LIMS. Refer to section 17.0 of this SOP for Interfering Element Correction (IEC) procedure.

8.6 Continuing Calibration Verification.

Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run. If the CCV solution is not within 10 percent of the true value for method 6010C and 5 percent for method 200.7 (for the initial CCV (ICCV)) the CCV must be reanalyzed to confirm the initial value. If the CCV is not within criteria after reanalysis no samples can be reported in the area bracketed by the failing CCV.

8.7 Method Blank.

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The laboratory must digest and analyze a method blank with each batch of samples. The method blank must contain elements at less than one half the reporting limit for each element. The exception to this rule is when the samples to be reported contain greater than 10 times the method blank level. In addition, if all the samples are less than a client required limit and the method blank is also less than that limit, then the results can be reported as less than that limit. Samples associated with the contaminated blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-digesting and reanalyzing the samples, qualifying the results with a "B" or "V" qualifier, or raising the reporting limit to greater than two times the background concentration,

8.8 Blank Spike Sample.

The laboratory must digest and analyze a spike blank sample with each batch of samples. Blank Spikes must be within 20 percent of the true value for method SW846-6010C and within 15 percent for method EPA 200.7. If the lab control is outside of the control limits for a reportable element, all samples must be re-digested and reanalyzed for that element. The exception is if the lab control recovery is high and the results of the samples to be reported are less than the reporting limit. In that case, the sample results may be reported with no flag. For solid standard reference materials (SRMs) $\pm$ 20 percent accuracy may not be achievable and the manufacturer's established acceptance criterion should be used for all soil SRMs.

8.9 Matrix Spike and Matrix Spike Duplicate Recovery.

The laboratory must digest and analyze a matrix spike and matrix spike duplicate with each batch of samples. The matrix spike recovery is calculated as shown below and must be within 20 percent of the true value for method SW846-6010C and within 30 percent for method EPA 200.7. If a matrix spike is out of control, then the results must be flagged with the appropriate footnote. If the matrix spike amount is less than one fourth of the sample amount, then the sample cannot be assessed against the control limits and must be footnoted to that effect.

Note: Both the matrix spike amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

$$\frac{\text{(Spiked Sample Result - Sample Result)}}{\text{Amount Spiked}} \times 100 = \text{matrix spike recovery}$$

8.10 Matrix Duplicate/Matrix Spike Duplicate Relative Percent Difference.

The laboratory must digest a duplicate with each batch of samples. The relative percent difference (RPD) between the duplicate and the sample must be assessed and must be $\leq$ 20 percent for sample results at or above the reporting limit. If the RPD is outside the 20 percent criteria the results must be qualified in LIMS. RPD's are also calculated in LIMS for sample results below the reporting limit. RPD's outside the 20 percent criteria are not considered failing and LIMS automatically footnotes these as "RPD acceptable due to low duplicate and sample concentrations."

Note: Both the duplicate amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

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8.11 Serial Dilution Analysis and Post Digestion Spike.

For one sample per preparation batch, or whenever matrix interferences are suspected for a batch of samples, a serial dilution must be prepared. For the serial dilution, a 1:5 dilution must be made on the sample. The results of the 1:5 dilution must agree within 10 percent of the true value as long as the sample and the dilution result are greater than 10 times the method detection limit and/or greater than 50 times the IDL. If the dilution does not agree, then the sample must be post digestion spiked (PDS) at a level no less than 10 times but no greater than 100 times the MDL concentration. The PDS must recover within ± 20 percent for method SW846-6010C and ± 15 percent for method EPA 200.7. If the PDS is outside these limits then matrix interference must be suspected and the proper footnote entered into LIMS.

$$\frac{\text{(Sample Result - Serial Dil. Result)}}{\text{Sample Result}} \times 100 = \text{Serial Dilution RPD}$$

8.12 Linear Calibration ranges.

The upper limit of the linear calibration ranges must be established for all elements by determining the signal responses from a minimum of three concentration standards, one of which is close to the upper limit of the linear range. The linear calibration range, which may be used for the analysis of samples must be judged by the analyst from the resulting data. The upper range limit should be an observed signal no more than 10% below the level extrapolated from lower standards. Linear calibration ranges must be determined whenever there is a significant change in instrument response or at a minimum, every 6 months.

8.13 Sample RSD

For samples containing levels of elements greater than five times the reporting limits, the relative standard deviation for the replicates should be less than 5%. If not, reanalyze the sample. If upon reanalysis, the RSD's are acceptable then report the data from the reanalysis. If RSD's are not acceptable upon reanalysis, then the results for that element should be footnoted that there are possible analytical problems and/or matrix interference indicated by a high RSD between replicates.

8.14 Interelement Spectral Interference Correction Validity

For the interelement spectral interference corrections to remain valid during sample analysis, the interferent concentration must not exceed its linear range. If the interferent concentration exceeds its linear range or its correction factor is big enough to affect the element of interest even at lower concentrations, sample dilution with reagent blank and reanalysis is required. In these circumstances, analyte dilution limits are raised by an amount equivalent to the dilution factor.

8.15 Internal Standard (Yttrium/Indium)

For any readings where the internal standard is outside of the range 60-125 percent of the internal standard level in the reference standard (Initial Calibration Blank), then the sample must be diluted until the internal standard is within range and all sample results must be footnoted in LIMS.

8.16 MSA (Method of Standard Additions)

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Accutest Southeast uses the internal standard technique as an alternative to the MSA per SW846-6010C section 4.4.2. However, in certain circumstances MSA may be needed by some project specific requirements. Accutest Southeast may perform an MSA when sample matrix interference is confirmed through the post digestion spike process or may qualify the results in LIMS. Accutest Southeast will use a single addition method as described in SW846-7000B.

9.0 GLASSWARE CLEANING

All glassware must be washed with soap and tap water and then rinsed with 5 percent nitric acid. It must then be rinsed at least 3 times with DI water. Refer to SOP GN196, current revision for further information regarding glassware cleaning.

10.0 DOCUMENTATION REQUIREMENTS

Refer to the Laboratory Quality Assurance Manual for documentation requirements. All raw data is printed to .PDF format and archived to a backup server for long term storage.

11.0 SAFETY

The analyst must follow normal safety procedures as outlined in the Accutest Laboratory Safety Manual which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and must be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor. Follow proper safety precautions when working with gas cylinders.

12.0 CALCULATIONS

For water samples, the following calculations must be used. Refer to the QC section for the calculations to be used for the QC samples.

Original sample concentration of metal (ug/l) =

$$\frac{\text{(conc. in the digestate (ug/l)) x (final digestate volume (ml))}}{\text{(initial sample volume (ml))}}$$

For soil samples, the following calculations must be used.

Concentration of the metal in the dry sample (mg/kg) =

$$\frac{\text{(conc. in the digestate (mg/l) x final digestate volume(L))}}{\text{(sample wt. (kg)) x (\% solids/100)}}$$

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13.0 INSTRUMENT MAINTENANCE

Recommended periodic maintenance includes the items outlined below. All maintenance must be recorded in the instrument maintenance log.

13.1 Change the pump tubing as needed.

13.2 Clean the filter on the recirculating pump approximately once a month and dust off the power supply vents as needed.

13.3 Clean or replace the nebulizer, torch assembly, and injector tube as needed.

13.4 Change the sampler tip as needed.

13.5 Clean the recirculating pump lines and internal sock filter every 3 months or as needed.

13.6 Clean the radial view quartz surface weekly or more often if needed.

14.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

14.1 Pollution Prevention

Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids must be followed. All method users must be familiar with the waste management practices described in Section 14.2.

14.2 Waste Management

Individuals performing this method must follow established waste management procedures as described in the Sample and Laboratory Waste Disposal SOP SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

15.0 GENERIC DEFINITIONS

15.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 24 hours which ever comes first.

15.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

15.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. A CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

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15.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

15.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the reporting level.

15.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

15.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the performance of a method in a given sample matrix.

15.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the precision and performance of a method in a given sample matrix.

15.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

15.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

15.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

16.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Statistical control limits are stored in the LIMS for QA purposes only. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

17.0 GENERATION OF INTERFERING ELEMENT CORRECTION FACTORS

17.1 It is recommended that all IEC's be verified and updated approximately every 6 months or whenever instrument conditions change significantly. It is also recommended that elements with frequent high concentrations or with large IEC's should be checked more frequently.

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17.2 Calculate the IEC correction factors and enter them into the method (refer to Thermo 6500 instrument manual). Calculate the correction factor using the equation shown below. This correction factor must be added to the correction factor already in place in the method for a given element.

$$IEC = \frac{\text{Concentration Result of the element with the interference}}{\text{Concentration result of the interfering element}}$$

17.3 Verify the new correction factors by reanalyzing the ICSA/ICSAB solutions and/or the SIC solutions or by reloading and recalculating the previously stored results. If the reanalysis is not within QC limits, make additional changes to the IEC factors and then re-verify both the individual and combined solution values.

17.4 Save and update the method.

17.5 Interfering element correction factors are saved as raw data along with the run printouts on a daily basis so that the IEC's for a given run are traceable.

TABLE 1: REPORTING LIMIT BY ELEMENT

Analyte	Water Reporting Limit (ug/L)	Soil Reporting Limit (mg/kg)	TCLP Reporting Limit (mg/L)/MCL
Tin	50	5	
Aluminum	200	20	
Antimony	5	1	
Arsenic	10	0.5	0.10 / 5.0
Barium	200	20	10 / 100
Beryllium	4	0.5	
Cadmium	5	0.4	0.05 / 1.0
Calcium	1000	500	
Chromium	10	1	0.10 / 5.0
Cobalt	50	5	
Copper	25	2.5	
Iron	300	10	
Lead	5	1	0.5 / 5.0
Magnesium	5000	500	
Manganese	15	1.5	
Nickel	40	4.0	
Potassium	5000	500	
Selenium	10	1	0.5 / 1.0
Silver	10	1	0.10 / 5.0
Sodium	5000	500	

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Thallium	10	1
Vanadium	50	5
Zinc	20	2
Molybdenum	50	2.5
Strontium	10	0.5
Titanium	10	0.5

TABLE 2. THERMO 6500 ANALYSIS LINES

Element	Wavelength
Al	396.1
As	189.042
Ca	317.933
Fe	259.9
Mg	279.078
Mn	257.610
Pb	220.353
Se	196.026
Tl	190.864
V	292.402
Ag	328.068
Ba	455.4
Be	313.042
Cd	226.502
Co	228.616
Cr	267.716
Cu	324.753
K	766.491
Na	589.5
Ni	231.604

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Sb	206.838
Zn	206.2
Mo	202.030
Sn	189.900
Sr	407.7
Ti	334.9

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TABLE 3: LOW, MID AND HIGH STANDARD LEVELS

Element	Low	Mid	High
	ug/l	ug/l	ug/l
Al	10000	40000	80000
As	500	2000	4000
Ca	10000	40000	80000
Fe	10000	40000	80000
Mg	10000	40000	80000
Mn	500	2000	4000
Pb	500	2000	4000
Se	500	2000	4000
Tl	500	2000	4000
V	500	2000	4000
Ag	62.5	250	500
Ba	500	2000	4000
Be	500	2000	4000
Cd	500	2000	4000
Co	500	2000	4000
Cr	500	2000	4000
Cu	500	2000	4000
K	10000	40000	80000
Na	10000	40000	80000
Ni	500	2000	4000
Sb	500	2000	4000
Zn	500	2000	4000
Mo	500	2000	4000
Sn	500	2000	4000
Sr	500	2000	4000
Ti	500	2000	4000

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TABLE 4: ICV STANDARD LEVELS

Element	Concentration
	ug/l
Al	40000
As	2000
Ca	40000
Fe	40000
Mg	40000
Mn	2000
Pb	2000
Se	2000
Tl	2000
V	2000
Ag	250
Ba	2000
Be	2000
Cd	2000
Co	2000
Cr	2000
Cu	2000
K	40000
Na	40000
Ni	2000
Sb	2000
Zn	2000
Mo	2000
Sn	2000
Sr	2000
Ti	2000

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TABLE 5: CCV STANDARD LEVELS

Element	Concentration
	ug/l
Al	40000
As	2000
Ca	40000
Fe	40000
Mg	40000
Mn	2000
Pb	2000
Se	2000
Tl	2000
V	2000
Ag	250
Ba	2000
Be	2000
Cd	2000
Co	2000
Cr	2000
Cu	2000
K	40000
Na	40000
Ni	2000
Sb	2000
Zn	2000
Mo	2000
Sn	2000
Sr	2000
Ti	2000

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TABLE 6: CRIA STANDARD LEVELS

Element	CRIA
	ug/l
Al	200
As	10
Ca	1000
Fe	300
Mg	5000
Mn	15
Pb	5
Se	5
Tl	10
V	50
Ag	10
Ba	200
Be	5
Cd	5
Co	50
Cr	10
Cu	25
K	5000
Na	5000
Ni	40
Sb	5
Zn	20
Mo	50
Sn	50
Sr	10
Ti	10

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TABLE 7: BLANK SPIKE, MATRIX SPIKE AND MATRIX SPIKE DUPLICATE LEVELS

Element	Concentration
	ug/l
Al	27000
As	2000
Ca	25000
Fe	26000
Mg	25000
Mn	500
Pb	500
Se	2000
Tl	2000
V	500
Ag	50
Ba	2000
Be	50
Cd	50
Co	500
Cr	200
Cu	250
K	25000
Na	25000
Ni	500
Sb	500
Zn	500
Mo	500
Sn	500
Sr	500
Ti	500

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TABLE 8: TYPICAL RUN SEQUENCE

BLANK
MID
HIGH
HIGH STD
ICV
ICB
CRIA
ICSA
ICSAB
CCV
CCB
MB
SB
SAMPLE1
DUPLICATE
SERIAL DILUTION
MATRIX SPIKE
MATRIX SPIKE DUPLICATE
POST DIGESTION SPIKE
SAMPLE2
SAMPLE3
CCV
CCB
SAMPLE4
SAMPLE5
SAMPLE6
SAMPLE7
SAMPLE8
SAMPLE9
SAMPLE10
SAMPLE11
SAMPLE12
SAMPLE13
CRIA
ICSA
ICSAB
CCV
CCB
ETC.

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TABLE 9: ICSA SOLUTION LEVELS

Element	Concentration
	mg/l
Al	500
As	0
Ca	500
Fe	200
Mg	500
Mn	0
Pb	0
Se	0
Tl	0
V	0
Ag	0
Ba	0
Be	0
Cd	0
Co	0
Cr	0
Cu	0
K	0
Na	0
Ni	0
Sb	0
Zn	0
Mo	0
Sn	0
Sr	0
Ti	0

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TABLE 10: ICSAB SOLUTION LEVELS

Element	Concentration
	mg/l
Al	500
As	1.0
Ca	500
Fe	200
Mg	500
Mn	0.5
Pb	1.0
Se	1.0
Tl	1.0
V	0.5
Ag	1.0
Ba	0.5
Be	0.5
Cd	1.0
Co	0.5
Cr	0.5
Cu	0.5
K	0
Na	0
Ni	1.0
Sb	1.0
Zn	1.0
Mo	1.0
Sn	1.0
Sr	1.0
Ti	1.0

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TABLE 11: SINGLE ELEMENT INTERFERENCE CHECK SOLUTION (SIC) LEVELS

Element	Concentration
	mg/l
Al	500
As	0
Ca	500
Fe	200
Mg	500
Mn	0
Pb	0
Se	0
Tl	0
V	0
Ag	0
Ba	0
Be	0
Cd	0
Co	0
Cr	0
Cu	0
K	0
Na	0
Ni	0
Sb	0
Zn	0
Mo	0
Sn	0
Si	50
Sr	0
Ti	0

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DIGESTION OF SOILS FOR ICP ANALYSIS

Prepared by: Dave Metzgar Date: 09/04/2013

Reviewed by: Svetlana Izosimova Date: 09/13/2013

Annual Review

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Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

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TEST NAME: DIGESTION OF SOILS FOR ICP ANALYSIS

METHOD REFERENCE: 3050B

DEPARTMENT: METALS

REPORTING LIMIT: Not applicable

REVISIONS: Section 6.4: Changed CPI to Environmental Express
Section 7.10: updated detail
Appendix A: page 12, Minimum sample size changed to 50 grams.

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 This method is applicable for the digestion of sediments, soils, sludges and solid wastes. After digestion, the samples can be analyzed by ICP. This digestion method is based upon SW846 method 3050B.

1.2 An aliquot of a homogenized soil is digested with repeated additions of nitric acid and hydrogen peroxide. The volume is reduced to 5 ml and then hydrochloric acid is added and the sample is refluxed for 15 minutes. The sample is cooled to room temperature and diluted to 50 ml. If particulate matter is present, the sample is filtered.

2.0 PRESERVATION

All soils must be refrigerated at $\leq$ 6 ^{o}C. All bottleware used by Accutest Southeast is tested for cleanliness prior to shipping to clients. Analysis results must be < ½ RL to be acceptable. Please refer to SOP SAM104, current revision for further instruction.

3.0 HOLDING TIME

All samples should be digested and analyzed within 6 months of the time of collection.

4.0 INTEREFRENCES

Sludge and soil samples can contain diverse matrix types, which may contain a variety of interference. Spiked samples can be used to determine if this interference is adequately treated in the digestion process. For discussion of other interference, refer to specific analytical methods.

5.0 APPARATUS

The apparatus needed for this digestion procedure are listed below.

5.1 Automatic repipettor (s)

5.2 Fisher Brand 0.45 micron (um) filter or equivalent. Filter lots are checked for cleanliness through the Method Blank process. All Method Blank analytical results must be < ½ RL to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated filters must be re-filtered through acceptable filters.

5.3 Top loader balance- capable of accurately weighing 0.01g. Refer to SOP QA005, current revision for balance calibration information.

5.4 Thermometer- capable of measuring to at least 125^0C and checked against NIST traceable thermometers. Refer to SOP QA002, current revision for further information.

5.5 Environmental Express Hot Block or equivalent capable of maintaining a temperature of 90-95°C.

5.6 Environmental Express digestion vessels or equivalent, 50ml capacity. Each Lot of digestion tubes comes with a Certificate of Analysis which demonstrates cleanliness as well as volume accuracy. Please refer to Digestion Tube Certificate Logbook for further information. Tube Lots are also checked through the Method Blank process. All Method Blank analytical results must be < ½ RL to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Re-digestion is required for all samples prepared with the contaminated tube lot.

5.7 Fisher Brand disposable 10 ml syringes or equivalent. Syringe lots are checked for cleanliness through the Method Blank process. All Method Blank results must be < ½ RL to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated syringes must be re-filtered through acceptable syringes.

5.8 Fisher Brand wooden spatulas or equivalent.

5.9 Eppendorf Pipette (s) - Pipette (s) are checked weekly for accuracy and to ensure they are in good working condition. Volumes are checked at 100% of maximum volume, the 50% (mid-range) and between 10% and 25% at the low range, whichever constitutes most frequently used volume for a particular pipette. Pipettes are checked within the metals department approximately once per week and stored electronically in the “Eppendorf Calibration Log”. Refer to SOP QA006, current revision for further information regarding pipette calibration.

5.10 Class A volumetric flask (s)

5.11 Class A volumetric pipette (s)

5.13 Teflon Chips

5.14 Solid Standard Reference Material (SRM) as required per project/client specific requirements.

6.0 REAGENTS

All chemicals listed below are trace metal grade unless otherwise specified. Refer to Acid Certificate of Analysis logbook for Certificate of Analysis and compliance with specifications of the grade listed. De-ionized (DI) water should be used whenever water is required. Accutest Laboratories produces DI water to the specifications for the ASTM Type II standard designation based on the system manufacturer's performance specifications. The DI water is used exclusively for laboratory purposes. Refer to SOP QA037, current revision for more information regarding testing and monitoring.

6.1 Hydrochloric acid, Fisher Trace metal grade or equivalent

6.2 Nitric acid, Fisher Trace metal grade or equivalent

6.3 Hydrogen peroxide, reagent grade ,30%

6.4 Metals spiking solutions commercially purchased:

Environmental Express Multielement spiking solution or equivalent made with 5% HNO3 and a trace of HF.

Inorganic Ventures 5000 mg/l Mineral solution.

Prepared Metals Standards:

100ppm Molybdenum, 100ppm Tin, 100ppm Strontium, and 100ppm Titanium spiking solution prepared as follows: Using a 10ml class A volumetric pipette, add 10mls of 1000ppm stock Molybdenum, 10mls of 1000ppm stock Tin, 10mls of 1000ppm Strontium, and 10mls of 1000ppm Titanium to a 100ml class A volumetric flask containing approximately 50mls of DI water and 3mls of concentrated Nitric acid and 5mls of concentrated HCL. Dilute to volume with DI water and mix well. This standard must be prepared every 6 months or before stock standard expiration date, whichever comes first. Refer to Metals Standard Prep Logbook for further information. Some of the information included in the logbook is as follows: standard name, elements in mix, manufacturer, lot number, parent expiration date, acid matrix, stock concentration, volume of standard added, total volume, final prepared concentration, prep date, initials, MET number, and prepared standard expiration date.

7.0 PROCEDURE

7.1 Decant any free liquid from the solid sample. Remove any foreign objects such as twigs or rocks. The sample container must have enough room to move the matrix around with the wooden spatula. Mix the sample thoroughly using the wooden spatula. Make certain the entire sample is mixed well. The wooden spatula must reach the bottom of the original container and be able to be moved through the entire sample to ensure proper mixing. If the sample is packed tightly or matrix is dense and can not be efficiently moved around in the original jar, a secondary container such as a porcelain dish must be used. Remove the sample from the original container and place in the clean secondary container. While in the secondary container thoroughly mix sample around until appearing uniform in consistency. Upon completion the sample is re-packed into the original container. Refer to SOP QA034, current revision for more information on sample homogenization. Using a wooden spatula weigh out approximately 1.0 gram of a homogeneous sample on a top loading balance and place in the digestion vessel.

7.2 The sample identification must be accurately recorded on the digestion vessel and sample digestion log. In addition to the samples, a serial dilution (performed at the analytical bench), a post digestion spike (performed at the analytical bench), a matrix spike (MS), matrix spike duplicate (MSD), blank spike, duplicate (DUP) and a method blank should be set up with each batch of 20 samples. Refer to Table 1 for the spiking solution levels to use for each matrix spike, matrix spike duplicate, and blank spike. For the method blank and blank spike, 1.0 g of Teflon chips should be used. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

7.3 Add 2.5 ml of concentrated nitric acid to all quality control and samples.

7.4 Pre heat the Hot Block to 90 to 95°C. Place the labeled digestion vessels into the heating apparatus. Heat the samples at a gentle reflux for 10-15 minutes at 90 to 95°C. Allow the samples to cool.

7.5 Add an additional 2.5 ml of concentrated nitric acid to all quality control and samples. Heat the samples at a gentle reflux for an additional 30 minutes. Allow samples to cool.

7.5.1 If brown fumes are generated, which indicates oxidation of sample by HNO3, then repeat step 7.5 until no brown fumes are present.

7.5.2 Allow sample to evaporate to 5 ml without boiling or heat at 90 to 95°C without boiling for 2 hours. Do not allow sample to go to dryness.

7.6 Allow samples to cool. Add 2 ml of DI water and 3 ml of 30% hydrogen peroxide to each sample and reflux until effervescence subsides.

7.7 Continue to add 30% hydrogen peroxide in 1ml aliquots with warming until the effervescence is minimal or until the general sample appearance is unchanged. Do not add more than a total of 10 mls of 30% hydrogen peroxide.

7.8 Allow sample to evaporate to 5 ml or heat at 90 to 95°C for 2 hours. Do not allow sample to go to dryness.

7.9 Allow samples to cool. Add 5 ml of concentrated HCl and reflux for an additional 15 minutes.

7.10 Allow the sample to cool. Dilute to final volume of 50 mls using DI water, cap and shake vessel. If particulate matter is present, uncap the vessel and filter using Fisher Brand disposable syringe and 0.45 micron (um) filter or equivalent. The method blank and blank spike for the filtered sample's prep group must be filtered as well. All samples are filtered at the analytical bench.

7.11 The sample is now ready for analysis by ICAP.

8.0 QC REQUIREMENTS:

For each digestion batch of 20 samples, a serial dilution (performed at the analytical bench), a post digestion spike (performed at the analytical bench), a matrix spike (MS), a matrix spike duplicate (MSD), a duplicate (DUP), a blank spike (LCS), and a method blank should be prepared. Re-digestion is suggested for QC that does not meet the Accutest QC limits. The appropriate lab supervisor or lab manager will notify the analyst of samples that need re-digestion. Please refer to TABLE 1 in this SOP for spiking volumes and concentrations. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

9.0 GLASSWARE CLEANING:

All glassware should be washed with soap and tap water and then soaked in a 5% nitric acid bath. It should then be rinsed at least 3 times with de-ionized water. Refer to SOP GN196, current revision for further information regarding glassware cleaning.

10.0 DOCUMENTATION REQUIREMENTS:

All digestion information should be completed in the Metals Digestion Log. The information required includes: the sample identification (including bottle number), the initial sample weight, the final sample volume, the acids (including the lot number and manufacturer), the spiking solutions used, the observed temperature, the corrected temperature, the thermometer ID, the digestion vessel lot number, the filter lot number, the Teflon chips lot number, analysts signature, and the digestion date. The analyst should write additional information such as unusual sample characteristics in the comment section.

11.0 SAFETY:

The analyst should follow normal safety procedures as outlined in the Accutest Laboratory Safety Manual which includes the uses of safety glasses and lab coats. In

addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact supervisor.

12.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

12.1 Pollution Prevention

Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids must be followed. All method users must be familiar with the waste management practices described in Section 12.2.

12.2 Waste Management

Individuals performing this method must follow established waste management procedures as described in the Sample and Laboratory Waste Disposal SOP SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

13.0 GENERIC DEFINITIONS

13.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 24 hours which ever comes first.

13.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

13.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. A CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

13.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

13.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

13.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

13.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

13.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the precision and bias of a method in a given sample matrix.

13.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

13.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

13.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

14.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Statistical control limits are stored in the LIMS for QA purposes only. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

15.0 Hotblock Maintenance

Clean surface area of hotblock periodically to prevent sample and reagent build up on the surface of the block. If the hotblock can not maintain a temperature between 90-95 degree C or the user experiences any other type of mechanical or electronic error a service representative will need to be contacted. Any hotblock that is not functioning properly must be tagged as “Out of Service”.

TABLE 1: ICP METALS SPIKING LEVELS

ELEMENT	INITIAL CONC (ppm)	VOLUME USED (ml)	FINAL CONC (mg/l)	FINAL VOL. (ml)
Ba	200	0.50	2.0	50
Be	5	0.50	.05	50
Cd	5	0.50	.05	50
Cr	20	0.50	.20	50
Cu	25	0.50	.25	50
Co	50	0.50	0.50	50
Mn	50	0.50	0.50	50
V	50	0.50	0.50	50
Zn	50	0.50	0.50	50
As	200	0.50	2.0	50
Se	200	0.50	2.0	50
Pb	50	0.50	0.50	50
Tl	200	0.50	2.0	50
Sb	50	0.50	0.50	50
Mo	100	0.25	0.50	50
Sn	100	0.25	0.50	50
Al	200/5000	0.5/0.25	27	50
Fe	200/5000	0.5/0.25	26	50
Mg	5000	0.25	25	50
Ca	5000	0.25	25	50
K	5000	0.25	25	50
Na	5000	0.25	25	50
Ag	5	0.50	0.05	50
Ni	50	0.50	0.50	50
Sr	100	0.25	0.50	50
Ti	100	0.25	0.50	50

APPENDIX A

1.0 Application

Appendix A designed to supplement SOPs MET104.xx and MET105.xx for the preparation of soil samples for compliance with DoD and certain state-specific projects

2.0 Background

A theory of particulate sampling was developed by geologist Pierre Gy to improve the quality of data gathered in support of mineral exploration and mining. The MIS approach described herein is based upon Gy's theories and is applicable to environmental sampling at contaminated sites.

A large portion of sampling error is a result of compositional and distributional heterogeneity.

Compositional heterogeneity describes the variability of contaminant concentrations between the particles that make up the population in the sample. This type of heterogeneity results in fundamental error (FE).

Distributional heterogeneity occurs when particles are not randomly distributed across the population due to slight spatial variations. Spatial variability will be missed if all samples are collected from one place. This type of heterogeneity results in grouping and segregation error (GSE).

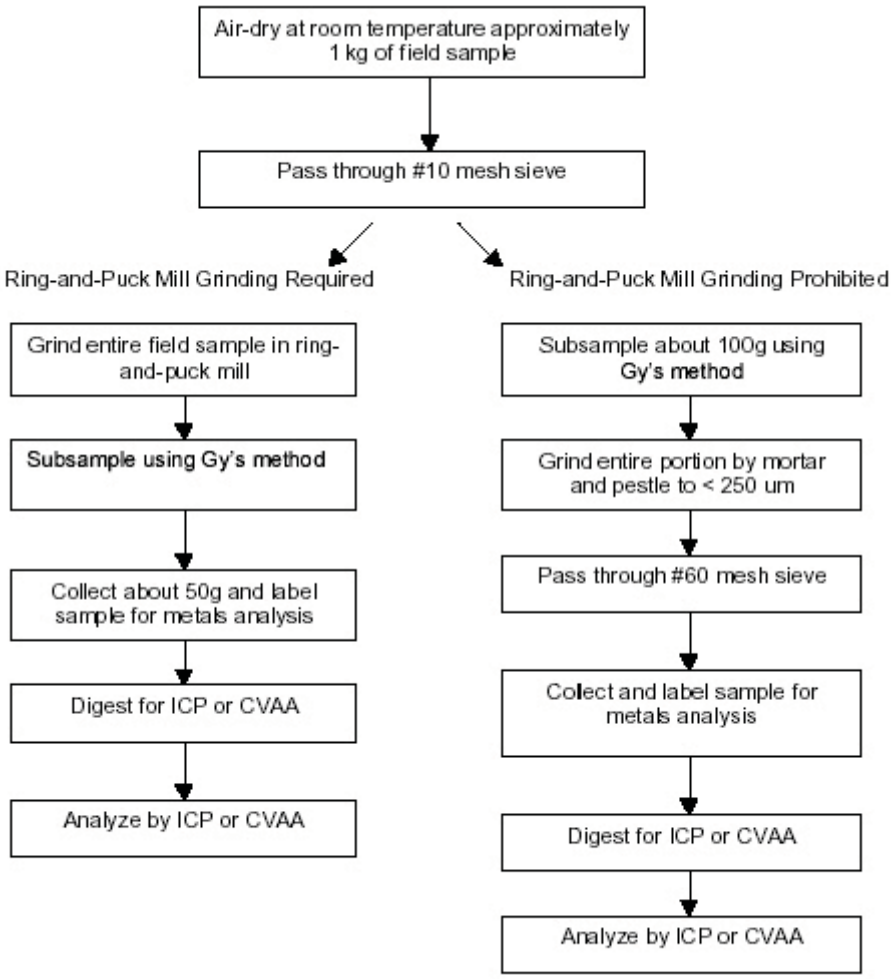
Gy found that fundamental error is directly proportionate to maximum particle size and inversely proportionate to sample size, therefore it is beneficial to collect and analyze a sample of sufficient size that consists of particulate matter where majority of contamination is present. In order to manage FE under 15%, particulate matter size must be under 2 mm and minimum sample mass above 30g.

To minimize GSE, it is imperative to collect sample increments randomly and in enough locations to capture the spatial variability, even within sample that already has been collected from the field.

3.0 Subsampling for Metals

Some projects require that metals analysis be performed on the multi-incremental sample that was collected for 8330B. The technique used should be listed in the project QAPP or SOW. Consult the client if this information is not available.

See flow chart below for various subsampling techniques:



If Ring and Puck Mill grinding is required, then proceed with the grinding procedure listed in SOP OP046 for explosives. The metallic components from the Ring and Puck Mill may introduce chromium and iron into the sample.

After grinding, place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick. Using a rectangular scoop, collect multiple top-to-bottom cuts across the sample (see figure below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Transfer the samples to the metals department for analysis.

If Ring and Puck Mill grinding is not required then follow the procedure listed below.

Transfer the sample to a large ziplock bag after it has been air dried and sieved. Sample should be transferred over the downdraft tables to minimize dust contamination. Seal the bag and thoroughly mix the sample.

Place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick. Using a rectangular scoop, collect multiple top-to-bottom cuts across the sample (see figure below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Return the remaining sample to the ziplock bag or mixing bowl.

Grind each sample and MB to a particle size less than 250 um with a non-metallic mortar and pestle.

Place a baking tray on the downdraft table. Sieve each sample through a #60 sieve onto a tray.

Collect and label the samples. Transfer the samples to the metals department for analysis.

For digestion withdraw approximately 5 g of sieved material. If mortar-and-pestle grinding was specified per QAPjP, 1 g is sufficient. Follow digestion procedure outlined in the body of this SOP.

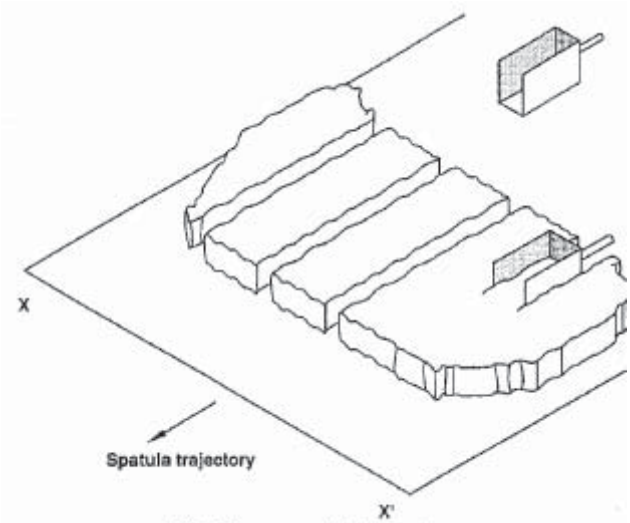


FIG. 1 Transversal Subsampling

ANALYSIS OF SEMIVOLATILE ORGANICS BY GC/MS SELECT ION MONITORING (SIM)

Prepared by:	Norm Farmer	Date:	08/31/13
Reviewed by:	Mark Erstling	Date:	09/06/13

Annual Review

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Issued to:		Date:	
Issued to:		Date:	

Effective 7 days after "*" date

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TEST NAME: ANALYSIS OF SEMIVOLATILE ORGANICS BY GC/MS SELECT ION MONITORING (SIM)

METHOD REFERENCE: SW846 8270D

DEPT: MS

Revised Sections: 1.2.3, 6.3, 7.1, 7.4.1.4, 7.5-7.5.4 and 11.1

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of various semivolatile organic compounds in water and solid matrices utilizing a gas chromatograph equipped with a mass spectrometer detector. Routine compounds can be found in Table 1.

1.1.2 Unlike convention full scan 8270; this method utilizes the instrument's select ion monitoring (SIM) capabilities. By monitoring for a few specific ions the sensitivity can be increased 10 to 20 fold.

1.1.3 Reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. Reporting limits may vary depending on matrix complications and sample volumes. Reporting limits for this method are in the range of 0.2 to 1.0 ug/l for aqueous samples and 7 to 70 ug/kg for solid samples. Solid matrices are reported on a dry weight basis.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

1.1.5 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.

1.2 Summary

1.2.1 This method is adapted from SW846 method 8270D.

1.2.2 Samples are received, stored and extracted within the appropriate holding times.

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1.2.3 Sample preparation is performed in accordance with Accutest SOP OP006, OP007, OP059 and OP060.

1.2.4 The extracts are analyzed on a gas chromatograph equipped with mass spectrometer detector.

1.2.5 The peaks detected are identified by comparison to characteristic ions and retention times specific to the known target list of compounds.

1.2.6 Library searches can not be performed on data acquired in SIM mode because data was only acquired for selected ions.

1.2.7 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in amber glass bottles with Teflon lined caps. One-liter bottles are recommended for aqueous samples and 300ml jars are recommended for solid samples.

2.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be refrigerated at –10°C to –20°C until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 7 days of collection.

2.2.2 Solid and waste samples must be extracted within 14 days of collection.

2.2.3 Extracts must be analyzed within 40 days of extraction.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.

3.2 Method interferences may be caused by contaminants in solvents, reagents, or glassware. Interferences from phthalate esters can be eliminated by using plastic-free solvent containers and solvent rinsed glassware.

3.3 Other organic compounds, including chlorinated hydrocarbons, petroleum hydrocarbons, and phthalate esters may be coextracted by this method.

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3.4 SIM may provide a lesser degree of confidence in compound identification unless multiple ions are monitored for each compound. In general, Accutest monitors 3 ions per compound.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all MS methods, a CCV must be analyzed at the beginning of each analytical run.

4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Internal Standards: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Internal standards for Mass Spec methods are often deuterated forms of target analytes. Internal standards are used to compensate for retention time and response shifts during an analytical run.

4.6 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

4.7 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.8 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.9 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

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4.10 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.11 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.12 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.13 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

5.1 Methylene Chloride – pesticide grade or equivalent

5.2 Semivolatile stock standards – Various mixes, traceable to Certificate of Analysis

5.3 Decafluorotriphenylphosphine mix (DFTPP) – Also contains pentachlorophenol, benzidine and DDT.

5.4 Base/neutral surrogate standards – dependent on the analytes being analyzed

Nitrobenzene-d5
2-Fluorobiphenyl
P-Terphenyl-d14

5.5 Acid surrogate standards – dependent on the analytes being analyzed

Phenol-d6
2-Fluorophenol
2,4,6-Tribromophenol

5.6 Internal standards – dependent on the analytes being analyzed

1,4-Dichlorobenzene-d4	Naphthalene-d8
Acenaphthene-d10	Phenanthrene-d10
Chrysene-d12	Perylene-d12

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6.0 APPARATUS

6.1 Gas Chromatograph – Agilent Technologies 6890 with 7683 Autosampler

6.1.1 Gas Chromatograph

The analytical system that is complete with a temperature programmable gas chromatograph and all required accessories, analytical columns, and gases.

6.1.2 The injection port is designed for split-splitless injection with capillary columns.

6.1.3 Autosampler allows for unattended sample and standard injection throughout the analytical run.

6.2 Mass Spectrometer – Agilent Technologies 5973 and 5975

The mass spectrometer must be capable of scanning from 35-500 amu every second or less utilizing a 70-volt (nominal) electron energy in the electron impact ionization mode. It must also be capable of producing a mass spectrum that meets all the criteria in section 7.4.1.1 when injecting 50 ng of Decafluorotriphenylphosphine (DFTPP).

The mass spectrometer must be capable of analyzing multiple groups for up to 30 specific ions. The start and end of each group should be time programmable. Each group of specific ions is referred to as a descriptor.

6.3 Data System – Agilent Technologies MS Chemstation rev. DA 02.0x or EA 02.0x.

6.3.1 A computer system interfaced to the mass spectrometer that allows for the continuous acquisition and storage of all mass spectral data obtained throughout the duration of the chromatographic program.

6.3.2 The computer utilizes software that allows searching any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP).

6.3.3 The software should allow for integrating the abundances in any EICP between specific time or scan number limits. See Table 3.

6.3.4 Data is archived to magnetic tape for long term storage.

6.4 Column – DB-5MS or equivalent: 30m X 0.25mm X 0.25um
– Rxi-5SIL or equivalent: 30m X 0.25mm X 0.25um

6.5 Gas-tight syringes and class “A” volumetric glassware for dilutions of standards and extracts.

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7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the Semivolatile Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at temperatures between –10 °C and –20 °C, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, and vendor part numbers can be found in the MS STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a "Certificate of Analysis" with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor's expiration date. Once opened, the hold time is reduced to one year or the vendor's expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with methylene chloride. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the semivolatile organics are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. The low standard is at a concentration at or below the RL and the remaining standards define the working range of the detector.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 Gas Chromatograph Conditions and Mass Spectrometer Descriptors

1ul or 2ul autosampler injection

Pulsed splitless or splitless

Carrier gas – UHP Helium (7.7psi to 36psi @1.5 psi/min ramp pressure)

Injection port temperature – 280 °C Transfer line temperature – 280 °C

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Source temperature – 230 °C Quad temperature – 150 °C

Oven program – 55 °C for 1.0 minutes
27.5 °C/min to 265 °C for 0 minutes
5 °C/min to 300 °C for 0 minutes
20 °C/min to 320 °C for 0 minutes

OR

Oven program – 40 °C for 1.5 minutes
30 °C/min to 190 °C for 0 minutes
10 °C/min to 260 °C for 0 minutes
25 °C/min to 320 °C for 2.0 minutes

GC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

MS Descriptors – Monitor 3 characteristic ions for each target analyte, and 2 characteristic ions for each surrogate and internal standard. Each descriptor may have up to 30 ions; however, the more ions in a descriptor, the less the sensitivity. Therefore, it is beneficial to use multiple descriptors for longer analytes lists.

GC conditions and mass spectrometer descriptors are dependent on the analytes being analyzed. Refer to the specific instrument methods for actual conditions and descriptors.

7.3 Sample Preparation

7.3.1 Water Samples

A 1000ml aliquot of sample is pH adjusted and extracted with methylene chloride utilizing separatory funnel extraction. The extract is concentrated to 1.0ml.

7.3.2 Solid Samples

A 30-gram aliquot of sample is extracted with methylene chloride and acetone utilizing pulse sonication or microwave extraction. The extract is concentrated to 1.0ml.

7.4 Gas Chromatographic Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures
Continuing Calibration Verification

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7.4.1 Initial Calibration Procedures

Before samples can be run, the GC/MS system must be tuned, the injection port inertness must be verified, and the instrument must be calibrated.

7.4.1.1 Tune Verification (DFTPP)

The instrument should be hardware tuned per manufacturer's instructions. Verify the instrument tune by injecting 50ng of DFTPP solution onto the instrument. The resulting DFTPP spectra should meet the criteria in the following table.

DFTPP KEY IONS AND ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
51	30-60 of mass 198
68	<2 % of mass 69
70	<2 % of mass 69
127	40-60 % of mass 198
197	<1 % of mass 198
198	Base peak, 100 % relative abundance
199	5-9 % of mass 198
275	10-30 % of mass 198
365	>1 % of mass 198
441	Present but less than mass 443
442	>40 % of mass 198
443	17-23 % of mass 442

Evaluate the tune spectrum using three mass scans from the chromatographic peak and a subtraction of instrument background. This procedure is performed automatically by the MS Chemstation software by running "autofind" on the DFTPP peak.

Select the scans at the peak apex and one to each side of the apex. Calculate an average of the mass abundances from the three scans.

Background subtraction is required. Select a single scan in the chromatogram that is absent of any interfering compound peak and no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tuning compound peak.

If the criteria are not achieved, the analyst must retune the mass spectrometer and repeat the test until all criteria are met.

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Analysis must not begin until the tuning criteria are met. The injection time of the acceptable tune analysis is considered the start of the 12-hour clock. The same mass spec settings must be used for the calibration standards and samples that were used for the tune evaluation standard.

7.4.1.2 Injection Port Inertness Verification

DDT, pentachlorophenol, and benzidine must also be evaluated in the tune standard. These compounds are used to assess injection port inertness and column performance.

Pentachlorophenol and benzidine should be present at their normal responses and, no peak tailing should be visible. The tailing factor for Benzidine must be less than 2 and the tailing factor for pentachlorophenol must be less than 2.

DDT breakdown should not exceed 20%. Breakdown is calculated as follows:

$$\%DDT_{BREAKDOWN} = \frac{(\text{DDE Area} + \text{DDD Area}) \times 100}{(\text{DDE Area} + \text{DDD Area} + \text{DDT Area})}$$

If degradation is excessive or peak tailing is noticed, injection port maintenance is required.

This performance test must be passed before any samples or standards are analyzed.

7.4.1.3 Internal Standard Calibration

A minimum 5-point calibration curve is created for the semivolatile organic compounds and surrogates using an internal standard technique. Accutest Laboratories routinely performs a 6-point calibration to maximize the calibration range.

The low point may be omitted from the calibration table for any compound with an RL set at the level two standard. Additionally the high point may be omitted for any compound that exhibits poor linearity at the upper end of the calibration range.

Response factors (RF) for each analyte are determined as follows:

$$RF = (A_{anayte} \mathbf{X} C_{istd})/(A_{istd} \mathbf{X} C_{analyte})$$

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A_{anayte} = area of the analyte
A_{istd} = area of the internal standard
$C_{analyte}$ = concentration of the analyte
C_{istd} = concentration of the internal standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of RF X 100) / Mean RF

If the %RSD $\leq$ 20%, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples. Alternatively if the %RSD > 20% a calibration curve of response vs. amount can be plotted. If the correlation coefficient (r) is $\geq$0.995 ($r^2 \geq$0.990) then the curve can be used to quantitate target analytes in the samples.

Note: If a linear regression is used for an analyte, then the low standard must be recalculated against the current initial calibration. The recovery of any analyte using a linear regression must be 70% -130% of the expected value. This requirement does not apply to quadratic regressions.

The method also employs minimum response factor (RF) criteria for select target analytes. See Table 2 for the analytes and associated minimum response factors. Unlike previous revisions that only set a minimum for the average RF, 8270D requires that the minimum RF be met for each level of the calibration curve.

7.4.1.4 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be $\leq$ 30%. If the %D > 30%, the analysis of samples may still proceed if the analyte failed high and the analyte is not expected to be present in the samples. However, if a reportable analyte is detected in a sample and the %D for that analyte was greater than 30% in the ICV, the sample will need to be reanalyzed on a system with a passing ICV for that analyte. For DOD projects, the %D for all analytes of interest should be $\leq$ 20%.

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If the ICV does not meet this criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

7.4.2 Continuing Calibration Verification (CCV)

7.4.2.1 Inject 1ul of the tune evaluation mix at the beginning of each 12-hour shift. Evaluate the resultant peaks against the criteria in sections 7.4.1.1 and 7.4.1.2. The injection time of this standard starts the 12-hour window.

7.4.2.2. Analyze a continuing calibration check standard. Since the method only requires one CCV per analytical batch, the level of the CCV should be varied throughout the week. At least one CCV must be below the mid-point of the calibration curve.

7.4.2.3. The response factor for any target analyte listed in Table 2 must meet the listed minimum value.

7.4.2.4. The %D for all other analytes of interest should be ≤ 20%. If the %D > 20%, the analysis of samples may still proceed if the analyte failed high and the analyte is not expected to be present in the samples. However, if a reportable analyte is detected in a sample and the %D for that analyte was greater than 20% in the CCV, the sample will need to be reanalyzed on a system with a passing CCV for that analyte, or the data must be qualified.

7.4.2.5. The criteria in 7.4.2.3 and 7.4.2.4 must be met for the continuing calibration to be considered valid. Only analytes that are being reported for a given sample must meet the criteria in 7.4.2.3 and 7.4.2.4. If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated.

7.4.2.6. If any of the internal standard area change by a factor of two (-50% to +100%) or retention time changes by more than 30 seconds from the midpoint standard of the last initial calibration, the mass spectrometer must be inspected for malfunctions and corrections made, as appropriate. Corrective action may include re-calibration (initial Calibration) of the instrument.

7.4.3 Sample Extract Analysis

7.4.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

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Tune Evaluation Mix
Initial Calibration Standards (or CCV)
QC Extracts
Sample Extracts

7.4.3.2 Two microliters of internal standard solution is added to every 100ul of extract in the autosampler vial. Generally, 400ul of extract are transferred to the autosampler vial with a gas tight syringe.

7.4.3.3 One or two microliters (same amount as standards) of extract is injected into the GC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.3.4 Qualitative identification

The target compounds shall be identified by analysts with competent knowledge in the interpretation of mass spectra by comparison of the sample mass spectrum to the mass spectrum of a standard of the suspected compound. The criteria required for a positive identification is:

The sample component must elute at the same relative retention time (RRT) as the daily standard. The RRT of sample component must be within ± 0.06 RRT units of the standard.

All ions monitored in the standard mass spectra should be present in the sample spectrum.

The relative intensities of these ions must agree within ± 30% between the daily standard and sample spectra. (Example: For an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 20 and 80%.

Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.

If peak identification is prevented by the presence of interferences, further cleanup may be required or the extract must be diluted so that the interference does not mask any analytes.

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7.4.3.5 Quantitative analysis

When a target compound has been identified, concentration will be based on the integrated area of the quantitation ion, which is normally the base peak.

The sample matrix may produce an interference with the primary ion. This may be characterized by an excessive background signal of the same ion, which distorts the peak shape beyond a definitive integration. The interference could also, severely inhibit the response of the internal standard ion. If an interference is apparent the secondary ion can be used to generate a new calibration factor. See Table 3.

If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.5 Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is

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regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

9.1 Internal Standards

9.1.1 1,4-Dichlorobenzene-d4, Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12 and Perylene-d12 can be used as internal standards for this method. The internal standards used are dependent on the compounds being analyzed. The response of the internal standard in all subsequent runs should be within a factor of two (-50% to +100%) of the internal standard response in the opening CCV for each sequence. On days that an initial calibration is performed, the internal standard responses should be compared to the internal standard responses for the mid-point standard.

9.1.2 If the internal standard responses are not within limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, integrations, or internal standards solutions. If errors are found, recalculate the data accordingly.

9.1.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.2.3 If no problem is found, prepare a second aliquot of extract and reanalyze the sample.

9.1.2.4 If upon reanalysis, the responses are still not within limits, the problem is considered matrix interference. The extract may need to be diluted or the results qualified.

9.2 Surrogates

9.2.1 Nitrobenzene-d5, 2-Fluorobiphenyl, and p-Terphenyl are used as the base neutral surrogate standards and Phenol-d5, 2-Fluorophenol, and 2,4,6-Tribromophenol are used as the acid surrogate standards to

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monitor the efficiency of the extraction. The surrogates used are dependent on the compounds being analyzed.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

% Recovery = (Sample Amount / Amount Spiked) X 100

The percent recovery must fall within the established control limits for all surrogates for the results to be acceptable.

9.2.2 If any surrogate recovery is not within the established control limits, the following are required. Note: If the samples are being analyzed for only base neutral compounds or only acid compounds, then only the relative surrogates need to be monitored.

9.2.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, surrogate solutions or internal standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.2.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.2.2.3 If no problem is found, re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report

9.2.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis should be reported on the final report.

9.3 Method Blank

9.3.1 The method blank is either de-ionized water or sodium sulfate (depending upon sample matrix) to which the surrogate standard has been added. The method blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high level samples. The method blank must be free of any analytes of interest or interferences at ½ the required reporting level to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the

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contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.3.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

9.3.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.3.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Blank Spike

9.4.1 The blank spike is either de-ionized water or sodium sulfate (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable. The large number of analytes in this method presents a substantial probability that a few of the analytes will fall outside of the established control limits. This may not indicate that the system is out of control; therefore, corrective action may not be necessary.

Upper and lower marginal exceedance (ME) limits can be established to determine when corrective action is necessary. A marginal exceedance in the Blank Spike is defined as a recovery being outside of 3 standard deviations but within 4 standard deviations of the mean.

The number of allowable marginal exceedances is based on the number of analytes in the Blank Spike. Marginal Exceedances must be random.

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If the same analyte exceeds the BS control limits repeatedly, it is an indication of a systematic problem and corrective action must be taken.

The number of allowable marginal exceedances is as follows:

1) 31-50 analytes in BS, 2 analytes allowed in ME range;

2) 11-30 analytes in BS, 1 analyte allowed in ME range;

3) < 11 analytes in BS, no analytes allowed in ME range

9.4.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions or internal standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary and the sample results can be reported without qualification.

9.4.2.4 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable.

9.4.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.4.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4.2.7 Because of their problematic nature, benzidine, benzaldehyde, and benzoic acid are generally not evaluated in the blank spike unless they are of specific concern for a given project.

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9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, spike solutions or internal standard solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extraction but are an indication of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for each analyte should fall within the established control limits. If more than 33% of the RPDs fall outside of the established control limits, the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and

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determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each analyte in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst}) \times (V_F / V_I) \times DF$

Soil (ug/kg) = $[(CONC_{inst}) \times (V_F / W_I) \times DF] / \%solids$

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean RF, linear curve, or quadratic curve
DF	=	Dilution Factor
V_F	=	Volume of final extract (ul)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

All soils are reported on a dry weight basis.

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Waste solvents from the sample analysis and standards preparation are collected in waste storage bottles and are eventually transferred to the chlorinated waste drum.

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Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000C Revision 3, March 2003

SW846 Method 8270D Revision 4, February 2007

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TABLE 1

Routine Target Analytes

Naphthalene
2-Methylnaphthalene
1-Methylnaphthalene
Acenaphthylene
Acenaphthene
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo[a]anthracene
Chrysene
Benzo[b]fluoranthene
Benzo[k]fluoranthene
Benzo[a]pyrene
Indeno[1,2,3-cd]pyrene
Dibenz[a,h]anthracene
Benzo[g,h,i]perylene
Carbazole
Pentachlorophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Hexachlorobenzene
Hexachlorobutadiene
bis(2-Chloroethyl)ether
2,4-Dichlorophenol
1,4-Dioxane
1,1'-Biphenyl
Diphenyl Ether
4-Nitrophenol
2,4-Dinitrophenol
N-Nitroso-di-n-propylamine
N-nitrosodimethylamine
Nitrobenzene
Dibenzofuran
bis(2-Ethylhexyl)phthalate
Hexachlorocyclopentadiene

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TABLE 2

Minimum Response Factors

Analyte	Min. RF	Analyte	Min. RF
Naphthalene	0.700	N-nitroso-di-n-propylamine	0.500
2-Methylnaphthalene	0.400	Hexachlorocyclopentadiene	0.050
1-Methylnaphthalene	0.400	2,4-Dinitrophenol	0.010
Acenaphthylene	0.900	4-Nitrophenol	0.010
Acenaphthene	0.900	Pentachlorophenol	0.050
Fluorene	0.900	bis(2-chloroethyl)ether	0.700
Phenanthrene	0.700	2,4-Dinitrotoluene	0.200
Anthracene	0.700	2,6-Dinitrotoluene	0.200
Fluoranthene	0.600	Hexachlorobenzene	0.100
Pyrene	0.600	1,4-Dioxane	n/a
Benzo[a]anthracene	0.800	1,1' Biphenyl	0.010
Chrysene	0.700	Diphenyl Ether	n/a
Benzo[b]fluoranthene	0.700	Carbazole	0.010
Benzo[k]fluoranthene	0.700	Dibenzofuran	0.800
Benzo[a]pyrene	0.700	bis(2-Ethylhexyl)phthalate	0.010
Indeno[1,2,3-cd]pyrene	0.500		
Dibenz[a,h]anthracene	0.400		
Benzo[g,h,i]perylene	0.500		

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TABLE 3

Characteristic Ions

Analyte	Quant. Ion	Q1	Q2	Analyte	Quant. Ion	Q1	Q2
Naphthalene-d8 IS	136	68		N-nitroso-di-n-propylamine	42	70	
Nitrobenzene-d5 SS	82	128	54	Hexachlorocyclopentadiene	237	235	
Naphthalene	128	129	127	2,4-Dinitrophenol	184	154	
2-Methylnaphthalene	142	141	115	4-Nitrophenol	139	65	
1-Methylnaphthalene	142	141	115				
Acenaphthene-d10 IS	164	162	160	2,4,6-Tribromophenol	330	332	141
2-Fluorobiphenyl SS	172	171		Pentachlorophenol	266	264	268
Acenaphthylene	152	151	153				
Acenaphthene	153	152	154	bis(2-chloroethyl)ether	93	63	95
Fluorene	166	165	167	2,4-Dinitrotoluene	165	63	182
Phenanthrene-d10 IS	188	94	80	2,6-Dinitrotoluene	165	89	121
Phenanthrene	178	179	176	Hexachlorobenzene	284	142	249
Anthracene	178	179	176				
Fluoranthene	202	101	203	1,4 Dioxane	88	58	43
Chrysene-d12 IS	240	120	236	1,1' Biphenyl	154	153	152
Pyrene	202	101	203	Diphenyl Ether	170	141	77
Terphenyl-d14 SS	244	122	212				
Benzo[a]anthracene	228	226	229	Carbazole	167	166	139
Chrysene	228	226	229	Dibenzofuran	168	139	169
Perylene-d12 IS	264	260	265	bis(2-Ethylhexyl)phthalate	149	167	279
Benzo[b]fluoranthene	252	253	125				
Benzo[k]fluoranthene	252	253	125				
Benzo[a]pyrene	252	253	125				
Indeno[1,2,3-cd]pyrene	276	138	277				
Dibenz[a,h]anthracene	278	139	279				
Benzo[g,h,i]perylene	276	138	277				

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STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF BASE-NEUTRAL AND ACID (BNAs) EXTRACTABLES FROM SOLID SAMPLES

Prepared by:	Norm Farmer	Date:	08/24/13
Reviewed by:	Mark Erstling	Date:	09/04/13

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TEST NAME: **STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF BASE-NEUTRAL AND ACID (BNAs) EXTRACTABLES FROM SOLID SAMPLES**

Method: SW846 3550C/8270D

Dept: OP

Revised Sections: 3.2.1, 7.0, 8.1, 8.6-8.18 and 10.1.4

1.0 Summary, Scope and Application

1.1 Summary

Solid samples are serially extracted by pulse sonication, concentrated by Kuderna-Danish apparatus, and stored in glass vials with Teflon lined screw caps.

1.2 Scope and Application

This procedure is applicable to solid samples, including soils and sediments, submitted for BNA analysis by GC/MS method SW-846 8270D.

2.0 Discussion and Comments

This procedure is adapted from SW-846 methods 3500C and 3550C. The method outlined in this SOP is designed for low concentration samples (concentration of the individual organic components is expected to be less than 20mg/kg).

Although the mass spectrometer identifies compounds by specific ions, it will respond to most organic compounds. It is important to minimize extraneous contaminants by scrupulously cleaning all glassware and by using only high purity reagents. Additionally, all extraction items that come in contact with the sample must be made from glass, stainless steel, wood, or Teflon. Plastic items must be avoided because they can lead to phthalate contamination.

3.0 Preservation and Holding Times

3.1 Preservation

3.1.1 Samples shall be collected in glass jars with Teflon lined caps. 250ml jars are recommended for solid samples.

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3.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be refrigerated at –10°C to –20°C until analysis.

3.2 Holding Time

3.2.1 Solid samples must be extracted within 14 days of collection. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.

3.2.2 Extracts must be analyzed within 40 days of extraction.

4.0 Definitions

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 12 hours which ever comes first.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.7 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

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4.8 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.9 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 Reagents

5.1 Acetone – pesticide grade or equivalent

5.2 Methylene chloride – pesticide grade or equivalent

5.3 Anhydrous sodium sulfate – precleaned to remove phthalates

5.4 BNA Surrogate Solution – prepared in acetone or methanol at a concentration specified by the GC/MS analyst. All surrogate solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.5 BNA Spike Solution #1– prepared in acetone or methanol at a concentration specified by the GC/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use. This solution contains the majority of the spiked analytes.

5.6 BNA Spike Solution #2– prepared in acetone or methanol at a concentration specified by the GC/MS analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use. This solution contains analytes that are not stable when mixed with those in Solution #1.

6.0 Glassware and Apparatus

6.1 400ml thick walled beaker

6.2 Glass funnels (large enough to support the filters)

6.3 500ml Erlenmeyer flask

6.4 Spatula – stainless steel, wood, or Teflon

6.5 0.5ml or 1.0ml syringes

6.6 1.0ml volumetric flask

6.7 500ml Kuderna-Danish (K-D) flask

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6.8 10ml graduated concentrator tube

6.9 3-ball macro Snyder column

6.10 Disposable transfer pipettes

6.11 Teflon boiling chips

6.12 Glass wool – precleaned

6.13 Fisher P8 filters – or equivalent

6.14 2.0ml glass screw cap vials – caps must have Teflon lined septa

6.15 Water bath – adjustable temperature control

6.16 Nitrogen evaporator

6.17 Ultrasonic disrupter – minimum power of 300 watts with pulse capability

6.18 Disrupter horns – ¾" solid titanium tip

6.19 Top loading balance – capable of weighing samples to +/- 0.1 grams

7.0 Sonic Disrupter

The Misonix S3000 and Qsonica Q500 dual horn sonic disrupters do not require tuning. The sonic disrupters should be set in the pulse mode with a 50% duty cycle (energy on 50% of the time and off 50% of the time). The Misonix S3000 dual horn sonic disrupters will adjust the amplitude automatically to deliver 300 watts to the disrupter horns. The Qsonica Q500 sonic disrupters have a maximum power output of 500 watts. The power level should be set at 60-65% to deliver a minimum of 300 watts to the disrupter horns. Higher power settings may be used.

Read and follow the manufacturer's instructions for operating the sonic disrupters. Manufacturer's instructions may be found in the Active SOP directory. Any instrument maintenance or repairs in should be documented in the "Instrument Repair and Maintenance" logbook.

8.0 Procedure

8.1 The extraction of all samples must be documented on a "prep sheet". The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the GC/MS analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

8.2 Decant any free liquid from the solid sample. Remove any foreign objects such as twigs or rocks. Thoroughly mix the sample with a wooden spatula. Samples that are tightly packed or contain obvious layers may need to be transferred to a larger container for proper mixing. Refer to SOP QA034 for more information on sample homogenization.

8.3 Transfer approximately 30 grams of each sample to the appropriately labeled beakers. Use a clean spatula for each sample. Record the weight to the nearest 0.1gram on the prep sheet.

8.4 Add approximately 30 grams of sodium sulfate to each sample and mix until each sample has a free flowing sandy texture. Wetter soils will require more sodium sulfate.

8.5 Transfer approximately 30 grams of each of the QC samples to the appropriately labeled beakers. This includes the method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD). Use 30 grams of sodium sulfate and/or clean sand for the MB and BS. Use additional 30 gram aliquots of a sample for the MS and MSD. If there is insufficient sample amount, a lesser amount may be used. Record the sample ID, bottle number and weight on the prep sheet.

8.6 Using the dedicated spike syringe add 0.5ml of spike solution #1 and #2 to the BS, MS, and MSD. Record the spike lot number on the prep sheet.

8.7 Using the dedicated surrogate syringe add 0.5ml of surrogate solution to each of the samples including the QC samples. Record the surrogate lot number on the prep sheet.

8.8 Immediately add 100ml of 80:20 methylene chloride and acetone to each of the beakers. This will minimize the loss of the more volatile analytes.

NOTE: Crushed concrete samples should be extracted with 100ml aliquots of methylene chloride. Concrete reacts with the acetone to form excessive Aldol Condensation by-products that interfere with the early eluting acid target compounds and surrogates.

CAUTION: ALL SOLVENT ADDITIONS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

8.9 Label the Erlenmeyer flasks and place a glass filter funnel containing a Fisher P8 filter on the top of each flask.

8.10 Place a glass filter funnel containing a Fisher P8 filter on the top of each Erlenmeyer flask. **NOTE:** Samples may also be filtered directly into the K-D's.

8.11 Place the disrupter horn in the beaker such that the tip of the horn is approximately ½ inch into to solvent but not touching the beaker or the sample.

8.12 Sonicate the sample for 3 minutes.

8.13 Remove the beaker and decant the solvent through the filter funnel into the Erlenmeyer flask.

8.14 Repeat steps 8.11 to 8.13 two more times with additional 100ml solvent aliquots. All three solvent aliquots will be combined in the K-D flask.

8.15 After the final extraction, transfer the entire sample to the funnel, rinse thoroughly, and allow the solvent to drain through the sample.

NOTE: It is important to clean the disrupter horn between samples. This is done by rinsing the horn with the extraction solvent and wiping it dry with a Kim-wipe or paper towel.

8.16 If the entire extraction procedure can not be completed on the same day, the Erlenmeyer flasks may be covered with aluminum foil and refrigerated.

8.17 Assemble and label the K-D flasks and concentrator tubes. Using forceps, place a Teflon boiling chip in each concentrator tube and set each K-D flask in a support stand.

8.18 Transfer each extract to the appropriately labeled K-D. Rinse each Erlenmeyer flask with methylene chloride and transfer it to the appropriate K-D. Attach a Snyder column to each K-D flask.

CAUTION: ALL EXTRACT TRANSFERS SHOULD BE DONE IN A HOOD TO MINIMIZE EXPOSURE TO SOLVENT VAPORS.

8.19 Pre-wet the Snyder column with a few drops of methylene chloride and place the K-D assembly in a hot (75 to 85 ^{o}C) water bath. **NOTE:** If the bath is too hot, the more volatile compounds may be lost during this step. Concentrate the extract to approximately 5ml.

8.20 Remove the K-D assembly from the bath and allow it to cool. Remove the Snyder columns and rinse them with methylene chloride and then with acetone before placing them back in their storage rack.

8.21 Wipe the water from the joint area between the K-D flask and the concentrator tube. Be sure that the sample ID is still on the concentrator tube. Remove the concentrator tube from the K-D flask, **rinse the joint with solvent**, and place the concentrator tube in the rack for the nitrogen evaporator.

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8.22 Use a steady stream of nitrogen to concentrate the extract to 0.5ml.

8.23 If the extract is cloudy or contains water droplets, run the extract through a micro column of glass wool and sodium sulfate.

8.24 Transfer the extract to a 1.0ml volumetric flask. Rinse the concentrator tube with a few drops of methylene chloride and transfer it to the volumetric flask. Adjust the final volume to 1.0ml. **NOTE:** If the extract will not concentrate to 1.0ml, choose the next appropriate final volume. Be sure to record the final volume on the prep sheet.

8.25 Transfer the extract to an appropriately labeled 2.0ml screw cap vial. Store the extracts in the "extract freezer" until they are needed for analysis.

9.0 Quality Assurance and Quality Control

9.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. A batch may be held open for up to 12 hours; however, samples should not be added after the QC set has been completed. **NOTE:** Some project plans may require different batch definitions.

9.2 A method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples.

10.0 Safety and Waste Disposal

10.1 Safety

10.1.1 Safety glasses, gloves and lab coats should be worn when handling samples, standards or solvents.

10.1.2 **Hearing protection** must be worn while operating the sonic disrupters. The high frequency could cause permanent hearing loss.

10.1.3 Avoid touching the disrupter horns while they are active. Contact may cause burns or tissue damage.

10.1.4 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

10.1.5 Methylene chloride is an inhalation hazard and a suspected carcinogen. Fume hoods must be used to minimize exposure to vapors.

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10.2 Waste Disposal

10.2.1 Waste methylene chloride is placed in the “chlorinated waste” container.

10.2.2 Waste acetone is placed in the “non-chlorinated waste” container.

10.2.3 Extracted soil samples are placed in a waste container after the solvent has drained or evaporated.

10.2.4 Waste soil from the homogenizing process should be placed in the “soil waste” container. **NOTE:** Waste soil from foreign soils must follow “foreign soil” disposal requirements.

10.2.5 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining soil samples are transferred to the appropriate drums for disposal.

11.0 References

SW-846 Method 3500C, Rev. 3, 02/07

SW-846 Method 3550C, Rev. 3, 02/07

SW-846 Method 8270D, Rev. 4, 02/07

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Appendix E

Contractor Forms

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Contractor Forms Index

Hazard Communications and Safety Training Acknowledgment Form
Daily Health & Safety Report
Daily Site Report
Daily Quality Control Report (DQCR)
Weekly Quality Control Report
Site Safety Tailgate Meeting Form
Field Activity Daily Log
MEC Discovery Form
Explosives Accountability Log
Daily Health and Safety Compliance Inspection Form
Nonconformance and Corrective Action Report Form
Visitors Sign-In Log
Daily G-858 Geophysical QC Form
G-858 Geophysical Target Reacquisition Form
G-858 Geophysical Target Dig Selection and Intrusive Results Table
On-Site QA Checklist
Three Phase Control - Preparatory Phase Inspection Report
Three Phase Control – Initial Phase Report
Three Phase Control – Follow-Up Phase Report
Photo Log

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FPM Remediations, Inc.

HAZARD COMMUNICATIONS AND SAFETY TRAINING ACKNOWLEDGMENT

PROJECT/OFFICE TITLE: _____

LOCATION: _____ CONTRACT#: _____

The following personnel acknowledge by their signature that they have received a copy of the FPM Corporate Safety & Health Plan and have reviewed and agree to comply with all of the provisions of applicable site specific Health and Safety Plans and Work Plans for this FPM location. The signed personnel understand that violating any of the health and safety requirements specified in the plan could prohibit the offender from working at this FPM location. In addition, personnel acknowledge that they have been trained on all elements of Hazard Communications as required by CFR 1910.1200 including the checked topics listed below:

- ☐ Emergency Response Plan – Emergency Response Numbers and Route to Hospital
- ☐ Chemical Hazards, Physical Hazards, and Job-specific Hazards
- ☐ Air Monitoring Procedures and Action Levels (if applicable)
- ☐ Site Control Measures and Personal Protective Equipment (PPE) Requirements
- ☐ Location of MSDS's/SDS's
- ☐ Confined Space Entry Procedures & Permits (if applicable)
- ☐ Location and Use of Emergency Equipment/Fire Extinguishers
- ☐ Use, Maintenance, and Storage of PPE
- ☐ Spill Containment and Response
- ☐ Incident Reporting Procedures (Accidents, Near Misses, Injuries, Illness)
- ☐ Decontamination Procedures (if applicable)
- ☐ Blood Borne Pathogens and FPM's Exposure Control Plan (1st Responders)
- ☐ FPM Standard Operating Procedures

NAME (Print)	SIGNATURE	DATE

FPM Remediations, Inc.

HAZARD COMMUNICATIONS AND SAFETY TRAINING ACKNOWLEDGMENT

NAME (Print)	SIGNATURE	DATE

FPM Remediations, Inc.

DAILY HEALTH & SAFETY REPORT

Date: _____

Report Number: _____
Project Title: _____
Location: _____
Contract Number: _____

WEATHER	CLEAR	PT CLOUDY	OVERCAST	RAIN	SNOW	FOG
TEMP	< 32 F	32 – 50 F	50 – 70 F	70-85 F	85-100 F	>100 F
WIND	< 10 mph	10 – 20 mph	20 – 30 mph	30 – 40 mph	> 40 mph	
HUMIDITY	DRY	MODERATE	HUMID			

Personnel On-Site

No.	Name/Company	Affiliation	Location/Description of Work
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Field Changes: YES_____ NO_____

If yes, filed Nonconformance and Corrective Action Report number (NCR No.):_____

FPM Remediations, Inc.

DAILY HEALTH & SAFETY REPORT

Date: _____

Health & Safety (Briefings held, PPE, injuries, near misses, etc.)
Daily Brief (SUXO/UXOSO): **Site Safety Tailgate Briefs (teams):** **H & S Compliance Inspection:** **Incidents/Accidents:** **Illnesses:** **Discrepancies/Action Items:** **Visitors:**

Contractor Verification: On behalf of the contractor, FPM Remediations, Inc., I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ _____

Signature Date

FPM Remediations, Inc.

DAILY SITE REPORT

Date: _____

Report Number: _____
Project Title: _____
Location: _____
Contract Number: _____

WEATHER	CLEAR	PT CLOUDY	OVERCAST	RAIN	SNOW	FOG
TEMP	< 32 F	32 – 50 F	50 – 70 F	70-85 F	85-100	>100 F
WIND	< 10 mph	10 – 20 mph	20 – 30 mph	30 – 40 mph	> 40 mph	
HUMIDITY	DRY	MODERATE	HUMID			

Personnel On-Site

No.	Name	Hrs.	Affiliation	Location/Description of Work
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Field Changes: YES_____ NO_____

If yes, filed Nonconformance and Corrective Action Report number (NCR No.):_____

Work Performed (include location)	
Equipment Used:	
Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	

FPM Remediations, Inc.

DAILY SITE REPORT

Date: _____

Ordnance or Ordnance Related Material Encountered, Condition and Location:	
Disposition of Ordnance Items Encountered, Include Dates:	
Verbal Instructions Received or Given:	
Changed Conditions/Delays/Conflicts Encountered:	
Other Comments or Additional Information:	

Contractor Verification: On behalf of the contractor, FPM Remediations, Inc., I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ _____

Signature Date

FPM Remediations, Inc.

DAILY QUALITY CONTROL REPORT

Date: _____

Report Number: _____
Project Title: _____
Location: _____
Contract Number: _____

WEATHER	CLEAR	PT CLOUDY	OVERCAST	RAIN	SNOW	FOG
TEMP	< 32 F	32 – 50 F	50 – 70 F	70-85 F	85-100	>100 F
WIND	< 10 mph	10 – 20 mph	20 – 30 mph	30 – 40 mph	> 40 mph	
HUMIDITY	DRY	MODERATE	HUMID			

Personnel On-Site

No.	Name	Affiliation	Location/Description of Work
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Instrumentation:

Type	Serial Number	Initial Time	Initial Reading	End Use Time	End Use Reading
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA- 52 B		N/A	N/A	N/A	N/A
Magnetometer, DML 2000		N/A	N/A	N/A	N/A
Magnetometer, DML 2000		N/A	N/A	N/A	N/A

FPM Remediations, Inc.

DAILY QUALITY CONTROL REPORT

Date: _____

Field Changes: YES_____ NO_____

If yes, filed Nonconformance and Corrective Action Report number (NCR No.):_____

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	
Work Performed	
Definable Feature of Work & Phase (Preparatory, Initial, Follow On)	
QA/QC Samples Collected	
Problems Encountered/Resolved	
Visitors	
Notes	
Tomorrow's Expectations	

Contractor Verification: On behalf of the contractor, FPM Remediations, Inc., I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ _____

Signature Date

FPM Remediations, Inc.

WEEKLY QUALITY CONTROL REPORT

Date: _____

Report Number: _____
Project Title: _____
Location: _____
Contract Number: _____

WEATHER	CLEAR	PT CLOUDY	OVERCAST	RAIN	SNOW	FOG
TEMP	< 32 F	32 – 50 F	50 – 70 F	70-85 F	85-100	>100 F
WIND	< 10 mph	10 – 20 mph	20 – 30 mph	30 – 40 mph	> 40 mph	
HUMIDITY	DRY	MODERATE	HUMID			

Personnel On-Site

No.	Name	Affiliation	Location/Description of Work
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Instrumentation:

Type	Serial Number	Initial Time	Initial Reading	End Use Time	End Use Reading
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA- 52 B		N/A	N/A	N/A	N/A
Magnetometer, DML 2000		N/A	N/A	N/A	N/A
Magnetometer, DML 2000		N/A	N/A	N/A	N/A

FPM Remediations, Inc.

WEEKLY QUALITY CONTROL REPORT

Date: _____

Field Changes: YES_____ NO_____

If yes, filed Nonconformance and Corrective Action Report number (NCR No.):_____

WEEKLY SYNOPSIS	
Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	
Work Performed	
Definable Feature of Work & Phase (Preparatory, Initial, Follow On)	
QA/QC Samples Collected	
Problems Encountered/Resolved	
Visitors	
Notes	

Contractor Verification: On behalf of the contractor, FPM Remediations, Inc., I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ _____

Signature Date

FPM Remediations, Inc.

SITE SAFETY TAILGATE MEETING

Date: _____

PROJECT NAME/CLIENT:		REPORT NUMBER:	
PROJECT NUMBER:		PROJECT MANAGER:	
TEAM:			
LOCATION:			
TASK TO BE PERFORMED:			
I. Purpose for meeting: (check all that apply)			
	DAILY SAFETY BRIEFING		
	Begin New Task. Task: Initial Site Visit/ Team assignment		
	Periodic Safety Meeting		
	New Site Procedures		
	New Site Conditions / Information		
	New Site Workers		
MEETING ATTENDEES:			

NAME (Print)	SIGNATURE	COMPANY

FPM Remediations, Inc.

SITE SAFETY TAILGATE MEETING

Date: _____

NAME (Print)	SIGNATURE	COMPANY

FPM Remediations, Inc.

SITE SAFETY TAILGATE MEETING

Date: _____

ON-SITE SAFETY MEETING RECORD *Page 2 of 2*

II. Topic (check all that apply)

	Site Safety Personnel		Decontamination
	Work Area Description		Emergency Response
	Site Characterization		Hazard Communication
	Equipment Hazard(s)		On-site Emergency
	Biological Hazard(s)		On-site Injuries
	Chemical Hazard(s)		Evacuation Procedures
	Physical Hazard(s)		Rally Point
	Heat Stress		Emergency Communications
	Cold Stress		Directions to Hospital
	Site Control		Emergency Equipment
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring
	Air Monitoring		Task Training
	Safe Work Practices		Unexploded Ordnance (UXO)

III. Remarks –

IV. Verification I certify that the personnel listed on this roster received the briefing described above. Site personnel not attending this meeting will be briefed before beginning their assigned duties.

_____

UXO Site Safety Officer

_____

Senior UXO Supervisor

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DAILY LOG	DATE			
	NO.			
	SHEET		OF	

FPM Remediations, Inc.

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	**PROJECT NO.**
PROJECT NAME:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE:	**CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:**
WEATHER CONDITIONS:	**IMPORTANT TELEPHONE CALLS:**
FPM PERSONNEL ON SITE:	
SIGNATURE:	**DATE:**

DAILY LOG	DATE			
	NO.			
	SHEET		OF	

FPM Remediations, Inc.

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	**PROJECT NO.**
PROJECT NAME:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	

FPM Remediations, Inc.

MEC/MULTIPLE ANOMALY DISCOVERY FORM

UXO Supervisor:_____ **Date:**_____

Anomaly ID No. (i.e. FAR A-001)						
Anomaly Longitude (X) / Latitude (Y)	X:			Y:		
Object Length				Inches		
Object Diameter/Thickness				Inches		
Object Weight (Estimated)				Pounds		
Slope of Terrain (Check one box)	□	<10°	□	10° to 30°	□	>30°
Vegetation Cover (Check one box)	□	Cleared	□	Vegetated	□	Wetland
Soil Type (Check one box)	□	Sand	□	Silt	□	Clay
Inclination (Circle one)	0°	45°	90°	135°	180°	
Orientation (Circle one)	N-S	NW-SE	E-W	SW-NE		

Item Description/Justification/Comments

Anomaly Type/Category (Check Appropriate Box)

□ UXO □ DMM □ Munitions Debris □ Practice Ordnance □ Inert Ordnance
□ Metal Waste □ Sub-surface Anomaly □ Other _____

Was photo taken?	□ Yes	□ No	File Name:

Ordnance Positive Identification (If known, record below. Include fuze condition and disposition)

Quantity:	Ordnance Mark/Mod:	Nose Fuze Mark/Mod:	Tail Fuze Mark/Mod:
Ordnance Filler:	□ Explosive □ Propellant	□ Pyrotechnic □ Other	N.E.W.

Ordnance Category:

□ Bombs □ Land Mines □ Rockets	□ Clusters/Dispensers □ Misc. Explosive Devices □ Pyrotechnics and Flares	□ Grenades □ Mortars □ Projectiles	□ Guided Missiles □ Underwater Ordnance □ Small Arms

Fuzing Types

Piezo-Electric All-ways Acting (PD) Mech Long Delay Powder Train Time Fuze (PTTF)	Proximity (VT) Electric Point-Initiating, Base-Detonating MT Superquick	Impact Point Detonating Mechanical Time	Base Detonating Influence Pressure

Status of MEC/UXO

□ Armed □ Unarmed

Physical Condition of MEC/UXO (Check all that apply)

□ Broken Open	□ Soil Staining	□ Filler Visible	□ Soil Sample Taken

FOR UXOSS USE

Disposition: (Clarify Under Remarks) Transport Leave In Place Other		Date:
Notifications To Installation By:	Signature:	Date:
Transported By:	Signature:	Date:
Transferred To:	Signature:	Date:
Storage Location:		
Destroyed By:	Signature:	Date:

Remarks:

Signature: _____

UXOSS

UXO – Ordnance fuzed, armed or otherwise prepared for action and fired or placed in such a manner that it constitutes a hazard
DMM – Ordnance that was disposed of by abandonment; may have been fuzed or armed, but was not employed
Inert – Same physical features as an ordnance item but does not and never did contain energetic material
Munitions Debris – Ordnance material that contained or was in contact with energetic material, which has been expended (e.g., fragments from projectile)

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FPM Remediations, Inc.

EXPLOSIVES ACCOUNTABILITY LOG

Contract:		Project Name:	
Date:		Work Area & Grid Numbers:	
Team Number:		Team Leader:	
Explosives Issued:		Signature of Team Leader:	
Item	Quantity	Lot Number	Checker's Initials
Explosives Expended:		Signature of Team Leader:	
Item	Quantity	Lot Number	Checker's Initials
Explosives Returned:		Signature of SUXOS:	
Item	Quantity	Lot Number	Checker's Initials

Notes:

The signatures in each section of this document indicated that the items listed in that section were in fact issued, expended, or returned to storage and that the qualities listed were verified through a physical count.

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FPM Remediations, Inc.

DAILY HEALTH AND SAFETY COMPLIANCE INSPECTION

DATE:	TIME:	LOG NO.:
CONTRACT NO.:	TASK ORDER NO.:	
SITE NAME AND LOCATION:		

WEATHER CONDITIONS: _____

I. AREAS INSPECTED: (List by grid number, Team or task) _____

II. INSPECTION RESULTS

Item Description	Pass	Item Description	Pass
1. Personal Protection (PPE) per HASP	Y / N	9. UXO/OE Detection Equipment	Y / N
2. Work Practices Follow HASP/WP	Y / N	10. UXO/OE Detection Equipment Calibration	Y / N
3. Site Control/Decon per HASP	Y / N	11. MSDSs and Container Labeling per HASP	Y / N
4. First Aid Kit(s)/Eyewash Station(s)	Y / N	12. On- and Off-Site Communications	Y / N
5. Fire Extinguisher(s)	Y / N	13. Site House Keeping	Y / N
6. Flammable Storage Areas	Y / N	14. Explosives / Ordnance Storage Areas	Y / N
7. Safety and Health Monitoring Equipment Use	Y / N	15. Other: (list)	Y / N
8. Monitoring Equipment Calibration	Y / N	16. Other: (list)	Y / N

III. SUMMARY OF DEFICIENCIES NOTED: (If Required) _____

IV. CORRECTIVE ACTIONS RECOMMENDED: (If required) _____

V. REINSPECTION RESULTS: (If required) _____

VI. SIGNATURES:

_____ UXO Safety Officer

_____ Sr. UXO Supervisor / Project Manager

Note: Safety Compliance Inspections are to be conducted each work day and documented on this form.

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FPM Remediations, Inc.

Nonconformance and Corrective Action Report

Date: _____

Report Number: _____

Project Title: _____

Location: _____

Contract Number: _____

Description of Nonconformance and Cause:	
Proposed Disposition:	

Submitted by: _____ **Date:** _____

Approved by: _____

Actual Disposition approved by Project Manager:	
Implementation of Disposition assigned to::	

Completed by: _____ **Date:** _____

Verified by: _____ **Date:** _____

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FPM Remediations, Inc.

VISITORS SIGN-IN LOG

PROJECT LOCATION: _____

PROJECT SITE: _____ **PROJECT NO:** _____

DATE	NAME	COMPANY	TASK	IN	OUT

COMMENTS: _____

_____

_____

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FPM Remediations, Inc.

G-858 QC Form

Project: _____
Location: _____

DATE:_____; OPERATOR:_____; GP data sys: G-858, 2 sensors separated horizontally by 0.6 m;
Position data: RTKGPS ☐, DGPS ☐, or local coordinates ☐ (check the box for navigation method)
If DGPS used, check which one: Sys 1 ☐, Sys2 ☐, Rental ☐
G-858: Sys 1 ☐, Sys2 ☐, Rental ☐
G-858 Warm Up: (minimum 15 min.) start time: _____ end time: _____
Check the mag battery voltage, if less than 80%, replace the battery. Sync the mag consoles & GPS clocks.

1) **Personal test – File_____; Line_____;**
Collecting time is minimum 5 seconds, acceptance criteria is 3nT, display is: Field 2 (left sensor)
Comments: _____

2) **Cable shake test – File_____; Line_____;**
Collecting time is minimum 5 seconds, acceptance criteria is "no spikes", display is: Gradient
Comments: _____

Opening Function Tests

3) **Static background / Static Standard test – File_____; Line_____;**
T section over established point is facing north (Recommendation: use one file for all QC tests)
Static background collecting time is 3 min without object. Acceptance criteria is 1nT peak to peak, display is: Gradient
Static standard collecting time each sensor is 1 min with object. Acceptance criteria is 20% of expected value,
Static recovery collecting time is 1 min without object. Acceptance criteria is 1nT peak to peak, display is: Gradient
Comments: _____

4) **Opening IVS and Latency test – File_____; Line_____;**
If you are using fiducial navigation method, you do not have to do latency test!
Latency object is ISO; path is north-south ☐ or east-west ☐ with each sensor over anomaly in both directions
Known Position of Object: IVS-C N=_____; E=_____; ELV=____; WGS84, UTM Zone 13N, meters, GEO03, RTK
Comments: _____

5) **Opening Background – File_____; Line_____;**

Closing Function Tests

6) **Static background / Static Standard test – File_____; Line_____;**
Static background collecting time is 3 min without object. Acceptance criteria is 1nT peak to peak, display is: Gradient
Static standard collecting time each sensor is 1 min with object. Acceptance criteria is 20% of expected value,
Static recovery collecting time is 1 min without object. Acceptance criteria is 1nT peak to peak, display is: Gradient
Comments: _____

7) **Closing IVS and Latency test – File_____; Line_____;**
If you are using fiducial navigation method, you do not have to do latency test!
Latency object is ISO; path is north-south ☐ or east-west ☐ with each sensor over anomaly in both directions
Known Position of Object: IVS-C N=_____; E=_____; ELV=____; WGS84, UTM Zone 13N, meters, GEO03, RTK
Comments: _____

8) **Closing Background – File_____; Line_____;**

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G-858 Geophysical target list for relocation and reacquisition
Project # _____
Site Name _____

Target information							Field result							
Target_ID	Easting [m]	Northing [m]	Grid_value [nT/m]	Comments	Mag type	ΔB [nT]	Local B max [nT]	Local B min [nT]	ΔB [nT]	Offset distance [m]	Offset direction [m]	Initials of Surveyor	Date	Comments

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G-858 Geophysical Target Dig Selection and Intrusive Results Table
Project # _____
Site Name _____

Target Information			Dig Reslts									Post Dig QC		
Target ID	**Grid Value (nT/m)**	**∆B (nT)**	**Offset Distance/ Direction (m/NE)**	**Anomaly Type (UXO, DMM, MD, CD, RRD …)**	**Anomay description and quantity (1 rebar, 5 nails, wire, MK3, Projectile 75mm MK1, Granade M42,NoDig/Utility …)**	**Object depth to top (m)**	**Object Weight (kg)**	**Object Dimensions (Length/Width/ Thicknes) (m)**	**If is MEC, Physical Condition and Inclination and Azimuth (degree 0,45,90../ direction N, NE …)**	**Date**	**Team Leader Initials**	**Hole Cleared (Y/N)**	**Date**	**QC Initials**

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APPENDIX G

GENERIC ON-SITE QA CHECKLIST

Project Name/Contract No. _____

Audit Date (Start): _____ **Audit Date (End):** _____

CHECKPOINTS:

1. Review Scope of Work (DO/TO & WP)	**YES**	**NO**	**N/A**	**COMMENTS**
a. Objectives Clearly Identified	☐	☐	☐	
b. Check for Changes to WP & Up To Date	☐	☐	☐	
c. Proper Depth of Clearance Identified	☐	☐	☐	
d. Proper Target Ordnance Identified	☐	☐	☐	
e. Detection & Target Depth(s) Specified	☐	☐	☐	
f. Exclusion Zone Identified in WP	☐	☐	☐	
2. Documentation Requirements	**YES**	**NO**	**N/A**	**COMMENTS**
a. Notice to Proceed from KO	☐	☐	☐	
b. Approval Letter for Work Plan/SSHP	☐	☐	☐	
c. Approval Letter, FAA (If Required)	☐	☐	☐	
d. Certificate of Grounding, Lightning Protection (if required)	☐	☐	☐	
e. Explosive Permits/License (if required)	☐	☐	☐	
f. GFE Transfer Documentation (if required)	☐	☐	☐	

2. Documentation Requirements (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
g. Approval Letter, Public/Personnel Withdraw Distance (e.g., 1 Frag in 600 sq. ft.)	☐	☐	☐	
h. Dig Permits for Utilities (if required)	☐	☐	☐	
i. Current copy of the Work Plan on site. Review the new contract to determine if approval of the work plan is required. If not, then delete the requirement to have an approval letter on site	☐	☐	☐	
3. CEHNC QA Files Established	**YES**	**NO**	**N/A**	**COMMENTS**
a. Quality Assurance Reports	☐	☐	☐	
b. Approval Letter's (NTP, Personnel & WP/SSHP) for Contractor Operations	☐	☐	☐	
c. Weekly Contractor Reports SUXOS/QC	☐	☐	☐	
(if provided)				
4. Site-Specific Safety & Health Plan (SSHP)	**YES**	**NO**	**N/A**	**COMMENTS**
a. Emergency Notification List Posted & Available	☐	☐	☐	
b. Emergency Routes/Maps Available & Issued to Each Team	☐	☐	☐	
c. Work Task Identified in Hazard Analysis, Approved SSHP	☐	☐	☐	
d. MSDS(s) On-Site Approved SSHP	☐	☐	☐	

4. Site-Specific Safety & Health Plan (SSHP) (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
e. Visitors/Safety Briefing Log Current and Updated	☐	☐	☐	
f. All Personnel On-Site in the Proper PPE	☐	☐	☐	
g. Minimum of Two Personnel On-Site First Aid/CPR Trained, EM 385-1-1, Section 3, Page 19, Paragraph 03.A.02	☐	☐	☐	
h. 16-Unit First Aid Kits or Kits Approved by a Licensed Physician in the Ratio of one for every 25 persons or less. EM 385-1-1. Section 3, Page 19, Paragraph 03.A.03	☐	☐	☐	
5. Technical Management	**YES**	**NO**	**N/A**	**COMMENTS**
a. Procedures Established for the Discovery of RCWM	☐	☐	☐	
b. Procedures Developed for Discovery of MEC which cannot be destroyed in place	☐	☐	☐	
c. Project Grid Size, Layout, Lane Width (e.g., 5’ or Less) Established	☐	☐	☐	
d. Established Procedures for Changed Site Conditions	☐	☐	☐	
e. Organizational Chart current and indicates Assignment, Duties, Responsibilities to include Geophysical Teams	☐	☐	☐	
f. Procedures for Reporting and Disposition of MPPEH	☐	☐	☐	
g. Procedures Established for Disposal of MEC in Populated/Sensitive Areas	☐	☐	☐	

5. Technical Management (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
h. Procedures Established for Managing, Reporting, Venting and Disposing of munitions debris and range-related debris.	☐	☐	☐	
i. Additional Task and Procedures being Followed (e.g., PAO, Community Relations, Weekly & Monthly Project Status Reports)	☐	☐	☐	
j. Procedures Established for Recording, Reporting and Implementing Lessons Learned	☐	☐	☐	
k. Limitations Posed and Ability of Detection System(s) Chosen	☐	☐	☐	
l. Proper Use of Geophysical Detections Systems Used	☐	☐	☐	
m. Procedures Established for Disposal of MEC in non-populated/non-sensitive areas	☐	☐	☐	
6. Facilities. Reference EM 385-1-1	**YES**	**NO**	**N/A**	**COMMENTS**
a. Adequate Work Space & Facilities (Restrooms, etc.)	☐	☐	☐	
b. Good Housekeeping (No Fire Hazards, Tripping Hazards, etc.)	☐	☐	☐	
c. Approved and Suitable Containers for Flammable Toxic or Explosive Materials	☐	☐	☐	
d. Approved/Adequate Explosive Storage Facilities	☐	☐	☐	
e. Fire/Emergency Exits Clear & Unbarred	☐	☐	☐	
f. Personnel Limits Maintained	☐	☐	☐	
g. Site Security Adequate	☐	☐	☐	

6. Facilities. Reference EM 385-1-1 (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
h. Toilets. EM 385-1-1, Section 2, Page 14, Paragraph 02.B Toilets	☐	☐	☐	
i. Washing Facilities. EM 385-1-1, Section 2, Page 16, Paragraph 02.C Washing Facilities	☐	☐	☐	
7. Equipment, Reference Approved WP/Manufacture Operators Manual	**YES**	**NO**	**N/A**	**COMMENTS**
a. Tools Appropriate and Serviceable	☐	☐	☐	
b. Proper Personnel Protective Equipment (PPE) Present, Serviceable & Utilized	☐	☐	☐	
c. Equipment Calibrated (Last Call Date _____ Next Call Date _____)	☐	☐	☐	
d. Survey Equipment Inspected & Serviceable	☐	☐	☐	
e. Heavy Equipment Inspected & Serviceable IAW EM 385-1-1, Section 16	☐	☐	☐	
f. Are Equipped with at Least One Dry Chemical or CO2 Fire Extinguisher-Minimum rating of 5-BC – IAW EM 385-1-1, Section 16	☐	☐	☐	
g. Two Separate Means of Communications, Radio(s) Cell Phone, Land Line(s)	☐	☐	☐	
h. Geophysical Equipment On-Hand & Serviceable	☐	☐	☐	

8. Explosive Storage Requirements. Reference EP 1110-1-18	**YES**	**NO**	**N/A**	**COMMENTS**
a. Proper Storage Containers Type 2 Magazines conforming to standards set forth in Section 55.206 of ATFP 5400.7, AFT Explosives Law and Regulations.	☐	☐	☐	
b. Placards. Each magazine will display the placards required by Department of Transportation (DOT) regulations in accordance with DOD 6055.09-STD and Department of the Army Pamphlet (DA Pam) 385-64 for Hazard Division of MEC stored in the magazine.	☐	☐	☐	
c. Explosive Compatibility Groups. Segregated into the appropriate hazard division/storage compatibility group criteria listed in Chapter 3, DOD 6055.09-STD.	☐	☐	☐	
d. Physical Security. Contractor shall conduct and document physical security survey. The survey is to determine if fencing or guards are required.	☐	☐	☐	
e. Locks. Shall meet the standards listed in Section 55.208 (a) (4), ATFP 5400.7.	☐	☐	☐	
f. A key control system will be documented in the Work Plan, EP 1110-1-18.	☐	☐	☐	

8. Explosive Storage Requirements. Reference EP 1110-1-18 (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
g. Lightning Protection. Magazine constructed of metal that has 3/16 inch steel or thicker in accordance with National Fire Protection Association (NFPA) 780.	☐	☐	☐	
h. Lightning Protection. Magazine grounded in accordance with NFPA.	☐	☐	☐	
i. Lightning Protection. Magazine is located at least 6.5 feet from the nearest fence.	☐	☐	☐	
j. Lightning Protection. BRAC, IRP, FUDS and Active Installation will meet the provisions of DOD 6055.09-STD. Army installations will also meet the provisions of DA Pam 385-64.	☐	☐	☐	
k. Fire Protection. Extinguishers of appropriate size (minimum 10 BC) and type will be located in all explosives storage facilities.	☐	☐	☐	
l. Explosive Limits Maintained. .	☐	☐	☐	
m. Waiver. MACOM approval for storage of commercial of explosives on-site (if required).	☐	☐	☐	
9. Explosive Management Plan. Reference Approved WP/49 CFR	**YES**	**NO**	**N/A**	**COMMENTS**
a. Signature Authority On-Hand	☐	☐	☐	
b. Periodic Inventories Conducted On-Schedule	☐	☐	☐	

9. Explosive Management Plan. Reference Approved WP/49 CFR (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
c. Accountability Records Maintained	☐	☐	☐	
d. Lost/Stolen Reporting Procedures in Place	☐	☐	☐	
e. Final Disposition Procedures Documented	☐	☐	☐	
f. Key Control/Security	☐	☐	☐	
10. Transportation of MEC. Reference EP 1110-11-18. Chapter 15/49 CFR	**YES**	**NO**	**N/A**	**COMMENTS**
a. Hazardous Waste Manifest (EPA Form 8700-22) (if required)	☐	☐	☐	
b. Hazard Classification of MEC IAW TB 700-2	☐	☐	☐	
c. Training of Transporting MEC IAW 49 CFR, Part 172 & State Applicable State Requirements	☐	☐	☐	
d. Documented Organizational Responsibilities for Transportation of MEC	☐	☐	☐	
e. Approved Transportation Plan	☐	☐	☐	
f. Pre-operational checks of vehicles being conducted	☐	☐	☐	
g. All operators licensed for vehicle	☐	☐	☐	
h. Fire Fighting & First Aid Equipment on board	☐	☐	☐	
i. Cargo properly segregated/blocked and braced and in proper container	☐	☐	☐	
j. Proper DOT Placards/Fire Fighting Symbols Used	☐	☐	☐	

11. UXO Operational Plan, Reference Approved WP & EP 1110-1-18	**YES**	**NO**	**N/A**	**COMMENTS**
a. Contractor following methodology defined in WP	☐	☐	☐	
(1) SUXOS conducted physical check prior to sweep operations	☐	☐	☐	
(2) Daily Safety Meeting Conducted by SUXOS/SSHO	☐	☐	☐	
b. Geophysical Detection/Magnetometer Used	☐	☐	☐	
(1) Pre-Operational Checks Performed Prior to Sweep Operations	☐	☐	☐	
(2) Operational Condition Annotated in Log Book	☐	☐	☐	
(3) UXO Teams	☐	☐	☐	
(4) Quality Control	☐	☐	☐	
(5) Quality Assurance	☐	☐	☐	
c. Operational Teams Operating IAW WP	☐	☐	☐	
(1) UXO Supervisor Conducted Physical Check Prior to Sweep Operation	☐	☐	☐	
(2) Pre-Sweep Operational/Safety Brief Conducted	☐	☐	☐	
(3) Individual Sweep Lanes/Transects Marked IAW WP	☐	☐	☐	
(4) Contacts Marked & Investigated Properly	☐	☐	☐	
(5) Results of Sweep Operation Recorded	☐	☐	☐	
(6) All MEC, Inert Items & Scrap Examined by at Least Two UXO Personnel	☐	☐	☐	

11. UXO Operational Plan, Reference Approved WP & EP 1110-1-18 (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
(a) AEDA (Range Residue) IAW PWS/SOW and Properly Addressed in WP	☐	☐	☐	
(7) All UXOs Clearly Marked	☐	☐	☐	
d. QC Operations IAW WP	☐	☐	☐	
e. Non-Munitions Debris Being Collected (as required)	☐	☐	☐	
f. Munitions Debris Inspected/Vented/Segregated	☐	☐	☐	
g. Geophysical Test Grids Appropriate and IAW PWS/SOW	☐	☐	☐	
12. Disposal Operations Planned On-Site IAW the Approved WP	**YES**	**NO**	**N/A**	**COMMENTS**
a. Disposal Method IAW WP	☐	☐	☐	
13. Location Survey & Mapping Plan. Reference Contract DIDs	**YES**	**NO**	**N/A**	**COMMENTS**
a. Professional Land Surveyor	☐	☐	☐	
b. Surveyors Received Safety Briefing	☐	☐	☐	
c. UXO Escort Provided	☐	☐	☐	
d. Grid Stake, Locations Swept with Geophysical Equipment prior to Driving Stakes	☐	☐	☐	
e. Survey Notes Being Recorded	☐	☐	☐	
14. Quality Control Plan. Reference PWS/SOW/DID(s)	**YES**	**NO**	**N/A**	**COMMENTS**
a. QC Operational/Checks Being Conducted IAW WP	☐	☐	☐	

14. Quality Control Plan. Reference PWS/SOW/DID(s) (continued)	**YES**	**NO**	**N/A**	**COMMENTS**
b. QC Grid/Transect Established IAW WP	☐	☐	☐	
c. Results of QC Checks Being Recorded	☐	☐	☐	
d. Pass/Fail Criteria Clearly Defined IAW PWS/SOW	☐	☐	☐	
15. Vegetation Removal Reference WP/SSHP & OSHA Req.	**YES**	**NO**	**N/A**	**COMMENTS**
a. Vegetation Removal & Localized, if required	☐	☐	☐	
b. Equipment Operation to Prevent Impact with Possible Surface UXO	☐	☐	☐	
c. Cutting does not Present Impalement Hazard	☐	☐	☐	
d. UXO Personnel Monitoring Cutting Operation	☐	☐	☐	
e. UXO Discovered Marked/Handled Appropriately	☐	☐	☐	
f. Equipment Being Operated Safely & IAW Equipment Operators Manual/WP	☐	☐	☐	
16. Munition Constituents (MC) Sampling and Analysis Plan, if required	**YES**	**NO**	**N/A**	**COMMENTS**
a. Key Personnel Identified	☐	☐	☐	
b. Quality Assurance Responsibilities Identified	☐	☐	☐	
c. Procedures for Collection of Samples	☐	☐	☐	
d. Local Carrier Location Identified	☐	☐	☐	

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FPM Remediations, Inc.

THREE PHASE CONTROL – PREPARATORY PHASE INSPECTION REPORT

Date: _____

Project Name _____

Project Location _____

Project Number _____

Contract Number _____

Inspection/Surveillance Point Task	Verified By (Signature)	Verification Date
Review and Approval of Project Planning Documents		
ESS		
Work Plan		
Project Schedule		
HSP		
UFP-QAPP		
SOPs		
Project Personnel Qualifications		
Pre-Mobilization Readiness Review		
Overall Readiness		
Site Access		
Permits		
Field Office/Equipment Staging		
Personnel Readiness - UXO		
Personnel Readiness - Geo		
Personnel Readiness - Other		
Equipment Readiness - UXO		
Equipment Readiness - Geo		
Equipment Readiness - Other		

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FPM Remediations, Inc.

THREE PHASE CONTROL – INITIAL PHASE REPORT

Date: _____

Project Name _____

Project Location _____

Project Number _____

Contract Number _____

Inspection/Surveillance Point Task	Verified By (Signature)	Verification Date
Review Preparatory Phase Inspection Report		
Mobilization		
Post-Mobilization – UXO Equipment		
Post-Mobilization – UXO Personnel		
Post-Mobilization – Geo Equipment		
Post-Mobilization – Geo Personnel		
Post-Mobilization – Other Equipment		
Post-Mobilization – Other Personnel		
IVS Establishment		
IVS Area Selection – Analog Assisted Surface Clearance		
IVS Area DGM Survey		
Digging of DGM targets		
DGM Resurvey of IVS Area		
Placement of ISOs		
RTG-GPS Measurement of ISO Locations		
Geophysical Investigation		
Initial QC Tests		
MEC Disposal		
Preparation for MEC Disposal		

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FPM Remediations, Inc.

THREE PHASE CONTROL – FOLLOW-UP PHASE REPORT

Date: _____

Project Name _____

Project Location _____

Project Number _____

Contract Number _____

Report Number _____

Weekly / Monthly / Final (circle one)

Inspection/Surveillance Point Task	Discrepancies / Corrective Action Taken	Corrective Action Completed	Verified By (Signature)	Verification Date
Review Initial Phase Inspection Report				
Detector-Aided Surface Clearance (UXO)				
Geophysical Investigation				
Opening QC				
Opening IVS (Amplitude)				
Closing QC				
Closing IVS (Amplitude)				
Static Positional Accuracy				
Dynamic Positional Accuracy				
Dynamic Background				

FPM Remediations, Inc.

THREE PHASE CONTROL – FOLLOW-UP PHASE REPORT

Date: _____

Inspection/Surveillance Point Task	Discrepancies / Corrective Action Taken	Corrective Action Completed	Verified By (Signature)	Verification Date
Anomaly detection				
Along-Line Measurement Spacing				
Repeat Measurement Amplitude and Positional Accuracy				
DGM Grid Coverage				
Anomaly Reacquisition (Geo)				
Anomaly Reacquisition (Geo)				
Intrusive Investigation				
Target Anomaly Location Resolution (UXO)				
MEC Disposal				
Pre-MEC Disposal Operations				
Post-MEC Disposal Operations				
MPPEH Documentation				

FPM Remediations, Inc.

Photo Log

Construction and Remediation Services

Log Number:

Project Title: ______________________

Location: ______________________

Contract Number: ______________________

WEATHER	BRIGHT SUN	CLEAR	OVERCAST	RAIN	SNOW
TEMPERATURE	< 32	32 - 50	50 - 70	70-85	>85
WIND	STILL	MODERATE	HIGH		
HUMIDITY	DRY	MODERATE	HUMID		

Personnel On-Site

Name	Affiliation	Location/Description of Work

Number	Date	Direction	Description

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Appendix F

Explosives Safety Submission

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XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs

EXPLOSIVES SAFETY SUBMISSION

HOLLOMAN AIR FORCE BASE
NEW MEXICO
RCRA PERMIT NUMBER: NM6572124422-2

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for:

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Avenue, Suite 155
Lackland AFB, Texas 78236-9853

June 2014

Prepared by:

FPM Remediations, Inc.
584 Phoenix Drive
Rome, NY 13441

URS **Group, Inc.**
7720 N 16th Street, Suite 100
Phoenix, AZ 85020-4493

XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs

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Performance Based Remediation
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Approved by:

Ron Vanderford — Date
UXO Safety and Quality Assurance
FPM Remediations, Inc.

Ivana Raicevic, PhD — Date
MMRP Installation Manager
FPM Remediations, Inc.

Maureen Whalen, CG, CPG, PMP — Date
Project Manager
FPM Remediations, Inc.

FPM Remediations, Inc. (FPM) prepared this Explosives Safety Submission (ESS) under the direction of the Air Force Civil Engineer Center (AFCEC). Details contained in this ESS are based, in part, on information provided in other documents and is subject to limitations and qualifications presented in the referenced documents. This document should be used only with the approval of the AFCEC.

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFMAN	USAF Manual
BATFE	Bureau of Alcohol, Tobacco, Firearms and Explosives
BEEF	Base Engineering Emergency Force
bgs	below ground surface
BIP	Blow-In-Place
BSP	Blind Seed Program
CARA	CBRNE Analytical and Remediation Activity
CBRNE	Chemical, Biological, Radiological, Nuclear and Explosives
CEHNC	Corps of Engineers–Huntsville Center
CSE	Comprehensive Site Evaluation
CSA	Courtesy Storage Agreement
DA	Department of the Army
DDESB	Department of Defense Explosives Safety Board
DFX 300	White's DFX 300 electromagnetic metal detector
DGM	Digital Geophysical Mapping
DoD	Department of Defense
DoDI	Department of Defense Instruction
EC	Engineering Controls
EED	Electro Explosive Device
EM	Engineer Manual
EM61	Geonics EM61-MK2
EMM	Earth-Moving Machinery
EOD	Explosive Ordnance Disposal
EP	Engineering Pamphlet
ESQD	Explosives Safety Quantity Distance
ESS	Explosives Safety Submission
FPM	FPM Remediations, Inc.
G-858	Geometrics G-858 Cesium Vapor Magnetometer
GA-52CX	Schonstedt GA-52CX magnetic locator
GIS	Geographic Information System
GPS	Global Positioning System
GSV	Geophysical System Verification
HFD	Hazardous Fragmentation Distance
HTRW	Hazardous, Toxic and Radioactive Waste
HSTT	High Speed Test Track
IAW	in accordance with
ISO	Industry Standard Object
ITRC	Interstate Technology Regulatory Council
IVS	Instrument Verification Strip
LGRDC	Logistics Readiness Cargo
LRS	Logistics Readiness Squadron
m	meter
mm	millimeter
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
MFD	Maximum Fragmentation Distance
MFD-H	Maximum Fragmentation Distance - Horizontal
MGFD	Munition with the Greatest Fragmentation Distance
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
MSA	Munitions Storage Area
MSD	Minimum Separation Distance
MXS	Holloman Munitions Storage Area designation
NFA	No Further Action
NEW	Net Explosive Weight
NTCRA	Non-Time-Critical Removal Action
OE	Ordnance and Explosives
OSHA	Occupational Safety and Health Administration
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
RCWM	Recovered Chemical Warfare Material
RI	Remedial Investigation
SDA	Safe Disposal Area
Shaw	Shaw Environmental, Inc.
SUXOS	Senior UXO Supervisor
TP	Technical Paper
TSD	Team Separation Distance
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force

UXO	Unexploded Ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
WESCO	Western Explosives Systems Company
WSMR	White Sands Missile Range

1.0 BACKGROUND

1.1 INTRODUCTION

This Conventional Explosives Safety Submission (ESS) has been prepared in support of the Holloman Air Force Base (AFB) Military Munitions Response Program (MMRP) to ensure that all applicable Department of Defense (DoD), United States Air Force (USAF), and Department of Army (DA) explosives safety standards are applied correctly during surface removal and intrusive removal actions at the following Munitions Response Sites (MRSs):

- XU853 (Missile Test Stands)
- XU854 (Able 51 Area)
- FI857a (Former Bunker)
- SR864 (Poorman Range)
- ML865 (Ballistics Rain Field)
- RR869a (Debris Field)

FPM Remediations, Inc. (FPM) has prepared this ESS under Contract FA8903-13-C-0008 with the Air Force Civil Engineer Center (AFCEC).

1.2 PURPOSE OF THE ESS

The intent of this ESS is to provide the explosives safety criteria and methodology to be employed during implementation of Munitions and Explosives of Concern (MEC) response actions and to protect Installation personnel and property from explosive hazards. MEC response actions at the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs will entail conducting a Remedial Investigation (RI) and/or Non-Time-Critical Removal Action (NTCRA), which has been deemed necessary to achieve site closeout for those sites.

This ESS has been prepared in accordance with (IAW) the most current versions of DoD Manual No. 6055.09-M, *Ammunition and Explosives Safety Standards* (DoD, 2008), U.S. Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-97, *Safety & Health Requirements Manual*, (USACE, 2010b), and USAF Manual (AFMAN) 91-201 *Air Force Explosives Safety Standards* (USAF, 2011).

1.3 MUNITIONS RESPONSE SITE LOCATIONS

Holloman AFB is located in Otero County, New Mexico, seven miles west of the city of Alamogordo **(Figure 2-1, Appendix A - Maps)**. It is situated in a semi-arid region within the northern portion of the Chihuahuan Desert. Holloman AFB is contiguous with the much larger (2.2 million acres) White Sands Missile Range (WSMR), which is located to the north, west and southwest of Holloman AFB.

Holloman AFB is situated on approximately 50,763 acres of land. The southern portion of the Installation contains the flight line, composed of a series of runways running north-south, east-west, and northeast-southwest. The Apache Mesa Golf Course is located south of the runways. The Main Base is located at the southeast corner of the Installation, where Route 70 borders the site. The West Area and the North Area refer to the improved areas around the original airfield (southeastern triangle formed by the runways). The Main Base contains housing and administrative buildings. The High Speed Test Track (HSTT) runs north-south and is located to the northwest of the airfield. The track is the world's longest of its kind at 9.5 miles, has been used for an array of missile testing for decades, and is still in use today (Shaw Environmental, Inc. [Shaw], 2010). The summary of acreages for Munitions Response Areas (MRAs) and associated MRSs identified following the CSE Phase II that will be **addressed by this ESS** is provided in **Table 1-1**.

Table 1-1
MRA and MRS Designations and Acreage Summary

MRA ID	MRA Acres*	MRS ID	Site Name	Site Acres*
853	205	**XU853**	**Missile Test Stands**	**205**
854	48	**XU854**	**Able 51 Area**	**48**
857	21	FI857	Former Bunker [No Further Action (NFA)]	20
		FI857a	**Former Bunker**	**1**
864	23	**SR864**	**Poorman Range**	**23**
865	18	**ML865**	**Ballistics Rain Field**	**18**
869	4	RR869	Debris Field [NFA]	1
		RR869a	**Debris Field**	**4**

*Acreage rounded to nearest whole number,1 shown for sites less than 1 acre

1.4 OPERATIONAL HISTORY AND CURRENT LAND USE

Holloman AFB was first established in 1942 as Alamogordo Army Air Field flying primarily B-17s, B-24s, and B-29s. In 1947, it became the primary site for the testing and development of un-manned aircraft, guided missiles, and other research programs. In 1968, the 49th Tactical Fighter Wing arrived at Holloman AFB and has since conducted fighter aircraft training and operations. Holloman AFB has also served as the German Air Force's Tactical Training Center since 1996.

Previous MMRP work conducted at MRAs 853, 854, 857, 864, 865, and 869 consisted of a Comprehensive Site Evaluation (CSE) Phase I followed by a CSE Phase II. The CSE Phase II included visual surveys of all MRAs and environmental media sampling of surface and subsurface soils at MRAs 857, 864, and 865 (HDR Environmental, Operations and Construction, Inc.[HDR], 2013).

1.4.1 XU853 – MISSILE TEST STANDS

Operational History

The approximately 205-acre Missile Test Stands MRA 853 is located in the south-central portion of the Base east of the southern end of the HSTT. The area was used primarily in the 1940s and 1950s as a launch area for an array of rocket and missile testing programs. The majority of missile testing at MRA 853 ended in the late 1950s with brief test vehicle programs lasting into the 1960s. Five launch complexes associated with the rocket and missile testing activities are the GAPA, or MX-606; the NATIV, or MX-770; the JB-2 Loon, or MX-544; the Aerobee, or MX-1011; and the Test Stand. The CSE Phase II visual survey found small arms debris (5.56mm, 7.62mm, and .50-caliber) associated with recent training activities and Munitions Debris (MD). Three expended 5-inch rocket motors used to denote a survey marker were observed in the southeastern corner of the MRA. An expended 5-inch rocket motor was observed in the western portion of the MRA. At the conclusion of the CSE Phase II, the entire MRA 853 was identified as MRS XU853 and recommended for further munitions response action.

Current Land Use

Currently, the Missile Test Stands (XU853) MRS is closed; however, many of the facilities and buildings remain. Many of the buildings present at the MRS have been used for warehousing/general storage. Part of the MRS, including buildings 1105, 1106, 1107 and the nearby water tank and water tower, is currently in use by the Holloman AFB water distribution utility shop.

1.4.2 XU854 – ABLE 51 AREA

Operational History

The approximately 48-acre Able 51 Area MRA 854 was used as a launch facility in the late 1950s and early 1960s for testing of Mace and Matador missiles. Also known as the BQM-34A Drone Launch area, this area was also used for research on mobile launch capability of both manned and unmanned aircraft, using rocket boosters, without the need for prepared airfields. Building 1440, completed in 1962, was used as a missile launch facility and as an observation blockhouse for Mace and Matador missiles and drone launches. Since missile testing ended at the Able 51 Area MRA 854 in the early 1970s, Building 1440 either has been used for storage or has been vacant. Building 1442 was constructed in 1959 as a missile launch facility and is currently vacant. Missiles and aircraft were launched from a fixed launcher as well as mobile launchers tethered to concrete pads within the Able 51 Area MRA 854. At the conclusion of the CSE Phase II, the entire MRA 854 was identified as MRS XU854 and recommended for further munitions response action. As shown in the figures **(Appendix A)**, MRS XU854 (Able 51 Area) and its Explosives Safety Quantity Distance (ESQD) arcs lie outside the installation boundary; however, the MRS is located on property owned by Holloman AFB.

Current Land Use

Although the Able 51 Area (XU854) MRS is not currently used for testing activities, recent evidence suggests the site was also used for small arms training activities. Vegetation

surrounding the buildings consists of desert scrubland, and the land surface within the MRS is relatively flat.

1.4.3 FI857A – FORMER BUNKER

Operational History

The Former Bunker MRA 857 was investigated as part of an archaeological survey and was described as having historical munitions activities. The site record lists a bomb tail section, four missile casings, nine bomb casings, drone parts, and a 1942 .30-06-caliber cartridge within the remnants of a collapsed wooden tower. In addition, the survey narrative describes an excavated pit with no associated munitions debris. Small arms debris consisting of .22, .32, .50 caliber, and 7.62mm casings, as well as a 7.62mm link and a .50 caliber link, were observed. MD observed at the MRA included a grenade pin, an M38 practice bomb box fin, and nine M38 practice bomb casings with no spotting charges present. These practice bombs were nearly intact with no damage and grouped together indicating that they were likely disposed of at the location. Holloman AFB Cultural Resources established that the area had also been used as a confidence training obstacle course for Security Forces personnel. The CSE Phase II recommended splitting the MRA into two MRSs: FI857 (19.8 acres) was recommended for NFA and FI857a (0.8 acre) was recommended for future munitions response action.

Current Land Use

The location of the Former Bunker (FI857a) MRS is currently unused. Vegetation at the MRS is consistent with desert scrubland and the area is generally flat lying.

1.4.4 SR864 – POORMAN RANGE

Operational History

The Poorman Range MRA 864 is located in the southwestern portion of the base immediately to the south of the Jeep Target Area Skeet Range MRA 862 and east of the active Jeep Target Area. The MRA is identified by the Laboratory of Anthropology Site Record for the Jeep Target Area as an area to the east with 25 gun placement stations. Each station has seven 8- x 8-foot concrete pads and 2- x 3-foot concrete footings for mounting the gun turret superstructure. The station dimensions are approximately 43 x 43 feet separated by 30 feet. Tow targets were reported among the debris scatter for the area. Based on a review of the CSE Phase II findings, .50 caliber casings and links were observed near the firing stations. In addition, 5.56mm and 7.62mm blanks were also observed on the MRA; however, these are likely from training exercises associated with the adjacent Prime Base Engineering Emergency Force (BEEF) Training Area. Clay target debris was scattered along the northwestern edge of the MRA. MD observed at the MRA consisted of expended M18 Smoke Grenades. These are likely from training activities associated with the Prime BEEF Training Area. MEC items found east and west of MRA boundary were documented consisting of intact M18 smoke grenades and M116A1 hand grenade simulators which are also likely associated with training exercises at the Prime BEEF Training Area. Based on the findings of the CSE Phase II, the MRA boundary was expanded to include the areas where MEC and MD were found resulting in a new MRA acreage

of approximately 23 acres. At the conclusion of the CSE Phase II, the entire MRA 864 (23 acres) was identified as MRS XU864 and recommended for further munitions response action.

Current Land Use

The Poorman Range (SR864) MRS is currently unused. There is evidence that training activities associated with the Prime BEEF Training Area have occurred at this site. The site exhibits relatively flat topography, and vegetation in the vicinity is consistent with desert scrubland.

1.4.5 ML865 – Ballistics Rain Field

Operational History

The Ballistics Rain Field MRA 865 is located in the western portion of the Base west of the HSTT and just north of Hay Draw. The MRA was used to create artificial rain for the purpose of testing the effects on artillery. The direction of fire was from the east to the west, although the firing point was not identified. The period of operation for the Ballistics Rain Field MRA 865 is unknown; however; aerial photography from 1972 shows the earth and timber target butt at the western end of a road perpendicular to the HSTT. Based on the CSE Phase II findings, the MRA boundary was expanded resulting in a new MRA acreage of approximately 18 acres. At the conclusion of the CSE Phase II, the entire MRA 865 (18 acres) was identified as MRS ML865 and recommended for further munitions response action.

Current Land Use

The Ballistics Rain Field (ML865) MRS is open space and relatively flat, and is currently unused. Facilities still present at the location include piping and nozzles for the artificial rain, and the earth and timber target structure with a steel plate at the face of the structure.

1.4.6 RR869a–Debris Field

Operational History

The Debris Field MRA 869 is located in the south-central portion of the Base north of Munitions Storage Buildings 1197 and 1198. Debris consistent with a possible missile drone crash site was observed during the CSE Phase I visual survey on the southern slope of Ritas Draw. MD observed within the MRA included 5-inch rocket motor fragments. The CSE Phase II visual survey identified one .50-caliber projectile and minor amounts of clay target debris. Metal scrap was observed across the MRA, as well as a rocket launcher and possible rocket debris, one expended hand grenade fuze, and expended electric squibs. One MEC item, a squib with a single intact charge, was identified. Based on the results of the CSE Phase II investigation, the Debris Field MRA 869 was recommended to be split into two MRSs. The 0.1-acre Debris Field (RR869) MRS falls under the Installation Restoration Program category and is ineligible under MMRP. The 3.5-acre Debris Field (RR869a) MRS contains surface MEC and MD and potential subsurface MEC and/or MD, and was recommended for further munitions response action.

Current Land Use

The Debris Field (RR869a) MRS is currently unused open space covered by desert scrubland vegetation along the southern bank of Ritas Draw. This MRS exhibits rolling topography with gorges and gullies.

1.5 REASON FOR MUNITIONS RESPONSE

The MRSs included in this ESS had varying missions ranging from missile testing to training at small arms ranges. All of the MRSs included in this ESS were recommended for further munitions response actions due to the presence of range-related debris, MD, or MEC. **Table 1-2** presents a summary of the munitions response actions that FPM will conduct at each site.

Project Scope

Under this contract, the MMRP RI and NTCRA work at the above MRSs will be addressed by separate work plans and will include the following actions:

- Providing MEC avoidance for all field activities.
- Performing 100% surface clearance within some locations.
- Removing Material Potentially Presenting an Explosive Hazard (MPPEH) that could pose a safety hazard to personnel during fieldwork.
- Eliminating sources of Digital Geophysical Mapping (DGM) signal interference (i.e., metal objects) that could obscure subsurface anomalies and thus reduce the effectiveness of the DGM surveys to detect and map subsurface targets.
- Performing intrusive investigation and subsurface removal actions on DGM targets as well as Munitions Constituents sampling at MEC/MPPEH locations and in areas with significant amounts of MD.
- Characterizing and segregating MPPEH into Material Documented as an Explosive Hazard (MDEH) (i.e., MEC/ Unexploded Ordnance [UXO]) or Material Documented as Safe (MDAS).
- Providing final disposition and certification of MEC, MDAS, and metallic scrap generated from surface and subsurface MEC activities.

Table 1-2
Description of Planned Remedial Actions at the MRSs

SITES	ACREAGE	MUNITIONS RESPONSE ACTION
XU853 (Missile Test Stands)	205	Surface clearance of transects and grids, DGM followed by subsurface clearance
XU854 (Able 51 Area)	48	Surface clearance of transects and grids, DGM followed by subsurface clearance
FI857a (Former Bunker)	1	100% Surface clearance, DGM followed by subsurface clearance
SR864 (Poorman Range)	23	100% Surface clearance, DGM followed by subsurface clearance
ML865 (Ballistics Rain Field)	18	100% Surface clearance, DGM followed by subsurface clearance
RR869a (Debris Field)	4	100% Surface clearance, DGM followed by subsurface clearance

2.0 MAPS

The following maps are included in **Appendix A.**

Figure 2-1 Holloman Air Force Base Location Map

Figure 2-2 XU853, XU854, FI857a, SR864, ML865, and RR869a MRS Location Map

Figure 2-3 XU853 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-4 XU854 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-5 FI857a MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-6 SR864 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-7 ML865 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-8 RR869a MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-9 XU853, XU854, FI857a, SR864, ML865, and RR869a Safe Disposal Areas Showing ESQD Arcs

Figure 2-10 Location of Donor Explosives Storage at Munitions Storage Area (MSA)

3.0 START DATE

Fieldwork for the RI will begin August 2014. Fieldwork for the NTCRA will begin January 2016.

4.0 TYPES OF MEC

Table 4-1 shows the types of MEC and MD recovered at the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs during the previous CSE Phase II.

Table 4-1
Types of MEC and Munitions Debris Recovered at the MRSs

AREA	MEC	MUNITIONS DEBRIS & OTHER MATERIAL
XU853 (Missile Test Stands)	None	Small arms, 40 millimeter (mm) flares, smoke grenades, tail boom for 81 mm illumination mortar, M13 Distress signal, 5” rocket motors
XU854 (Able 51 Area)	None	Small arms, 40 mm flares, M74 airburst simulator, slap flares, smoke grenades
FI857a (Former Bunker)	None	Small arms, M38 100 lb. practice bombs
SR864 (Poorman Range)	M18 Smoke Grenade, M116A1 Grenade Simulator	Small arms, smoke grenades
ML865 (Ballistics Rain Field)	105mm Projectile with T-bar fuze (2)	155 mm projectiles, 105 mm projectiles, 75 mm projectiles, projectile fuzes, 5” rocket motors
RR869a (Debris Field)	Electric squib	Small arms, debris from 2.75” rocket launcher and possibly 5” rocket motors, electric squibs

5.0 EXPLOSIVES SAFETY QUANTITY DISTANCE FOR MUNITION WITH THE GREATEST FRAGMENTATION DISTANCE

5.1 SELECTION OF MUNITION WITH THE GREATEST FRAGMENTATION DISTANCE

The MRSs included in this ESS will have the Munition with the Greatest Fragmentation Distance (MGFD) based upon the most likely munition to be encountered in that MRS. As the items discovered during the CSE Phase II are not listed in the Fragmentation Database Review Forms, items that are more hazardous have been substituted to ensure a satisfactory Minimum Separation Distance (MSD).

If MEC with a greater fragmentation distance is encountered, the MSD will be adjusted in accordance with Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 16 *Methodologies for Calculating Primary Fragment Characteristics* (DDESB, 2011), operations will continue, and an amendment to the ESS submitted for approval (a copy of this document will be available on site). ESQD arcs will be adjusted accordingly.

5.2 MINIMUM SEPARATION DISTANCES

The MSD is equivalent to the MGFD of the UXO item that may be present in a particular zone and is based on the data presented in **Table 5-1.** The Fragmentation Data Review Forms for the MSDs are presented in **Appendix B**.

Table 5-1
Minimum Separation Distances

MRS	MEC	MSD (feet)						
		For Unintentional Detonations			For Intentional Detonations			
		Hazardous Fragmentation Distance (HFD)		K40[1] TSD	Without EC: Larger of MFD-H or K328[2]	Using Sandbag Mitigation (Single Item)		Water Mitigation
		Without EC	With EC			Single Layer	Double Layer	
XU854, SR864, FI857	M383 40mm grenade	207	200	22	302	200	12.5	200
XU853, RR869A	MK10 5" Rocket Motor	428	Not permitted	115	1874	Not permitted	Not permitted	Not permitted
ML865	M549A1 155mm projectile	387	220	99	2371	220	Not permitted	275

1. K40 also referred as "team separation distance (TSD)" - The allowable blast overpressure distance for unintentional detonations of non-fragmenting munitions.
2. K328 - The allowable blast overpressure distance or MSD for a planned detonation of non-fragmenting munitions.

For XU854, SR864, and FI857a:

- The MGFD is the M383 40mm grenade (high explosive filler).
- The MSD for the M383 40mm grenade for *Unintentional Detonations* is 200 feet with engineering controls (EC) and 207 feet without EC. For *Intentional Detonations*, the MSD is 302 feet (based on the MFD-H distance without EC).

For XU853 and RR869a:

- The MGFD is the MK10 5" rocket motor.
- The MSD for the MK10 5" rocket motor for *Unintentional Detonations* is not permitted with EC and 428 feet without EC. For *Intentional Detonations*, the MSD is 1,874 feet (based on the MFD-H distance without EC).

For ML865:

- The MGFD is the M549A1 155mm projectile.
- The MSD for the M549A1 155mm projectile for *Unintentional Detonations* is 220 feet with EC and 387 feet without EC. For *Intentional Detonations*, the MSD is 2,371 feet (based on the MFD-H distance without EC).

FPM is responsible for ensuring non-essential personnel remain outside the ESQD arc of an active FPM operation (surface or subsurface clearances and demolition). MSD restrictions from MEC areas to non-project personnel will be applied during surface and subsurface investigations.

Essential Project Personnel are defined as those on-site contractors and DoD personnel required to participate in the MEC removal/sampling, along with those approved and authorized visitors. *Non-Essential Project Personnel* are defined as all other personnel not considered to be required to accomplish the task, such as unauthorized visitors.

For *Essential Project Personnel*, the MSD/TSD is listed in **Table 5-1** under the K40 TSD column. For *Non-Essential Project Personnel*, the MSDs are listed under the HFD – Without EC column.

5.3 EXPLOSIVES SAFETY QUANTITY DISTANCE ARCS

Figures 2-3 through 2-8 illustrate the ESQD arcs around each of the six MRSs. As shown in the figures, MRS XU854 (Able 51 Area) and its ESQD arcs lie outside the installation boundary; however, the MRS is located on property owned by Holloman AFB. In addition to securing all ESQD arcs within the Holloman AFB boundary, FPM will ensure that areas outside of the base boundary are secured during explosive operations by coordinating with WSMR, Holloman AFB, and local law enforcement agencies.

5.4 DEMOLITION REQUIREMENTS

5.4.1 LICENSING AND PERMITS

FPM maintains a Bureau of Alcohol, Tobacco, & Firearms Type 33 Federal Explosives License, No. 6-NY-00986, which allows authorized site UXO personnel to purchase, receive and use donor explosives to dispose of MEC.

5.4.2 PLANNED SAFE DISPOSAL AREAS

A safe disposal area (SDA) will be established within each MRS in the event that multiple, safe-to-move MEC items must be destroyed. **Figure 2-9** depicts the approximate locations for the SDAs and associated ESQD arcs at each of the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs.

5.4.3 BLOW-IN-PLACE

FPM will dispose of all unsafe-to-move MEC items by the Blow-In-Place (BIP) method. The FPM Senior UXO Supervisor (SUXOS) will determine if a BIP is required or the item can be safely moved to a collection point.

5.4.4 COLLECTION POINTS

Collection points may be established within each MRS to facilitate the inventory and disposition of safe-to-move MEC. The collection of multiple MEC items is not anticipated for this project,

but if deemed necessary, the maximum Net Explosive Weight (NEW) at a collection point will be limited such that the K40 overpressure distance for the total NEW does not exceed the hazardous fragmentation distance for the area.

5.4.5 IN-GRID CONSOLIDATED SHOT

If determined acceptable to move by the SUXOS, MEC items may be consolidated prior to demolition and/or disposal. U.S. Army Engineering and Support Center, Huntsville publication "*Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites*," dated March 2000 will be used and a copy of this report will be available on site. The maximum NEW for a consolidated shot will be limited such that the K328 overpressure distance for the total NEW (including donor charges) does not exceed the MSD for the intentional detonation.

Net Explosive Weight for disposal of consolidated shots will not exceed 25 pounds. No MEC will be transported outside an MRS by FPM unless required for the protection of personnel and/or property. Any transportation of MEC outside an MRS will be coordinated with Holloman AFB Explosive Ordnance Disposal (EOD) and Base Security.

5.4.6 EXPLOSIVES STORAGE MAGAZINES

A Courtesy Storage Agreement (CSA) between FPM Remediations and the 49th MXS (designation for Holloman AFB Munitions Storage Area) allows courtesy storage of up to 100 pounds NEW of donor explosives in properly sited DDESB-approved facilities. The CSA is attached to this document as **Appendix C**. **Figure 2-10** depicts the location of the MSA; the 49th MXS will assign specific munitions storage bunkers for FPM's use after mobilization.

5.4.7 DELIVERY AND TRANSPORTATION OF DONOR EXPLOSIVES

MEC items will be disposed of by the use of donor explosives. Western Explosives Systems Company (WESCO) will be FPM's explosives vendor and explosives will be delivered on a pre-arranged schedule based on the 49th MXS operations tempo. All security and access procedures will be arranged by FPM's SUXOS and coordinated with the 49th MXS and Base Security. All incoming explosive shipments to Holloman AFB are inspected and cleared by the 49th LRS (Logistics Readiness Squadron)/LGRDC (Logistics Readiness Cargo) section. USAF security (or contract security as directed by Holloman AFB Security Police) will escort the delivery vehicle to the MSA and provide all directions to the driver. The FPM SUXOS or his/her designated representative will be on site to inspect and sign for all explosives. All personnel handling explosives will be listed on FPM's most current Bureau of Alcohol, Tobacco, Firearms and Explosives (BATFE) Notice of Clearance.

FPM will follow all applicable explosives and safety standards while handling and transporting explosives. Rules commonly found in safety standards for explosive-laden vehicles are:

- Transportation of donor explosives between the MSA and MRSs shall use the safest and most direct route possible.
- Donor explosives will not be left unattended in a vehicle.

- Excess donor explosives will be returned to the MSA after each demolition operation.
- Vehicles used to transport donor explosives will be equipped with a minimum of two serviceable and properly mounted 2A:10BC rated fire extinguishers.
- Vehicles will be equipped with wheel chocks to prevent a parked vehicle without a driver from rolling.
- Explosives shall be properly secured in a vehicle to prevent movement.
- Vehicles will properly display Department of Transportation hazard class explosives placards for the highest hazard class of the explosives being transported.

5.4.8 INVENTORY AND MAINTENANCE OF EXPLOSIVES AND STORAGE FACILITIES

Once donor explosives are stored, the USAF will maintain control of all items. Access to explosives will be coordinated with the 49th MXS and the FPM SUXOS, or in the SUXOS' absence, senior FPM employees named on FPM's BATFE Notice of Clearance. A mandatory monthly inspection of all donor explosives will be conducted as per the CSA with the 49th MXS. Weekly inventories will be conducted by FPM, unless otherwise prevented by MSX operations. Due to the potential constraints on access, FPM personnel will take each access opportunity granted to inventory explosives.

6.0 MEC MIGRATION

The region surrounding Holloman AFB and Alamogordo, New Mexico has a semi-arid climate. Temperatures below the freezing mark may be encountered from the end of November to mid-February. Buried ordnance heaving due to freeze/thaw is not expected in an area with a frost depth of 0-1 inches. The potential for migration of MEC due to frost heave will not be a factor at Holloman AFB.

7.0 DETECTION EQUIPMENT AND RESPONSE TECHNIQUES

7.1 DETECTION EQUIPMENT

The geophysical instruments chosen for this investigation were selected based on their proven ability to detect the ordnance items expected at the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs at the required depths, and based on anticipated future land use of the project sites. The geophysical instruments (digital and analog) that will be used during this investigation are:

- Geonics EM61-MK2 (EM61)
- Geometrics G-858 Cesium Vapor Magnetometer (G-858)
- Geometrics MetalMapper
- Schonstedt GA-52CX
- White's DFX 300

The DGM surveys will be conducted using the EM61 electromagnetic and the G-858 magnetic systems based on their proven ability to detect the targets of primary interest with great accuracy. The digital systems will be used both to initially detect anomalies as well as to perform anomaly reacquisitions. The MetalMapper may be used to further discriminate between detected anomalies and targets of interest.

Hand-held magnetic locators (Schonstedt GA-52CX) and electromagnetic locators (White's DFX 300) will be used during intrusive investigation of the identified anomaly locations to locate potential UXO in the subsurface. Descriptions of the digital and analog detection instruments are provided below.

7.1.1 GEONICS EM61-MK2

The EM61 is a high-resolution time-domain electromagnetic system that can detect electrically conductive objects. The basic elements of an electromagnetic sensor are a transmit coil and a receive coil. A current pulse running through the transmit coil creates the primary electromagnetic field. Changes in this primary field set up eddy currents in the object, under the sensor. The eddy currents produce a secondary or induced electromagnetic field emanating from the object. This induced electromagnetic field is associated with the decay of eddy currents in metal objects near the sensor and is measured by the receiver coil, the output signal being proportional to the rate of change of the electromagnetic flux through the receiver coil. The receiver is timed to measure the signal within four time gates (216, 336, 660, and 1,266 microseconds) after the current pulse in the transmitter loop is completed. The four time gates allow discrimination between different types of targets based on the time-decay rate of the response. A measurable response in milliVolts implies that a metal object is present, and the profile of that response can be used to estimate the object's size. The EM61 can record up to 12 records per second with four time gates per record.

An EM61 system consists of a pair of 0.5- by 1.0-m coils. The lower coil is both a transmitter and receiver and the upper coil is exclusively a receiver coil. The lower coil is located 0.42 m above the ground surface for optimal data collection using the standard wheel mode, and the upper coil is 0.30 m above the lower coil. The EM61 is fully equipped for simultaneous logging of Global Positioning System (GPS) and electromagnetic data. Actual configurations will depend on site conditions and maximum operating efficiency, but larger arrays are normally deployed on either vehicle-towed frameworks mounted on wheels or skids. Smaller, man-portable wheel mounted systems containing a single transmitter and receiver are also available.

Details regarding the use of EM61 magnetic sensors for geophysical data collection and target reacquisitions are included in the RI Work Plan.

7.1.2 GEOMETRICS G-858 CESIUM VAPOR MAGNETOMETER

The G-858 is used for detecting and mapping ferrous metallic objects by measuring the net strength of the total magnetic field simultaneously within two optically pumped cesium vapor sensors. The total magnetic field includes the Earth's geomagnetic field [approximately 48,500 nanoTeslas at the Holloman AFB location] and any anomaly generated from nearby ferromagnetic material. The G-858 is comprised of a belt-mounted display and logging console

connected to two cesium sensors mounted on a hand-held counterbalanced staff. To provide data positioning, the G-858 will be coupled to a GPS. The console contains electronics to acquire magnetic field data with positional data and display them on its screen for review and edit. The G-858 consists of three items: (1) a photon emitter containing a cesium light emitter (lamp); (2) an absorption chamber containing cesium vapor and a "buffer gas" through which the emitted photons pass; and (3) a photon detector, arranged in that order. When the sensor encounters a perturbation (quantum energy) from a local magnetic source (e.g., 60-mm ordnance), this energy may hit one of the cesium atoms and cause it to jump into a new energy state, which may, in turn, absorb a photon from the cesium emitter. If this is the case, it will cause a decrease in the number of photons reaching the detector and this decrease can be easily recorded as a measure of the magnetic anomaly.

A magnetic base station consisting of a single G-858 sensor and microprocessor console will be established in an area away from vehicle or pedestrian traffic, and clear of surface and subsurface cultural interference (e.g., metallic debris, fencing, and utilities). The base station console will be time-synchronized with the mobile field system console daily. The base station data will be later used to correct for diurnal variations in the Earth's magnetic field during the time of the G-858 surveys.

7.1.3 GEOMETRICS METALMAPPER

The MetalMapper is an advanced electromagnetic system configured for the detection and characterization of UXO. This technology represents a significant departure from existing commercially available electromagnetic instruments for UXO detection. This system uses time domain electromagnetic principles to induce electrical currents in buried metallic objects and then measure the effects of those currents in receivers on the surface.

The system can be operated in static and dynamic mode. Static measurements are acquired when the system is stationary over a known target. The other default measurement type is dynamic acquisition. This is intended for use while towing the Metal Mapper over an area.

In static mode, the MetalMapper system is placed on top of previously identified targets and then measures the magnetic field caused by the current in that target. It uses that information to compute the size, shape and the depth of the buried object and then compares the gathered data of an unlabeled target to that of an established "UXO library". In this way, the system allows scrap metal to be distinguished from UXO. A prioritized dig list can be then generated that identifies each target as either one that has a high confidence of being MEC related or one that is non-hazardous.

7.1.4 SCHONSTEDT GA-52CX

The Schonstedt GA-52CX hand-held magnetic locator (GA-52CX) detects changes in the Earth's ambient magnetic field caused by ferrous metal. The technology uses two fluxgate magnetometers, aligned and mounted a fixed distance apart, to detect localized changes in the Earth's field caused by ferrous metal or disturbances in soil conditions. An audio signal is provided to the operator who uses changes in the signal pitch to pinpoint the location of the ferrous metal item. The detection capability of the GA-52CX varies according to the local

conditions, the size of the object, and the skill of the operator. The GA-52CX is a useful, inexpensive, and highly portable magnetometer that has become the standard UXO detection device used by UXO/EOD technicians.

7.1.5 WHITE'S DFX 300

The White's DFX 300 (DFX 300) is a hand-held analog electromagnetic metal detector. The DFX 300 has multi-frequency capability and uses operating frequencies of three and 15 kiloHertz, or both at the same time for enhanced target discrimination. An audio signal is provided to the operator who uses changes in the signal pitch and a Liquid Crystal Display screen to display/pinpoint the location of the metal item. In general, the DFX 300 is capable of detecting both ferrous and non-ferrous metals to a maximum depth of ~1.5 m (~4.5 feet). The actual detection capability of the instrument varies according to the local conditions, the size, orientation, and depth of the object, and the skill of the operator.

7.2 CAPABILITIES AND LIMITATIONS OF THE DETECTION METHOD

The detection capabilities of the Geometrics EM61 and G-858 will be tested by establishing an Instrument Verification Strip (IVS) at Holloman AFB in order to conduct MMRP work.

The maximum MEC depth of detection is estimated by multiplying the MEC principal diameter (in mm) by 11 (Interstate Technology Regulatory Council [ITRC], 2004). **Table 7-1** summarizes the estimated maximum detection depths for the munitions items most likely to be encountered at the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs.

Table 7-1
Estimated Maximum MEC Detection Depths [1]

MEC ITEM	DIAMETER	ESTIMATED MAXIMUM DETECTION DEPTH
M383 40mm grenade	40 mm	0.44 m (1.45 feet)
MK10 5" Rocket Motor	127 mm	1.397 m (4.58 feet)
M549A1 155mm projectile	155 mm	1.705 m (5.59 feet)

Note:
1. ITRC, 2004

7.2.1 MEC REMOVAL DEPTHS

The planned future land use for the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs is unrestricted land use. FPM will investigate anomalies that are above established thresholds to the estimated detection depth of a 155mm projectile (5.59 feet). If an anomaly of interest is more than 5.59 feet bgs, further investigation of the anomaly may continue to a maximum of 10 feet bgs. It is anticipated that ordnance items will not be found beyond their respective Maximum Detection Depths.

7.2.2 IMPOSED LIMITATIONS

The terrain and geology at Holloman AFB does not impose significant limitations on the proposed clearance method. Vegetation removal will be limited to only what is absolutely necessary to accomplish the task.

7.3 GEOPHYSICAL SURVEY MODES

For FI857a, SR864, ML865, and RR869a, 100% coverage surface clearances will be followed by 100% coverage DGM, data processing, and intrusively investigating and removing all anomalies above the established site-specific threshold. For XU853 and XU854, transects and grids will be laid out and then surface clearance, DGM, data processing, and subsurface clearance will be performed in those areas. Visual Sample Plan software will be used to statistically determine the number of intrusive samples required to be dug to achieve a 95% confidence level of MEC potential at the sites.

7.4 ANOMALY REACQUISITION

In preparation for MEC intrusive investigation, anomaly locations will be reacquired using the same type of geophysical and navigational instrumentation as was used to detect and map the anomalies. Anomaly locations identified in the geophysical data will first be relocated with the GPS and marked on the ground with plastic pin flags. Using the geophysical equipment, the reacquisition team, consisting of a geophysicist and a UXO technician, will then re-survey the area around the reacquired coordinate location within a radius of ~1 meter (~3 feet) from the flag.

7.5 SURFACE SWEEP PROCEDURES

Areas to receive surface sweeps will be sectioned into grids. Within each grid, a UXO Sweep Team will begin a survey in a straight-line abreast, but as the sweep commences, each member will stagger their start to minimize any interference between the handheld metal detectors. The staggered start will also ensure ample overlap of survey paths, reducing the potential for missed anomalies. At all times, when a survey line is halted for an item examination by a UXO technician, the rest of the line will stop as well until the item is marked, and a signal to proceed given. The sweep path will be marked along the way so that 100% coverage is assured. This will be achieved by the use of environmentally safe marking paint, nylon ropes, or live GPS tracking.

7.6 MANUAL AND MECHANICAL EXCAVATION

Intrusive investigations are normally conducted manually by using hand tools and using a magnetometer to define location and depth of an anomaly. The anomalies will then be excavated until their sources are encountered and identified. To gain access to a partially buried or subsurface anomaly, excavation will not be conducted directly over the anomaly but shall be initiated to the side of the anomaly to prevent the inadvertent striking of possible UXO.

Earth Moving Machinery (EMM) may be used to remove soil that is too compacted or too deep to efficiently excavate using hand tools. Excavations shall progress in 6-inch lifts and off to the side of the anomaly source. After each lift, the anomaly location and depth will be redefined with a handheld metal detector and the excavation location adjusted as required to ensure the excavation is being conducted to the side of the anomaly source. Excavation with EMM will stop within an estimated 12 inches of the anomaly and UXO Technicians will continue the excavation with hand tools. This process will continue until the source of the anomaly can be located in the sidewall of the excavation with a hand-held metal detector and then removed using hand tools.

To limit noise exposure, the EMM operator will use hearing protection IAW the Health and Safety Plan and Occupational Safety and Health Administration (OSHA) 1910.95. At no time will the EMM operator receive an 8-hour time-weighted noise exposure exceeding 85 decibels.

7.7 QUALITY CONTROL AND QUALITY ASSURANCE

A Geophysical System Verification (GSV) (Nelson, et al., 2009) will be established and used to confirm that the geophysical detection system and ongoing monitoring of production work are performed correctly.

The GSV consists of two main elements: an IVS and a Blind Seed Program (BSP). The objectives of the IVS are to verify that the geophysical detection system is operating as designed, to capture levels of background noise due to site conditions on a daily basis, and to streamline daily Quality Control (QC) checks. DGM Team members will test the functionality of the EM61, MetalMapper and GPS instruments by passing through the IVS that is seeded with Industry Standard Objects (ISO) placed at a variety of detectable depths and orientations.

As part of the Quality Assurance (QA) program, the BSP will be used throughout the DGM transects and grids to provide ongoing systematic confirmation that the targets can be detected and source items recovered.

To ensure high-quality geophysical data and established Data Quality Objectives (DQO) are being met, part of the QA program will also involve the FPM QC Geophysicist monitoring and evaluating the DGM QC data, survey data and data collection procedures, and data processing steps to verify that the field instruments are operating properly and established procedures are being followed; the QC Geophysicist will also oversee 10% reprocessing of DGM data. Details of the GSV elements and QA/QC program are included in the Work Plan.

UXO Team members will perform daily operational QC tests on the GA-52CX and DFX 300 to verify the detection capability of their instruments. The QC tests will be conducted by passing through a hand-held instrument test strip that is seeded with ISOs placed at a variety of detectable depths. The operator must detect each ISO or the instrument will not be used.

The UXO Quality Control Specialist (UXOQCS) will perform a QC inspection of a minimum of 10% of the areas/targets cleared. For QC inspections, the UXOQCS will use both GA-52CX and a DFX 300 instruments. Additionally, the UXOQCS will conduct inspections of recovered MDAS scrap, and any material or item potentially presenting an explosive hazard, to ensure there are no explosive components or hazards. QC failures are summarized as:

- Failure to completely clear DGM target locations.
- Any MEC or associated explosive component that is left uninvestigated.
- Any failure to recover a blind seed.

If a detection failure is identified, the UXOQCS will conduct a Root-Cause-Analysis to determine if the failure is the result of the process, procedures, equipment and/or personnel. The UXOQCS will provide his/her findings to the Project Manager (PM) and SUXOS with suggested corrective actions. Once approved by management, FPM will implement the corrective actions, such as re-collecting DGM grid-based data. The Root-Cause-Analysis and corrective actions will be attached to the weekly report. QC failures will be documented, reported, and corrective actions taken.

A Root-Cause-Analysis may include, but not necessarily be limited to the following actions:

- Careful evaluation, recovery, and destruction of MEC/UXO.
- Certification of the identification and disposition of each anomaly excavated.
- Review of representative dig sheet data.
- Review and evaluation of geophysical data.
- Field evaluation of the site QC operations.

QA procedures will also be applied to gauge performance versus project DQOs. The procedures include the following steps:

- Evaluation of site conditions at the time of dig and comparison to basis for planned approach.
- Excavation only at flagged locations where an anomaly has been relocated.
- Checking excavations to ensure anomaly was fully investigated prior to proceeding.
- Recording of anomaly excavation results and feedback to anomaly assessment.

8.0 DISPOSITION TECHNIQUES

8.1 COMMUNICATIONS PROCEDURES

Personnel will have two forms of communications at all times by the use of hand-held radios and cellular telephones to coordinate activity on the worksite. Daily radio checks will be conducted to ensure proper working order, and the results recorded in the UXO Safety Officer (UXOSO) logbook.

Hand-held radios will not be used closer than 25 feet from exposed EED's (electro explosive devices) i.e. electric blasting caps and no closer than 10 feet for packaged EED's. Use of cellular phones will not be allowed closer than 10 feet to EED's in any configuration.

8.2 EXCAVATION PROCEDURES

Targets will be primarily excavated manually with a hand tools. **Section 7.6** addresses potential EMM operations with equipment such as a backhoe for targets buried >0.7 meters (>2.0 feet).

8.3 SUBSURFACE ANOMALY CLEARANCE METHODOLOGY

Point clearance activities will be conducted where required for the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs.

Targeted anomaly locations identified during the geophysical mapping will be intrusively investigated until a source representing the geophysical anomaly is recovered and/or the anomaly cannot be replicated/reacquired (e.g., a sufficient metal source is removed or mineralized soil concentration/nodules have been removed such that they no longer produce a coherent geophysical response). Data describing the anomaly sources discovered during the intrusive investigation process will be recorded and input into the site GIS database. Recorded anomaly data will, at a minimum, include size, estimated weight, orientation, depth bgs, and a description of the item excavated. All MPPEH/MEC items identified will be reported to the SUXOS. The SUXOS will then determine the appropriate Removal Actions (e.g., BIP). After the source item(s) have been excavated and disposed of, the area within a 1-meter (3-foot) radius of the position of the discovered source will be checked by the UXO Team Leader using the GA-52CX and DFX 300 hand-held instruments. The UXOQCS will also use the GA-52CX and DFX 300 hand-held instruments to perform 10% QC checks to verify the metallic source items have been removed from the holes.

8.3.1 OPERATIONS IN POPULATED AREAS

MEC remediation activities conducted under this ESS will not be performed in close proximity to populated areas.

8.3.2 ADMINISTRATIVE CONTROLS

Administrative controls will be coordinated with Base Security. These will consist of prior notification to Base Security and FPM's AFCEC representative of upcoming MEC disposal. If needed, a traffic control and flow plan will be established and coordinated with local authorities in the event installation roadways are required to be closed during the intended operations.

8.3.3 ENGINEERING CONTROLS

Engineering Controls for demolition of MEC will be used where required IAW Corps of Engineer–Huntsville Center (CEHNC) document HNC-ED-CS-S 98-7, *Use of Sand Bags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions* (CEHNC, 1999) and Buried Explosive Module procedures. These controls will be applied as necessary to mitigate fragmentation and blast hazards created during open detonation demolition operations. The UXOSO and SUXOS will coordinate and determine the appropriate EC that will be needed during demolition operations.

8.4 DEMOLITION OPERATIONS

UXO personnel will dispose of MEC on a daily basis using appropriate EC. If demolition operations cannot be conducted at the time the item is located, it will be secured in place with sand bags and security will be provided 24 hours a day until disposal of the item can be achieved.

Demolition activities are inherently hazardous and require strict adherence to approved safety and operational procedures. At a minimum, the demolition operations team will consist of three UXO-qualified personnel, including the UXOSO, a UXO Demolition Supervisor, and a UXO Technician. These operations will be performed under the direction and supervision of the SUXOS. All on-site personnel have the authority to stop work in the event they observe unsafe conditions. The UXOSO will monitor compliance with the safety measures contained in USACE EM 385-1-1 *Safety and Health Requirements Manual* (USACE, 2011).

To control/mitigate hazards associated with blast and fragmentation, all demolition operations will be conducted by detonating MEC items IAW DA Technical Manual 60A-1-1-31 *General Information on Explosive Ordnance Disposal (EOD) Procedures* (DA, 2009), USACE EM 385-1-97, *Safety & Health Requirements Manual*, (USACE, 2013 Change 1)*;* and CEHNC-approved EC, as specified in HNC-ED-CS-S-98-7, (CEHNC, 1999).

FPM will use the Holloman AFB EOD notification matrix to inform and coordinate with those listed (e.g., AFCEC, Wing Command Post or Operations Center, EOD, Range Control, Base Security, Air Control Tower, local law enforcement and the local fire department) before demolition operations are conducted. Authority to initiate the demolition operation setup and the actual detonation of MEC will rest solely with the SUXOS. Prior to authorizing the detonation of explosive charges, the SUXOS is responsible for ensuring that all personnel have been evacuated from the demolition area and all personnel have been accounted for. The SUXOS will also ensure that all pertinent parties have been notified of an intentional detonation and that the area is secure.

Upon completion of demolition operations, the demolition team will visually inspect each demolition shot to confirm that no residual hazards are present. At that point, the SUXOS will authorize the resumption of site operations. The team will also use the GA-52CX and DFX 300 instruments to ensure all MPPEH is removed from the detonation crater.

8.5 SCRAP AND MPPEH PROCEDURES

8.5.1 INSPECTION AND CERTIFICATION

During performance of field operations, the UXO Team will recover, inspect and dispose of MPPEH. Inspection and classification of MPPEH is a critical aspect of MEC operations and only qualified personnel, such as a UXO Technician II or above will perform these inspections and at least two techs will verify the MPPEH is free of explosive hazards prior to removal from the grid as MDAS. Containers, such as lockable 55-gallon drums or roll-offs, will be used for storage of MDAS depending on the volume accumulated. Each container will be kept closed and sealed, except when materials are being loaded into the container or the contents of the container are being inspected. Each container will be closed in a manner requiring the container seal be

broken to gain access to the interior of the container. FPM will have all MDAS delivered to an approved local metals processing facility for recycling/smelting at the end of the project or periodically as required.

8.5.2 DD FORM 1348-1

All MPPEH procedures will be conducted in accordance with DoD Instruction (DoDI) 4140.62 *Material Potentially Presenting an Explosive Hazard* (2014), EM 1110-1-4009 (USACE, 2010a), and EM 385-1-97 (USACE, 2013 Change 1).

MPPEH will be documented by authorized and technically qualified personnel as MDAS after a 100% inspection and an independent 100% re-inspection to determine that it is safe from an explosives safety perspective. MDAS may be released to the public, but MDEH material may be released only to an entity or individual that has the required knowledge, training, permits and licenses to treat MDEH. The following statement will be printed on the accompanying documentation where only MDAS is processed:

> *"This certifies and verifies that the material listed has been 100% inspected and, to the best of our knowledge and belief, is inert and/or free of explosive hazards or related materials."*

Where Range Debris is being processed along with MDAS, the following statement will be entered on each DD Form 1348-1:

> *"This certifies and verifies that the material listed has been 100% inspected and, to the best of our knowledge and belief, is free of explosive hazards, engine fluids, illuminating dials and other visible liquid Hazardous Toxic and Radioactive Waste (HTRW) materials."*

9.0 ENVIRONMENTAL, ECOLOGICAL, CULTURAL, AND OTHER CONSIDERATIONS

The northwestern portion of the XU853 MRS is within the wetland buffer and protected habitat zone for the White Sands Desert Pupfish (Cyprinodon tularosa). FPM will coordinate all operations within XU853 with the Holloman AFB Natural Resources office and IAW the Holloman AFB Integrated Natural Resource Management Plan. FPM will also coordinate all brush clearing activities with the Holloman AFB Natural Resources office, and vegetation removal will be limited to only what is absolutely necessary to accomplish the task. Two areas within the scope of this ESS contain structures that are considered eligible for inclusion in the National Register of Historic Places. In XU853, Buildings 1116, 1127, 1139; the JB-2 ramp; and a Test Stand are associated with important historical events. In XU854, Buildings 1440 and 1442 also are considered to have historical significance.

10.0 TECHNICAL SUPPORT

10.1 TECHNICAL ESCORT UNIT

Previous investigations have not identified the presence of Recovered Chemical Warfare Material (RCWM) in these MRSs. However, if suspected RCWM is encountered during any phase of work, FPM will immediately cease all operations, withdraw upwind from the work area, and establish an exclusion zone IAW Engineering Pamphlet (EP) 75-1-3 *Recovered Chemical Warfare Materiel (RCWM) Response Procedures* (USACE, 2007). FPM will maintain a security watch over the suspect item until relieved by competent authority, maintaining the "two-man rule" at all times.

The SUXOS will immediately request Holloman AFB EOD support from the Wing Command Post for official identification of the suspect item. If Holloman AFB EOD determines the item to be RCWM, they will notify the 20th Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Command or a subordinate unit such as the CBRNE Analytical and Remediation Activity (CARA) through the official DoD process.

10.2 CONTRACT UXO PERSONNEL

FPM has a full-time staff of UXO personnel. Additional UXO field personnel will be contracted on an as-needed basis when the projected work tempo increases. All UXO personnel will meet the requirements in DDESB TP 18 *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel* (DDESB, 2004)**.**

11.0 RESIDUAL RISK MANAGEMENT

11.1 LAND USE CONTROLS

Land Use Controls are not anticipated at any of the sites addressed in this ESS since all six sites will be closed.

11.2 LONG-TERM MANAGEMENT

Long-term management (e.g. five-year reviews) will not be applicable since all six sites will be closed.

12.0 UXO SAFETY EDUCATION PROGRAM

There is no public education program planned for this project as all work is taking place on Holloman AFB. No base housing will be impacted during this project and it is not anticipated that work areas from other entities will be impacted. FPM will coordinate efforts with other entities that may require access into Holloman AFB MRSs and ensure they are aware of possible UXO hazards. Any issues requiring potential public notification or education will be conducted through the AFCEC/Holloman AFB Public Affairs Office.

13.0 STAKEHOLDER MANAGEMENT

Transparent and proactive communication between FPM, AFCEC, the Installation, State and Federal regulators (New Mexico Environment Department and U.S. Environmental Protection Agency, Region 6), and local stakeholders is critical for the success of this project. Agreement between Base officials and regulators/stakeholders on the path forward is documented in the approved work plans. Communication and the exchange of monthly reports, deliverable documents, meeting information/minutes, photos, and milestone status among the project team and between the project team and stakeholders will be facilitated through the use of a web-based SharePoint site (Project Website) developed for this project.

This website will be available to the project team, AFCEC and Holloman AFB, and other stakeholders via a username and password. FPM's PM and Deputy PM will coordinate with AFCEC, Holloman AFB, and the team with shared calendars, alerts, and notifications.

14.0 CONTINGENCIES

None has been identified at this time.

15.0 REFERENCES

The following references were used in the preparation of this ESS. FPM will comply with applicable Federal, State, and local requirements in the course of completing this project.

15.1 USACE PUBLICATIONS

- CEHNC, 1999, U.S. Army Engineering and Support Center, Huntsville (CEHNC) document *Use of Sand Bags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions* HNC-ED-CS-S 98-7 and approved by the DDESB on 23 February.
- CEHNC, 2000, U.S. Army Engineering and Support Center, Huntsville publication titled "*Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites*," March.
- CEHNC, 1998, U.S. Army Engineering and Support Center, Huntsville document *Buried Explosion Module (BEM): A Method for Determining the Effects of Detonation of a Buried Munition* HNC-ED-CS-S-97-7-Revision 1, January.
- USACE, 2007, U.S. Army Corps of Engineers, EP 75-1-3, *Recovered Chemical Warfare Materiel (RCWM) Response Procedures*, 30 November 2004 (Errata #1, dated December 2007).
- USACE, 2010a, U.S. Army Corps of Engineers EM 1110-1-4009, Engineer Manual, *Military Munitions Response Actions*, 15 June 2007 (Errata #1 through 3, dated June, November, December 2007; Errata #4, dated February 2010).

- USACE, 2013, U.S. Army Corps of Engineers, EM 385-1-97, *Safety & Health Requirements Manual*, 17 May (Change 1).
- USACE, 2011, U.S. Army Corps of Engineers EM 385-1-1, *Safety and Health Requirements Manual*, September 2008 (Changes #1 through 3, dated April, October and June 2010; Changes #4 through 6, dated March, April and July 2011).

15.2 US AIR FORCE PUBLICATIONS

- USAF, 2011, AFMAN 91-201 *Explosives Safety Standards*, 12 January.

15.3 DEPARTMENT OF THE ARMY PUBLICATIONS

- DA, 2009, Department of the Army (DA) Technical Manual 60A-1-1-31 *General Information on Explosive Ordnance Disposal (EOD) Procedures*, September.

15.4 DEPARTMENT OF DEFENSE PUBLICATIONS

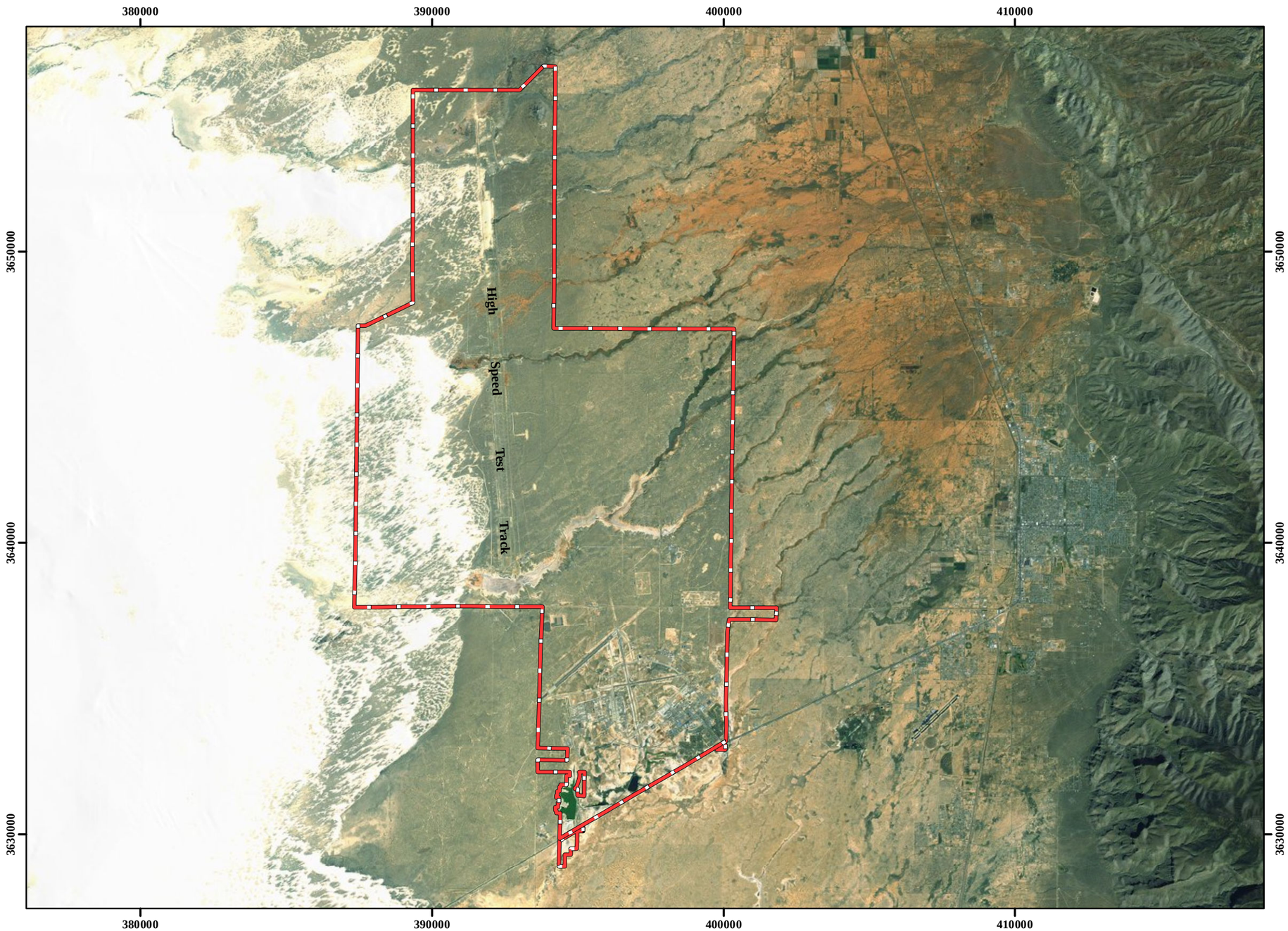
- DDESB, 2004, DDESB TP 18 *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel*, 20 December**.**
- DDESB, 2013, Technical Paper 16, *Methodologies for Calculating Primary Fragment Characteristics*, 16 April.
- DoDI, 2008, DoDI 4140.62 *Material Potentially Presenting an Explosive Hazard (MPPEH)*, 25 November 2008 with Change 1, 19 February 2014.
- DoD, 2008, DoD 6055.09-M, *Ammunition and Explosives Safety Standards*, date varies by Volume.

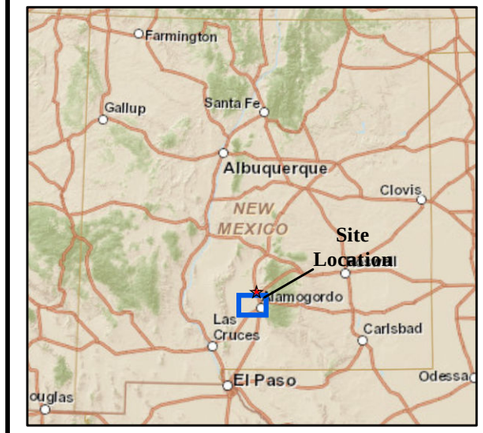
15.5 OTHER DOCUMENTATION

- HDR, 2013, *Final Report of the Comprehensive Site Evaluation Phase II Report*, September.
- Nelson, et al., 2009, *Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response*. Environmental Security Technology Certification Program (ESTCP), July.

APPENDIX A

Maps





Legend

Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-1

Holloman AFB Location

FPM Remediations, Inc.

2014

NOTES:

Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 12,000 feet

0 1,850 3,700 Meters

0 6,000 12,000 Feet

N W E S

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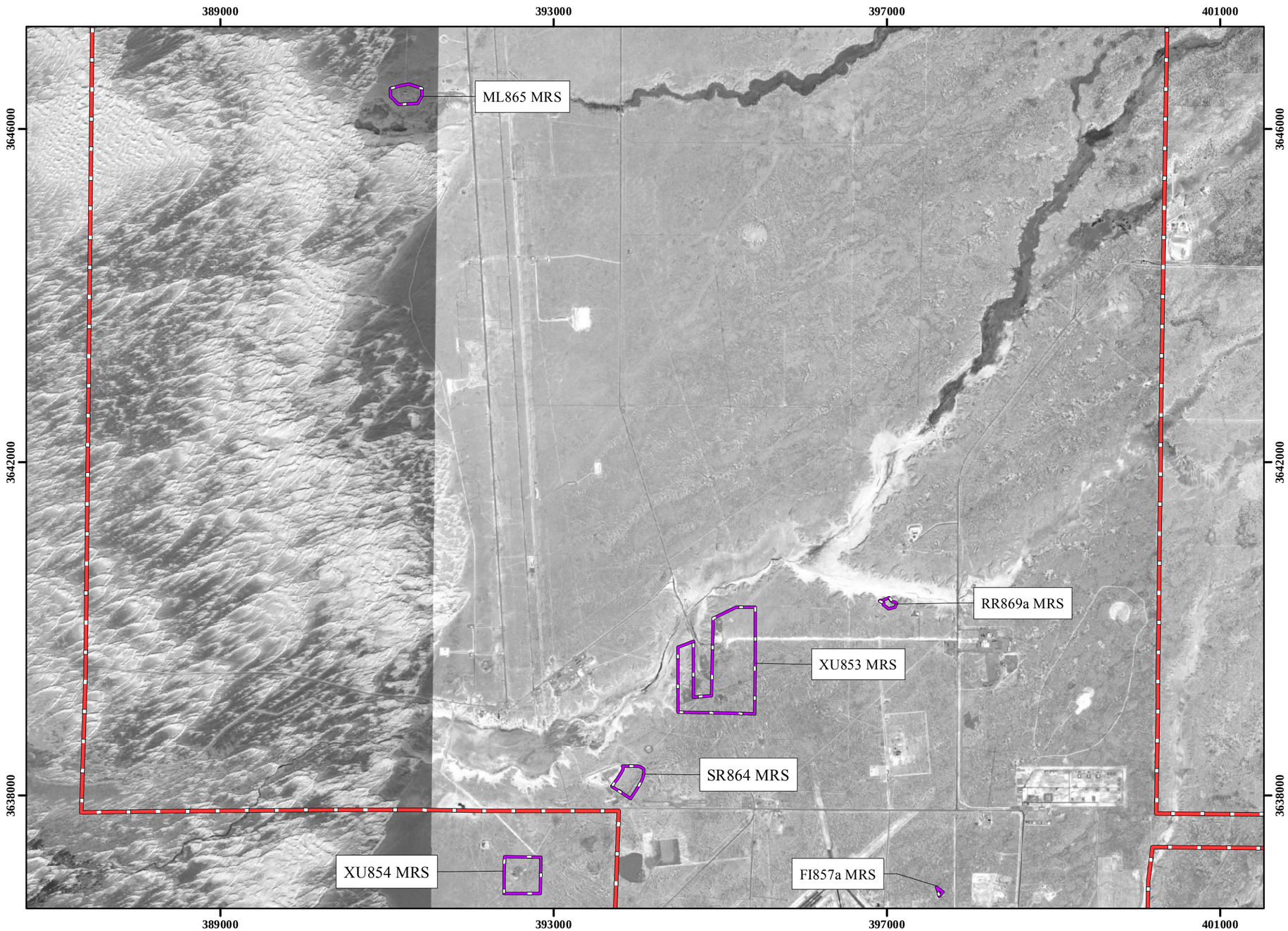
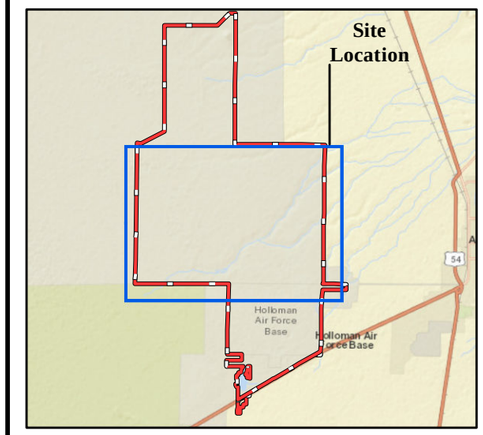




Legend

- MRS Boundaries
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-2

XU853, XU854, FI857a, SR864, ML865, and RR869a MRS Location Map

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

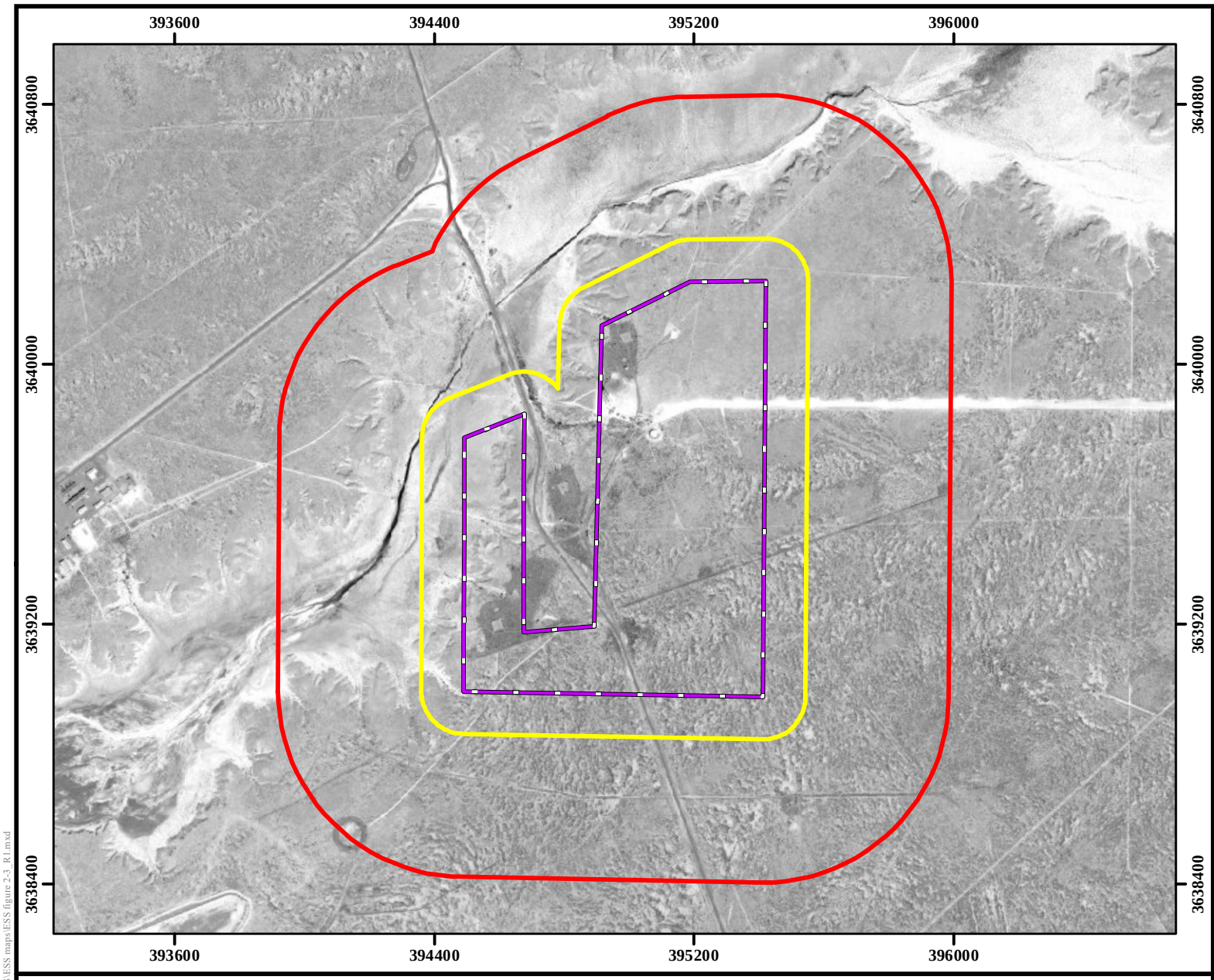
1 inch = 4,200 feet

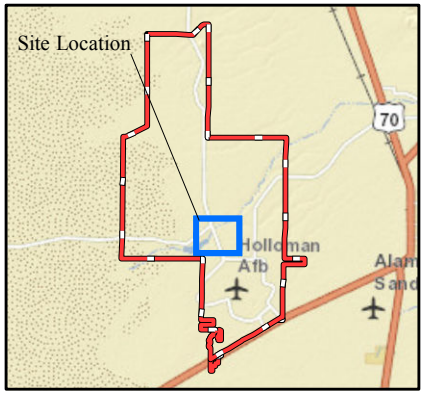
0 650 1,300 Meters

0 2,100 4,200 Feet

N W E S

Path: C:\Projects\New Mexico\GIS\ESS maps\ESS figure 2-2.mxd





Legend

- ESQD Arc for HFD Unintentional Detonations (428 feet)
- ESQD Arc for MFD-H Intentional Detonations (1874 feet)
- XU853 MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-3

XU853 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 1,500 feet

0 230 460 Meters

0 750 1,500 Feet

N W E S

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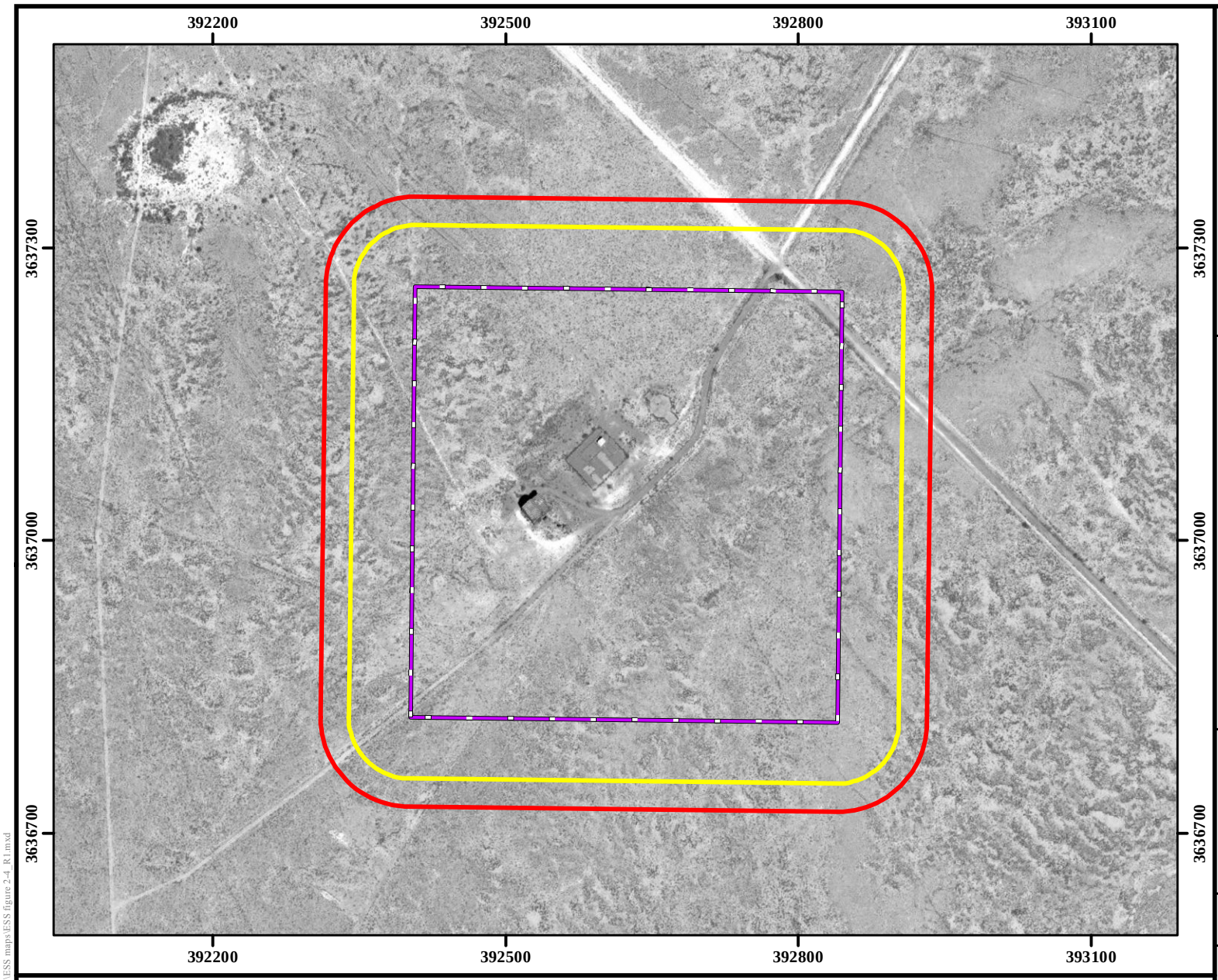

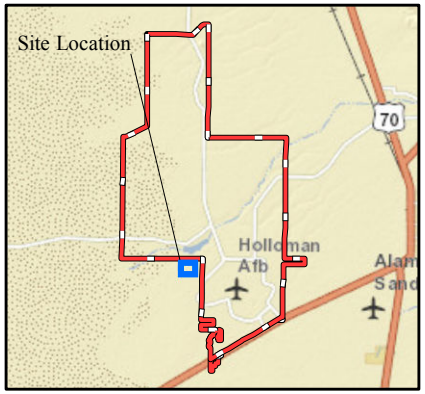

Legend

- ESQD Arc for HFD Unintentional Detonations (207 feet)
- ESQD Arc for MFD-H Intentional Detonations (302 feet)
- XU854 MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-4

XU854 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 500 feet

0 75 150 Meters

0 250 500 Feet

N W E S

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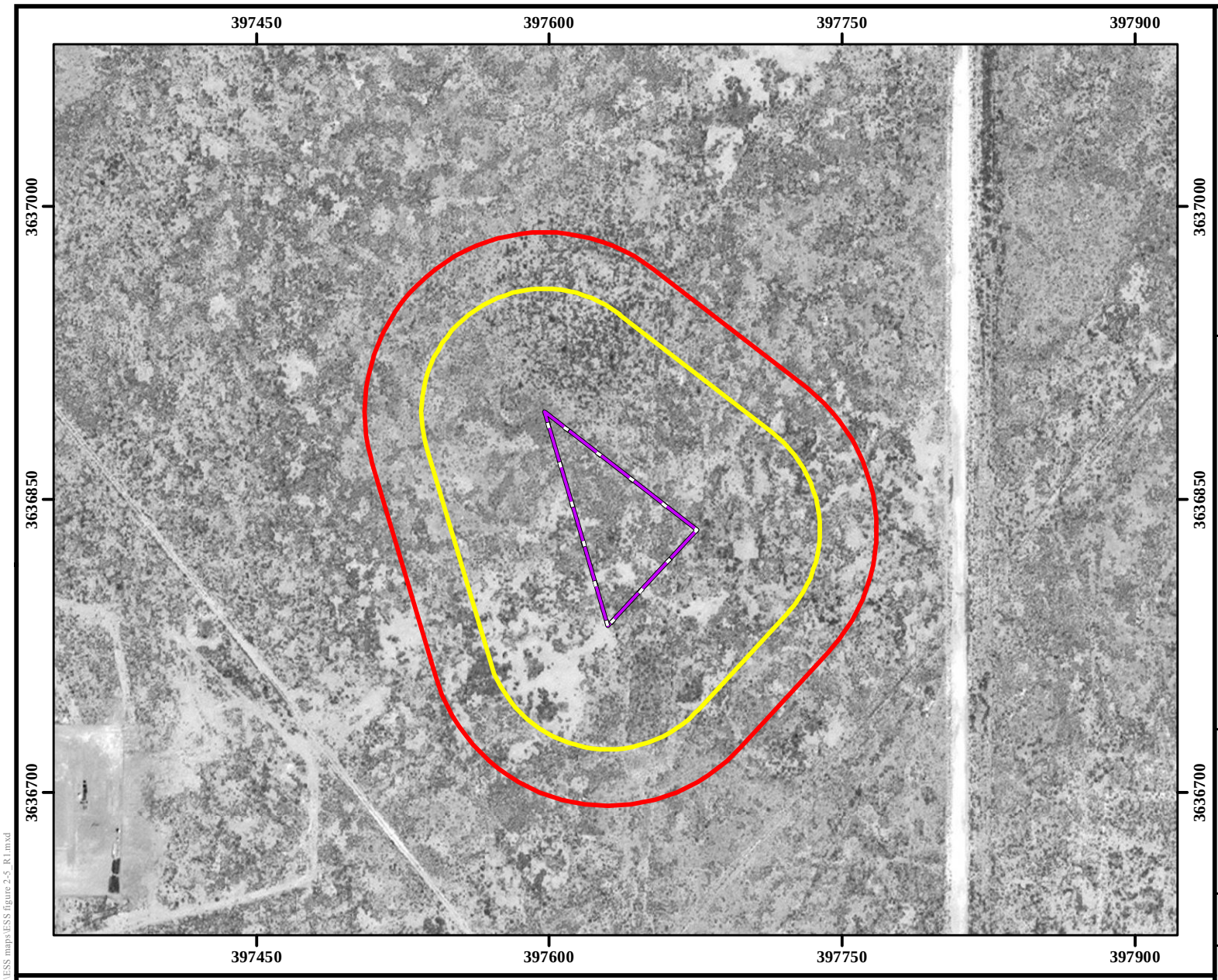

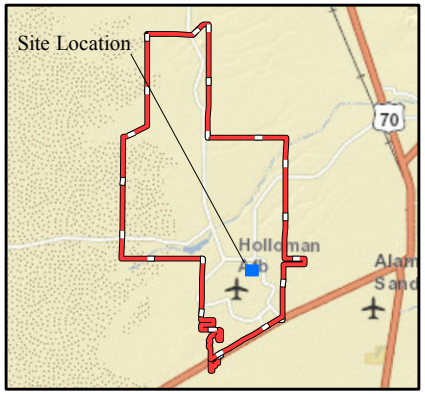

Legend

- ESQD Arc for HFD Unintentional Detonations (207 feet)
- ESQD Arc for MFD-H Intentional Detonations (302 feet)
- FI857a MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-5

FI857a MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 250 feet

0 40 80 Meters

0 125 250 Feet

N W E S

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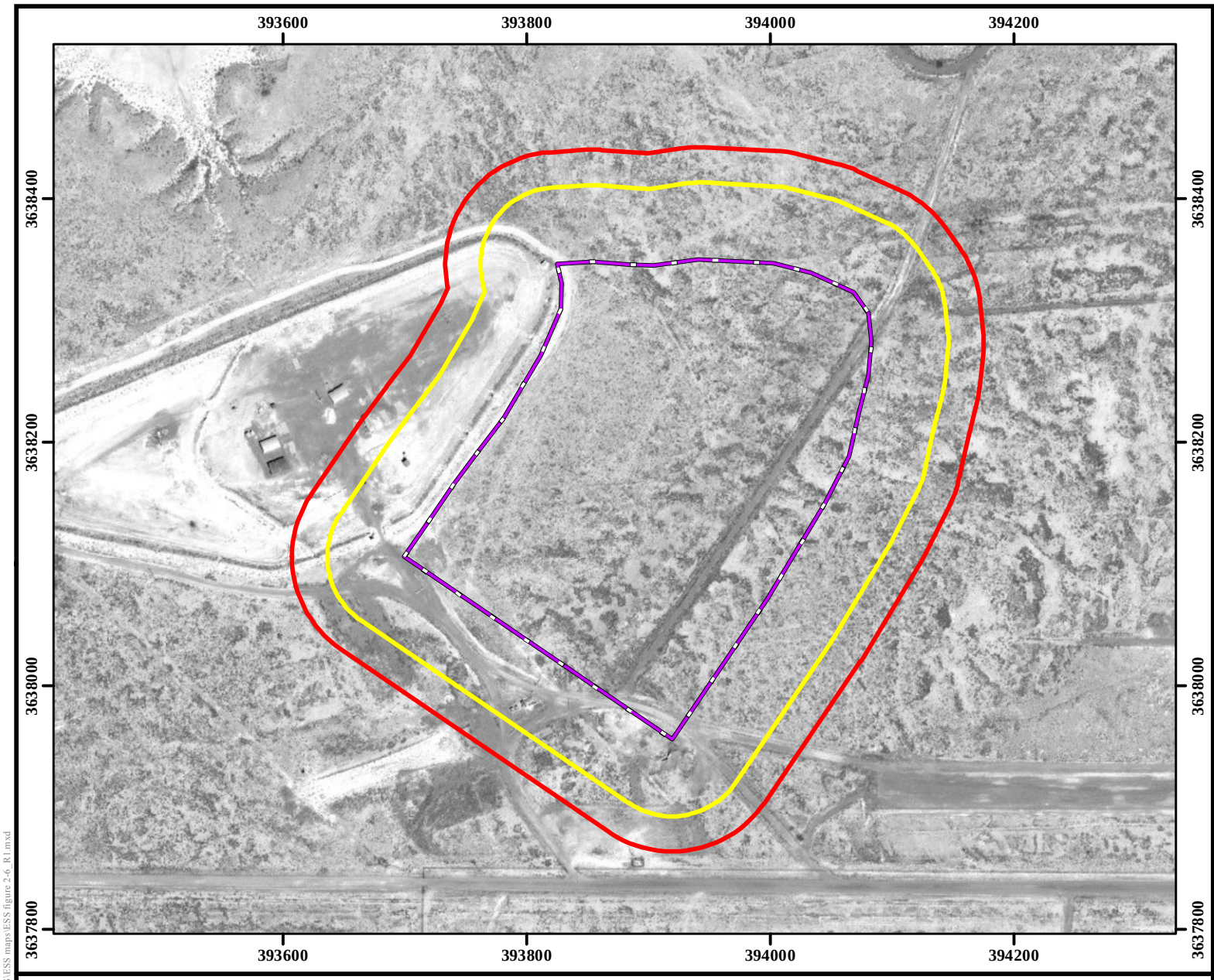

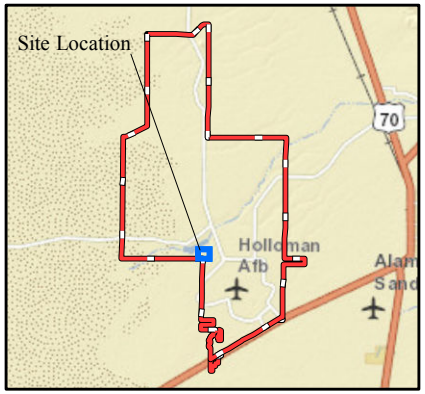

Legend

- ESQD Arc for HFD Unintentional Detonations (207 feet)
- ESQD Arc for MFD-H Intentional Detonations (302 feet)
- SR864 MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-6

SR864 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 400 feet

0 60 120 Meters

0 200 400 Feet

N W E S

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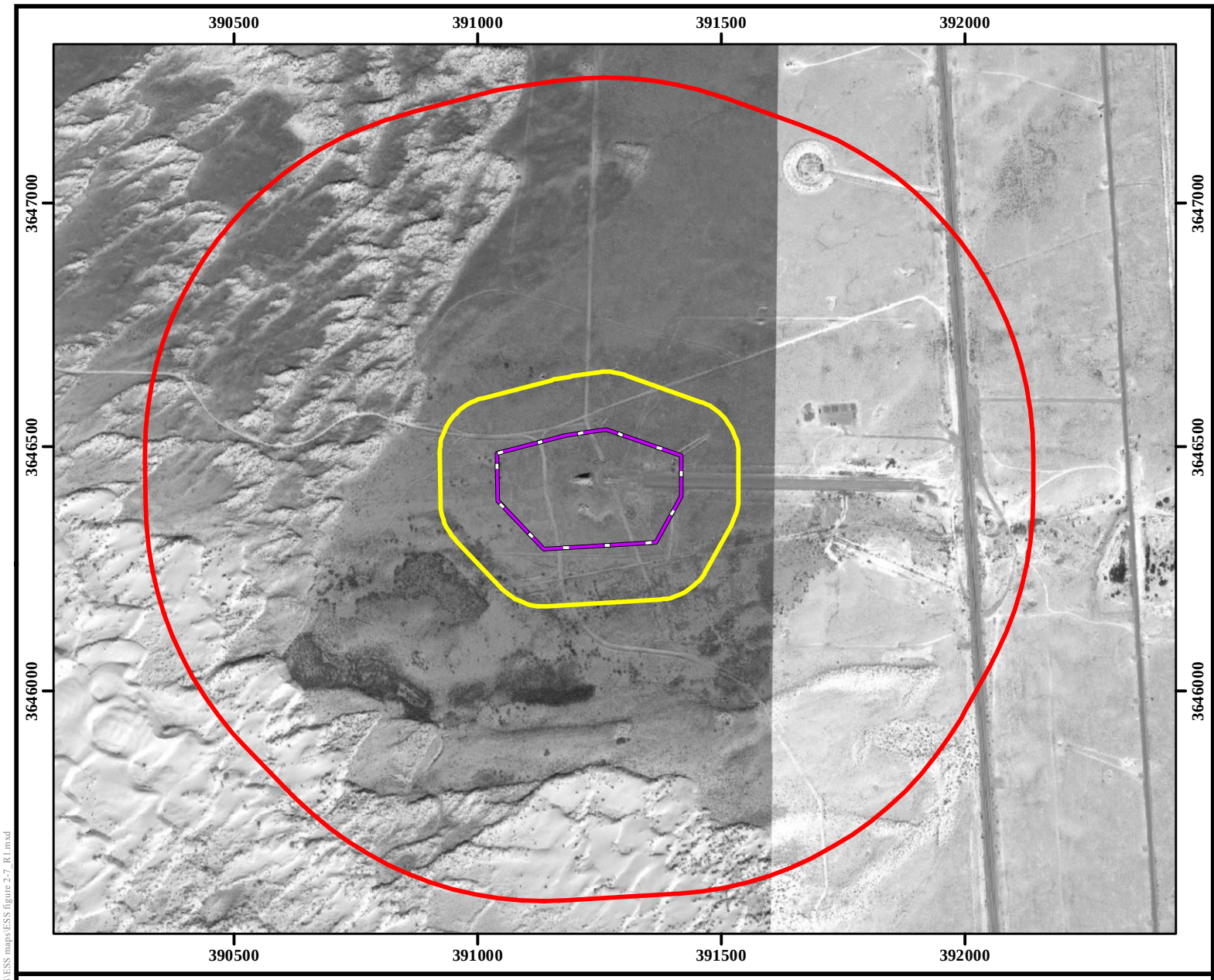
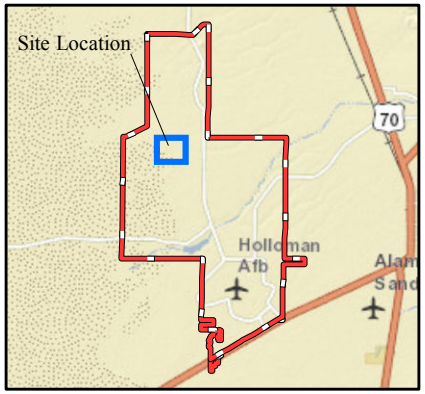




Legend

- ESQD Arc for HFD Unintentional Detonations (387 feet)
- ESQD Arc for MFD-H Intentional Detonations (2371 feet)
- ML865 MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-7

ML865 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

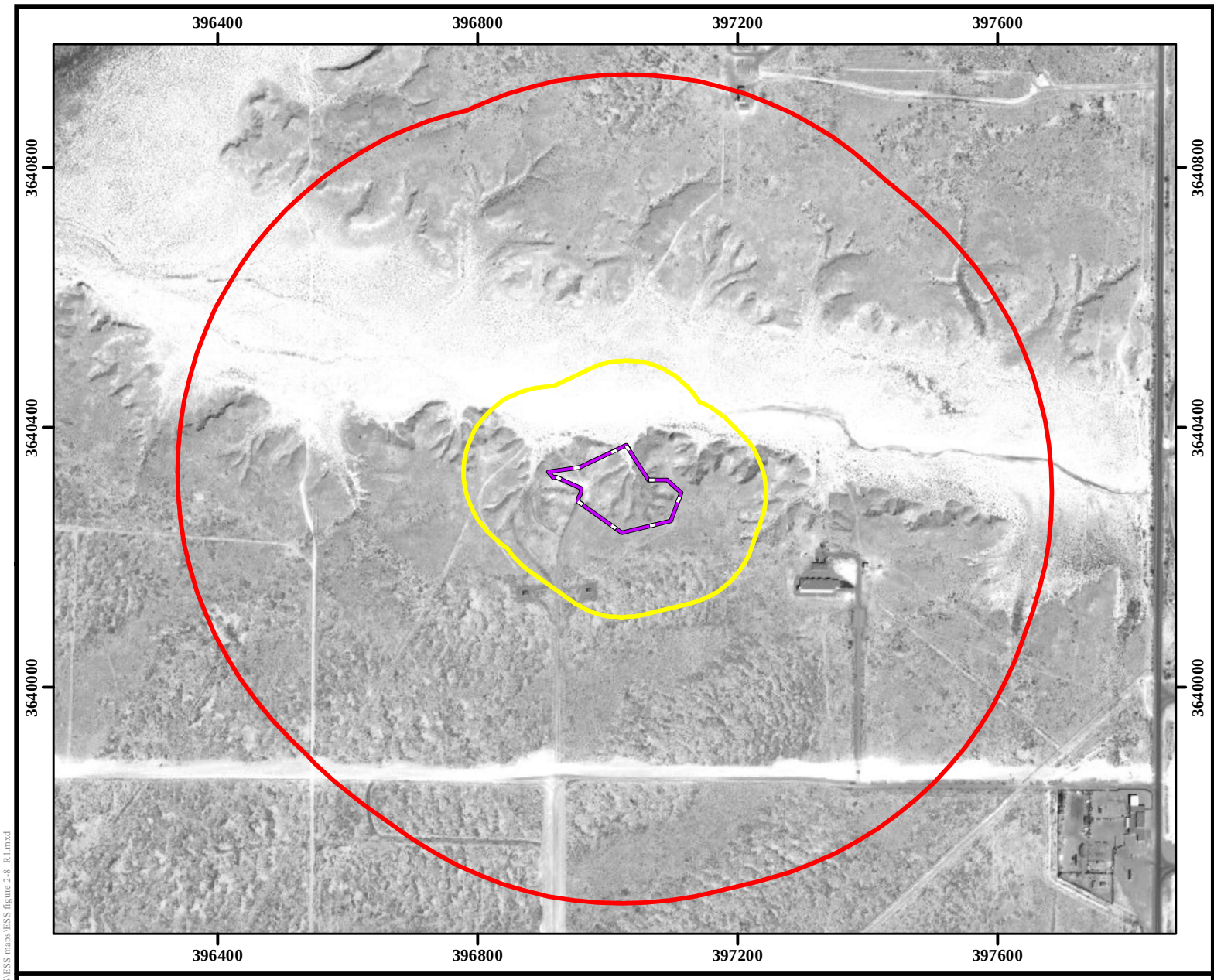
1 inch = 1,000 feet

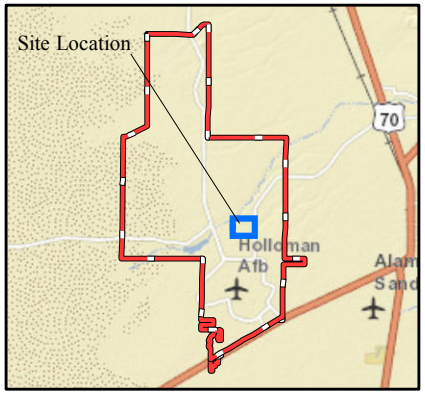
0 150 300 Meters

0 500 1,000 Feet

N W E S

Path: C:\Projects\New Mexico\GIS\ESS maps\ESS figure 2-7_R1.mxd





Legend

- ESQD Arc for HFD Unintentional Detonations (428 feet)
- ESQD Arc for MFD-H Intentional Detonations (1874 feet)
- RR869a MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-8

RR869a MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 750 feet

0 115 230 Meters

0 375 750 Feet

N W E S

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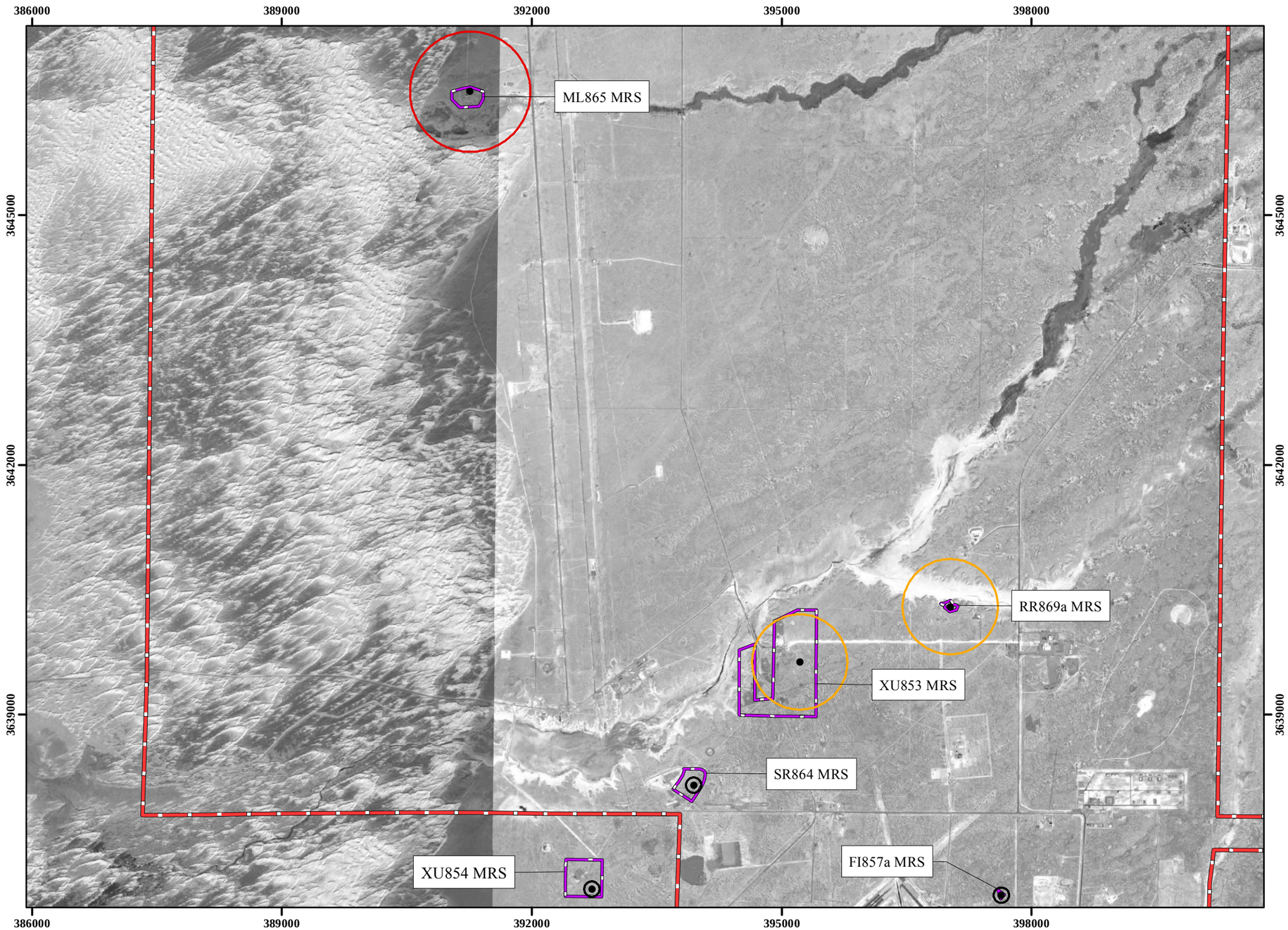
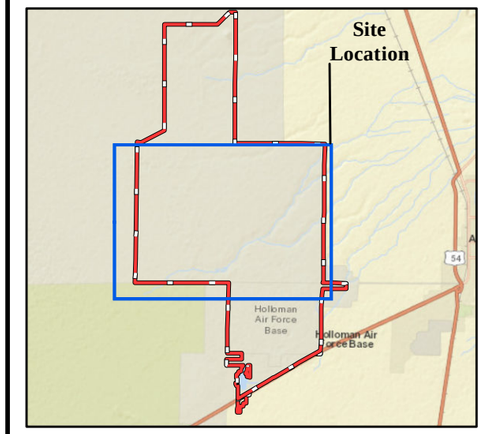




Legend

- Safe Disposal Areas
- ESQD Arcs for Intentional Detonation (302 feet)
- ESQD Arc for Intentional Detonation (2371 feet)
- ESQD Arcs for Intentional Detonation (1874 feet)
- MRS Boundaries
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-9

XU853, XU854, FI857a, SR864, ML865, and RR869a Safe Disposal Areas Showing ESQD Arcs

FPM Remediations, Inc.

2014

NOTES:

Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

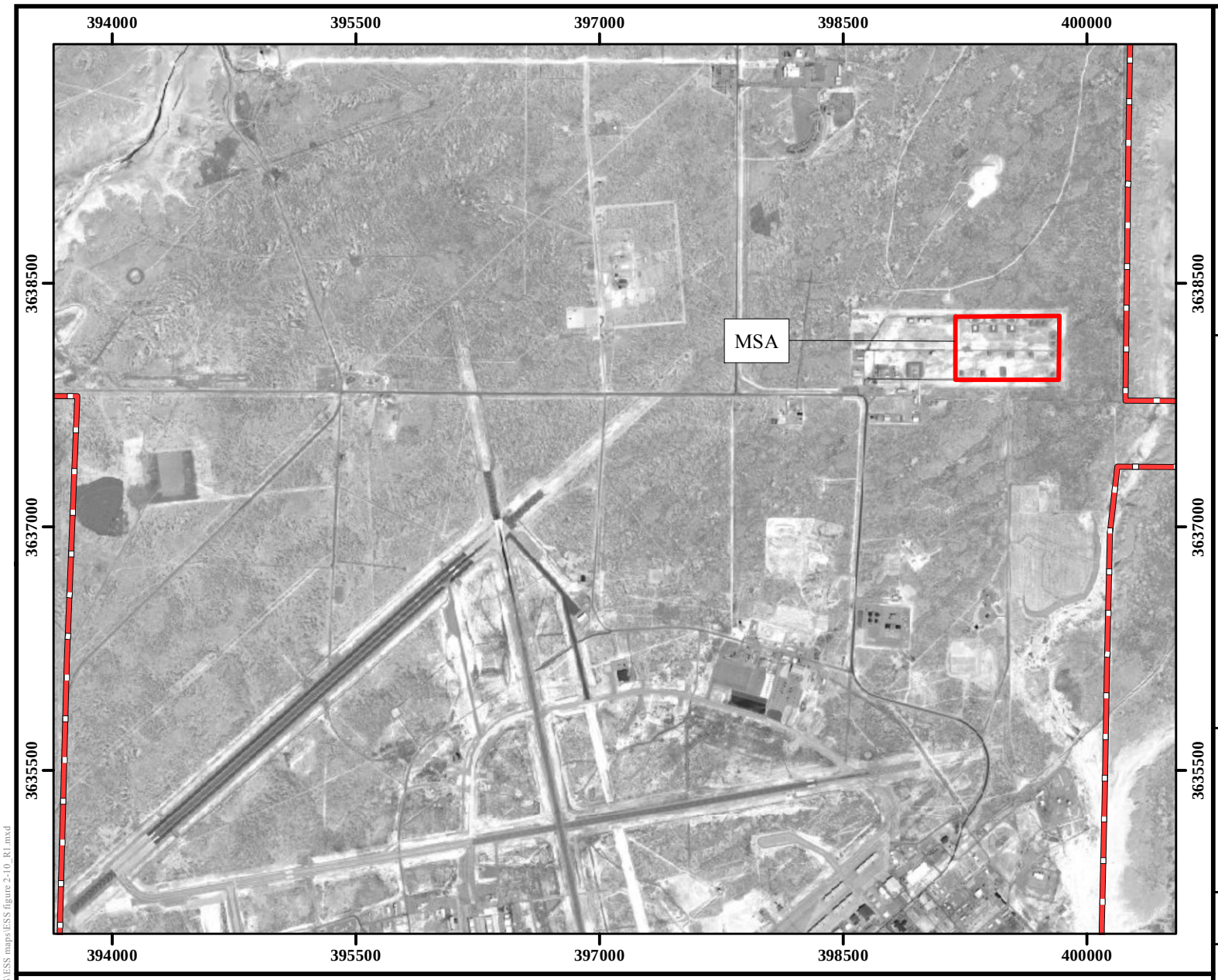
1 inch = 4,200 feet

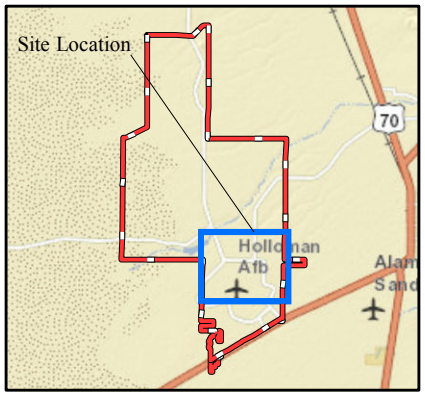
0 650 1,300 Meters

0 2,100 4,200 Feet

N W E S

Path: C:\Projects\New Mexico\GIS\ESS maps\ESS figure 2-9_R1.mxd





Legend

- MSA
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-10

Location of Donor Explosives Storage at Munitions Storage Area

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 3,000 feet

0 450 900 Meters

0 1,500 3,000 Feet

N W E S

Path: C:\Projects\New Mexico\GIS\ESS maps\ESS figure 2-10_R1.mxd

APPENDIX B

Fragmentation Data Review Forms for Minimum Separation Distance (DDESB TP 16)

Fragmentation Data Review Form

Database Revision Date 4/16/2013

Category:	Grenades & Mines
Munition:	40 mm M383 Grenade
Case Material:	Steel, Mild
Fragmentation Method:	Pre-formed Fragmenting
Secondary Database Category:	Shoulder Fired Grenade
Munition Case Classification:	Robust

DODIC:	B571
Date Record Created:	9/21/2004
Record Created By:	MC
Last Date Record Updated:	7/9/2012
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition A-5
Explosive Weight (lb):	0.117
Diameter (in):	1.5600
Cylindrical Case Weight (lb):	0.15906
Maximum Fragment Weight (Intentional) (lb):	0.0003
Design Fragment Weight (95%) (Unintentional) (lb):	0.0003
Critical Fragment Velocity (fps):	6832

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	207
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	302
MFD-V [Maximum Fragment Distance, Vertical] (ft):	246

Overpressure Distances

TNT Equivalent (Pressure):	1.46
TNT Equivalent Weight - Pressure (lbs):	0.171
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	10
Public Traffic Route Distance (2.3 psi); K24 Distance:	13
Inhabited Building Distance (1.2 psi), K40 Distance:	22
Intentional MSD (0.0655 psi), K328 Distance:	182

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1.3
TNT Equivalent Weight - Impulse (lbs):	0.152
Kinetic Energy 10^6 (lb-ft²/s²):	0.0066

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	12
Expected Max. Throw Distance (ft):	25
Minimum Separation Distance (ft):	200

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	24
Expected Max. Throw Distance (ft):	10
Minimum Separation Distance (ft):	12.5

Water Mitigation

Minimum Separation Distance (ft):	200/200
Water Containment System:	5 gal carboys/ inflatable pool

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	1.12	1.12
Mild Steel:	0.30	0.30
Hard Steel:	0.24	0.24
Aluminum:	0.69	0.69
LEXAN:	2.92	2.92
Plexi-glass:	1.51	1.51
Bullet Resist Glass:	1.07	1.07

Item Notes

Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (17 October 2002). Other requests shall be referred to the Chairman, Department of Defense Explosives Safety Board, Room 856C, Hoffman Building I, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600.

Fragmentation Data Review Form

Database Revision Date 4/16/2013

Category:	Rocket Motors
Munition:	5 inch Mk 10 Rocket Motor
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	
Munition Case Classification:	Robust

DODIC:	
Date Record Created:	9/20/2010
Record Created By:	SDH
Last Date Record Updated:	9/14/2011
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Ballistite
Explosive Weight (lb):	23.9
Diameter (in):	5.0000
Cylindrical Case Weight (lb):	39.16382
Maximum Fragment Weight (Intentional) (lb):	0.1452
Design Fragment Weight (95%) (Unintentional) (lb):	0.0148
Critical Fragment Velocity (fps):	5385

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	428
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	1874
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1470

Overpressure Distances

TNT Equivalent (Pressure):	1
TNT Equivalent Weight - Pressure (lbs):	23.900
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	52
Public Traffic Route Distance (2.3 psi); K24 Distance:	69
Inhabited Building Distance (1.2 psi), K40 Distance:	115
Intentional MSD (0.0655 psi), K328 Distance:	945

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1
TNT Equivalent Weight - Impulse (lbs):	23.900
Kinetic Energy 10^6 (lb-ft²/s²):	2.1050

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	Not Permitted
Water Containment System:	Not Permitted

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	10.44	4.11
Mild Steel:	1.95	0.79
Hard Steel:	1.60	0.65
Aluminum:	3.90	1.67
LEXAN:	8.53	4.89
Plexi-glass:	6.98	3.33
Bullet Resist Glass:	6.11	2.69

Item Notes

Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (17 October 2002). Other requests shall be referred to the Chairman, Department of Defense Explosives Safety Board, Room 856C, Hoffman Building I, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600.

Fragmentation Data Review Form

Database Revision Date 4/16/2013

Category:	Surface-Launched HE Rounds
Munition:	155 mm M549A1
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	Projectile
Munition Case Classification:	Robust

DODIC:	D579
Date Record Created:	6/2/2011
Record Created By:	SDH
Last Date Record Updated:	
Individual Last Updated Record:	
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	TNT
Explosive Weight (lb):	15
Diameter (in):	4.5900
Cylindrical Case Weight (lb):	33.29500
Maximum Fragment Weight (Intentional) (lb):	0.3168
Design Fragment Weight (95%) (Unintentional) (lb):	0.0574
Critical Fragment Velocity (fps):	5481

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	387
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	2371
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1857

Overpressure Distances

TNT Equivalent (Pressure):	1
TNT Equivalent Weight - Pressure (lbs):	15.000
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	44
Public Traffic Route Distance (2.3 psi); K24 Distance:	59
Inhabited Building Distance (1.2 psi), K40 Distance:	99
Intentional MSD (0.0655 psi), K328 Distance:	809

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1
TNT Equivalent Weight - Impulse (lbs):	15.000
Kinetic Energy 10^6 (lb-ft²/s²):	4.7585

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	36
Expected Max. Throw Distance (ft):	220
Minimum Separation Distance (ft):	220

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	275
Water Containment System:	1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	14.74	7.31
Mild Steel:	2.71	1.38
Hard Steel:	2.23	1.13
Aluminum:	5.31	2.82
LEXAN:	10.43	6.87
Plexi-glass:	9.11	5.24
Bullet Resist Glass:	8.20	4.43

Item Notes

This item has the same body as the 155 mm M549. The only difference in the rounds is the explosive fill.

Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (17 October 2002). Other requests shall be referred to the Chairman, Department of Defense Explosives Safety Board, Room 856C, Hoffman Building I, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600.

APPENDIX C
Courtesy Storage Agreement

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 49TH WING (ACC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO

21 Feb 2014

MEMORANDUM FOR 49 MXS/MXMW

FROM: FPM-Remediations

SUBJECT: Munitions Courtesy Storage Agreement (CSA), FPM-Remediations

1. Request permission to courtesy store custody account and non-stock listed munitions within the Munitions Storage Area (MSA) IAW AFI 21-201, *Conventional Munitions Maintenance Management*. I understand that the care, preservation and accountability of our assets remain our responsibility. Attached is a list reflecting the maximum quantities of munitions requiring courtesy storage and any unique storage requirements for our organization.

2. <u>FPM-Remediations</u> Account Custodian Responsibilities:

2.1. Responsibility for the munitions remains with the custodians of the owning organization.

2.2. Schedule munitions pick-ups and returns with as much notice as possible. If support is needed for after hours or non-duty days, it can be scheduled, if possible 24 hours, in advance through Munitions Storage Dispatch, at DSN 572-1500/1501.

2.3. Custodians are responsible for providing adequate personnel and equipment to handle and transport munitions assets, and MUST adhere to all *Safety* and *Security* requirements IAW AFMAN 91-201, *Explosive Safety Standards*, AFMAN 24-306, *Manual for the Wheeled Vehicle Driver*, AFI 31-101, *The Air Force Installation Security Program*, AFI 91-203, *Air Force Consolidated Occupational Safety Standard* and TO 11A-1-61-1, *Storage and Outloading Instructions* and applicable MAJCOM/Base directives and supplements.

2.3.1. These movements will include periodic inspections (PIs), return munitions inspections (RMIs), pulls (pick-ups), restores (turn-ins) and the movement stated in paragraph 2.5.

2.4. Ensure individuals withdrawing or returning munitions for courtesy storage are listed on the AF Form 68, *Munitions Authorization Record*. If individuals are not on the AF Form 68, they will only be allowed to receive munitions if they are identified in Attachment 1. All individuals must provide their military ID (CAC) for authentication and sign the AF IMT 4331, *Munitions Transaction Sheet*, provided by the Munitions Storage Element when withdrawing, storing or transporting assets to and from storage facilities IAW FOI 21-204.

2.5. Deliver "Lite" boxes to Munitions Inspection for lot consolidation if picking up or storing partial lots. Only one "Lite box" per lot is allowed in storage unless operational commitments dictate otherwise. Notify Munitions Inspection at DSN 572-1622/1623 before delivering assets. All maintenance on munitions will be accomplished and coordinated with Munitions Inspection.

2.6. Maintain appropriate storage, handling and housekeeping procedures IAW AFMAN 91-201, TO 11A-1-61-1 and applicable MAJCOM/Base directives and supplements for all assets in the courtesy storage area.

2.7. Store munitions in approved, properly marked and securely sealed containers. Stack munitions neatly with "Lite" boxes to the front and top of the stack. Munitions kits needed to support mission requirements may be packaged in nonstandard containers, but will have all required information stenciled on the containers and sealed. Any questions concerning containers should be directed to Munitions Inspection at DSN 572-1622/1623.

2.8. Ensure munitions containers are conspicuously marked with the organization and shop code.

2.9. IAW AFI 21-201 non-DoD owned explosives and other hazardous and toxic materials will not be stored in the MSA. Refer to AFI 21-201 para, 5.2.15.1. and AFMAN 91-201 for guidance.

2.10. Provide technical data to the Munitions Flight for non-DoD materials/munitions (i.e., required for test) prior to storage.

2.11. Email this package to Munitions Storage at 49 MXS/Munitions Storage on the Global address list (49MXSMunitionsStorage@holloman.af.mil) or hand carry to Storage Dispatch upon completion.

2.12. The owning Organization is responsible of accounting and reporting custody account munitions.

2.13. If munitions (which are not on the annual approved allocation letter) need to be stored, the owning Organization will notify Munitions Storage at 572-1500/1501 with the NSN, Nomenclature and quantity of munitions. These assets will only be stored after approval from Munitions Supervision.

2.14. Proper container packaging, marking and lot separation is the owning organization's responsibility. The Storage Element will ensure the owning organization complies with these requirements.

2.15. Renew this agreement annually or when there is a change of Commander.

3. Munitions Flight Responsibilities:

3.1. Munitions Storage will evaluate the CSA to ensure there is enough storage space to honor the request. The CSA will then be forwarded to the Munitions Flight Chief for approval. If approved, Storage Dispatch will forward the completed master copy to the Munitions Operations Element for filing in their electronic records file plan. Storage Dispatch will also file a copy in the Courtesy Storage Agreement book under the appropriate custodian's account number. If disapproved, this letter will be returned to the custodian with reason for disapproval. Any questions should be directed to Munitions Storage Dispatch at DSN 572-1500/1501.

3.2. The Munitions Storage Element will provide escort service and accompany the custodians when withdrawing, storing, inventorying or transporting munitions assets within the MSA.

3.3. The Munitions Flight will provide escort support for contingency operations, ready-response teams, mobility exercises or other valid short-notice requests. Contact Munitions Control at DSN 572-3151 after 1600 on weekdays and Maintenance Operations Center (MOC) at DSN 572-3342 on weekends, if support is required. Those agencies will contact the Munitions Storage stand-by personnel.

3.4. Munitions Storage personnel will ensure that only the individuals listed on the AF Form 68, Munitions Authorization Record, withdraw and return courtesy stored munitions.

3.5. The Munitions Storage Element will notify custodians when assets are scheduled to be re-warehoused for Explosive Site Plan (ESP) or Master Storage Plan (MSP) adjustments. At a minimum, the custodian will be notified by e-mail or telephone. If at all possible, the custodian should be present prior to moving assets.

3.6. IAW AFI 21-201, responsibility for repairing packing discrepancies caused by storage conditions belongs to munitions organizations. Proper container packaging, marking, and lot separation is the owning organization's responsibility. The Storage Element will ensure the owning organization complies with these requirements.

3.7. In the event that seals on a munitions container are discovered damaged or missing, Munitions Inspection will inspect the contents for damaged or missing assets and then re-seal the container.

3.8. Specific conventional munitions authorized for storage IAW AFMAN 91-201 and non-stock listed, will be managed in CAS *Non-accountable Program* (AM101A) and will be updated by Munitions Storage personnel.

4. This letter supersedes all previous letters, same subject.

5. The next annual renewal date is **21 Feb 2015**.

Russell A. Shattles
FPM Remediations, Inc.
MMRP Operations Manager
FPM Remediations Custodian

Attachments:
1. Authorized Individuals not on AF Form 68

1st Ind, FPM-Remediations

MEMORANDUM FOR 49 MXS/MXMW

Concur/~~Nonconcur~~

Russell A. Shattles
FPM Remediations, Inc.
MMRP Operations Manager

2d Ind, 49 MXS/MXMWMC

MEMORANDUM FOR 49 MXS/MXMW

Courtesy storage space is / ~~is not~~ available in the Munitions Storage Area.

SUTTLES.SCOTT.W.1075580491

Digitally signed by SUTTLES.SCOTT.W.1075580491
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=SUTTLES.SCOTT.W.1075580491
Date: 2014.02.25 07:08:59 -07'00'

SCOTT W. SUTTLES, MSgt, USAF
NCOIC, Munitions Storage

3d Ind, 49 MXS/MXMW

MEMORANDUM FOR 49 MXS/MXMW

Approved / ~~Disapproved~~

JEZ.ADAM.J.1084510838

Digitally signed by JEZ.ADAM.J.1084510838
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=JEZ.ADAM.J.1084510838
Date: 2014.03.10 13:14:23 -06'00'

ADAM J. JEZ, SMSgt, USAF
Munitions Flight Chief

Individuals Authorized to Receive Munitions/Material that are not on AF Form 68

Name	Security Clearance	Rank/Duty title	SSAN(Last 6)	Phone

FPM personnel will be listed on this roster once positions are assigned.

Appendix G

Contractor Personnel Qualification Certification Letter

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FPM Remediations, Inc. _____ Environmental Remediations and Construction Services

CORPORATE HEADQUARTERS
584 Phoenix Drive
Rome, NY 13441
315/336-7721
FAX 315/336-7722

September 8, 2014

Mr. Brian Renaghan
AFCEC/CZRX
2261 Hughes Avenue, Suite 155
Joint Base San Antonio – Lackland, TX 78236-9853

Subject: Personnel Qualifications Certification Letter
Military Munitions Response Program (MMRP)
RR869a Debris Field MRS
Holloman Air Force Base
New Mexico

Dear Brian:

Data Item Description MMRP-09-012 requires a certification letter to be provided to identify and verify the qualifications of key unexploded ordnance (UXO) personnel for the MMRP Remedial Action field activities. Mr. George Vaughn of FPM Remediations, Inc. will be the Senior UXO supervisor (SUXOS) for the RR869a Debris Field Munitions Response Site (MRS) Remedial Action. I certify that the person listed meets or exceeds contact requirements for the functions he will perform. This letter will be updated when additional UXO personnel are identified for the RR869a Debris Field MRS Remedial Action field activities.

Please do not hesitate to contact me if you have any questions about this letter.

Sincerely,

FPM Remediations, Inc.

Maureen L. Whalen

Maureen Whalen, CG, CPG, PMP
New Mexico-Arizona Group PBR
Contract Project Manager, FPM
315-336-7721 x216

Enclosures (Resume and EOD School Graduation Certificate)

George H. Vaughn Jr.

9021 Hollow Bluff Dr. / Haughton, LA 71037
Home:(318) 949-3149 / Cell:(318) 617-1719

DATE ATTENDED BASIC EOD SCHOOL: Oct 1990 – July 1991
OTHER PERTINENT TRAINING: HAZWOPER 40 HOUR – Nov 2010, Refresher February 2014
HAZWOPER 8 HOUR Supervisor Training – September 2013
USACE #2515
Current DOS approved Senior EOD Tech Bio
Current DOS approved Secret Clearance
Current DoD TS/SCI background investigation

MILITARY EOD ASSIGNMENTS:

July 91 – May 96 Basic EOD , 49th CES/CED (EOD), Holloman AFB, NM
Member of EOD response team, conducted annual range clearances.

May 96 – June 04 Senior EOD, 3rd CES/CED (EOD), Elmendorf AFB, AK
EOD response team leader. Participated in range clearances at Eielson AFB.

June 04 – Jan 05 Senior EOD, 2 CES/CED (EOD), Barksdale AFB, LA
EOD response team leader, NCOIC training

Jan 05 – Jun 05 Senior EOD, Baghdad, Iraq
EOD response team leader

Jun 05 – Jan 07 Senior EOD, 2 CES/CED (EOD), Barksdale AFB, LA
EOD response team leader, NCOIC Logistics

Jan 07 – Jan 08 Senior EOD, 732 ECES Al Taqaddum AB, Iraq
Weapon Intelligence team lead, WIT 7

Jan 08 – Feb 09 Master EOD (MSgt), 2 CES/CED (EOD), Barksdale AFB, LA
EOD response team leader, NCOIC Logistics

Feb 09 – Aug 09 Master EOD (MSgt), 755 ECES Bagram AB, Afghanistan
EOD response team leader, Flight Superintendent, Supervised 18 individuals

Aug 09 – Oct 10 Master EOD (MSgt) 2 CES/CED (EOD), Barksdale AFB, LA
Flight Superintendent, supervised 16 individuals

Oct 10 – Jan 1 2011 Terminal Leave

2 Jan 2011 Retirement

CIVILIAN UXO/EOD EXPERIENCE:
Dec 2010 – Jan 2011 UXO Tech III (Team Lead), USA Environmental, Raritan Job site, New Jersey / Removal Action

Jan 2011 – March 2011 UXO Tech III (Team Lead), USA Environmental, Ft Stewart Job site, Georgia / Removal Action

April 2011 – May 2011 UXO Tech III (Team Lead), Native American Environmental, Alexandria, LA, Removal Action, Louisiana Explosives handler's license

May 2011 – June 2011 UXO Tech III (Team Lead), USA Environmental, Indian Head, MD and Raritan, NJ job sites / Removal Action

July 2011 – Feb 2012 Senior EOD Tech, Triple Canopy, US Embassy Baghdad, Iraq, WPS Contract, EOD Team lead

Mar 2012 – June 2012 UXO Tech III (Team Lead), USA Environmental, FT Polk, LA job site / Removal Action

July 2012 – Sept 2012 UXO Tech III (Team Lead), USA Environmental, Indian Head, MD job site / Removal Action

October 2012 – Present UXO Tech III / SUXOS, FPM Remediations, Barksdale AFB, LA job site / RI/FS, Removal Action and Construction Support

Naval School Explosive Ordnance Disposal

This is to certify that

A1C George H. Vaughn Jr.

has successfully completed the

Basic EOD Course

Class 100S-91

Graduated – 23 July 1991

In witness thereof, this certificate has been signed and given under my hand at Naval School Explosive Ordnance Disposal, Eglin AFB, Florida

This 25th day of August in the Year of Our Lord, Two Thousand Ten

Commanding Officer

NAVSCOLEOD 1500/26
REV (2-00)

Appendix H

Project Schedule

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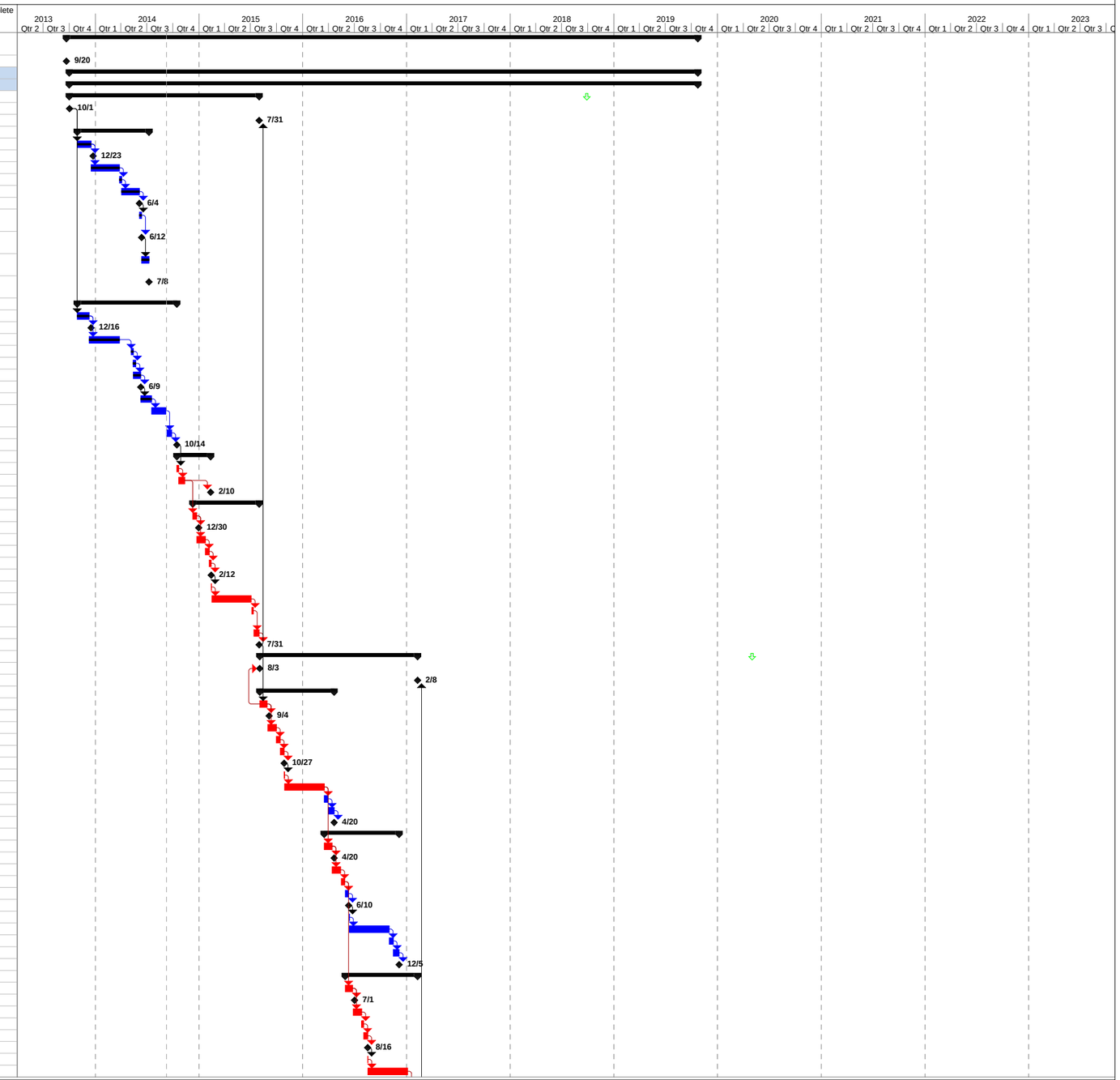
New Mexico-Arizona Group
Holloman AFB, New Mexico
Performance Based Remediation
Integrated Master Schedule

FPM Remediations, Inc.

ID	Site Name	SubCLIN	Name	Projected Date of Exercise	POP Deadline	Duration	Start	Finish	% Complete
1			**Environmental Remediation in accordance with the PBR Statement of Objectives (SOO) - Contract Award**		9/26/2018	**1588 days**	**Fri 9/20/13**	**Wed 10/23/19**	**14%**
2			Award			0 days	Fri 9/20/13	Fri 9/20/13	0%
3			**Holloman AFB**			**1582 days**	**Tue 10/1/13**	**Wed 10/23/19**	**14%**
4			**RR869 - Debris Field**			**1582 days**	**Tue 10/1/13**	**Wed 10/23/19**	**14%**
5	**RR869**	**0075AA**	**Achieve Final Remedial Investigation (RI) Report**	**10/1/2013**	**5/1/2015**	**479 days**	**Tue 10/1/13**	**Fri 7/31/15**	**59%**
6	RR869	0075AA	NTP (RR869/0075AA)			0 days	Tue 10/1/13	Tue 10/1/13	100%
7	RR869	0075AA	POP Completion Date			0 days	Fri 7/31/15	Fri 7/31/15	0%
8	**RR869**	**0075AA**	**Explosive Safety Submission (ESS)**			**181 days**	**Tue 10/29/13**	**Tue 7/8/14**	**100%**
9	RR869	0075AA	Prepare and Submit Draft ESS			35 days	Tue 10/29/13	Mon 12/16/13	100%
10	RR869	0075AA	Air Force Approval Draft ESS Milestone			0 days	Mon 12/23/13	Mon 12/23/13	100%
11	RR869	0075AA	Air Force Review of Draft/Provide Comments			72 days	Tue 12/17/13	Wed 3/26/14	100%
12	RR869	0075AA	Respond to Air Force Comments/Prepare and Submit Draft Final ESS			5 days	Thu 3/27/14	Wed 4/2/14	100%
13	RR869	0075AA	Air Force Review of Draft Final ESS/Revise as needed			45 days	Thu 4/3/14	Wed 6/4/14	100%
14	RR869	0075AA	Air Force Approval Draft Final ESS Milestone			0 days	Wed 6/4/14	Wed 6/4/14	100%
15	RR869	0075AA	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Review of Draft Final/Provide Comments			6 days	Thu 6/5/14	Thu 6/12/14	100%
16	RR869	0075AA	Respond to AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Comments on Draft Final and Prepare Final ESS			0 days	Thu 6/12/14	Thu 6/12/14	100%
17	RR869	0075AA	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Review of Final ESS/Revise as needed			18 days	Fri 6/13/14	Tue 7/8/14	100%
18	RR869	0075AA	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Approval of Final ESS Milestone			0 days	Tue 7/8/14	Tue 7/8/14	100%
19	**RR869**	**0075AA**	**Remedial Investigation Work Plan**			**251 days**	**Tue 10/29/13**	**Tue 10/14/14**	**76%**
20	RR869	0075AA	Prepare and Submit Draft Remedial Investigation Work Plan			30 days	Tue 10/29/13	Mon 12/9/13	100%
21	RR869	0075AA	Air Force Approval Draft Remedial Investigation Work Plan Milestone			0 days	Mon 12/16/13	Mon 12/16/13	100%
22	RR869	0075AA	Air Force Review of Draft/Provide Comments			77 days	Tue 12/10/13	Wed 3/26/14	100%
23	RR869	0075AA	Respond to Air Force Comments			6 days	Wed 5/7/14	Wed 5/14/14	100%
24	RR869	0075AA	Prepare and Submit Draft Final Remedial Investigation Work Plan			7 days	Wed 5/14/14	Fri 5/23/14	100%
25	RR869	0075AA	Air Force Approval of Draft Final Remedial Investigation Work Plan Milestone			18 days	Thu 5/15/14	Mon 6/9/14	100%
26	RR869	0075AA	Submit Draft Final for EPA Review			0 days	Mon 6/9/14	Mon 6/9/14	100%
27	RR869	0075AA	EPA Review of Draft Final/Provide Comments			28 days	Tue 6/10/14	Thu 7/17/14	100%
28	RR869	0075AA	Respond to EPA Comments on Draft Final and Prepare Final Remedial Investigation Work Plan			36 days	Fri 7/18/14	Fri 9/5/14	0%
29	RR869	0075AA	Air Force and EPA Review of Final Remedial Investigation Work Plan/Revise as needed			15 days	Mon 9/8/14	Fri 9/26/14	0%
30	RR869	0075AA	EPA and Air Force Approval of Final Remedial Investigation Work Plan Milestone			0 days	Tue 10/14/14	Tue 10/14/14	0%
31	**RR869**	**0075AA**	**Remedial Investigation Field Activities**			**85 days**	**Wed 10/15/14**	**Tue 2/10/15**	**0%**
32	RR869	0075AA	UIC Permit/Utility Locates/Dig Permits/Mobilization			5 days	Wed 10/15/14	Tue 10/21/14	0%
33	RR869	0075AA	MEC Survey and Soil Sampling			15 days	Wed 10/22/14	Tue 11/11/14	0%
34	RR869	0075AA	ERPIMS Submission			0 days	Tue 2/10/15	Tue 2/10/15	0%
35	**RR869**	**0075AA**	**Remedial Investigation Report**			**168 days**	**Wed 12/10/14**	**Fri 7/31/15**	**0%**
36	RR869	0075AA	Prepare and Submit Draft Remedial Investigation Report			10 days	Wed 12/10/14	Tue 12/23/14	0%
37	RR869	0075AA	Air Force Approval Draft Remedial Investigation Report Milestone			0 days	Tue 12/30/14	Tue 12/30/14	0%
38	RR869	0075AA	Air Force Review of Draft/Provide Comments			22 days	Wed 12/24/14	Thu 1/22/15	0%
39	RR869	0075AA	Respond to Air Force Comments			10 days	Fri 1/23/15	Thu 2/5/15	0%
40	RR869	0075AA	Prepare and Submit Draft Final Remedial Investigation Report			5 days	Fri 2/6/15	Thu 2/12/15	0%
41	RR869	0075AA	Air Force Approval of Draft Final Remedial Investigation Report Milestone			0 days	Thu 2/12/15	Thu 2/12/15	0%
42	RR869	0075AA	Submit Draft Final for EPA Review			1 day	Fri 2/13/15	Fri 2/13/15	0%
43	RR869	0075AA	EPA Review of Draft Final/Provide Comments			100 days	Mon 2/16/15	Fri 7/3/15	0%
44	RR869	0075AA	Respond to EPA Comments on Draft Final and Prepare Final Remedial Investigation Report			5 days	Mon 7/6/15	Fri 7/10/15	0%
45	RR869	0075AA	Air Force and EPA Review of Final Remedial Investigation Report/Revise as needed			15 days	Mon 7/13/15	Fri 7/31/15	0%
46	RR869	0075AA	EPA and Air Force Approval of Final Remedial Investigation Report Milestone			0 days	Fri 7/31/15	Fri 7/31/15	0%
47	**RR869**	**0075AB**	**Achieve Final Non-Time Critical Removal Action (NTCRA) Work Plan**	**5/1/2015**	**4/13/2017**	**398 days**	**Mon 8/3/15**	**Wed 2/8/17**	**0%**
48	RR869	0075AB	NTP (RR869/0075AB)			0 days	Mon 8/3/15	Mon 8/3/15	0%
49	RR869	0075AB	POP Completion Date			0 days	Wed 2/8/17	Wed 2/8/17	0%
50	**RR869**	**0075AB**	**Engineering Evaluation/Cost Analysis (EE/CA)**			**188 days**	**Mon 8/3/15**	**Wed 4/20/16**	**0%**
51	RR869	0075AB	Prepare and Submit Draft EE/CA			20 days	Mon 8/3/15	Fri 8/28/15	0%
52	RR869	0075AB	Air Force Approval Draft EE/CA Milestone			0 days	Fri 9/4/15	Fri 9/4/15	0%
53	RR869	0075AB	Air Force Review of Draft/Provide Comments			22 days	Mon 8/31/15	Tue 9/29/15	0%
54	RR869	0075AB	Respond to Air Force Comments			10 days	Wed 9/30/15	Tue 10/13/15	0%
55	RR869	0075AB	Prepare and Submit Draft Final EE/CA			10 days	Wed 10/14/15	Tue 10/27/15	0%
56	RR869	0075AB	Air Force Approval of Draft Final EE/CA Milestone			0 days	Tue 10/27/15	Tue 10/27/15	0%
57	RR869	0075AB	Submit Draft Final for EPA Review			1 day	Wed 10/28/15	Wed 10/28/15	0%
58	RR869	0075AB	EPA Review of Draft Final/Provide Comments			100 days	Thu 10/29/15	Wed 3/16/16	0%
59	RR869	0075AB	Respond to EPA Comments on Draft Final and Prepare Final EE/CA			10 days	Thu 3/17/16	Wed 3/30/16	0%
60	RR869	0075AB	Air Force and EPA Review of Final EE/CA/Revise as needed			15 days	Thu 3/31/16	Wed 4/20/16	0%
61	RR869	0075AB	EPA and Air Force Approval of Final EE/CA Milestone			0 days	Wed 4/20/16	Wed 4/20/16	0%
62	**RR869**	**0075AB**	**Action Memorandum**			**188 days**	**Thu 3/17/16**	**Mon 12/5/16**	**0%**
63	RR869	0075AB	Prepare and Submit Draft Action Memorandum			20 days	Thu 3/17/16	Wed 4/13/16	0%
64	RR869	0075AB	Air Force Approval Draft Action Memorandum Milestone			0 days	Wed 4/20/16	Wed 4/20/16	0%
65	RR869	0075AB	Air Force Review of Draft/Provide Comments			22 days	Thu 4/14/16	Fri 5/13/16	0%
66	RR869	0075AB	Respond to Air Force Comments			10 days	Mon 5/16/16	Fri 5/27/16	0%
67	RR869	0075AB	Prepare and Submit Draft Final Action Memorandum			10 days	Mon 5/30/16	Fri 6/10/16	0%
68	RR869	0075AB	Air Force Approval of Draft Final Action Memorandum Milestone			0 days	Fri 6/10/16	Fri 6/10/16	0%
69	RR869	0075AB	Submit Draft Final for EPA Review			1 day	Mon 6/13/16	Mon 6/13/16	0%
70	RR869	0075AB	EPA Review of Draft Final/Provide Comments			100 days	Tue 6/14/16	Mon 10/31/16	0%
71	RR869	0075AB	Respond to EPA Comments on Draft Final and Prepare Action Memorandum			10 days	Tue 11/1/16	Mon 11/14/16	0%
72	RR869	0075AB	Air Force and EPA Review of Final Action Memorandum/Revise as needed			15 days	Tue 11/15/16	Mon 12/5/16	0%
73	RR869	0075AB	EPA and Air Force Approval of Final Action Memorandum Milestone			0 days	Mon 12/5/16	Mon 12/5/16	0%
74	**RR869**	**0075AB**	**Non-Time Critical Removal Action (NTCRA) Work Plan**			**183 days**	**Mon 5/30/16**	**Wed 2/8/17**	**0%**
75	RR869	0075AB	Prepare and Submit Draft NTCRA Work Plan			20 days	Mon 5/30/16	Fri 6/24/16	0%
76	RR869	0075AB	Air Force Approval Draft NTCRA Work Plan Milestone			0 days	Fri 7/1/16	Fri 7/1/16	0%
77	RR869	0075AB	Air Force Review of Draft/Provide Comments			22 days	Mon 6/27/16	Tue 7/26/16	0%
78	RR869	0075AB	Respond to Air Force Comments			5 days	Wed 7/27/16	Tue 8/2/16	0%
79	RR869	0075AB	Prepare and Submit Draft Final NTCRA Work Plan			10 days	Wed 8/3/16	Tue 8/16/16	0%
80	RR869	0075AB	Air Force Approval of Draft Final NTCRA Work Plan Milestone			0 days	Tue 8/16/16	Tue 8/16/16	0%
81	RR869	0075AB	Submit Draft Final for EPA Review			1 day	Wed 8/17/16	Wed 8/17/16	0%
82	RR869	0075AB	EPA Review of Draft Final/Provide Comments			100 days	Thu 8/18/16	Wed 1/4/17	0%



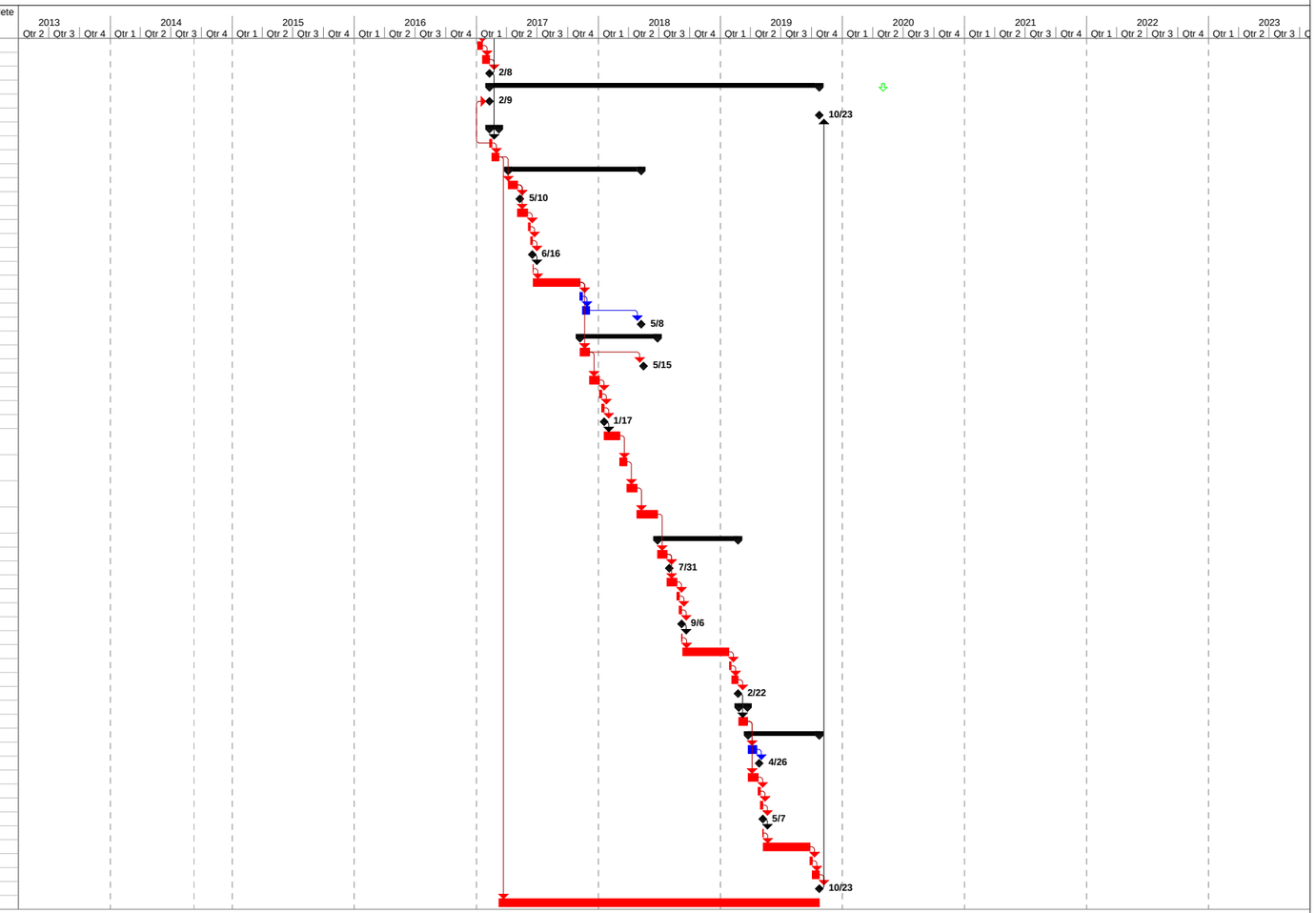
Project: Integrated Master Schedule

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Critical | Critical Split | Progress | Deadline

New Mexico-Arizona Group
Holloman AFB, New Mexico
Performance Based Remediation
Integrated Master Schedule

FPM Remediations, Inc.

ID	Site Name	SubCLIN	Name	Projected Date of Exercise	POP Deadline	Duration	Start	Finish	% Complete
83	RR869	0075AB	Respond to EPA Comments on Draft Final and Prepare NTCRA Work Plan			10 days	Thu 1/5/17	Wed 1/18/17	0%
84	RR869	0075AB	Air Force and EPA Review of Final NTCRA Work Plan/Revise as needed			15 days	Thu 1/19/17	Wed 2/8/17	0%
85	RR869	0075AB	EPA and Air Force Approval of Final NTCRA Work Plan Milestone			0 days	Wed 2/8/17	Wed 2/8/17	0%
86	**RR869**	**0075AC**	**Achieve Site Closeout (SC) in accordance with Table 1 of the SOO**	**4/13/2017**	**1/30/2020**	**705 days**	**Thu 2/9/17**	**Wed 10/23/19**	**0%**
87	RR869	0075AC	NTP (RR869/0075AC)			0 days	Thu 2/9/17	Thu 2/9/17	0%
88	RR869	0075AC	POP Completion Date			0 days	Wed 10/23/19	Wed 10/23/19	0%
89	**RR869**	**0075AC**	**NTCRA Field Activities**			**20 days**	**Thu 2/9/17**	**Wed 3/8/17**	**0%**
90	RR869	0075AC	UIC Permit/Utility Locates/Dig Permits/Mobilization			5 days	Thu 2/9/17	Wed 2/15/17	0%
91	RR869	0075AC	MEC Removal and Site Restoration			15 days	Thu 2/16/17	Wed 3/8/17	0%
92	**RR869**	**0075AC**	**After Action Report**			**284 days**	**Thu 4/6/17**	**Tue 5/8/18**	**0%**
93	RR869	0075AC	Prepare and Submit Draft After Action Report			20 days	Thu 4/6/17	Wed 5/3/17	0%
94	RR869	0075AC	Air Force Approval Draft After Action Report Milestone			0 days	Wed 5/10/17	Wed 5/10/17	0%
95	RR869	0075AC	Air Force Review of Draft/Provide Comments			22 days	Thu 5/4/17	Fri 6/2/17	0%
96	RR869	0075AC	Respond to Air Force Comments			5 days	Mon 6/5/17	Fri 6/9/17	0%
97	RR869	0075AC	Prepare and Submit Draft Final After Action Report			5 days	Mon 6/12/17	Fri 6/16/17	0%
98	RR869	0075AC	Air Force Approval of Draft Final After Action Report Milestone			0 days	Fri 6/16/17	Fri 6/16/17	0%
99	RR869	0075AC	Submit Draft Final for EPA Review			1 day	Mon 6/19/17	Mon 6/19/17	0%
100	RR869	0075AC	EPA Review of Draft Final/Provide Comments			100 days	Tue 6/20/17	Mon 11/6/17	0%
101	RR869	0075AC	Respond to EPA Comments on Draft Final and Prepare After Action Report			5 days	Tue 11/7/17	Mon 11/13/17	0%
102	RR869	0075AC	Air Force and EPA Review of Final After Action Report/Revise as needed			15 days	Tue 11/14/17	Mon 12/4/17	0%
103	RR869	0075AC	EPA and Air Force Approval of Final After Action Report Milestone			0 days	Tue 5/8/18	Tue 5/8/18	0%
104	**RR869**	**0075AC**	**Certificate of Clearance**			**166 days**	**Tue 11/7/17**	**Tue 6/26/18**	**0%**
105	RR869	0075AC	Prepare and Submit Draft Certificate of Clearance			20 days	Tue 11/7/17	Mon 12/4/17	0%
106	RR869	0075AC	Air Force Approval Draft Certificate of Clearance Milestone			0 days	Tue 5/15/18	Tue 5/15/18	0%
107	RR869	0075AC	Air Force Review of Draft/Provide Comments			22 days	Tue 12/5/17	Wed 1/3/18	0%
108	RR869	0075AC	Respond to Air Force Comments/Prepare and Submit Draft Final Certificate of Clearance			5 days	Thu 1/4/18	Wed 1/10/18	0%
109	RR869	0075AC	Air Force Review of Draft Final Certificate of Clearance/Revise as needed			5 days	Thu 1/11/18	Wed 1/17/18	0%
110	RR869	0075AC	Air Force Approval Draft Final Certificate of Clearance Milestone			0 days	Wed 1/17/18	Wed 1/17/18	0%
111	RR869	0075AC	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Review of Draft Final/Provide Comments			33 days	Thu 1/18/18	Mon 3/5/18	0%
112	RR869	0075AC	Respond to AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Comments on Draft Final and Prepare Final Certificate of Clearance			15 days	Tue 3/6/18	Mon 3/26/18	0%
113	RR869	0075AC	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Review of Final Certificate of Clearance/Revise as needed			22 days	Tue 3/27/18	Wed 4/25/18	0%
114	RR869	0075AC	AFCEC, Wing Safety, Command Safety, AF Safety Center, and DDESB Approval of Final Certificate of Clearance Milestone			44 days	Thu 4/26/18	Tue 6/26/18	0%
115	**RR869**	**0075AC**	**Proposed Plan**			**173 days**	**Wed 6/27/18**	**Fri 2/22/19**	**0%**
116	RR869	0075AC	Prepare and Submit Draft Proposed Plan			20 days	Wed 6/27/18	Tue 7/24/18	0%
117	RR869	0075AC	Air Force Approval Draft Proposed Plan Milestone			0 days	Tue 7/31/18	Tue 7/31/18	0%
118	RR869	0075AC	Air Force Review of Draft/Provide Comments			22 days	Wed 7/25/18	Thu 8/23/18	0%
119	RR869	0075AC	Respond to Air Force Comments			5 days	Fri 8/24/18	Thu 8/30/18	0%
120	RR869	0075AC	Prepare and Submit Draft Final Proposed Plan			5 days	Fri 8/31/18	Thu 9/6/18	0%
121	RR869	0075AC	Air Force Approval of Draft Final Proposed Plan Milestone			0 days	Thu 9/6/18	Thu 9/6/18	0%
122	RR869	0075AC	Submit Draft Final for EPA Review			1 day	Fri 9/7/18	Fri 9/7/18	0%
123	RR869	0075AC	EPA Review of Draft Final/Provide Comments			100 days	Mon 9/10/18	Fri 1/25/19	0%
124	RR869	0075AC	Respond to EPA Comments on Draft Final and Prepare Proposed Plan			5 days	Mon 1/28/19	Fri 2/1/19	0%
125	RR869	0075AC	Air Force and EPA Review of Final Proposed Plan/Revise as needed			15 days	Mon 2/4/19	Fri 2/22/19	0%
126	RR869	0075AC	EPA and Air Force Approval of Final Proposed Plan Milestone			0 days	Fri 2/22/19	Fri 2/22/19	0%
127	**RR869**	**0075AC**	**Public Comment Period**			**20 days**	**Mon 2/25/19**	**Fri 3/22/19**	**0%**
128	RR869	0075AC	Comment Period			20 days	Mon 2/25/19	Fri 3/22/19	0%
129	**RR869**	**0075AC**	**No Further Action Record of Decision (NFA ROD)**			**153 days**	**Mon 3/25/19**	**Wed 10/23/19**	**0%**
130	RR869	0075AC	Prepare and Submit Draft NFA ROD			20 days	Mon 3/25/19	Fri 4/19/19	0%
131	RR869	0075AC	Air Force Approval Draft NFA ROD Milestone			0 days	Fri 4/26/19	Fri 4/26/19	0%
132	RR869	0075AC	Air Force Review of Draft/Provide Comments			22 days	Mon 3/25/19	Tue 4/23/19	0%
133	RR869	0075AC	Respond to Air Force Comments			5 days	Wed 4/24/19	Tue 4/30/19	0%
134	RR869	0075AC	Prepare and Submit Draft Final NFA ROD			5 days	Wed 5/1/19	Tue 5/7/19	0%
135	RR869	0075AC	Air Force Approval of Draft Final NFA ROD Milestone			0 days	Tue 5/7/19	Tue 5/7/19	0%
136	RR869	0075AC	Submit Draft Final for EPA Review			1 day	Wed 5/8/19	Wed 5/8/19	0%
137	RR869	0075AC	EPA Review of Draft Final/Provide Comments			100 days	Thu 5/9/19	Wed 9/25/19	0%
138	RR869	0075AC	Respond to EPA Comments on Draft Final and Prepare NFA ROD			5 days	Thu 9/26/19	Wed 10/2/19	0%
139	RR869	0075AC	Air Force and EPA Review of Final NFA ROD/Revise as needed			15 days	Thu 10/3/19	Wed 10/23/19	0%
140	RR869	0075AC	EPA and Air Force Approval of Final NFA ROD Milestone			0 days	Wed 10/23/19	Wed 10/23/19	0%
141	RR869	0075AC	PBR Contractor Plan B (Trigger Evaluation/Implementation)			685 days	Thu 3/9/17	Wed 10/23/19	0%



Project: Integrated Master Schedule

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | Critical | Critical Split | Progress | Deadline

FINAL

REMEDIAL INVESTIGATION WORK PLAN

for

XU853 MISSILE TEST STAND AREA MRS and
XU854 ABLE 51 AREA MRS

HOLLOMAN AIR FORCE BASE
NEW MEXICO
RCRA PERMIT NUMBER: NM6572124422-2

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for:

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Ave., Suite 163
Joint Base San Antonio Lackland, Texas 78236-9853

October 2014

Prepared by:

FPM Remediations, Inc.

584 Phoenix Drive
Rome, NY 13441

URS Group, Inc.
7720 N 16th Street, Suite 100
Phoenix, AZ 85020-4493

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XU853 Missile Test Stand Area and XU854 Able 51 Area MRSs

Remedial Investigation

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sites:

XU853 Missile Test Stand Area and
XU854 Able 51 Area
Holloman Air Force Base
New Mexico

Submitted to:
Mr. Chuck Hendrickson
USEPA, Region 6 (6PD-F)
1445 Ross Ave, Suite 1200
Dallas, TX 75202-2733

Prepared for:

Air Force Civil Engineer Center (AFCEC)
2261 Hughes Ave., Suite 163
Lackland AFB, Texas 78236-9853

Prepared by:

FPM Remediations, Inc.
584 Phoenix Drive, Rome, NY 13441

October 2014

Author: _____
Ivana Raicevic

Title: Site Lead
Date: _____

Reviewer: _____
Maureen Whalen CG, CPG, PMP

Title: Project Manager
Date: _____

Reviewer: _____
DeAnna Rothhaupt

Title: Holloman AFB Environmental Chief
Date: _____

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LIST OF ABBREVIATIONS AND ACRONYMS

%	percent
°C	Degrees Celsius
°F	Degrees Fahrenheit
AAAF	Alamogordo Army Air Field
AF	Air Force
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFI	Air Force Instruction
AFJI	Air Force Joint Instruction
AFMAN	Air Force Manual
AR	Army Regulation
BATFE	Bureau of Alcohol, Tobacco, Firearms, and Explosives
BIP	Blow-In-Place
bgs	below ground surface
BSP	Blind Seeding Program
CFR	Code of Federal Regulations
CHE	Chemical Hazard Evaluation
COR	Contracting Officer's Representative
CSE	Comprehensive Site Evaluation
CSM	Conceptual Site Model
DA	Department of the Army
DD, DoD	Department of Defense
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DID	Data Item Description
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DMM	Discarded Military Munitions
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
EHE	Explosives Hazard Evaluation
EM	Engineering Manual
EM61	EM61-MK2
EOD	Explosive Ordnance Disposal
EPP	Environmental Protection Plan
ERA	Ecological Risk Assessment
ERP	Environmental Restoration Program
ESRI	Environmental Sciences Research Institute
ESS	Explosive Safety Submission
EZ	Exclusion Zone
FCR	Field Change Request
FEL	Federal Explosives License
FPM	FPM Remediations, Inc.
FS	Feasibility Study

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

ft	feet
GAPA	Ground-to-Air Pilotless Aircraft
GIP	Geophysical Investigation Plan
GIS	Geographic Information System
GLONASS	Global Navigation Satellite System
GPO	Geophysical Prove-Out
GPS	Global Positioning System
GSV	Geophysical System Verification
HA	Hazard Assessment
HDR	HDR Environmental, Operations and Construction, Inc.
HFD	Hazardous Fragmentation Distance
HH	Human Health
HHE	Human Health Hazard Evaluation
HHRA	Human Health Risk Assessment
HASP	Health and Safety Plan
HSTT	High Speed Test Track
Hz	hertz
IAW	in accordance with
IDW	Investigative-Derived Waste
INRMP	Integrated Natural Resources Management Plan
IS	incremental sampling
ISO	Industry Standard Object
IVS	Instrument Verification Strip
kg	kilogram
LANL	Los Alamos National Laboratory
lb	pound
m	meter
m/s	meter per second
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
mg/kg	milligrams/kilogram
MGFD	Munition with the Greatest Fragmentation Distance
MHAT	MEC Hazard Assessment Tool
mm	millimeter
MOA	Memorandum of Agreement
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

MSA	Munitions Storage Area
MSD	Minimum Separation Distance
mV	millivolt
NA	No value available
NAD	North American Datum
NATIV	North American Test Instrument Vehicle
NEW	Net Explosive Weight
NFA	No Further Action
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environmental Department
NMWQCC	New Mexico Water Quality Control Commission
NRHP	National Register of Historic Places
OSHA	Occupational Safety and Health Administration
PBR	Performance-Based Remediation
PC	Personal Computer
PDA	Personal Digital Assistant
PM	Project Manager
POC	Points of Contact
PP	Proposed Plan
PPE	Personal Protective Equipment
ppm	parts per million
Q-D	Quality-Distance
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
RRD	Range Related Debris
RSL	Regional Screening Levels
RTK-GPS	Real-Time Kinematic Global Positioning System
SAA	Small Arms Ammunition
SARA	Superfund Amendments and Reauthorization Act of 1986
SDA	Safe Disposal Area
SKY	Sky Research, Inc.
SLERA	Screening-Level Ecological Risk Assessment
SOO	Statement of Objectives
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SUXOS	Senior UXO Supervisor
TDS	Total Dissolved Solids
TP	Technical Paper
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
URS	URS Group, Inc.

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

U.S.	United States
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USAF	U.S. Air Force
USAESCH	U.S. Army Engineering Support Center, Huntsville
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance
UXO I	UXO Technician I
UXO II	UXO Technician II
UXO III	UXO Technician III
UXOQCS	UXO QC Specialist
UXOSO	UXO Safety Officer
WP	Work Plan
WSMR	White Sands Missile Range
WSNM	White Sands National Monument
WWII	World War II
ZEL	Zero Length

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1.0 INTRODUCTION

This Remedial Investigation (RI) Work Plan (WP) describes the work elements, technical approach, and safety guidance to conduct an RI at two Military Munitions Response Program (MMRP) Munitions Response Sites (MRSs) at Holloman Air Force Base (AFB) located in south-central New Mexico in Otero County. The two (2) MRSs requiring RI are the Missile Test Stand Area (XU853) and Able 51 Area (XU854).

1.1 Project Authorization

The investigation is being performed in support of the United States Air Force (USAF) MMRP at Holloman AFB. The MMRP was created by Congress in 2001 under the Defense Environmental Restoration Program (DERP) as established by Section 211 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and is codified in Sections 2701-2710 of Title 10 of the United States Code (U.S.C.). The Department of Defense (DoD) has established the MMRP under the DERP to address DoD sites with Unexploded Ordnance (UXO), Discarded Military Munitions (DMM), and Munitions Constituents (MC) located on current and former military installations.

The USAF is the lead agency for this RI. Participation of and cooperation with federal, state, and local authorities and the local public will be solicited for the duration of this activity and for all environmental restoration activities at Holloman AFB. Participation of these entities is required for the environmental restoration process and aids in ensuring the protection of human health and the environment. Federal, state, and local authorities will have input into the actions implemented at Holloman AFB through planning meetings, plan review, and the public comment process. Concerns of the federal, state, and local authorities will be solicited and provisions of federal, state, and local regulations will be given full consideration for all actions taken at Holloman AFB.

This RI WP is being completed by the FPM Remediations, Inc. (FPM) Team, under FPM's Air Force Civil Engineer Center (AFCEC) Contract FA8903-13-C-0008, to support the USAF MMRP. The Statement of Objectives (SOO) for the Performance-Based Remediation (PBR) at Holloman AFB is included in **Appendix A**.

1.2 Project Purpose and Scope

The purpose of this RI is to provide site characterization data of sufficient quantity to determine nature and extent of Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH)/Munitions Debris (MD) and MC within the MRSs in order to either focus follow-on restoration efforts on MEC/ MPPEH and/or MC delineated areas or to verify that No Further Action (NFA) is needed for the two MRSs. Geophysical investigation was not performed at these two sites, and therefore, there is no information regarding the distribution of subsurface anomaly density. The RI will be performed to:

(1) Characterize potential explosive safety hazards (surface and subsurface) including MEC/ MPPEH/MD;

(2) Characterize the nature and extent of MC contamination (metals and explosives) in site media (e.g., surface/subsurface soil);

(3) Perform a Hazard Assessment (HA) for MEC using the USAF MEC Hazard Assessment Tool (MHAT) and perform a risk screening for MC; and

(4) Use the information collected during the RI to update the Conceptual Site Models (CSMs), evaluate human health and ecological risks, update Munitions Response Site Prioritization Protocol (MRSPP) scores, and develop a Feasibility Study (FS) for both MRSs.

Specific project tasks will include: (1) Site visits; (2) Preparation of technical planning documents including an Explosives Safety Submission (ESS) and RI WP; (3) RI field activities including surface clearance, Digital Geophysical Mapping (DGM), intrusive investigation of statistically derived number of DGM anomalies that will indicate a 95% confidence factor of the MEC/MPPEH/MD potential on the site and MC sampling, and (4) preparation of deliverables such as RI Report.

1.3 Summary of Technical Approach

A summary of the technical approach is presented below. The detailed technical approach is presented in Field Investigation Plan (**Section 3.0**).

(1) Surface clearance and brush clearing along transects and grids at both MRSs;

(2) DGM along transects and grids utilizing the Geonics electromagnetic system EM61-MK2 (EM61); the system will be employed as a multi-coil towed array;

(3) Intrusive investigation of statistically derived number of DGM anomalies that will indicate a 95% confidence factor of the MEC/MPPEH/MD potential on the site;

(4) MC sampling (metals and explosives) at MEC/MPPEH locations and in areas with significant amounts of MD;

(5)

(6) MC sampling for propellants at missile launch pads and at isolated locations showing evidence of potential contamination (e.g., discolored soils);

(7) Characterizing MPPEH as either Material Documented as an Explosive Hazard (MDEH) or Material Documented as Safe (MDAS);

(8) Removing and storing material determined to be MDEH and MDAS in separate storage containers/locations;

(9) MEC and MPPEH (classified as MDEH) demolition; and

(10) Offsite disposal/recycling of MDAS.

1.4 Work Plan Organization

This RI WP has been organized as follows:

Section 1: Introduction - describes the project authorization, project purpose and scope, site location, setting, and current and future land uses.

Section 2: Technical Management Plan - identifies the project objectives, organization schedule and deliverables, reporting, public relations support, and identifies key project personnel and their roles.

Section 3: Field Investigation Plan - describes the methodology and procedures to be followed for the field investigation.

Section 4: Quality Control Plan (QCP) - describes the standard processes that will be used to monitor, inspect, and control daily activities to ensure quality performance, processes to correct quality issues, Quality Control (QC) to contract deliverables, and QC reporting requirements.

Section 5: Explosives Management Plan - provides the details for management of explosives-related operations conducted on the MRSs.

Section 6: Environmental Protection Plan (EPP) - provides the approach, methods, and operational procedures to be employed to protect the natural environment during field activities.

Section 7: References - provides a list of references used to develop this RI WP.

Appendix A: The Statement of Objectives - provides a copy of the SOO for the PBR at Holloman AFB.

Appendix B: Health and Safety Plan (HASP) – outlines the level of personal protection and safe operating guidelines.

Appendix C: Points of Contact (POC) - identifies POC for the RI.

Appendix D: Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP) - includes Standard Operating Procedures (SOPs) that will be used during RI field activities for MC sampling and a MC Sampling and Analysis Plan prepared in accordance with (IAW) the UFP-QAPP.

Appendix E: Contractor Forms - provides copies of the field forms that will be used during the RI field activities.

Appendix F: Explosive Safety Submission - provides safety criteria for planning and siting explosives operations.

Appendix G: Contractor Personnel Qualification Certification Letter – certifies that key UXO personnel meet training and experience requirements.

Appendix H: Project Schedule - provides detailed project schedule.

1.5 Site Location

Holloman AFB is located in south-central New Mexico, 7 miles west of the city of Alamogordo in Otero County (**Figure 1-1**). It is adjacent to the White Sands Missile Range (WSMR). A portion of the Base to the south is bordered by Route 70, which also runs roughly north-south and parallel to the eastern boundary of the base. Holloman AFB occupies approximately 50,763 acres of land. It is contiguous to the much larger (2.2 million acre) WSMR, and located to the southeast of the WSMR. The southern portion of Holloman AFB contains the flight line, composed of a series of runways running north-south, east-west, and northeast southwest. The Main Base is located at the southeast corner of the installation, where Route 70 borders the site. The Main Base contains housing and administrative buildings. The West Area and the North Area refer to the improved areas around the original airfield (southeastern triangle formed by the runways). High Speed Test Track (HSTT) runs north-south and is located northwest of the airfield. The track is the world's longest of its kind at 9.5 miles and has been used for an array of missile testing for decades and is still in use today. Access to Holloman AFB requires admittance through the security gate and there is a fence around the installation.

1.5.1 Installation Mission and History

Holloman AFB began nine months after the United States (U.S.) entered World War II (WWII), and was an integral facility in the early stages of the U.S. space program throughout the Cold War. On 6 February 1942, construction began on an extensive bombing and gunnery range later known as the Alamogordo Bombing and Gunnery Range. On 10 August 1942, the Alamogordo Army Air Field (AAAF) was officially established. Because the facility was initially intended to be used by Great Britain as part of their WWII British Training Program for bomber crews, the base was designed after Royal Air Force bases. The first atomic bomb was detonated at the Trinity Site in the northwest corner of the Alamogordo Bombing and Gunnery Range (now the WSMR) on 16 July 1945. In 1946, as more lands became available within the Tularosa Basin, the AAAF was reassigned to be a missile development facility. With the creation of the USAF as a separate service, the facility came under the direction of the Air Materiel Command, which decided that the facility would be used to conduct guided missile programs. On 13 January 1948, the base was renamed Holloman AFB, after Col. George V. Holloman, an early pioneer in guided missile development.

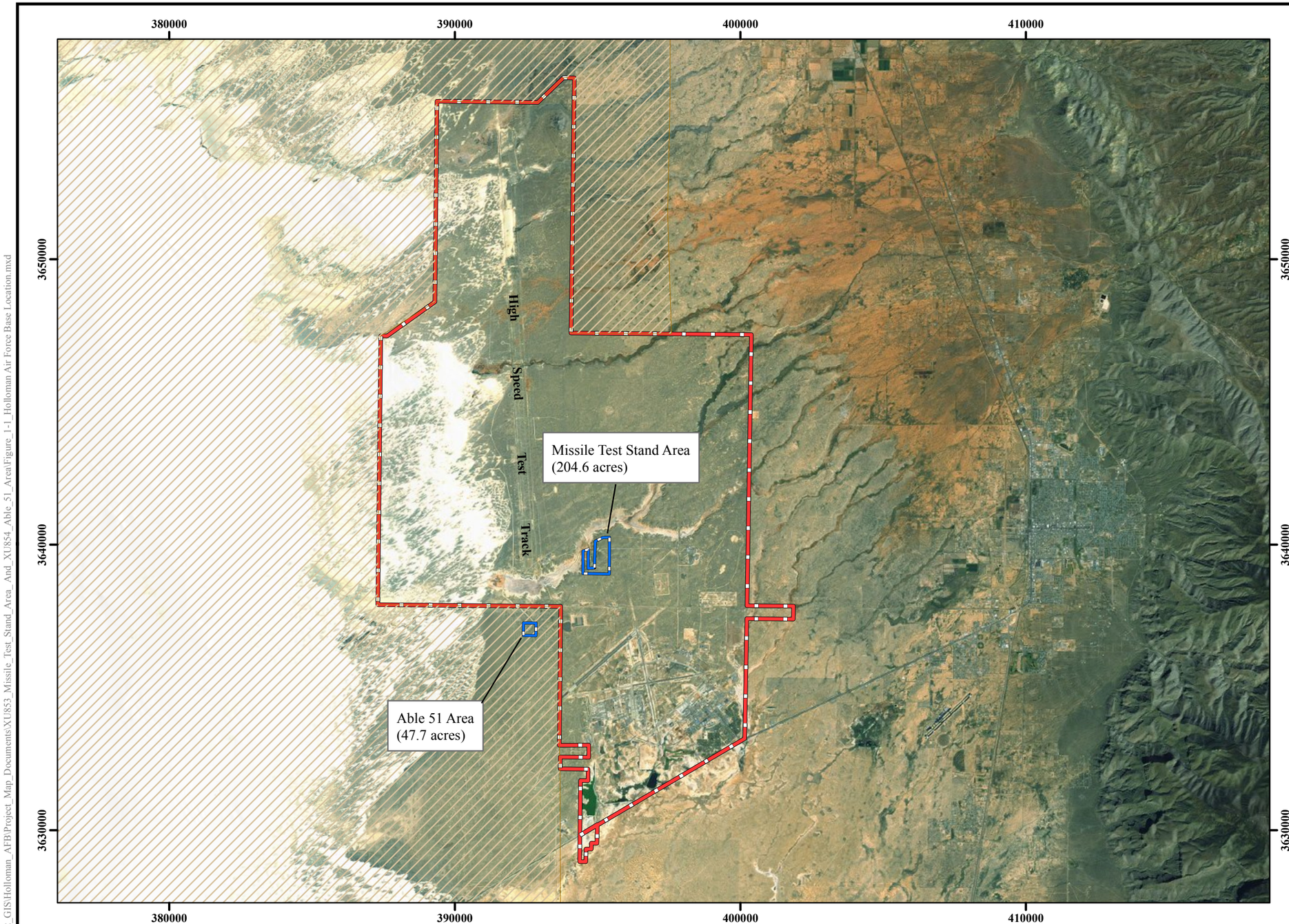
To support the Holloman mission of developing guided missiles, the Army Ordnance Corps built White Sands Proving Grounds at about this time. The combination of the White Sands Proving Grounds and Alamogordo Bombing Range was 100 miles long and 40 miles wide. On September 1, 1952, the two ranges were combined to form the Integrated White Sands Range. From 1952 to 1970, missile development and testing at White Sands included the Snark Matador, Mace, Falcon, Aerobee, JB-2 Loon, and Firebee missiles. High speed sled tests, high altitude balloon projects, and Aeromedical Field Laboratory experiments were also conducted. Testing activities included the Central Inertial Guidance Test Facility and the Radar Target Scatter Test Facility.

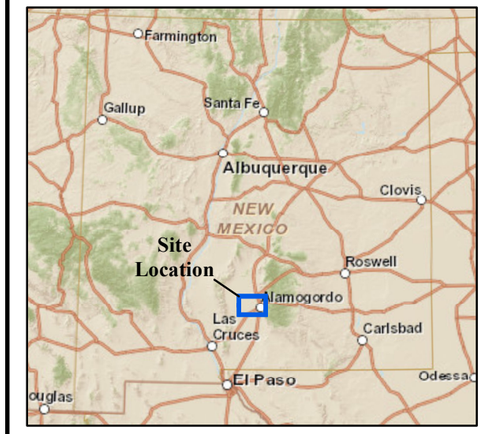
In 1972, the base was taken over by Tactical Air Command and became primarily a fighter base with some continued developmental testing. On 15 November 1991, command responsibility passed from the 833rd Air Division to the 49th Wing. Today, the 49th Wing provides leadership to the installation. Two projects begun during the Cold War era continue on the base: the HSTT and the Primate Research Lab (both considered tenant organizations).

1.5.2 Missile Test Stand Area Description and Operational History

The XU853 Missile Test Stand Area MRS is 204.6-acre site located east of the southern end of the HSTT (**Figure 1-2**). However, as shown in **Figure 1-2**, a portion of this site (20.3 acres) has been included in the recently established Explosives Ordnance Disposal (EOD) 50-pound (lb) range. Since this portion of the XU853 MRS is in the process of administrative closeout, the total acreage of XU853 MRS will be 204.6 acres until this process is complete.

Missile Test Stand Area Munitions Response Area (MRA) was used primarily in the 1940s and 1950s as a launch area for an array of missile testing programs. The majority of missile testing at this site ended in the late 1950s with brief test vehicle programs lasting into the 1960s. The 1998 Architectural Legacy Report (Tagg, Cooper, and Fulton, 1998) describes a total of five launch complexes within the MRS (although activities involving munitions use have only been documented at four of the five sites). The five launch complexes are the Ground-to-Air Pilotless Aircraft (GAPA) or MX-606, the North American Test Instrument Vehicle (NATIV) or MX-770, the JB-2 Loon or MX-544, the Aerobee, or MX-1011, and the Test Stand.





Legend

- MRA Boundary
- Installation Boundary
- White Sands Missile Range

NOTES:

Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 12,000 feet

0 2,500 5,000 Meters

0 6,000 12,000 Feet

N W E S

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 1-1

Holloman AFB Location

FPM Remediations, Inc.

2014

Path: \\ssat\SAT_Clients\SAT_DATA\02_GIS\Holloman_AFB\Project_Map_Documents\XU853_Missile_Test_Stand_Area_And_XU854_Able_51_Area\Figure_1-1_Holloman Air Force Base Location.mxd

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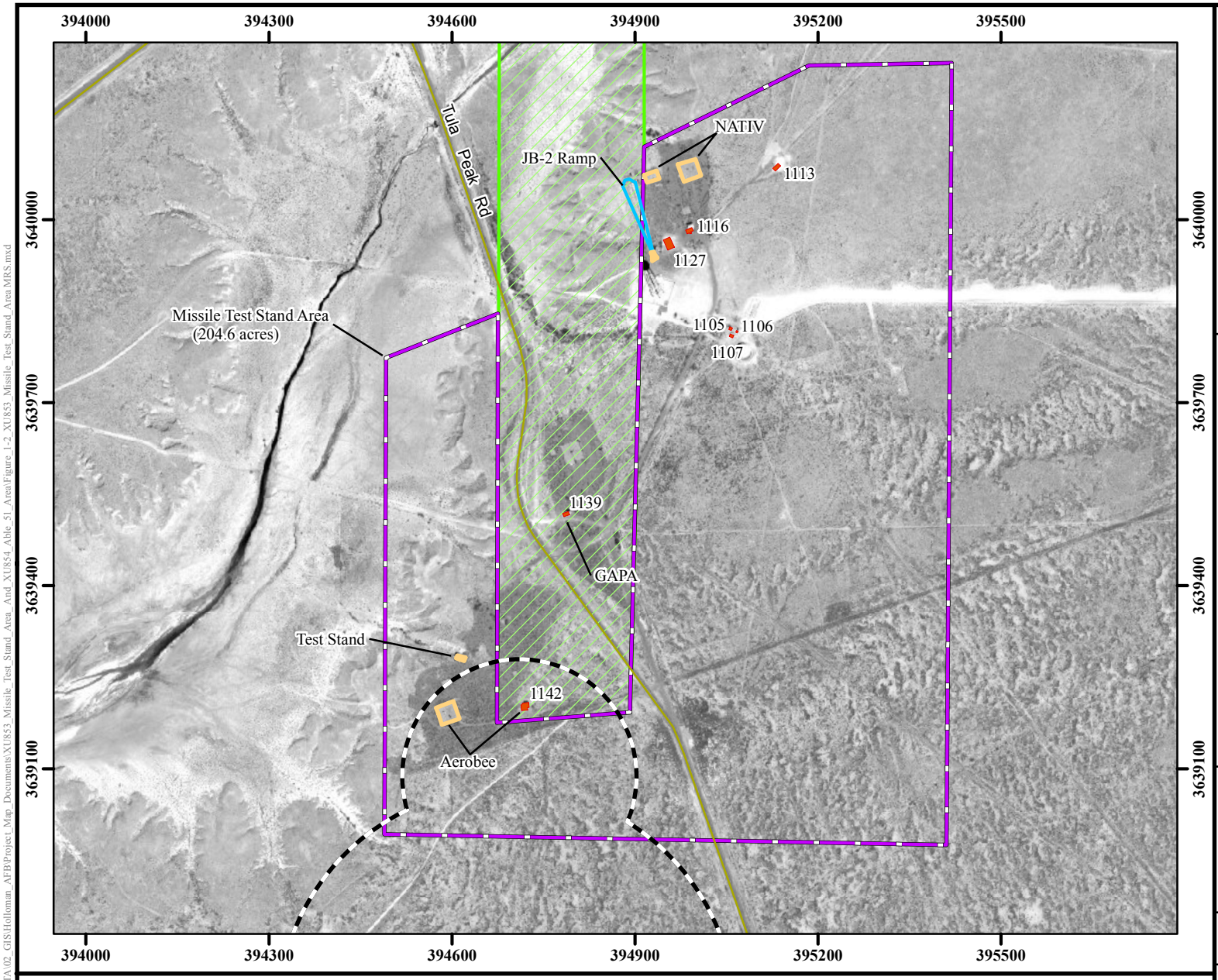

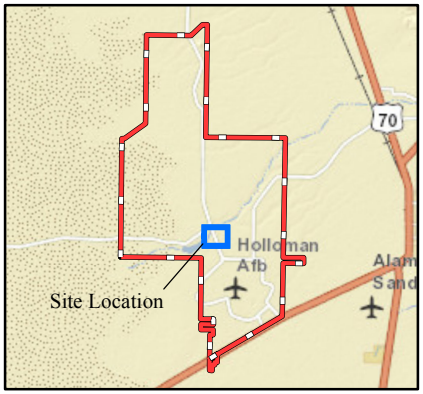

Legend

- Road
- Launch Pad
- Buildings
- 853 MRA/XU853 MRS (204.6 acres)
- ERP Site (OT-37)
- EOD 50-lb Range Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 1-2

XU853 Missile Test Stand Area
MRS Location

NOTES:
Revision Date: 2/6/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 800 feet

0 120 240 Meters

0 200 400 800 Feet

N W E S

FPM Remediations, Inc.

Path: \\sat\SAT_Clients\SAT_DATA\02_GIS\Holloman_AFB\Project_Map_Documents\XU853_Missile_Test_Stand_Area_And_XU854_Able_51_Area\Figure_1-2_XU853_Missile_Test_Stand_Area MRS.mxd

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A portion of the original Missile Test Stand Area was previously investigated under the Environmental Restoration Program (ERP). The Early Missile Test Site ERP Site (OT-37) covers an area of approximately 160 acres and includes three block houses, the inclined test track, three vertical launch pads, a very large pit, and transformer concrete pads (**Figure 1-2**).

GAPA Launch Complex

The GAPA, launch complex included an observation blockhouse (Building 1139), a launch pad with two towers, a zero length slant angle launcher, a "vertical-minus-five-degrees tower," and a possible former munitions magazine. According to the 1998 report, a subterranean cable trench runs from Building 1139 to the firing apron, which supported the launch ramp and continues to an unidentified depression cut into the side of the Lost River Bank, identified as a possible munitions magazine. Testing included solid fuel and liquid propulsion rockets and a ramjet powered missile.

NATIV Launch Complex

Located 1,000 feet (ft) northeast of the GAPA complex, the NATIV (MX-770) complex included a blockhouse (Building 1116), a Rocket Motor Conditioning Building (Building 1127), a static test stand, a launch pad with a 125 ft tall steel tower, and conduit trenches. The test vehicle was reportedly powered by a liquid fuel rocket motor. Testing of the Shrike-Rascal (MX-776) was also reported at the NATIV complex.

JB-2 Loon Launch Complex

The JB-2 Loon, or MX-544, complex was situated 300 ft west of the NATIV complex to utilize Building 1116 in conjunction with a 440 ft long inclined launch ramp. Building 1116 was used in 1963 for base rocket assembly storage and later for other miscellaneous storage. Testing of the Falcon missile (MX-904) reportedly utilized the area of the NATIV and JB-2 complexes. Concrete pads were used to tie down a B-25 for use in air launch Falcon tests as well as a static, or zero length, launcher. Building 1127 was constructed in 1955 as a rocket motor conditioning facility for the Falcon missile. At the time of the 1998 report, Buildings 1127 and 1139 reportedly functioned as a Morale, Welfare, and Recreation Supply/Non-appropriated Fund Central Storage buildings.

Aerobee Launch Complex

The Aerobee (MX-1011) launch complex, located 1,000 ft southwest of the GAPA complex, included a blockhouse (Building 1142), a firing apron, and a concrete lined cable trench. Additional test programs at the site included the Aerobee-Hi (MX1961) and the Aerobee 150. Rockets and boosters used in the test programs reportedly used both liquid and solid propellants. The Aerobee is located in the active EOD range area and is thus excluded from the RI investigation.

Test Stand

A fifth complex at the XU853, the Test Stand, was constructed in approximately 1955 and is thought to be a prototypical, possibly unfinished, static test stand for use in Thor/Atlas intercontinental ballistic missile testing. Located at the far north end of the Aerobee complex, the Test Stand consists of a 20 ft by 50 ft, two story concrete structure set into the bank of an erosional channel leading to the Lost River. There are no records of use for this structure. In 1956, the Atlas-A test program was assigned to Vandenberg AFB in California, after a policy

which required that future missile development be conducted away from the seacoasts was overturned.

The Early Missile Test Site (OT-37) is being investigated under the Environmental Restoration Program; therefore, this site is ineligible for the MMRP and is excluded from the XU853 boundary. Because of this and the new EOD 50-lb Range only the launch pads and buildings related to NATIV, JB-2 Loon, and Test Stand launch complexes are present at the current XU853 MRS.

Since the activities were designed for testing it is unlikely that the test items contained high explosives. However, evidence from Comprehensive Site Evaluation (CSE) Phase II visual survey (HDR Environmental, Operations and Construction, Inc. [HDR], 2013) suggests the site was also used for training activities. Based on the CSE Phase II results the following munitions may be found at the MRS:

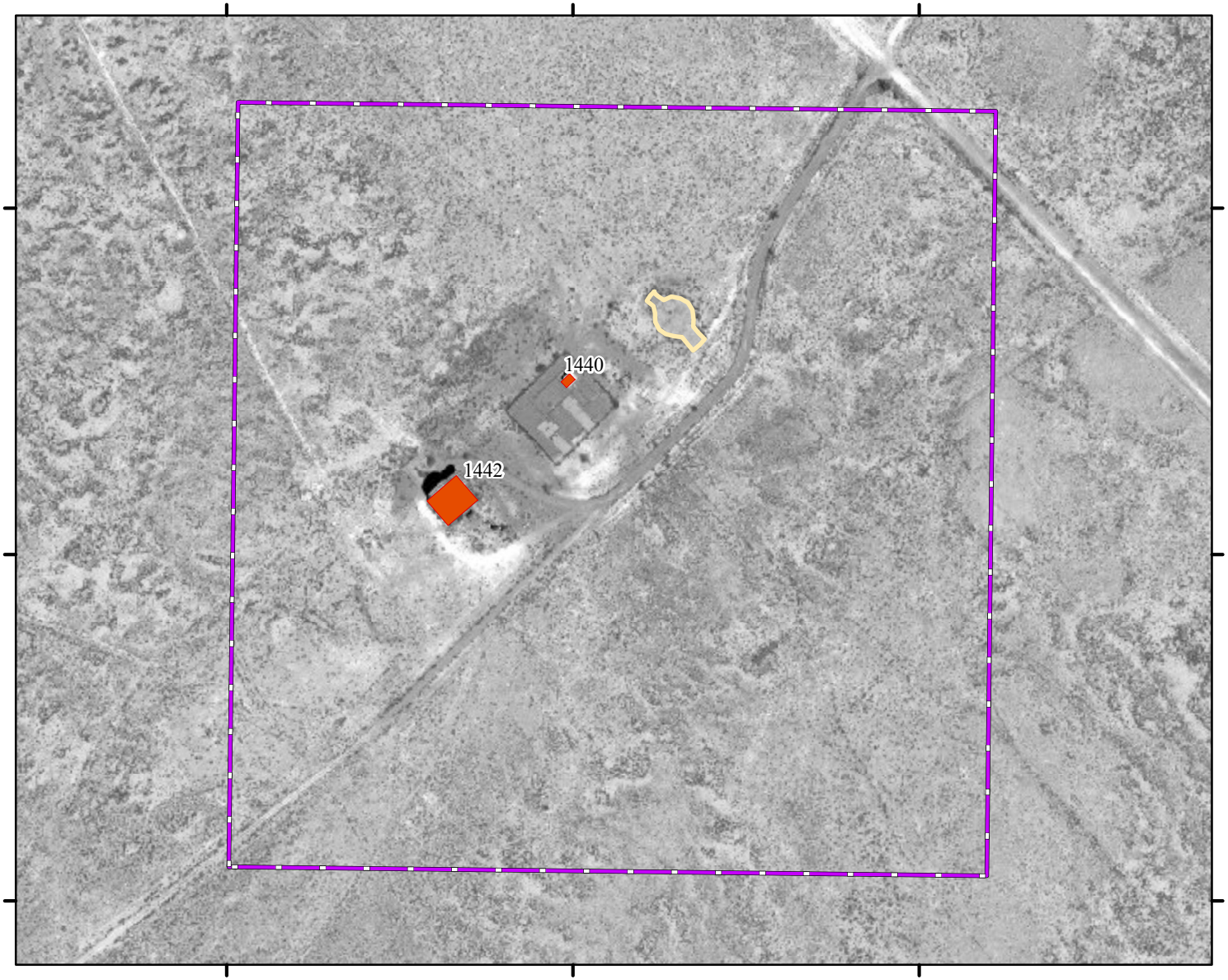
- Small arms (5.56 millimeter [mm], 7.62 mm, and .50-caliber),
- 30 mm projectiles,
- Rockets (Aerobee) and rocket booster motors,
- M74A1 40 mm flare,
- M18 smoke grenades,
- 81 mm Illumination Mortar,
- MK 13 Day & Night Distress Signal, and
- 5-inch rockets.

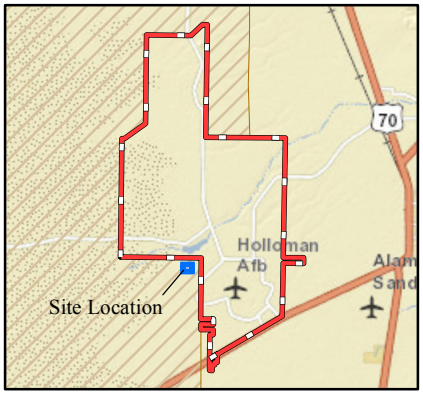
1.5.3 Able 51 Area Description and Operational History

XU854 MRS is located just west of the Holloman AFB main installation boundary fence; however, the site is located on Holloman AFB property which is administered by WSMR (**Figure 1-3**). The MRS is 47.7 acres in size.

Able 51 Area MRA was used as a launch facility in the late 1950s and early 1960s for testing of Mace and Matador missiles. Also referred to as the Zero Length (ZEL) site or BQM-34A Drone Launch site, this area was also used for research on mobile launch capability of both manned and unmanned aircraft, using rocket boosters, without the need for prepared airfields. Building 1440, completed in 1962, was used as a missile launch facility as an observation blockhouse for Mace and Matador missiles and drone launches. Since missile testing ended at the Able 51 Area in the early 1970s, Building 1440 has been either used for storage or has been vacant. Building 1442 was constructed in 1959 as a missile launch facility and is currently vacant. Missiles and aircraft were launched from a fixed launcher as well as mobile launchers tethered to concrete pads within the Able 51 Area. Since the activities were designed for testing it is unlikely that the test items contained high explosives. However, evidence from CSE Phase II visual survey (HDR, 2013) suggests the site was also used for training activities. Based on the CSE Phase II results the following munitions may be found at the Able 51 Area:

- Small arms (.22-caliber, 5.56 mm, 7.62 mm, .38-caliber, .45-caliber, and .50-caliber),
- 40 mm flares,





Legend

- Launch Pad
- Buildings
- XU854 Able 51 Area MRS (47.7 acres)
- Installation Boundary
- White Sands Missile Range
- 1440 Building Number

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 1-3

XU854 Able 51 Area
MRS Location

NOTES:
Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 300 feet

0 50 100 Meters

0 150 300 Feet

N W E S

FPM Remediations, Inc.

Path: \\sat\SAT_Clients\SAT_DATA\02_GIS\Holloman_AFB\Project_Mxd_Documents\XU853_Missile_Test_Stand_Area_And_XU854_Able_51_Area\Figure_1-3_XU854_Able_51_Area MRS.mxd

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- M74 airburst simulator projectiles,
- Slap flares, and
- Smoke grenades

1.5.4 Climate

Holloman AFB is located in a semi-arid region within the northern portion of the Chihuahuan Desert. Its climate resembles other semi-arid regions with warm to hot summer days, cool nights, and mild winters. Monthly mean high temperatures range from 55 degrees Fahrenheit (°F) in January to 93.6°F in August. Monthly mean low temperatures range from 29°F in January to 66°F in July. Evapotranspiration is usually high due to dry air, large daily solar radiation totals, seasonally high winds, and warm temperatures. Seasonal fluctuation in precipitation rates is a result of prevailing wind directions, which can bring in frontal storms from the north or the Pacific or Caribbean cyclonic systems. Holloman averages 13.20 inches of annual rainfall. Nearly half of this amount falls within the months of July through September, known as the summer monsoons. Monsoon thunderstorms are generally short in duration and high in intensity. Occurrences are highly variable from year to year and one or two short-term events may contain a large percentage of the net annual precipitation.

1.5.5 Topography

Holloman AFB lies within the Tularosa basin of south-central New Mexico. This area is part of the Mexican Highland section of the Basin and Range physiographic province and is characterized by fault-block mountains interspersed with low desert plains and basins. The base lies on relatively flat alluvial plains below the Sacramento Mountains. These plains are bordered to the west by the White Sands dune field. Elevations range from 4,000 to 4,250 ft above mean sea level (Sky Research, Inc. [SKY], 2011).

The majority of XU853 is flat, with the Lost River channel running to the north and northwest of the MRS. The terrain of the XU854 MRS is relatively flat.

1.5.6 Soils

The soils on Holloman AFB are basin fill deposits formed primarily from alluvial and eolian processes. All soils have a high gypsum and salt content, primarily due to the eastern migration of gypsum sands from WSMR and White Sands National Monument. Alluvial floodplains on the eastern and southern portions of the base are basin fill deposits from the western slope of the Sacramento Mountains. Subsoils, or undersoils, are formed from sediments of Lake Otero, a Pleistocene lake formed during a climatic cycle of increased moisture. During periods of low precipitation, this large lake, reaching a depth of several hundred feet, would contract and leave salt and gypsum evaporates. Holloman AFB has three primary soil types: several associations and complexes of Holloman, Gypsum Land, and Yesum soils, located in the flats; Dune Land, found in the White Sands dunes; and Mead silty clay loam soil, found in the alluvial floodplains (including most jurisdictional wetlands). None of the soil types are very productive, due to high gypsum and salt content, and all are highly subject to both wind and water erosion when the vegetation is sparse or the soil is exposed.

Soils at the XU853 MRS consist of the Yesum Sandy Loam and Yesum-Nasa complex. Based on proximity with soil mapping units on Holloman AFB, soils at the XU854 MRS are assumed to consist of the Yesum-Nasa complex.

1.5.7 Geology

Holloman AFB is located in the Tularosa Basin, a downfaulted, closed, intermountain basin located in the southern portion of the Rio Grande Rift. The Tularosa Basin is a bolson, which is

a basin with no surface drainage outlet, in which sediments are carried by surface water into the closed basin and deposited (Bhate Environmental Associates, Inc., 2007). The Tularosa Basin is thought to have formed approximately 35 million years ago as a result of faulting, with the most recent formational activity having occurred as recently as 10,000 years ago. Basin fill of the Tularosa Basin is derived from the erosion of the uplifted material and fluvial deposits from the Rio Grande River. The Basin fill consists of unconsolidated coarse- to fine-grained alluvial fan deposits along the rims of the basin that are gradational toward the basin into finer-grained alluvial, fluvial, and lacustrine deposits. Evaporite materials, such as selenite, are present. Prominent local physiographic features include the Sacramento Mountains to the east, San Andres Mountains, and White Sands National Monument to the west (49th FW, 2009). The Tularosa Basin was formed as a structural trough during the Middle to Late Cenozoic era. Alluvial fill deposition includes sand, gravel, and clay in alluvial fans along the basin margins and extensive lake, alluvial, and evaporate deposits within the interior basin.

1.5.8 Hydrogeology

Streams sustained by groundwater discharge within the basin include Salt Creek and Malpais Spring. It is estimated that the groundwater resources of the Tularosa Basin contain over 100 million-acre feet of brackish groundwater. A wide range of water chemistries including sodium chloride, carbonate, and sulfate-based brine waters exist in the basin and water with salinity from 1,000 parts per million (ppm) Total Dissolved Solids (TDS), approximate to fresh water, to over 20,000 ppm TDS, approximate to sea water, can be found within the basin. The predominance of groundwater occurs as an unconfined aquifer in the unconsolidated deposits of the central basin. The primary source of groundwater recharge is percolation of rainwater and a minor contribution from stream run-off along the western edge of the Sacramento Mountains. Beneath Holloman AFB, depth to groundwater ranges from 5 ft to 50 ft below ground surface (bgs). Groundwater flow is generally toward the southwest with localized influences from the variations in base topography with shallower groundwater found on the southern end of the base (SKY, 2011).

1.5.9 Hydrology

The only permanent water in the Tularosa Basin is found in small streams between Alamogordo and Three Rivers, New Mexico. There are no perennial streams within Holloman AFB or in the nearby surrounding landscape; however, a set of perennial pools exist within the base. They are the final one-third of the Lost River, a set of pools near the confluence of Ritas and Malone Draws, and the Salt Lakes just south of the Lost River and Camera Pad Road Pond. The Rio Grande, located west of the San Andres Mountains, and the Pecos River, east of the Sacramento Mountains, are the closest perennial rivers in the region. There are at least nine prominent east-west drainages that receive intermittent flows during seasonal thunderstorms. The largest of these drainages is the Lost River drainage system, including alone Draw, Carter Draw, and Ritas Draw. Prior to extensive management of the surface topography and construction of U.S. Highway 70/82, Dillard Draw emptied into the Main Base, creating a network of flats and playas including what are now Lake Holloman, Stinky Playa, and Pond G. Construction activities have disrupted the natural flow of this wetland ecosystem (SKY, 2011).

The Lost River channel runs to the north and northwest of the XU853 MRS. There are no wetlands or surface water associated with the XU853 or XU854 MRSs.

1.5.10 Vegetation

The vegetation of Holloman AFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca also occur. Sensitive species that currently receive no federal protection include lichen (A. *clauzadeana*), proposed for rare and endangered listing and the grama grass cactus, included due to its former candidate status (SKY, 2011).

Vegetation within the XU853 and XU854 MRSs is consistent with desert scrubland.

1.5.11 Ecological Profile

No federally listed species covered under the Endangered Species Act currently reside at Holloman AFB. Several federally listed species, however, have been observed at the base in the past. Mountain plover (proposed federally threatened) nested at Lake Holloman during the 1980s. Brown pelicans (recently delisted) are occasionally observed at Lake Holloman and the constructed wetlands. Peregrine falcons (recently delisted) regularly forage at Lake Holloman. Five other sensitive species currently receive no federal protection: a lichen (*A. clauzadeana*), proposed for rare and endangered listing; the grama grass cactus, included due to its former candidate status; the White Sands pupfish, a state-endangered species; the western burrowing owl, a species of concern; and the western snowy plover, also a species of concern.

The Lost River, just north of the XU853 Missile Test Stand Area MRS, hosts one of only four known populations of White Sands Desert Pupfish (*Cyprinodon tularosa*). The White Sands Desert Pupfish is a federal species of concern and a threatened species in the state of New Mexico (New Mexico Department of Game and Fish [NMDGF], 2012).

A buffer extending 100 meters (330 ft) from either side of the center of the stream channel around the White Sands Pupfish habitat overlaps a portion of the XU853 MRS. No rare, threatened or endangered species are expected to inhabit either the XU853 or XU854 MRSs.

1.5.12 Buildings, Structure and Utilities Near/Within the MRSs

<u>XU853 Missile Test Stand Area</u>

Many of the buildings present at the MRS have been used for warehousing/general storage. Part of the MRS, including buildings 1105, 1106, 1107 and the nearby water tank and water tower, is currently in use by the Holloman AFB water distribution utility shop. Several unused structures of historical significance, Buildings 1113, 1116, and 1127, portions of the JB-2 Ramp and a Test Stand, thought to be a possible unfinished prototype for the Atlas-A ICBM, are also within the MRS area. Utilities associated with buildings/structures are expected to be present at the MRS. There are 148 buildings within a two-mile radius of the MRS. Operational mission support, recreational, and flight line support buildings are located to the southeast of the MRS within a four-mile radius.

<u>XU854 Able 51 Area</u>

Buildings 1440 and 1442 are within the MRS. Building 1440 has been either used for storage or has been vacant. Building 1442 is currently vacant. Both buildings are considered individually eligible for inclusion in the National Register of Historic Places (NRHP). There are 81 buildings

within a two-mile radius of the XU854 MRS. Operational mission support, recreational, and flight line support buildings are located to the southeast of the XU854 MRS within a five-mile radius. Utilities associated with buildings/structures on-site are expected to be on/near the XU854.

1.6 Previous Investigations

Previous investigations performed at the Missile Test Stand Area and Able 51 Area MRAs included:

- Modified CSE Phase I Report (Shaw Environmental, Inc. [Shaw], 2010); and
- CSE Phase II Report (HDR, 2013).

1.6.1 Modified CSE Phase I

Modified CSE Phase I was completed in 2010. Prior to the start of the CSE Phase I, no MRAs had been discovered at Holloman AFB and it was believed that there was a low probability of a significant number of MRAs being found at the base. Therefore, the USAF has modified the CSE Phase I process by deferring some actions typically performed in a Phase I, to the CSE Phase II, if a Phase II is required. For this Modified CSE Phase I, it was determined that a CSM and MRSPP and Hazard Ranking System scoring elements were not required. The activities performed during the CSE Phase I included identification and review of data repositories located both on and off the installation, interviews with base personnel, and visual surveys.

Modified CSE Phase I Results for the Missile Test Stand Area MRA

A visual survey was performed at the Missile Test Stand Area MRA during the Modified CSE Phase I. No MEC, MD or small arms were identified and no MC sampling was conducted at the MRA. However, since historical use of this site as a missile test/launch facility may have resulted in MC release, the site was recommended for further evaluation during the CSE Phase II.

Modified CSE Phase I Results for the Able 51 Area MRA

A visual survey was performed at the Able 51 Area MRA during the Modified CSE Phase I. No MEC or MD other than small arms debris was observed. Several 5.56mm blank cartridges were observed on the ground in the vicinity of buildings 1440 and 1442 and appeared to be unfired or possibly misfires. No MC sampling was conducted at the MRA during the CSE Phase I. Since historical use of this site as a missile test/launch facility may have resulted in MC release, the site was recommended for further evaluation during the CSE Phase II.

1.6.2 CSE Phase II

A CSE Phase II investigation was performed at both Missile Test Stand Area and Able 51 Area MRAs. The field activities included:

- Visual surveying to identify MEC or MEC-related items and/or features,
- Sampling and analysis of surface and/or subsurface soil to determine if MC, hazardous substances, pollutants and contaminants, or other constituents have been released into the environment.

Both sites were prioritized for further munitions response actions, based on relative risk, using the MRSPP scoring system. The MRS Priority is determined by selecting the highest rating from

the Explosives Hazard Evaluation (EHE), Chemical Hazard Evaluation (CHE), and Human Health Hazard Evaluation (HHE) modules and ranges from 1 to 8. Priority 1 and 8 indicate the highest and the lowest potential hazards, respectively. Only a site with a chemical warfare hazard can receive an MRS Priority of 1.

CSE Phase II Results for the Missile Test Stand Area MRA

Structures identified at the MRA during the CSE Phase II visual survey included the GAPA, NATIV, JB-2 Loon, Aerobee, and Test Stand complexes.

Observed small arms debris associated with recent training activities were comprised of 5.56mm, 7.62mm, and .50-caliber. Intact small arms ammunition (5.56mm and 7.62mm) were also documented and disposed of by Holloman AFB EOD. MD items associated with recent training activities included 30 mm casings and links just east of the northern end of the ramp at the JB-2 Loon complex located in the northern portion of the MRA. The Aerobee complex and Test Stand area are located western portion of the MRA, where multiple Aerobee fins, as well as a set of Aerobee fins still attached to an expended booster motor and expended M74A1 40mm flare cartridge casings were documented. A possible fuel release was also observed in the southwest portion of the MRA near the Aerobee launch pad, consisting of a single chip of an orange substance with a strong kerosene odor. Expended M18 smoke grenades and the tail boom from an 81mm Illumination Mortar were observed in the southern portion of the MRA. An expended MK 13 Day & Night Distress Signal was documented in the central part of the MRA. Three expended 5-inch rocket motors were used to denote a survey marker in the southeastern corner of the MRA. An additional expended 5-inch rocket motor was observed in the western part of the MRA, north of the Test Stand.

No MEC was encountered in the MRA during the visual survey; therefore, no MC sampling was conducted in the MRA. -Although intact Small Arms Ammunition (SAA) was identified during the visual survey, there is no historical record of small arms training conducted at the MRA, and since the CSE Phase II visual survey did not discover any evidence of formal small arms training (e.g., targets, berms, and firing positions), the small arms debris discovered at the MRA during the CSE Phase II suggest recent but minor usage of small arms. Therefore, no MC sampling for lead was conducted in the MRA. As a result, no human health or ecological screening was conducted for this site. The CSE Phase II concluded that any human health or ecological risks at this site was expected to be similar to background conditions.

Based on the presence of surface MD within the MRA, the entire Missile Test Stand Area MRA (204.6 acres) was identified as the XU853 MRS at the conclusion of the CSE Phase II. This MRS obtained an MRSPP score of 6 and was recommended for further munitions response action.

CSE Phase II Results for the Able 51 Area MRA

During the CSE Phase II visual survey, the launch site and support buildings which consisted of an observation building, the launch shelter, and concrete launch pads were present and generally intact, but fenced and locked.

Intact small arms ammunition (5.56mm and 7.62mm), small arms munitions debris (.22-caliber, 5.56mm, 7.62mm, .38-caliber, .45-caliber, and .50-caliber) and MD (40mm flares, M74 airburst simulator, projectiles, slap flares, and smoke grenades) were discovered at the site. It was

concluded that the small arms debris and MD items documented during visual surveys were likely associated with recent small arms training activities.

No MEC or missile debris were observed during the visual survey; therefore, no MC sampling was conducted in the MRA Although intact SAA was identified during the visual survey, there is no historical record of small arms training conducted at the MRA, and since the CSE Phase II visual survey did not discover any evidence of formal small arms training (e.g., targets, berms, and firing positions), the small arms debris discovered at the MRA during the CSE Phase II suggest recent but minor indocumente usage of small arms. Therefore, no MC sampling for lead was conducted in the MRA. As a result, no human health or ecological screening was conducted for this site. The CSE Phase II concluded that any human health or ecological risks at this site was expected to be similar to background conditions.

Based on the presence of surface MD within the MRA the identified 47.7-acre XU854 MRS obtained an MRSPP score of 6 and was recommended for further munitions response action at the conclusion of the CSE Phase II.

1.7 Conceptual Site Models

1.7.1 MEC Exposure Pathway Analysis

MEC Exposure Pathway Analysis for XU853 and XU854 MRSs are shown in **Figures 1-4** and **1-5,** respectively. Since the historical activities at both sites were designed for testing rockets and missiles, it is unlikely that the test items contained high explosives. However, MD items were identified at both MRSs during the CSE Phase II visual survey including expended smoke grenades and hand grenade simulators which present a potential explosive hazard.

Human receptors at both XU853 and XU854 MRSs include authorized personnel, contractors and possibly trespassers. Due to restricted access to the XU854 MRS, base residents and visitors are considered human receptors at XU853 MRS only.

The MEC exposure pathways at XU853 and XU854 MRSs are shown to be potentially complete for MEC at surface and in the subsurface for all human scenarios.

Biota are generally not considered when evaluating MEC risk because, with the exception of threatened and endangered species, risk to biotic receptors is usually evaluated at the population level. Though an individual ecological receptor may experience a negative affect from encountering MEC, MEC does not pose risk to biotic populations unless a large area of habitat were to be destroyed, for example, by a large detonation. Since rare, threatened, and endangered species are not expected to inhabit the XU853 and XU854 MRSs, MEC exposure pathways to biota are shown as incomplete.

1.7.2 MC Exposure Pathway Analysis

MC Exposure Pathway Analysis for both XU853 and XU854 MRSs are shown in **Figures 1-6** and **1-7,** respectively.

In general, migration pathways involve movement via air, water, soil, and the interfaces between these media. Based on the types of releases and the characteristics of MC/Contaminants of Potential Concern (COPCs), the fate and transport of contaminants at Holloman AFB is expected to occur mainly in the terrestrial environment, but there is potential for migration by aquatic and atmospheric pathways as well.

In the terrestrial environment, if the contaminant is released to soil, it may volatilize, adhere to the soil by sorption, leach into the groundwater system with precipitation, or degrade due to chemical (abiotic) or biological (biotic) processes. If the contaminant is volatilized from soil, it may be released to the atmosphere or migrate to groundwater. Constituents that are dissolved in groundwater may eventually be transported to a surface aquatic environment. There are no known aquatic environments present within the XU853 and XU854 MRSs. However, since Lost River is adjacent to the XU853 MRS and since there is the potential for overland flow during storm events, this MC pathway for biota is shown as potentially complete at XU853.

In the atmospheric environment, contaminants may exist as vapors or as suspended particulate matter. The transport of contaminants relies mostly on wind currents, and continues until the contaminants are returned to the earth by wet or dry deposition. Degradation of organic compounds in the atmosphere can occur due to direct photolysis, reaction with other chemicals, or reaction with photochemically generated hydroxyl radicals. Based upon the data collected during CSE Phase II activities, transport of MC/COPCs via the atmospheric environment is unlikely at Holloman AFB and therefore at XU853 and XU854 as well.

Human receptors at both XU853 and XU854 MRSs include authorized personnel, contractors and possibly trespassers. Due to restricted access to the XU854 MRS, base residents and visitors are considered human receptors at XU853 MRS only. Since CSE Phase II results suggest potential presence of MEC (potential sources of MC) at surface and in the subsurface, all soil pathways are shown as potentially complete for these two MRSs.

There is no present-day human exposure to groundwater at Holloman AFB. The aquifer below Holloman AFB is an unconfined sole source brackish aquifer, with an average depth to GW of 5 ft. to 50 ft. bgs. Groundwater flow beneath the installation generally occurs from the northeast to the southwest, and depths to groundwater tend to be shallowest toward the main installation. Depending on future land use, there is a possibility that groundwater supply wells could be put in place for domestic and/or industrial uses, though the high total dissolved solids in the aquifer indicates that the water would likely need pretreatment before it was considered potable. Therefore, exposure pathways are shown to be potentially complete for MC in ground water for future base residents (ingestion and dermal contact at both MRSs.

MC exposure pathways to biota are shown as incomplete for surface/subsurface soil and potentially complete for the groundwater root uptake pathway at both MRSs.

1.8 Current and Potential Future Land Uses

1.8.1 XU853 MRS

Currently, the XU853 MRS is inactive; however, many of the facilities and buildings remain. Many of the buildings present at the MRS have been used for warehousing/general storage. Part of the MRS, including buildings 1105, 1106, 1107 and the nearby water tank and water tower, are currently in use by the Holloman AFB water distribution utility shop. No future land usage changes for this site are known at this time. There is no fencing or other controls associated with the XU853; however, access to Holloman AFB requires admittance through the security gate and there is a fence around the installation. Therefore, access to the XU853 is restricted for the general public, but is open to base personnel, contractors, and base residents. The goal of MMRP efforts at this MRS is site closeout (unrestricted use/unlimited exposure) so land could be used for any purpose (e.g., residential, day care) without any controls or restrictions.

1.8.2 XU854 MRS

The XU854 MRS is currently unused; however, recent evidence suggests the site may be periodically used for small arms related training activities. No future land usage changes for this site are known at this time. The XU854 MRS lies just west of the Holloman AFB main installation boundary; however, the MRS is located on Holloman AFB property. There is a locked gate located at the end of the main access road. The combinations for the locks to access the area are controlled by Holloman Security Forces. Access to the XU854 Able 51 Area is restricted to authorized personnel and contractors. The goal of MMRP efforts at this MRS is site closeout (unrestricted use/unlimited exposure) so land could be used for any purpose (e.g., residential, day care) without any controls or restrictions.

Figure 1-4 XU853 MRS MEC Pathway Analysis

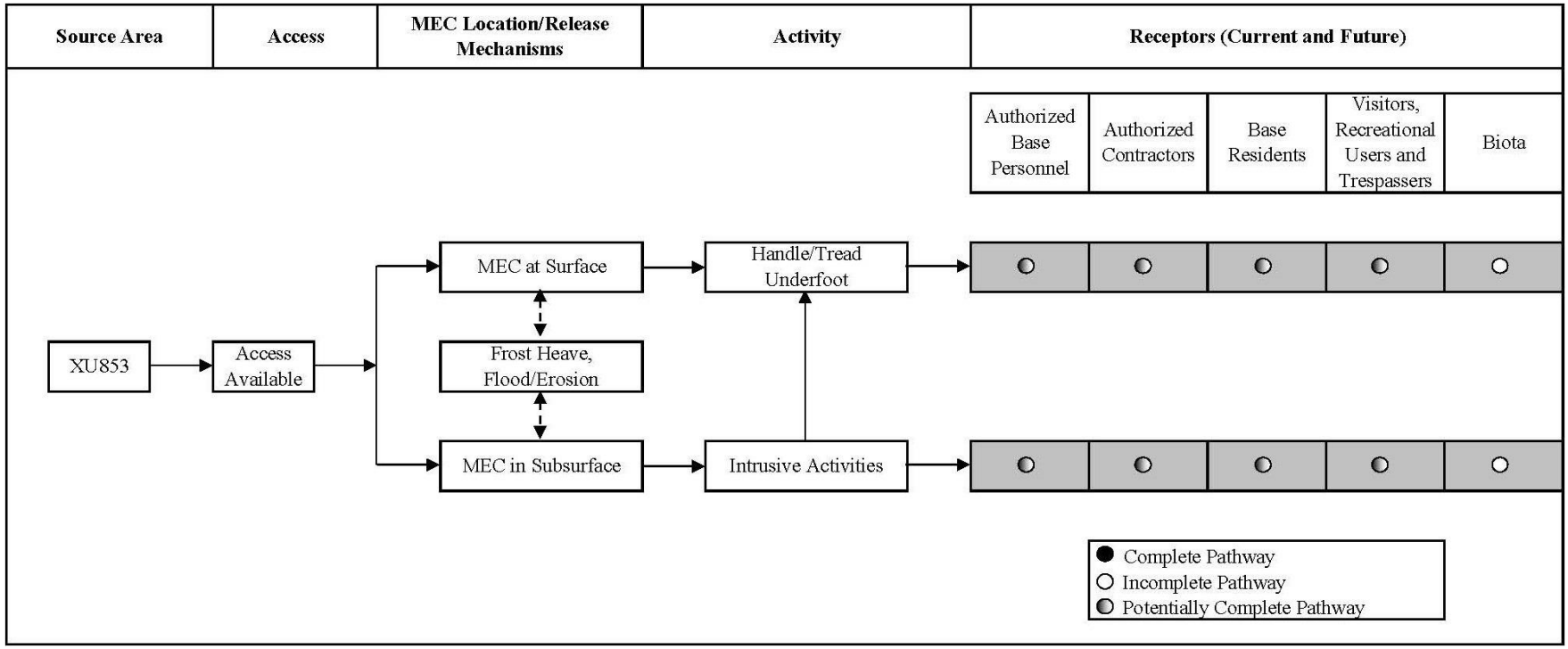


Figure 1-5 XU854 MRS MEC Pathway Analysis

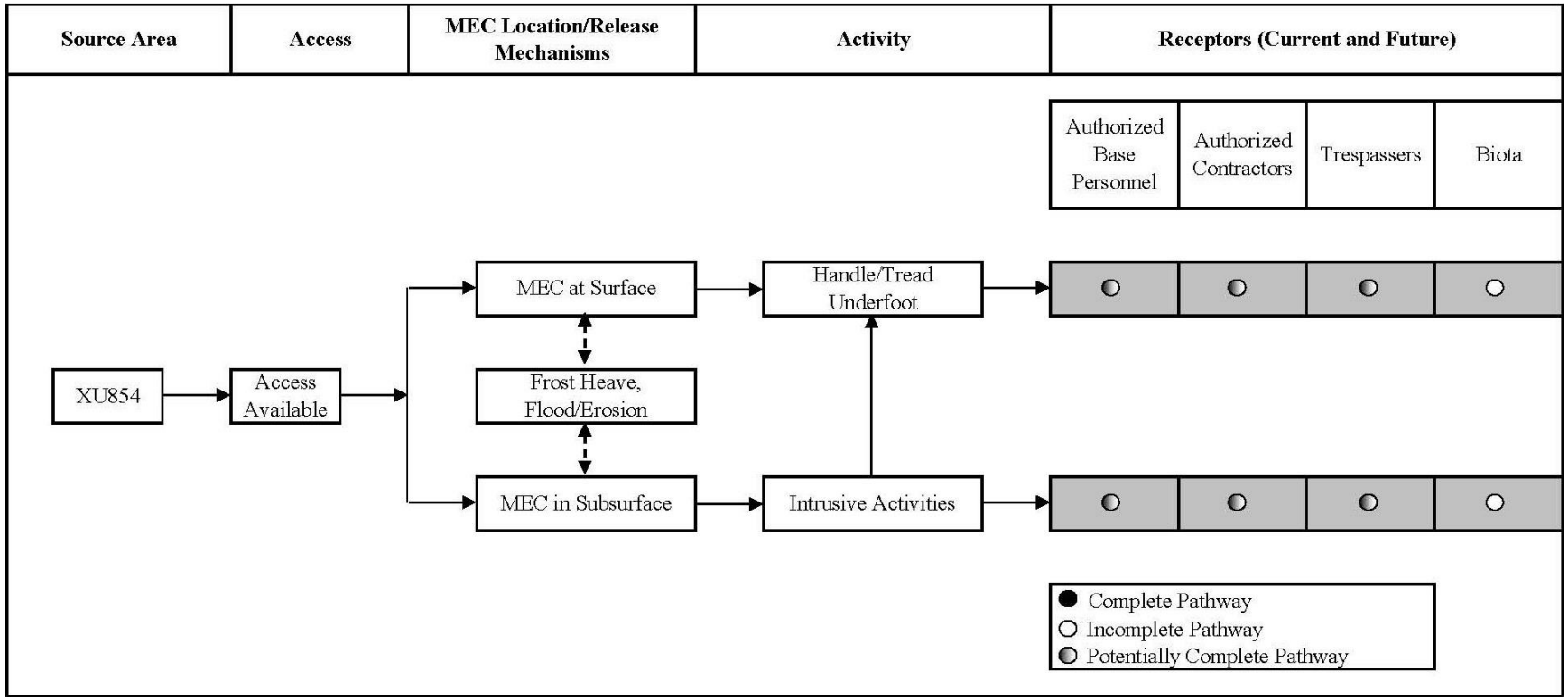


Figure 1-6 XU853 MRS MC Pathway Analysis

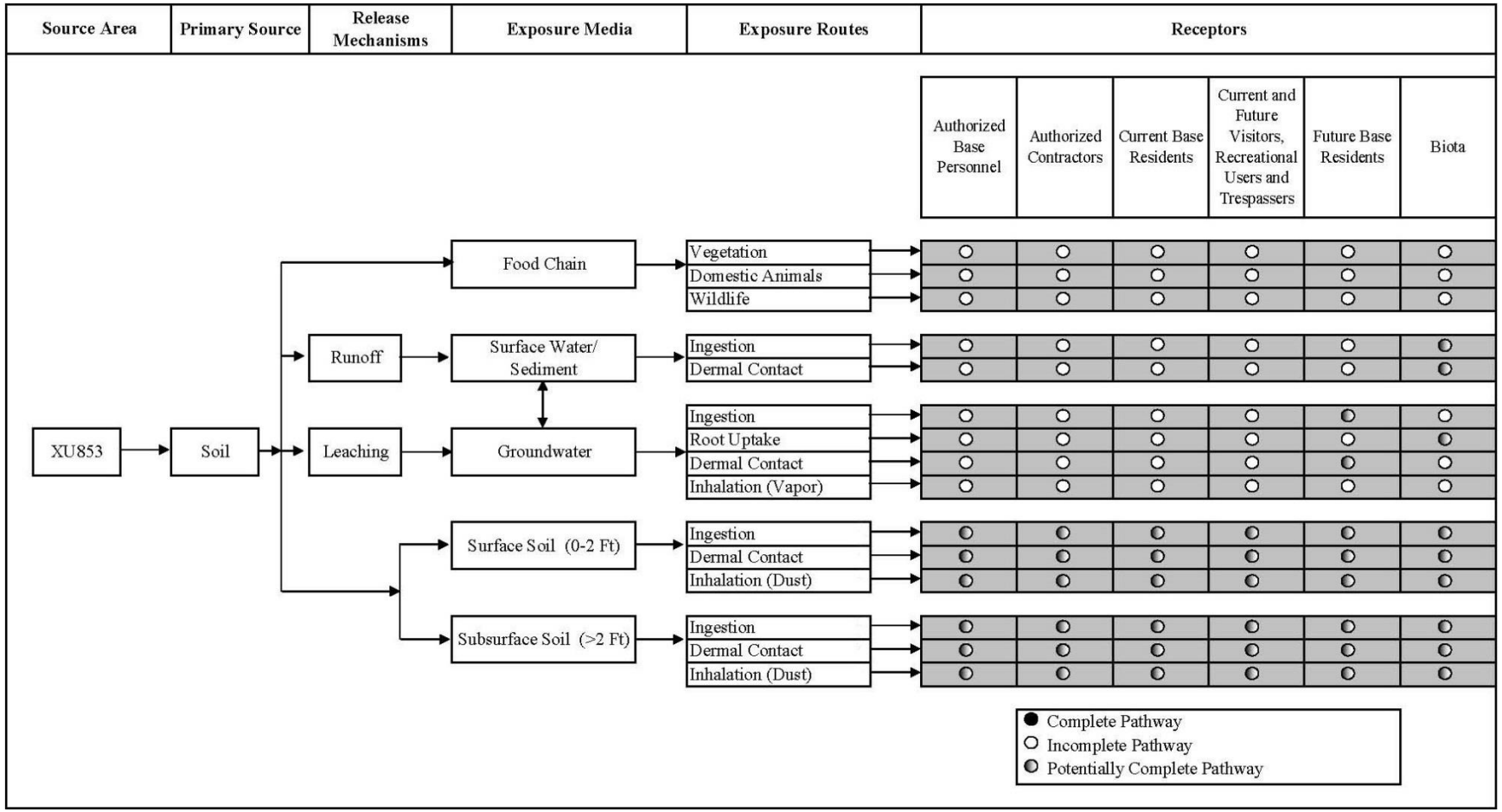
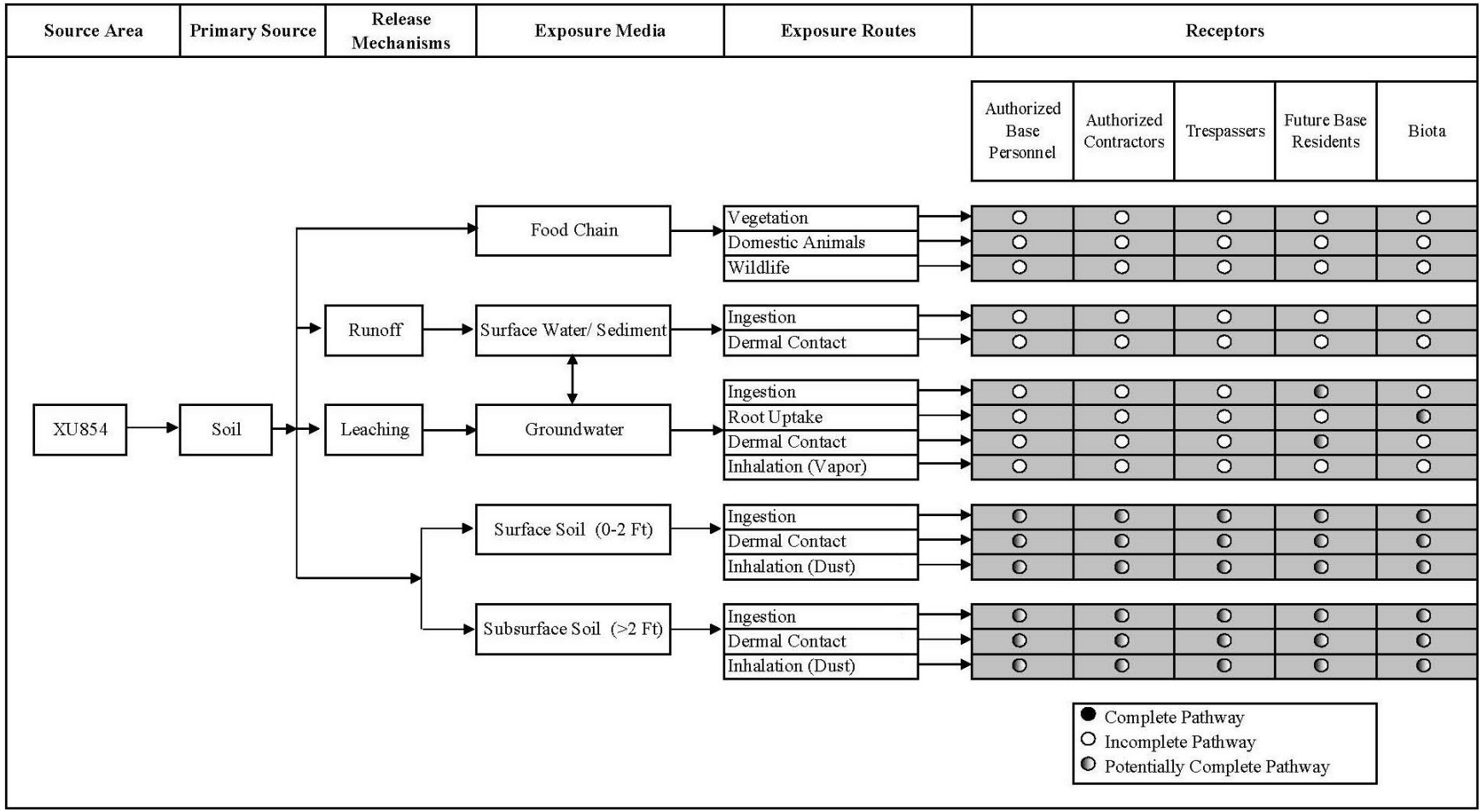


Figure 1-7 XU854 MRS MC Pathway Analysis



2.0 TECHNICAL MANAGEMENT PLAN

For the RI process to be successful, close coordination and cooperation between the stakeholders, community regulators, and technical support personnel must occur. The following sections describe the technical management approach for the RI characterization activities at both the XU853 and XU854 MRSs. The Technical Management Plan details the organizational structure roles and functions of the project management approach methods and operational procedures that will be used during the RI.

2.1 Project Objectives

The objectives of the RI are to:

- Assess hazards associated with MEC/ MPPEH, including potential nature and extent,
- Characterize nature and extent of MC (explosives and/or metals), if MEC/MPPEH/MD is found,
- Characterize nature and extent of contamination related to both propellants and possible fuel release, if any,
- Perform MEC HA and a risk screening for MC, if necessary,
- Provide adequate information for future FS,

2.2 Project Organization

The RI for XU853 and XU854 will be completed by FPM using subcontractors as needed. A project team organization chart, illustrating the relationships of key project personnel for the RI has been provided in **Figure 2-1**. Close coordination will be maintained with the project delivery team consisting of AFCEC, Holloman AFB, New Mexico Environment Department (NMED), and United State Environmental Protection Agency (USEPA) Region 6. In addition, FPM will maintain close coordination with the installation office of Natural Resources, the Cultural Resources Manager, the HAFB Environmental Chief, and appropriate Federal and State authorities throughout RI field activities.

2.3 Contractor Personnel

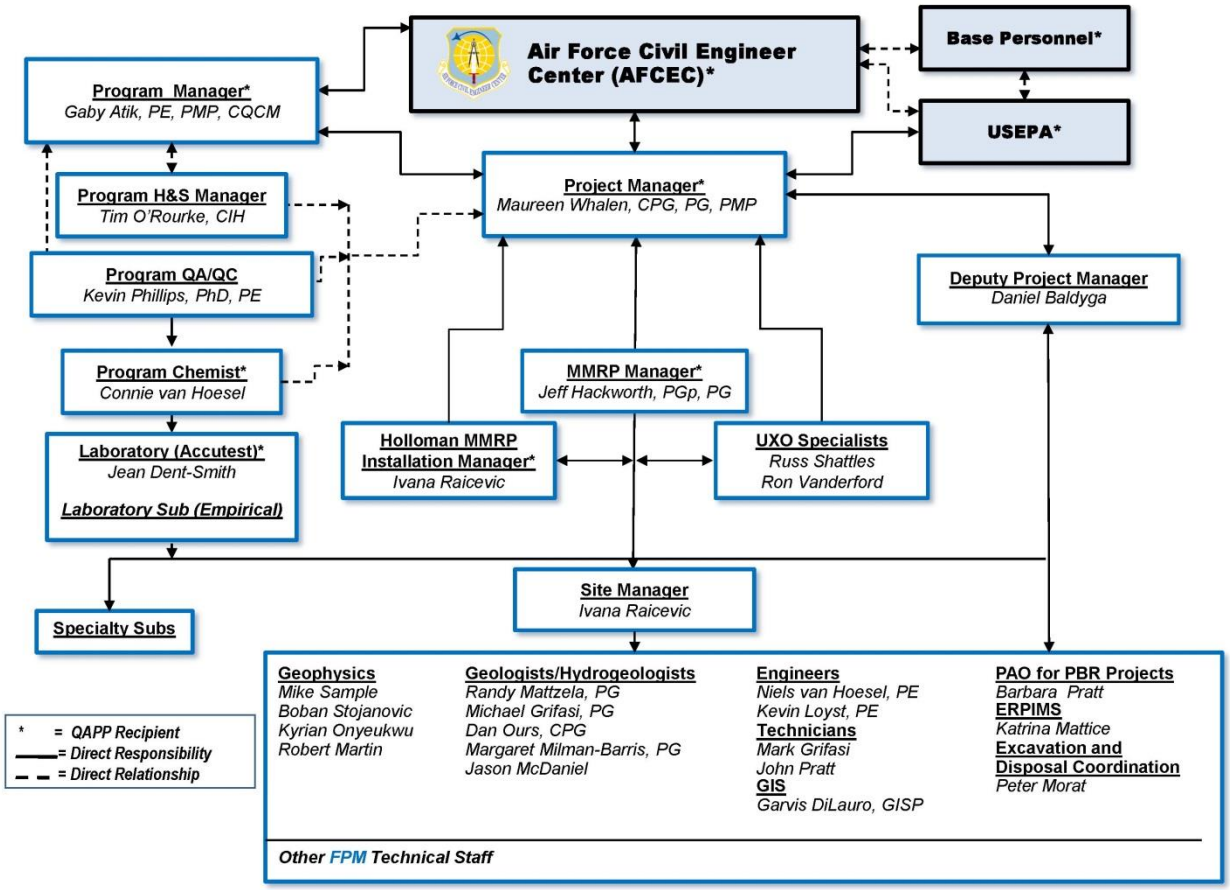
The FPM project team will consist of personnel experienced in MEC/MPPEH/MD and MC investigations. Key contractor project team members will include a Program Manager, Project Manager (PM), MMRP Manager, Munitions Response Safety and QC Managers and Program Chemist. Key field personnel and project staff will include a Senior UXO Supervisor (SUXOS), a dual-hat UXO Safety Officer (UXOSO)/ UXOQC Specialist (UXOQCS), UXO technicians, Project Geophysicists/Scientists, MC sampling personnel, and chemists. Authorization documentation for UXO personnel will be available at the site for inspection or verification, as required. Data evaluation and reporting will require the efforts of chemists and human and ecological risk assessors. The roles and responsibilities of contractor project personnel are detailed below.

2.3.1 Project Manager

The FPM PM will be responsible for monitoring the overall progress of the project, reviewing monthly progress reports, and checking that necessary resources are available to the MMRP

Manager. The PM will also maintain close communication with the AFCEC/Holloman AFB to assess their satisfaction during performance on this contract.

Figure 2-1 Project Organization Chart



2.3.2 MMRP Manager

The MMRP Manager will have authority to do the following:

- Assign key personnel and take corrective action for unacceptable performance,
- Reviewing and approving all project deliverables,
- Reporting to the PM on budget, technical, schedule, and quality issues,
- Approving labor charges, subcontractor invoices, and other direct cost expenditures,
- Coordinating daily work and ensuring technical quality of all activities,
- Supervising and overseeing all field activities, and
- Stop, amend, or curtail work for quality, health and safety, regulatory, or operational deficiencies.

2.3.3 MMRP Installation Manager

The MMRP Installation Manager is responsible for implementing the project such that technical, financial, and scheduling objectives are successfully completed and reports directly to the MMRP Manager. The MMRP Installation Manager has the authority to commit the resources necessary to meet project objectives and requirements. The MMRP Installation Manager will be responsible for the following:

- Serving as the POC for management/technical direction of RI tasks,
- Executing tasks to meet scope, schedule and budget constraints,
- Selecting and directing technical personnel on the task,
- Preparing schedule, and monthly progress input to the PM,
- Reviewing and approving all project deliverables, and
- Supervising and overseeing subcontractors.

2.3.4 Senior Unexploded Ordnance Supervisor

The SUXOS will meet applicable requirements of Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP), Minimum Qualifications for UXO Technicians and Personnel 18 (DDESB, 2004). The SUXOS reports directly to the MMRP Installation Manager and will confirm that field personnel conduct MEC operations at the site IAW the RI WP and in a systematic manner using proven operating methods and techniques. Typical responsibilities include:

- Planning, coordinating, and supervising explosives operations,
- Coordinating on-site field activities with the MMRP Manager (e.g., intrusive investigations) to minimize impacts to productivity and to confirm compliance with the Base-Wide HASP (**Appendix B**),
- Directly interfacing with and relaying safety and health concerns to the MMRP Manager,
- Managing on-site manpower and equipment necessary to safely conduct the tasks associated with the field investigation,
- Preparing and submitting a detailed daily accounting of activities performed each workday, and
- Performing a final inspection of MPPEH and certifying it to be free of any explosive hazard.

2.3.5 Unexploded Ordnance Safety Officer/ Quality Control Specialist

The UXOSO/QCS will serve a dual role as the projects UXOSO and UXOQCS. The UXOSO/QCS will meet applicable requirements of DDESB TP18 (DDESB, 2004) for both the UXOSO and UXOQCS. The UXOSO/QCS is responsible for implementing and enforcing the safety and health requirements listed in the Base-Wide HASP. The UXOSO/QCS is also responsible for implementing and enforcing the UFP-QAPP and verifying elements of the RI WP. The UXOSO/QCS reports to the FPM UXO Safety/QC Manager and responsibilities include, but are not limited to:

Safety Responsibilities

- Evaluating MEC and explosives operational risks, hazards, and safety requirements,
- Conducting the UXO safety briefings for project and visiting personnel,
- Conducting and documenting daily safety inspections and weekly safety audits,
- Developing and implementing corrective action plans to eliminate or mitigate hazards,
- Monitoring compliance with the safety measures contained in the HASP and associated documents during field activities,
- Confirming the proper use of Personal Protective Equipment (PPE) IAW the requirements of the HASP,
- Establishing and verifying compliance with site-specific safety requirements,
- Implementing health and safety training and medical surveillance monitoring,
- Investigating and documenting injuries, illnesses, accidents, incidents, and near-misses,
- Establishing and maintaining Minimum Separation Distances (MSDs) during field operations IAW the DDESB-approved ESS, and
- Stopping work if health and/or safety are jeopardized or compromised.

QC Responsibilities

- Verifying compliance with MMRP-related DoD publications, AFCEC and Holloman AFB documents, as well as local, state, and federal statutes and codes,
- Conducting QC final acceptance sampling inspections,
- Checking for defective or damaged equipment,
- Verifying appropriate personnel are being utilized during field investigation activities, maintaining inspection and surveillance documentation (e.g., QC reports, equipment standardization results and equipment maintenance results, and nonconformance and corrective action documents),
- Performing and documenting daily inspections/surveillances of job site activities on a Daily QC Report (DQCR) form,
- Verifying that required equipment tests and checks have been performed and that inspection and standardization results comply with specifications, and
- Issuing a stop work order for unsafe or for any major quality nonconforming conditions.

2.3.6 Program Chemist/Chemical Quality Control Manager

The Program Chemist reports directly to the FPM PM and will be responsible for execution of the MC characterization. The Program Chemist will be responsible for the development of the site-specific UFP-QAPP. In addition the Program Chemist will conduct the data evaluation and validation efforts on all chemical analyses. Additional duties include:

- Serving as the primary POC for technical coordination of the Environmental/MC sampling and analyses program,

- Developing and monitoring implementation of the Chemical QC Plans and UFP-QAPP for environmental/MC sampling,
- Developing and insuring compliance with chemical Data Quality Objectives (DQOs),
- Directing the analytical laboratory coordination during sampling activities,
- Reviewing and validating laboratory analytical data IAW the UFP-QAPP, United States Army Corps of Engineers (USACE) Data Quality Evaluation Guidance (if applicable), DoD Quality Systems Manual, and the USEPA National Functional Guidelines,
- Preparing data validation reports and QC Summary Reports for documentation of compliance with DQOs,
- Evaluating data completeness and usability with respect to DQOs,
- Preparing data usability reports,
- Performing field audits to evaluate compliance with the UFP-QAPP and field sampling protocols, and
- Participating in laboratory audits.

2.3.7 Quality Control Geophysicist

The QC Geophysicist will provide QC/Quality Assurance (QA) oversight of the geophysical effort. This individual shall have a degree in geophysics, geology, geological engineering, or a closely related field, and shall have a minimum of 5 years of directly related geophysical experience such as data collection, processing, and interpretation sufficient to provide oversight of the geophysical processes and quality of results. The QC Geophysicist reports to the MMRP Manager and will be responsible for:

- Developing and implementing the geophysics QC program,
- Developing daily QC databases,
- Developing QC figures,
- Developing summary tables to include all positional and production QC data,
- Reprocessing 10% of the production data,
- Posting all raw and production QC data to SharePoint, and
- Reviewing Instrument Verification Strip (IVS) and Blind Seeding Program (BSP) results.

2.3.8 Project Geophysicist

The Project Geophysicist has overall responsibility for design, implementation, and management of all geophysical investigations required for the work effort, but may not be on-site full time. This individual shall have a degree in geophysics, geology, geological engineering, or a closely related field, and shall have a minimum of 5 years of directly related geophysical experience. The Project Geophysicist will report directly to the MMRP Installation Manager. The Project Geophysicist will assist in providing solutions to geophysical problems encountered in the field in order to meet the required geophysical objectives of the project. The Project Geophysicist for

this project meets the requirements defined in Data Item Description (DID) Number OE-025.02, Personnel/Work Standards (USACE, 2004). Typical responsibilities include:

- Recommending experienced and qualified personnel and maintaining the geophysical staff throughout the project. Coordinating field teams and support personnel to ensure consistency of performance and meeting established schedules,
- Providing technical leadership in the disciplines of geophysics, statistics, and QC and QA of the geophysical data. Using experienced personnel to process and assess the quality of the Real-Time Kinematic Global Positioning System (RTK-GPS) data,
- Establishing a list of equipment, computers, materials, and supplies necessary to perform the task,
- Developing and implementing the Geophysical System Verification (GSV),
- Monitoring technical performance of team members,
- Performing technical reviews of all deliverables,
- Approving contributions to any technical deliverable for any work element,
- Serving as the primary point-of-contact for technical coordination of project geophysical requirements,
- Reporting to the MMRP Manager on budget, technical, schedule, and quality issues relating to geophysics, and
- Coordinating daily work and verifying technical quality of geophysical activities.

2.3.9 Site Geophysicist

The Site Geophysicist will be on site at all times and is required to oversee the day-to-day operations of the site geophysical investigations. This individual shall have a degree in geophysics, geology, geological engineering, or a closely related field. The Site Geophysicist will be assigned when field work commences. The Site Geophysicist for this project meets the requirements of DID OE-025.02 (USACE, 2004). The specific responsibilities of the Site Geophysicist include the following:

- Scheduling field crew activities in concert with the Project Geophysicist,
- Ensures the entire geophysical team attends the Daily "Tailgate" Safety Briefing each day,
- Coordinate all field activities with the SUXOS,
- Coordinate all QC/QA checks with the UXOQCS,
- Adhere to Team Separation Distances at the Site,
- Observe the “Buddy System” safety rule,
- Establishing and maintaining communications with team personnel, UXOSO; SUXOS; UXO Team Leader,
- Maintaining data acquisition-related paperwork and ensuring its accuracy,

- Coordinating and directing activities of all personnel on the geophysical field team, including setting and enforcing the schedules required to achieve the goals for each day's activities,
- Supervising geophysical field operations and related surveying activities, including directing field team activities,
- Logging all activities at the geophysical survey site in the field logbook and maintaining relevant files,
- Ensuring that all materials needed at the survey site are in stock (e.g., geophysical equipment, writing materials, tape, diskettes, markers, etc.),
- Planning the field data acquisition schedule for the next day with the Project Geophysicist,
- Checking sites to be surveyed and access routes in advance of data acquisition activities,
- Reporting the level of effort expended to the Project Geophysicist on a daily basis,
- Downloading data at the processing center on a daily basis,
- Performing daily repeatability checks at the specified area for all geophysical instrumentation and RTK-GPS instruments,
- Analyzing current field procedures on a daily basis and refining approaches to improve the efficiency and/or quality of the data based on site-specific survey conditions,
- Inventory all rental equipment to determine that all necessary items have been received and that the equipment is in working order, and
- Record and maintain an inventory of all geophysical equipment on site. The document should include all serial numbers of the geophysical equipment.

The authority of the Site Geophysicist includes shutting down geophysical operations on site to prevent compromising technical quality.

2.3.10 UXO Technician III/Team Leader

UXO Technician III (UXO III) will meet all applicable requirements of DDESB TP18 (DDESB, 2004) and will report directly to the SUXOS. The UXO III will supervise a project team performing work on this project and may also serve in the capacity of Demolition Supervisor during demolition and explosive demilitarization operations. This individual will meet all applicable requirements of DDESB TP18. Typical responsibilities include:

- Supervising the team to which he/she is assigned,
- Providing the MEC subject matter expertise to ensure the team's safety and the project's quality,
- Ensuring the team's actions are accomplished safely and efficiently,
- Maintaining a field logbook related to the team's operations,
- Implementing the work, safety and quality plans for this project,
- Supervising the conduct of all on-site evaluations directly related to MEC operations,

- Being familiar with the duties of all assigned personnel and being able to perform all of the functions enumerated for UXO Technicians I and II, and
- If assigned as a Demolition Supervisor during demolition operations, the UXO III is also responsible for:
    - Ensuring all personnel are familiar with the nature of the materials, hazards, and precautions,
    - Coordinating with the SUXOS to ensure all notifications are completed prior to demolition, and
    - Along with the SUXOS and UXOSO/UXOQCS being present and in direct control during all on-site disposal operations.

2.3.11 UXO Technician II

UXO Technician II (UXO II) personnel will meet all applicable requirements of DDESB TP 18 (DDESB, 2004) and will report to the UXO III/Team Leader for field operations. This individual will meet all requirements of DDESB TP-18. The UXO II is responsible for performing daily operations as directed by the SUXOS. The UXO II responsibilities include, but are not limited to:

- Perform field collection procedures to identify contaminated soil,
- Prepare an on-site holding area to temporary store MEC that has an acceptable risk of movement,
- Investigate anomalies to confirm the presence of MEC or MD,
- Conduct explosive demolition operations to dispose of MEC items,
- Supervise and mentor UXO Tech I personnel during all field operations,
- Perform land navigation techniques,
- Transport UXO that has been determined Safe to Move,
- Escort personnel who are not directly involved in UXO-related operations, but have activities to perform within exclusion areas,
- Inspect MPPEH for the presence of explosive safety hazards, and
- Be capable of performing all activities of a UXO Technician I (UXO I).

2.3.12 UXO Technician I

UXO I personnel will meet all applicable requirements of DDESB TP18 (DDESB, 2004) and will report to the UXO III/Team Leader. The UXO I will be responsible for performing daily operations as directed by the SUXOS. The UXO I responsibilities include but are not limited to:

- Reconnoiter and classify UXO and DMM,
- Identify all types of military munitions,
- Excavate subsurface UXO and DMM,
- Perform demolition operations,

- Operate personnel decontamination stations,
- Assist in the inspection of MPPEH for the presence of explosive hazards,
- Construct UXO-related protective works,
- Perform field collection procedures to identify contaminated soil, and
- Perform land navigation techniques.

2.3.13 Team Subcontractors

URS Group, Inc. (URS) has been selected as a team subcontractor to perform various reach-back services. URS has significant experience in performing RI and has teamed with FPM over the past eight years on numerous DoD contracts and task orders.

Accutest Laboratories Southeast, Inc. of Florida has been selected as the analytical laboratory to support this project. Accutest Laboratories Southeast, Inc. holds DoD Environmental Laboratory Accreditation Program.

Empirical Laboratories, LLC of Tennessee has been subcontracted by Accutest Laboratories Southeast, Inc. to conduct analysis of one analyte (Nitrocellulose). Empirical Laboratories, LLC of Tennessee holds DoD Environmental Laboratory Accreditation Program.

2.4 Project Communication and Reporting

The operational and administrative lines of communication for the RI are identified in **Figure 2-1**. To assure consistency throughout the project, the FPM PM will be the primary POC between the stakeholders and project personnel. The FPM MMRP Installation Manager will provide AFCEC/Holloman AFB with monthly project status reports to communicate activities completed during the month, difficulties encountered, corrective actions taken, activities planned for the next month, and updates to the project schedule. POC information for the XU853 and XU854 RI is included in **Appendix C**.

2.5 Project Deliverables

The major project deliverables include:

- Project Management Plan – Submitted in Draft and Final versions to the AFCEC and Holloman AFB for review.
- UFP-QAPP – Submitted in a Draft version to the AFCEC and Holloman AFB for review and finalization.
- ESS – Submitted in Draft and Final versions to the AFCEC and Holloman AFB for review, including 49th Wing, the Air Force Safety Center, and DDESB.
- RI WP – Submitted in Draft, Draft-Final, and Final versions to the AFCEC and Holloman AFB, and Draft Final and Final versions to the regulatory agencies for review.
- RI Report – Submitted in Draft, Draft-Final, and Final versions to the AFCEC and Holloman AFB, and Draft-Final and Final versions to the regulatory agencies for review.

2.6 Project Schedule

The project schedule is presented in **Table 2-1**. FPM will update the project schedule each month and report schedule changes in monthly progress reports submitted to the AFCEC PM and Holloman AFB throughout the project duration.

Table 2-1 Project Schedule

Activity	Date
Final RI WP	October 2014
RI Fieldwork	November 2014
Draft RI Report	December 2014
Final RI Report	July 2015

2.7 Periodic Reporting

2.7.1 Progress Reports

FPM will submit monthly progress reports to, and host a monthly teleconference with the AFCEC and Holloman AFB. Additionally, FPM will prepare weekly progress reports during field activities.

2.7.2 Daily Site Reports

A daily site report will be included as part of the RI Report. The Daily Site Report will include:

- A concise summary of daily activities
- Personnel on-site
- Ordnance or ordnance related material encountered
- Changed conditions, delays or conflicts encountered
- A consolidation and summary of daily events of significance
- Deviations from the planned activities and procedures

2.7.3 Daily Quality Control Reports

The information included in DQCR is described in detail in the QCP (**Section 4.0**). During each day of field work, FPM will complete a DQCR that includes the following information:

- Contract information (e.g., Agency, PM, Contract Number, etc.)
- A description of the definable feature work completed
- What phase of control that definable feature of work is in
- UXOSO/QCS inspections conducted (if applicable)
- Site weather conditions
- List of subcontractor work performed (if applicable)

- A description of any visitors to the site
- Materials received
- Quality management information pertaining to field activities

FPM will submit DQCRs to the AFCEC PM and Holloman AFB as required or requested. DQCRs will be included in the RI Report.

2.8 Project Public Relations Support

All public participation will be coordinated through the Contracting Officer's Representative (COR) for AFCEC approval. FPM will provide the necessary support to initiate, schedule, and address all public participation aspects of the project (e.g., preparation of briefings, presentations, fact sheets, newsletters, public notices). The FPM Public Affairs Lead is Barbara Pratt.

2.9 Subcontractor Management

It is anticipated that subcontractors and vendors will be enlisted for the following services:

- UXO Technicians personnel reach-back
- MC sample laboratory analyses
- Providing donor explosives for MEC/MPPEH demolition

Prior to subcontract work being performed, FPM will negotiate and prepare a subcontract that will identify the scope of services and detail necessary and appropriate terms and conditions. Subcontractor procurement will follow Federal Acquisition Regulation requirements. Once the subcontract is executed, FPM will perform periodic reviews to verify that contractual requirements and milestones are being met. The PM will manage unresolved issues or conflicts that may impact the schedule or budget.

2.10 Management of Field Operations

Prior to beginning field activities, the MMRP Manager will coordinate support with Holloman AFB. This will include providing access to the MRSs (gate keys/combinations). Field operations that will be completed as part of the RI include:

- Site delineation,
- Surface clearance,
- DGM,
- Intrusive investigation (i.e., target anomaly selection and reacquisition and excavation of target anomalies potentially representing MEC/MPPEH/MD).
- MC sampling for explosives and metals at MEC/MPPEH/MD find locations,
- MC sampling for propellants at launch pad locations and isolated locations showing evidence of potential contamination (e.g., discolored soil),
- MPPEH inspection process,
- MEC/MPPEH demolition, and

- Off-site disposal of MDAS.

SOPs for the various MC sampling field activities were developed IAW the requirements of UFP-QAPP (**Appendix D**) and procedures for intrusive investigation are provided in Intrusive Investigation Plan (**Section 3.6)**. Compliance with procedures will support the collection of representative and comparable data. The MMRP Manager will ensure that the MEC/MPPEH/MD investigation (overseen by SUXOS) and MC sampling activities (overseen by MC Task Lead) are completed IAW procedures, the HASP, and ESS. The UXOSO/QCS will verify that work being performed on site is IAW approved plans, procedures, and guidance documents. The UXOQCS will complete field audits, as needed, to verify that field operations are being completed IAW the RI WP and applicable guidance documents. FPM will maximize sustainable opportunities (e.g., combining field activities in ways that reduce waste generation, conserve resources, and minimize land and ecosystem disturbance).

3.0 FIELD INVESTIGATION PLAN

3.1 Overall Approach to Munitions Response Activities

This section provides a description of the overall RI approach for both the XU853 and XU854 MRSs, establishes DQOs, and describes data collection and utilization.

3.1.1 Project Goals

The goal of the RI is to provide site characterization data of sufficient quantity and quality to close existing data gaps and determine nature and extent of MEC/MPPEH/MD and MC within the MRSs in order to focus follow-on restoration efforts on MEC/MPPEH/MD and/or MC delineated areas. Data from the RI will also be used to refine the CSM, complete the MEC HA, update the MRSPP, and determine response alternatives that will be documented in the FS.

Site MEC/MPPEH/MD characterization goals include:

- Accurately locating and recording geophysical anomalies,
- Properly analyzing and interpreting the geophysical data, and
- Properly documenting the intrusive findings.

Residual MC contamination will be assessed through a biased sampling program for explosives and target metals. Surface and subsurface soil samples will be collected using composite sampling at MEC/MPPEH find locations and in areas with significan amounts of MD. In addition, residual MC contamination associated with rocket/missile tests will be assessed through a biased sampling program for propellants. Surface soil samples will be collected using IS at missile launch pad sites. Surface soil samples will also be collected using composite sampling at locations showing evidence of potential contamination (e.g., discolored soils). The MC sampling will be conducted IAW the procedures outlined in the site-specific UFP-QAPP (**Appendix D**). This data will be used to evaluate risk to human health, and the environment in the RI Report.

3.1.2 Data Quality Objectives

The DQO Process is a systematic planning tool that defines the performance criteria that will be used to establish the final data collection design as well as to determine acceptable quantitative criteria on the quality and quantity of the data to be collected. The DQO Process will be followed for both the XU853 and XU854 MRSs to identify the type, number, location, and physical quantity of samples and data, as well as the QC and QA activities that will ensure that sampling design and measurement errors are managed sufficiently to meet the performance and acceptance criteria specified in the DQOs.

3.1.2.1 Data Quality Objectives Process Overview

As identified in Guidance for Systematic Planning Using the Data Quality Objective Process (USEPA, 2006), the steps of the DQO development process include:

1. State the problem – Concisely describe the problem to be studied. Review prior studies and existing information to gain a sufficient understanding to define the problem.
2. Identify the Decision – Identify what questions the study will attempt to resolve, and what actions may result.

3. Identify the Inputs to the Decision – Identify the information that need to be obtained and the measurement that needs to be taken to resolve the decision statement.
4. Define the study boundaries – Specify the time periods and spatial area to which decisions will apply. Determine when and where data should be collected.
5. Develop a Decision Rule – Define the statistical parameter of interest specify the action level, and integrate the previous DQO outputs into a statement that describes the logical basis for choosing the alternative actions.
6. Specify Tolerable Limits on Decision Errors – Define the decision maker's tolerable error rates based on a consideration of the consequences of making incorrect decision.
7. Optimize the Design – Evaluate information from the previous steps and generate alternative data collection designs. Choose the most resource-effective design that meets DQOs.

The above process will be implemented to identify data needed to support decisions at both MRSs. The DQO development process (USEPA, 2006) as it applies to the XU853 and XU854 MRSs is described below.

3.1.2.2 Problem Statement

Since historical activities within both XU853 and XU854 MRSs were designed for testing rockets and missiles, it is unlikely that the test items contained high explosives. Therefore, MEC/MPPEH/MD presence at the surface or subsurface of both sites is not expected as a result of these activities. On the other hand, MD items were observed within both MRSs during CSE Phase II visual survey (HDR, 2013) and were associated with recent training activities. Since geophysical survey and intrusive investigation were not performed at two MRSs, there is no information regarding the type of subsurface anomalies (non-munitions metal scrap *vs*. munitions related). As a result of this data gap, an RI investigation is needed to provide DGM and intrusive investigation data to provide information for full characterization (nature and extent of MEC/MPPEH/MD and associated MC [explosives and metals]) of both XU853 and XU854. In addition, historical activities at two MRSs indicate that the propellants might be the potential contaminants of concern. Therefore, MC sampling for propellants is needed to provide data regarding the propellant contamination at both sites.

3.1.2.3 Decision Identification

The goal of the RI is to collect data such that the following decisions can be made regarding the MRSs:

- Do the previously collected information regarding the presence and distribution of MD and the RI surface clearance and intrusive investigation data indicate the presence of MEC/MPPEH/MD at the MRSs?
    - If yes, then a MEC HA is required to evaluate the potential explosive hazard.
    - If there are portions of the MRSs where MEC/MPPEH/MD is not present, recommend NFA for these portions and acreage reduction for the MRSs.
    - If no MEC is found, then recommend NFA for MEC for the entire MRSs.

- If MEC/MPPEH/MD is found during the surface clearance and/or intrusive investigation, environmental samples will be collected at MEC/MPPEH locations and in areas with significant amounts of MD to determine the presence or absence of MC (explosives and metals) in soil. If MC is present above screening levels, does it pose an unacceptable risk?
    - If yes, then a Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) may be prepared for those analytes exceeding screening levels.
    - If no, then recommend NFA for MC associated with MEC/MPPEH/MD.
- Do the results of surface propellant sampling at the MRSs indicate the presence of propellants above screening levels?
    - If yes, perform the subsurface propellant sampling.
        - Do subsurface sampling results indicate the potential for migration of MC into groundwater?
            - If yes, then conduct groundwater sampling to evaluate potential groundwater contamination.
    - If any of the surface, subsurface or groundwater propellant sampling results are above the screening levels prepare an HHRA and ERA for those analytes exceeding screening levels.
    - If none of the surface, subsurface, or groundwater propellant sampling results are above screening levels recommend NFA for propellants in soil and groundwater.

3.1.2.4 Inputs to the Decisions

The following information and data are needed to make the decisions specified above:

- Historical information for the munitions that may have been used at the MRSs.
- Results of the intrusive investigations to verify anomalies detected during the geophysical surveys. Applicable data include:
    - The number, location, and magnitude of anomalies.
    - Results of dig and verification of the anomalies indicating whether MEC/MPPEH/MD was present, the depth and orientation of discovered objects, and to the extent possible, what type of MEC/MPPEH/MD was found.
- MC concentrations for samples collected during the RI.
- Results of the HHRA and ERA.

3.1.2.5 Study Boundaries and Field Limitations

The study area for each MRS includes all acreage located within the respective MRS boundaries (**Figures 1-2** and **1-3**). Both MRSs are relatively flat and vegetation in the vicinity of both XU853 and XU854 MRSs is consistent with desert scrubland. There are no wetlands, or surface water associated with the XU853 and XU854 MRSs. No rare, threatened or endangered species are expected to inhabit either the XU853 or XU854. The buffer around the White Sands Pupfish

habitat overlaps a portion of the XU853 MRS, however the RI field activities are not expected to impact or be restricted by the White Sands Pupfish habitat buffer area. Both MRSs contain facilities considered individually eligible for the NRHP: Building 1113 (a former radio relay facility), Buildings 1116, 1127, the JB-2 Ramp, and a Test Stand are located within XU853 and Buildings 1440 and 1442 are located within XU854.

Geophysical surveys, intrusive investigations, and MC sampling will not be performed in areas where reinforced concrete pads and/or trenches are present.

3.1.2.6 Tolerance Limits on Decision Errors

This section describes the tolerance limits on decision errors for DGM, intrusive investigation and MC sampling.

False positives result when an anomaly is detected at a given location, declared as a significant DGM anomaly to be intrusively investigated or otherwise posted to a dig sheet, and no basis for the anomaly is identified in the field. False positives can be a result of low threshold selection of anomalies (i.e., conservative anomaly picking), spikes in the data not successfully removed during processing (e.g., instrument jolts resulting from terrain), and heterogeneities in the subsurface (e.g., highly-ferrous soils). False positives are unavoidable and do not affect the data quality in terms of removing MEC/MPPEH/MD items from the subsurface. The performance goal with respect to false positives is to minimize their occurrences while maintaining the same MEC/MPPEH/MD identification rates.

The consequences of false positive measurements may overestimate the presence of potential MEC/MPPEH/MD. The probability of making an incorrect decision using the collected data, which may contain sampling design or measurement errors, can be controlled by following the procedures in the Geophysical Investigation Plan (GIP) presented in **Section 3.4**. Data quality evaluation procedures and determination of usability are defined in the QCP (**Section 4.0**.)

For the DGM surveys at both MRSs, a false positive goal of no more than 15% will be established on this project, IAW USACE DID MMRP-09-004 (USACE, 2009a). False positives will be minimized to the extent possible through the use of the best available geophysical practices executed by the geophysical field team and data analyst. False positives will be documented in the database so that the 15% false positive metric can be monitored. Exceeding 15% false positives will result in a re-evaluation of the detection methods, data, and project QC. QA targets chosen below the selection criteria will not be considered a false positive. A Corrective Action Report, if appropriate, will be provided explaining the root cause for the excessive false positive rate. Additional corrective actions may be performed as deemed necessary for false positives less than 15%.

A false negative is the omission of any item meeting target selection criteria from being selected as a target. Target selection criteria are discussed in **Section 3.4.6.1**. <u>FPM will implement a rigorous QC program to ensure no false negatives occur during the RI. This includes initial and daily geophysical equipment QC checks, static and positional accuracy tests for RTK-GPS, IVS and blind seeding program, QC reprocessing of 10 % of initially processed geophysical data, and QC inspection of minimum of 10% of the areas intrusively investigated. All QC tests including their tolerance limits are discussed in detail in **Section 4.0.**</u>

The results of QA/QC efforts during sample collection and analysis, in combination with professional judgment, will be used to evaluate the usability of chemical data for making

decisions. Acceptable limits for the MC sampling include analytical method reporting and/or detection limits that are sufficiently low to meet applicable human health regulatory screening criteria. Analytical method detection limits, reporting limits, and QC acceptance criteria are specified in the UFP-QAPP (**Appendix D**).

3.1.2.7 Design Optimization

The data collection design presented in this RI WP is based on the proposed actions and evaluation of existing data. Initial DGM survey results and field observations will be assessed to optimize the follow-on approaches. The project team will have opportunities to provide input through regular project updates during data collection activities, analysis of data, and preparation of reports.

3.1.3 Investigative Approach

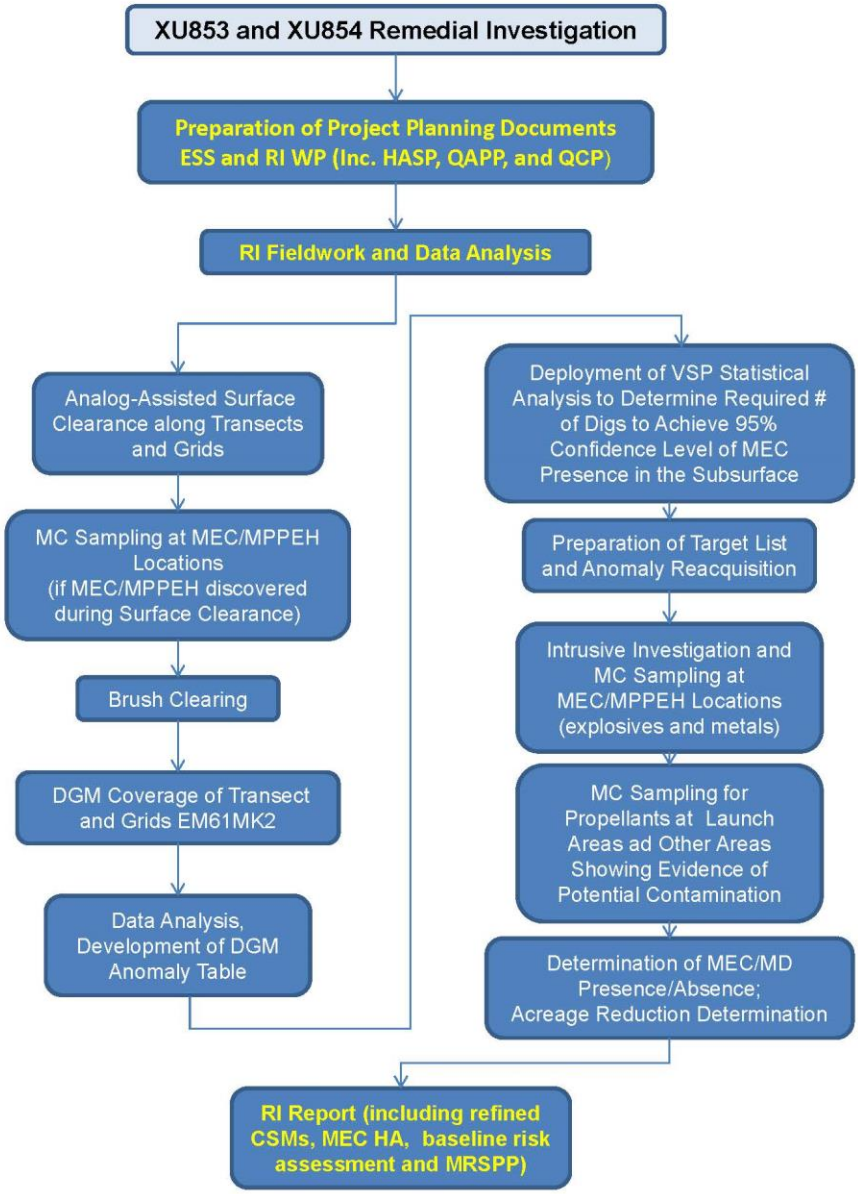
Based on the history of both MRSs and the lack of investigative data, a phased approach is planned for the RI field investigation that is comprised of:

- Analog-assisted surface clearance and brush clearing along DGM transects and grids;
- DGM surveys using the electromagnetic induction sensor EM61;
- Data analysis, anomaly/target selection and development of anomaly table;
- Deployment of Visual Sample Plan (VSP) statistical analysis to determine the required number of digs to achieve MEC/MPPEH potential on the sites with 95% confidence level;
- Intrusive investigation of statistically (VSP) derived number of DGM anomalies that will indicate a 95% confidence factor of the MEC/MPPEH potential on the site;
- Characterizing MPPEH as either Material Documented as an Explosive Hazard (MDEH) or Material Documented as Safe (MDAS);
- Removing and storing material determined to be MDAS in a secure storage location;
- MEC/MPPEH demolition;
- MC sampling for explosives and metals at MEC/MPPEH find locations and in areas with significant amounts of MD;
- MC sampling for propellants at launch pad sites and at isolated locations showing evidence of contamination (e.g., soil discoloration);
- Offsite disposal of MDAS.

Figure 3-1 illustrates in more detail the phased technical approach to be implemented at both sites.

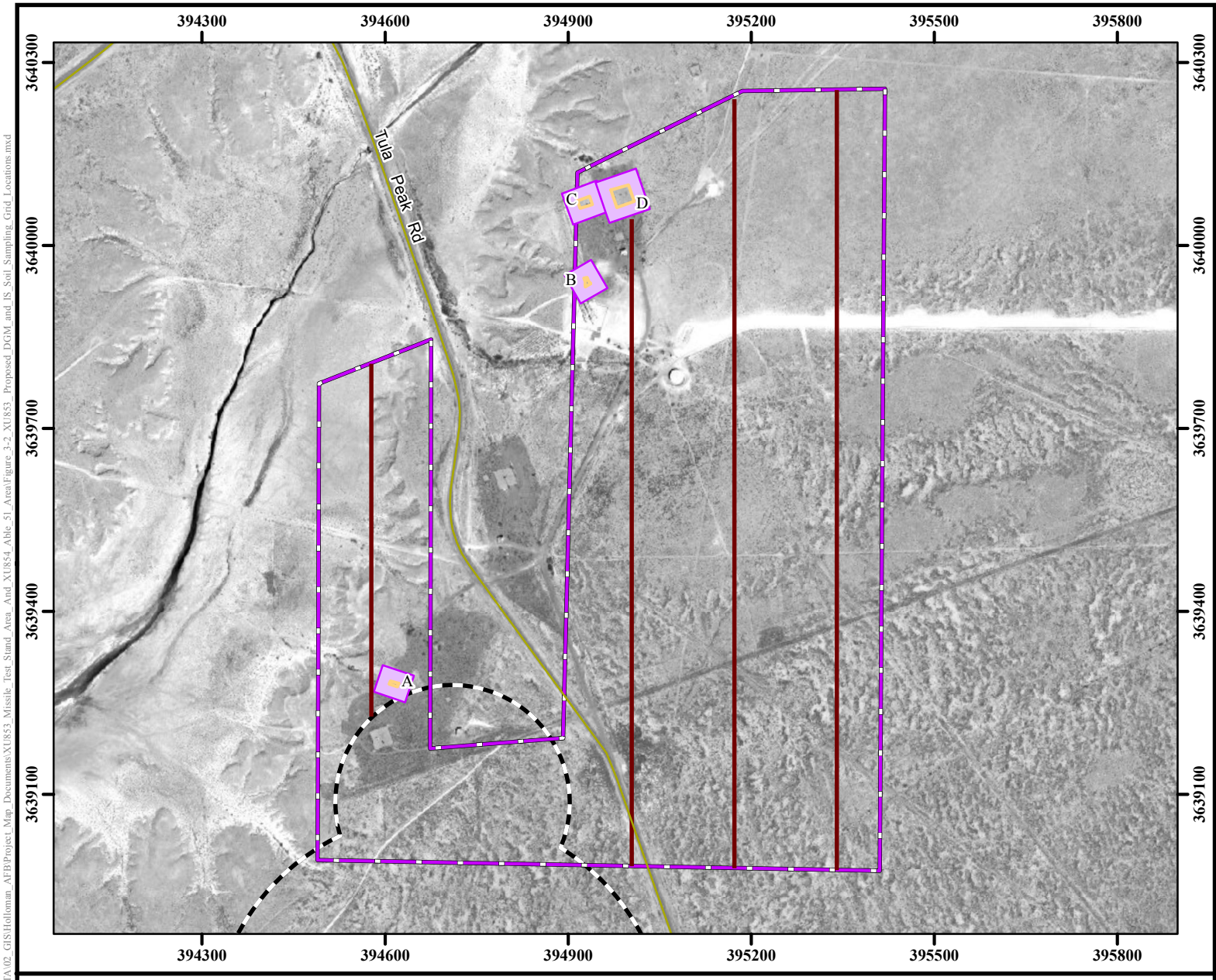
Both MRSs will be characterized by performing DGM along equally spaced transects (**Figures 3-2** and **3-3**). In addition, the grid-based DGM will be performed across areas surrounding the launch pad sites to verify that potential DMM was not buried in the vicinity of the launch areas. Additional details on the DGM are provided in **Section 3.4**.

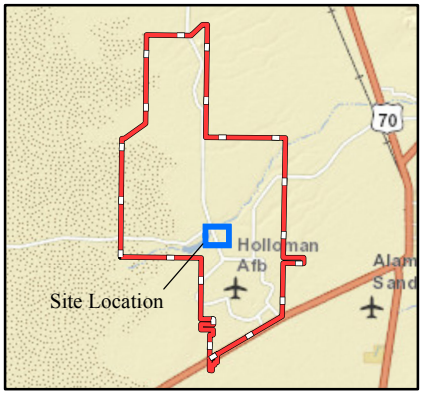
Figure 3-1 Technical Approach XU853 and XU854 MRSs



Intrusive investigation of target anomalies identified by DGM will be conducted to characterize the nature and extent of potential MEC/MPPEH/MD within each MRS. Intrusive investigation of all target anomalies in the DGM areas will be performed by the UXO team. UXO personnel will be qualified to perform their assigned jobs IAW DDESB TP 18 (DDESB, 2004). MPPEH discovered during intrusive investigations will be inspected to determine the explosive safety status. Additional details on the Intrusive Investigation Plan are presented in **Section 3.6**.

MC sampling will be conducted using composite sampling for explosives and metals at MEC/MPPEH find locations and in areas with significant amounts of MD. Additionally, MC soil sampling will be conducted using incremental sampling (IS) techniques for propellants at rocket/missile launch pad sites and composite sampling at isolated locations showing evidence of





Legend

- Road
- DGM Transect
- Launch Pad
- DGM Grid
  - A = 0.60 acres
  - B = 0.64 acres
  - C = 0.75 acres
  - D = 1.00 acres
- XU853 MRS (204.6 acres)
- EOD 50-lb Range Boundary
- Installation Boundary

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FIGURE 3-2

Location of DGM Transects and 100% Coverage Grids XU853 MRS

NOTES:
Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 800 feet

0 120 240 Meters

0 400 800 Feet

N W E S

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Path: \\sat\SAT_Clients\SAT_DATA\02_GIS\Holloman_AFB\Project_Mxp_Documents\XU853_Missile_Test_Stand_Area_And_XU854_Able_51_Area\Figure_3-2_XU853_Proposed_DGM_and_IS_Soil_Sampling_Grid_Locations.mxd

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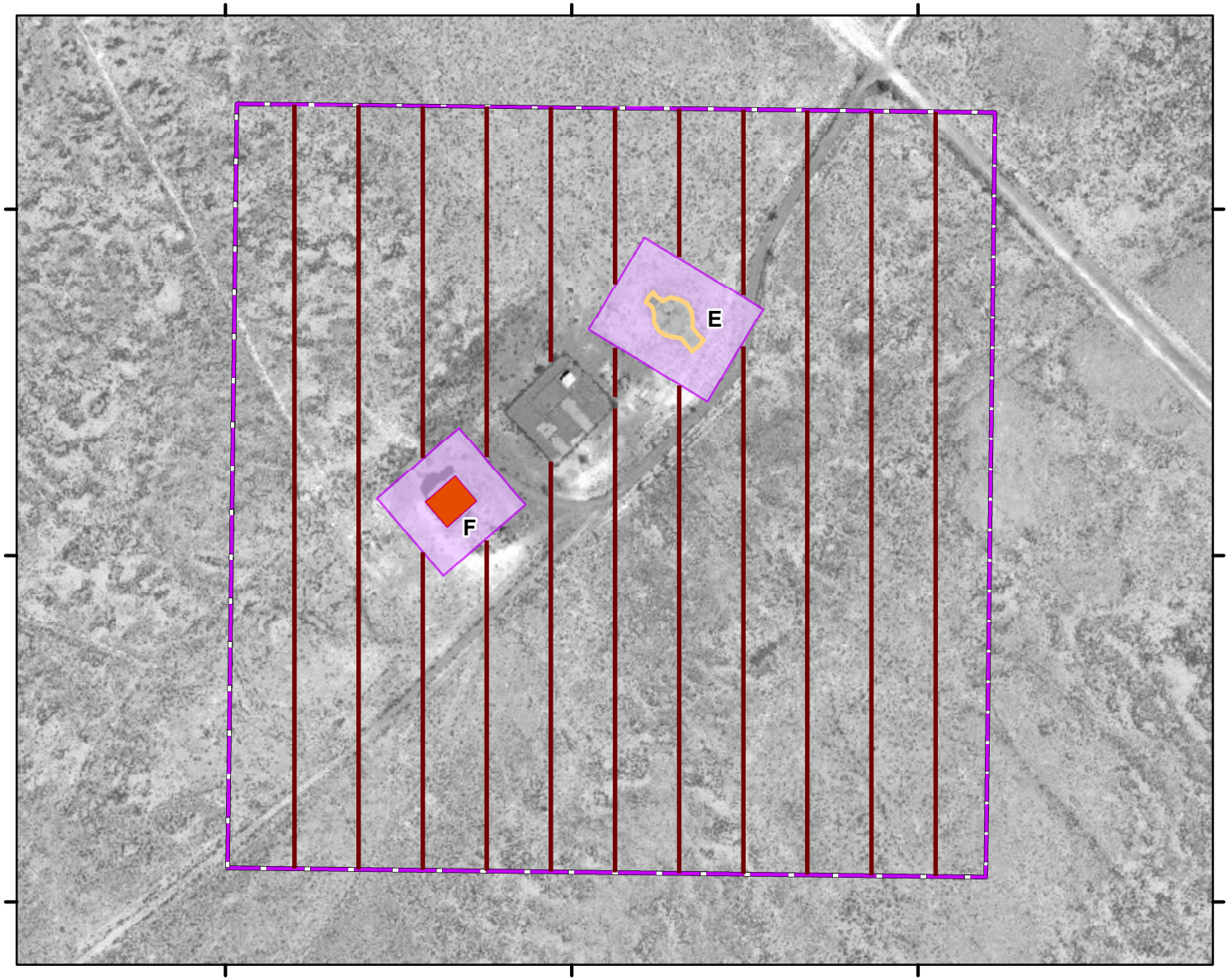

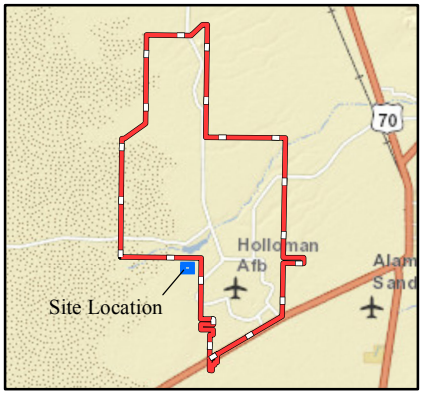

Legend

- DGM Transect
- DGM Grid
  E = 1.1 acres
  F = 0.8 acres
- Launch Pad
- Building 1442
- XU854 MRS Boundary
- Installation Boundary

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FIGURE 3-3

XU854 Able 51 Area MRS
Proposed DGM Sampling
Grid and Transect Locations

NOTES:
Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 300 feet

0 50 100 Meters

0 150 300 Feet

N W E S

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2014

Path: \\sat\SAT_Clients\SAT_DATA\02_GIS\Holloman_AFB\Project_Mxp_Documents\XU853_Missile_Test_Stand_Area_And_XU854_Able_51_Area\Figure_3-3_XU854_Proposed_DGM_and_IS_Soil_Sampling_Grid_Locations.mxd

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contamination (e.g., soil discoloration). Additional details on the MC sampling are provided in **Section 3.7**.

3.1.4 Data Incorporation into Project Reports

3.1.4.1 Remedial Investigation Report

The results of the geophysical investigation, intrusive investigations, and MC sampling, will be evaluated and included in the project Geographic Information System (GIS) and the RI Report. The GIS database will be managed and updated as new information becomes available.

3.1.4.2 Feasibility Study Report

The FS report will document development and evaluation of potential remedial alternatives to provide decision-makers with an appropriate range of options and sufficient information to adequately compare alternatives against one another. The FS report will also recommend the most appropriate remedial approach that is protective of human health and the environment, complies with applicable or relevant and appropriate requirements, and is cost-effective.

3.1.4.3 Proposed Plan and Record of Decision

Following completion of the FS, the preferred remedial action to address potential risks associated with explosives hazards at the MRSs will be recommended in the Proposed Plan (PP). After responding to public comments on the PP, the selected remedy will be formally selected and documented in a Record of Decision (ROD). The PP and ROD documents will be prepared IAW the requirements of Comprehensive Environmental Response, Compensation, and Liability Act Section 117(a) and Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan.

3.2 Surface Clearance

Detector-aided surface clearance will be conducted along transects and across grids prior to the geophysical survey at both XU853 and XU854 MRSs. The purpose of the surface clearance is to:

1. Remove surface hazards (MEC/MPPEH/MD) from transect and grid footprints that could pose a safety hazard to personnel and/or equipment, and
2. Eliminate sources of DGM signal interference that could obscure subsurface anomalies and thus reduce the effectiveness of the DGM surveys to detect and map subsurface targets.

3.2.1 Equipment

The UXO team will use hand-held magnetic locators and electromagnetic metal detectors for surface clearance. Geophysical instrumentation will be used by FPM's UXO team to locate potential MEC/MPPEH/MD in the shallow subsurface. The position of the surface clearance team will be recorded using a sub-meter Differential Global Positioning System (DGPS).

3.2.1.1 White's EM DFX 300 Metal Detector

The White's DFX 300 metal detector is a hand-held analog electromagnetic system. The DFX 300 has multi-frequency capability and uses operating frequencies of 3 and 15 kilohertz, or both at the same time for enhanced target discrimination. An audio signal is provided to the operator who uses changes in the audio signal and a liquid crystal display visual display to pinpoint the

location of the metal item. The White's DFX 300 is capable of detecting both ferrous and non-ferrous metals. The detection capability of the instrument varies according to the local conditions, the size, orientation, and depth of the object, and the skill of the operator.

3.2.1.2 Schonstedt GA-52Cx Magnetometer

The Schonstedt GA-52Cx magnetometer (Schonstedt) detects changes in the Earth's ambient magnetic field caused by ferrous metal. The technology uses two fluxgate magnetometers, aligned and mounted a fixed distance apart, to detect changes in the Earth's ambient magnetic field caused by ferrous metal or disturbances in soil conditions. An audio signal is provided to the operator who uses changes in the audio signal to pinpoint the location of the ferrous metal item. The detection capability of the Schonstedt varies according to the local conditions, the size of the object, and the skill of the operator. However, detection of a medium-sized target (e.g., 75 mm projectile) is generally limited to a maximum depth of 1.0 m.

3.2.1.3 Navigational and Positioning Equipment

Trimble® GPS Pathfinder® ProXRT

A real-time DGPS Trimble® GPS Pathfinder® ProXRT or equivalent will be used to determine the positions of analog geophysical instruments used for SC. The Trimble® GPS Pathfinder® ProXRT can achieve decimeter accuracy by combining H-Star™ technology, OmniSTAR support, and Global Navigation Satellite System (GLONASS) support on top of dual frequency GPS. Installing the GLONASS option on the GPS Pathfinder ProXRT receiver increases the number of satellites available for tracking. The increased number of observed satellites is especially useful in conditions with limited sky visibility (i.e., densely vegetated areas, closed canopies, etc.). Tracking GLONASS satellites as well as GPS satellites can also improve productivity by reducing the time required to achieve decimeter or sub foot accuracy, either in real-time or after post processing. Positional data will be sampled and recorded at 1 sample per second.

3.2.1.4 Surface Clearance Equipment Verification

The UXO III (Team Leader) will be responsible for verifying all instrumentation is in proper working order at the start of each day. The White's electromagnetic metal detectors, Schonstedt magnetic locators and the DGPS will be checked throughout the day for adequate battery charge. Extra batteries will be carried with the surface clearance field team at all times.

The instruments will be tested each morning at the same IVS where DGM equipment will be tested using a series of metallic Industry Standard Objects (ISOs) (surrogates for munitions, see **Section 3.4.4** for more details). Any "failure to detect" occurrences will result in that specific instrument being replaced by a properly functioning instrument of the same type. All IVS results will be documented in the Field Activity Daily Log form (**Appendix E**).

3.2.2 Personnel

A UXO III will directly supervise the SC task and be accompanied by at least two other UXO technicians (UXO II and/or I). All team members will be familiar with the RI WP, HASP, ESS, and site history prior to commencement of fieldwork. All UXO technicians will meet or exceed the qualification requirements specified in DDESB TP 18 (DDESB, 2004). Typical personnel responsibilities are described in detail in **Section 2.0**.

3.2.3 Surface Clearance Procedures

Surface clearance work will be conducted by a minimum of three UXO technicians, side by side, with the geophysical sensors. Lanes will be established by pulling fiberglass measuring tapes or ropes from grid node to grid node. Each member of the sweep crew will perform detector assisted visual inspection following a lane. UXO qualified personnel will flag, identify, and record the location of discovered MPPEH with DGPS prior to moving the item. If the MPPEH item is determined to be UXO, the SUXOS will determine if the UXO item can be safely moved to the established MRS Safe Disposal Area (SDA). The potential SDA locations for the XU853 and XU854 MRSs are identified in **Figure 3-4** and in the DDESB-approved ESS (**Appendix F**)

If the UXO item is determined to be unsafe to move, FPM will conduct a Blow-in-Place (BIP) operation IAW procedures described in the approved ESS. In addition, MD and non-MEC related materials, will be collected, segregated (i.e., MD separated from non-MEC related materials) and temporarily stored for final processing and disposition.

3.2.4 Material Potentially Presenting an Explosive Hazard Inspection Process

Material recovered from the MRSs will be inspected, re-inspected, and certified free of explosives hazards by at least two UXO-qualified personnel IAW Chapter I, Section 11, Engineering Manual (EM) 385-1-97 (USACE, 2010b); DoD Instruction 4140.62 (DoD, 2008a); and Chapter 14, EM 1110-1-4009 (USACE, 2010a). MPPEH will be categorized as one of the following:

- **MDEH**– The explosive hazards are known or suspected and documented. These items will be disposed of by detonation IAW the ESS.
- **MDAS** – Not presenting an explosive hazard, and consequently safe for unrestricted transfer or release. This is no longer considered MPPEH and is reclassified accordingly. Once certified as MDAS, the material will be reclassified as MD, Range Related Debris (RRD), or other debris. MD classified material will be segregated, containerized, and secured until final disposition. MD will be documented on a Department of Defense (DD) Form 1348-1A (**Section 3.2.4.1**). A log book entry and pictures will be completed documenting the inspection.

3.2.4.1 DD Form 1348-1A

Upon completion of removal activities, the contractor will complete a DD Form 1348-1A as the turn-in documentation for MD. The contractor will certify that 100% of the MD is properly inspected, provide a 100% re-inspection, and declare that all materials are free of explosive hazards by qualified UXO personnel. The following statement shall be signed and dated by the SUXOS and verified/signed by the UXOSO/QCS:

"This certifies and verifies that the material listed has been 100% inspected and, to the best of our knowledge and belief, is inert and/or free of explosives or related material."

Where RRD is being processed along with MDAS, the following statement will be entered on each DD Form 1348-1:

"This certifies and verifies that the material listed has been 100% inspected and, to the best of our knowledge and belief, is free of explosive hazards, engine fluids, illuminating dials and other visible liquid hazardous toxic and radioactive waste materials.".

3.3 Brush Clearing

Following the completion of the SC, brush clearing will be conducted along planned DGM transects and across the DGM grids of both MRSs. The brush clearing will be conducted using manual methods. Personnel on the ground will utilize hand or power tools such as machetes, brush hooks, or powered circular saw type weed cutters to perform this task. It will be ensured that cleared vegetation debris do not pose the safety hazard to personnel, do not impact quality of DGM data, and do not present a wildfire hazard.

3.4 Geophysical Investigation Plan

This GIP describes the project requirements for all activities related to geophysical operations and those tasks that rely on geophysical data and interpretations. The plan also explains how the proposed methods and procedures will be tailored to anticipated site conditions, technical requirements, applicable safety and security regulations, and strategies. This GIP follows the guidelines specified in USACE DID Number MMRP-09-004, Geophysics (USACE, 2009a).

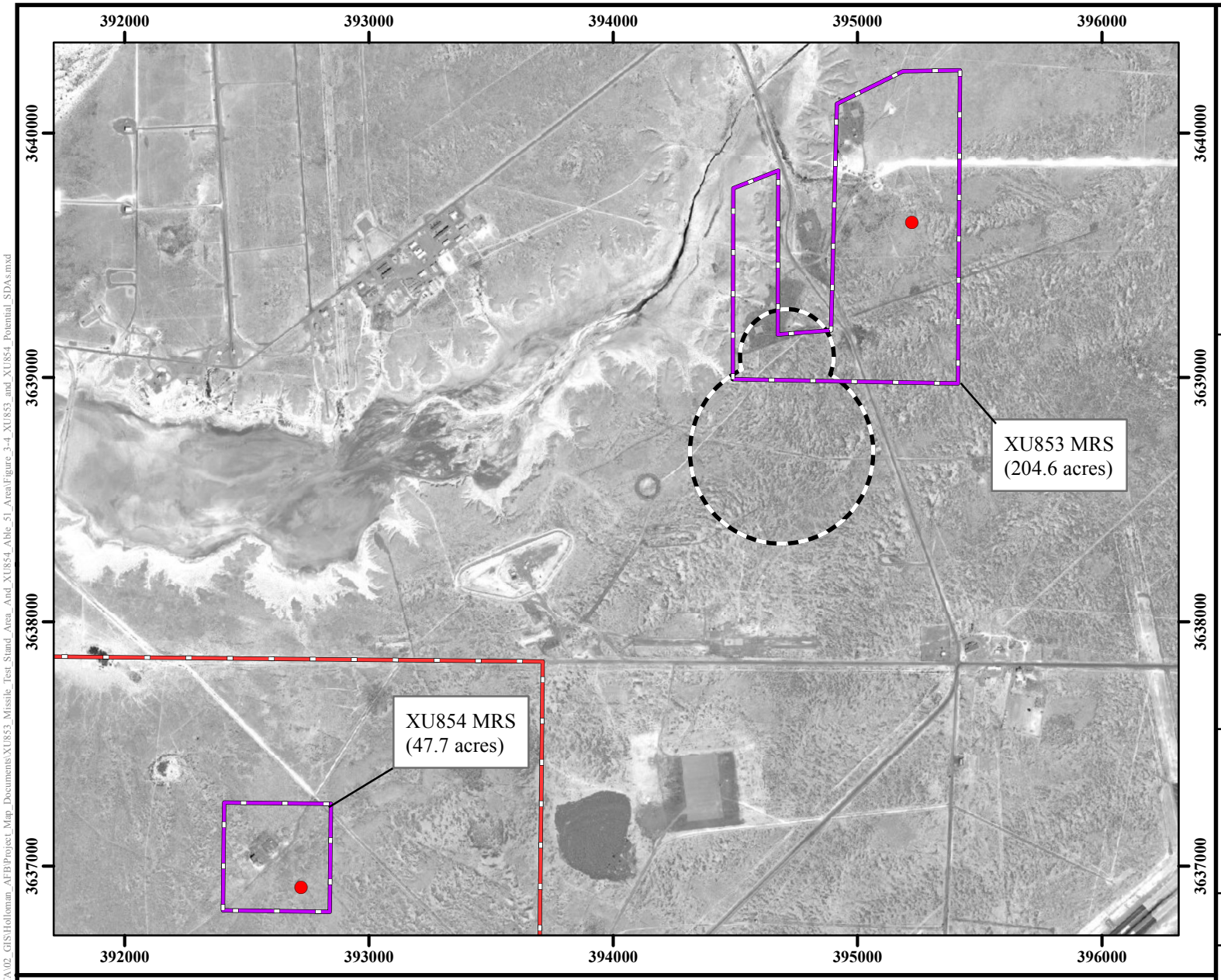
3.4.1 Geophysical Data Quality Objectives

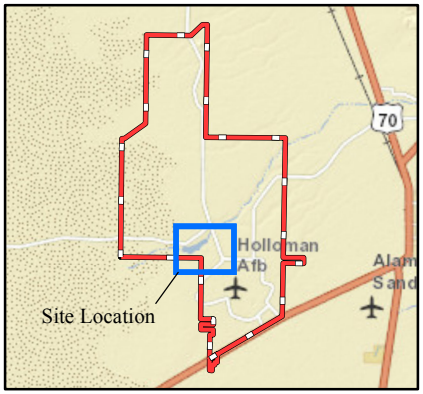
The geophysical DQOs are based on USACE EM 1110-1-4009 Military Munitions Response Actions (USACE, 2010a). The geophysical DQOs establish acceptance criteria concerning sensor performance, navigation accuracy, data density, data processing standards, and anomaly selection criteria to meet the minimum goals for the investigation. These criteria are listed in detail in **Section 4.3.5**. Metrics will be confirmed or appropriately adjusted based on the results of the GSV.

3.4.2 Geophysical Investigation Approach

DGM will be conducted utilizing the EM61. Five EM61 systems will be configured as a single array to be towed behind a vehicle to increase the productivity of data collection. The swath of this system will be 3 m. DGM will be performed along transects separated approximately 168 and 37 meters (m) at XU853 and XU854, respectively (**Figures 3-2** and **3-3**). In addition, 100% DGM coverage will be performed within established grids at launch pad site locations, across the areas surrounding the concrete pads and around the building 1442 in XU854, since this building was used as a launch area (**Figures 3-2** and **3-3**). The total area for grid-based DGM equals 2.9 acres (XU853) and 1.9 acres (XU854). With this design, approximately 2.9% and 11.1% of the land area of XU853 and XU854, respectively, will be investigated. This design exceeds the minimum recommended coverage in EM 1110-1-4009 (USACE, 2010a) for both sites (1/5% of the MRS area for XU853 and 7.5% of the MRS area for XU854). The sensor positioning at both sites will be accomplished using the RTK-GPS. Based on initial DGM and intrusive results, additional transects and/or grids may be required to better delineate areas (if any) to adequately determine the nature and extent of MEC/MPPEH/MD. Note: FPM understands that the 20.3 acres of XU853 MRS is currently within the new EOD range, therefore, our planned transects and grids shown in **Figure 3-2** exclude that acreage. However, if required, FPM will complete additional transects and grids within this portion of the site comprising a total of 0.85 acres.

The USACE DID Number MMRP-09-004 (USACE, 2009a) shall be used in association with EM-1110-1-4009 (USACE, 2010a) Chapters 6-9 as guidance for DGM operations.





Legend

- Safe Disposal Area
- MRS Boundary
- EOD 50-lb Range Boundary
- Installation Boundary

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FIGURE 3-4

Potential SDAs
XU853 and XU854 MRS

NOTES:
Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 2,000 feet

0 300 600 Meters

0 1,000 2,000 Feet

N W E S

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Path: \\sat\SAT_Clients\SAT_DATA\02_GIS\Holloman_AFB\Project_Mgp_Documents\XU853_Missile_Test_Stand_Area_And_XU854_Able_51_Area\Figure_3-4_XU853_and_XU854_Potential_SDAs.mxd

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3.4.3 Equipment

3.4.3.1 Geonics EM61-MK2 Electromagnetic System

The Geonics EM61 is a high-resolution time-domain electromagnetic system that can detect electrically conductive objects. The basic elements of an electromagnetic sensor are a transmit coil and a receive coil. A current pulse running through the transmit coil creates the primary electromagnetic field. Changes in this primary field set up eddy currents in the object, under the sensor. The eddy currents produce a secondary or induced electromagnetic field emanating from the object. This induced electromagnetic field is associated with the decay of eddy currents in metal objects near the sensor and is measured by the receiver coil, the output signal being proportional to the rate of change of the electromagnetic flux through the receiver coil. The receiver is timed to measure the signal within four time gates (216, 336, 660, and 1,266 microseconds) after the current pulse in the transmitter loop is completed. The four time gates allow discrimination between different types of targets based on the time-decay rate of the response. A measurable response in milliVolts (mV) implies that a metal object is present, and the profile of that response can be used to estimate the object's size. The EM61 can record up to 12 records per second with four time gates per record.

An EM61 system consists of a pair of 0.5- by 1.0-m coils. The lower coil is both a transmitter and receiver and the upper coil is exclusively a receiver coil. The lower coil is located 0.42 m

above the ground surface for optimal data collection using the standard wheel mode, and the upper coil is 0.30 m above the lower coil. The EM61 is fully equipped for simultaneous logging of GPS and electromagnetic data.

3.4.3.2 Real-Time Kinematic Global Positioning System

A Trimble R8 RTK-GPS will be the positioning system during DGM data collection. The RTK-GPS is a dual frequency system that utilizes a code-based measurement technique. The system is equipped with on-the-fly ambiguity resolution which allows receivers to collect high-quality solutions very quickly and without complicated initialization procedures. The RTK-GPS base station will be set up based on benchmarks established by U.S. National Geodetic Survey or another suitable control point established by a licensed surveyor.

3.4.3.3 Integration of Geophysical and RTK-GPS Data

Geophysical survey data linked with RTK-GPS will provide real-time positional control. The data will be acquired by linking the RTK-GPS to the field Personal Computer (PC). An RS-232 data cable will serve as the communication bridge between the RTK-GPS and the respective data logger. Positional data will be sampled and recorded at a rate of 1 sample per second or 1 hertz (Hz). The RTK-GPS will be configured to output a National Marine Electronics Association data string utilizing the GPS Fixed Data format to the geophysical data logger.

3.4.4 Geophysical System Verification

A GSV (Nelson *et al*., 2009a) will be used to confirm that the geophysical detection system is functioning properly and provide ongoing monitoring of production work to verify the surveys are being performed correctly. A GSV includes an initial instrument demonstration, identification of background noise levels, daily QC checks, and a BSP. This physics-based verification of sensor performance originates from a large database of Geophysical Prove-Outs (GPOs) executed on a variety of site conditions and a better understanding of the capabilities and

limitations of common geophysical detection systems over the years, as well as development of reliable models for the signals expected from common sensors. The GSV is effective because the EM61 sensors that will be used in the survey obey well-defined basic physics principles. The USACE-accepted GSV is generally intended to replace the empirical GPO previously used to verify performance of geophysical systems under controlled conditions near the work site. The GSV is not intended to replace current QC practices; it will be added to existing DGM QC and QA procedures.

The GSV is comprised of two main elements: an IVS and a BSP. Both an IVS and a BSP will be utilized during the RI at both MRSs to verify the performance of the geophysical system.

3.4.4.1 Instrument Verification Strip

The objectives of the IVS are to verify that the geophysical detection system is operating as designed, to capture levels of background noise due to site conditions on a daily basis, and to streamline daily QC checks. The IVS can be performed using the responses from ISOs (surrogates for munitions) described in **Table 3-1** since the EM61 responses of different targets scale in a well-defined, calculable way (Nelson et al., 2009b).

The IVS for the EM61 will be composed of four (4) linear tracks 30 m in length. Six (6) ISOs (three [3] of each, medium and small) will be emplaced at two (2) different depths measured to the center of the items (depth of 5 x, and 3 x the diameter for medium and small ISOs, respectively) and three different orientations (vertical, horizontal across track, and horizontal along track). Two sizes of the ISOs were chosen to represent types of munitions previously found at both MRSs: small ISO represents the M18 smoke grenade and medium ISO represents the M125A1 illumination signal. In addition, the ISOs will be emplaced with a spacing of 5 m which will also provide a site-specific noise measurement during the strip. The physics characteristics of the chosen ISOs will be sufficiently similar to the targets of interest such that they can be detected and used to verify that the system is operating properly. The two (2) depths are chosen to ensure a high Signal to Noise Ratio on the sensor measurements. The location and depth of the IVS items will be measured at the middle and the depth measured to the center of the items, respectively, to a precision of ±0.02 m.

Table 3-1 ISOs Characterized for Use as Munitions Surrogates

Item	Nominal Pipe Size	Outside Diameter	Length	Part Number	ASTM Specification
Small ISO	1”	1.315” (33 mm)	4” (102 mm)	44615K466	A53/A773
Medium ISO	2”	2.375” (60 mm)	8” (204 mm)	44615K529	A53/A773
* Part number from the McMaster-Carr catalog					

3.4.4.2 IVS Data Collection Procedures

The IVS location will be identified on the first day of operation and will be chosen to represent typical soils, geology and vegetation. A background DGM survey will be performed at the location to verify the area chosen is free of anomalies. If the test strips location is cluttered with

buried metal items, the area will be cleared of those items and the background DGM test repeated, or another location will be selected for establishing the IVS, and the process repeated. Once the DGM background data are determined to be suitable for constructing the IVS, the ISOs will be buried along one line and their depth and location measured to the center and at the middle of the items, respectively, recorded to a precision of ±0.02 m.

The IVS protocol for the first day for the EM61 sensors will include the following:

- One line of data will be collected with the sensor passing directly over top of the items. This will provide the peak signal measurements to confirm sensor operation.
- Two additional lines of data will be collected, the first offset from the center by half the planned line spacing (0.3 m) and the second by the full line spacing (0.6 m) in the same direction. This will provide confirmation that the line spacing is sufficiently close to detect the targets of interest.
- A line of data will be collected offset from the center by the planned line spacing in the other direction. The three lines of data collected as prescribed for field data collection can be used to produce a two-dimensional map to confirm geolocation accuracy in both directions and check for latencies in the data.
- A line of data will be collected offset from the IVS to measure site noise.

The noise measurements will be made along line that is more than 2 m distance from the buried targets so that their signals do not contaminate the measured noise background. This line will not contain discrete anomalies or non-representative terrain or geology that will affect the instrument. Noise measurements will determine whether targets of interest can be detected reliably to their depth of interest under the site conditions.

In addition, the survey crew will be required to survey the test strip at the beginning and end of each day. This will be a simplified survey, two passes in opposite directions over the line of emplaced targets to confirm sensor operation and one pass over the line for noise measurement. Continuous noise monitoring throughout the production data will indicate whether the conclusions from the IVS measurements will apply throughout the site. Note since multiple sensors will be utilized for surveys, the above described procedures for the first day and all fieldwork days will be followed for each sensor.

3.4.4.3 Blind Seeding Program

A BSP will be performed in the production site as an integral part of the GSV. The main purpose of the BSP is to provide ongoing confirmation that targets of interest can be detected and recovered. In order to serve as an effective QC procedure, the BSP includes placement of known objects at surveyed locations that are blind to the survey, data processing, and anomaly resolution teams at sufficient frequency that they are useful for daily quality checks under the actual conditions of the site. Seed items must be available, affordable, well characterized, and representative of the items of interest at the site. They should be planted such that measured signals for known objects are within the expected detectable range of the sensors, and further that the signals are detectable above measured site noise.

For the BSP in XU853 and XU854 MRSs, the number of small and medium ISOs buried along transects and in grids will depend on the production rate and will be chosen so that at least one seed is encountered per DGM crew per day. The planned locations for seeds will be flexible so

that they may be emplaced safely. Anomaly avoidance will be practiced in the burying of seeds, and all procedures will be in compliance with relevant safety guidelines. The depth for small and medium ISOs will be ~3 times and ~ 5 times their diameter, respectively. All depths will be defined based on center to the object. All buried ISOs will have vertical orientation.

3.4.4.4 GSV Results

For each item in the IVS for EM61, the peak signal strength from the daily measurement should be compared to the expected signal for consistency. In all cases, the signal should be no lower than the predicted signal for the least favorable orientation, and only the signals for objects in that orientation should approach the lower line. Similarly, the signal should be no higher than the predicted signal for the most favorable orientation, and only the signals for objects in that orientation should approach the upper line.

Comparison of the IVS results to published results for EM61 will provide the following information:

- Whether the targets of interest are detectable to the depth of interest in the presence of the measured survey noise, and
- Whether the data are being collected correctly.

For the BSP, for each grid that contains a seed, the QC geophysicist will determine whether the seed(s) made it to the target list. If so, the QC geophysicist will ensure that the location accuracy is within contract specifications and, after the anomaly has been dug, make sure that the correct item (or items if this was a stacked seed) is recovered. If the seed is not on the target list, the QC geophysicist will begin a root cause analysis. Questions to be asked include:

- Is there a geophysical signal at the seed location that should have been picked?
- Is there an anomaly but is it below the selection threshold?
- Is there an anomaly remaining that was below a shallower anomaly (stacked seed)?
- Is there a sensor location issue?

The failure to detect a seed target will allow a project team to recognize that problems exist and undertake corrective action while still in the field.

3.4.5 General Field Procedures

Procedures will be followed to help facilitate the collection of accurate and reliable geophysical data. Most important is the proper operation and function of the geophysical instruments, and proper function of the positioning equipment. Tests will be conducted daily to assess those functions. The QC procedures will include allowing the equipment a proper warm-up period of a minimum 15 minutes as well as completing static, spike, relaxation, cable shake, personnel, latency, and positioning tests to ensure accuracy and repeatability of collected field data. All of these QC tests are summarized in **Sections 4.4.1.1** and **4.4.1.2**. Failed components will be repaired or replaced. QC checks will be recorded electronically, and included as part of the geophysical data deliverable. A separate Geosoft Database including all of the IVS results will be maintained. The main elements and general sequence of the field procedures are:

- The geophysical team will be familiar with the XU853/XU854 RI WP.

- Shape files and points of interest will already be uploaded into the RTK-GPS controller so that the field operator will be able to see his/her position and the corresponding background in real time.
- Visual checking of the instruments for possible mechanical damage will be performed, and the team will check that the batteries are charged.
- Geophysical and navigational instruments will be set up.
- The RTK-GPS will be checked for proper functioning and positional accuracy tested at a known control point(s).
- After warming up equipment, opening QC tests will be conducted.
- The results of QC tests will be written on daily QC forms (**Appendix E**).
- If QC tests are checked as "Pass," the operator may begin with the IVS.
- If the results of the IVS are within the predicted bounds identified in the initial IVS testing results, the operator may begin data collection.
- Data collection, with obstacles and deviations from planned survey path will be documented and recorded in the field log (**Appendix E**).

Since distance between neighboring coils in 5-coil towed array will be 0.6 m, EM61 data will be collected along survey lines spaced 0.6 m apart. The coils of the EM61 will be oriented with the long axis perpendicular to the direction of travel. Data will be recorded using a field PC. The average velocity of data collection for the 5-coil towed array will be 1 meter per second (1m/s). Using a collection rate of 10 Hz, the sampling interval will be approximately one reading per 0.01 m. This data density provides adequate coverage to satisfy the project DQOs, and the performance standard of 98% of the collected data being less than 0.25 m apart will be met.

The geophysical sensor will be coupled with an RTK-GPS for real-time sensor positioning. The RTK-GPS base station will be set up based on benchmarks established by U.S. National Geodetic Survey or a licensed surveyor. A Trimble R8 Rover will be interfaced with the data logger to record positional data coincident with instrument readings. Correction data will be radio transmitted from the base station to the R8 rover. The GPS readings will be recorded at a rate of 1 Hz. The positional information will be logged in the Projected Coordinate System; North American Datum 1983 (NAD83), Universal Transverse Mercator (UTM) Zone 13 North and recorded in meters.

- Subsequent to collecting data, both the closing QC tests and IVS will be performed.
- Results will be written on the QC form (**Appendix E**).
- At the end of the day all instruments and cables will be visually checked.
- All batteries will be recharged.
- DGM production data will be downloaded, backed up, and sent to the data processor.
- Daily IVS and QC data will be sent to the QC Geophysicist.

3.4.6 Geophysical Data Processing and Analysis

Geophysical sensor and positional data will be processed and interpreted using Geonics DAT61MK2, and Geosoft Oasis Montaj®. The overall-processing stream for EM61 data will be accomplished using the following steps:

- Raw binary geophysical data will be downloaded from the EM61 data logger to a PC
- Data spikes will be removed.
- The geometry of geophysical system and RTK-GPS will be included in the data.
- Data will be converted to Geosoft *.xyz files and imported in Oasis Montaj.
- The following initial QC checks of the data will be performed to verify the quality and/or identify substandard values:
  1) The QC forms will be checked for personal and shake tests.
  2) The latency correction will be calculated using latency test.
  3) Data will be checked for spikes.
  4) It will be verified whether the data are within the expected range.
- The static/standard test will be evaluated for QC compliance.
- The data will be latency and drift corrected. Only the GPS data with quality factor 4 will be used, and when possible the remaining data will be interpolated. All data falling below required positioning standards will be recollected.
- The noise level will be checked using the fourth differential.
- Different filters (e.g., low pass, non-linear, Euler or Werner deconvolution and Wiener optimal filter) may be utilized to help alleviate the effect of the soil and cultural EM sources.
- A dynamic background will be calculated based on three (3) standard deviations and the production data will be sub-set to include only those data that satisfy normal decay Channel 1 > Channel 2 > Channel 3 > Channel 4.
- Drift corrections will be performed using demedian correction.
- The sum of all channels will be calculated.
- The channel 2 or the sum of all channels will be gridded using a minimum curvature gridding function with a 0.10-m cell size and 0.4-m blanking distance.
- Gridded data will be plotted and non-systematic lag correction will be performed if needed.
- Maps will be made and data will be displayed in gridded format as 2-dimensional polynomial function using a color scheme where the response to the object shows up as an isolated feature or "anomaly" above the background level.

All processing steps will be documented so that results can be checked and procedures verified.

3.4.6.1 Target Selection

The most common, standard approach to select anomalies is referred to as "threshold picking." Often these approaches are applied in a simple manner and base anomaly selections are performed using the automated tools described below. However, recommended approaches use either a more sophisticated method to detect and select anomalies, or a phased approach to first detect above-background measurements and then quantify one or more anomaly characteristics to select anomalies onto dig lists based on multiple criteria.

The targets will be picked using the following steps:

- EM anomalies will be selected from the gridded data (filtered channel 2 or sum of all channels) utilizing a peak-picking algorithm (Blakely test) and using a 1-pass smoothing (Hanning) filter.
- A grid value cutoff level (threshold) for the EM61 will be determined in agreement with MRS-specific requirements.
- The locations of all known cultural features recorded during the survey will be plotted on the same map as the data. All anomalies that are in close proximity to those features will be masked and excluded from target selection.
- Additional targets will be manually selected from the portion of the data with the signal strength that is within 5% of the required threshold. Analysis of the anomaly footprint (i.e., anomaly size), and shape and time decay of these anomalies will be used for this target selection as well.

3.4.6.2 Dig Sheet Development

The Anomaly and Dig Selection & Intrusive Results Tables will be submitted digitally in a Microsoft Access Database IAW DID MMRP-09-004-Attachment B (USACE 2009a). The Dig Sheets will include all anomalies from the Anomaly Table that have been selected for intrusive investigation.

The initial number of targets that need to be intrusively investigated will be determined using the "Anomaly Verification Sampling" Statistical Analysis module of the VSP software. This module works as follows. If there are N anomalies in anomaly table, we will make an assumption that *M* out of these *N* anomalies are MEC. Then, if we pick *n* anomalies at random without replacement out of *N*, this statistics will give the probability P (*m*) that exactly *m* out of *n* anomalies are MEC. This probability is given by

$$P(m) = \frac{\dfrac{M!}{(M-m)!}\dfrac{(N-M)!}{(N-M-n+m)!(n-m)!}}{\dfrac{N!}{(N-n)!n!}}$$

Once the number of anomalies that need to be initially excavated is established, targets for intrusive investigation will be randomly selected from the anomaly table to be representative of that particular area. Depending on the dig results in the field, the initial assumptions will be adjusted (i.e., the iterative approach will be applied until the final dig list is completed). The

final dig list will indicate that, after excavating a specific number of targets, a 95% confidence level of MEC potential on site has been achieved.

3.4.6.3 Anomaly Reacquisition

Anomaly reacquisition for EM61 will be conducted using the following procedures:

- The target lists will be given to a Site Geophysicist who will relocate the targets using RTK-GPS.
- After locating the target, the geophysicist will use the EM61 to locate the peak of the response. He/she will pass over the anomaly in two (2) perpendicular directions to locate the response peak as accurately as possible. However, the EM61 readings will be recorded while passing in the direction parallel to data collection since the best correlation can be achieved with the previous data collection. Then, the flag will be placed at determined position.
- The search radius will be up to ~1.5 meters around the anomaly identified during data collection. If multiple peaks are identified at the time of anomaly reacquisition, those locations will be flagged in the field and the results documented on the reacquisition target list.
- Finally, the direction between the flag and position determined with RTK-GPS, and its distance, will be recorded.

An example of Anomaly Reacquisition Table for the EM61 is provided in **Appendix E**.

3.4.7 Quality Control

All QC aspects of the GIP discussed in this section were developed IAW DID MMRP-09-004 (USACE 2009a) and EM 1110-1-4009 (Chapter 9) (USACE 2010a) requirements and are described in detail in **Section 4.0**.

QC inspections/surveillance points to be performed during the IVS include area selection, seed item placement and survey, repeat data, and static position test QC checks. All IVS QC actions will be reviewed and confirmed by the QC Geophysicist.

QC inspections/surveillance points performed as part of the geophysical investigation include equipment maintenance, instrument standardizations checks, battery strength checks, positioning accuracy test, warm-up test, personnel check, cable shake test, static test, standard instrument response test, static system relaxation test, latency test, repeatability test, along line measurement spacing, processed data checks, database checks, anomaly selection, and anomaly reacquisition. All geophysical investigation QC actions will be reviewed and confirmed by the QC Geophysicist.

QC inspections/surveillance points performed as part of the target anomaly verification include checks to verify that the UXO team resolved the target anomalies. Verification of target anomalies includes determination of:

- Anomaly Type (e.g., UXO, DMM, MD, RRD, Other Debris, False Positive, No Dig/Utility).
- Anomaly Description and quantity (e.g., 1 rebar, 5 nails, wire, MK3, Projectile 75 mm).

- Object Depth to Top.
- Estimated Object Weight (kilogram [kg]).
- Estimated Object Dimensions (Length/Width/Thickness)
- Physical Condition of MEC (Intact, Broken Open, Filler Visible)

Verification of the target anomalies will be performed by the Field Geophysicist/UXO technician and reviewed by the Project Geophysicist/SUXOS.

3.4.7.1 Final Processed Data Format and Storage

The Final Processed Data will be produced and presented in American Standard Code for Information Interchange formatted files and native Geosoft format (.GDB). Final processed data is defined as data that represents, to the best of FPM's ability, the true anomaly amplitude that exists at each anomaly location measured by the geophysical system. Final processed data will have all corrections applied needed to correct for positioning offsets, instrument bias (including instrument latency), instrument drift and diurnal magnetic variations (magnetic method). Advanced processed data is defined as Final Processed data that has been subjected to additional advanced processing techniques and was used in the anomaly selection process. All corrections and processing steps will be documented. Metadata for final processed and advanced processed data will include UTM zone and coordinate units, and descriptions and units of all "z" values, which are the data associated with each measurement event. All measurement events will have a time stamp. Unprocessed, interim-processed, final processed, and advanced processed (if used) "z" values shall be included in a single file. Data file size will be limited to 100 megabytes or less, and the file length will be limited to 600,000 lines or less. Each data file will be logically and sequentially named so that the file name can be easily correlated with the project-specific naming conventions.

3.4.7.2 Map Formats

For submittals, maps will be provided in editable Geosoft form and map images (.map) will be provided in image format (.jpeg) for viewing and include grid (.grd) files. Maps will include the following basic map features in addition to other necessary site information.

Selected anomalies and known features will be marked with symbols on the map. Map scales will be even multiples of the base units presented in the map. Map sizes will be designed to fit standard printer or plotter sizes. Grid ticks or grid lines will be visible and labeled.

The title block will include the figure number, map title, and sub-title and location of the information being presented. Objects/symbols shown on the map will be identified in a legend. A map scale bar, coordinate system, and north arrow will be included. Color scale bars will use a color scheme that clearly differentiates between anomalies and background readings. Background values will be plotted in white or gray. A classic "cold to hot" color scale will be used with negative values plotted in blue and high positive values plotted in red or pink. The range of values will be "fixed" so that the same color scale is utilized across the site.

Additional project information provided in boxes will include at a minimum the following information:

- Client,

- Project,
- Contractor,
- Map approver, and
- Date created.

3.5 Geospatial Information and Electronic Submittals

The Geospatial Information and Electronic Submittals Plan details the site-specific survey, mapping, aerial photography, computer-aided drafting and design/GIS, and electronic submittals required for the RI.

3.5.1 Control Points

Survey points will be tied to an established network of monuments with horizontal and vertical control of "Class I, Third Order" or better. Horizontal control will be based on the metric system and referenced to the NAD83 and the UTM Grid System. Surveying and mapping requirements will meet the minimum standards set forth in USACE EM 1110-1-1004, Geodetic and Control Surveying (USACE, 2002). Newly established control points and recovered monuments will be of a permanent nature for recoverability during future phases of work within the same project. Control points will be iron or steel pins, concrete monuments, or other permanently constructed points. Installation of control points and monuments will meet minimum standards set forth in USACE EM 1110-1-1002, Survey Markers and Monumentation (USACE, 1990a).

3.5.2 Geographic Information System Incorporation

Spatial data created as part of the RI will be submitted in an Environmental Sciences Research Institute (ESRI)-compliant format (shape files, coverage's, or geodatabase). Supporting tabular data will be submitted in either Microsoft® Excel or Access format.

3.5.3 Computer Files and Digital Data Sets

Final document files (e.g., reports and associated figures and tables) generated will be submitted in PC-compatible Microsoft Office 2000® or higher software and in Adobe Portable Document Format. Final GIS data generated will be submitted in non-proprietary spatial data transfer standard format at the close of the project, as well as in the ESRI shape file format.

3.6 Intrusive Investigation Plan

Intrusive activities will be completed IAW the RI WP, and DDESB-approved ESS. All excavation operations will be conducted IAW AF guidance document Air Force Manual (AFMAN) 91-201 (AFMAN, 2011), USACE EM 385-1-1 Safety and Health Requirements Manual (USACE, 2011a), USACE EM 385-1-97 Explosives Safety and Health Requirements Manual (USACE, 2010b) and Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1926 Subpart P (OSHA, 2012).

3.6.1 Target Anomaly Sampling Locations

UXO personnel will excavate subsurface geophysical targets identified as a result of the DGM surveys and data evaluation efforts, and picked for excavation using the RI DQO methodology. Therefore, MEC/MPPEH/MD sampling locations will be generally along the same paths that the geophysical investigation teams used to collect the subsurface data. During the field activities,

revised field maps will be generated that illustrates the actual paths taken with anomaly points picked form MEC/MPPEH/MD sampling for use by field crews and QC personnel.

3.6.2 Munitions with the Greatest Fragmentation Distance

For XU853, the MK10 5" Rocket Motor is the Munition with the Greatest Fragmentation Distance (MGFD); for XU854, the MGFD is the M383 40 mm grenade.

3.6.3 Minimum Separation Distances

Prior to the start of intrusive activities, the SUXOS and UXOSO will verify that the area around the MRS is clear of all nonessential personnel and that other UXO supervisors have been notified. MSDs will be established and maintained around each MRS during intrusive activities. The MSDs are dependent on the MGFD as listed in **Table 3-2.**

3.6.4 Target Anomaly Investigation Procedures

A UXO excavation team will perform intrusive investigation. Intrusive activities will not begin until the UXOSO has given a safety briefing, the UXO Team Leader has given a site-specific safety briefing to their team, communications are established with the field command post, and all non-essential personnel are evacuated from the area outside the specified MSDs.

Exclusion Zones (EZs) will be established IAW the approved ESS during MEC operations. The establishment of EZs may require posting of security watches, or physical marking of the zone to confirm that non-essential personnel do not enter. Essential personnel and authorized visitors as defined in AFMAN 91-201 (AFMAN, 2011) will be allowed within the EZ. If non-essential or unauthorized personnel enter the area, intrusive investigations will cease.

Table 3-2 Minimum Separation Distances

MRS	MEC	MSD (ft)						
		For Unintentional Detonations			For Intentional Detonations			
		Hazardous Fragmentation Distance (HFD)		K40[1] TSD	Without EC: Larger of MFD-H or K328[2]	Using Sandbag Mitigation (Single Item)		Water Mitigation
		Without EC	With EC			Single Layer	Double Layer	
XU853	MK10 5" Rocket Motor	428	Not Permitted	115	1,874	Not Permitted	Not Permitted	Not Permitted
XU854	M383 40 mm grenade	207	200	22	302	200	12.5	200

Notes:

1. K40 also referred as "team separation distance (TSD)" - The allowable blast overpressure distance for unintentional detonations of non-fragmenting munitions.
2. K328 - The allowable blast overpressure distance or MSD for a planned detonation of non-fragmenting munitions.

If MEC with a greater fragmentation than the established MGFD (**Table 3-2**) is encountered, the MSD will be adjusted IAW DDESB TP 16 Methodologies for Calculating Primary Fragment Characteristics (DDESB 2009a), operations will continue, and an amendment to the ESS submitted for approval (a copy of this document will be available on site). Explosives Safety Quantity Distance arcs will be adjusted accordingly.

If intrusive investigations must occur within the Hazardous Fragmentation Distance (HFD) listed in **Table 3-2**, appropriate and applicable engineering controls will be used. If engineering controls cannot be implemented, any public roadways within the HFD areas will be evacuated and/or roadways blocked to prevent non-essential personnel from entering during intrusive investigations of the anomalies.

Hand excavation will be the primary intrusive method, and will be performed using hand trowels or shovels. White's all metal detectors will be used to assist the team in determining the location and orientation of the anomaly item. The UXO team personnel excavating an anomaly shall initially remove no more than a 6-inch layer of soil at the location of the anomaly. A visual and electronic search of the excavation shall then be made. This process shall be repeated until the audible signal from the instrument indicates the object is close to the surface of the excavation. Once this determination has been made, soil will be removed by hand until the anomaly is located. Heavy equipment may be used in some areas where appropriate, including areas of very dense anomalies or if large, heavy items are discovered. It will be used to remove the immediate overburden from atop anomalies. Heavy equipment will not come in contact with the target anomaly. The intrusive anomaly investigation team will refine and pin-point each excavation location utilizing hand-held detectors (electromagnetic and/or magnetometer). Prior to excavations, each work area will be evaluated for underground utilities by the SUXOS and the UXOSO.

If the subsurface contact proves to be non-MEC, the item will be removed and the excavation rechecked by the UXO technician using the White's all metal detectors. If the hole is "clean," (i.e., negligible response with White's detector) it will be refilled and tamped. If the subsurface contact is a MEC, procedures developed in the ESS will be implemented. To verify all source items are investigated, the area within a diameter of 1 m centered on the target location will be checked by the UXO technician using a White's detector to verify no other metallic items exist within this area. This is required since the primary geophysical anomaly (target) could mask additional anomalies. All access/excavation/detonation holes will be backfilled with the soils excavated from the hole.

3.6.5 Accountability and Records Management

The UXO dig team will record results and dispositions of geophysical targets electronically, utilizing handheld Personal Digital Assistant (PDAs). Data recorded in each PDA will be downloaded daily by the Project Geophysicist/Data Manager and compared with specific geophysical data characteristics contained in the overall dig sheets to better refine the dig process as the RI progresses. Detailed records will be made of all MEC items encountered during the RI activities. This record will include the nomenclature (if applicable) type, approximate weight, depth, orientation, condition, and location of the item indicated. Excavated anomaly attributes will also be added to the project GIS database. The UXOQC will review the accuracy of the project GIS database.

The example of an Intrusive Results Table is provided in **Appendix E.**

3.6.6 Material Potentially Presenting an Explosive Hazard Inspection Process

The MPPEH inspection process will be conducted following the procedures described in **Sections 3.2.4** and **3.2.4.1**.

3.6.7 Personnel Qualifications

UXO personnel qualifications are presented in **Section 2.0.**

3.6.8 Munitions and Explosives of Concern Disposition

FPM maintains a Bureau of Alcohol, Tobacco, & Firearms Type 33 Federal Explosives License (FEL), No. 6-NY-00986, which authorizes site UXO personnel to purchase, receive and use donor explosives to dispose of MEC/MPPEH. MEC/MPPEH will be disposed on a daily basis using appropriate engineering controls. The Base Command Post and EOD will be notified of MEC/MPPEH disposal activities and will, in turn, notify Fire and Emergency Medical Technician for stand-by. If demolition operations cannot be conducted at the time the item is located, the item will be secured in place with sand bags and security will be provided 24 hours a day until disposal of the item can be achieved. Prior to explosive operations, the UXOSO will ensure that appropriate MSDs for non-essential and essential personnel are properly established and maintained IAW the approved ESS. The SUXOS will ensure that the explosive materials used are appropriate for the operations performed. All MEC/MPPEH disposal activities will be conducted by qualified UXO personnel IAW DDESB TP-18 (DDESB, 2004), and any applicable state or local regulations. At a minimum, the demolition operations team will consist of a minimum of three UXO-qualified personnel, including the UXOSO, a UXO III acting as Demolition Supervisor, and a UXO II or UXO I. These operations will be performed under the direction and supervision of the SUXOS. In the unlikely event that an accidental detonation or the emergency occurs, the emergency contingency plan in the HASP will be followed. The UXOSO will be the primary contact and will coordinate all emergency activities.

All explosive operations will follow the procedures outlined in AFMAN 91-201 (AFMAN, 2011) EM 385-1-1 (USACE, 2011a), EM 385-1-97 (USACE, 2010b), Department of the Army (DA) TM I 60A-1-1-31, EOD Procedures/General Information on EOD Disposal Procedures (DA, 2008). Munitions that are encountered during the RI will be either BIP or transported to the MRS SDA. The FPM SUXOS will determine which method is the most appropriate. If BIP is deemed to be the most appropriate, FPM will implement applicable and necessary engineering controls (i.e., use of sandbags or water) for mitigation of fragmentation and blast effects due to intentional detonation of munitions IAW HNC-ED-CS-S-98-7, Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions (USACE, 1998) and HNC-ED-CS-5-00-3, Use of Water for Mitigation of Fragmentation and Blast Effect due to Intentional Detonation of Munitions (USACE, 2000) for all demolition shots. Demolition shots will be fired during daylight hours. The exceptions to the BIP requirement are when the SUXOS determines the risk associated with movement is acceptable and movement is necessary for the efficiency of either the activities being conducted, or protection of people, property, or critical assets. In such cases, the SUXOS may evaluate the munitions and authorize its movement within the MRS to the approved SDA for securing and destruction either individually or as part of a consolidated shot. It is assumed that all DMM will be transported to the SDA for disposal.

If determined acceptable to move by the SUXOS, consolidating multiple MEC/MPPEH may be anticipated for this project. Consolidated MEC/MPPEH disposal operations will be conducted IAW: AFMAN 91-201 (AFMAN, 2011), DDESB Memorandum Approval of Minimum Separation Distance to Non-Essential Personnel When Using DDESB-Approved Consolidated Shot Method (September 25, 2009) (DDESB, 2009b); DA TM 60A-1-1-31, (DA, 2008); USACE Engineering Pamphlet 1110-1-17 Establishing a Temporary Open Burn and Open Detonation

Site for Conventional Ordnance and Explosive Projects (USACE, 1999); and the unnumbered U.S. Army Engineering Support Center, Huntsville (USAESCH) publication entitled "Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives Sites" (USAESCH, 1998). Consolidated shots shall be initiated in such a manner that detonation of all munitions items is simultaneous.

3.7 Munitions Constituents Sampling and Analysis

The objective of the MC sampling with respect to MEC/MPPEH/MD is to determine the presence or absence of MC contamination associated with such items (explosives and metals) and if present establish the contamination's extent.

Soil samples will be collected using composite sampling at locations of confirmed MEC/MPPEH and in areas with significant amounts of MD. The sampling depths will be determined based in part upon the depth of MEC/MPPEH/MD found during the intrusive investigation. MEC/MPPEH/MD surface finds will result in only surface soil being collected because any resulting MC are expected to be close to the surface if soil is undisturbed. If surface soil sample results indicate that MC is present above the screening levels, the subsurface soil at the same location will be analyzed to determine the vertical extent of MC contamination. Conversely, MEC/MPPEH subsurface finds will result in subsurface soil being collected at the same location and depth of MEC/MPPEH/MD and analyzed for MC.

In addition, since both MRSs were used for rocket/missile testing, MC associated with rocket/missile testing is potentially present in the soils of both XU853 and XU854 MRSs. The objective of the MC sampling with respect to missile testing is to determine the presence or absence of MC contamination associated with such activities (propellants) and if present establish the contamination's extent.

Incremental and composite soil samples will be collected from rocket/missile launch pad sites and isolated areas showing evidence of potential contamination (e.g., discolored soils), respectively. The soil samples will be taken from a depth 0 to 6 inches bgs. One of the components of propellants, nitrocellulose, is virtually insoluble and survives for long periods of time in soil (USACE, 2011b). If surface soil sample results indicate that nitrocellulose is present, the subsurface soil at the same location will be analyzed to determine whether other components of propellants which are leachable are present in the subsurface. If surface/subsurface soil sample results indicate the potential for migration of contaminants into groundwater, then groundwater samples will be collected at those specific locations for analysis.

Sampling activities will be conducted with the support of a UXO escort providing MEC/MPPEH/MD and anomaly avoidance IAW USACE EP 75-1-2, UXO Support during Hazardous, Toxic, and Radioactive Waste and Construction Activities (USACE, 2007). The sampling requirements, procedures, and chemical analyses are described below and in the UFP-QAPP (**Appendix D**). QA/QC procedures for the various sampling methods are also described in the site-specific UFP-QAPP. The NMED has recently revised its risk based Soil Screening Levels (SSLs) (NMED, 2012). USEPA also publishes Regional Screening Levels (RSLs) (USEPA, 2014). The SSLs or RSLs are employed to determine whether MC contamination exists. For ground water screening Maximum Contaminant Levels (MCLs) from both USEPA and New Mexico Water Quality Control Commission (NMWQCC) Ground and Surface Water Protection (NMWQCC, 2002) were used. The project soil and ground water screening standards are summarized in **Table 3-3**.

3.7.1 Areas with Occurrences of Confirmed MEC

Surface or subsurface soil samples will be collected from areas containing occurrences of confirmed MEC/MPPEH and in areas with significant amounts of MD using composite soil sampling techniques as described below and in the site-specific UFP-QAPP (**Appendix D**). The samples will be submitted for laboratory analysis using USEPA Method 8330A for explosives (1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; o-Nitrotoluene; 3,5-Dinitroaniline; m-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; p-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl) and USEPA Method 6010C for metals (aluminum, antimony, chromium, copper, iron, lead, and zinc). The samples will be analyzed to determine if MCs have been released to the environment. The number of composite samples collected will depend on the number of MEC items identified. If no MEC/MMPEH items are identified and if no areas with significant amounts of MD are found then no MC sampling will be conducted.

Composite soil samples will be collected using a seven-point “spoke and hub” method, in which six sub-samples are collected from a wheel shaped layout of two ft in diameter and a seventh sub-sample collected from the center of the wheel.

The procedure for sample collection is as follows:

- The intended sample location is laid out and recorded in the field log book. Prior to sample collection, don clean nitrile gloves and do not allow disposable sampling equipment to come in contact with potential sources of contamination.
- At each of the seven sub-samples locations, dig down approximately 6 inches using a disposable polyethylene scoop. The radius from the center sub-sample should be approximately 1 foot from the center sample.

Table 3-3 Soil Screening Standards

Analytes	Holloman AFB Soil Background Levels[a] (mg/kg)	Human Health (HH) Residential Soil Screening Value milligrams/kilogram (mg/kg)			Ecological soil Screening Values (mg/kg)	
		USEPA RSLs[b]	New Mexico SSLs[c]	Recommended HH Soil Screening Values	LANL Ecological Benchmarks[d]	Recommended Ecological Screening Values
Explosives						
1,3-Dinitrobenzene	NA	0.62	NA	0.62	0.073	0.073
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	NA	15	NA	15	10	10
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	NA	15	NA	15	3.6	3.6
2,4-Dinitrotoluene	NA	1.7	15.7	1.7	2.5	2.5
2,6-Dinitrotoluene	NA	0.36	61.1	0.36	1.8	1.8
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	NA	6.0	58.2	6.0	7.5	7.5
Nitrobenzene	NA	5.1	53.5	5.1	2.2	2.2
Nitroglycerin (NG)	NA	0.62	6.11	0.62	71	71
2-Nitrotoluene (o-Nitrotoluene)	NA	3.2	29.1	3.2	9.9	9.9
3-Nitrotoluene (m-Nitrotoluene)	NA	0.62	7.82	0.62	12	12
4-Nitrotoluene (p-Nitrotoluene)	NA	25	244	25	22	22
Octahydro- 1,3,5,7-tetranitro-1,3,5,7-tetra (HMX)	NA	380	3,910	380	27	27
Pentaerythritol tetranitrate (PETN)	NA	12	NA	12	100	100

1,3,5- Trinitrobenzene (sym-TNB)	NA	220	NA	220	6.6	6.6
2,4,6,-Trinitrotoluene (TNT)	NA	3.6	39.1	3.6	6.4	6.4
Trinitrophenylmethylnitramine (Tetryl)	NA	12	244	12	0.99	0.99
3,5-Dinitroaniline	NA	NA	NA	NA	NA	NA
Nitrocellulose	NA	1.8E+07	NA	1.8E+07	NA	NA
Metals						
Aluminum	13,722	7,700	78,000	7,700	NA	NA
Antimony	1.6	3.1	31.3	3.1	0.05	0.05
Chromium	25	12,000	117,000	12,000	28	28
Copper	13	310	3,130	310	15	15
Iron	23,049	5,500	54,800	5,500	NA	NA
Lead	10.9	400	400	400	14	14
Zinc	54.6	2,300	23,500	2,300	48	48
Nutrients						
Nitrate	NA	13,000	125,000	13,000	NA	NA
Perchlorates						
Perchlorate	NA	5.5	54.8	5.5	NA	NA

Notes:

LANL = Los Alamos National Laboratory
NA = No value available
a – (USEPA, 2014). Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
b – (New Mexico Water Quality Control Commission [NMWQCC] Regulations and Standards, 2002). Ground and Surface Water Protection. http://www.nmenv.state.nm.us/wqcc/regulations.html
c – Unless otherwise noted, the ecological screening value in this column represents the Ecological Screening Level (ESL) for soil developed by Los Alamos National Laboratory., (LANL, 2012). Ecological Screening Levels. Los Alamos National Laboratory Eco Database. U.S. Department of Energy.

- The soil from each sampling location is placed into a decontaminated stainless steel bowl or disposable polyethylene bag. The samples are then homogenized by hand mixing with a decontaminated stainless steel spoon or disposable polyethylene scoop until the sample color is homogenous.
- Once the composite sample is collected, the location will be documented and photographed; and GPS coordinates will be recorded.
- Once collected, the sample will be containerized as per the analytical laboratories requirements, labeled as specified in the SOP for Sample Handling, Documentation, and Tracking and placed in a cooler chilled to a maximum temperature of 4 degrees Celsius (°C).
- The team will set aside a portion of the sample to use in logging a description of the soil characteristics (using the Unified Soil Classification System) in the field logbook.

3.7.2 Rocket/Missile Launch Pad Areas

Representative surface soil samples will be collected using incremental sampling technique from rocket/missile launch pad sites. Samples will be submitted for laboratory analysis using USEPA Method 8330B for explosives (2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; and RDX), USEPA Method 353.2 for explosives (Nitrocellulose), USEPA method 300/9056A for Anions (Nitrate), and USEPA method 6850 for Perchlorate. One incremental surface soil sample will be collected at each launch pad site, therefore, four (4) and two (2) incremental samples will be collected in XU853 and XU854, respectively.

The goal of the incremental sampling is to obtain an unbiased and reproducible estimate of the average concentration of analytes through the collection of soil sample increments distributed evenly throughout the decision unit/sampling area. Ideally, the target weight of an incremental sample is approximately 1 kg and is comprised of 30 (minimum) to 100 increments within the decision unit. The soils samples collected using incremental sampling technique will be collected as follows:

- Area around each launch pad will be identified as decision unit. Once the boundary of the decision unit is defined, a systematic random sampling grid will be set up at the decision unit. Flags will be used to mark each grid cell corner to create a visual sub-grid pattern. For example, if 30 increments are needed, a systematic random sampling design of 5 x 6 may be used. A random incremental sample would be collected from within each grid cell. Additional flags can be placed within the interior of the decision unit if visual obstructions impede the visualization of evenly spaced increments throughout.
- Working in a team of two, one person will collect each increment while the other holds the sample container (clean plastic bag) and keeps track of the number of increments collected. The increments are sampled in a snake-like pattern from one corner of the decision unit to the corner opposite to the starting corner.
- For the collection of QA/QC samples, the replicate samples should be collected from a sub-grid collection point offset from the original starting position and followed in the same snake-like pattern walked during the collection of the primary sample.

- The sampling depths will be from 0 inch to 6 inches at each increment location. The diameter of the sampling tool and the volume collected at each increment location will need to be adjusted to satisfy the 1 kg sample mass as it pertains to the selected quantity of increments in each decision unit.
- Once collected, the sample will be containerized as per the analytical laboratories requirements, labeled as specified in the SOP for Sample Handling, Documentation, and Tracking provided in the UFP-QAPP (**Appendix D**) and placed in a cooler chilled to a maximum temperature of 4°C.
- Once the sample collection is completed, the location will be documented and photographed; and GPS coordinates will be recorded at each of the four corners of the decision unit.
- The team will set aside a portion of the sample to use in logging a description of the soil characteristics (using the Unified Soil Classification System) in the field logbook.

3.7.3 Isolated Locations Showing Evidence of Potential Contamination

Representative surface soil samples will be collected using composite sampling techniques from isolated locations showing evidence of potential contamination such as discolored soil due to range related activities (i.e., propellants from missile testing). Samples will be submitted for laboratory analysis using USEPA Method 8330B for explosives (2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; and RDX), USEPA Method 353.2 for explosives (Nitrocellulose), USEPA method 300/9056A for Anions (Nitrate), and USEPA method 6850 for Perchlorate.

The composite soil samples will be collected following the procedures described in Section **3.7.1** and in the site-specific UFP-QAPP (**Appendix D**).

3.7.4 Groundwater Sampling (If Required)

If surface/subsurface soil sampling results indicate the potential for migration of MC into groundwater then groundwater sampling will occur at the specific locations and for the specific contaminant(s) identified. Groundwater sampling (if required) will be conducted IAW the procedures described in the site-specific UFP-QAPP (**Appendix D**).

3.8 Investigative-Derived Waste

This Investigative-Derived Waste (IDW) Plan describes procedures for handling and disposing of IDW generated during the RI field activities. This plan is applicable to IDW generated during MC sampling and does not apply to MEC/MPPEH/MD.

Planned MC sampling activities include soil sampling using disposable sampling equipment, such as disposable polyethylene scoops. Sampling is not anticipated to generate IDW. PPE and other disposable sampling equipment will be bagged and temporarily staged for off-site disposal IAW USEPA regulations. Sampling personnel will follow local and state protocols, as well as stakeholder guidance, in determining the proper disposal of PPE.

If site information necessitates the sampling of additional matrices and utilizing alternative sampling approaches, a change to this document will be completed detailing the IDW anticipated and procedures and protocols required for disposal.

3.9 Risk Characterization and Analysis

Following field work, a qualitative evaluation of explosive hazards for the XU853 and XU854 MRSs will be performed. A MEC HA will be utilized for both MRSs. Potential risk associated with the MRSs will also be evaluated by conducting a MC HHRA and ERA. The preliminary CSMs for both MEC and MC exposure pathway analyses that are serving as a starting point for the RI WP are shown on **Figures 1-4**, **1-5** and **1-6**. These preliminary CSMs will be refined for the RI pending the outcome of the surface clearance, geophysical investigation, intrusive investigation, and MC sampling results.

3.9.1 Munitions and Explosives of Concern Hazard Assessment

This MEC HA ranks potential explosive hazards to human receptors at sites where MEC was identified during the RI. The MEC HA is a systematic approach to assess the potential acute explosive hazards at an MRS given current site conditions and under various cleanup or land use control alternatives. The qualitative HA technique presented here follows the USAF MHAT (USAF, 2011), which provides an assessment of the acute explosive hazards associated with remaining MEC at an MRS by analyzing site-specific conditions and human issues that affect the likelihood that a MEC accident will occur. The MEC HA method focuses on hazards to human receptors and does not directly address environmental or ecological concerns that might be associated with MEC. The process for conducting the MEC HA is described in the MEC HA interim guidance document (USEPA, 2008) and the tool used to perform the calculations developed by the USAF and described in the MHAT user's guide (USAF, 2011).

Hazard Assessment Framework

The MEC HA was structured around three major components of potential explosive hazard incidents:

- Severity – the potential consequences of the effect on a human receptor should a MEC item detonate;
- Accessibility – the likelihood that a human receptor will be able to come in contact with a MEC item; and
- Sensitivity – the likelihood that a MEC item will detonate if a human receptor interacts with it.

Each of these three components was assessed by input factors collected from historical site information and field data collection. Each input factor has multiple categories, each of which is associated with a numeric score that reflects the relative contributions of the different input factors to the MEC HA. The factors are entered into the USAF MHAT. **Table 3-4** shows the input factor maximum scores and resulting weights.

These results should not be considered quantitative measures of explosive hazard; instead, the output places an MRS within one of four hazard levels (highest potential to low potential explosive hazard conditions).

3.9.2 Baseline Human Health Risk Assessment

The general approach for the screening level HHRA, involves comparison of maximum detected MC values with conservative screening levels. The more conservative of the USEPA RSLs or

NMED SSLs is used for the HHRA (see **Table 3-3**). The residential screening values represent the most conservative unrestricted future land use, so they will be applied regardless of applicable exposure scenarios to protect all possible current and future exposure scenarios.

The receptors to be evaluated include base personnel, authorized contractors, residents, visitors, and trespassers. The primary MC exposure pathways for human receptors are through subsurface soil and surface soil. Future land use is anticipated to remain consistent with current land use. Therefore, potential receptors should remain the same.

Table 3-4 Input factors, Maximum Scores, and Resulting Weights

Explosive Hazard Component	Input Factor	Maximum Scores	Weights
Severity	Energetic Material Type	100	10%
	Location of Additional Human Receptors	30	3%
	Component total	130	13%
Accessibility	Site Accessibility	80	8%
	Total Contact Hours	120	12%
	Amount of MEC	180	18%
	Minimum MEC Depth/Maximum Intrusive Depth	240	24%
	Migration Potential	30	3%
	Component total	650	65%
Sensitivity	MEC Classification	180	18%
	MEC Size	40	4%
	Component total	220	22%
Total Score		1,000	100%

3.9.3 Screening-Level Ecological Risk Assessment

A Screening Level ERA (SLERA) will be completed to assess potential adverse impacts on current or future ecological receptors exposed to MC in surface/subsurface soil at Holloman AFB MRSs. The assessment endpoints for the SLERA are the protection of local populations and communities of plants, mammals, birds, and soil invertebrates from adverse impacts from MC (explosives, metals, and propellants) in soil. If necessary, the SLERA will also assess endpoints for MC (propellants) in groundwater. The SLERA will be prepared IAW the USEPA's Risk Assessment Guidance for Superfund (USEPA, 2001). The SLERA will include screening-level problem formulation/ecological effects evaluation and screening-level preliminary exposure estimates/risk calculation components.

The primary exposure pathways for ecological receptors are through the food chain, surface soil, and subsurface soil.

3.9.4 Munitions Response Site Prioritization Protocol

FPM will update the MRSPP and assign both MRSs an updated relative priority for response activities based on the results of the RI analysis and considering various factors related to safety and environmental hazards. The MRSPP will be applied IAW 32 CFR Part 179 (CFR, 2009) and the guidance provided in the DoD MRSPP Primer (DoD, 2007). FPM will assign a MRSPP rating ranging from 1 to 8 to each MRS. The priority will be determined by selecting the highest rating amongst the EHE and HHE modules.

4.0 QUALITY CONTROL PLAN

The QCP presented in this chapter addresses the QC procedures to be followed during the completion of MEC-related activities during the RI at the XU853 and XU854 MRSs. The QCP describes the way in which FPM will produce the deliverables, and the step-by-step approach that will be taken to ensure the quality of the services and the products derived from those services. The FPM QC process ensures that the training, actions, procedures, and tools support every employee according to the requirements and in such manner that the environment is protected and the impact of the project activities is minimized. The QCP adheres to the requirements specified in MMRP industry standard guidance documents published by DoD, DDESB, and USACE.

The overall objectives of this QCP are to identify and implement quality requirements to ensure that overall project activities are accomplished using an acceptable level of internal controls and review procedures. The intent of such controls is to eliminate conflicts, errors, and omissions and ensure the technical accuracy of all deliverables. Specifically, this plan:

- Identifies the specific project QC objectives for the associated RI project elements.
- Identifies the RI project QC organization and defines each individual's respective authority, responsibilities, and qualifications.
- Defines RI project documentation management and control, communications, and recordkeeping procedures.
- Establishes comprehensive evaluation of correct application of methods, adequacy of basic data and assumptions, correctness of calculations, and compliance with guidance, standards, regulations and laws.
- Describes procedures for the management of deficiencies, nonconforming conditions.
- Defines procedures for RI project submittals and recordkeeping.

4.1 Quality Assurance

QA will be monitored by the USAF. The USAF will evaluate field activities to verify that the approved RI WP is being followed and that the projects DQOs are being met.

4.2 Project Personnel Qualifications

Project personnel will be qualified to perform their assigned jobs IAW DDESB TP 18 (DDESB, 2004). Each employee will have a file at the project site which will include copies of necessary licenses, permits, training records, certificates of qualifications, and resumes that support the employee's placement and position. The UXOQCS will verify that project personnel have the required certifications to complete their assigned role on the project. Personnel minimum qualifications are described in detail in Technical Management Plan (**Section 2.0**).

4.2.1 Explosive Ordnance Disposal, Unexploded Ordnance Certifications, and Training Requirements

FPM will ensure that only qualified and properly trained personnel are assigned to positions on project sites. Prior to mobilization of personnel, FPM will ensure that training required by OSHA 29 CFR 1910.120, has been completed for all personnel assigned to the project. In addition, prior to the start of operations all personnel will receive the following as a minimum:

- Familiarization with the WP and its policies and procedures.
- HASP/Activity Hazard Analysis/SOP orientation.
- PPE training.
- Environmental considerations peculiar to the operations on the project site.
- Instruction and training on equipment usage and safe work practices.
- Daily safety training outlining the day's activities.

Training is conducted by the SUXOS or dual-hat UXOSO/UXOQCS, and records of attendance are maintained on site. Certificates of Training will be issued when applicable. The UXOSO/UXOQCS will have a monitoring program in place to identify when project personnel require refresher training and he will be responsible for reviewing EOD/UXO certifications.

4.2.2 Health and Safety Training

Health and safety requirements for project personnel have been established IAW the OSHA 1910.120 requirements for hazardous waste site works. Training certifications for field project personnel will be maintained on site by the UXOSO/UXOQCS. Project personnel training requirements are discussed in greater detail in the Base-Wide HASP (**Appendix B).**

4.3 Quality Program

4.3.1 Contract Submittal Quality Control Process

Documents required under this contract will be developed and maintained by a project team consisting of the PM, Program Chemist/Chemical Quality Control Manager, QC Geophysicist, and UXOQCS. These team members will contribute their corporate knowledge and experience to the documents to ensure technical quality. **Table 4-1** provides a summary matrix of project personnel QC responsibilities and associated submittals.

Comments on submitted documents will be directed by project personnel to the appropriate subject matter expert for resolution. Changes to final WP will be submitted to the PM immediately upon approval. The PM will be responsible for ensuring that the changes are posted to the hard copy on file and that all field personnel are made aware of the changes.

4.3.2 View and Acceptance of the Quality Control Program

The QCP will be reviewed and approved by the PM. After completion of the management review, the QCP will be submitted to the AF for review and acceptance prior to starting operational field activities. Revisions to the QCP will be reviewed and approved in the same manner as the original plan.

4.3.3 Review and Approval of Quality Control Plan Implementation and Project Procedures

The UXOSO/QCS has the authority and responsibility to verify that the QCP has been implemented for project activities. The Project Procedures presented in this RI WP will be reviewed by the UXOSO/QCS, SUXOS, Program Chemist/Chemical Quality Control Manager, QC Geophysicist, Project Geophysicist, the MMRP Installation Manager, the MMRP Manager, and the PM.

Table 4-1 Quality Control Submittal Register

Project Personnel	QC Responsibilities	Associated Submittals
Project Manager	Review and approve	All project deliverables
Program Chemist/Chemical Quality Control Manager	Develop and implement Chemical QC Plan and UFP-QAPP for environmental/MC sampling	Chemical QC Plan
		UFP-QAPP for environmental/MC sampling
	Develop and ensure compliance with chemical DQOs	Daily Chemical QC Report
		Chemical QC Summary Report
		Data Validation Reports
QC Geophysicist	Develop and implement the Geophysics QC Program	Geophysics QC Program
	Review and verify compliance with geophysical DQOs	Daily QC database updates
		QC figures
		Summary table of positional and production QC data
		Post raw and production QC data to SharePoint website
UXOQCS	Perform and document QC inspections/surveillances	Daily and Weekly QC Reports
	Perform and document nonconformance and corrective actions	Nonconformance and Corrective Action Reports

4.3.4 QC Management Philosophy

The Management Philosophy addresses the contractor's commitment to quality through QC Program which includes Quality Production, Internal Quality Checks and Reviews, and Technical Review.

The Quality Production includes a specific number of activities i.e., definable features of work, that are the major categories of work to be performed and form the framework for the QC approach for the project.

The internal quality checks and reviews will include a comprehensive evaluation of:

- Correct application of methods.
- Adequacy of basic data and assumptions.
- Correctness of calculations.
- Completeness of documentation.
- Compliance with guidance, standards, regulations, and laws.

The Technical Review will ensure that:

- The concepts, assumptions, features, methods, analyses, and details are appropriate, fully coordinated, and correct.
- An appropriate range of feasible alternatives was evaluated.
- The problems, opportunities, and issues are properly defined and scoped.
- The analytical methods used are appropriate and yield reliable results.
- The results and recommendations are reasonable, within policy guidelines, and supported by the presentation.
- Any deviations from policy, guidance, and standards are appropriately identified and have been properly approved.
- The products meet the customers' needs.

These major categories of work with associated QC actions and acceptance criteria are listed in **Table 4-2**.

4.3.5 Three-Phase Control Process

The UXOSO/UXOQCS and QC Geophysicist will verify compliance with project requirements through implementation of the three-phase control process (Engineer Regulation 1180-1-6, Contracts-Construction Quality Management (USACE, 1995) and EP 715-1-2, A Guide to Effective Contractor Quality Control (USACE, 1990b). This process checks that project activities comply with the approved plans and procedures. Elements of the three-phase control process are: (1) preparatory phase, (2) initial phase, and (3) follow-up phase. Each control phase is important for obtaining a quality product. However, the preparatory and initial phases are particularly valuable in preventing problems. Production work is not to be performed on a definable feature of work until successful preparatory and initial phase inspections have been completed and documented. The specific QC monitoring requirements for the definable features of work are listed in **Table 4-2**.

4.3.5.1 Preparatory Phase

The preparatory phase, as it applies to a definable feature of work, commences with actions in advance of production work. The preparatory phase includes review and approval of plans, specifications, SOPs, and other applicable documents, and to verify that equipment and personnel are in place before work starts. This inspection phase is conducted with the people responsible for performing each definable feature of work checking that personnel know what is expected and understand their role. The Installation Manager, UXOQCS, and QC Geophysicist

Table 4-2 Definable Features of Work and Quality Control Actions

Definable Feature of Work	Inspection/ Surveillance Point	Attribute	QC Action (performed or confirmed by)	Sampling Frequency	Acceptance Criteria
Prepare Plans	Pre-Draft/Draft/ Final	Not Applicable (N/A)	Internal independent technical review (technical staff)	N/A	N/A
Pre-Mobilization	Readiness review	Capture lessons learned	Three-phase control (QC Geophysicist/ UXOQCS)	N/A	N/A
IVS Establishment	Area selection	Minimal background noise	Review pre-seed Survey (QC Geophysicist/ UXOQCS)	Pre-survey	Low background readings
	Seed item placement survey	Survey accuracy	Review survey data (QC Geophysicist/ UXOQCS)	All items in IVS	x, y = 2 cm z = 5 cm
	Repeat data	Amplitude and positional accuracy	Review data (QC Geophysicist)	Once for all equipment infield	ISO response within predicted bounds; and ±25 cm positional accuracy along line of data collected directly over the seed items
Mobilization	Post mobilization	Capture lessons learned	Three-phase control (QC Geophysicist/ UXOQCS)	N/A	N/A
Detector-aided Surface Clearance	Grids completed and turned over by Operations	No remaining hazards in the detector-aided surface cleared areas	Three-phase control (UXOQCS)	Minimum 10%of cleared surface areas	No MEC, MPPEH, and metallic items
Geophysical Investigation	Static noise levels, cable shake and personnel tests	Background noise	Review static responses (QC Geophysicist)	Twice Daily	Background: Peak to peak variation ≤ 2.5 mV for Channels 2,3,and 4 and ≤4 mV for Channel 1

Definable Feature of Work	Inspection/ Surveillance Point	Attribute	QC Action (performed or confirmed by)	Sampling Frequency	Acceptance Criteria
	IVS	Response to known ISO, location of known ISO	Review Results (QC Geophysicist)	Twice Daily	ISO response within predicted bounds; and ±25 cm positional accuracy along line of data collected directly over the seed items
Geophysical Investigation (continued)	Anomaly selection	Anomalies chosen by data interpreter	Identify target anomalies (QC Geophysicist)	10% of data to be reanalyzed	No more than 5% anomaly selection differences at or above the minimum response threshold
	Along line measurement spacing	Distance between data points	Measure data Density (QC Geophysicist)	By dataset	98% ≤ 25 cm along line
	Anomaly reacquisition	Reacquire anomaly within critical radius	Review reacquire data (QC Geophysicist)	All selected anomalies	90% of all items within 1 m
	Target anomaly locations determined to be resolved by operations	Target anomaly excavation location resolution IAW project requirements	Conduct verification of a minimum of10% of target Anomaly locations (transect and grid) solved by Operations (UXOQCS)	As operational target anomaly excavation locations are completed	Target anomaly location is resolved IAW project target anomaly requirements
Blind Seeding Program	Blind seed locations	Amplitude and positional accuracy	Review data (QC Geophysicist/UX OQCS)	All blind seeds	All blind seeds detected and all blind seeds recovered
MEC Disposal	Pre- and post-MEC disposal operations	Safety and quality of MEC disposals	Three-Phase Control to include final QC acceptance inspections at each MEC disposal location (UXOQCS)	Before and after every MEC disposal operation	No MEC/explosive hazards remain at disposal locations
MPPEH Certification	Throughout	Documentation of explosives safety status prior to transfer	Three-phase control to include a final random sampling inspection of the segregated MDAS (UXOSO/QCS)	Continuous	MPPEH inspection process is IAW (DoD 2008b);certified MDAS does not contain or have the potential to contain energetic material

are responsible for conducting and verifying that all preparatory actions required prior to conduction work have been accomplished.

4.3.5.2 Initial Phase

The initial control of each definable feature of work is performed when a work process begins. The purpose of the inspection is to:

- Verify that the work to be performed will be in compliance with procedures and contract specifications.
- Verify that equipment and personnel on site meet the requirements established during the preparatory phase.
- Review acceptable level of workmanship for site personnel who will be conducting the definable feature of work.
- Review the preparatory phase inspection report.
- Resolve any differences of interpretation.

The initial phase is first documented UXOQCS field compliance inspection for a definable feature of work. Initial phase inspections may be repeated when acceptable levels of quality are not demonstrated or at the discretion of the UXOQCS or QC Geophysicist. The UXOQCS or QC Geophysicist (if applicable) will verify that corrective action has been completed and is appropriate to prevent recurrence of the condition. When corrective action cannot be completed in a timely manner or the root cause is not known, immediate corrective action that fixes the deficiency may be taken and verified, and work continued pending root cause analysis and more appropriate corrective action.

4.3.5.3 Follow-up Phase

Follow-up phase inspections are performed after a work process has begun and periodically throughout the work process. Following completion of RI fieldwork, a final inspection will be conducted as part of the Follow-Up Phase. The purpose of the inspection is to evaluate whether the process is being completed IAW agreed upon standards and to evaluate whether the level of quality meets QC acceptance criteria. The UXOQCS and QC Geophysicist are responsible for monitoring work processes and verifying continued compliance with RI WP and QC criteria requirements. Deficiencies identified during follow-up phase inspections will be documented and corrective action taken. The UXOQCS or QC Geophysicist will verify that corrective action has been completed and is appropriate to prevent recurrence of the condition. When corrective action cannot be completed in a timely manner or the root cause is not known, immediate corrective action that fixes the deficiency may be taken and verified, and work continued pending root cause analysis and more appropriate corrective action.

4.3.6 Documentation

Project documents are required to be kept up-to-date and available where the work is being performed. The WP and standard FPM procedures and documents are to be prepared, maintained up-to-date, and made available to project team members. All documents will be maintained in the project files and available in hardcopy version and electronically on the project's SharePoint/Folders website. Project team members will have access to the SharePoint website.

4.3.6.1 Project Logbooks

Project logbooks, consisting of bound books with hard covers and sequentially numbered pages, will be maintained on a daily basis by each of the field team leaders in charge of a specific task. These logbooks will contain detailed record of all activities related to specific field tasks and specific references to other field documents used on a daily basis. The front of each logbook shows the project name, logbook number, and the dates of use.

4.3.7 Document Preparation, Review, and Approval

The project documentation will conform to the following requirements:

- Documents and associated revisions defining technical, management, and QC requirements will include the job number and unique control number for verifying implementation.
- Each technical, management, and quality document will indicate the preparer, reviewer, approver, purpose of issue, and revision status.
- Changes to the previously issued document will be identified either within the document or in an appropriate attachment.
- Documents and associated revisions are reviewed by personnel who are:
  - Responsible for implementation,
  - Qualified by experience, education, or training to provide a critical review,
  - Responsible for checking that the document does not contain information or direction that conflicts with documents of superior authority or other documents that relate to the same work or subject, and
  - Participants in the original review and approval, unless designated otherwise.

4.3.7.1 Field Change Request Form

Periodic changes to procedures can be issued through the implementation of Field Change Request (FCR) forms. Field team members assigned to perform or supervise a task that recognizes the necessity for a change in the task procedures are responsible for initiating, completing, and submitting the FCR for review and approval of appropriate field changes. The FCR process includes review and approval of the recommended change by the site senior UXO staff, QC Geophysicist (if applicable for geophysical task), Program Chemist/Chemical QC Manager (if applicable for Environmental/QC sampling task), PM, and appropriate COR prior to process alteration in the field and incorporation into a revised WP element. The AF may ask that the FCR be reviewed by appropriate regulatory personnel if it is deemed to be a significant change to a process or overall Scope of Work. FCRs should be approved or disapproved in no more than one week. When an FCR is approved, changes to procedures will be reviewed with project personnel during the morning meeting/safety briefing prior to implementation. FCRs will be numbered sequentially and will be maintained in the project files on site.

4.3.7.2 Training Records

Training Records will be maintained by the PM. These records will contain any licenses, permits, certificates, or other qualifying data, to include:

- Date and nature of training
- Personnel attending and instructor(s)
- Signature of instructor and SUXOS or UXOSO

4.3.7.3 Daily Field Activity Reports

All field activities affecting QC will be performed IAW documented procedures identified in the WP or applicable guidance. During all field activities, FPM may use any or all of the following reporting forms and additional forms and reporting media as necessary:

- Daily Health and Safety Meeting Report,
- DQCR,
- Site Safety Tailgate Meeting Log,
- Nonconformance and Corrective Action Form,
- Health and Safety Compliance Inspection,
- Site Visitors Logs, and
- QA Audit Checklist.

4.3.7.4 Daily Quality Control Reports

DQCRs shall be maintained in the project files for inclusion in the final report. The UXOQCS shall prepare a DQCR including, as a minimum, the following information:

- Preparer (name and signature)
- Date
- The criteria for and results of any inspection, surveillance, or review performed (attach inspection or surveillance forms as applicable)
- The results of any review of submittals or other items
- The results of QC inspections of grids
- Any significant issues or open items

The UXOQCS will maintain a field logbook of all inspection and testing activities. This daily logbook will be used in preparing the recurring reports and deliverables and the project report. Additionally, the UXOQCS or QC Geophysicist will conduct random surveillance of documents in the field and for field office use to validate that the most current documents are in place and being implemented.

4.3.7.5 Site Safety Tailgate Meeting Log

Site Safety Tailgate Meeting Logs shall be maintained in the project files for inclusion in the final report. The UXOSO shall prepare a log including, as a minimum, the following information:

- Preparer (name and signature)
- Date

- Weather conditions, discussion of any incidents, accidents, or significant site events that may impact safety, and stopping work due to safety issues
- Signatures of all project personnel and visitors acknowledging that they have participated in a safety briefing

4.3.7.6 MEC and Anomaly Excavation Records

The MEC and anomaly records are used to record data on anomaly excavations and MEC/MPPEH/MD encountered. An example of Dig Selections and the Intrusive Results Table is provided in **Appendix E**.

4.3.7.7 Visitor Documentation

Visitors on site during RI activities will be required to log in and off the site. The UXOSO will verify that visitors to the site have received a briefing by the UXOSO and/or SUXOS of the site activities scheduled the day of the visit, the health and safety issues associated with those activities, areas of the site that are off-limits, whether visitors have the required PPE, and that visitors are briefed and understand the established danger warning system used on site by project. All visitors to the site will be required to sign in with the UXOSO and receive the health and safety briefing. New project personnel and subcontractors must review the HASP and receive site-specific training. All visitors must be escorted by project personnel. The UXOSO will document the visitor briefing and maintain the documentation onsite for the duration of the project.

4.4 Quality Control Surveillance

QC surveillance is an ongoing process that will take place throughout the project on a daily basis. Surveillance is the process of monitoring and verifying the status of procedures, methods, conditions, products, processes, and services and the analysis of records in relation to requirements to confirm that the requirements for quality are met. Surveillance will be conducted on a scheduled or unscheduled basis and is conducted as part of the follow-up inspection process of the three-phase control system. **Table 4-2** presents the project's definable features of work with associated QC actions for project activities, except MC sampling activities covered in the UFP-QAPP (**Appendix D**) including the frequency of the inspection and the party responsible for performing the activity. The UXOQCS and/or QC Geophysicist will conduct surveillance to collect objective evidence to document and report conditions observed. Daily QC surveillance of program activities and processes will be performed to evaluate completion of required activities and their effectiveness. QC surveillance activities will be documented on the DQCR and will be part of the project records.

4.4.1 Geophysical Quality Control

The QC Geophysicist will be responsible for overseeing and documenting QC performed with respect to the digital geophysical surveys. QC of the field data will include checks and reviews of the digital data deliverable. Specific checks will include data completeness, quality, WP QC criteria compliance, and format. Data that have not undergone QC checks will not be delivered to the AF unless by mutual agreement. In that case, a statement of limitations will be included with the data deliverable indicating that QC checks have not been completed for the subject data.

4.4.1.1 Initial Geophysical Equipment QC Checks

The following checks will be completed at least once at the beginning of the DGM activities. These tests will be performed at each IVS location.

1. **Six Line Test.** This test will be performed in the same area as that planned for the IVS. The test will be conducted over the same line each time the test is performed. Data from the first two passes will be collected at a normal walking speed (1m/s) with no objects buried. Next, one ISO will be buried in the vertical orientation (at the same location where this ISO is planned for the IVS) and data will be collected along this line with two additional passes at a normal walking speed (1m/s), and one pass each at slow and fast walking speeds. Repeatability of response amplitude, positional accuracy, and latency will be evaluated. The acceptance criteria are ±20% for repeatability of amplitude response and ±25 cm for positional accuracy. Comparison of noise levels between the three acquisition speeds will also be performed.
2. **Pull Away Test.** This test demonstrates the effects of navigational equipment and/or vehicles used to tow sensors or arrays. With the instrument collecting data in a static (background) test, navigational equipment is positioned as that would be in the field survey and pulled slowly away from the sensor to gauge any differences in response. This must be performed twice: once with the navigational equipment power off, the second with the equipment power on. A simple direct current shift may be observed when the equipment is in normal operating position, compared to values when it is distant; however, this is easily removed from the data. If excessive noise is noted, steps will be taken to identify the source and correct the problem.

4.4.1.2 Daily Quality Checks

The following daily QC checks will be performed at the IVS location. The minimum frequency for each daily QC test is defined in **Table 4-2**. Additional follow-on QC checks (warm-up, cable shake, personnel, and static background) will be performed following transportation of the instrument/operator to the site, and prior to each data collection session.

1. **Positional Accuracy.** This test will be conducted to verify the proper set-up and functioning of the RTK-GPS base station. Prior to data collection, coordinates are measured at an established control point to record any offset. Acceptance criteria are ±2.5 cm from the established coordinates for the point. The horizontal RTK-GPS accuracy for static tests is 5cm.
2. **Equipment/Electronics Warm-Up**. Equipment/electronics warm-up will be conducted at power-up to minimize sensor drift due to thermal stabilization. The manufacturer's instructions for equipment startup will be followed and at least 15 minutes of warm-up will be performed. If instrument readings fail to stabilize within the recommended warm-up period, an additional five minutes of warm-up will occur. If data instability persists, troubleshooting procedures will be initiated. If the data instability cannot be resolved the equipment will be replaced.
3. **Null Instrument**. The instrument will be nulled at the start of each day's activities following equipment warm-up and prior data collection. Nulling the instrument corrects for previous instrument drift and normalizing background values by adjusting the signal response for each time gate to 0 mV.

4. **Vibration Test (Cable Shake).** This test, also known as a cable shake, will be used to identify shorting cables and problematic connectors. Cables will be shaken for a minimum of five seconds with the instrument held in a static position. If shorts are found, the associated cables and/or connectors will be replaced immediately. The vibration test will be repeated once repairs are complete. Acceptance criteria include absence of data spikes in the data profile during the test. If data spikes persist, troubleshooting procedures will be initiated. If the data spike cannot be resolved the equipment will be replaced.
5. **Personnel Test.** This test will be conducted on survey personnel to confirm that potential interference sources (e.g., pocket knives, pens, buckles, steel-toed boots, cell phones, and portable radios) have been removed from their bodies. Personnel who will be performing the surveys or who will be coming in close proximity to the survey equipment will approach the sensor and have the instrument operator monitor and record the results. An acceptance criterion of ≤ 2.5 mV on Channel 2 for the EM61 will be used.
6. **Static Background Test.** This test will be performed to quantify instrument background readings or electronic drift and locate potential interference spikes in the time-domain. A minimum of 3 minutes of static background data will be collected after instrument warm-up. The instrument operator will monitor readings to confirm stability. For the static background test acceptance criteria for the EM61 are ≤ 2.5 mV peak to peak on Channels 2, 3, and 4 and ≤ 4 mV on Channel 1.
7. **IVS Test.** This test will be performed to determine impulse response and repeatability of the instrument to find ISO items, the ability to locate these items accurately, and also verify consistency in background noise levels during mapping. Each IVS track, background and seeded, will be mapped in each direction at the normal data collection pace. Acceptance criteria include meeting minimum expected response as predicted by the Naval Research Laboratory curves and ±25 cm for positional accuracy along line of data collected directly over the seed items.
8. **Latency Test.** This test measures repeatability of instrument response while moving, and it will be performed to determine the instrument response to a standard object. For this test, a standard item (ISO) is temporarily emplaced in the vertical orientation at a known location along the background track of the IVS area. The EM61 will pass over the standard item two times in opposite directions. The obtained results will be compared to determine the difference in the location of the standard. The time difference will be used during the data processing to correct data positions in a process referred to as latency correction.

4.4.1.3 Data Quality Checks

The Site Geophysicist/geophysical technician will monitor the sensor performance during the QC tests. Any observed failure to meet acceptance criteria will result in immediate corrective action. The operator will check the instrument to determine the cause of the failure and if possible make repairs (tighten or replace cables, replace battery, etc.). The QC tests are repeated and the results monitored. Continued failure to meet acceptance criteria will result in immediate notification of the Site Geophysicist and removal of the faulty instrument from service until repairs can be completed.

During the processing of field data, the Site Geophysicist will review the individual data profiles to identify abnormal spikes in the measured data and larger than usual fluctuations in the background noise level. The QC Geophysicist will review QC issues and will determine whether the data are useable or if the DGM area should be resurveyed. The QC Geophysicist will also assess the root cause of the problem and make recommendations for corrective actions.

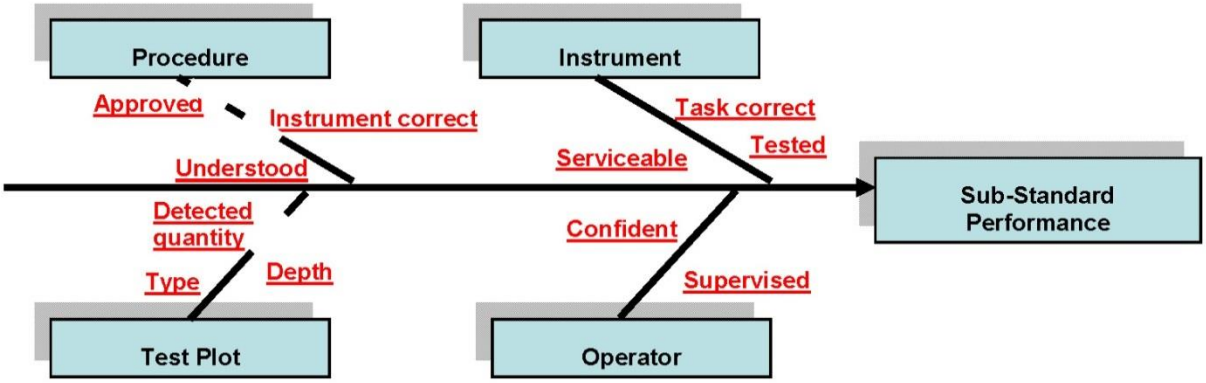
4.4.1.4 Independent Geophysical QC Reprocessing

Once the initial geophysical anomaly analysis and interpretation is completed, the data and initial dig sheet will be delivered to an independent QC geophysicist for QC reprocessing. At a minimum, 10% of the data will be reprocessed. This reprocessing will be performed using the same procedure as the initial processing including all processes from preprocessing to target picking. If any target additions or deletions in reprocessing occur, the independent QC Geophysicist will work with the Project Geophysicist to perform a root cause analysis and implement corrective actions.

4.4.1.5 Root Cause Analysis

Any portion of the process or analysis not consistent with the DQO is considered a quality failure. The QC Geophysicist will conduct a Root Cause Analysis to determine if the failure is the result of the process, procedures, equipment and/or personnel and to what extent of previously performed work may have been affected by the failure. The QC Geophysicist will provide his findings to the PM, and SUXOS with suggested or required corrective actions. Once approved by management, the team will implement the corrective actions. All target reacquisition and intrusive QC measures will be documented, with copies sent to appropriate personnel for review and inclusion into other documents as deemed necessary. **Figure 4-1** illustrates the flow of the root cause and effect process that the QC Geophysicist will use to determine failure causes.

Figure 4-1 Root Cause and Effect Process



4.5 Equipment Maintenance and Checks

Tools, instruments, and equipment deployed to the project site will be properly maintained and calibrated (as necessary) IAW the instrument manufacturer specifications, standard industry practice. This applies to equipment used in the field for activities that have an impact on quality, including geophysical instruments, communication equipment, vehicles/machinery, environmental monitoring equipment, and PPE. Rulers, tape measures, levels, and other such

devices will not be standardized if normal commercial equipment provides adequate accuracy, but must be maintained in good working condition. Equipment will be visually checked for damage prior to use. Preventative maintenance on equipment will be performed on a regular basis according to the manufacturers operating instructions or recommendations. Critical spare parts will be kept on hand to minimize downtime, particularly batteries for GPS, radio, and geophysical equipment. Maintenance activities will be recorded in field logbooks. The quality of geophysical data sets is dependent on the operational capabilities of the equipment used. By manufacturer's design, these instruments are calibrated at the time of manufacture and do not require field calibration. Manufacturer's manuals will be maintained on site for reference. To check that equipment is fully capable and will perform IAW the manufacturer's specifications, pre-operational and post-operational checks will be performed daily. Following these checks, equipment that is found unsuitable will be immediately removed from service. These checks will provide QC data indicating the proper functionality of the instruments. The UXOQCS or QC Geophysicist will verify these actions using the three-phase control process and QC surveillance.

4.6 UXO Quality Control

The UXOQCS will perform a QC inspection of a minimum of 10% of the areas cleared. For QC inspections, the UXOQCS will use a White's DFX 300 metal detector or similar for clearing the EM61 geophysical target anomaly locations. Any unexcavated anomaly identified by the UXOQCS will trigger an analysis of the process to determine the cause of the anomaly detection failure by the UXO Team. The anomaly will be addressed for identification and removal, if appropriate. Additionally, the UXOQCS will conduct inspections of recovered MD scrap, and any material or item potentially presenting an explosive hazard, to ensure there are no explosive components or hazards.

If a detection failure is identified, the UXOQCS will conduct a Root Cause Analysis to determine if the failure is the result of the process, procedures, equipment and/or personnel. A Root Cause Analysis may include, but not limited to the following actions:

- Careful evaluation, recovery, and destruction of MEC/UXO.
- Certification of the identification and disposition of each anomaly excavated.
- Review of representative dig sheet data.
- Review and evaluation of geophysical data.
- Field evaluation of the site QC operations.

The UXOQCS will provide his findings to the MMRP Manager and SUXOS with suggested corrective actions. Once approved by management, the UXO Team will implement the corrective actions. The Root Cause Analysis and corrective actions will be attached to the weekly report. A QC discovery of any isolated MEC item of detectable size or larger or any live MEC item found at the depth of concern for that area, but outside the physical area cleared, will not be considered a QC failure. QC failures will be documented, reported, and corrective actions taken.

4.7 Nonconformance and Deficiency Identification

Nonconformance identification assumes recognition of circumstances that prevent a work process to control output from conforming to the contract requirements. Project personnel have the responsibility, as part of their normal work duties, to promptly identify and report conditions adverse to quality. An identified nonconformance will be identified, documented, investigated and corrected.

A deficiency is a condition that can be corrected quickly by standard methods during normal course of work. A deficiency usually is not systematic in nature. It will be the responsibility of project personnel to identify deficiencies and notify their supervisor or manager as soon as the conditions are identified. Determination of deficiencies will be supported with objective evidence.

4.8 Audit Procedures

The audit process involves identifying, documenting, and reporting non-conformances or deficiencies, initiating corrective actions through appropriate channels, and conducting a compliance review.

4.8.1 Internal Audit Process

The internal audit procedures include the following:

- Audit of Environmental/MC sampling and analyses program activities performed by the Program Chemist/Chemical Quality Control Manager,
- Audit of geophysical procedures performed by QC Geophysicist,
- Audit inspections of geophysical equipment performance, operating and maintenance records, equipment testing records, equipment QC checks, geophysical data acquisition, dig location selection, anomaly reacquisition, result corrections performed by the QC Geophysicist and UXOQCS,
- Audit inspections of dig sheets and the UXO database, in conjunction with the 10% QC checks of each grid performed by the UXOQCS,
- Reporting of any suspected technical non-conformances or deficiencies performed by field teams, and
- Follow-up audits to verify that QA procedures are maintained throughout the investigation.

Internal audits will be completed at the beginning, middle, and end of the project and, all results will be reported to the PM. When the audit is completed, the original records generated for all audits will be retained within the central projects files. Records will include audit reports, written replies, the record of completion of corrective action, and documents associated with the conduct of audits, which support audit findings and corrective actions, as appropriate.

4.8.2 External Audit Process

The USAF may conduct the external audits of the MEC/MPPEH/MD activities at any time during the field operations. These audits may or may not be announced and will be completed according to field activity information presented in this RI WP, and SOPs. The external field audit process can include (but not limited to):

- GSV development,
- Equipment testing and performance requirements,
- Geophysical data acquisition, reacquisition,
- Anomaly selection and verification,
- "Dig" locations, intrusive sampling locations,
- MEC/MPPEH/MD activity documentation and electronic data file management.

4.9 Corrective Actions

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or QC nonconforming condition which can affect data quality. Corrective action can occur during field activities, laboratory analyses, and during the data review and validation. Field activity discrepancies will be discussed with the SUXOS who will document the discrepancy in the field log book. The SUXOS will then inform the QA/QC Manager and MMRP Manager. The MMRP Manager will define the required corrective action. The SUXOS and/or FM will document the corrective action in the field log book and will instruct field personnel on the implementation of the corrective action. It will be the responsibility of the UXOQC to ensure that the corrective action is properly implemented. A copy of the corrective action documentation will be provided to the MMRP Manager on the same day the corrective measure is implemented. This will enable the PM to include the corrective action in the monthly project status report.

The MMRP Manager will document major discrepancies and discuss a recommended corrective action with the field team. Corrective actions for major discrepancies can be defined as measures that change the number of samples collected, change previously selected sampling locations, and impact the project quality objectives. The UXOQC will be responsible for ensuring that the corrective action is properly implemented and documented. The QA/QC Manager will review non-conformances to determine if trends adverse to quality are developing, and proposing and implementing long-term corrective action to prevent recurrence of any nonconformance trends.

4.10 Lessons Learned

The objective of the lessons learned is to capture and share experience or recognized potential problems or better business practices to:

- Prevent the recurrence of repetitive design/execution deficiency
- Clarify interpretation of regulations and standards
- Reduce the potential for mistakes in high risk/probability areas of concern
- Pass on information specific to an installation or project
- Promote a good work practice that should be ingrained for repeat application
- To promote efficient and cost-effective business practice

This process is designed to identify nonconforming conditions. As required by this program, actions will be taken to correct nonconformance and to prevent their recurrence. These

conditions will be assessed to determine if they are systematic or unique occurrences. After informal review and discussion by the project team, those conditions that might aid other projects will be written up as lessons learned, describing the original condition and results, changes made, and the resultant improvements. If no changes were made, but in hindsight should have been, this information will be detailed. Lessons learned will be discussed in the final RI Report. All personnel are encouraged to continuously review their processes and suggest changes that improve the process, provide benefits, or improve project efficiency, safety, and quality. These suggestions can be either formally submitted (written memo to project leadership) or informally through verbal discussions at project meetings.

4.11 Stop Work Authority

When a condition is identified that is adverse to quality and/or safety, the dual hat UXOQCS and/or QC Geophysicist have the authority to stop work until the condition is resolved. The decision to stop work pending corrective action should not be taken lightly.

A stop work request may be issued for a portion of a process, which would allow as much work as possible to continue, thus limiting the impact of the stop work request on areas not affected by the condition. The UXOQCS will immediately notify SUXOS, MMRP Installation Manager, MMRP Manager, and PM, and document the stop work request.

In the event the SUXOS and MMRP Manager do not agree with the stop work request, the PM will have the final decision to making authority.

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5.0 EXPLOSIVES MANAGEMENT PLAN

An Explosives Management Plan has been prepared IAW AFMAN 91-201 Explosives Safety Standards (AFMAN 2011), DID MMRP-09-002, Explosives Management Plan (USACE, 2009b), and DDESB-approved ESS describing the procedures to be used by UXO personnel to purchase, receive, use, store, transport, issue, and report the loss of explosives utilized during RI. All personnel involved with explosives will be trained and qualified in the tasks to be performed and will comply with all federal, state, and local laws as required. The procedures will be performed IAW following regulations:

- DoD 4145.26-M, Contractor's Safety Manual for Ammunition and Explosives (DoD, 2008b)
- DoD 6055.09-M, DoD Ammunition and Explosives Safety Standards (DoD, 2008c)
- 49 CFR Transportation Parts 172-397. Transport of Hazardous Materials; Driving and Parking Rules (CFR, 2012)
- Army Regulation (AR) 385-64, Ammunition and Explosives Safety (AR, 2011)
- AR 190-11, Physical Security of Arms, Ammunition and Explosives (AR, 2006)
- USACE EM 385-1-97, Explosives Safety and Health Requirements Manual (USACE, 2010b)
- USACE EM 385-1-1, Safety and Health Requirements Manual (USACE, 2011a)
- BATFE Publication 5400.7, Federal Explosives Laws and Regulations

5.1 Personnel and Explosives Limits

All explosives operations will be designed to ensure compliance with the *Cardinal Principle of Explosives Safety*: "Expose the minimum number of people to the minimum amount of explosives for the minimum amount of time." The authorized Net Explosive Weight (NEW) and Hazard classification/Division will be clearly posted on each cubicle, magazine, or pad where explosives are stored, maintained, inspected, or handled. Personnel limits for the operations being conducted at each explosives operating location will be clearly posted. Posted limits will distinguish between supervisors, workers, and casuals and be included in written procedures.

5.2 Handling Explosives and Movement Precautions

Only trained personnel under the supervision of an individual who understands the hazards and risks involved in the operation will be handling explosives. The following guidance will be used for handling explosives:

- Detonators, Initiators, squibs, and other such electrically or mechanically initiated devices will be handled in protective containers. The container designated to prevent item-to item contact will be used.
- Bale hooks will not be used to handle explosives.
- Munitions will not be tumbled, dragged, dropped or thrown.

- Conveyors, chutes, hand trucks, or forklifts will not be used in atmospheres and locations where they can create hazards. Sections of roller conveyors used to move explosives will be interlocked and supported.
- Boxes containing explosives will not be used to support conveyors.

5.3 Licenses and Permits

FPM maintains a Bureau of Alcohol, Tobacco, Firearms and Explosives (BATFE) Type 33 FEL, No. 6-NY-00986, which authorizes site UXO personnel to order and use donor explosives to dispose of MEC/MPPEH.

5.4 Acquisition

MEC/MPPEH items will be disposed of by the use of donor explosives. Western Explosives System Company will be FPM's explosives vendor. Explosives will be delivered on a pre-arranged schedule based on the 49th MXS (designation for Holloman AFB Munitions Storage Area [MSA]) operations tempo. All security and access procedures will be arranged by FPM's SUXOS and coordinated with the 49th MXS and base security. USAF security (or contract security as directed by Holloman AFB Security Police) will escort the delivery vehicle to the MSA and provide all directions to the driver. The FPM SUXOS or his/her designated representative will be on site to inspect and sign for all explosives. All personnel handling explosives will be listed on FPM's most current BATFE Notice of Clearance.

5.5 Initial Receipt of Explosives

The licensed commercial explosives vendor is responsible for permits and documentation required by federal, state, and local regulations regarding the transportation of explosives to the location where FPM will take custody of the explosives. Only the SUXOS may sign for explosives received from the vendor. The following procedures will be adhered to upon initial receipt of explosive materials (see **Figure5-1**):

- Upon arrival at the site, the SUXOS will escort the vendor/supplier to a designated area for loading/unloading.
- An individual authorized to receive the explosives will compare the explosives delivery record to the actual quantity delivered prior to accepting custody for the explosives.
- Once the quantity has been confirmed, the explosive delivery record will be signed and the explosives transferred to and stored in the Conventional MSA.
- All material introduced or removed from the Conventional MSA will be entered on stack cards and explosive records will be updated.
- If it is determined that there is a discrepancy between the quantity delivered and quantity shipped, the following will occur:
  - Notify the UXOSO.
  - Do not accept shipment.
  - Contact the Shipper immediately to resolve the discrepancy.

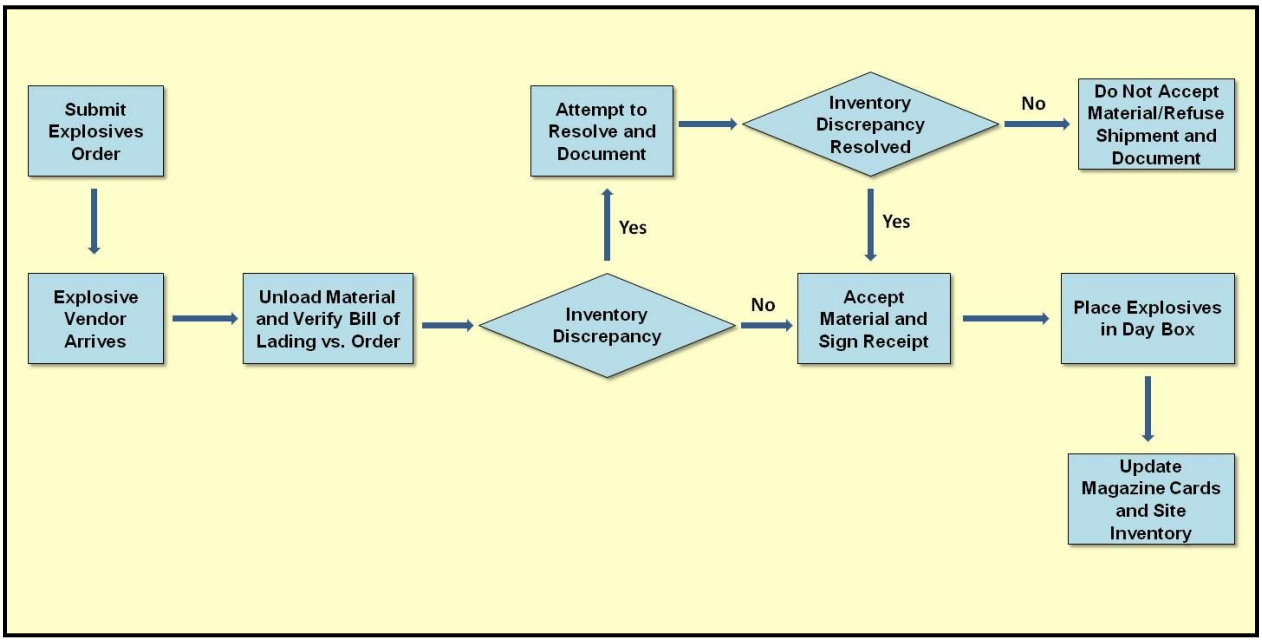
Note: If the discrepancy cannot be resolved within 24 hours, the SUXOS will notify the Local Law Enforcement Agency, FPM Program H&S Manager, and FPM MMRP Manager.

5.6 Explosives Storage Magazine

A segregated area will be set aside to store only explosives, related non-explosives items, equipment and supplies. Explosives will have an assigned hazard classification for storage. This classification includes the Quality-Distance (Q-D) hazard classification/division and a storage compatibility group designation (TO 11A-1-47, Explosives hazard Classification Procedures [DoD, 1998]). The Joint hazard Classification System will be the source for final hazard classification.

A Memorandum of Agreement (MOA) is pending between FPM and the Holloman AFB 49th MXS to allow courtesy storage of up to 100 pounds NEW of donor explosives in properly cited DDESB-approved facilities. The 49th MXS will assign specific munitions storage bunkers for FPM's use and provide FPM the MOA with required signatures at the time of mobilization.

Figure 5-1 Receipt of Explosive Material Process



5.7 Transportation

Transportation of explosives and MEC will be conducted IAW Title 49, CFR when specifically prescribed, AFMAN 91-201 (AFMAN, 2011), Defense Transportation Regulation 4500.9R Part 2, 2008, and Air Force Joint Instruction (AFJI) 24-210, Packaging of Hazardous Material (AFJI, 2010), as well as IAW New Mexico laws for transportation of explosives and other dangerous articles. The transportation of explosives to locations requiring demolition operations will be conducted in the following manner:

- Explosives acceptable for transportation will have an assigned hazard classification.
- Packaging of explosives will comply with Title 49, CFR, Parts 171-179, and 29 CFR1926.902.
- Vehicles will have a safety inspection performed prior to loading explosives.

- Any vehicle found or suspected to be in a hazardous condition will be moved to an area isolated from other locations by the proper Q-D, unless it is more hazardous to move the vehicle.
- Vehicles will be equipped with a first aid kit and a minimum of two (2) each 2A:10BC rated fire extinguishers.
- Transport vehicles will be equipped with wood lined bed to ensure a non-sparking surface.
- Vehicles will be placarded during the transport of explosives as outlined in Subpart F of Title 49, CFR, Part 172.
- It will be ensured that lifting devices on vehicles or handling equipment have a serviceable mechanism designed to prevent sudden dropping of the load in event of power failure.
- It will be ensured that explosives loaded on all types of vehicles and handling equipment are stable and protected by an effective restraining system before movement.
- The safest possible primary and alternate explosive movement routes will be designated to cover all phases of movement.
- Vehicles will be refueled before the explosives are loaded and at least 100 ft from structures or sites containing explosives.
- Speeds will be kept to 20 miles per hour or less, depending on road conditions.
- Radio communications will be maintained with the UXOSO.
- All incoming motor vehicles carrying hazard class 1 explosives and other hazard class items that carry an explosives compatibility group will be inspected at a designated inspection station by a representative of the commander before further routing on base.

5.8 Receipt Procedures

Prior to accepting any explosives, the procedures outlined above in the initial receipt procedures will be accomplished. The FPM SUXOS is authorized to purchase, receive, access, issue, transport, and use explosives for this project. Any other project personnel who will have access, issue, transportation, and use authority for explosives on this project will be annotated on the approved user list, which will be maintained within the explosive management records. Upon completion of each demolition operation, an ammunition consumption report will be completed. Upon expenditure of all explosives, the authorized person will certify in writing that the explosives were used for their intended purpose.

5.9 Inventory

Once donor explosives are stored, the USAF will maintain control of all items. Access to explosives will be coordinated with 49th MXS and the FPM SUXOS. A mandatory monthly inspection of all donor explosives will be conducted as per the MOA. Weekly inventories will be conducted by FPM, unless the 49th MXS operations tempo prevents it.

5.10 Reporting Lost or Stolen Explosives

Loss or theft of explosives will be reported as stated in 27 CFR on Commerce in Explosives. If it is confirmed that ordnance or explosives are missing, then the SUXOS will contact the Contracting Officer immediately by telephone and in writing within 24 hours.

5.11 Termination of Use of Facilities Storing Explosives

The storage no longer used for explosives will undergo a process to ensure explosives and any visible explosives residues are removed within 180 days from the last use of the storage facility. These procedures help ensure that no threats to human health or the environment remain when the unit is no longer used as an explosives storage. These procedures will include:

- Emptying the storage facility of all explosives and related materials.
- Cleaning the storage facility, as required, to remove any visible explosives residue.
- Visually inspecting the storage facility for the presence of remaining explosives or visible explosives residue by a knowledgeable individual that the installation or responsible activity commander appoints.
- Removing from the storage facility all fire and chemical hazard symbols and marking the storage facility as empty.
- Securing the storage facility to prevent inadvertent use or access.
- Notifying the appropriate emergency response and regulatory authorities of the change in the storage facility's use.
- Recording the date the storage facility was inspected, the name and position of the inspector, and the results in permanent real estate records.

5.12 Return to Storage of Non-Exploded Explosives

All explosives ordered and received will be consumed.

5.13 Disposal of Remaining Explosives

All explosives ordered and received will be consumed during the disposal operations.

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6.0 ENVIRONMENTAL PROTECTION PLAN

This EPP has been developed IAW Air Force Instruction (AFI) 32-7064 (AFI, 2004), Integrated Natural Resources Management Plan (INRMP) (Holloman AFB, 1999), and AFCEC MMRP Integration with Cultural Resource Management (AFCEC, 2011) and complies with the requirements of the National Environmental Policy Act and its implementing regulations. This EPP describes the approach, methods, and procedures that will be employed to reduce adverse impacts to the natural environment during RI field activities.

FPM has incorporated site-specific Green and Sustainable Remediation practices into the RI project planning approach to reduce the footprint of RI related activities. Our approach includes:

- Sequencing the execution of like events such that the number of mobilizations is reduced.
- Utilizing the base's recycling center.
- Utilizing reusable items during sampling where practical in place of disposable alternatives.
- Incorporating, if feasible, work trucks and equipment powered by biodiesel or alternative fuels.
- Utilizing electronic media, including email, web-based communication tools, and videoconferencing, where practicable and where in compliance with the contract, to communicate among stakeholders and reduce the use of paper and number of energy-intensive trips.

Prior to the start of RI field activities FPM will coordinate with the installation office of Natural Resources, the Cultural Resources Manager, the MMRP Remedial PM, and appropriate Federal and State authorities to agree upon strategy(s) to minimize, or if possible avoid, any adverse impacts to site resources. Potential site resources and mitigation procedures to avoid or lessen the adverse impacts from the geophysical investigations, intrusive activities and MC sampling, are identified below.

6.1 Potential Site Resources

Potential site resources known to be present within the boundaries of both the XU853 and XU854 MRSs include NRHP eligible cultural sites. No special status species have been identified as present within the boundaries of two sites. However, the buffer surrounding the White Sands Pupfish Protected Habitat Zone overlaps a portion of the XU853 MRS. The potential site resources discussed below are in the context of the installation and/or MRSs, based on available data.

6.1.1 Water Resources

The only permanent water in the Tularosa Basin is found in small streams between Alamogordo and Three Rivers, New Mexico. There are no perennial streams within Holloman AFB or in the nearby surrounding landscape; however, a set of perennial pools exist within the base. They are the final one-third of the Lost River, a set of pools near the confluence of Ritas and Malone Draws, and the Salt Lakes just south of the Lost River and Camera Pad Road Pond. The Rio Grande, located west of the San Andres Mountains, and the Pecos River, east of the Sacramento Mountains, are the closest perennial rivers in the region. The Lost River channel runs to the

north and northwest of the XU853 MRS. There are no surface water resources within either the XU853 or XU854 MRSs.

6.1.2 Wetlands

There are at least nine prominent east-west drainages that receive intermittent flows during seasonal thunderstorms. The largest of these drainages is the Lost River drainage system, including Malone Draw, Carter Draw, and Ritas Draw. Prior to extensive management of the surface topography and construction of U.S. Highway 70/82, Dillard Draw emptied into the Main Base, creating a network of flats and playas including what are now Lake Holloman, Stinky Playa, and Pond G. Construction activities have disrupted the natural flow of this wetland ecosystem (SKY, 2011). No wetlands are identified within either the XU853 or XU854 MRSs. The distribution of water resources including wetlands within Holloman AFB and their relationship to the XU853 and XU854 MRSs is illustrated in **Figure 6-1**.

6.1.3 Vegetation

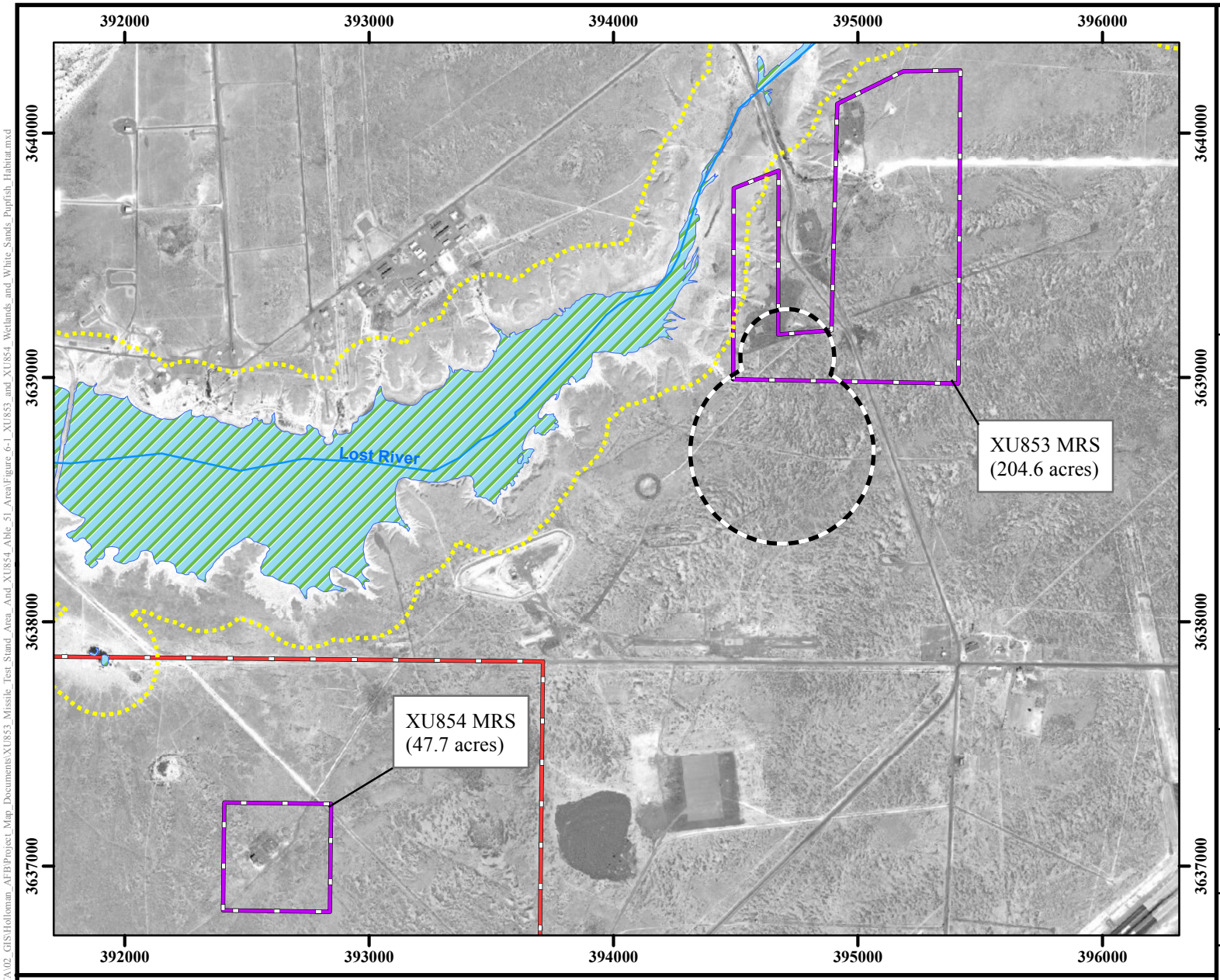
The vegetation of Holloman AFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca also occur. Sensitive species that currently receive no federal protection include lichen (A. clauzadeana), proposed for rare and endangered listing and the grama grass cactus, included due to its former candidate status (SKY, 2011). The vegetation within both MRSs is characteristic of desert scrub communities. No sensitive plant species have been identified within either the XU853 or XU854 MRSs.

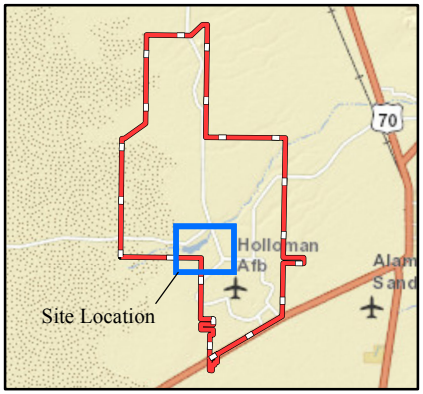
6.1.4 Fish and Wildlife

Considering its relatively small size, Holloman AFB provides a relatively large diversity of habitats for aquatic and terrestrial species. Throughout the Tularosa Basin suitable wildlife habitat is limited due to ranching, farming, and urban and rural development. Within this patchwork, wildlife is typically left to survive in increasingly smaller pockets of native habitat further fragmented by roads and fences (Holloman AFB, 1999).

New Mexico has one of the most diverse mammalian faunas in North America, with eighty-nine taxa described from New Mexico, ten of which are holotypes from Otero County. The most common mammals at Holloman AFB are various rodents and the Black-tailed jackrabbit (Lepus californicus), found ubiquitously in the Great Basin Desert Scrub habitats in New Mexico. The Main Base and Boles Wells Well Field have small colonies of bats that forage for insects at the numerous playas, wetlands and riparian habitats. Bats on Holloman AFB roost in abandoned and inhabited buildings. The bats identified on Holloman are: the Pallid bat (Antrozous pallidus pallidus), Small-footed myotis (Myotis ciliolabrum melanorhinus), California myotis (Myotis californicus), and Spotted bat (Euderma maculatum). Surveys conducted within habitats at the periphery of the dune found fourteen species of rodents. The Ord's Kangeroo Rat (Dipodomys ordii), Desert Pocket Mouse (Chaetodipus penicillatus) and Plains Pocket Mouse (Perognathus flavescens gypsi) were found primarily within the dunes and others were found equally distributed or too few were captured to determine the habitat affinity.

The kit fox (Vulpes macrotis neomexicanus) inhabits the marginal and interior dunes of the White Sands (Bison-M). These foxes prey on rodents, especially kangaroo rats, within the duneland; their ranges may extend approx. 3 kilometer (1.9 miles) from their dens.





Legend

- Stream
- Wetland
- Pupfish Habitat Buffer
- MRS Boundary
- EOD 50-lb Range Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

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FIGURE 6-1

Wetlands and White Sands Pupfish Habitat near XU853 and XU854 MRSs

FPM Remediations, Inc.

2014 Page 6-3

NOTES:
Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 2,000 feet

0 300 600 Meters

0 1,000 2,000 Feet

N W E S

Path: \\saat\SAT_Clients\SAT_DATA\02_GIS\Holloman_AFB\Project_Mgp_Documents\XU853_Missile_Test_Stand_Area_And_XU854_Able_51_Area\Figure_6-1_XU853_and_XU854_Wetlands_and_White_Sands_Pupfish_Habitat.mxd

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The mountain lion (Felis concolor) occupies broken and mountainous country from the Pecos River west and commonly occurs within the San Andres and Oscura Mountains west of Holloman AFB. Mountain lion scat was found within Holloman AFB in 1994, near the confluence of Malone and Ritas Draws. Mule deer (Odocoileus hemionus) and porcupine (Erethizon dorsatum) have been observed near the Boles Wells Wellfield facilities. Porcupines are common in most habitat types and are occasionally observed on WSMR from grasslands and shrublands to higher elevation woodlands; no observations have been made on the Main Base. The oryx (Oryx gazella), a non-native, introduced game animal is currently a resident of the base. Oryx range into most habitats found within Holloman AFB and consume the dominant plant types, e.g. mesa dropseed and alkali sacaton. The Texas horned lizard, formerly a Category 2 species for federal listing as endangered or threatened, was reclassified February 28, 1996 as a Species of Concern (Department of Interior 1996). The Texas horned lizard appears to be abundant on Holloman AFB and was found within the major plant community types on both the Main Base and Boles Wells Water System Annex.

The White Sands pupfish (Cyprinodon tularosa) is endemic to the Tularosa Basin, with two naturally- occurring populations at Malpais Spring and Salt Creek within WSMR and two introduced populations at Mound Springs (WSMR) and Lost River within Holloman AFB.

6.1.5 Migratory Birds

At least 230 bird species have been confirmed at Holloman AFB. A substantial proportion of these, including grebes, herons, ducks, sandpipers, waders, gulls, and terns, were detected at the Holloman wetlands. A reasonably large number of species in the family Emberizidae (including warblers, towhees, sparrows, and blackbirds) was detected, especially considering the virtual absence of riparian or forested areas with permanent water. These species are usually seen primarily near the wetlands and to a lesser extent during surveys of grassland habitats. Also detected on grassland surveys were nine species of sparrows and other typical grassland species such as Swainson's Hawk, Prairie Falcon, Eastern and Western Meadowlark, Scaled Quail, four species of wren, and three thrasher species (Holloman AFB, 1999).

The majority of species detected during surveys at cinetheodolite missile towers were residents (23), followed by long-distance migrants (20) or short-distance migrants (5) that breed or winter on Holloman. Similarly, the majority of grassland species detected during surveys were residents (23), followed by stopover migrants (15), winter residents (9), and migrant breeders (5, Mehlhop et al. 1998b). In contrast, the numbers of bird species and individuals at the wetlands peak during spring and fall migration, and there are few resident or breeding wetland species.

Several sensitive bird species occur in wetland habitats at Holloman AFB. The Interior Least Tern (Sterna antillarum athalassos) is federally and state endangered and is a rare vagrant at the wetlands. The Peregrine Falcon (Falco peregrinus), an occasional migrant, is federally and state endangered. The White-faced Ibis (Plegadis chihi) is a federal species of concern observed regularly on migration. Another federal species of concern, the Western Snowy Plover (Charadrius alexandrines nivosus) breeds in relatively small numbers on Stinky Playa and Lagoon G and is fairly abundant during migration. The Bald Eagle (Haliaetus leucocephalus), federally listed as threatened, and the Neotropic Cormorant (Phalacrocorax brasilianus), state endangered group 2, are potential visitors to the Holloman Wetlands complex, but to date neither has been observed there.

In grassland habitats, the most common sensitive bird species is the Western Burrowing Owl (Athene cunicularia hypugaea). This federal species of concern is a common year-round resident and successful breeder. The Ferruginous Hawk (Buteo regalis) is a federal species of concern. Only one individual was detected during raptor surveys in 1994-95. Baird's sparrows (Ammodramus bairdii) occur in relatively undisturbed grasslands and are rarely reported in New Mexico. Only one incidental sighting has occurred on Holloman, and none was detected during surveys targeted at the species (unpublished Baird's Sparrow report). A former category 2 species, Baird's sparrows now have no federal or state status. The Northern Aplomado Falcon (Falco femoralis septenrionalis) is a federally and state endangered species that has not been detected on Holloman. Finally, one state endangered group 1 species, the Common Ground Dove (Columbina passerina) is a potential shrubland inhabitant but has not been observed at Holloman.

6.1.6 Endangered and Threatened Species

No federally listed species covered under the Endangered Species Act currently reside at Holloman AFB. Several federally listed species, however, have been observed at the base in the past. Mountain plover (proposed federally threatened) nested at Lake Holloman during the 1980s. Brown pelicans (recently delisted) are occasionally observed at Lake Holloman and the constructed wetlands. Peregrine falcons (recently delisted) regularly forage at Lake Holloman (Holloman AFB, 1999).

The White Sands Pupfish (Cyprinodon tularosa), is considered a Federal Species of Concern (formerly a Federal Category 2 species) and is listed by the State of New Mexico as 'threatened'. This species is managed under the jurisdiction of the NMDGF (NMDGF, 2012). Potential habitat on Holloman AFB includes all stream channels of Malone Draw and Lost River on Holloman AFB, White Sands National Monument (WSNM), and WSMR, and a corridor 200 m (660 ft) wide, extending 100 m (330 ft) from either side of the center of the stream channel. It also includes any other areas where White Sands pupfish are found or transplanted by mutual agreement of all signatories as well as a 100 meter (330 foot) buffer around said habitat as demonstrated in the previous delineations, with the exception of the four isolated populations of translocated fish formerly located in the experimental ponds near Lake Holloman on Holloman AFB and any future exceptions under mutual agreement with WSMR, Holloman AFB, WSNM, U.S. Fish and Wildlife Services and the NMDGF and the party or parties seeking such exceptions (WSMR, 2006). Four other sensitive species currently receive no federal protection: a lichen (A. clauzadeana), proposed for rare and endangered listing; the grama grass cactus, included due to its former candidate status; the western burrowing owl, a species of concern; and the western snowy plover, also a species of concern.

No sensitive species are identified as present with either the XU853 or XU854 MRSs. According to the INRMP (Holloman AFB, 1999), the Lost River, just north of the XU853 MRS, hosts one of only four known populations of White Sands Pupfish (Cyprinodon tularosa). The buffer around the White Sands Pupfish habitat overlaps a portion of the XU853 MRS (**Figure 6-1**). FPM has not had any preliminary discussion with the office of Natural Resources to date regarding the White Sands Pupfish habitat buffer area. Prior to commencing RI field work, FPM will consult with the office of Natural Resources. Since only a small portion of one DGM transect at XU853 MRS overlaps with the buffer area, FPM will shift that portion of the transect if necessary to avoid the brush clearing within the buffer. In addition, if the intrusive investigation of DGM anomalies is required within the buffer area, FPM will coordinate with the

office of Natural Resources to implement additional mitigation measures, if necessary, to avoid any soil disturbances that might affect the habitat.

6.1.7 Cultural and Archaeological Resources

The National Historic Preservation Act requires the federal government to consider the effects of undertakings to historic properties. According to the 1996 North Main Base Cultural Resources Survey (Sale et al., 1996), the XU853 is considered eligible for inclusion in the NRHP, based on its association with important historical events. Facilities considered individually eligible for the NRHP within the XU853 MRS are Building 1113 (a former radio relay facility), Buildings 1116, 1127, the JB-2 Ramp, and a Test Stand. The XU854 MRS contains buildings 1440 and 1442 which are considered individually eligible for inclusion in the NRHP. Building 1440, completed in 1962 as a missile launch facility, was an observation blockhouse for Mace and Matador missiles and drone launches. Building 1442 was constructed in 1959 as a missile launch facility. A simulated atomic blast proof shelter, it was constructed to withstand the overpressure resulting from an atomic bomb explosion, thereby protecting the ZEL launcher and aircraft parked inside. The known NRHP eligible sites within the XU853 and XU854 MRSs are shown in **Figures 6-2** and **6-3**, respectively. FPM has not had any preliminary discussion with the Cultural Resources Manager regarding the NRHP eligible buildings located in both sites. Due to the nature of the RI field activities planned for both MRSs, it is not expected that buildings eligible for inclusion in the NRHP will have any impact to successful performance of the RI and vice versa; however, if additional resources are identified, FPM will work closely with the Cultural Resources Manager to come to an agreement on the proper path forward.

6.2 Mitigation Procedures

6.2.1 Coordination with the Installation Natural Resources Office

FPM will maintain close coordination with the installation office of Natural Resources, the Cultural Resources Manager, the HAFB Environmental Chief, and appropriate Federal and State authorities throughout RI field activities. If site-specific conditions change or additional resources are identified, FPM will work closely with installation office of Natural Resources, the Cultural Resources Manager, the MMRP RPM, and appropriate Federal and State authorities to come to an agreement on the proper path forward. Addition conservation measure and/or revisions to mitigation procedures may be incorporated into field activities, as necessary.

6.2.2 Waste Disposal

Soil removed during intrusive investigations will be placed as close to the excavation as reasonable during excavation activities. When complete, the soil will be returned to the excavation. While arrangements for MD removal will be made prior to the start of field activities, MD determined to be safe may be temporarily stored at a secured location (to be determined on-site).

Solid waste generated during field activities will be collected daily and placed in proper trash receptacles off-site. FPM will arrange for removal of solid waste including pin flags, wooden stakes, and other material used. MDAS will be disposed offsite and recycled.

6.2.3 Dust and Emission Control

It is anticipated that planned field activities will generate little or no fugitive dust emissions. Airborne dust resulting from the use of heavy equipment will be monitored. If necessary, water will be used to control dust.

6.2.4 Spill Prevention and Control

Minimal amounts of chemicals will be brought on-site during the field activities. Field vehicle refueling will be completed at commercial off-site facilities. Field procedures will focus on minimizing or preventing spills during field activities.

Fuel or other liquid spills from on-site vehicles, if any, will be contained and the impacted soil removed, characterized, and disposed of at an off-site facility as appropriate. MC sample preservatives, if used, will be provided in sample containers by the laboratory to minimize the on-site handling of acids or other chemicals. Additional spill control and prevention details are discussed in the Base-Wide HASP (**Appendix B**).

6.2.5 Storage Areas and Temporary Facilities

If needed, temporary storage areas within a secured area with restricted to authorized personnel will be established. Temporary storage areas will be locked and/or secured to prevent disturbance by trespassers or vandals.

6.2.6 Access Routes

FPM will use established roadways (dirt or paved) to the extent possible to gain access to the sites. Field personnel will confine motorized traffic to established access routes to reduce potential impacts to surface topography and vegetation.

6.2.7 Vegetation Removal

Vegetation may be cut to facilitate the use of geophysical instruments and other work. Vegetation will be cut no closer than six inches to the ground. It is not anticipated that any trees will be disturbed by RI field activities.

6.2.8 Water Run-On and Run-Off Control

Excavation activities will not disturb the local drainage patterns. Excavated soils will be used to backfill the excavations and manually graded to site contours.

6.2.9 Equipment Decontamination and Disposal

If necessary, equipment will be decontaminated IAW the Equipment and Personnel Decontamination SOP provided in the UFP-QAPP (**Appendix D**), during field activities.

Planned MC sampling activities include surface soil sampling using disposable sampling equipment, such as disposable polyethylene scoops and bottles. Surface soil sampling is not anticipated to generate IDW. PPE and other disposable sampling equipment will be bagged and temporarily staged for off-site disposal IAW USEPA and NMED regulations. Sampling personnel will follow local and state protocols, as well as stakeholder guidance, in determining the proper disposal of PPE.

If site information necessitates the sampling of additional matrices and utilizing alternative sampling approaches, a FCR will be completed detailing the alternative sampling approaches, the IDW anticipated and procedures and protocols required for disposal.

6.2.10 Minimizing Disturbance

FPM will make all reasonable efforts to avoid disturbances to any natural and cultural resources encountered during RI field activities. Procedures for minimizing areas of disturbance include such measures as:

- Driving on established roads as much as possible;
- Limiting vehicle trips in areas without roads; and
- Replacing soil into holes that result from intrusive excavation.

FPM will utilize pertinent restoration efforts to ensure that disturbed areas are restored to pre-investigation conditions.

6.2.11 Post-Activity Clean-Up

All project materials, solid wastes, and MDAS will be removed from the project site at the conclusion of field activities prior to leaving the site. Excavations will be backfilled with the displaced soil and/or imported backfill, and re-graded as best as possible to its prior contours. IDW will be disposed of on routine basis, following the procedures described in **Section 3.8** and IAW the Investigation-Derived Waste SOP provided in the UFP-QAPP (**Appendix D**).

6.2.12 Air Monitoring Plan

The necessity for air monitoring is not anticipated at the work sites. Should on-site conditions warrant air monitoring will be conducted IAW procedures defined in the Base-Wide HASP (**Appendix B**).

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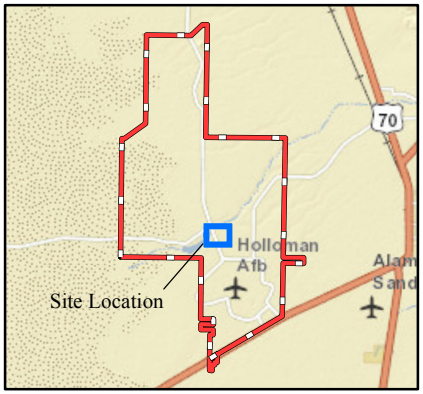

Legend

- Road
- Buildings
- JB-2 Ramp (NRHP Eligible)
- NRHP Eligible Area
- XU853 MRS (204.6 acres)
- EOD 50-lb Range Boundary
- Installation Boundary
- 1106 Building Number

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 6-2

NRHP Eligible Sites
XU853 MRS

NOTES:
Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 800 feet

0 120 240 Meters

0 400 800 Feet

N W E S

FPM Remediations, Inc.

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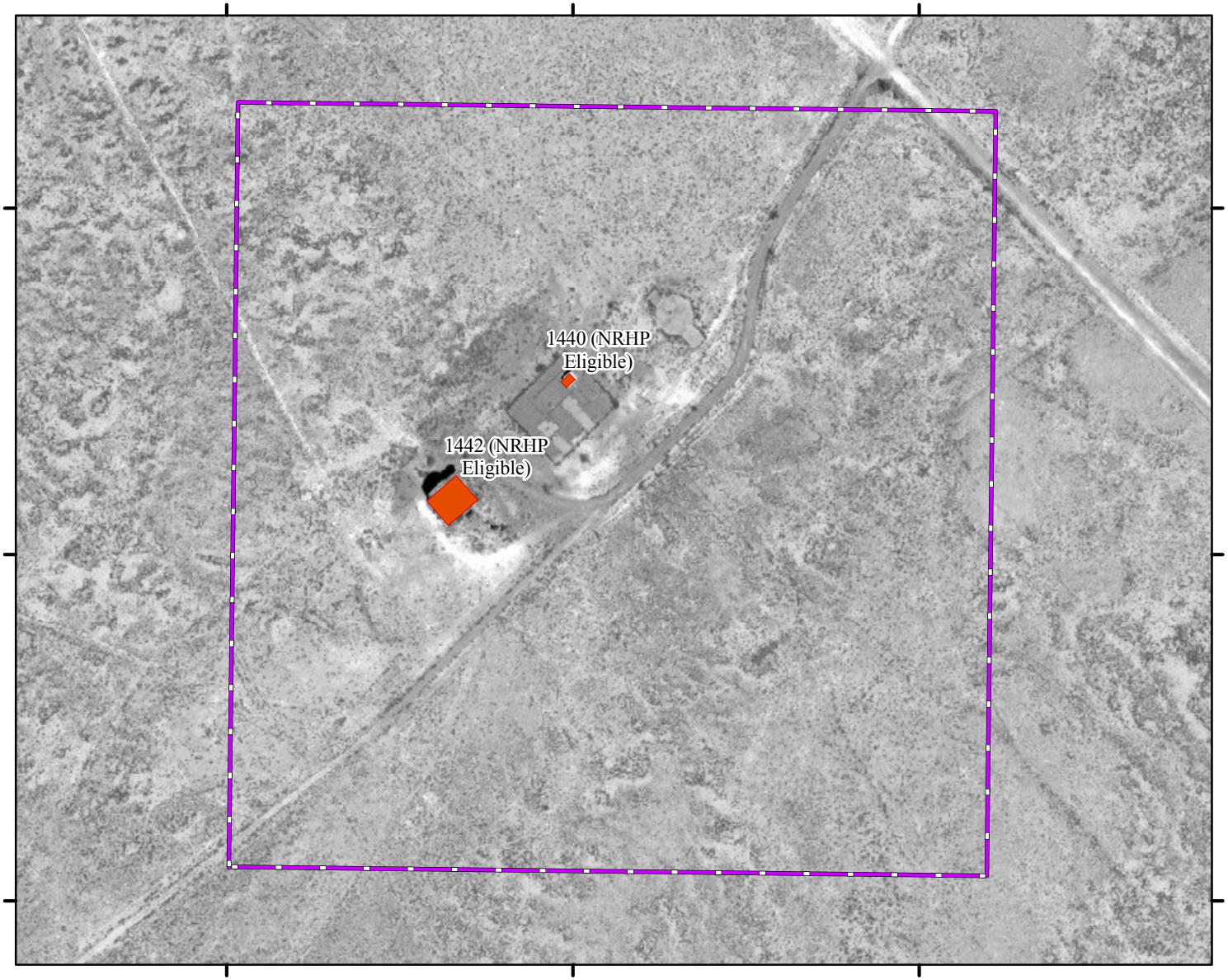

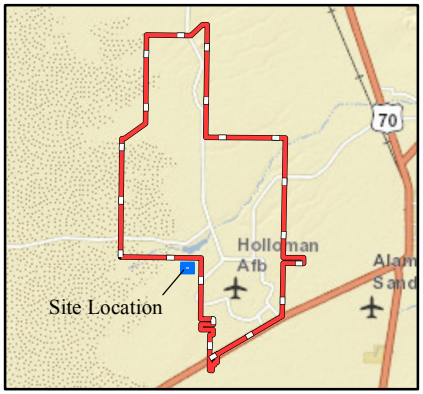

Legend

- Buildings
- XU854 MRS (47.7 acres)
- Installation Boundary
- 1440 Building Number

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 6-3

NRHP Eligible Sites
XU854 MRS

NOTES:
Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 300 feet

0 50 100 Meters

0 150 300 Feet

N W E S

FPM Remediations, Inc.

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APPENDIX A

Field Standing Operating Procedures

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1.0 SOP NO. 1 – SURFACE AND NEAR SURFACE SOIL SAMPLING

1.1 PURPOSE AND SCOPE

The purpose of this document is to define the Standard Operating Procedure (SOP) for collecting soil samples at Holloman Air Force Base (AFB) using hand tools. This SOP describes the equipment, field procedures, and Quality Assurance/Quality Control (QA/QC) procedures implemented for sample collection.

This SOP is intended to be used together with the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) and other appropriate SOPs. Health and safety procedures and equipment for the investigation are detailed in the project Health and Safety Plan (HASP).

Applicable SOPs are listed below:

- SOP No. 3 – Sample Handling, Documentation, and Tracking
- SOP No. 4 – Equipment and Personnel Decontamination
- SOP No. 5 – Global Positioning System (GPS) Measurements
- SOP No. 6 – Permits and Clearances
- SOP No. 8 – Investigation-Derived Waste

1.2 EQUIPMENT AND MATERIALS LIST

The following equipment and materials should be on site for soil sampling:

- Stainless steel hand auger or hand trowel
- Surveyor's stakes and flags
- Pick
- Field logbook
- Sample Collection Field Sheets
- Nitrile gloves
- Hard plastic disposable tools (i.e., polyethylene [PE] scoop)
- Sample containers
- Sample container labels
- Label tape (clear)
- Disposable sealed zip-type PE bag
- Paper towels
- Digital camera
- 100 foot hand tape
- Waterproof and permanent marking pens
- Plastic sheeting
- Trash bags
- Cooler with sufficient ice to maintain a temperature of 4°C
- Appropriate health and safety equipment, as specified in the HASP

- Appropriate decontamination supplies, as specified in SOP No. 4

Other materials and equipment may be needed based on field conditions.

1.3 LOCATING THE SAMPLING POINTS

Sampling locations will be determined in the field. At the time of locating each sampling point, the sampling point identification will be entered in the field logbook and the GPS coordinates recorded. Information concerning nearby landmarks, or other information that will help to re-locate the point in the future will be recorded. The sample locations will be marked using surveyor's stakes and flags (or lath), and the flags (or lath) will be labeled using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations into site landmarks if available (such as foundations). If the surveyor's stake is offset from the sample location, the offset will be noted on the field map or field logbook.

1.4 SURFACE AND NEAR SURFACE SOIL DISCRETE SAMPLING PROCEDURES

Discrete samples consist of soil collected for chemical analysis from a single location. Sampling sites will be located and marked using surveying stakes or flags. Discrete surface soil and subsurface soil samples will be collected as follows:

- At each location, clear an area approximately 12 inches in diameter of surface vegetation and debris from the vicinity where a sample is to be collected.
- Use a decontaminated stainless steel spoon or disposable spoon to collect the surface soil to a depth interval of 0 to 2 inches. A steel pick may be used as needed to loosen the soil prior to sampling.
- Use a decontaminated hand auger or direct push technology to collect the shallow soil from a depth of 2 inches to 3 feet below ground surface (bgs). When proper sample depth is reached, remove the cuttings from the borehole while keeping the core intact.
- To the extent possible, eliminate gravel size or larger particles or debris based on visual observation.
- Immediately fill the appropriate sample containers. Label and handle the containers as specified in SOP No. 3, Sample Handling, Documentation, and Tracking.
- Decontaminate the sampling equipment in accordance with SOP No. 4, Equipment and Personnel Decontamination.
- Once the sample is collected, the location will be documented and photographed; and GPS coordinates will be recorded.

1.5 INCREMENT SAMPLING PROCEDURES

The goal of Increment Sampling (IS) is to obtain an unbiased and reproducible estimate of the average concentration of analytes through the collection of soil sample increments distributed evenly throughout the decision unit/sampling area. Ideally, the target weight of an IS sample is

approximately 1 kilogram (kg) and is comprised of 30 (minimum) to 100 increments within the decision unit. IS samples will be collected as follows:

- Determine the appropriate size of the decision unit to fit the investigation objective. Decision unit size recommendations range from 33-ft x 33-ft to 165-ft x 165-ft and consist of 30 increments to 100 increments, respectively. The location and size of individual decision units are to be based on previous investigations, visual evidence of Munitions and explosives of concern (MEC) or Munitions Debris (MD), and/or type of MEC present.
- Using survey flags, delineate a decision unit boundary at each corner of the selected area. Note that the size and shape of the decision unit will be largely determined by the terrain features and the data quality objectives set forth in the UFP-QAPP.
- Once the boundary of the decision unit is defined, place nine flags at evenly spaced intervals along two opposite sides of the decision unit to define 10 lanes. Flags can then be used to fill in the remaining sides to create a visual sub-grid pattern. Additional flags can be placed within the interior of the decision unit if visual obstructions impede the visualization of evenly spaced increments throughout.
- With 100 increments established throughout the grid area, IS locations can then be selected. For 50-increment samples, every other flag will act as a sampling location. For 33-increment samples, every third flag will act as a sampling location. This pattern can be adjusted to satisfy the desired quantity of increments, as needed.
- Working in a team of two, one person will collect each increment while the other holds the sample container (clean plastic bag) and keeps track of the number of increments collected. The increments are sampled in a snake-like pattern from one corner of the decision unit to the corner adjacent to the starting corner.
- For the collection of QA/QC samples, the replicate samples should be collected from a sub-grid collection point offset from the original starting position and followed in the same snake-like pattern walked during the collection of the primary sample.
- Recommended sampling depths range from 1 inch to 4 inches at each increment location and are based on the overall depth distribution of anticipated analytes. The diameter of the sampling tool and the volume collected at each increment location will need to be adjusted to satisfy the 1 kg sample mass as it pertains to the selected quantity of increments in each decision unit.
- Once collected, the sample will be containerized as per the analytical laboratories requirements and labeled as specified in SOP No. 5, Sample Handling, Documentation, and Tracking.
- Once the sample collection is completed, the location will be documented and photographed; and GPS coordinates will be recorded at each of the four corners of the decision unit.

1.6 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All

QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

1.6.1 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. The initial sample containers for a particular parameter or set of parameters will be filled first, and then the duplicate sample containers for the same parameter(s) will be filled, and so on until all necessary sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. Duplicate samples will be blind to the laboratory. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

1.6.2 Matrix Spike and Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the chain of custody (COC) form and on the containers. It may be necessary to increase the sample volume for samples where the MS/MSD designation is to be made. If additional volume is necessary, the additional sample container will be filled immediately after the initial sample. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

1.7 SAMPLE HANDLING

Sample containers, preservatives and analysis are specified in Worksheet #19. Samples will also be labeled and handled as described in SOP No. 3, Sample Handling, Documentation, and Tracking.

1.8 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the activities concluded and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets.

1.8.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sampling location. Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location (and depths)

- Date and time of sampling
- Person(s) performing sampling
- Type of sample (grab or composite)
- Color (describe), odor (describe)
- Sample description
- Sample identification number
- Analyses required
- Number of sample bottles taken for each analyses
- Preservation of samples, if any
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sample quality.

1.8.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field logbook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Locations, depths, and sample station numbers
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information
- Calculations, if required.

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2.0 SOP NO. 2 - SUB-SURFACE SOIL SAMPLING

2.1 PURPOSE AND SCOPE

This SOP describes the equipment, materials, field procedures, and documentation procedures for collecting sub-surface soil samples using direct push or auger methods for soil characterization and chemical analysis.

Health and safety procedures and equipment to be used during soil sampling are described in a separate HASP. These SOPs are intended to be used with the UFP-QAPP and with other SOPs listed below:

- SOP No. 3 - Sample Handling, Documentation, and Tracking
- SOP No. 4 - Equipment and Personnel Decontamination
- SOP No. 6 – Permits and Clearances
- SOP No. 7 – Equipment Calibration
- SOP No. 8 – Investigation-Derived Waste

2.2 EQUIPMENT AND MATERIALS LIST

One of the following drilling equipment:

- Direct push rig (e.g., Geoprobe® rig or similar) with appropriate drilling and sampling tools (sub-surface soil)
- Hollow Stem Auger Kit and electric drill
- Hand Auger

The following equipment and materials should be on site for sub-surface soil sampling regardless of the drilling equipment used:

- Photoionization Detector (PID) (with 10.2 eV lamp)
- Weighted tape measure and ruler with 0.01-foot increments
- Surveyor's stakes and flags
- Field logbook
- Drilling Log form
- Sample Collection Field Form
- Stainless-steel bowl and spoon
- Sample containers
- Sample container labels
- Label tape (clear)
- Ziploc® bags
- Paper towels
- Digital Camera
- Waterproof and permanent marking pens
- Plastic sheeting

- Trash bags
- Ice chest with ice
- Appropriate health and safety equipment, as specified in the HASP
- Appropriate decontamination supplies, as specified in SOP No. 4
- Granular bentonite and potable water

2.3 LOCATING THE SAMPLING POINTS

The facilities designated for sampling are shown on figures provided in the UFP-QAPP (Worksheet #17). The approximate soil sampling locations will be identified on site figures before field work commences. The exact soil sampling locations will be determined in the field. Sampling coordinates will be mapped on the front of the Drilling Log in the Location Sketch/Comments Area. The sampling locations will be defined in the investigation specific work plan (WP) similar to previous investigation and long term monitoring locations.

When each soil sampling location is identified in the field, the sampling point identification will be entered in the field logbook and on the Drilling Log. Include any information concerning nearby landmarks, or other information that will help to re-locate the point in the future. Mark the sample locations using surveyor's stakes and flags, and label the flag using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations to site landmarks (such as foundations) if available. If the surveyor's stake is offset from the sample location, the offset will be noted on the field map and the field logbook.

2.4 SOIL SAMPLING PROCEDURES

Direct push samples will be collected using a dual tube sampling system or a discrete interval, piston-type sampler (Geoprobe®, MacroCore®, or equivalent). With a dual tube system, the outer rods remain in the ground while the inner rod and sample liner are extracted to retrieve a soil sample from the desired interval. Soil samples may be collected continuously throughout the depth of the direct push boring or from discrete intervals. The direct push rods will be decontaminated between boring locations, but not between samples at the same boring since a new acetate liner is used for each sample.

With a piston-type sampler, a four-foot or five-foot-long stainless steel sampler with an acetate liner is advanced to the top of the desired sampling interval. The sampler is closed to soil during advancement of the sampler to the desired sampling interval. When the top of the desired sampling interval is reached, a piston rod inside the sampler is unlocked through the drill rods, and the sampler is advanced to the bottom of the sampling interval. The sampler and all drill rods are then removed from the ground, and the acetate liner is removed from the piston sampler. Aside from the cutting shoe, the soil sampler never comes in contact with the soil sample. The cutting shoe is decontaminated after each sample is collected, and a new acetate liner is used for every sample interval. The outer sampling barrel is decontaminated after each boring is completed. The sampling will be documented in the field logbook and drill log.

With a hand auger or hollow stem auger kit, the auger head will be advanced manually to the depth. Auger extensions will be used when sampling at depths exceeding 4 feet. Once the desired depth is achieved, the auger is removed for sample collection as described below. Following collection, the hand auger or hollow stem auger kit will be decontaminated. When using manual samplers, the sampling will be documented in the field logbook and Soil/Sediment sampling form.

At each sampling location, the sampler will be advanced by a combination of hydraulic vertical pressure and percussion hammering. Once the target depth is achieved, the sample will be withdrawn and the liner filled with the soil sample is retrieved.

The following procedures will be followed once the soil sample has been retrieved:

- Don a clean pair of nitrile gloves.
- Cut acetate sleeve to provide access to the soil sample (direct push sampling only).
- Measure the recovery. Record the sampling interval and recovery on the drilling log.
- Remove soil smear from the outside of the acetate sleeve and examine the sample, with particular attention for visible evidence of staining, odors, or other evidence of contamination. Record the soil description on the Drilling Log or Soil/Sediment Sampling Form.
- Conduct PID screening of the soil. The soil with the highest PID levels will be collected for a sample.
- The soil from the sampling interval will be removed from the liner and homogenized in a stainless-steel bowl. Once the soil has been homogenized, fill the appropriate sample containers as specified in the UFP - QAPP (Worksheet #19). Record the sample interval and analysis requested on the Drilling Log or Soil/Sediment Sampling Form and the COC.
- Label, store, transport, and document the samples (depending on the use of the sample) according to SOP No. 3. The parameters for analysis and preservation are specified in UFP QAPP Worksheet #19.
- If no other samples will be collected from the boring, abandon the boring by backfilling the hole with hydrated granular bentonite. Pour the granular bentonite down the hole in approximate 1-foot to 2-foot lifts, and then pour approximately 0.5 gallon of potable water down the hole to hydrate the bentonite. Continue this from the bottom of the hole to the surface.

2.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

2.5.1 Field Blanks

Field blanks are QC samples collected to evaluate potential external contamination of samples and will consist of trip, ambient, and equipment blanks. The sample collection coordinator or the project QA/QC coordinator will designate these blanks. The blanks will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples.

A trip blank serves as a check on sample contamination originating from the container or sample transport. A trip blank consists of a volatile organic analysis (VOA) vial which was filled with VOA-free water at the lab, transported to the site, kept in the same cooler as the normal samples throughout the entire sampling day, and shipped back to the laboratory with the normal samples. One trip blank will be sent with each cooler containing water samples for volatile organic analyses.

The ambient blank serves as a check on sample contamination originating from ambient air during volatile organic compounds (VOCs) sample collection. An ambient blank consists of an empty VOA vial which is filled in the field with VOA free water. While pouring the sample, the water is given ample contact with ambient air conditions. The ambient blank is typically collected at the sampling location that potentially exhibits the largest ambient influence (near a busy road, airfield, etc.).

The equipment blank serves as a check on sample contamination originating from sampling equipment reuse during sample collection. The equipment blank consists of a set of sample bottles identical to the normal sample, which is filled with lab-grade water that is flushed over a decontaminated, reusable piece of equipment.

2.5.2 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. All sampling containers will be filled in the following order: volatile or gaseous analyses first, then semi-volatile organic compounds (SVOCs), including polynuclear aromatic hydrocarbons (PAHs); metals; mercury; cyanide; total organic carbon; anions; other remaining analytes (no specific order). The initial sample containers will be filled first, and then the duplicate sample containers for the same parameter(s) and so on until all sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

2.5.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) analyses are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the COC form and on the containers. It may be necessary to increase the sample volume for MS/MSD samples. If

additional volume is necessary, the additional sample containers will be filled in the identical fashion as described above in the duplicate sample section. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

2.6 FIELD DOCUMENTATION

Field documentation for sub-surface soil sampling includes field logbooks and field forms. The most important aspect of field documentation is thorough, organized, and accurate record keeping. Two forms are used in the field during sub-surface soil sampling. These forms include the Drill Log and the Soil/Sediment Sampling Form. Each form is described in **Section 2.6.2**. An important factor of record keeping is the proper preservation and storage of all field documentation. To preserve the field documentation, the field notes and field forms are scanned and the electronic record of the field notes is stored in the project folder and backed up on additional hard drives to prevent data loss.

Additional forms including Health and Safety Meeting forms, Health and Safety Inspection forms, and COCs used during the sampling event are detailed in SOP No. 3.

2.6.1 Field Logbook

All information pertinent to soil sampling and not documented on the field forms will be recorded in a bound field logbook with consecutively numbered pages. The field logbook notes will be recorded in indelible ink. The field logbooks notes are entered to create an accurate record of the work performed so that the sampling activity can be reconstructed without relying on the memory of field personnel. Information documented in the field logbook may include information on date of notes, weather conditions, field personnel, site, mobilization, work performed including location and time, etc. After each day, field notes are reviewed by the field team leader or site responsible person for accuracy. Refer to SOP No. 3 for detailed procedures regarding documentation in the field logbook.

2.6.2 Field Forms

<u>Drill Log</u>

The Drilling Log contains the following minimum information:

- Project name and number
- Contractor company, field personnel
- Boring Identifier
- Drilling subcontractor company and name of drilling personnel
- Site Identifier
- Brand and model of drill rig
- Sizes and types of drilling and sampling equipment

- Surface elevation (if available, this may be entered later after the survey)
- Date drilling started and finished
- Overburden thickness, depth drilled into rock, and total depth of hole
- Depth to water during drilling and depth to water after drilling with elapsed time
- Number of geotechnical samples, type of samples, and core boxes (if cores are saved)
- Number of chemical samples and requested analyses
- Signature of field geologist who completed the Drilling Log field form
- Field sketch showing the boring location
- Sampling interval and measured sample recovery.
- A description of the recovered soil sample in accordance with the Unified Soil Classification method for unconsolidated geologic materials. The descriptions should include origin, grain size, sorting, texture, structure, bedding, color, moisture content, and consistency.
- Sample Identifier
- Sample Collection Time
- As applicable, field screening results, geotechnical samples, chemical samples, and blow counts (split-spoon sampling only).
- As applicable, record pertinent observations (such as odors, staining, colors, changes in drill rod advancement, chatter, water, etc.) in the "Remarks" column.
- If portions of the Drilling Log are not applicable (e.g., if samples are not collected for chemical analysis or if cores are not collected, etc.) record an "NA" in the appropriate location on the form.
- Bore hole abandonment (method of abandonment)

Soil/Sediment Sampling Form

The Soil/Sediment Sampling Form contains the following minimum information:

- Field personnel
- Project name and number
- Site Identifier
- Sample Location Identifier
- Sizes and types of sampling equipment
- Date of sample
- Sampling depth.
- A description of the recovered soil sample. The descriptions should include origin, grain size, texture, structure, color, and odor.
- Comments or Observations
- Sample Identifier
- Sample Collection Time

3.0 SOP NO. 3 – SAMPLE HANDLING, DOCUMENTATION, AND TRACKING

3.1 PURPOSE AND SCOPE

This SOP describes the procedures for sample handling, documentation, and tracking. This SOP is intended to be used with the UFP-QAPP, and with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling

3.2 SAMPLE IDENTIFICATION

The sampling locations, sample types, and naming conventions will be established prior to field activities for each sample to be collected. On-site personnel will obtain assistance in defining any special sampling requirements from the FPM Project Manager or designated Task Manager. Each sample will have a discrete, alpha-numeric sample identification (ID). A unique sample ID is needed to track each of the samples collected for analysis during the life of this project. In addition, the sample IDs will be used in the database to identify and retrieve the analytical results received from the laboratory. Each sample ID will be assigned at the time of sampling.

Sample ID

The sample ID will be designated as follows: Site Code, Sample Type and Sampling Location Indicator, Sample Location Number, Sample Depth Identifier, and Sample Type Qualifier.

Site Code

The first segment consists of two to five alphanumeric characters that designate the site code. Examples of site codes include:

- SR864 for Poorman Range
- ML865 for Ballistics Rain Field

For a soil sample designated “SR864SO0101A”, “SR864” indicates the sample is collected from the Ballistics Rain Field site.

Sample Type and Sampling Location Indicator

The second segment consists of one or two alphanumeric characters that indicate the sample type and sampling location indicator. Sample types are as shown below:

SO Surface Soil (0 to 2 inches)
SS Subsurface Soil (2 inches or greater)

For a soil sample designated "SR864SO0101A", "SO" indicates the sample is collected from surface soil.

Sample Location Number

The two-digit number following the sample indicator completes the identification of the sampling location at a specific site.

For a soil sample designated "SR864SO0101A", "01" indicates the sample is collected from sampling location 1.

Sample Depth Identifier

The fourth segment consists of two numerical characters that will be used to identify the depth in feet below top of inner casing in wells and feet bgs for soil samples.

For a soil sample designated "SR864SO0101A", "01" indicates the sample is collected 1 foot bgs.

Sample Type Qualifier

The fifth segment is one or two alphabetic characters used to designate the type of sample. The first letter denotes the round of sampling completed (e.g., "A" for first quarterly sampling round, "B" for second quarterly sampling round, etc.). The sample types will be identified by the second character as listed below:

- A = Primary sample
- B = Primary sample
- C = Field duplicate groundwater sample
- D = Matrix Spike Duplicate (MSD)
- E = Equipment blank
- F = Ambient blank
- R = Trip blank
- S = Matrix Spike (MS)

The letter A or B appearing at the end of a sample number indicates that the sample is a primary sample. These letters will be selected randomly to mask the predominance of primary samples over QA/QC samples. This system was devised to minimize the likelihood that the laboratory personnel can distinguish the primary samples from the QA/QC samples using the sample identification.

3.3 SAMPLE LABELS

Sample labels will be filled out as completely as possible by a designated member of the sampling team prior to beginning field sampling activities each day. All sample labels will be

filled out using waterproof ink. At a minimum, each label will contain the following information:

- Sampler's company affiliation
- Site location
- Sample ID
- Date and time of sample collection
- Analyses required
- Method of preservation (if any) used
- Sample matrix (i.e., soil, groundwater, surface water)
- Sampler's signature or initials

3.4 SAMPLE HANDLING PROCEDURES

This section discusses proper sample containers, preservatives, and handling and shipping procedures. The UFP-QAPP summarizes the information contained in this section and also includes the sample holding times for each analyte.

3.4.1 Sample Containers

Certified, commercially clean sample containers will be obtained from the contract analytical lab. The contract laboratory will label the containers to indicate the type of sample to be collected. Required preservatives will be prepared and placed in the containers at the laboratory prior to shipment to the site. Appropriate sample containers for the specific analyses required will be listed in the UFP-QAPP.

3.4.2 Sample Preservation

Sample preservation efforts will commence at the time of sample collection and will continue until analyses are performed. Samples will be stored on ice at 4°C in coolers immediately following collection. The ice will be double bagged in plastic storage bags. Additional sample preservation requirements are listed in the UFP-QAPP. Chemical preservatives, if necessary, will be added to the sample containers by the laboratory prior to shipment to the field, unless otherwise specified in the UFP-QAPP.

3.4.3 Sample Handling and Shipping

The sample containers will be wiped clean of all sample residue and then wrapped in protective packing material (bubble wrap) and taped. Samples will be double-bagged with plastic bags and then placed upright in an iced cooler. Additional packing material will be placed around the samples as necessary to protect them from damage and to keep them upright. A COC form will accompany each cooler. The COC will be placed in a plastic bag and attached to the inside lid of the cooler. The cooler lid will be taped closed with a custody seal.

Coolers will be hand delivered or shipped by overnight express carrier to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific

holding times. This may require daily shipment of samples with short holding times. The condition of all samples as received and temperature of all coolers will be reported by the laboratory.

3.4.4 Holding Times and Analyses

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest and stability factors, and preservative (if any) used. Allowable holding times are listed in the UFP-QAPP.

3.5 SAMPLE DOCUMENTATION AND TRACKING

This section describes documentation required in the field notes, on the sample collection field sheets, on the daily QC reports, and on the sample COC forms.

3.5.1 Field Logbook

All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions that are initialed and dated. Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook for a particular site. A site-specific logging procedure will be developed to include sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel. The logbooks will be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become a part of the final project file.

The following information (as applicable) shall be recorded in the field log book:

- Sampler’s printed name and signature
- Names of other field personnel (FPM and any FPM subcontractors) and site visitors
- Date (month, day, year)
- General weather conditions
- Time and location of sampling (including approximate distance to adjacent landmarks if possible)
- Level of personal protective equipment (PPE) used
- Brief description of sampling method with references to appropriate SOPs and WP
- Sample ID (includes location and matrix)
- Any QA/QC sample
- Number and volume of sample containers and requested analysis
- Sample handling and preservation
- Results of any field measurements, equipment used, and equipment calibration information
- Decontamination information
- Brief discussion of any field decisions, unusual conditions, problems encountered and corrective action taken, and/or changes required by field conditions

- Signature and date by person responsible for writing the field notes

3.5.2 Daily Quality Control Report

Each sampling crew will also maintain DQCRs to supplement the information recorded in the field logbook. DQCRs will be maintained by members of the field sampling team and cross-checked for completeness at the end of each day by the sampling team members and/or Field Manager. They will be signed and dated by individuals making entries and initials by the reviewer upon completion. Copies of the DQCR will be forwarded to the QA Officer for review. The DQCR will include the following information:

- Project name
- Project number
- Personnel on site
- Visitor on site
- Subcontractors on site
- Equipment on site
- Weather conditions
- Field work performed
- Quality control and health and safety activities
- Problem, down time, and standby time
- Name and title of person completing the DQCR

3.5.3 Sample Chain of Custody

During field sampling activities, traceability of the sample must be maintained from the time that the samples are collected until laboratory data are issued. Initial information concerning collection of the samples will be recorded in the field logbook as described above. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. The COC form used in the field is a one-page form.

The sampler will be responsible for initiating and filling out the COC form. The sampler will sign the COC when the sampler relinquishes the samples to anyone else. One COC form will be completed for each cooler of samples collected daily. The COC will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times

- Method of shipment
- Shipping air bill number (if appropriate)

The person responsible for delivery of the samples to the laboratory will sign the COC form, and retain a copy of the COC form, document the method of shipment, and send the original and the second copy of the COC form with the samples. Upon receipt at the laboratory, the person receiving the samples will sign the COC form and return the second copy to the FPM Chemical Quality Control Coordinator. Copies of the COC forms documenting custody changes and all custody documentation will be received and kept in the central files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original COC will be sent by the laboratory to the FPM Chemical Quality Control Coordinator to be incorporated into the central files.

4.0 SOP NO. 4 – EQUIPMENT AND PERSONNEL DECONTAMINATION

4.1 PURPOSE AND SCOPE

This SOP describes the equipment, materials, field procedures, and documentation procedures for decontaminating sampling equipment and personnel. Health and safety procedures and equipment to be used during soil sampling are described in a separate HASP. The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling
- SOP No. 8 – Investigation-Derived Waste

The overall objective of an environmental sampling program is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., all non-disposable equipment that will come in direct contact with samples) and field support equipment (e.g., drill rigs, vehicles) is, therefore, required prior to, between, and after uses to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

4.2 EQUIPMENT AND MATERIALS LIST

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot water – high-pressure sprayer
- Sponges or paper towels
- Alconox detergent (or equivalent)
- Potable tap water or distilled water
- Laboratory-grade de-ionized water
- Garden-type water sprayers
- Appropriate Health and Safety equipment (i.e., nitrile gloves, safety glasses, etc.)
- Appropriate containers for Investigative Derived Waste (IDW)

4.3 DECONTAMINATION PROCEDURES

Site activities should be conducted with the general goal of preventing the contamination of personnel and equipment. However, some type of decontamination will always be required on site. A sample personnel decontamination will use remote sampling techniques, bag monitoring instruments, avoid contact with obvious contamination, and employ dust suppression methods as necessary to reduce the probability of becoming set-up guideline and a sample decontamination equipment and supplies list are included in the HASP.

4.3.1 Decontamination Solutions

A decontamination solution should be capable of removing, or converting to a harmless substance, the contaminant of concern without harming the object being decontaminated. The preferred solution is a mixture of detergent and water, which is a relatively safe option compared to chemical decontaminants. A solution recommended for decontaminating consists of 1 to 1.5 tablespoons of Alconox per gallon of warm water. Skin should be decontaminated by washing with hand soap and water. The decontamination solution must be changed when it no longer foams or when it becomes extremely dirty. Rinse water must be changed when it becomes discolored, begins to foam, or when the decontamination solution cannot be removed.

4.3.2 Personnel Decontamination

A temporary personnel decontamination line will be set up in the Contamination Reduction Zone, which is outside of the Exclusion Zone where intrusive work is being performed. If contamination is not encountered, a dry decontamination station may be established which consists of an area where disposable PPE can be donned and discarded. It is anticipated that all work at the Holloman AFB will be completed in Level D.

4.3.3 Sampling Equipment Decontamination

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the HASP.
- Gross contamination on equipment will be scraped off at the sampling or construction site.
- Equipment that cannot be damaged by water will be placed in a wash tub containing Alconox or low-sudsing non-phosphate detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by a de-ionized or distilled water rinse.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with de-ionized or distilled water. Care will be taken to prevent equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately after

decontamination, the equipment will be covered or wrapped in plastic sheeting, foil, or heavy-duty trash bags to minimize potential contact with contaminants.

4.3.4 Equipment Leaving the Site

Vehicles used for activities in non-contaminated areas shall be cleaned on an as-needed basis, as determined by the unexploded Ordnance (UXO) Site Safety Officer/QC Supervisor (UXOSO/QCS), using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles leaving the area.

4.3.5 Responsible Authority

Decontamination operations at each hazardous waste site shall be supervised by the UXOSO/QCS. The UXOSO/QCS is responsible for ensuring that all personnel follow decontamination procedures and that all contaminated equipment is adequately decontaminated. The UXOSO/QCS is also responsible for maintaining the decontamination zone and managing the wastes generated from the decontamination process.

4.3.6 Investigation Derived Waste

Liquid wastewater from decontamination will be removed from the site and properly disposal of. Solid waste, including sample liners and PPE, will be removed from the site and properly disposed of as well.

4.4 EMERGENCY DECONTAMINATION

Emergency decontamination procedures should be followed if necessary to prevent the loss of life or severe injury. In the case of threat to life, decontamination should be delayed until the victim is stabilized; however, decontamination should always be performed first, when practical, if it can be done without interfering with essential lifesaving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life. During an emergency, provisions must also be made for protecting medical personnel and disposing of contaminated clothing or equipment.

4.5 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination will include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions
- IDW handling

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5.0 SOP NO. 5 - GLOBAL POSITIONING SYSTEM MEASUREMENTS

5.1 PURPOSE AND SCOPE

This SOP provides technical guidance and methods that will be used to perform GPS measurements at the field site.

GPS surveying at the field site is used to record:

- Locations of MEC or MD
- Excavation footprints
- Sampling locations
- Injection locations
- Other surface and subsurface feature locations and elevations

The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Soil Sampling

5.2 PERSONNEL QUALIFICATIONS

GPS measurements at the field site will be performed by qualified field personnel. All personnel engaged in recording GPS measurements will be knowledgeable and experienced in methods and equipment use.

5.3 GPS SURVEYING

GPS equipment capable of achieving measurement precision of equal to or less than the specified accuracy without correction will be used. GPS equipment should collect data such that post-processing of spatial data can be performed to increase measurement precision, if needed. The equipment will be operated in accordance with manufacturer's specification, operations manual, and generally accepted surveying practices.

Surveying equipment will be field-verified each day before beginning surveying by establishing the coordinates of a known location (ie, temporary benchmark) using the GPS unit. The benchmark identification (or description) and measured coordinates will be recorded in the survey logbook.

5.3.1 Survey Points

GPS equipment will be used to record the grid corner and center-point coordinates, that will be marked for future reference during the investigation. GPS will be used to record other pertinent site feature data, for example the location of MEC or MD and anthropogenic material, if encountered. Prior to collecting the center-point sampling location coordinates, each location will be marked with a survey flag. The sample location ID will be recorded on each survey flag.

Sample locations will be measured from the center of the grid cell or grab location. For each GPS location recorded an identifier and the coordinates will be stored in the data logger.

If the coordinates at a survey location cannot be determined due to the presence of tree cover or other obstacles which prohibit adequate signal reception, coordinates will be obtained at a minimum of two alternate locations (offsets) close to the original survey location. The distance and bearing from each of the alternate locations to the original survey location will then be determined using a measuring tape and compass.

5.3.2 Coordinate Systems

It is assumed all GPS measurements will be recorded using the projected Universal Transverse Mercator (UTM) coordinate system and the World Geodetic System 1984 (WGS84) datum. The grid will be referenced to known National Geodetic Survey (NGS) benchmarks, if possible.

5.3.3 Required Accuracy

At a minimum, surveyed location coordinates will be determined to an accuracy of ±0.5 foot. Vertical elevations measured by GPS are suspect due to limited system accuracy. Accuracy will be assessed using the FGDC Geospatial Positioning Accuracy Standards. Data may be post-processed to increase accuracy, if required.

5.4 DOCUMENTATION

The field team is responsible for documenting all survey measurements. A complete and accurate record correlating the sample IDs to the instrument assigned stations IDs will be kept in the field logbook. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets as applicable. Upon completion of each day's fieldwork, the electronic record will be downloaded from the instrument, correlated with the sample IDs, and uploaded into the project database.

6.0 SOP NO. 6 - PERMITS AND CLEARANCES

6.1 PURPOSE AND SCOPE

This document defines the SOP for obtaining all permits and clearances required for work at Holloman AFB. Permits and clearances are required for entrance onto the Base to complete fieldwork, for Base security, and to locate underground utilities for intrusive fieldwork. Additional permits may be required to access restricted areas. All required permits and clearances will be verified with Holloman AFB personnel. The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling

6.2 CONTRACTOR BADGES, VEHICLE PASSES, AND CAMERA PASS

6.2.1 Contractor Badges

A daily pass must be obtained from the visitor's center at the gate. The Holloman AFB Remedial Project Manager will be notified in advance of the list of contractor and subcontractor employees that will be entering the Base prior to arriving at the gate. Security personnel will issue daily passes to contractor and subcontractor employees. These passes are per vehicle and are issued for those employees riding in that vehicle. Once the pass is issued, the personnel listed on a single pass must stay together. All personnel entering the Base must present a valid driver's license to Base security once arriving on base. Vehicle registration and proof of insurance are required to obtain a Base pass. Contractor's passes are the property of the United States (U.S.) Air Force and will be returned to the Base Security Office when no longer needed. The pass will be kept with the contractor at all times while on Base property.

6.2.2 Vehicle Passes

All vehicles that enter the Base must be registered at the Base Security Office, and obtain and display a contractor pass\vehicle permit tag from Base Security. The registrant will furnish the vehicle registration, proof of insurance, rental agreement (if applicable), and valid driver's license. Vehicle passes serve as contractor badges and are issued on a daily basis only. Vehicle/contractor passes must be displayed (taped) on the lower corner of the windshield on the driver's side of the vehicle.

6.2.3 Photography

A camera pass is not required for taking any photographs on Base. However, contractors and subcontractors are not to photograph aircraft or other potentially sensitive items. Photography

will be limited to the site and site features, documentation of field activities, and field personnel. **At no time will personnel take pictures of the aircraft or maintenance bays.**

6.3 UTILITY CLEARANCES

Digging permits will be obtained for all machine-driven intrusive activities prior to initiating the work, in accordance with Part VII of Chapter 8 of Revised Statute Title 40. Digging permits are obtained by:

The planned drilling or digging areas at each site will be marked with white paint, tape or flagging. White is the only color allowed for marking excavations and borings.

A call will be placed to the statewide utility hotline New Mexico One Call at (800) 321-2537. The street address and the nearest street intersection along with a call-back telephone number will be provided. In addition, New Mexico One Call may request a faxed copy of a site map if multiple drilling locations require utility locates. Notice shall be given and will include a specific location request for excavation or demolition work to be performed at least forty-eight hours, but not more than one hundred twenty hours, excluding weekends and holidays, in advance of actual work commencement.

A utility locate request requires the name, address, and telephone number of the person filing the notice of intent, and, if different, the person responsible for the excavation or demolition, the starting date, anticipated duration, and description of the specific type of excavation or demolition operation to be conducted, the specific location of the proposed excavation or demolition and a statement as to whether directional boring or explosives are to be used. If the excavation or demolition is part of a larger project, the notice shall be confined to the actual area of proposed excavation or demolition that will occur during the ten-day time period under RS40:1749.14(C).

A Base Civil Engineering Work Clearance Request (AF Form 103) will be completed for each planned drilling or digging area and it will be provided to the Base Restoration Project Manager for signature and processing.

Await a return of the completed AF Form 103 to the Base Restoration Project Manager. A site meeting may be required in order to clarify the locations for intrusive work.

Permits are valid for a period of 10 days once approval has been given. If the work at the site is not initiated or completed within the 10 day period, the clearance process must be repeated starting with step number 1 above.

6.4 NOTICE TO AIRMEN (NOTAM)

NOTAMs for drilling, well installation, well sampling or other work activities on or near the Holloman AFB Flightline (i.e., parking ramp, between runways, revetments, etc.) will be

coordinated through FPM who will submit the NOTAMs to Base Operations for publishing. It is not anticipated that contractors will be required to work on or near the flightline.

6.5 FLIGHTLINE DRIVING PERMIT

Currently, access to the flightline requires escort to be provided by the Holloman AFB Restoration Project Manager. It is not anticipated that contractors will need flightline driver passes or badges.

6.6 HOT WORK PERMIT

A hot work permit is required for all work utilizing an open flame, including but not limited to, welding, cutting torch use, and kerosene-fired steam cleaners. A hot work permit must be obtained from the Holloman AFB Fire Department prior to the initiation of permit required activities. The Fire Department non-emergency phone number to call to obtain a hot work permit is **(575)-572-7228**.

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7.0 SOP NO. 7 - EQUIPMENT CALIBRATION

7.1 PURPOSE AND SCOPE

This SOP describes the procedures for equipment calibration and documentation. This SOP is intended to be used with the UFP-QAPP and with other SOPs listed below:

- SOP No. 2 – Subsurface Soil Sampling

7.2 EQUIPMENT AND MATERIALS LIST

The following section provides a list of equipment that may be needed to perform equipment calibration.

Horiba U-22 and Horiba U-52:

- Horiba U-22
- Horiba U-52
- Auto calibration solution pH 4
- Calibration cup
- Calibration log for Horibas

YSI 556

- YSI 556
- Calibration cup
- Calibration log for YSI
- DI water
- Conductivity solution (1.413 µS/cm)
- pH 4 solution
- pH 7 solution
- ORP solution (240 mV)
- PID, miniRAE
- Tedlar bag
- Isobutylene (100 ppm)
- Calibration log for PID

7.3 EQUIPMENT CALIBRATION PROCEDURES

The following provides the procedures for the calibration of the Horiba U-22 and U-52, YSI 556, and PID miniRAE.

Horiba U-22:

- Turn on Horiba.
- Place probe in auto calibration solution (pH 4.00).
- Press Cal button.
- Press Ent button, calibration begins.
- END appears when calibration is complete.
- Press MEAS button and collect pH reading.
- The acceptable pH range is 3.96 to 4.04.
- If any errors appear, refer to Horiba U-22 manual.

Horiba U-52:

- Turn on Horiba.
- Place probe in auto calibration solution (pH 4.00).
- Press Cal button.
- Press Ent button, calibration begins when the parameters on screen start to blink.
- When parameters stop blinking, calibration is complete.
- Collect pH reading.
- The acceptable pH range is 3.96 to 4.04.
- If any errors appear, refer to Horiba U-52 manual.

YSI 556:

- Turn on YSI 556.
- Press ESC which will lead to main menu.
- Scroll to Calibrate and press ENT.
- Scroll to DO, press enter, scroll to DO%
- Enter barometric pressure.
- Place probe in DI water (in calibration cup) and loosely tighten probe to calibration cup.
- Press enter, and then enter again.
- DO% is instantly calibrated.
- Acceptable range is 95% to 105%.
- Press ESC to return to calibration menu.
- Scroll to Conductivity, press enter, scroll to Conductivity in list and press enter
- Enter standard, 1.413 µs/cm.
- Fill calibration cup with conductivity solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- Conductivity is instantly calibrated.
- Acceptable range is 1.408 to 1.418 µs/cm.
- Press ESC to return to calibration menu.
- Scroll to pH, press enter, scroll to 2-point calibration and press enter

- Enter 1st standard, 4.00.
- Fill calibration cup with pH 4.00 solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- pH is instantly calibrated.
- Acceptable range is 3.95 to 4.05.
- Press enter.
- Enter 2nd standard, 7.00.
- Fill calibration cup with pH 7.00 solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- pH is instantly calibrated.
- Acceptable range is 6.95 to 7.05.
- Press ESC to return to calibration menu.
- Scroll to ORP, press enter
- Enter standard, 240 mV.
- Fill calibration cup with ORP solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- Conductivity is instantly calibrated.
- Acceptable range is 235 to 245 mV.
- If any errors appear, refer to YSI 556 manual.

PID miniRAE:

Zero Calibration

- Turn on PID to Zero Calibration menu.
- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.
- Zero calibration starts.
- When Zero calibration is complete, you see this message: Zeroing is done!, Reading = 0.000 ppm.

Span Calibration

- Turn on PID to Scan Calibration menu.
- The span gas is first be filled into a Tedlar bag.
- Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.
- Press [Y/+] to enter Span calibration.
- Turn on your span calibration gas.
- Press [Y/+] to initiate calibration.

- Span calibration starts and displays this message: Calibrating...
- When Span calibration is complete, you see this message: Span 1 is done!, Reading = 100.0 ppm.

Per the Mini RAE manual, there is no set range of what is allowed above or below 100 ppm. The Manual simply states that the "reading should be very close to the span gas value".

7.4 DOCUMENTATION:

Documentation for equipment calibration forms which are included in the DQCRs. The calibration forms include:

- Equipment model and number
- Date
- Calibration personnel
- Standard calibration values
- Scan gas concentration for PID calibration
- Standard calibration solution parameters for water quality

8.0 SOP NO. 8 - INVESTIGATION-DERIVED WASTE

8.1 PURPOSE AND SCOPE

This document defines the SOP for the handling and disposal of investigation-derived waste (IDW) at Holloman AFB. IDW will include soil cuttings, decontamination fluids, well purge water, and personal protective equipment (PPE). These procedures are intended to be used with the WP or WP addenda as well as the applicable SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Soil Sampling
- SOP No. 4 - Equipment and Personnel Decontamination
- SOP No. 7 – Equipment Calibration

8.2 EQUIPMENT LIST

The following equipment is required for handling IDW:

- Department of Transportation (DOT)-approved 55-gallon drums
- Photoionization Detector (PID) (10.2 eV lamp considered appropriate for most applications)
- Sampling equipment and sample containers [for Toxicity Characteristic Leaching Procedure (TCLP) sampling, if applicable]

8.3 FIELD PROCEDURES

8.3.1 IDW Handling

Soil cuttings from different borings at the same site will be combined in the same drum, but soil from different sites will be kept separate. If headspace results or visual or olfactory observations indicate potentially highly contaminated materials, cuttings from individual soil borings will be containerized separately from cuttings from other borings at the same site.

Fluids from heavy equipment and small tool equipment decontamination will be containerized for characterization. No fluids will be discharged directly into waterways or drainages leaving the site. All IDW determined to be characteristically hazardous will be disposed off-site using a licensed waste disposal firm.

PPE used during investigation activities (including nitrile gloves, paper towels, etc.) is expected to have minimal contamination, and will not be required to be containerized. All PPE will be treated as solid waste and will be placed in plastic trash bags and disposed of on site at a trash receptacle or dumpster identified by Holloman AFB personnel. Well materials from abandoned wells will be pulled from the ground, scraped clean, and disposed of as solid waste on Base.

Disposable sampling equipment, such as bailers, PE tubing, Terra Core soil samplers, etc., will also be discarded as solid waste.

8.3.2 Waste Storage

All IDW required to be containerized will be stored in 55-gallon drums. The drums will be marked with the following information:

- Installation identification (i.e., Holloman AFB)
- Site name and number
- Type of IDW (i.e., soil cuttings, purge water, decontamination fluids)
- Boring number(s) or sampling location number (s)
- Date(s) of accumulation
- Name and phone number of Holloman AFB contact (to be provided by Holloman AFB Restoration Project Manager at start of field activities)

All containerized IDW will be stored on site at a designated storage area identified by Holloman AFB personnel until the need for off-site disposal has been made, as described in the following subsection.

All water containerized as IDW will be stored in 55-gallon drums and will be transported to the central staging area for off-site disposal by a licensed waste disposal firm.

8.3.3 Determination of Disposal

All IDW that is determined to not be disposable on-Base will be properly disposed of at a licensed off-Base facility. The analytical results from the field sampling activities will be used to indicate the contamination levels of IDW from each site to determine an appropriate disposal facility. If analytical results indicate none or minimal contamination, IDW will disposed of off-site or at a location on base identified by the Holloman Restoration Project Manager.

If results indicate that IDW from a given site may be characteristically hazardous, a sample of containerized IDW will be collected and analyzed for the appropriate waste characteristic using the TCLP. Analytical test results will be compared to TCLP threshold criteria to determine if the material is characteristically hazardous. Characteristically hazardous IDW will be properly manifested and shipped to a licensed off-Base Subtitle C disposal facility. **A representative of Holloman AFB will sign all manifests for IDW shipped off site.**

9.0 SOP NO. 9 - GROUNDWATER SAMPLING

9.1 PURPOSE AND SCOPE

This section defines the SOP for the collection of groundwater samples. This procedure describes equipment, field procedures, and QA/QC procedures necessary to collect groundwater samples. The sample locations and frequency of collection are specified in the project UFP QAPP.

This SOP is intended to be used together with the UFP QAPP and other appropriate SOPs. Health and safety procedures and equipment that will be required during the investigation are detailed in the HASP. Applicable SOPs are listed below:

- SOP No. 3, Sample Handling, Documentation, and Tracking
- SOP No. 4, Decontamination

9.2 EQUIPMENT AND MATERIALS LIST

The following equipment will be used during well purging and sampling:

Bailer Sampling:
- Well lock keys (if required)
- Water level probe with 0.01-foot intervals
- Assorted tools (knife, screwdriver, etc.)
- Disposable bailers
- Nylon rope
- Multi-parameter water quality meter (Horiba U-52, YSI 556, or similar)
- Calibration fluids
- Plastic squeeze or spray bottle filled with de-ionized water
- Plastic or glass container (for field parameter measurements)
- Paper towels
- Calculator
- Field logbook
- Waterproof and permanent marker
- Appropriate containers for holding purged water
- Appropriate health and safety equipment, as specified in the HASP
- Well purging and sampling form for bailer sampling
- Appropriate decontamination supplies, as specified in **SOP No. 4.**
- Cooler with ice
- Garbage bag
- Sample labels
- Sample bottles with preservatives added will be obtained from the analytical laboratory
- Several extra sample bottles in case of breakage or other problems

Low Flow Sampling:

- Well lock keys (if required)
- Water level probe with 0.01-foot intervals
- Assorted tools (knife, screwdriver, etc.)
- Peristaltic Pump
- Marine battery
- Multi-parameter water quality meter (Horiba U-52, YSI 556, or similar)
- polyethylene tubing (assorted diameters); Teflon-lined tubing for sample withdrawal is preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs, and inorganics. PVE, polypropylene, or polyethylene tubing may be used when collecting samples for metals and other inorganic analyses.
- Flow-through cell
- Plastic, see-through measuring cup (2 cups size)
- Calibration fluids
- Plastic squeeze or spray bottle filled with de-ionized water
- PE or glass container (for field parameter measurements)
- Paper towels
- Garbage bags
- Calculator
- Field logbook
- Waterproof and permanent marker
- Appropriate containers for holding purge water
- Appropriate health and safety equipment, as specified in the HASP
- Well purging and sampling form for low-flow sampling
- Appropriate decontamination equipment, as specified in the **SOP No. 4**
- Cooler with ice
- Sample labels
- Sample bottles with preservatives added will be obtained from the analytical laboratory
- Several extra sample bottles in case of breakage or other problems

9.3 IDENTIFYING THE GROUNDWATER SAMPLING LOCATIONS

The groundwater sampling locations will be identified in the site-specific work plan. All existing monitoring wells have been surveyed by a certified surveyor and are included on maps and figures. All additional monitoring wells and temporary well locations will be surveyed after well completion and development.

9.4 GROUNDWATER SAMPLING PROCEDURES

This section summarizes the step-by-step procedures for collecting groundwater samples in the field. Groundwater purging and sampling will be conducted in accordance with the USEPA Region 4 Science and Ecosystem Support Division (SESD) Operating Procedure for

Groundwater Sampling (USEPA, 2013) and the USEPA Region 1 *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (USEPA Region I, 2010). Observations made during sample collection will be recorded in the field notebook and on the well purging and sampling form.

The purpose of well purging is to remove stagnant water from the well and obtain representative water from the geologic formation while minimizing disturbance to the collected samples. Before a sample is collected, the well will be purged as described in the subsections below. Evacuated groundwater shall be containerized for proper disposal, and necessary precautions shall be taken to prevent spilling of water. The following **Sections 9.5.1** and **9.5.2** describe sample collection using the bailer and low flow collection methods.

9.4.1 Bailer

Before well purging begins, the following set up procedures will be performed at each well:

- The condition of the outer well casing, concrete well pad, and any unusual conditions of the area around the well will be noted in the field logbook.
- The well will be opened.
- The condition of the inner well cap and casing will be noted.
- Newly-constructed wells will be checked for the presence of LNAPL or DNAPL before the initial sampling round, if site conditions and history warrant.
- The depth of static water level and total well depth will be measured (to nearest 0.01 foot) and recorded from a measuring point on the well casing. The measuring point should be identified, and time recorded in the field logbook.
- The volume of water in the well casing will be calculated in gallons based on water column height and casing diameter. Three casing volumes will be calculated.

The well will be purged prior to sampling according to the following procedure:

- Temperature, pH, conductivity, dissolved oxygen (DO), oxygen reduction potential (ORP), and turbidity measurements will be recorded initially and during purging, at a minimum of one set of readings per well casing volume purged.
- The purge will be considered adequate when three to five well volumes have been removed and the parameters have stabilized. Stabilization will have occurred when the following conditions have been met for three consecutive readings (USEPA Region 4, 2013):

    - pH remains constant within 0.1 pH unit.
    - Specific conductance varies no more than 5%.
    - Turbidity has stabilized or turbidity readings are below 10 nephelometric turbidity units (NTU)
    - Dissolved oxygen (DO) may also be used as a purge adequacy parameter. Normal goals for DO are 0.2 mg/L or 10% saturation, whichever is greater.

- If the parameters have not stabilized after three well volumes have been removed, additional well volumes will be removed up to five well volumes. If the parameters have not stabilized after five well volumes have been removed, it is up to the discretion of the project leader whether or not to collect a sample or to continue purging. If, after five well volumes, pH and conductivity have stabilized and the turbidity is still decreasing and approaching an acceptable level, additional purging should be considered to obtain the best sample possible, with respect to turbidity.
- If the well is purged dry, this generally constitutes an adequate purge and the well can be sampled following sufficient recovery (enough volume to allow filling all of the sample containers).

For wells with slow recovery, attempts should be made to avoid purging them to dryness. This can be accomplished, for example, by slowing the purge rate. As water enters a well that has been purged to dryness, it may cascade down the sand pack and/or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the column.

Wells will be sampled as soon as possible after purging. If adequate volume is available immediately upon completion of purging, the well will be sampled immediately. If not, sampling will occur as soon as adequate volume has recovered. The following sampling procedure will be followed when using disposable bailers:

- Typically, new disposable equipment (PE bailer and nylon rope) are used for each sampling location. Decontaminated sampling equipment will be assembled if necessary.
- All sample bottles for all analyses will be gathered and identification labels for each sample bottle will be completed for each sample and affixed to the bottles.
- The bailer will be lowered **slowly** and **gently** into contact with the water in the well. The well will be checked for light and dense NAPL. After checking for the presence of NAPL, the bailer will be lowered to the same depth in the well each time.
- The bailer will be retrieved **smoothly** and the water will be **slowly** drained into the sample containers through the bailer's bottom discharge control device.
- The individual sample bottles should be filled in the order given below:
  1. VOCs
  2. SVOCs
  3. Metals
  4. Other remaining analytes (no specific order)
- VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space remains in the vial. Turn the vial over and tap it to check for bubbles in the vial, which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.
- Fill bottles for SVOCs, metals and other analytes until almost full.
- Time of sampling will be recorded.
- The bailer and string will be removed from the well and placed in garbage bags for proper disposal as household waste.

- The well cap will be replaced and locked.
- Field documentation will be completed, including the COC.

9.4.2 Low Flow

According to USEPA Region 1 *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (USEPA Region I, 2010), the goal of low-flow sampling is to collect water samples that reflect transport through the subsurface under ambient flow conditions, with minimal physical and chemical alteration from sampling operations. There is a need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns and by using low pumping rates during purging and sampling operations. The procedures in this section are in accordance with that guidance.

Before well purging begins, the following set up procedures will be performed at each well:

- The condition of the outer well casing, concrete well pad, and any unusual conditions of the area around the well will be noted in the field logbook.
- The well will be opened.
- The condition of the inner well cap, casing and associated tubing will be noted.
- Newly-constructed wells will be checked for the presence of LNAPL or DNAPL before the initial sampling round, if site conditions and history warrant.
- The depth of static water level will be measured (to nearest 0.01 foot) and recorded from a measuring point on the well casing. The measuring point should be identified, and time recorded in the field logbook.
- The low flow equipment will be set up at the well. The set-up includes:
  - The pump will be connected to the marine battery.
  - Teflon-lined polyethylene tubing will be run from the pump into the well, to form the pump intake. The pump intake will be located within the screened interval and at a depth that will remain underwater at all times. The pump intake will be at the same depth as used for previous sampling events, or at the midpoint or lowest historical mid-point of the saturated screen interval.
  - A multi-parameter water quality meter with flow-through cell will be connected with new disposable polyethylene tubing to the dedicated peristaltic or bladder pump and associated tubing. Samples for turbidity measurements will be obtained before water enters the flow-through cell.
  - If groundwater samples are to be analyzed for VOCs, the sampler will shade the equipment from sunlight using an umbrella or tent, in order to prevent groundwater in the tubing from heating up and losing VOCs.
- The water purge rate will be set within the range of 100 to 500 mL per minute.

The well will be purged prior to sampling according to the following procedure:

- Temperature, pH, conductivity, dissolved oxygen (DO), oxygen reduction potential (ORP), and turbidity measurements will be recorded initially and during purging. Measurements

will be recorded at a rate of one set of readings per flow-through cell volume purged, no more frequently than once every five minutes.

- During purging, depth to water will be measured continuously. Drawdown of less than 0.3 feet is considered ideal, but not mandatory.
- The pump will be started at low speed, and the speed will be slowly increased until discharge occurs. The pump speed will be adjusted until there is little or no water level drawdown. The time and discharge rate of any pumping rate adjustments will be recorded. If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, purging will continue.
- Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder pumps or peristaltic pumps). If the recovery rate to the well is less than 50 mL/minute, or the well is being essentially dewatered during purging, the well will be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. Samples in this specific situation may be collected without stabilization of indicator field parameters. If this type of problematic situation persists in a well, then water sample collection may be changed to a passive or no-purge method, if consistent with the site's data quality objectives, or a new well will be installed.
- Stabilization of field parameters will be used to indicate when conditions are suitable for sampling to begin. The final purge volume must be greater than the stabilized drawdown volume plus the pump's tubing volume. Parameters will be considered to have stabilized when the following conditions have been met for three consecutive readings:

  - pH remains constant within ±0.1 pH unit.
  - Specific conductance varies no more than 3%.
  - Turbidity has stabilized within 10% for values greater than 5 NTU, or three readings below 5 NTU.
  - DO has stabilized within 10% for values greater than 0.5 mg/L, or three readings below 0.5 mg/L.
  - ORP remains constant within ±10 millivolts (mV).

- If after two hours of purging, field parameters have not stabilized, one of three optional courses of action may be taken:

  1. Continue purging until stabilization is achieved;
  2. Discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization);
  3. Discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note that there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may reflect a sampling bias and therefore the data may not meet the data quality objectives of the sampling event.)

Wells will be sampled as soon as possible after purging. If adequate volume is available immediately upon completion of purging, the well will be sampled immediately. If not,

sampling will occur as soon as adequate volume has recovered. The following sampling procedure will be used when using the low-flow method:

- All sample bottles for all analyses for the sampling locations are organized and identification labels for all sample bottles will be completed.
- The discharge polyethylene tubing will be unhooked from the flow-through cell.
- Groundwater samples will be collected with water purge rates at or below 250 mL/min.
- The individual sample bottles should be filled in the order given below:
  i. VOCs
  ii. SVOCs
  iii. Metals
  iv. Other remaining analytes (no specific order)
- VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space remains in the vial. Turn the vial over and tap it to check for bubbles in the vial, which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.
- Bottles for SVOCs, metals and other analytes will be filled until almost full.
- Time of sampling will be recorded.
- The sampling equipment will be turned off and disconnected from the well.
- The well cap will be replaced and locked.
- Field documentation will be completed, including the COC.

9.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

The well sampling order will be dependent on expected levels of contamination in each well, if known, and will be determined prior to sampling. Typically, the sampling order of the monitoring wells is from the least contaminated well to the most contaminated well. QA/QC samples will be collected during groundwater sampling.

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory in the same batch as the normal samples for analyses.

9.5.1 Field Blanks

Field blanks are QC samples that check for potential external contamination of samples and will consist of trip, ambient, and equipment blanks. The sample collection coordinator or the project QA/QC coordinator will designate these blanks. The blanks will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples.

A trip blank serves as a check on sample contamination originating from the container or sample transport. A trip blank consists of a VOA vial which was filled with VOA-free water at the lab,

transported to the site, kept in the same cooler as the normal samples throughout the entire sampling day, and shipped back to the laboratory with the normal samples. One trip blank will be sent with each cooler containing water samples for volatile organic analyses.

The ambient blank serves as a check on sample contamination originating from ambient air during VOCs sample collection. An ambient blank consists of an empty VOA vial which is filled in the field with VOA free water. While pouring the sample, the water is given ample contact with ambient air conditions. The ambient blank is typically collected at the sampling location that potentially exhibits the largest ambient influence (near a busy road, airfield, etc.).

The equipment blank serves as a check on sample contamination originating from sampling equipment reuse during sample collection. The equipment blank consists of a set of sample bottles identical to the normal sample, which is filled with lab-grade water that is flushed over a decontaminated, reusable piece of equipment.

9.5.2 Duplicate Samples

Duplicate samples are samples collected to assess the precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. All sampling containers will be filled in the following order: volatile or gaseous analyses first, then SVOCs, including PAHs; metals; mercury; cyanide; total organic carbon; anions; other remaining analytes (no specific order). The initial sample containers will be filled first, and then the duplicate sample containers for the same parameter(s) and so on until all necessary sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

9.5.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) analyses are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the COC form and on the containers. It may be necessary to increase the sample volume for MS/MSD samples. If additional volume is necessary, the additional sample container will be filled in the identical fashion as described above in the duplicate sample section. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

9.6 FIELD DOCUMENTATION

Field documentation for groundwater sampling includes field logbooks and field forms. The most important aspect of field documentation is thorough, organized, and accurate record keeping. Two forms are used in the field during groundwater sampling. These forms include the Bailer Sampling Form and the Low-Flow Sampling Form. Each form is described in **Section 9.7.2**. An important factor of record keeping is the proper preservation and storage of all field

documentation. To preserve the field documentation, the field notes and field forms are scanned and the electronic record of the field notes is stored in the project folder and backed up on additional hard drives to prevent data loss. The field forms will also be provided in the Daily Chemical Quality Control Reports (CQCR).

9.6.1 Field Logbook

All information pertinent to groundwater sampling and not documented on the field forms will be recorded in a bound field logbook with consecutively numbered pages. The field logbook notes will be recorded in indelible ink. The field logbooks notes are entered to create an accurate record of the work performed so that the sampling activity can be reconstructed without relying on the memory of field personnel. Information documented in the field logbook may include information on date of notes, weather conditions, field personnel, site, mobilization, work performed including location and time, etc. After each day, field notes are reviewed by the field team leader or site responsible person for accuracy. Refer to **SOP No. 3** for detailed procedures regarding documentation in the field logbook.

9.6.2 Field Forms

<u>Bailer Sampling Form</u>

The Bailer Sampling Form contains the following minimum information:

- Project name and number
- Sampling personnel
- Site Identifier
- Date of sample
- Well number
- Well Diameter
- Weather conditions
- Depth to water and total depth of well
- Purge volume calculations
- Purge date
- Purge method
- Water characteristics and appearance
- Water parameter measurement results (pH, conductivity, temperature, turbidity, DO, and ORP)
- Sample ID
- Sample time
- Any QA/QC Samples

<u>Low-Flow Sampling Form</u>

The Low-Flow Sampling Form contains the following minimum information:

- Project name and number
- Sampling personnel
- Site Identifier
- Date of sample
- Well number
- Well Diameter
- Weather conditions
- Depth to water and total depth of well
- Pump intake depth
- Depth of water during purging
- Purge date
- Purge method
- Water characteristics and appearance
- Water parameter measurement results (pH, conductivity, temperature, turbidity, DO, and ORP)
- Purge rate
- Sample ID
- Sample time
- Any QA/QC Samples

Attachment 1 Field Forms

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SOIL / SEDIMENT SAMPLING FORM

Project: _____ Sampled by: _____

Site and Site Code (**SITEID**): _____

Sampling Location ID. (**LOCID**): _____

Date (**LOGDATE**): _____ Time: _____

FIELD OBSERVATIONS:

Sample Depth or Interval	Material Description/ Color

Comments/Observations:

_____

_____

_____

_____

Sample Time: _____ Sample ID: _____

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Equipment Calibration Log

Instrument Name: _____

Model Number: _____

Date	First Standard Concentration	First Standard Reading	Second Standard Concentration	Second Standard Reading	Comments

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WASTE INVENTORY TRACKING FORM

LOCATION : _____

PROJECT NAME:_____

ACTIVITIES: _____

Date Waste Generated	Activity Generating Waste (borehole # / well #)	Description of Waste	Field Evidence of Contamination	Estimated Volume	Type of Container (storage ID#)	Location of Container	Waste Characterization	Comments

Note: Describe whether soil or water samples have been collected for waste characterization, include date, if known.

Signature: _____

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WELL PURGING & SAMPLING FORM

Project: _____ Sampled by: _____

Location and Site Code (**SITEID**): _____

Well No. (**LOCID**): _____ Well Diameter (**SDIAM**): _____

Date (**LOGDATE**): _____ Weather: _____

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION:

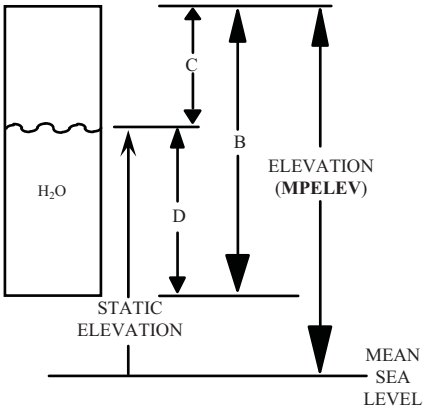
Measured Well Depth (B) (**TOTDEPTH**) _____ft.

Measured Water Level Depth (C) (**STATDEP**)_____ft.

Length of Static Water Column (D) = _____ - _____ = _____ ft.
(B) (C) (D)

Casing Water Volume (E) = _____ x _____ = _____ gal
(A) (D)

Minimum Purge Volume = _____ gal (3 well volumes)



Purge Date and Method: _____

Physical Appearance/Comments: _____

FIELD MEASUREMENTS:

Allowable Range: ± 0.1 ± 5% ±1°C

Time	Volume Removed (gal)	pH	EC (mS/cm)	Temp. (F or C)	Turbidity (NTU)	D.O. (mg/L)	ORP (mV)

Sample Time: _____ Sample ID: _____

Note: Attempt to get at least 5 sets of field measurements during purging. Sample may be collected after 3 to 5 well volumes have been removed and parameters have stabilized. Sample may be collected after 6 well volumes if parameters do not stabilize. VOC and gas sensitive (e.g. alkalinity, Fe^{2+}, CH_4, H_2S) parameters should be sampled first.

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WELL PURGING & SAMPLING FORM
(LOW FLOW)

Project: _____ Sampled by: _____

Location and Site Code (**SITEID**): _____

Well No. (**LOCID**): _____ Well Diameter (**SDIAM**): _____

Date (**LOGDATE**): _____ Weather: _____

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION:

Measured Well Depth (B) (**TOTDEPTH**) _____ft. (optional)

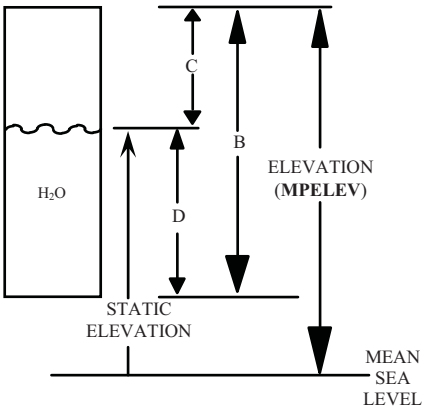
Measured Water Level Depth (C) (**STATDEP**) _____ft.

Length of Static Water Column (D) = _____ - _____ = _____ ft. (optional)
(B) (C) (D)

Pump Intake Depth (ft): _____

Depth during Purging/Sampling: _____ft
(provide range)

Comments (re: Depth during purging/sampling): _____



Purge Date and Method: _____

Physical Appearance/Comments: _____

Dissolved Ferrous Iron (mg/L): _____

FIELD MEASUREMENTS:

Allowable Range:		± 0.1	± 3%		± 10%	± 10%	± 10mV	
Time	Depth to Water (ft BTOC)	pH	EC (mS/cm)	Temp. (F or C)	Turbidity (NTU)	D.O. (mg/L)	ORP (mV)	Flow Rate (mL/min)

Sample Time: _____ Sample ID: _____

Note: Maintain a flow rate of 200-500 mL/min during purging. Collect samples at a flow rate between 100-250 mL/min. VOC and gas sensitive (e.g. alkalinity, Fe^{2+}, CH_4, H_2S) parameters should be sampled first.

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Appendix B
Health and Safety Plan

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The Health and Safety Plan is on a parallel review track and is awaiting AFCEC approval.

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Appendix C
Points of Contact

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POINTS OF CONTACT

MMRP REMEDIAL INVESTIGATION
XU853 MISSILE TEST STAND AREA MRS and
XU854 ABLE 51 AREA MRS
HOLLOMAN AIR FORCE BASE
Contract Number FA8903-13-C-0008

Name	Role	Email Address	Organization	Phone Number
Naomi Alvarado	CO	Naomi.alvarado@us.af.mil	772 ESS/PKB	210-395-8151
Rita Leal	Contract Specialist	Rita.Leal@us.af.mil	772 ESS/PKB	210-395-8228
DeAnna Rothhaupt	RPM	Deanna.rothhaupt@us.af.mil	49 CES/CEA	575-572-3931
Brian Renaghan	COR	brian.renaghan@us.af.mil	AFCEC/CZRX	210-395-8581
Layi Oyelowo	Alt COR	Layi.oyelowo@us.af.mil	AFCEC/CZRX	210-395-8567
H. Don Ficklen	AFCEC/CZRW – Program Manager - Restoration Program Office	holmes.ficklen@us.af.mil	AFCEC/CZRX	210-395-8577
Laquita Joy Lozano	AFCEC Contractor Support	laquita.lozano.ctr@us.af.mil	AFCEC/CZR	210-395-8573
David Rizzuto	Holloman AFB Contractor Support	David.rizzuto@holloman.af.mil	USAF	575-572-5395
DJ Davis	Holloman AFB Contractor Support	Darrell.Davis@holloman.af.mil	USAF	575-572-3931
John Kieling, Chief	NMED Project Manager	John.kieling@state.nm.us	NMED	505-827-1603
Chuck Hendrickson	USEPA Region 6 Project Manager		USEPA	214-665-2196
Gaby Atik	FPM Program Manager	g.atik@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x202
Maureen Whalen	FPM Project Manager	m.whalen@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x216
Daniel Baldyga	FPM Deputy Project Manager	d.baldyga@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x207
Kamalesh Pinisetti	URS Program Manager	Kamalesh.pinisetti@urs.com	URS Corporation	602-317-5204
Jeff Hackworth	FPM MMRP Manager	j.hackworth@fpm-remediations.com	FPM Remediations, Inc	210-495-7744
Ivana Raicevic	FPM MMRP Installation Manager	i.raicevic@fpm-remediations.com	FPM Remediations, Inc	210-495-7744
Russell Shattles	FPM UXO Services Manager	r.shattles@fpm-remediations.com	FPM Remediations, Inc	678-920-8315
Katrina Mattice	FPM ERPIMS	k.mattice@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x212
Connie Van Hoesel	FPM Program Chemist	c.vanhoesel@fpm-remediations.com	FPM Remediations, Inc	315-336-7721 x250
Jean Dent-Smith	Accutest Laboratories Project Manager	jeans@accutest.com	Accutest Laboratories	407-425-6700

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Appendix D
Uniform Federal Policy-Quality Assurance Project Plan

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FINAL

UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN

for

XU853 MISSILE TEST STAND AREA MRS and XU854 ABLE 51 AREA MRS

HOLLOMAN AIR FORCE BASE
NEW MEXICO
Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Ave., Suite 163
Joint Base San Antonio Lackland, Texas 78236-9853

October 2014

Prepared by:

FPM Remediations, Inc.
584 Phoenix Drive
Rome, NY 13441

URS Group, Inc.
7720 N 16th Street, Suite 100
Phoenix, AZ 85020-4493

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LIST OF ABBREVIATIONS AND ACRONYMS

°C	degrees Celsius
%	percent
%D	% Difference/Drift
%R	% Recovery
µg/kg	microgram per kilogram
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
CAS	Chemical Abstracts Service
CCV	Continuing Calibration Verification
CO	Contracting Officer
CoC	Chain of Custody
COR	Contracting Officer Representative
CSE	Comprehensive Site Evaluation
CSM	Conceptual Site Model
CZRX	Environmental Center of Excellence Restoration - Execution
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DL	Detection Limit
DoD	Department of Defense
DQI	Data Quality Indicator
DQO	Data Quality Objective
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
FPM	FPM Remediations, Inc.
g	gram(s)
GAPA	Ground-to-Air Pilotless Aircraft
GPS	Global Positioning System
H&S	Health and Safety
HDR	HDR Environmental, Operations and Construction, Inc.
HH	Human Health
HSTT	High Speed Test Track
IAW	in accordance with
ICAL	Initial Calibration
ICP	Inductively Coupled Plasma
ICS	Interference Check Solutions
ICV	Initial calibration Verification
IS	incremental sampling
LCS	Laboratory Control Sample
LOD	Limit of Detection
LOQ	Limit of Quantitation
MB	Method Blank
MC	munitions constituents
MD	munitions debris
MDEH	Material Documented as an Explosive Hazard
MDL	Method Detection Limit

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

MEC	Munitions and Explosives of Concern
mg/kg	milligram per kilogram
mg/L	milligrams per liter
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
MS	Matrix Spike
MSD	Matrix spike duplicate
MTSA	Missile Test Stand Area
N/A	Not Applicable
NA	Not Available
NATIV	North American Test Instrument Vehicle
NFA	No Further Action
NMED	New Mexico Environmental Department
No.	number
oz	ounce
PBR	Performance Based Remediation
PDS	post-digestion spike
PE	Performance Evaluation
PID	Photoionization Detector
PM	Project Manager
POC	point of contact
ppm	parts per million
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
R	Correlation Coefficient
RCRA	Resource Conservation Recovery Act
RI	Remedial Investigation
RL	Reporting Limit
RPD	Relative Percent Difference
RPM	Restoration Program Manager
RSD	relative standard deviation
RSL	Regional Screening Level
RTK-GPS	Real-Time Kinematic Global Positioning System
Shaw	Shaw Environmental, Inc.
SOP	Standard Operating Procedure
SSL	Soil Screening Levels
TBD	To Be Determined
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan

LIST OF ABBREVIATIONS AND ACRONYMS (Continued)

WP	Work Plan
WSMR	White Sands Missile Range
Zel	Zero Length

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Introduction

This Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) has been prepared in support of a Remedial Investigation (RI) for the XU853 Missile Test Stand Area (MTSA) and XU854 Able 51 Area Munition Response Sites (MRSs) at Holloman Air Force Base (AFB). This document was prepared in accordance with (IAW) the UFP-QAPP Manual (Intergovernmental Data Quality Task Force, 2005) and using the Optimized UFP-QAPP format http://www.epa.gov/fedfac/pdf/ufp_qapp_worksheets.pdf (Intergovernmental Data Quality Task Force, 2012).

The primary purpose of this document is to present the field sampling plan for the RI at the MTSA and Able 51 Area MRSs, and will be used in conjunction with the Site Specific Work Plan (WP) for these sites.

Holloman AFB is located in south-central New Mexico, about 7 miles west of the city of Alamogordo in Otero County, New Mexico (**Figure 1**). Holloman AFB occupies approximately 50,763 acres of land. Historically, the Base was used for the testing and development of unmanned aircraft, guided missiles, and other research programs. Holloman AFB is home to the 49th Wing, who provides leadership to the installation. It has also served as the German Air Force's Tactical Training Center since 1996. The southern portion of Holloman AFB contains the flight line, composed of a series of runways running north-south, east-west, and northeast southwest. The Main Base is located at the southeast corner of the installation, where Route 70 borders the site. The Main Base contains housing and administrative buildings.

The MTSA site is 204.6-acre site located within the south-central portion of the Holloman AFB, east of the southern end of the High Speed Test Track (HSTT) (**Figure 2**). Initially, the MTSA was identified as 204.6-acre Munitions Response Area (MRA). The MTSA was used primarily in the 1940s and 1950s as a launch area for an array of missile testing programs. The majority of missile testing at the MTSA ended in the late 1950s with brief test vehicle programs lasting into the 1960s. Five launch complexes are described within the MTSA area and they are the Ground-to-Air Pilotless Aircraft (GAPA), or MX-606; the North American Test Instrument Vehicle (NATIV), or MX-770; the JB-2 Loon, or MX-544; the Aerobee, or MX-1011; and the Test Stand. Following the Comprehensive Site Evaluation (CSE) Phase II investigation, a new active "EOD 50 lb Range" is under development in the area which includes a 20.3-acre portion of the MTSA site. Active ranges are ineligible under the Military Munitions Response Program (MMRP) and the 20.3-acre portion of the active range overlapping with the MTSA MRS will be removed from the XU853 MTSA MRS boundary when the new EOD range becomes active. One missile launch site, the Aerobee, or MX-1011, is located in the overlapping active range area and therefore, will excluded from further MMRP investigation once the range becomes active. The focus of the RI is on the entire 204.6-acre XU853 MTSA MRS which consists of the launch complexes and areas where munitions debris (MD) items were observed as well as areas that have not been investigated for Munitions and Explosives of Concern (MEC)/ Material Potentially Presenting an Explosive Hazard (MPPEH) hazards under either the Environmental Restoration Program (ERP) or MMRP. Currently, the XU853 MTSA MRS is unused; however, many of the facilities and buildings remain. Many of the buildings present at the MRS have been used for warehousing/general storage. Part of the MRS, including buildings 1105, 1106, 1107 and the nearby water tank and water tower, are currently in use by the Holloman AFB water distribution utility shop. The majority of the MTSA site is flat, with the Lost River channel running to the north and northwest of the MRS. The soils within the MTSA site consist of the

Yesum Sandy Loam and Yesum-Nasa complex and the vegetation is consistent with desert scrubland.

The XU854 Able 51 Area MRS is a 47.7-acre site located south of the HSTT and outside of the Holloman AFB boundary on property owned by the United States Air Force (USAF) which is administered by the White Sands Missile Range (WSMR) (**Figure 3**). The Able 51 Area was used as a launch facility in the late 1950s and early 1960s for the Mace and Matador missile test programs. Also referred to as the Zero Length (ZEL) site or BQM-34A Drone Launch site, this area was also used for research on mobile launch capability of both manned and unmanned aircraft, using rocket boosters, without the need for prepared airfields. The focus of this RI is on the 47.7-acre Able 51 Area MRS which consists of the launch complex and support facilities, including buildings 1440 and 1442, and areas where MD items were observed. The Able 51 Area MRS is currently unused. The terrain of the Able 51 Area MRS is relatively flat with soils that are assumed to consist of Yesum-Nasa complex. Vegetation within the Able 51 Area MRS is consistent with desert scrubland.

FPM Remediations, Inc. (FPM) has been contracted by the Air Force Civil Engineer Center (AFCEC) under Contract FA8903-13-C-0008 to conduct Performance Based Remediation (PBR), in compliance with United States Environmental Protection Agency (USEPA) and New Mexico Environment Department (NMED) regulatory requirements, at Holloman AFB.

The scope of work to be completed for this project is summarized in **Table 1** and described in greater detail in the RI WP.

Table 1
Holloman AFB PBR
Holloman AFB PBR Missile Test Stand Area and Able 51 Area
Scope of Work

Work Element	Monitoring Matrix	Preliminary Site Chemical of Concern	Site Objective
RI – Field Activities (Sampling)	Soil (and if required, groundwater)	Explosives and metals associated with MEC/MPPEH and propellants associated with rocket/missile testing	Complete data collection necessary to characterize the site for follow-on remedial action (if necessary) or site closeout

QAPP Worksheet #1 & #2 – Title and Approval Page

1. Project Identifying Information

    a. Site name/project name: Holloman AFB/PBR RI

    b. Site location/number:

    XU853 – Missile Test Stand Area
    XU854 – Able 51 Area

    c. Contract/work assignment number: FA8903-13-C-0008; Task Order: NA

2. Lead Organization

    a. Lead Organization Project Manager (PM):

    _____ _____
    Stephanie Ramon Date
    Contracting Officer's Representative (COR) AFCEC
    Environmental Center of Excellence Restoration
    - Execution (CZRX)

    b. Lead Organization Quality Manager:

    _____ _____
    Layi Oyelowo Date
    AFCEC/CZRX Contracting Officer Alternate

3. Federal Regulatory Agency:

    _____ _____
    Chuck Hendrickson, PM Date
    USEPA Region 6

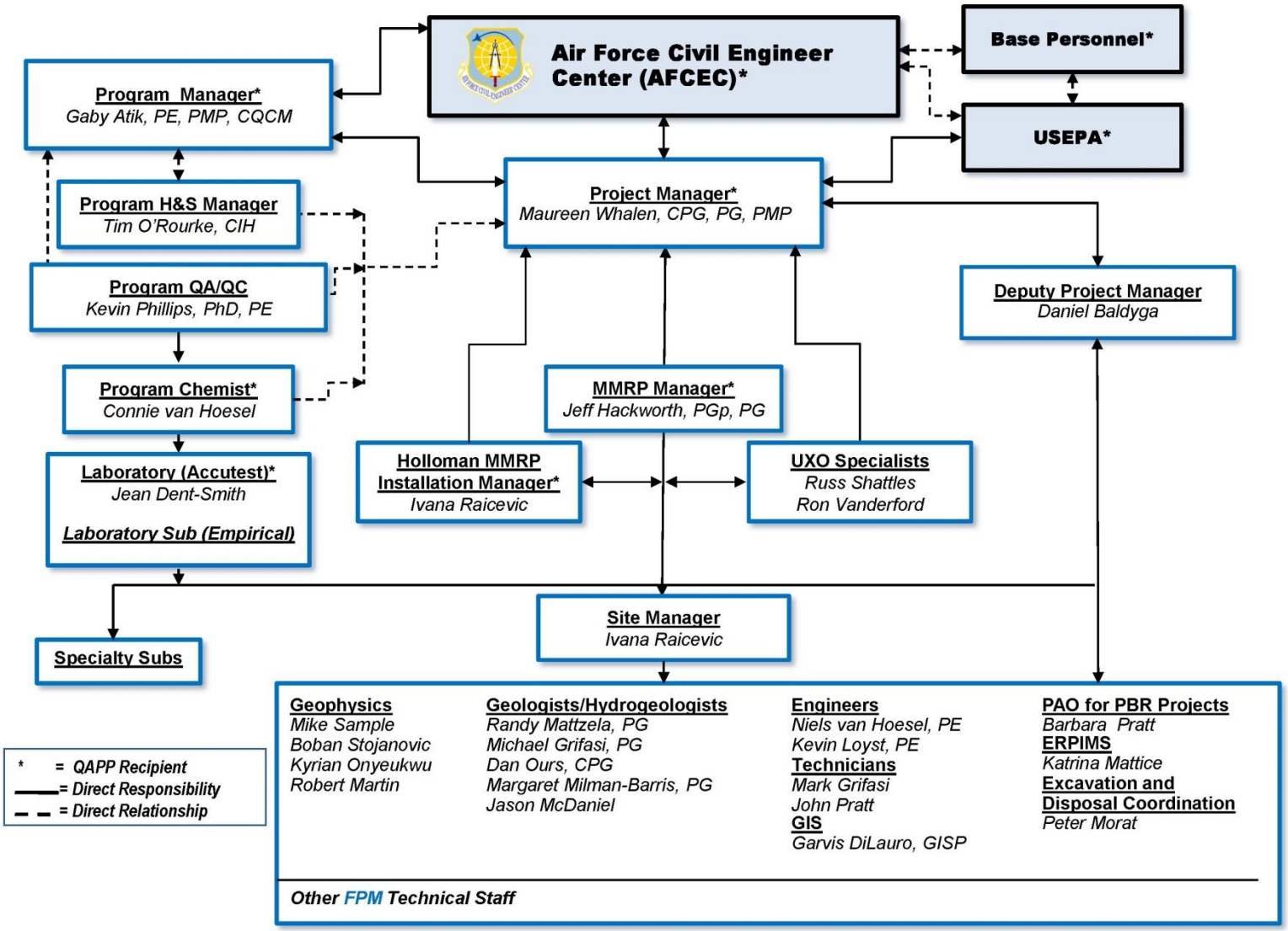
4. Other stakeholders:

    _____ _____
    DeAnna Rothhaupt, 49 Civil Engineer Squadron (CES) Date
    Civil Environmental and Infrastructure Engineering
    (CEIER) Environmental Chief Restoration Program Manager (RPM)

5. Plans and Reports from previous investigations relevant to this project:

Date	Title	Site
2010	Final Report - Modified Comprehensive Site Evaluation Phase I, Holloman Air Force Base, New Mexico	XU853 and XU854
2011	Holloman Air Force Base, New Mexico – Comprehensive Site Evaluation Phase II Final Work Plan, Military Munitions Response Program.	XU853 and XU854
2011	Basewide Background Study Report, Holloman Air Force Base, NM.	XU853 and XU854
2012	Draft Report – Comprehensive Site Evaluation Phase II, Holloman Air Force Base, NM.	XU853 and XU854
2013	Final Report - Comprehensive Site Evaluation Phase II, Holloman Air Force Base, NM.	XU853 and XU854

QAPP Worksheet #3 & #5 – Project Organization and QAPP Distribution



QAPP recipients' contact information is provided below:

QAPP Recipients	Title	Organization / Address	Telephone Number (No.)	E-mail Address
Naomi Alvarado	Contracting Officer (CO)	772 Enterprise Sourcing Squadron/Environmental Contracting (ESS/PKB) /2261 Hughes Ave., Suite 163, Joint Base San Anotonio Lackland (JBSA-Lackland), Texas 78236-9856	210-395-8151	Naomi.alvarado@us.af.mil
Stephanie Ramon	COR	AFCEC/CZRX/2261 Hughes Ave., Suite 155, (JBSA Lackland), Texas 78236-9856	210-395-8628	Stephanie.ramon.1@us.af.mil
Layi Oyelowo	AFCEC COR Alternate	AFCEC/CZRX/2261 Hughes Ave., Suite 155, (JBSA Lackland), Texas 78236-9856	210-395-8567	Layi.oyelowo@us.af.mil
Rita Leal	Contract Specialist	772 ESS/PKB/2261 Hughes Ave., Suite 163, (JBSA Lackland), Texas 78236-9856	210-395-8228	Rita.leal@us.af.mil
DeAnna Rothhaupt	49 Civil Engineer Squadron (CES)/Civil Environmental and Infrastructure Engineering (CEIER) – Environmental Chief – RPM	49 CES/CEIER/550 Tabosa Ave Holloman AFB, NM 8830	575-572-3931	Deanna.rothhaupt@us.af.mil
David Rizzuto	Holloman AF Contractor Support	USAF/550 Tabosa Ave Holloman AFB, NM 8830	575-572-5395	David.rizzuto@holloman.af.mil
DJ Davis	Holloman AF Contractor Support	USAF/550 Tabosa Ave Holloman AFB, NM 8830	575-572-3931	Darrell.Davis@holloman.af.mil

QAPP Recipients	Title	Organization / Address	Telephone Number (No.)	E-mail Address
Chuck Hendrickson	USEPA Region 6 PM	USEPA, Region 6 (6PD-F) / 1445 Ross Ave, Suite 1200, Dallas, TX 75202-2750	214-665-2196	
Gaby Atik PE	Program Manager	FPM/584 Phoenix Drive, Rome NY, 13441	315-336-7721	g.atik@fpm-remediations.com
Maureen Whalen PG, CPG, PMP	PM	FPM/584 Phoenix Drive, Rome, NY 13441	315-336-7721	m.whalen@fpm-remediations.com
Jeff Hackworth PG	MMRP Manager	FPM/5811 University Heights BLVD., Suite 101, San Antonio, TX 78249	210-495-7744	j.hackworth@fpm-remediations.com
Ivana Raicevic, PhD.	Holloman AFB MMRP Installation Manager	FPM/5811 University Heights BLVD., Suite 101, San Antonio, TX 78249	210-495-7744	i.raicevic@fpm-remediations.com
Jean Dent-Smith	Accutest Laboratories PM	4405 Vineland Road Suite C-15 Orlando, FL 32811	407-425-6700	jeans@accutest.com

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QAPP Worksheet #4, #7, & #8 – Personnel Qualifications and Sign-Off Sheet

Organization: AFCEC

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Naomi Alvarado	CO			
Stephanie Ramon	AFCEC/CZRX – COR			

Organization: Holloman AFB

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
DeAnna Rothhaupt	Holloman AFB RPM			

Organization: FPM

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Gaby Atik PE	Program Manager	B.S.C.E., Master in Engineering. Engineering Management / Environmental Systems, 20+ years of environmental experience.		
Kevin Phillips Ph.D., PE	Quality Assurance (QA) / Quality Control (QC) Officer	Ph.D. Environmental Engineering, M.S. Hydrodynamics, B.C.E., Civil Engineering. 30+ years of experience	Licensed Professional Engineer in New York, New Jersey, Pennsylvania, Connecticut, Maryland, Massachusetts, Alabama, and Texas	
Maureen Whalen PG, CPG, PMP	PM	M.S. Quaternary Studies, B.S. Geology. CPG, PG, PMP. 20 + years of environmental experience		

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Jeff Hackworth, PGp, PG	MMRP PM	B.S. Geophysics PG 26+ years of environmental experience	Registered Geophysicist: California Registered Professional Geologist: Tennessee	
Tim O'Rourke, CIH	Health and Safety (H&S) Manager	Certified Industrial Hygienist 15 years experience		
Connie van Hoesel	Program Chemist/Chemical QC Manager	M.S. Environmental Engineering, B.A. Chemistry, 12 years experience		
RI Field Team [1]	RI Field Team Personnel	Various	H&S Training per 29 Code of Federal Regulations 1910.120 Tailgate meeting to discuss daily plans and procedures	

Organization: Laboratory

Project Personnel	Title	Education/Experience	Specialized Training/Certifications	Signature/Date
Jean Dent-Smith	Accutest Laboratory Inc. PM		Accutest Laboratory is a Department of Defense (DoD) Accredited laboratory. Accreditation certificate is provided in **Appendix B**.	

1 All sampling personnel will be trained using sampling techniques described in the Standard Operating Procedures (SOPs) (**Appendix A**). All field personnel (including sub-contractors) certifications will be electronically retained by FPM for review.

QAPP Worksheet #6 – Communication Pathways

Communication Drivers	Organization	Name	Contact Info	Procedure (timing, pathways, etc.)
Point of contact (POC) with USEPA Region 6	Holloman AFB RPM	DeAnna Rothhaupt	575-572-3931	Ms. Rothhaupt is the Holloman AFB RPM.
	AFCEC/CZRX - COR	Stephanie Ramon	210-395-8628	Ms. Ramon is the AFCEC COR PM.
	AFCEC/CZRX – COR/Alternative	Layi Oyelowo	210-395-8567	Mr. Oyelowo is the alternate POC to Stephanie Ramon.
Overall Project Management	AFCEC/CZRX - COR	Stephanie Ramon	210-395-8628	Ms. Ramon is the AFCEC COR PM.
Program and Project Activities and Issues	FPM Program Manager	Gaby Atik PE	315-336-7721	Is the primary interface with AFCEC and ensures performance objectives are met.
Manages Project; Project activities; WP and/or QAPP Changes	FPM PM/Holloman AFB	Maureen Whalen PG, CPG, PMP	315-336-7721	Overall responsibility of the project. Supervises field sampling activities. Reports to AFCEC and Holloman AFB within three days of the change. Once approved, the UFP-QAPP recipients will receive a copy of the change.
Daily Field Progress Reports	Holloman AFB MMRP Installation Manager	Ivana Raicevic, PhD	210-495-7744	Supervises field sampling and Operation and Maintenance activities. Authors status and completion reports. Reports to PM and/or AFCEC and Holloman AFB within three days of the change. Once approved, the UFP-QAPP recipients will receive a copy of the change.
Sampling and Remediation Activities	Holloman AFB MMRP Installation Manager	Ivana Raicevic, PhD	210-495-7744	Responsible for all sampling and remediation activities to assure goals are attained. Reports to AFCEC and Holloman AFB daily during field efforts.

Communication Drivers	Responsible Entity	Name	Phone No.	Procedure (timing, pathways, etc.)
Project QA /QC	QA/QC Officer	Kevin Phillips PhD., PE	631-737-6200	Will determine corrective action for field, data interpretation, and reporting issues
Reporting Lab Data Quality Issues	Chemical QC Manager	Connie van Hoesel	315-336-7721	Will determine corrective action for lab data quality issues
Field and Analytical Corrective Actions	Chemical QC Manager	Connie van Hoesel	315-336-7721	Will determine corrective action for field and analytical issues
Release of Analytical Data	Chemical QC Manager	Connie van Hoesel	315-336-7721	No analytical data can be released until it has been reviewed by the Chemical QC Manager and data validation has been completed.
QAPP Amendments	AFCEC/CZRX - COR	Stephanie Ramon	210-395-8628	Any major changes to the QAPP must be approved by Stephanie Ramon before the changes can be implemented.

QAPP Worksheet #9 – Project Planning Session Summary

No site-specific planning sessions have been held to date, however one will be planned two weeks after the document is submitted for review. Two meetings have been held discussing PBR contract objectives. If any meetings are held with USEPA Region 6, AFCEC, and/or Holloman AFB regarding scoping and/or elements specifically relating to this UFP-QAPP, this worksheet will be revised accordingly.

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QAPP Worksheet #10 – Conceptual Site Model

Site Background

The MTSA and Able 51 Area MRAs were identified during previous investigations as containing the potential for MEC/MPPEH and associated munitions constituents (MC) (e.g., explosives and metals) in soil. Additionally, based on the historical use of the sites as launch areas for an array of rocket/missile testing programs, the MRAs were identified as containing the potential for MC associated with missile testing (e.g., propellants) in soil. The MTSA MRA consists of 204.6 acres of desert scrubland east of the southern end of the HSTT. The Able 51 Area MRA consists of 47.7 acres of desert scrubland south of the HSTT and outside of the Holloman AFB boundary on property owned by the USAF which is administered by WSMR.

The CSE Phase II visual survey at the MTSA MRA observed intact small arms ammunition (5.56 millimeter (mm) and 7.62mm), small arms debris (5.56mm, 7.62mm, and .50-caliber) and identified numerous MD items (30mm casings with links, expended M74A1 40mm flare cartridge casings, expended M18 smoke grenades, tail boom from an 81mm Illumination Mortar, expended MK 13 Day & Night Distress Signal, and expended 5-inch rockets) which were associated with recent training activities. Also identified at the MTSA were missile debris items (multiple Aerobee fins, a set of Aerobee fins still attached to an expended booster motor).

The CSE Phase II visual survey at the Able 51 Area MRA observed intact small arms ammunition (5.56mm and 7.62mm), small arms debris (.22-caliber, 5.56mm, 7.62mm, .38-caliber, .45-caliber, and .50-caliber) and identified numerous MD items (40mm flares, M74 airburst simulator projectiles, slap flares, and smoke grenades) which were associated with recent training activities. No missile debris items were observed at the Able 51 Area MRA. No MC sampling was conducted in the MTSA or the Able 51 Area MRAs for MC analysis as no MC source (e.g., MEC/MPPEH) was identified.

Previous Investigations

The MTSA and Able 51 Area MRAs have been investigated in a Modified CSE Phase I (Shaw Environmental, Inc. [Shaw], 2010) and a CSE Phase II (HDR Environmental, Operations and Construction, Inc. [HDR], 2013) under the USAF MMRP. Additionally, a portion of the original Missile Test Stand Area was previously investigated under the ERP as the Early Missile Test Site ERP Site (OT-37).

ERP Site (OT-37) Investigation - 2007 – The OT-37 site covers an area of approximately 160 acres. Soil and groundwater samples were collected at the site in 2007. Perchlorate and arsenic were detected in soil and groundwater, requiring site characterization and additional risk characterization to obtain site closure. Holloman AFB has proposed additional investigation of the OT-37. Because the OT-37 is currently being investigated under the ERP, that portion of the Missile Test Stand Area is ineligible for the USAF MMRP and is therefore excluded from the boundary defined for the MRA MRS (Shaw, 2010). Additionally, one of the missile launch complexes, the GAPA Launch Complex, falls within the OT-37 site and is ineligible under the MMRP.

Modified Comprehensive Site Evaluation Phase I - 2010 – Modified CSE Phase I was completed in 2010. Prior to the start of the CSE Phase I, no MRAs had been discovered at Holloman AFB and it was believed that there was a low probability of a significant number of MRAs being found at Holloman AFB. Therefore, the USAF has modified the CSE Phase I

process by deferring some actions typically performed in a Phase I, to the CSE Phase II, if a Phase II is required. For this Modified CSE Phase I, it was determined that a Conceptual Site Model (CSM) and Munitions Response Site Prioritization Protocol and Hazard Ranking System scoring elements were not required. The activities performed during the CSE Phase I included identification and review of data repositories located both on and off the installation, interviews with base personnel, and visual surveys. No MEC/MPPEH was observed at either site. MD observed at the Able 51 Area site consisted of a limited number of small arms blanks, not indicative of historic site use. However, based on the historical use of the sites as missile test/launch facilities further investigations were warranted to assess if MC (propellants) had been released to the environment. A CSE Phase II was recommended.

Comprehensive Site Evaluation Phase II - 2013 – A CSE Phase II was completed in 2013, and involved the compilation and evaluation of information relating to the possible contamination of environmental media from MC related to historic munitions related activities at identified MRSs at Holloman AFB. Activities included visual reconnaissance surveys and the sampling and analysis of surface and/or subsurface soil determine if MC, hazardous substances, pollutants and contaminants, or other constituents have been released into the environment.

The CSE Phase II visual survey at the 204.6-acre MTSA MRA observed intact small arms ammunition (5.56mm and 7.62mm), small arms debris (5.56mm, 7.62mm, and .50-caliber) and identified numerous MD items (30mm casings with links, expended M74A1 40mm flare cartridge casings, expended M18 smoke grenades, tail boom from an 81mm Illumination Mortar, expended MK 13 Day & Night Distress Signal, and expended 5-inch rockets) which were associated with recent training activities. Also identified at the MTSA were missile debris items (multiple Aerobee fins, a set of Aerobee fins still attached to an expended booster motor).

The CSE Phase II visual survey at the 47.7-acre Able 51 Area MRA observed intact small arms ammunition (5.56mm and 7.62mm), small arms debris (.22-caliber, 5.56mm, 7.62mm, .38-caliber, .45-caliber, and .50-caliber) and identified numerous MD items (40mm flares, M74 airburst simulator projectiles, slap flares, and smoke grenades) which were associated with recent training activities. No missile debris items were observed at the Able 51 Area MRA.

No MEC/MPPEH were encountered during the visual surveys at the MTSA and Able 51 Area sites and consequently, no MC samples were collected. The CSE Phase II recommended the 204.6-acre MTSA (XU853) and 47.7-acre Able 51 Area (XU854) MRSs for further munitions response action based on a potential for MEC/MPPEH due to the presence of MD items at the site.

Site Models

The MTSA and Able 51 Area sites consist primarily of desert scrubland with relatively flat topography, and are not managed for ecological habitat. The CSM is a description of a site and its environment based on existing knowledge. It describes contaminated sources, possible receptors, and the interactions that link them. The CSM evolves through an iterative process of data collection and actions. Current CSMs for MEC and MC are included in RI **WP Section 1.7**. The CSMs for the MTSA and Able 51 Area MRSs will continue to be refined through the RI.

QAPP Worksheet #11 – Project/Data Quality Objectives

1. State the Problem

What is the nature and extent of MEC/MPPEH at the MTSA and Able 51 Area sites? Is further action necessary to address residual MEC and MPPEH (classified as MDEH) that may pose a threat to Human Health (HH) or is no further action (NFA) appropriate?

If MEC/MPPEH or areas with significant amounts of MD are identified, what is the nature and extent of associated MC, explosives (1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; o-Nitrotoluene; 3,5-Dinitroaniline; m-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; p-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl) and metals (aluminum; antimony; chromium; copper; iron; lead; and zinc), at the MEC/MPPEH/MD find (source) locations? Is further action necessary to address residual concentrations of MC associated with MEC/MPPEH/MD (explosives and metals) that may pose a threat to HH or is NFA appropriate?

What is the nature and extent of MC associated with missile testing activities, propellants (explosives [2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; RDX, Nitrocellulose], anions [Nitrate], and Perchlorate), in the soil at missile launch pad locations at each site? Is further action necessary to address residual concentrations of MC associated with missile testing (propellants) that may pose a threat to HH or is NFA appropriate?

2. Identify the Goals of the Study

The goal of this study is to provide site characterization data of sufficient quantity and quality to close existing data gaps and determine nature and extent of MEC/MPPEH/MD and MC within the MRSs in order to focus follow-on restoration efforts on MEC/MPPEH/MD and/or MC delineated areas if necessary.

3. Identify Information Inputs

Surface clearance will be conducted to determine if MEC/MPPEH/MD is present on the surface. Digital Geophysical Mapping (DGM) will be conducted along transects and grids utilizing the Geonics electromagnetic system EM61-MK2 (EM61) to map subsurface anomalies that may represent MEC/MPPEH/MD. Intrusive investigation of DGM anomalies randomly selected using Visual Sample Plan statistical analysis will be conducted to determine the presence of MEC/MPPEH/MD in the subsurface soil.

Soil samples will be collected at confirmed MEC and MPPEH find locations and in areas of significant amounts of MD and the soil samples will be analyzed at an off-site laboratory (Accutest Laboratories, Inc.) for explosives (1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; o-Nitrotoluene; 3,5-Dinitroaniline; m-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; p-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl) (by USEPA SW-846 Method 8330A) and metals (aluminum; antimony; chromium; copper; iron; lead; and zinc) (by USEPA SW-846 Method 6010C). The depth of a specific soil sample will depend on the depth of the associated MEC/MPPEH/MD find. If no MEC/MPPEH items are identified, and if areas with significant amounts of MD are not discovered, no soil samples will be collected.

Surface soil samples will be collected at launch pad sites and at isolated locations showing evidence of potential contamination (e.g., discolored soil) and analyzed at an off-site laboratory (Accutest Laboratories) for propellant constituents consisting of: explosives [2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; and RDX] by USEPA method 8330B, for Anions [Nitrate] by USEPA method 300/9056A, and for perchlorate by USEPA method 6850. Additionally the soil samples will be analyzed at an off-site laboratory (Empirical Laboratories, LLC) for the propellant constituent Nitrocellulose by USEPA Method 353.2.

If soil sample results indicate the potential for contaminant migration into groundwater then groundwater samples will be collected at the specific source location for the identified contaminant of concern by the USEPA methods described above.

4. Define the Boundaries of the Study

The spatial limits of work at each MRS are illustrated in **Figures 2** and **3.** Sampling for MC associated with MEC/MPPEH/MD (explosives [1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; o-Nitrotoluene; 3,5-Dinitroaniline; m-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; p-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl] and metals [aluminum; antimony; chromium; copper; iron; lead; and zinc]) will occur at the specific locations and depths where MEC or MPPEH (classified as MDEH) items, if any, are identified.

Incremental sampling locations (surface soils) for MC associated with missile testing activities, propellants (explosives [2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; RDX, Nitrocellulose], anions [Nitrate], and Perchlorate), at launch pad sites as shown in **Figures 2** and **3**. Sampling for MC associated with missile testing activities (propellant constituents) at isolated locations showing evidence of potential contamination (e.g., discolored soil) will depend on where such locations, if any, are identified.

5. Develop the Analytical Approach

The following decision rules will be utilized to link potential results with conclusions or future actions.

Decision Rule 1. If MEC/MPPEH and areas with significant amounts of MD are found during the surface clearance and/or intrusive investigation, environmental samples will be collected at MEC/MPPEH locations to determine the presence or absence of MC (explosives and metals) in soil. In addition, soil samples will be collected before and after any BIPs. No sampling will be performed at locations of MPPEH classified as MDAS since this material is certified as free from an explosive hazard. Soil samples will also be collected at launch pads locations and other isolated locations showing evidence of potential contamination to determine the presence or absence of propellants. One of the components of propellants, nitrocellulose, is virtually insoluble and survives for long periods of time in soil (USACE 2011). If surface soil sample results indicate that nitrocellulose is present, the subsurface soil at the same location will be analyzed to determine whether other components of propellants which are leachable are present in the subsurface.

Decision Rule 2. Soil samples collected for explosives (1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-

Dinitrotoluene; o-Nitrotoluene; 3,5-Dinitroaniline; m-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; p-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl) and metals (aluminum, antimony, chromium, copper, iron, lead, and zinc) associated with MEC/MPPEH and soil samples collected for propellants (explosives [2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; RDX, Nitrocellulose], anions [Nitrate], and Perchlorate) associated with missile testing analysis will be evaluated to determine the presence of contamination, as follows:

- ***If*** explosives and/or metals or propellants are detected above the Limit of Detection (LOD) (see **Worksheet #15**) in a sample, ***then*** it will be determined that the corresponding compound is present and included as a detect in the existing analytical dataset for the site (see Decision Rule 3).
- ***If*** explosives and/or metals or propellants are not detected above the LOD (see **Worksheet #15**) in a sample, ***then*** it will be determined that the compound is not present and included as a non-detect in the existing analytical dataset for the site (see Decision Rule 3).

Decision Rule 3. The site will be reassessed based on the existing dataset (comprised of historical and new data) to determine if further action is necessary, as follows:

- ***If*** the concentrations of explosives and/or metals or propellants in soil exceed the project action limits (see **Worksheet #15**), ***then*** it will be determined that further remedial action for MC in soil may be required.
- ***If*** the concentrations of explosives and/or metals or propellants in soil exceed the project action limits (see **Worksheet #15**) and results indicate the potential for contaminant migration to groundwater, ***then*** it will be determined that groundwater sampling for MC may be required.
- ***If*** the concentrations of explosives and/or metals or propellants in groundwater exceed the project action limits (see **Worksheet #15**), ***then*** it will be determined that further remedial action for MC in groundwater may be required.
- ***If*** the concentrations of explosives and/or metals or propellants in soil (or groundwater) are less than the respective project action limits (see **Worksheet #15**), ***then*** it will be determined that no further remedial action for MC is appropriate.

6. Specify Performance or Acceptance Criteria

Sample analytical results will be compared to the project action limits as shown in **Worksheet #15**. **Worksheet #37** describes the usability assessment of the data. Decision errors include data quality and usability. To ensure the quality of the data, all data will be reviewed, verified, and validated IAW this QAPP. To ensure usability of laboratory data, appropriate laboratory methods have been selected to provide the necessary laboratory detection limits (DLs). Acceptance criteria for the analytical data are listed in **Worksheet #28**.

7. Develop the Detailed Plan for Obtaining Data

The sampling design and rationale are presented in **Worksheet #17**. **Worksheets #16, #17**, and **#18** describe the details of the sampling. **Worksheets #19, #20, #24-28**, and **#30** will specify analysis design requirements.

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QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	Soil	Data qualifier definitions and full data review/validation criteria are listed in Tables 12-2 and 12-3.			
Analytical Group	Explosives				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1, No. 2, and No. 3	SW-846 8330A/ LAB SOP# OP019/ GC016	Bias Contamination	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <1/2 Lab Reporting Limit (RL).	Field Blank/Equipment Blank	S
		Precision - Overall	All Target Compounds; see **Table 12-1** for analyte specific Relative Percent Difference (RPD) criteria.	Field Duplicates	S&A
		Accuracy/ Bias Contamination	<1/2 Lab RL.	Method Blank (MB)	A
		Accuracy/ Method Bias in ideal matrix	%Recovery (%R) = (Calculated Value/True Value) *100%	Laboratory Control Sample (LCS)	A
		Precision and Accuracy	%R = (Calculated Value - Sample Value/True Value) *100%	Matrix Spike (MS)	A

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1, No. 2, and No. 3 (Continued)	SW-846 8330A/ LAB SOP# OP019/ GC016	Precision and Accuracy	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MS Duplicate (MSD), and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	MSD	A
		Precision and Accuracy	%R = (Calculated Value/True Value) *100%	Surrogate Spike	A
		Sensitivity	Sample results will be reported to the DL.	Sample results that are less than the Limit of Quantitation (LOQ), but greater than the DL, will be reported with a **J**-flag. Quarterly LOD verification.	A
		Completeness	90 and 95% for soil	Data Completeness Check	S&A

[1] Reference No. from QAPP **Worksheet #21**

[2] Reference No. from QAPP **Worksheet #23**

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	Soil and Aqueous	Data qualifier definitions and full data review/validation criteria are listed in Tables 12-2 and 12-4.			
Analytical Group	Explosives				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**DQIs**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1, No. 2, No. 3, and No. 9	SW-846 8330B/ LAB SOP# Op046/ GC034	Bias Contamination	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <1/2 Lab RL.	Field Blank/Equipment Blank	S
		Precision - Overall	All Target Compounds; see **Table 12-1** for analyte specific RPD criteria.	Field Duplicates	S&A
		Accuracy/Bias Contamination	<1/2 Lab RL.	MB	A
		Accuracy/Method Bias in ideal matrix	%R = (Calculated Value/True Value) *100%	LCS	A
		Precision and Accuracy	%R = (Calculated Value - Sample Value/True Value) *100%	MS	A

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1, No. 2, No. 3, and No. 9 (Continued)	SW-846 8330B/ LAB SOP# OP046/ GC034	Precision and Accuracy	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	MSD	A
		Precision and Accuracy	%R = (Calculated Value/True Value) *100%	Surrogate Spike	A
		Sensitivity	Sample results will be reported to the DL.	Sample results that are less than the LOQ, but greater than the DL, will be reported with a **J**-flag. Quarterly LOD verification.	A
		Completeness	90 and 95% for soil	Data Completeness Check	S&A

[1] Reference No. from QAPP **Worksheet #21**

[2] Reference No. from QAPP **Worksheet #23**

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	Soil	Data qualifier definitions and full data review/validation criteria are listed in Tables 12-2 and 12-5.			
Analytical Group	Metals				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**DQIs**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1, No. 2, and No. 3	SW-846 6010C/ LAB SOP# MET104/ MET100	Bias Contamination	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <1/2 Lab RL.	Field Blank/Equipment Blank	S
		Precision - Overall	All Target Compounds; see **Table 12-1** for analyte specific RPD criteria.	Field Duplicates	S&A
		Accuracy/Bias Contamination	<1/2 Lab RL.	MB	A
		Accuracy/Method Bias in ideal matrix	%R = (Calculated Value/True Value) *100% +/- 20%	LCS	A
		Precision and Accuracy	%R = (Calculated Value - Sample Value/True Value) *100% +/- 20%	MS	A

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1, No. 2, and No. 3 (Continued)	SW-846 6010C/ LAB SOP# MET104/ MET100	Precision and Accuracy	%R = (Calculated Value – Sample Value/True Value) *100%; +/- 20% RPD (%) = [(XA-XB)/ XM] * 100; <20% Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	MSD	A
		Sensitivity	Sample results will be reported to the DL.	Sample results that are less than the LOQ, but greater than the DL, will be reported with a **J**-flag. Quarterly LOD verification.	A
		Completeness	90 and 95% for soil	Data Completeness Check	S&A

[1] Reference No. from QAPP **Worksheet #21**

[2] Reference No. from QAPP **Worksheet #23**

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	**Soil and Aqueous**	**Data qualifier definitions and full data review/validation criteria are listed in Tables 12-2 and 12-6.**			
Analytical Group	**Explosives**				
Conc. Level	**Low**				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**DQIs**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1, No. 2, No. 3, and No. 9	USEPA Modified 353.2NCI/ Empirical SOPs 179, 234	Overall Precision	RPD ≤ 30% when analyte is detected in both samples ≥ sample specific LOQ	Field Duplicates	S&A
		Analytical Precision (laboratory)	See **Worksheet No. 15**, analyzed if no MSD in batch	LCS Duplicates	A
		Analytical Accuracy/bias (laboratory)	See **Worksheet No. 15**	LCS	A
		Analytical Accuracy/bias/ precision (matrix interference)	See **Worksheet No. 15**	MSDs	A

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1, No. 2, No. 3, and No. 9 (Continued)	USEPA Modified 353.2NCI/ Empirical SOPs 179, 234	Overall Accuracy/Bias Contamination	Not target analytes ≥ 1/2 LOQ.	Equipment Blank	S
		Sensitivity	Recovery within LCS control limits (analyzed quarterly with records maintained at lab)	LOQ verification sample (spiked at LOQ)	A
		Completeness	See **Worksheet No. 34**	See Worksheet No. 34	A

[1] Reference No. from QAPP **Worksheet #21**

[2] Reference No. from QAPP **Worksheet #23**

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	Soil and Aqueous	Data qualifier definitions and full data review/validation criteria are listed in Tables 12-2 and 12-7.			
Analytical Group	Anions				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**DQIs**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1, No. 2, No. 3, and No. 9	SW-846 9056A/ LAB SOP# GN228	Bias Contamination	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <1/2 Lab RL.	Field Blank/Equipment Blank	S
		Precision - Overall	All Target Compounds; see **Table 12-1** for analyte specific RPD criteria.	Field Duplicates	S&A
		Accuracy/Bias Contamination	<1/2 Lab RL.	MB	A
		Accuracy/Method Bias in ideal matrix	%R = (Calculated Value/True Value) *100% Recovery 90-110%	LCS	A

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1, No. 2, No. 3, and No. 9 (Continued)	SW-846 9056A/ LAB SOP# GN228	Precision and Accuracy	%R = (Calculated Value – Sample Value/True Value) *100% Recovery 90-110%	MS	A
		Precision and Accuracy	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2 Recovery 90-110%, %RPD20%	MSD	A
		Sensitivity	Sample results will be reported to the DL.	Sample results that are less than the LOQ, but greater than the DL, will be reported with a **J**-flag. Quarterly LOD verification.	A
		Completeness	90 and 95% for soil	Data Completeness Check	S&A

[1] Reference No. from QAPP **Worksheet #21**

[2] Reference No. from QAPP **Worksheet #23**

QAPP Worksheet #12 – Measurement Performance Criteria

Matrix	Soil and Aqueous	Data qualifier definitions, and full data review/validation criteria are listed in Tables 12-2 and 12-8.			
Analytical Group	Perchlorate				
Conc. Level	Low				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**DQIs**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), and/or Analytical (A)**
SOPs No. 1, No. 2, No. 3, and No. 9	SW-846 6850/ LAB SOP# MS013	Bias Contamination	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <1/2 Lab RL.	Field Blank/Equipment Blank	S
		Precision - Overall	All Target Compounds; see **Table 12-1** for analyte specific RPD criteria.	Field Duplicates	S&A
		Accuracy/Bias Contamination	<1/2 Lab RL.	MB	A
		Accuracy/Method Bias in ideal matrix	%R = (Calculated Value/True Value) *100%; within +/-20% of true value.	LCS	A

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), and/or Analytical (A)
SOPs No. 1, No. 2, No. 3, and No. 9 (Continued)	SW-846 6850/ LAB SOP# MS013	Precision and Accuracy	%R = (Calculated Value - Sample Value/True Value) *100%; within +/-20% of true value	MS	A
		Precision and Accuracy	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100; <15% for upper half of the curve, <50% for lower half of the curve. Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	MSD	A
		Sensitivity	IS Area = -50% to +100% of Continuing Calibration Verification (CCV)	Internal Standards	A
		Completeness	90 and 95% for soil	Data Completeness Check	S&A

[1] Reference No. from QAPP **Worksheet #21**

[2] Reference No. from QAPP **Worksheet #23**

Table 12-1
Accuracy and Precision Criteria for Chemical Analysis

Spiking Compound	Chemical Abstracts Service (CAS) No.	Accuracy (%R)				Precision (RPD)		
		Aqueous		Soil		Aqueous		Soil
EXPLOSIVES (8330A)								
1,3-Dinitrobenzene	99-65-0	79-122		80-125		17		15
2-Amino-4,6-dinitrotoluene	35572-78-2	81-120		79-122		19		20
4-Amino-2,6-dinitrotoluene	19406-51-0	79-119		76-124		20		23
2,4-Dinitrotoluene	121-14-2	80-123		80-130		19		20
2,6-Dinitrotoluene	606-20-2	81-131		75-143		17		22
RDX	121-82-4	77-125		78-120		19		16
Nitrobenzene	98-95-3	78-130		77-139		19		17
Nitroglycerin	55-63-0	73-121		73-121		17		17
o-Nitrotoluene	88-72-2	76-131		84-126		20		21
m-Nitrotoluene	99-08-1	78-122		84-129		18		21
p-Nitrotoluene	99-99-0	79-124		83-132		18		25
HMX	2691-41-0	77-144		64-159		21		17
PETN	78-11-5	74-140		74-140		17		17
1,3,5-Trinitrobenzene	99-35-4	79-128		81-133		16		19
2,4,6-Trinitrotoluene	118-96-7	72-112		69-124		16		18
Tetryl	479-45-8	65-124		63-135		20		25
3,5-Dinitroaniline	618-87-1	79-122		79-122		18		18
EXPLOSIVES (8330B)								
2-Amino-4,6-dinitrotoluene	35572-78-2	80-120		81-127		19		15
4-Amino-2,6-dinitrotoluene	19406-51-0	79-119		74-125		20		23
2,4-Dinitrotoluene	121-14-2	80-123		81-128		19		17
2,6-Dinitrotoluene	606-20-2	81-131		81-134		17		20
RDX	121-82-4	77-125		79-126		19		21
Nitroglycerin	55-63-0	69-123		73-121		18		15
HMX	2691-41-0	77-144		75-147		21		22
2,4,6-Trinitrotoluene	118-96-7	72-112		70-123		16		16
METALS (6010C)								
Aluminum	7429-90-5	80-120		80-120		20		20
Antimony	7440-36-0	80-120		80-120		20		20
Chromium	7440-47-3	80-120		80-120		20		20
Copper	7440-50-8	80-120		80-120		20		20

Spiking Compound	Chemical Abstracts Service (CAS) No.	Accuracy (%R)				Precision (RPD)		
		Aqueous		Soil		Aqueous		Soil
Iron	7439-89-6	80-120		80-120		20		20
Lead	7439-92-1	80-120		80-120		20		20
Zinc	7440-67-7	80-120		80-120		20		20
EXPLOSIVES (353.2)								
Nitrocellulose	9004-70-0	50-120		50-120		20		20
ANIONS (9056A)								
Nitrate	14797-55-8	90-110		90-110		20		20
PERCHLORATE (6850)								
Perchlorate	14797-73-0	80-120		80-120		15		15

Table 12-2
Data Qualifier Definitions

Qualifier	Description
J	Estimated. The analyte was positively identified; the quantitation is an estimation due to discrepancies in meeting certain analyte-specific QC criteria, or the concentration is less than the sample quantitation limit.
UJ	The analyte was not detected. The result is estimated due to discrepancies in meeting certain analyte-specific QC criteria.
M	Matrix effect: The result is estimated due to a matrix effect.
B	Blank contamination. The analyte was found in the sample at a concentration similar to that observed in a blank.
R	Rejected. The data are rejected due to deficiencies in meeting QC criteria and may not be used for decision-making.

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Table 12-3
Data Review/Validation Criteria for USEPA Method 8330A

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once quarterly LOD verification checks shall be performed.	See DoD QSM v 4.2. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat DL determination and LOD verification check at higher level and set LOD.	LOD is 2-3x the DL (for a single-analyte standard) or greater than 1-4x the DL (for a multi-analyte standard).	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently o quarterly LOQ verification checks shall be performed.	See DoD QSM v 4.2. LOQ must be set within the calibration range prior to sample analysis.	Not Applicable (N/A)	None	N/A
Holding time	Every sample	Soil samples: 7 days to preparative extraction, 40 days to analysis	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to non-detects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to non-detects to samples > 2X holding time criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Sample temperature	Every cooler	4±2 degrees Celsius (°C)	Contact FPM as to additional measures to be taken.	None	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to non-detects. Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to non-detects.
Minimum five point initial calibration (ICAL) for all analytes	Minimum of 5 calibration standards with the lowest standard concentration at or below the RL. Once calibration curve or line is generated, the lowest calibration standard must be re-analyzed.	The apparent signal-to-noise ratio at the RL must be at least 5:1. % relative standard deviation (RSD) <20 or, if linear regression is used, $r \geq 0.995$.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flag to data without a valid ICAL

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Second source calibration verification	Once after each calibration verification	Value of second source for all analytes within ± 20% of expected value (initial source)	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flags to data without second source verification.
CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All analytes within + 20% of expected value form ICAL	Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification	If % Difference/Drift (%D) for an individual analyte is > 20%, no samples may be analyzed until the problem has been corrected.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to non-detects..

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MB, Equipment Blank	One per preparatory batch, one per sampling day	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination.
LCS	One per preparatory batch	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	LCS should contain all analytes to be reported, including surrogates	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects. Very low bias (%R<30%): Apply **J**-flag to detects and **R**-flag to non-detects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MS/MSD	One per preparatory batch per matrix	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	Examine the project-specific Data Quality Objectives (DQOs). Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	For the specific analyte(s) in the parent sample, apply **M**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data.
Laboratory sample duplicate	One per preparatory batch per matrix (if MS/MSD is not performed)	RPD < 30% (sample and sample duplicate)	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met.	Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Surrogate spike	All field and QC samples	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Analytes identified in UFP-QAPP **Table 12-2**.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to non-detects.
Confirmation of positive results (second column or detector)	All positive results (exceeding the LOD) must be confirmed.	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD < 40%.	N/A	Report the higher of two confirmed results unless overlapping peaks are causing erroneously high results, then report the non-affected result and document in the case narrative.	Apply **J**-flag if RPD >40%. Apply **U**-flag if primary result not confirmed.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Results reported between DL and LOQ	N/A	N/A	N/A	None	Apply **J**-flag to all results between DL and LOQ.
Field Duplicate	One per 10 field samples	See UFP-QAPP **Worksheet #12** (UFP-QAPP Manual Section 2.6.2).	N/A	N/A	Apply **J**-flag to detects and **UJ**-flag to non-detects.

Table 12-4
Data Review/Validation Criteria for USEPA Method 8330B

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOD verification checks shall be performed.	See DOD QSM v 4.2. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat DL determination and LOD verification check at higher level and set LOD.	LOD is 2-3x the DL (for a single-analyte standard) or greater than 1-4x the DL (for a multi-analyte standard).	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOQ verification checks shall be performed.	See DoD QSM v 4.2. LOQ must be set within the calibration range prior to sample analysis.	N/A	None	N/A
Holding time	Every sample	Soil samples: 7 days to preparative extraction, 40 days to analysis	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to non-detects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to non-detects to samples > 2X holding time criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Sample temperature	Every cooler	4±2 °C	Contact FPM as to additional measures to be taken.	None	Samples arriving at temperature 6-10°C, apply **J**-flag to detects and **UJ**-flag to non-detects. Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to non-detects.
Soil grinding blank	Between each sample.	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (e.g., ground and subsampled) and analyzed in the same manner as a field sample. Grinding blanks can be analyzed individually or composited. No target analytes detected great	All blank results must be reported and the affected samples must be flagged accordingly if blank criteria is not met.	None	If the composite grinding blank exceeds the acceptance criteria, apply **U**-flag to analytes detected in field samples < 5X blank contamination associated with the grinding composite. If any individual grinding blank is found to exceed the acceptance criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Soil sample triplicate	At the subsampling step, one sample per batch. Cannot be performed on any type of blank sample.	Three 10 gram (g) subsamples are taken from a sample expected to contain the highest levels of explosives within the Quantitation Range of the method. The RSD for results above the RL must not exceed 20%.	Corrective action must be taken if this criterion is not met (e.g., the grinding process should be investigated to ensure that the samples are being reduced to a sufficiently small particle size).	None	Apply J-flag if corrective action does not solve problem and no sample available.
Minimum five point ICAL for all analytes	Minimum of 5 calibration standards with the lowest standard concentration at or below the RL. Once calibration curve or line is generated, the lowest calibration standard must be re-analyzed.	The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear regression is used, $r \geq 0.995$.	Correct problem then repeat ICAL.	None	Apply **R**-flag to data without a valid ICAL

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Second source calibration verification	Once after each ICAL	Value of second source for all analytes within ± 20% of expected value (initial source)	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flags to data without second source verification.
CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All analytes within + 20% of expected value form ICAL	Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification	If %D for an individual analyte is > 20%, no samples may be analyzed until the problem has been corrected	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **R**-flag to non-detects..

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MB, Equipment Blank	One per preparatory batch, one per sampling day.	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination.
LCS	One per preparatory batch	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	LCS should contain all analytes to be reported, including surrogates.	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects. Very low bias (%R<30%): Apply **J**-flag to detects and **R**-flag to non-detects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MS/MSD	One per preparatory batch per matrix	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	For the specific analyte(s) in the parent sample, apply **M**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data.
Laboratory sample duplicate	One per preparatory batch per matrix (if MS/MSD is not performed)	RPD < 30% (sample and sample duplicate)	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met.	Data shall be evaluated to determine the source of difference. Apply **J**-flag to detects if acceptance criteria are not met.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Surrogate spike	All field and QC samples	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	For QC and field samples, correct problem, then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available.	Analytes identified in UFP-QAPP **Table 12-2**.	High bias: Apply **J**-flag to detects Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects. Very low bias (%R<10%): Apply **J**-flag to detects and **R**-flag to non-detects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Confirmation of positive results (second column or detector)	All positive results (exceeding the LOD) must be confirmed.	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD < 40%.	N/A	Report the higher of two confirmed results unless overlapping peaks are causing erroneously high results, then report the non-affected result and document in the case narrative.	Apply **J**-flag if RPD >40%. Apply **U**-flag if primary result not confirmed.
Results reported between DL and LOQ	N/A	N/A	N/A	None	Apply **J**-flag to all results between DL and LOQ.
Field Duplicate	One per 10 field samples	See UFP-QAPP **Worksheet #12** (UFP-QAPP Manual Section 2.6.2).	N/A	N/A	Apply **J**-flag to detects and **UJ**-flag to non-detects.

Table 12-5
Data Review/Validation Criteria for USEPA Method 6010C

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOD verification checks shall be performed.	See DoD QSM v 4.2. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat DL determination and LOD verification check at higher level and set LOD.	LOD is 2-3x the DL (for a single-analyte standard) or greater than 1-4x the DL (for a multi-analyte standard).	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOQ verification checks shall be performed.	See DoD QSM v 4.2. LOQ must be set within the calibration range prior to sample analysis.	N/A	None	N/A
Instrument DL study (Inductively coupled plasma [ICP] only).	At initial set-up and after significant change	DLs established shall be < LOD	N/A	Samples cannot be analyzed without an Instrument DL.	Apply **R**-flag to data without a valid Instrument DL study.
Linear dynamic range or high-level check standard (ICP only).	Every 6 months.	Within ±10% of true value.	N/A	N/A	N/A

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Holding time	Every sample	Soil samples: 6 months	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to non-detects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to non-detects to samples > 2X holding time criteria.
Sample temperature	None	N/A	Contact FPM as to additional measures to be taken.	None	N/A
ICAL for all analytes ICP: minimum one high standard and a blank.	Daily ICAL prior to sample analysis.	$r \geq 0.995$.	Correct problem then repeat ICAL	Problem must be corrected. No samples may be run until ICAL has passed	Apply **R**-flag to data without a valid ICAL

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Second source Initial calibration Verification (ICV)	Once after each ICAL, prior to sample analysis	Value of second source for all analytes within ± 10% of expected value (initial source)	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flag to data without second source verification.
CCV	After every 10 samples and at the end of the analysis sequence.	ICP: All analytes within + 10% of expected value from ICAL.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed	Apply **R**-flag to data with CCV outside criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MB, Equipment Blank	One per preparatory batch, one per sampling day	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination.
Calibration blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct problem. If required, reprep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Interference check solutions (ICSs) (ICP only).	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes). ICS-AB: Within + 20% of expected value.	Terminate analysis; locate and correct problem; reanalyze ICS.	No samples may be analyzed without a valid ICS.	Apply **R**-flag to data with ICS outside criteria.
LCS	One per preparatory batch	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects. Very low bias (ICP Metals %R<60%: Apply **J**-flag to detects and R-flag to non-detects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Dilution test (ICP only).	Each preparatory batch or when a new or unusual matrix is encountered.	Fivefold dilution must agree within + 10% of the original determination.	ICP: Perform post-digestion spike (PDS) addition.	Only applicable for samples with concentrations > 50X LOQ (6010B)	Apply **J**-flag to analytes in parent sample outside criteria.
PDS (ICP only)	When dilution test fails or analyte concentration in all samples < 50X LOD.	75-125%	See flagging criteria.	The spike addition should produce a level between 10-100X LOQ	Apply **J**-flag to analytes in parent sample outside criteria

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
MS/MSD	One per preparatory batch per matrix.	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. No data flagging if native concentrations are > 4X spiking amount.	For the specific analyte(s) in the parent sample, apply **M**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data.
Laboratory sample duplicate	One per preparatory batch per matrix (if MS/MSD is not performed).	RPD < 20% (sample and sample duplicate).	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	The data shall be evaluated to determine the source of difference.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met.
Field Duplicate	One per 10 field samples	See UFP-QAPP **Worksheet #12** (UFP-QAPP Manual Section 2.6.2).	N/A	N/A	Apply **J**-flag to detects and **UJ**-flag to non-detects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Results reported between DL and LOQ	N/A	N/A	N/A	None	Apply **J**-flag to all results between DL and LOQ.

Table 12-6
Data Review/Validation Criteria for USEPA Method Modified 353.2

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once quarterly LOD verification checks shall be performed.	See DoD QSM v 4.2. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat DL determination and LOD verification check at higher level and set LOD.	LOD is 2-3x the DL (for a single-analyte standard) or greater than 1-4x the DL (for a multi-analyte standard).	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently quarterly LOQ verification checks shall be performed.	See DoD QSM v 4.2. LOQ must be set within the calibration range prior to sample analysis.	N/A	None	N/A
Holding time	Every sample	28 days to analysis	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to non-detects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to non-detects to samples > 2X holding time criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Sample temperature	Every cooler	6°C-10°C	Contact FPM as to additional measures to be taken.	None	Samples arriving at temperature 6°C-10°C, apply **J**-flag to detects and **U**-flag to non-detects. Samples arriving at temperature > 10°C, apply **J**-flag to detects and **R**-flag to non-detects.
Minimum five point ICAL for all analytes	Minimum of 5 calibration standards with the lowest standard concentration at or below the LOQ.	The apparent signal-to-noise ratio at the RL must be at least 5:1. %RSD <20 or, linear correlation coefficient r ≥ 0.995 or r2≥0.990.	Correct problem then repeat ICAL	Problem must be corrected. No samples may be run until ICAL has passed	Flagging criteria are not appropriate.
Second source ICV	Once after each ICAL,	Value of second source for all analytes within ± 10% of expected value (initial source)	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Problem must be corrected. No samples may be run until calibration has been verified.	Flagging criteria are not appropriate.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All analytes within ± 10% of expected value from ICAL.	Correct problem then repeat ICAL and reanalyze all samples since the last successful calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply **R**-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.
MB	One per preparatory batch.	No analytes detected > 1/2 LOQ.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Problem must be corrected. Results may not be reported without a valid MB. Apply **R** flag only in cases where the samples cannot be reanalyzed.	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply **B**-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LCS	One per preparatory batch	Recovery within 50%-120%.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply **R**-flag to specific analyte(s) in all samples in the associated preparatory batch.
MS/MSD	One per preparatory batch per matrix.	Recovery within 50%-120% and RPD $\leq$ 20.	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	For the specific analyte(s) in the parent sample, apply **J**-flag if acceptance criteria are not met.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Results reported between DL and LOQ	N/A	N/A	N/A	None	Apply **J**-flag to all results between DL and LOQ.
Field Duplicate	One per 10 field samples	See UFP-QAPP **Worksheet #12** (UFP-QAPP Manual Section 2.6.2).	N/A	The data shall be evaluated to determine the source of difference.	Apply **J**-flag if acceptance criteria are not met.

Table 12-7
Data Review/Validation Criteria for USEPA Method 300/ SW-846 9056A

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOD verification checks shall be performed.	See DoD QSM v 4.2. LOD verification checks must produce a signal at least 3 times the instrument's noise level.	Repeat DL determination and LOD verification check at higher level and set LOD.	LOD is 2-3x the DL (for a single-analyte standard) or greater than 1-4x the DL (for a multi-analyte standard).	Apply **R**-flag to data without a valid LOD verification
LOQ establishment and verification	At initial set-up and subsequently once per 12-month period; otherwise quarterly LOQ verification checks shall be performed.	See DoD QSM v 4.2. LOQ must be set within the calibration range prior to sample analysis.	N/A	None	N/A
Holding time	Every sample	48 hours (nitrate/nitrite)/28 days (chloride, bromide, sulfate); see **Worksheet #19**	Contact FPM as to additional measures to be taken.	None	Apply **J**-flag to detects and **UJ**-flag to non-detects to samples < 2X holding time criteria. Apply **J**-flag to detects and **R**-flag to non-detects to samples > 2X holding time criteria.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
ICAL for all analytes ICP: Minimum three standards and one calibration blank	Daily ICAL prior to sample analysis.	$r \geq 0.995$.	Correct problem then repeat ICAL	Problem must be corrected. No samples may be run until ICAL has passed	Apply **R**-flag to data without a valid ICAL
Second source ICV	Once after each ICAL, prior to sample analysis	Value of second source for all analytes within ± 10% of expected value (initial source) and retention times within appropriate windows.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Problem must be corrected. No samples may be run until calibration has been verified.	Apply **R**-flag to data without second source verification.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Midrange CCV	After every 10 samples and at the end of the analysis sequence.	All analytes within + 10% of expected value from ICAL. All project analytes within established retention time windows.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed	Apply **R**-flag to data with CCV outside criteria.
MB, Equipment Blank	One per preparatory batch, one per sampling day	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank.	Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Apply **B**-flag to analytes detected in field samples < 5X blank contamination.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LCS	One per preparatory batch	Laboratory in-house limits not to exceed ±20%. Control limits may be not greater than ±3 x the standard deviation of the mean LCS recovery.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed	High bias: Apply **J**-flag to detects. Low bias: Apply **J**-flag to detects and **UJ**-flag to non-detects. Very low bias (ICP Metals %R<60%: Apply **J**-flag to detects and R-flag to non-detects.
MS/MSD	One per preparatory batch per matrix.	QC acceptance criteria specified in UFP-QAPP **Table 12-1** (not to exceed ±20%).	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	For matrix evaluation only. If MS results are outside QC limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error. No data flagging if native concentrations are > 4X spiking amount.	For the specific analyte(s) in the parent sample, apply **M**-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Laboratory sample duplicate	One per preparatory batch per matrix (if MS/MSD is not performed).	RPD < 15% (sample and sample duplicate).	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	The data shall be evaluated to determine the source of difference.	For the specific analyte(s) in the parent sample, apply **J**-flag to detects if acceptance criteria are not met.
Results reported between DL and LOQ	N/A	N/A	N/A	N/A	Apply J-flag to all results between DL and LOQ.
Field Duplicate	One per 10 field samples	See UFP-QAPP **Worksheet #12** (UFP-QAPP Manual Section 2.6.2).	Correct problem and reanalyze sample and duplicate.	N/A	Apply **J**-flag to detects and **UJ**-flag to non-detects if sample cannot be rerun or reanalysis does not correct problem.

Table 12-8
Data Review/Validation Criteria for USEPA Method 6850

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Method Detection Limit (MDL) study	At initial set-up and subsequently once per 12 month period; otherwise quarterly MDL verification checks will be performed.	Per DoD Perchlorate handbook requirements	Run MDL verification check at higher level and set MDL higher or re-conduct MDL study.	Samples cannot be analyzed without a valid MDL.	Apply R-flag to data without a valid MDL study.
MS tuning check/ Mass Calibration	Prior to ICAL and calibration verification	Refer to criteria listed in the method and DoD Perchlorate Handbook.	Retune instrument and verify	None	Apply R-flag to data without a valid Mass tuning and Mass calibration
Holding time	Every sample	28 days	Contact FPM as to additional measures to be taken.	None	Apply J-flag to detects and UJ-flag to non-detects to samples < 2X holding time criteria. Apply J-flag to detects and R-flag to non-detects to samples > 2X holding time criteria.
Sample temperature	Every cooler	≤ 6°C	Contact FPM as to additional measures to be taken.	None	Samples arriving at temperature 6-10°C, apply J-flag to detects and UJ-flag to non-detects. Samples arriving at temperature > 10°C, apply J-flag to detects and R-flag to non-detects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
ICAL (minimum five standards)	ICAL prior to sample analysis.	Option 1 – mean RSD ≤ 20%. Option 2 linear – least squares regression, r ≥ 0.995. Option 3 non-linear – COD ≥ 0.995 (six points shall be used for second order, seven points shall be used for third order).	Correct problem then repeat ICAL	Problem must be corrected. No samples may be run until ICAL has passed	Apply R-flag to data without a valid ICAL
ICV	Once multipoint calibration, upon reestablishing calibration, quarterly	Instrument response within ± 15% of expected value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Problem must be corrected. No samples may be run until calibration has been verified.	High bias: Apply J-flag to detects. Slightly Low bias: Apply J-flag to detects and UJ-flag to non-detects. Low bias (%R<80%): Apply J-flag to detects and R-flag to non-detects.
Manual Integration	All	Acceptance by FPM Chemist or 3rd party validator	Provide justification for each instance of manual integration	Laboratory will provide initialed and dated chromatograms before and after each manual integration.	Apply R-flag to all compounds with improper integration.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
CCV	Daily before and after every 10 samples and at the end of the analysis sequence.	Instrument response within + 15% of expected response, alternately using separate mid and high level standards.	Correct problem then repeat CCV. Reanalyze all samples since the last successful calibration verification.	None	High bias: Apply J-flag to detects. Low bias: Apply J-flag to detects and R-flag to non-detects.
MB, or Laboratory Reagent Blank	One per analytical batch.	Perchlorate must be ≤ ½ RL	Correct problem. If necessary, reprep and reanalyze MB and all samples processed with the contaminated blank.	None	Apply U-flag to analytes detected in field samples < 5X blank contamination.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LCS	One per preparatory batch	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.	LCS will contain all analytes to be reported, including surrogates.	High bias: Apply J-flag to detects. Low bias: Apply J-flag to detects and UJ-flag to non-detects. Very low bias (%R<30% or ½ the lower limit): Apply J-flag to detects and R-flag to non-detects.
MS/MSD	One per preparatory batch per matrix.	QC acceptance criteria specified in UFP-QAPP **Table 12-1**.	Examine the project-specific DQOs. Contact FPM as to additional measures to be taken.	MS will contain all analytes to be reported, including surrogates	For the specific analyte(s) in the parent sample, apply J-flag to detects if acceptance criteria are not met. MS/MSD data should not be used alone to qualify data.
ICS	One ICS is prepared with every batch of 20 samples and must undergo the same preparation and pretreatment steps as the samples in the batch.	Recovery within 30% of expected concentration.	Correct problem and then reanalyze all samples in that batch.	None	High bias: Apply J-flag to detects. Low bias: Apply J-flag to detects and UJ-flag to non-detects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
LOD determination and verification	Analyze before and directly after every batch of samples or after every 10 samples.	Refer to criteria listed in the method and DoD Perchlorate Handbook.	Correct problem and rerun LOD verification and all samples analyzed since last successful LOD verification.	None	Apply J-flag to detects and UJ-flag to non-detects
Isotope Ratio $^{35}Cl/^{37}Cl$	Every sample, QC sample, and standard	Refer to criteria listed in the method and DoD Perchlorate Handbook.	If criteria are not met, the samples must be rerun. (see DoD Perchlorate Handbook).	None	Apply J-flag to detects and UJ-flag to non-detects
Internal Standards	Addition of 18O-labeled Perchlorate to every sample, QC sample, standard and blank.	Refer to criteria listed in the method and DoD Perchlorate Handbook.	N/A	Rerun the sample at increasing dilutions until the ± acceptance criteria are met. If criteria cannot be met with dilution, then interferences are suspect and the sample must be reprepped using additional pretreatment steps.	Apply J-flag to detects and UJ-flag to non-detects.

QC Check	Minimum Frequency	Acceptance Criteria	Laboratory Corrective Action	Comments	FPM Flagging Criteria
Field Duplicate	One per 20 field samples	If the parent sample and duplicate values are > 5XRL, then <30% RPD for water samples (<50% RPD soil). If the parent sample or duplicate sample value is <5XRL, then absolute difference is <2XRL for water samples (<3XRL for soil).	N/A	N/A	Apply J-flag to detects and UJ-flag to non-detects.

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QAPP Worksheet #13 – Secondary Data Uses and Limitations

Data Type	Data Source	How Data Will Be Used	Limitations on Data Use
Soil Data	Holloman Air Force Base, Basewide Background Study Report NationView, LLC., NMED.	To assess potential areas of contamination and focus data collection activities in specific site areas where contamination is most likely. To determine if clean-up requirements and Site Closeout goals are met.	Secondary data may not meet all DQOs, and, therefore, may not be able to be used without limitation.
Soil Data	Holloman Air Force Base, Comprehensive Site Evaluation Phase II Report, September 2013 (USACE) Historic maps, records, and various documents relating to historic site use, CSE Phase I information, soil sample collection and contamination delineation. USACE and HDR.		

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QAPP Worksheet #14 and #16 – Project Tasks & Schedule
The project schedule is provided in WP **Appendix D.**

Summary of Project Tasks

Sampling Tasks (Performed by FPM)**:**

- Specific discussion of the sampling approach and sampling design and rationale is provided in **Worksheet #17**.
- Soil sampling will assess the absence or presence of MC contamination at the XU853 MTSA and XU854 Able 51 Area MRSs. Sample locations will be surveyed using Real-Time Kinematic Global Positioning System (GPS) (RTK-GPS), or Differential GPS (DGPS) equipment.
- Groundwater sampling will be retained as an option to assess the absence or presence of MC contamination at the MTSA and Able 51 Area MRSs if soil sample analysis results indicate the potential for contaminant migration to groundwater. Sample locations will be surveyed using RTK-GPS or DGPS equipment.
- Samples will be collected using the field SOPs attached as **Appendix A** of this UFP-QAPP.

Analysis Tasks:

- Accutest will analyze samples using USEPA SW-846 Method 8330A for the following explosives: 1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; o-Nitrotoluene; 3,5-Dinitroaniline; m-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; p-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl.
- Accutest will analyze samples using USEPA SW-846 Method 8330B for the following explosives: 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; and RDX.
- Accutest will analyze samples using USEPA SW-846 Method 6010C for the following metals: aluminum; antimony; chromium; copper; iron; lead; and zinc.
- Accutest will analyze samples using USEPA SW-846 Method 9056A for the following Anions: Nitrate.
- Accutest will analyze samples using USEPA SW-846 Method 6850 for Perchlorate.
- Empirical Laboratories, LLC will analyze samples using USEPA Method Modified 353.2 for the following explosives: Nitrocellulose.

Summary of Project Tasks

QC Tasks – All Projects: 1. MS/MSDs will be collected at an approximate frequency of 5%. 2. Duplicates will be collected at a rate of 10% and analyzed by Accutest Laboratories to assess field and laboratory precision. 3. Equipment blanks will be collected from each type of non-disposable, decontaminated sampling device. 4. Laboratory performance evaluation (PE) samples will be collected at each site to assess the laboratory's ability to provide defensible data of a known quality. 5. Data validation will be conducted on 100% of all analytical data collected.
Secondary Data – All Projects: Previously collected data will be evaluated. Secondary data may not meet all DQOs, and, therefore, may not be able to be used without limitation. See **Worksheet #13**.
Data Management Tasks – All Projects: Data will be delivered in an Environmental Restoration Program Information Management System (ERPIMS) database compatible format after data verification/ validation have been performed and data qualifiers have been added.
Waste Management Tasks – All Projects: 1. Soils sampled but not used for laboratory analysis will be containerized in 55 gallon Department of Transportation approved drums. Soils contained in 55 gallon drums will be characterized for proper disposal off site. Decontamination water (if non disposable sampling equipment is used) will also be collected in drums and analyzed disposal off site.
Documentation and Records – All Projects: 1. All field documentation will be recorded in indelible ink in bound field books. These will summarize all daily field activities, weather conditions, personnel present, visitors, etc. All samples collected will be documented as to their location, which will be measured using a RTK-GPS or DGPS. Each day's samples and associated field measurements shall be recorded on field sampling forms. Chain of Custody (CoC) forms, bills of lading, airbills, and sample logs will be prepared and retained for each sample. 2. A copy of the final UFP-QAPP will be retained in a central project file (electronically on a server) and in print form in the onsite

Summary of Project Tasks

office, as well as in the Administrative Record.
Data Packages – All Projects: The applicable laboratory, Accutest or Empirical Laboratories, will complete analytical data packages IAW the AFCEC approved forms or similar and will provide ERPIMS X file.
Assessment / Audit Tasks – All projects: Field Sample Collection and Documentation Audits: to be determined (TBD)
Data Review Tasks – All projects 1. For the samples, the applicable Laboratory (Accutest or Empirical Laboratories) will verify that all data are complete for samples received. All data package deliverable requirements will be met. Data will be 100% verified by FPM IAW this UFP-QAPP. A data verification report will be prepared for each lab work order (lab data package). 2. Verified and validated data and all related field logbooks/notes/records will be reviewed to assess total measurement error and determine overall usability of the data for project purposes. Data limitations will be determined and data will be compared to Project Quality Objectives and required Action Limits. Corrective Action will be completed as necessary. Final validated data are placed in the ERPIMS database, with any necessary qualifiers and tables, charts and graphs generated.

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QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: Explosives (SW-846 Method 8330A)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Soil Background Levels[a] (mg/kg)	Project Action Limit – HH Residential Screening Level milligram per kilogram (mg/kg)			Project Action Limits – Ecological	Achievable Laboratory Limits[1]		
			USEPA Regional Screening Levels (RSLs)[b]	New Mexico Soil Screening Levels (SSLs)[c]	Recommended HH Soil Screening Values	Soil (mg/kg)	LOQs (mg/kg)	LODs (mg/kg)	MDL (mg/kg)
1,3-Dinitrobenzene	99-65-0	NA	0.62	NA	0.62	0.073[d]	0.2	0.1	0.08
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	15	NA	15	10[d]	0.2	0.1	0.08
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	15	NA	15	3.6[d]	0.2	0.1	0.08
2,4-Dinitrotoluene	121-14-2	NA	1.7	15.7	1.7	2.5[d]	0.2	0.1	0.08
2,6-Dinitrotoluene	606-20-2	NA	0.36	61.1	0.36	1.8[d]	0.2	0.1	0.08
RDX	121-82-4	NA	6.0	58.2	6.0	7.5[d]	0.2	0.1	0.08
Nitrobenzene	98-95-3	NA	5.1	53.5	5.1	2.2	0.2	0.1	0.08
Nitroglycerin	55-63-0	NA	0.62	6.11	0.62	71[d]	2	1	0.5
o-Nitrotoluene	88-72-2	NA	3.2	29.1	3.2	9.9[d]	0.2	0.1	0.08

Analyte	CAS No.	Holloman AFB Soil Background Levels[a] (mg/kg)	Project Action Limit – HH Residential Screening Level milligram per kilogram (mg/kg)			Project Action Limits – Ecological	Achievable Laboratory Limits[1]		
			USEPA Regional Screening Levels (RSLs)[b]	New Mexico Soil Screening Levels (SSLs)[c]	Recommended HH Soil Screening Values	Soil (mg/kg)	LOQs (mg/kg)	LODs (mg/kg)	MDL (mg/kg)
m-Nitrotoluene	99-08-1	NA	0.62	7.82	0.62	12[d]	0.2	0.1	0.08
p-Nitrotoluene	99-99-0	NA	25	244	25	22[d]	0.2	0.1	0.08
HMX	2691-41-0	NA	380	3,910	380	27[d]	0.2	0.1	0.08
PETN	78-11-5	NA	12	NA	12	100[d]	2	1	0.5
1,3,5-Trinitrobenzene	99-35-4	NA	220	NA	220	6.6[d]	0.2	0.1	0.08
2,4,6-Trinitrotoluene	118-96-7	NA	3.6	39.1	3.6	6.4[d]	0.2	0.1	0.08
Tetryl	479-45-8	NA	12	244	12	0.99[d]	0.2	0.1	0.08
3,5-Dinitroaniline	618-87-1	NA	NA	NA	NA	NA	0.2	0.1	0.08

Notes:
NA = No value available
a – (NMED, 2012a). Approved Basewide Background Levels Holloman AFB, NMED Approval Letter. 1 March.
b – (USEPA, 2014). Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (NMED, 2012b). New Mexico Soil Screening Levels. http://www.nmenv.state.nm.us/HWB/documents/NMED_RA_Guidance_for_SI_and_Remediation_Feb_2012_.pdf
d – Unless otherwise noted, the ecological screening value in this column represents the Ecological Screening Level (ESL) for soil developed by Los Alamos National Laboratory., (LANL, 2012). Ecological Screening Levels. Los Alamos National Laboratory Eco Database. U.S. Department of Energy.
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies.

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: Explosives (SW-846 Method 8330B)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Soil Background Levels[a] (mg/kg)	Project Action Limit – HH Residential Screening Level (mg/kg)			Project Action Limits – Ecological	Achievable Laboratory Limits[1]		
			USEPA RSLs[b]	New Mexico SSLs[c]	Recommended HH Soil Screening Values	Soil (mg/kg)	LOQs (mg/kg)	LODs (mg/kg)	MDL (mg/kg)
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	15	NA	15	10[d]	0.1	0.05	0.04
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	15	NA	15	3.6[d]	0.1	0.05	0.04
2,4-Dinitrotoluene	121-14-2	NA	1.7	15.7	1.7	2.5[d]	0.1	0.05	0.04
2,6-Dinitrotoluene	606-20-2	NA	0.36	61.1	0.36	1.8[d]	0.1	0.05	0.04
RDX	121-82-4	NA	6.0	58.2	6.0	7.5[d]	0.1	0.05	0.04
Nitroglycerin	55-63-0	NA	0.62	6.11	0.62	71[d]	1	0.5	0.25
HMX	2691-41-0	NA	380	3,910	380	27[d]	0.1	0.05	0.04
2,4,6-Trinitrotoluene	118-96-7	NA	3.6	39.1	3.6	6.4[d]	0.1	0.05	0.04

Notes:
NA = No value available
a – (NMED, 2012a). Approved Basewide Background Levels Holloman AFB, NMED Approval Letter. 1 March.
b – (USEPA, 2014). Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (NMED, 2012b). New Mexico Soil Screening Levels. http://www.nmenv.state.nm.us/HWB/documents/NMED_RA_Guidance_for_SI_and_Remediation_Feb_2012_.pdf

d – Unless otherwise noted, the ecological screening value in this column represents the Ecological Screening Level (ESL) for soil developed by Los Alamos National Laboratory., (LANL, 2012). Ecological Screening Levels. Los Alamos National Laboratory Eco Database. U.S. Department of Energy.

1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies.

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection / Quantitation Limits Table

Matrix: Aqueous
Analytical Group: Explosives (SW-846 Method 8330B)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Approved Basewide Background Levels[a]		Project Action Limit – HH Groundwater Screening Value milligrams/liter (µg/l)			Achievable Laboratory Limits[1]		
		Total Analytes in Groundwater UTL (µg/l)	Dissolved Analytes in Groundwater UTL (µg/l)	USEPA MSLs[b]	New Mexico MSLs[c]	Recommended HH Groundwater Screening Values	LOQs (µg/l)	LODs (µg/l)	MDL (µg/l)
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	NA	NA	NA	3.9[d]	0.2	0.1	0.08
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	NA	NA	NA	3.9[d]	0.2	0.1	0.08
2,4-Dinitrotoluene	121-14-2	NA	NA	NA	NA	0.24[d]	0.2	0.1	0.08
2,6-Dinitrotoluene	606-20-2	NA	NA	NA	NA	0.048[d]	0.2	0.1	0.08
RDX	121-82-4	NA	NA	NA	NA	0.7[d]	0.2	0.1	0.08
Nitroglycerin	55-63-0	NA	NA	NA	NA	0.2[d]	0.2	0.1	0.08
HMX	2691-41-0	NA	NA	NA	NA	100[d]	0.2	0.1	0.08
2,4,6-Trinitrotoluene	118-96-7	NA	NA	NA	NA	0.98[d]	0.2	0.1	0.08

Notes:
NA = No value available
a – Final approved background levels for constituents in soil, and unfiltered (total) and filtered (dissolved) constituents in groundwater (Holloman AFB, 2012).
b – (USEPA, 2014). Maximum Contaminant Level-based SSL from Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (New Mexico Water Quality Control Commission [NMWQCC] Regulations and Standards, 2002). Ground and Surface Water Protection. http://www.nmenv.state.nm.us/wqcc/regulations.html
d – (USEPA, 2014). Regional Screening Levels based SSL for tapwater from Regional Screening Levels Table. (no USEPA or NMWQCC MSL available).
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: Metals (SW-846 Method 6010C)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Soil Background Levels[a] (mg/kg)	Project Action Limit – HH Residential Screening Level (mg/kg)			Project Action Limits – Ecological	Achievable Laboratory Limits[1]		
			USEPA RSLs[b]	New Mexico SSLs[c]	Recommended HH Soil Screening Values	Soil (mg/kg)	LOQs (mg/kg)	LODs (mg/kg)	MDL (mg/kg)
Aluminum	7429-90-5	13,722	7,700	78,000	7,700	NA	10	1.25	1
Antimony	7440-36-0	1.6	3.1	31.3	3.1	0.05[d]	1	0.1	0.095
Chromium	16065-83-1	25	12,000	117,000	12,000	28[d]	0.5	0.1	0.09
Copper	7440-50-8	13	310	3130	310	15[d]	1.25	0.1	0.09
Iron	7439-89-6	23,049	5,500	54,800	5,500	NA	15	5	3.5
Lead	7439-92-1	10.9	400	400	400	14[d]	1	0.1	0.055
Zinc	7440-66-6	54.6	2,300	23,500	2,300	48[d]	1	0.25	0.15

Notes:
NA = No value available
a – (NMED, 2012a). Approved Basewide Background Levels Holloman AFB, NMED Approval Letter. 1 March.
b – (USEPA, 2014). Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (NMED, 2012b). New Mexico Soil Screening Levels. http://www.nmenv.state.nm.us/HWB/documents/NMED_RA_Guidance_for_SI_and_Remediation_Feb_2012_.pdf
d – Unless otherwise noted, the ecological screening value in this column represents the Ecological Screening Level (ESL) for soil developed by Los Alamos National Laboratory., (LANL, 2012). Ecological Screening Levels. Los Alamos National Laboratory Eco Database. U.S. Department of Energy.
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies.

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: Explosives (USEPA Method Modified 353.2)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Soil Background Levels[a] (mg/kg)	Project Action Limit – HH Residential Screening Level (mg/kg)			Project Action Limits – Ecological	Achievable Laboratory Limits[1]		
			USEPA RSLs[b]	New Mexico SSLs[c]	Recommended HH Soil Screening Values	Soil (mg/kg)	LOQs (µg/kg)	LODs (µg/kg)	MDL (µg/kg)
Nitrocellulose	9004-70-0	NA	1.8E+07	NA	1.8E+07	NA	4,000	2,000	1,000

Notes:
NA = No value available
a – (NMED, 2012a). Approved Basewide Background Levels Holloman AFB, NMED Approval Letter. 1 March.
b – (USEPA, 2014). Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (NMED, 2012b). New Mexico Soil Screening Levels. http://www.nmenv.state.nm.us/HWB/documents/NMED_RA_Guidance_for_SI_and_Remediation_Feb_2012_.pdf
d – Unless otherwise noted, the ecological screening value in this column represents the Ecological Screening Level (ESL) for soil developed by Los Alamos National Laboratory., (LANL, 2012). Ecological Screening Levels. Los Alamos National Laboratory Eco Database. U.S. Department of Energy.
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies.

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection / Quantitation Limits Table

Matrix: Aqueous
Analytical Group: Explosives (USEPA Method Modified 353.2)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Approved Basewide Background Levels[a]		Project Action Limit – HH Groundwater Screening Level (µg/l)			Achievable Laboratory Limits[1]		
		Total Analytes in Groundwater UTL (µg/l)	Dissolved Analytes in Groundwater UTL (µg/l)	USEPA MSLs[b]	New Mexico MSLs[c]	Recommended HH Groundwater Screening Values	LOQs (µg/l)	LODs (µg/l)	MDL (µg/l)
Nitrocellulose	9004-70-0	NA	NA	NA	NA	6.0E+06[d]	1,200	800	400

Notes:
NA = No value available
a – Final approved background levels for constituents in soil, and unfiltered (total) and filtered (dissolved) constituents in groundwater (Holloman AFB, 2012).
b – (USEPA, 2014). Maximum Contaminant Level-based SSL from Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (New Mexico Water Quality Control Commission [NMWQCC] Regulations and Standards, 2002). Ground and Surface Water Protection. http://www.nmenv.state.nm.us/wqcc/regulations.html
d – (USEPA, 2014). Regional Screening Levels based SSL for tapwater from Regional Screening Levels Table. (no USEPA or NMWQCC MSL available).
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: Anions (SW-846 Method 300/9056A)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Soil Background Levels[a] (mg/kg)	Project Action Limit – HH Residential Screening Level (mg/kg)			Project Action Limits – Ecological	Achievable Laboratory Limits[1]		
			USEPA RSLs[b]	New Mexico SSLs[c]	Recommended HH Soil Screening Values	Soil (mg/kg)	LOQs (mg/kg)	LODs (mg/kg)	MDL (mg/kg)
Nitrate	14797-55-8	NA	13,000	125,000	13,000	NA	0.5	0.5	1

Notes:
NA = No value available
a – (NMED, 2012a). Approved Basewide Background Levels Holloman AFB, NMED Approval Letter. 1 March.
b – (USEPA, 2014). Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (NMED, 2012b). New Mexico Soil Screening Levels. http://www.nmenv.state.nm.us/HWB/documents/NMED_RA_Guidance_for_SI_and_Remediation_Feb_2012_.pdf
d – Unless otherwise noted, the ecological screening value in this column represents the Ecological Screening Level (ESL) for soil developed by Los Alamos National Laboratory., (LANL, 2012). Ecological Screening Levels. Los Alamos National Laboratory Eco Database. U.S. Department of Energy.
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies.

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection / Quantitation Limits Table

Matrix: Aqueous
Analytical Group: Anions (SW-846 Method 300/9056A)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Approved Basewide Background Levels[a]		Project Action Limit – HH Groundwater Screening Level (µg/l)			Achievable Laboratory Limits[1]		
		Total Analytes in Groundwater UTL (µg/l)	Dissolved Analytes in Groundwater UTL (µg/l)	USEPA MSLs[b]	New Mexico MSLs[c]	Recommended HH Groundwater Screening Values	LOQs (µg/l)	LODs (µg/l)	MDL (µg/l)
Nitrate	14797-55-8	NA	NA	10,000	10,000	10,000	50	50	100

Notes:
NA = No value available
a – Final approved background levels for constituents in soil, and unfiltered (total) and filtered (dissolved) constituents in groundwater (Holloman AFB, 2012).
b – (USEPA, 2014). Maximum Contaminant Level-based SSL from Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (New Mexico Water Quality Control Commission [NMWQCC] Regulations and Standards, 2002). Ground and Surface Water Protection. http://www.nmenv.state.nm.us/wqcc/regulations.html
d – (USEPA, 2014). Regional Screening Levels based SSL for tapwater from Regional Screening Levels Table. (no USEPA or NMWQCC MSL available).
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soils
Analytical Group: Perchlorates (SW-846 Method 6850)
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Soil Background Levels[a] (mg/kg)	Project Action Limit – HH Residential Screening Level (mg/kg)			Project Action Limits – Ecological	Achievable Laboratory Limits[1]		
			USEPA RSLs[b]	New Mexico SSLs[c]	Recommended HH Soil Screening Values	Soil (mg/kg)	LOQs (µg/kg)	LODs (µg/kg)	MDL (µg/kg)
Perchlorate	14797-73-0	NA	5.5	54.8	5.5	NA	2	1	0.4

Notes:
NA = No value available
a – (NMED, 2012a). Approved Basewide Background Levels Holloman AFB, NMED Approval Letter. 1 March.
b – (USEPA, 2014). Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (NMED, 2012b). New Mexico Soil Screening Levels. http://www.nmenv.state.nm.us/HWB/documents/NMED_RA_Guidance_for_SI_and_Remediation_Feb_2012_.pdf
d – Unless otherwise noted, the ecological screening value in this column represents the Ecological Screening Level (ESL) for soil developed by Los Alamos National Laboratory., (LANL, 2012). Ecological Screening Levels. Los Alamos National Laboratory Eco Database. U.S. Department of Energy.
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies.

QAPP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection / Quantitation Limits Table

Matrix: Aqueous
Analytical Group: Perchlorates (SW-846 Method 6850
Concentration Level: Low

Analyte	CAS No.	Holloman AFB Approved Basewide Background Levels[a]		Project Action Limit – HH Groundwater Screening Level (µg/l)			Achievable Laboratory Limits[1]		
		Total Analytes in Groundwater UTL (µg/l)	Dissolved Analytes in Groundwater UTL (µg/l)	USEPA MSLs[b]	New Mexico MSLs[c]	Recommended HH Groundwater Screening Values	LOQs (µg/l)	LODs (µg/l)	MDL (µg/l)
Perchlorate	14797-733-0	NA	NA	15	NA	15	0.2	0.1	0.06

Notes:
NA = No value available
a – Final approved background levels for constituents in soil, and unfiltered (total) and filtered (dissolved) constituents in groundwater (Holloman AFB, 2012).
b – (USEPA, 2014). Maximum Contaminant Level-based SSL from Regional Screening Levels Table. http://www.epa.gov/region6/6pd/rcra_c/pd-n/screen.htm
c – (New Mexico Water Quality Control Commission [NMWQCC] Regulations and Standards, 2002). Ground and Surface Water Protection. http://www.nmenv.state.nm.us/wqcc/regulations.html
d – (USEPA, 2014). Regional Screening Levels based SSL for tapwater from Regional Screening Levels Table. (no USEPA or NMWQCC MSL available).
1 - Laboratory-specific MDL/LOD/LOQ values are limits that an individual laboratory can achieve when performing a specific analytical method. MDLs may be subject to update during quarterly studies

QAPP Worksheet #17 – Sampling Design and Rationale

The Holloman XU853 MTSA and XU854 Able 51 Area locations are shown in **Figure 1**. Field activities at the MTSA and Able 51 Area sites will consist of MEC/MPPEH/MD surface clearance, DGM, MEC/MPPEH/MD intrusive investigations, and MC sampling. Specific details of the MEC/MPPEH/MD surface clearance, DGM, and MEC/MPPEH/MD intrusive investigations sampling design and rationale are provided in the RI **WP Sections 3.2, 3.4,** and **3.6**, respectively. Specific details of the MC sampling design and rationale are provided below. Additional details of the MC sampling plan are provided in the RI **WP Section 3.7**.

Sampling activities at both MRSs will include surface/subsurface soil sampling for explosives and metals at confirmed MEC and MPPEH locations and in areas with significant amounts of MD and could occur anywhere within the MRSs. Sampling activities at both MRSs will also include surface soil sampling for propellants at historic missile launch sites and at isolated locations showing evidence of potential contamination (e.g., discolored soil). The soil samples will be collected to identify and delineate any soil contamination above USEPA residential screening levels. Previously collected background soil sample data obtained from the Basewide Background Study Report, Holloman AFB, NM (NationView, 2011/NMED 2012) will be used during data evaluation to determine potentially impacted soil areas. If soil sampling results indicate the potential for migration of MC into the groundwater, then GR sampling may be conducted at the specific source location(s) for the identified contaminant(s) of concern.

All sampling results will be used to determine if additional remedial actions are necessary for any impacted areas at the site. All field parameter measurements will be documented in the daily QC reports issued as part of the Investigation/Sampling Reports issued as part of the RI report.

MC Associated with MEC

Soil sampling will be conducted at the XU853 MTSA and XU854 Able 51 Area MRSs to determine the nature and extent of MC contamination associated with MEC/MPPEH/MD. Representative soil samples will be collected at MEC and MPPEH (classified as MDEH) find locations and in areas with significant amounts of MD using the composite sampling method following procedures described in the field SOPs presented in **Appendix A**. The sampling depths will be determined based in part upon the depth of the MEC/MPPEH/MD find during the intrusive investigation. MEC/MPPEH/MD surface finds will result in only surface soil being collected because any resulting MC are expected to be close to the surface if soil is undisturbed. Conversely, MEC/MPPEH/MD subsurface finds will result in subsurface soil being collected at the same location and depth of MEC/MPPEH/MD and analyzed for MC. The number of soil samples collected will be dependent on the number of MEC finds. We estimate that approximately 20 and 4 composite samples will be required at the MTSA and Able 51 Area sites, respectively. However, if no MEC or MPPEH is found and no areas with significant amounts of MD then MC soil sampling will not occur. The composite soil samples will be analyzed for explosives (1,3,5-Trinitrobenzene; 1,3-Dinitrobenzene; 2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; o-Nitrotoluene; 3,5-Dinitroaniline; m-Nitrotoluene; 4-Amino-2,6-Dinitrotoluene; p-Nitrotoluene; HMX; Nitrobenzene; Nitroglycerin; PETN; RDX; and Tetryl) by USEPA method SW 846 8330A and for metals (aluminum, antimony, chromium, copper, iron, lead, and zinc) by USEPA method SW 846 6010C to determine if contamination posing a potential threat to the human and ecological environment is present.

MC Associated with Missile Testing

Soil sampling will also be conducted at the XU853 MTSA and XU854 Able 51 Area MRSs to determine the nature and extent of MC contamination associated with the historical use of the sites as missile launch test facilities. Representative soil samples will be collected at rocket/missile launch pad locations using the incremental sampling (IS) method following procedures described in the field SOPs presented in **Appendix A**. Surface IS soil samples will be collected from each decision unit (one decision unit per launch pad site). We estimate that approximately 4 and 2 IS samples will be required at the MTSA and Able 51 Area sites, respectively (one at each launch pad site). The IS soil samples will be analyzed for explosives (2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; and RDX) by USEPA Method 8330B, for explosives (Nitrocellulose) by USEPA Method 353.2, for Anions (Nitrate) by USEPA method 300/9056A, and for Perchlorate by USEPA method 6850 to determine if contamination posing a potential threat to the human and ecological environment is present. The approximate locations and size of the IS decision units for the MTSA and Able 51 Area sites are illustrated in **Figures 2** and **3**, respectively. The IS decision units are coincident with the DGM grid locations at the launch pad sites.

Representative soil samples will also be collected at isolated locations showing evidence of potential contamination (e.g., discolored soil) using the composite sampling method following procedures described in the field SOPs presented in **Appendix A**. Surface composite soil samples will be collected at each suspect location. We estimate that approximately 4 and 1 composite samples will be required at the MTSA and Able 51 Area sites, respectively. The composite soil samples will be analyzed for explosives (2,4,6-Trinitrotoluene; 2,4-Dinitrotoluene; 2,6-Dinitrotoluene; 2-Amino-4,6-Dinitrotoluene; 4-Amino-2,6-Dinitrotoluene; HMX; Nitroglycerin; and RDX) by USEPA Method 8330B, for explosives (Nitrocellulose) by USEPA Method 353.2, for Anions (Nitrate) by USEPA method 300/9056A, and for Perchlorate by USEPA method 6850 to determine if contamination posing a potential threat to the human and ecological environment is present.

Groundwater Sampling (If Necessary)

If surface/subsurface soil sampling results indicate the potential for migration of MC into groundwater, then groundwater sampling will be conducted at the specific source location(s) and for the identified contaminant(s) of concern. If required, groundwater sampling will be conducted following the procedures described in the field SOPs presented in **Appendix A**. Groundwater samples will be analyzed for the identified contaminant(s) of concern only using the USEPA methods described for the analyte(S) above. We do not anticipate that groundwater sampling will be required. However, for estimating purposes approximately 4 and 2 groundwater samples may be required at the MTSA and Able 51 Area sites, respectively.

QAPP Worksheet #18 – Sampling Locations and Methods

Sampling Location	Matrix	Depth (inches)	Analytical Group	Concentration Level	No. of Samples	Sampling SOP Reference[1]	Rationale for Sampling Location
XU853	Soil	Variable	Explosives and Metals	Low	20	SOP No. 1, No. 2, and No. 3	See **Worksheet #17**
XU853	Soil	0-6	Explosives, Anions, and Perchlorate	Low	8	SOP No. 1, No. 2, and No. 3	See **Worksheet #17**
XU853	Aqueous	Depth to groundwater	Explosives, Anions, and Perchlorate	Low	4 (if necessary)	SOP No. 3, and No. 9	See **Worksheet #17**
XU854	Soil	Variable	Explosives and Metals	Low	4	SOP No. 1, No. 2, and No. 3	See **Worksheet #17**
XU854	Soil	0-6	Explosives, Anions, and Perchlorate	Low	3	SOP No. 1, No. 2, and No. 3	See **Worksheet #17**
XU854	Aqueous	Depth to groundwater	Explosives, Anions, and Perchlorate	Low	2 (if necessary)	SOP No. 3, and No. 9	See **Worksheet #17**

Notes:

[1] Specify the appropriate letter or No. from the Project Sampling SOP References table (**Worksheet #21**).

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QAPP Worksheet #19 & #30 – Sample Containers, Preservation, and Hold Times

Laboratory: Accutest Laboratories, Inc., 4405 Vineland Road, Suite C-15 Orlando, FL 32811, Jean Dent-Smith jeans@accutest.com, 407-425-6700.
List any required accreditations/certifications: DoD Environmental Laboratory Accreditation Program accreditation, compliant with the most recently published version of the DoD QSM Version 4.2.

Backup-up Laboratory: None

Sample Delivery Method: FedEx

Data Package Turnaround: 20 Days

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Sample Size[2]	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[3] (preparation / analysis)
Soil	Explosives	SW-846 8330B/ SOP# OP046/ GC034	2 g	500 g minimum, 1 gal Ziploc bag, double-bagged	Cool 4°	14 days to extraction / 40 days for analysis
Soil	Metals–ICP/CVAA	SW-846 6010C/ SOP# MET104/ MET100	5 g	(2) - 8- ounce (oz) jar	None specified per Ch.3 of SW-846	6 months/28 days for Hg
Soil	Perchlorate	SW-846 6850/ SOP# MS013	1 g	(2) - 8- oz jar	Cool 4°	28 days
Soil	Explosives	SW-846 8330A/ SOP# OP019/ GC016	2 g	(2) - 8- oz jar	Cool 4°	14 days to extraction / 40 days for analysis
Soil	Anions (Nitrate)	SW-846 9056A/ SOP# GN228	1 g	(1) - 8-oz jar	Cool 4°	48 hours for aqueous leachate
Soil	Explosives (Nitrocellulose)	EPA Modified 353.2NCl/ SOP# 179/ 234	2 g	4-oz glass jar	Cool 4°C	28 days to analysis

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Sample Size[2]	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[3] (preparation / analysis)
Aqueous (groundwater)	Explosives	SW-846 8330B/ SOP# OP047/ GC034	1 liter	(2)-1 liter amber bottle	Cool 4°	7 days to extraction / 40 days for analysis
Aqueous (groundwater)	Explosives (Nitrocellulose)	EPA Modified 353.2NCl/ SOP# 179/ 234	20 mL	250 ml plastic	Cool 4°	28 days to analysis
Aqueous (groundwater)	Anions (Nitrate)	SW-846 9056A/ SOP# GN228	5 ml	500 ml Nalgene	Cool 4°	48 hours
Aqueous (groundwater)	Perchlorate	SW-846 6850/ SOP# MS013	10 ml	125-ml Nalgene bottle, filled 2/3 full	Cool 4°	28 days

Notes

[1] Refer to the Analytical SOP References table (**Worksheet #23**).
[2] The minimum sample size is based on analysis allowing for sufficient sample for reanalysis. Additional volume is needed for the laboratory MS/MSD sample analysis.
[3] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted

QAPP Worksheet #20 – Field QC Summary

Matrix	Analytical Group	No. of Field Samples[1]	No. of Field Duplicate Samples[2]	No. of MSs[3]	No. of MSDs[3]	No. of Blanks (Trip)[4]	No. of Equipment Blanks[5]	No. of Proficiency Testing Samples	Total No. of Samples
Soil	Explosives and Metals	24	3	2	1	0	6	As specified by AFCEC	30
	Explosives, Anions, and Perchlorate	6 (IS)	1	1	1		1		9
		5 (Composite)	1	1	1		1		8
groundwater (if necessary)	Explosives, Anions, and Perchlorate	6	1	1	1		1		9
							9		56
								Total	65

[1] The No. of samples collected may vary depending on field conditions.
[2] Total numbers of Field Duplicate Samples will meet project goal of 10%.
[3] Total MS/MSD Samples will meet project goal of 5%.
[4] Trip blank samples are not required for coolers containing explosives, metals, anions (nitrate), or perchlorate samples.
[5] Equipment blanks will be collected from non-disposable decontaminated sampling devices at a rate of 1 per day of field sampling.

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QAPP Worksheet #21 – Field SOPs

SOPs are located in **Appendix A**.

Reference No.[1]	Title, Revision Date and / or No.	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP No. 1	Surface and Near Surface Soil Sampling	FPM	Hand Sampling Tools	N	Includes descriptions and procedures for surface soil sampling.
SOP No. 2	Subsurface Soil Sampling	FPM	Hand Sampling Tools or Direct Push Rig	N	Includes descriptions and procedures for subsurface soil sampling.
SOP No. 3	Sample Handling, Documentation, and Tracking	FPM	N/A	N	Includes descriptions and procedures for sample packaging, shipping, and chain-of-custody requirements.
SOP No. 4	Decontamination	FPM	N/A	N	Includes descriptions and procedures for decontamination of personnel and equipment.
SOP No. 5	Global Positioning System Measurements	FPM	GPS units	N	Includes description and procedures for marking data points using GPS units.
SOP No. 6	Permits and Clearances	FPM	N/A	N	Includes procedures and requirements for site access.
SOP No. 7	Equipment Calibration	FPM	Various field parameter measuring equipment	N	Includes descriptions and procedures or calibrating field parameter measuring equipment.
SOP No. 8	Investigation- Derived Waste	FPM	Department of Transportation approved 55-gallon drums and various Field equipment	N	Includes procedures for handling and disposal of investigation-derived waste at Holloman AFB

Reference No.[1]	Title, Revision Date and / or No.	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP No. 9	Groundwater Sampling	FPM	Various well purging and sampling equipment	N	Includes description of field equipment, field procedures, and QA/QC procedures necessary to collect groundwater samples

Notes:
[1] – FPM SOPs are not project specific, as such the SOP document may include SOPs that are not relevant to the immediate project and/or tasks.

QAPP Worksheet #22 – Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Calibration Activity	SOP Reference[1]	Responsible Person	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action
Photoionization Detector (PID)	Calibrated to 100 parts per million (ppm) using 100 ppm isobutylene	SOP Nos. 2, 7, and 8.	Field personnel	Check response with marking pen	Observe pump and PID response	Daily	Within 3%	Clean Lamp
Horiba U-52 or YSI 556 or equivalent	Calibration check prior to first field sample.	SOP Nos. 2, 7, and 9	Field personnel	Calibration check and post sampling calibration check.	Observe response to calibration check and inspect sensors.	Daily	Within 5%	Manufacturer service

[1] The Project Sampling SOP References table is found on **Worksheet #21**.

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QAPP Worksheet #23 – Analytical SOP's

Laboratory SOPs are located in **Appendix B**.

SOP Reference No.	Title, Revision Date, and / or No.	Definitive or Screening Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project Work? (Y/N)
GC016	Analysis Of Nitroaromatics and Nitramines by HPLC, Dual DAD, Sep 2013	Definitive	Explosives SW-846 8330A	HP1100, Dual DAD	No
OP019	SOP for the Extraction of Nitroaromatics/Nitramines from Solid Samples, Sep 2013	Definitive	SW-846 8330A	Sonic Disruptor	No
GC034	Analysis Of Nitroaromatics and Nitramines by HPLC method 8330B, Dual DAD, Sep 2013	Definitive	Explosives SW-846 8330B	HP1100, Dual DAD	No
OP046	SOP for the Extraction of Nitroaromatics/Nitramines from Solid Samples, SW-846 8830B, Sep 2013	Definitive	SW-846 8330B	Sonic Disruptor	No
MET100	Metals by ICP, Jun 2012	Definitive	Metals – ICP 6010C	Trace 6000 Series	No
MET104	Digestion of Soils for ICP Analysis, Jun 2012	Definitive	Prep Method Metals – ICP SW-846 3050B	SCP Science	No
SOP179	Nitrate/Nitrite, Nitrite in Surface Water, Wastewater 0.02 to 2.0 mg N/L and NO3- or NO2- By EPA Method Modified 353.2 R10	Screening	solid and aqueous, Nitrocellulose EPA Method Modified 353.2	Lachat	No
SOP234	Analysis of Nitrocellulose in Aqueous and Non-Aqueous Samples by Basic Hydrolysis and Measurement of Nitrate and Nitrite (Modified 353.2), R03	Definitive	solid and aqueous, Nitrocellulose EPA Method Modified 353.2	Lachat	No
GN228	Anions by Ion Chromatography, Oct 2012	Definitive	Anions – Nitrate EPA 300/SW-846 9056A	Dionex 2000 series	No

SOP Reference No.	Title, Revision Date, and / or No.	Definitive or Screening Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project Work? (Y/N)
MS013	Analysis of Perchlorate by LC/MS/MS, Sep 2013	Definitive	Perchlorate SW-846 6850	Agilent HPLC/MS/MS (Electrospray detector)	No

QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person	SOP[1]
HP1110, Dual DAD	SW-846 8330A, 8330B, 5-points minimum	Major maintenance (per method) or second consecutive failure of opening CCV warrants recalibration	ICAL %RSD <20%, or Correlation coefficient R≥0.995 ICV, CCV %D <15%	Instrument maintenance, leak check, Lamp test, pump test, standard inspection, recalibration	Laboratory Analyst	GC016, GC034
Thermo ICAP 6000 Series	Metals, SW-846 6010C	ICAL daily	ICAL %RSD <5%, or R≥0.995 ICV and CCV %D <10%	Instrument maintenance, nebulizer cleaning, torch inspection, standard inspection, recalibration	Laboratory Analyst	MET100
Dionex 2000 series	Anions, EPA 300/SW-846 9056A	Major maintenance (per method) or second consecutive failure of opening CCV warrants recalibration	Correlation coefficient R≥0.995 CCV and ICV %D <10%	Instrument maintenance, standard inspection, recalibration	Laboratory Analyst	GN228
Agilent HPLC/MS/MS (Electrospray detector)	Perchlorate, SW-846 6850, 6 points minimum	Major maintenance (per method) or second consecutive failure of opening CCV warrants recalibration	ICAL RSD <20% or Correlation coefficient R≥0.995 CCV and ICV %D <15%	Instrument maintenance, standard inspection, recalibration	Laboratory Analyst	MS013

Lachat (Nitrocellulose)	ICAL	Perform after major instrument maintenance and upon failure of second consecutive CCV.	Correlation Coefficient greater than or equal to 0.995	Repeat ICAL and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst, Department Manager	Empirical SOP 179, 234
	ICV	Each analytical sequence	Analytes must agree within 10% of analyte true value	Correct problem and verify second source standard; recalibrate. If it fails again, repeat ICAL		
	CCV	Every 10 samples and at the end of the analytical sequence	Analytes must agree within 10% of analyte true value	Correct problem and rerun CCV. If it fails again, repeat ICAL and all affected samples.		

[1] The Analytical SOP References table is found on **Worksheet #23**.

QAPP Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP[1]
HP1110	Needle, needle seat, column filters, guard columns, pump piston seals, mobile phase filters	SW-846 8330A, 8330B	Leak test, injection needle and needle seat inspection, filter inspection, lamp test as needed	Need for maintenance determined by passing calibration and chromatography – see GC016, GC034	Passing CCV	Column backflush, guard columns replacement, lamp replacement (as needed)	Laboratory Analyst	GC016, GC034
Trace 6000 Series	Torch, nebulizer, spray chamber, autosampler, pump tubing maintenance,	SW-846 6010C	Check connections, flush lines, clean nebulizer	Frequency determined by instrument remaining in calibration and free of interference – Met 100	Passing calibration	Reconnect sample pathways, recalibrate, reanalyze affected samples	Laboratory Analyst	MET100
Lachat	Degas solutions, Change tubing, lamp, clean connectors	solid and aqueous, Nitrocellulose EPA Method Modified 353.2	Tubing, rollers	Prior to ICAL or as necessary	See **Worksheet #24**.	Recalibrate and/or perform necessary equipment maintenance. Reanalyze samples not bracketed by passing CCVs	Analyst, Supervisor	Empirical SOP-179, 234

Dionex 2000 Series	Pump maintenance, guard column cleaning	EPA 300/SW-846 9056A	Clean or replace tubing, check connections	Frequency determined by instrument remaining in calibration and free of interference – GN228	Passing Calibration	Reconnect tubes, check pump rate. Rerun calibration and samples	Laboratory Analyst	GN228
Agilent HPLC/MS/MS	Spray chamber, Clean capillary	SW-846 6850	Check Tune, Leak checks, Pressure check, Mobile phase filters, Needle inspection	Need for maintenance determined by passing calibration– see MS013	Passing calibration	Check LC column, Run Autotune, Check calculations, Re-run affected samples	Laboratory Analyst	MS013

[1] The Analytical SOP References table is found on **Worksheet #23**. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis.

QAPP Worksheet #26 & #27 – Sample Handling, Custody, and Disposal

Sampling Organization: FPM

Laboratory: Accutest Laboratories, Inc. or Empirical Laboratories, LLC

Method of sample delivery: FedEx

Number of days from reporting until sample disposal: 30

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Labeling	FPM, Field Personnel	SOP #3
Chain-of-Custody Form Completion	FPM, Field Team Leader	SOP #3
Packaging	FPM, Field Personnel	SOP #3
Shipping Coordination	FPM, Field Personnel	SOP #3
Sample Receipt, Inspection, & Log-in	Accutest Laboratories Inc., Randy Shields	Accutest Laboratories Inc., SOPs GC016, OP019, GC034, OP046, MET100, MET104, GN228, and MS013
	Empirical Laboratories, LLC, Sample Receiving Personnel	Empirical Laboratories, LLC, SOPs 179, and 234
Sample Preparation and Determinative Analysis	Accutest Laboratories Inc., Mark Erstling (Organics), Dave Metzgar (Metals)	Accutest Laboratories Inc., SOPs GC016, OP019, GC034, OP046, MET100, MET104, GN228, and MS013
	Empirical Laboratories, LLC, Analyst, Laboratory Supervisor	Empirical Laboratories, LLC, SOPs 179, and 234

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Custody and Storage	Accutest Laboratories Inc., Randy Shields	Accutest Laboratories Inc., SOPs GC016, OP019, GC034, OP046, MET100, MET104, GN228, and MS013
	Empirical Laboratories, LLC, Sample Receiving Personnel	Empirical Laboratories, LLC, SOPs 179, and 234
Sample Disposal	Accutest Laboratories Inc., Randy Shields	Accutest Laboratories Inc., SOPs GC016, OP019, GC034, OP046, MET100, MET104, GN228, and MS013
	Empirical Laboratories, LLC, Sample Receiving Personnel	Empirical Laboratories, LLC, SOPs 179, and 234

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix		Soil				
Analytical Group		Explosives				
Analytical Method / SOP Reference		SW-846 8330A/ LAB SOP# GC016				
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Responsible Person (s)**	**DQI**	**Measurement Performance Criteria**
ICAL	As needed (see CCV passing criteria below and SW-846 8000 method)	%RSD ≤20%, or R≥0.995	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	Chromatographic performance
ICV	1 per ICAL, analyzed after ICAL, before field samples	%D ≤15%	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	Chromatographic performance
CCV	Opening CCV, then every 10 samples, with closing CCV	%D ≤15%	If the criterion has not achieved corrective action, re-calibration is performed before any samples may be analyzed. Corrective action may include re-analysis of the samples.	Analyst	Laboratory Accuracy	Chromatographic performance

MB	1 per extraction batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples ND – report without qualification 2. Samples >10X contamination level – report with qualification 3. Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	<1/2 RL
LCS	1 per extraction batch	%R = (Calculated Value/True Value) *100%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples ND – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%R = (Calculated Value/True Value) *100%
External Control Sample	1 per extraction batch	%R = (Calculated Value/True Value) *100%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples ND – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in certified reference matrix	%R = (Calculated Value/True Value) *100%

MS	1 per 20 samples or one for each extraction batch	%R = (Calculated Value - Sample Value/True Value) *100%	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix.	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value - Sample Value/True Value) *100%
MSD	1 per 20 samples or one for each extraction batch	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	See above	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2
Surrogate Spikes	Every sample	%R = (Calculated Value/True Value) *100%	Reason for poor recoveries is investigated and eliminated before further analytical activities. Corrective actions are: 1. High bias, samples ND – report without qualification. 2. Low bias – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Individual sample preparation efficiency control	%R = (Calculated Value/True Value) *100%

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix		Soil and Aqueous				
Analytical Group		Explosives				
Analytical Method / SOP Reference		SW-846 8330B/ LAB SOP# GC034				
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Responsible Person (s)**	**DQI**	**Measurement Performance Criteria**
ICAL	As needed (see CCV passing criteria below and SW-846 8000 method)	%RSD $\leq$20%, or R$\geq$0.995	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	Chromatographic performance
ICV	1 per ICAL, analyzed after ICAL, before field samples	%D $\leq$15%	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	Chromatographic performance
CCV	Opening CCV, then every 10 samples, with closing CCV	%D $\leq$15%	If the criterion has not achieved corrective action, re-calibration is performed before any samples may be analyzed. Corrective action may include re-analysis of the samples.	Analyst	Laboratory Accuracy	Chromatographic performance

MB	1 per extraction batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples ND – report without qualification 2. Samples >10X contamination level – report with qualification 3. Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	<1/2 RL
LCS	1 per extraction batch	%R = (Calculated Value/True Value) *100%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples ND – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%R = (Calculated Value/True Value) *100%
External Control Sample	1 per extraction batch	%R = (Calculated Value/True Value) *100%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples ND – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in certified reference matrix	%R = (Calculated Value/True Value) *100%

MS	1 per 20 samples or one for each extraction batch	%R = (Calculated Value - Sample Value/True Value) *100%	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix. The project Chemist will be contacted and a decision will be made to either report the data as is with a notation in the analytical narrative or if the samples should be re-extract and re-analyzed.	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value - Sample Value/True Value) *100%
MSD	1 per 20 samples or one for each extraction batch	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	See above	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2

Surrogate Spikes	Every sample	%R = (Calculated Value/True Value) *100%	Reason for poor recoveries is investigated and eliminated before further analytical activities. Corrective actions are: 1. High bias, samples ND – report without qualification. 2. Low bias – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Individual sample preparation efficiency control	%R = (Calculated Value/True Value) *100%

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix		Soil				
Analytical Group		ICP Metals				
Analytical Method / SOP Reference		SW-846 6010C/ LAB SOP# Met100				
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**CA**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
ICAL	As needed (see CCV passing criteria below)	%RSD <5%, or R≥0.995	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	%RSD <5%, or R≥0.995
ICV	1 per ICAL, analyzed after ICAL, before field samples	%D ≤10%	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	%D ≤10%
CCV	Opening CCV, then every 10 samples, with closing CCV	%D ≤10%	If the criterion has not achieved corrective action, re-calibration is performed before any samples may be analyzed. Corrective action may include re-analysis of the samples.	Analyst	Laboratory Accuracy	%D ≤10%

Calibration Blank	After every ICV and CCV, including terminal CCV	No analytes detected above LOD	Determine source of contamination, correct problem. Qualify associated data with B qualifier and appropriate footnote. Corrective action may include reanalysis of CCB and reanalysis of associated samples.	Analyst	Absence of interference/ contamination	<LOD
MB	1 per extraction batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples ND – report without qualification 2. Samples >10X contamination level – report with qualification 3. Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	<1/2 RL

LCS	1 per extraction batch	%R = (Calculated Value/True Value) *100%; 80%≤%R≤120%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1.Biased high, samples ND – report without qualifications. 2.Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%R = (Calculated Value/True Value) *100%; 80%≤%R≤120%
MS	1 per 20 samples or one for each extraction batch	%R = (Calculated Value - Sample Value/True Value) *100%: 80%≤%R≤120%	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix.	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value - Sample Value/True Value) *100%: 80%≤%R≤120%

MSD	1 per 20 samples or one for each extraction batch	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	See above	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2
Linear dynamic range or High-level calibration check standard	Every 6 months	Within ±10%R of expected value.	Not Applicable	Analyst	Laboratory Accuracy	Within ±10%R of expected value.
Low-level calibration check standard	Daily, after one-point ICAL	Within ±20%R of expected value. Low-level calibration check standard should be less than or equal to the RL.	Correct problem then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed.	Analyst	Laboratory Accuracy	Within ±20%R of expected value. Low-level calibration check standard should be less than or equal to the RL.

ICS	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all nonspiked analytes <2x MDL (unless they are a verified trace impurity from one of the spiked analytes) ICS-AB: Within ± 20% of expected value	Terminate analysis; locate and correct problem; reanalyze ICS. Flagging criteria are not appropriate. No samples may be analyzed without a valid ICS.	Analyst	Accuracy	ICS-A: Absolute value of concentration for all nonspiked analytes <2x MDL (unless they are a verified trace impurity from one of the spiked analytes) ICS-AB: Within ± 20% of expected value
Serial Dilution Test	Each preparatory batch or when a new or unusual matrix is encountered	Five-fold dilution must agree within ± 10% of the original determination. Only applicable for samples with concentrations >50x MDL for ICP.	Perform PDS addition. Flagging criteria are not appropriate.	Analyst	Precision (field samples)	Five-fold dilution must agree within ± 10% of the original determination. Only applicable for samples with concentrations >50x MDL for ICP.
PDS addition	When dilution test fails or analyte concentration in all samples <50x MDL	Recovery within 75-125% of expected result. The spike addition should produce a level between 10x to 100x MDL.	Run samples by method of standard additions (MSA) or Apply J-flag to all sample results (for same matrix) for specific analyte(s) for all samples associated with the PDS addition.	Analyst	Accuracy	Recovery within 75-125% of expected result. The spike addition should produce a level between 10x to 100x MDL.

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix		Soil and Aqueous				
Analytical Group		Explosives (Nitrocellulose)				
Analytical Method / SOP Reference		EPA Modified 353.2/ LAB SOP# 233				
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**CA**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
MB	One per batch of 20 or less	No target compounds should be > 1/2 the LOQ	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst, Laboratory Supervisor	Bias / Contamination	Same as SOP QC Acceptance Limits.
LCS	One per batch of 20 or less	See **Worksheet #15**	Reprep and reanalyze for batch if MS/MSD fail as well. Flag data accordingly	Analyst, Laboratory Supervisor	Accuracy / Bias	Same as SOP QC Acceptance Limits.
MS/MSD	One per batch of 20 or less	See **Worksheet #15**	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst, Laboratory Supervisor	Accuracy / Bias	Same as SOP QC Acceptance Limits.

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix		Soil and Aqueous				
Analytical Group		Anions (Nitrate)				
Analytical Method / SOP Reference		SW-846 9056A/ LAB SOP# GN228				
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**Corrective Action**	**Responsible Person (s)**	**DQI**	**Measurement Performance Criteria**
ICAL	As needed (see CCV passing criteria)	Minimum 5 standards and a Blank. Correlation coefficient R≥0.995	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	Correlation coefficient R≥0.995
ICV	1 per ICAL, analyzed after ICAL, before field samples	%D ≤10%	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	%D ≤10%
CCV	Opening CCV, then every 10 samples, with closing CCV	%D ≤10%	If the criterion has not achieved corrective action, re-calibration is performed before any samples may be analyzed. Corrective action may include re-analysis of the samples associated with failing CCV(s).	Analyst	Laboratory Accuracy	%D ≤10%

MB	1 per digestion batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples ND – report without qualification 2. Samples >10X contamination level – report with qualification 3. Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst/Prep analyst	Absence of interference/ contamination	<1/2 RL
LCS	1 per digestion batch	%R = (Calculated Value/True Value) *100%; Waters 90%≤%R≤110%	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1. Biased high, samples ND – report without qualifications. 2. Biased low – re-extract and reanalyze. Insufficient volume – qualify and footnote	Analyst/Prep analyst	Laboratory Accuracy/Method bias in ideal matrix	%R = (Calculated Value/True Value) *100%; Waters 90%≤%R≤110%,
MS	1 per 20 samples or one for each digestion batch	%R = (Calculated Value/True Value) *100%; Waters 90%≤%R≤110%	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix.	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value/True Value) *100%; Waters 90%≤%R≤110%,

MSD	1 per 20 samples or one for each digestion batch	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2: %RPD ≤ 20%	See above	Analyst/Prep analyst	Precision and Accuracy in field samples	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2: %RPD ≤ 20%

QAPP Worksheet #28 – Analytical Quality Control and Corrective Action

Matrix		Soil and Aqueous				
Analytical Group		Perchlorate				
Analytical Method / SOP Reference		SW-846 6850/ LAB SOP# MS013				
QC Sample	**Frequency / No.**	**Method / SOP QC Acceptance Limits**	**CA**	**Person(s) Responsible for CA**	**DQI**	**Measurement Performance Criteria**
MS tuning – Perchlorate standard	Prior to ICAL and after maintenance	Ratio of 83/85 is between 2.3 and 3.8	Retune instrument and verify. Rerun affected samples. Flagging criteria are not appropriate and problem must be corrected. No samples may be accepted without a valid tune.	Analyst	Laboratory Accuracy	Refer to method for specific ion criteria.
ICAL	6 points and a Blank minimum, as needed (see CCV passing criteria below)	%RSD <20%, or R≥0.995	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed	Analyst	Laboratory Accuracy	%RSD <20%, or R≥0.995
Relative Retention Time window establishment (optional)	Retention Time monitored throughout the run	Relative Retention Time = 1.0 +/- 2%	N/A	Analyst	Laboratory Accuracy	Chromatographic system performance in real matrix

ICV	1 per ICAL, analyzed after ICAL, before field samples	Mid-level; %D ≤15%	If the acceptance criteria were not met, re-calibration is performed before any samples may be analyzed.	Analyst	Laboratory Accuracy	%D ≤15%
CCV	Mid-level, every 10 samples; and low-level CCVs in the beginning and the end of analytical sequence	%D for mid-level ≤15%, low-level ≤30%	If the criterion has not achieved corrective action, re-calibration is performed before any samples may be analyzed. Corrective action may include re-analysis of the samples.	Analyst	Laboratory Accuracy	%D for all analytes ≤20%,
Conductivity Limit Study	At the instrument set-up	Matrix conductivity threshold (MCT) is the highest conductivity at which standard recovery is still 85-115% and ISTD within 50 – 150%	Sample conductivity must be below limit and samples might have to be diluted.	Analyst	Absence of interference/ contamination	Detector stability

ICS	With every batch with conductivity at MCT and Perchlorate at LOQ. At least one ICS must be analyzed daily	Within 30% of Perchlorate true value	Correct problem and reanalyze all samples in the batch	Analyst	Absence of interference/ contamination	Detector stability
MB	1 per extraction batch	<1/2 RL	The source of the contamination is investigated and eliminated before proceeding with further analysis. Corrective actions are: 1. Samples ND – report without qualification 2. Samples >10X contamination level – report with qualification Samples <10x contamination – re-extract and reanalyze. Insufficient sample - qualify and footnote	Analyst	Absence of interference/ contamination	<1/2 RL

LCS	1 per extraction batch	%R = (Calculated Value/True Value) *100%; within 20% of true value.	Source of poor recovery is investigated and eliminated before proceeding with further analysis, corrective actions are: 1.Biased high, samples ND – may be reported without qualifications. 2.Biased low – re-prep and reanalyze. Insufficient volume – qualify and footnote.	Analyst	Laboratory Accuracy/Method bias in ideal matrix	%R = (Calculated Value/True Value) *100%

MS	1 per 20 samples or one for each extraction batch	%R = (Calculated Value - Sample Value/True Value) *100%; within 20% of true value	If the recoveries indicate that the problem is procedure related, re-extraction and re-analysis is required. If the recoveries indicate that the failures are matrix-related, refer to Blank Spike as measure of method performance in clean matrix. The project Chemist will be contacted and a decision will be made to either report the data as is with a notation in the analytical narrative or if the samples should be re-extract and re-analyzed.	Analyst	Precision and Accuracy in field samples	%R = (Calculated Value - Sample Value/True Value) *100%

MSD	1 per 20 samples or one for each extraction batch	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100; below 15% Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	See above	Analyst	Precision and Accuracy in field samples	%R = (Calculated Value – Sample Value/True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2
Internal standards	Every sample	IS Area = -50% to +100% of CCV	Reanalyze samples at increasing dilutions until criteria are met. If upon re-analysis the responses are still not within limits, the problem may be considered sample matrix interference and sample must be re-prepped with additional pretreatment steps.	Analyst	Instrument sensitivity control	Detector Stability

QAPP Worksheet #29 – Project Documents and Records

Project Documents and Records:

Record	Generation	Verification	Storage location/archival
Field logbook and data collection sheets	FPM Field Team Leader	FPM Site Manager, Ivana Raicevic	Project file and Electronic Storage, FPM office
Daily field reports			Electronic storage in project files, FPM office
CoC form	FPM Field Staff	FPM Site Manager, Ivana Raicevic and relevant Laboratory Accutest Laboratories Inc., Randy Shields or Empirical Laboratories, LLC, receiving personnel	Project file and Electronic storage, FPM office and relevant Laboratory (Accutest or Empirical) permanent project records folder
Custody seals			Not stored; condition upon cooler receipt recorded on Sample Receiving Checklist
Sample labels			Not stored
Air bills	FPM Field Staff and Shipper (FedEx)	FPM Field Team Leader	Project file, FPM office
Deviations	FPM Field Team Leader and FPM Site Manager, Ivana Raicevic	FPM PM	Project file and Electronic Storage, FPM office
Corrective Action Reports	FPM PM, Maureen Whalen	COR	Project file, FPM office
Correspondence among project team	Various	N/A	Electronic storage in project files, FPM office

Project Assessments:

Record	Generation	Verification	Storage location/archival
Field audit checklists	FPM Site Manager, Ivana Raicevic	FPM PM, Maureen Whalen	Project file, FPM office
Data verification checklists	FPM Chemical QC Manager, Connie van Hoesel	FPM Site Manager, Ivana Raicevic and FPM PM, Maureen Whalen	
Data validation report			
Data usability assessment report			

Laboratory Records

Record	Generation	Verification	Storage location/archival
Shipping Receipt or Freight Bill	Relevant Laboratory Accutest Laboratories Inc., Randy Shields or Empirical Laboratories, LLC, receiving personnel	Relevant Laboratory Accutest PM, Jean Dent-Smith or Empirical PM	Initially stored in relevant laboratory (Accutest or Empirical) permanent project records folder; after job completion & invoicing, stored in ERPIMS
Sample Receiving Checklist			
Condition Upon Receipt Anomaly Form			
Priority form			
CoC form	FPM Field staff	Relevant laboratory Accutest Sample Receiving personnel, Randy Shields or Empirical receiving personnel	Stored in relevant laboratory (Accutest or Empirical) permanent project records folder and in the Project file and Electronic Storage at FPM's office

Record	Generation	Verification	Storage location/archival
Internal CoC Report	Relevant laboratory Accutest Laboratories Inc., Randy Shields or Empirical Laboratories, LLC, receiving personnel	Relevant Laboratory Accutest PM, Jean Dent-Smith or Empirical PM	Relevant Laboratory (Accutest or Empirical) electronic storage and ERPIMS.
Raw data files	Relevant laboratory Accutest analytical personnel, Mark Erstling (Organics), Dave Metzgar (Metals) or Empirical, Analyst, Laboratory Supervisor		
Final analytical report			
Other vital records (*e.g.*, instrument maintenance records, QA records)	Relevant laboratory (Accutest or Empirical)	Relevant laboratory (Accutest or Empirical)	Relevant laboratory (Accutest or Empirical) Warehouse

Laboratory Data Deliverables

Record	Metals	Explosives	Explosives (Nitrocellulose)	Anions (Nitrate)	Perchlorate
Narrative	x	x	x	x	x
COC	x	x	x	x	x
Summary Results	x	x	x	x	x
QC Results	x	x	x	x	x
Chromatograms					x

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QAPP Worksheets #31, #32, & #33 – Assessments and Corrective Action

Assessments:

Assessment Type	Responsible Party & Organization	Number/ Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Review field documentation (log book, field forms, chain-of-custody forms, etc.)	PM, Maureen Whalen (FPM)	As work progresses	Will be included in RI Report	Marked-up copy of document provided to Field team leader; notify FPM PM	See **Worksheet #16**
Field sampling audit	PM, Maureen Whalen (FPM)	Once	TBD	Email or verbal report to describe the deviation from QAPP	Within 2 days of finding deficiency
Internal laboratory assessment	Relevant Laboratory Accutest PM, Jean Dent-Smith or Empirical PM	Once	TBD	Documented in the laboratory report	2 weeks
External AFCEC laboratory audit PE	USAEC	Once	TBD	AFCEC report on laboratory assessment	4 weeks

QAPP Worksheets #31, #32, & #33 – Assessments and Corrective Action

Assessment Response and Corrective Action:

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Review Field Documents (Logbooks, Sampling Logs, and CoC forms)	Marked up copy of document	Maureen Whalen PM, FPM	Within 24 hours of finding deficiency	Review of corrected documentation	Field Team Leader, FPM, and Maureen Whalen PG, CPG, PMP, FPM	24 hours after notification
Field Sampling Audit	E-mail or verbal report to detail the deviation from QAPP	Maureen Whalen, PM, FPM	Within 2 days of the start of sampling	E-mail and/or phone log	Field Team Leader, FPM, and Maureen Whalen PG, CPG, PMP, FPM	2 days
Internal Laboratory Assessment	Lab Report to detail project deviations	Relevant laboratory Accutest or Empirical PM	Within 5 days of sample analysis	Documented in the lab report	Relevant laboratory Accutest or Empirical QA Manager	2 weeks
External AFCEC Laboratory Assessment	AFCEC findings of Laboratory project deviations	Project Chemist, FPM and relevant laboratory Accutest or Empirical Laboratory Manager	Within 7 days of analysis	AFCEC Report on Laboratory Assessment	Maureen Whalen PG, CPG, PMP, FPM, AFCEC, and relevant (Accutest or Empirical) Laboratory	4 weeks

QAPP Worksheet #34 – Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (Conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	x	
2	Contract	x	
3	Field SOPs	x	
4	Laboratory SOPs	x	
Field Records			
5	Field log books	x	x
6	Equipment calibration records	x	x
7	Chain-of-custody forms	x	x
8	Geophysics reports	x	x
9	Relevant correspondence	x	x
10	Field audit reports	x	x
11	Field corrective action reports	x	x
Analytical Data Package			
12	Cover sheet (laboratory identifying information)	x	x
13	Case narrative	x	x
14	Internal laboratory chain-of-custody	x	x
15	Sample receipt records	x	x
16	Sample chronology	x	x
17	Communication records	x	x
18	LOD/LOQ establishment and verification	x	x
19	Standards traceability	x	x
20	Instrument calibration records	x	x
21	Definition of laboratory qualifiers	x	x
22	Results reporting forms	x	x
23	QC sample results	x	x
24	Corrective action reports	x	x

Item	Description	Verification (completeness)	Validation (Conformance to specifications)
25	Raw data	x	x
26	Electronic data deliverable	x	x

QAPP Worksheet #35 – Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field log book	QAPP	Verify that records are present and complete for each day of field activities. Verify that all planned samples including QC samples were collected and that sample collection locations are documented. Verify that changes or exceptions were documented and reported.	Daily – Site Manager
Chain-of-custody forms	QAPP	Verify the completeness of chain-of-custody forms. Examine entries for consistency with the field logbook. Verify that the required volume of sample has been collected. Verify that sample IDs and analytes are correct and legible. Verify that all required signatures and dates are present.	Daily – Field team leader At conclusion of sampling event – Site Manager and PM
Laboratory deliverable	QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Compare the data package with the chain-of-custody forms to verify that results were provided for the correct analytes for all the collected samples. Check the sample receipt records to ensure sample condition upon receipt was noted. Review the narrative to ensure that all QC exceptions are described	Before sending to FPM – Laboratory QA Manager Upon receipt – Chemical Project QA Manager
Audit Reports, Corrective Action Reports	QAPP	Verify that all planned audits were conducted. Examine any audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	Project QA Manager

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QAPP Worksheet #36 – Data Validation Procedures

Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator
Soil and Aqueous	Explosives, Metals, Anions, and Perchlorate	Low	DoD QSM 4.2	Connie van Hoesel, FPM Chemical QC Manager
Soil and Aqueous	Explosives, Metals, Anions, and Perchlorate	Low	QAPP **Worksheets #12, #15** and **#24**. QAPP **Tables 12-1** through **12-8**	Connie van Hoesel, FPM Chemical QC Manager

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QAPP Worksheet #37 – Data Usability Assessment

A complete (100%) data review will be performed on the samples collected during the sampling event. The review will consist of a verification and validation based on completeness and compliance checks of sample receipt conditions and both sample-related and instrument-related QC results, as addressed in **Worksheet #12**. Any flags that limit the usability of the data shall be applied to all associated samples; flags are listed in **Table 12-2**. The Data Usability Assessment will be performed by FPM personnel. Connie van Hoesel, FPM Chemical QC Coordinator will be responsible for information in the Usability Assessment. Note that the Data Usability Assessment will be conducted on verified/validated data. After the Data Usability Assessment has been performed, data deemed appropriate for decision-making purposes will be used to assess contaminant extents at sites at Holloman AFB. The results of the Data Usability Assessment will be presented in the RI Report. The following items will be assessed and conclusions drawn based on their results.

Precision: Results of field duplicates will be presented separately in tabular format for each sample pair when results are reported above the LOD. For each field duplicate pair, the results will be assessed as stated in **Tables 12-3** through **12-8**. MS/MSD RPDs are calculated by the laboratories (Accutest and Empirical) and those with RPDs outside the criteria established in **Table 12-1** will be listed in tabular form in the data verification report. A discussion will follow summarizing the results of the laboratory precision. Any conclusions about the precision of the analyses will be drawn and any limitations on the use of the data will be described.

Accuracy/Bias Contamination: Results for all laboratory MBs will be evaluated and analytes detected in these blanks will be listed in tabular form in the data verification report. Laboratory data will be qualified based on the criteria listed in **Tables 12-3** through **12-8**. A discussion will follow summarizing the results of the laboratory accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

Overall Accuracy/Bias: Results for all LCS, surrogate and MS/MSD recoveries that are outside evaluation criteria will be presented in tabular format in the data verification reports. The results will be checked versus those listed in **Table 12-1**. A discussion will follow summarizing the overall accuracy/bias. Any conclusions about the accuracy/bias of the analyses based on contamination will be drawn and any limitations on the use of the data will be described.

Performance Evaluation: PE samples will be evaluated and if discrepancies are discovered they will be investigated and the effect on field sample results will be determined and discussed with FPM, the relevant laboratory, Accutest or Empirical, and AFCEC. A discussion of PE sample results will be included with QC sample discussion and aid in data defensibility. If results from PE samples are outside the expected values, an investigation will be completed to determine the source of the discrepancy. A corrective action report will be prepared to document the results of the investigation and to address whether re-sampling or reanalysis is required. If the cause is determined to also affect all samples that were collected, then an evaluation of the reliability of the field sample results will be made and reported in the data usability assessment and RI Report.

Representativeness: Representativeness is a qualitative measure of the degree to which data accurately and precisely represent a characteristic of a population, and is mainly addressed in the sample design. A measure of representativeness can also be obtained by assessing holding times

and blank data. Any conclusions about the representativeness of the samples will be drawn and any limitations on the use of the data will be described.

Comparability: IAW this UFP-QAPP the data are comparable when collection techniques, measurement method and reporting procedures are the same for each data set.

Completeness: A completeness check will be performed on all data generated by the laboratories (Accutest and Empirical). Completeness criteria are presented on **Worksheet #12**. Completeness will be calculated as the No. of data points for each analyte that is deemed useable (not rejected) divided by the total No. of data points for each analyte. A discussion will follow summarizing the results of the calculation of data completeness. Any conclusions about the completeness of the data will be drawn and any limitations on the use of the data will be described. Data completeness addresses only those samples that are collected and only data that is analyzed by the respective laboratory (Accutest or Empirical).

Graphics: Figures and maps will be prepared showing the site specific sampling locations and results.

Reconciliation: Each of the measurement performance criteria listed in **Worksheet #12** will be examined to determine if the objective was met. Each analysis will be evaluated separately in terms of the major impacts observed from the data verification/validation, DQIs and measurement performance criteria assessments. Based on the results of these assessments, the quality of the data will be determined. Usability of the data will be based on the quality assessment. After establishing the usability of the data, it will be determined if the DQO was met and if project action limits were met. The final report will include a summary of all points that comprised the reconciliation of each objective. Any conclusions or limitations on the usability of any of the data will be described.

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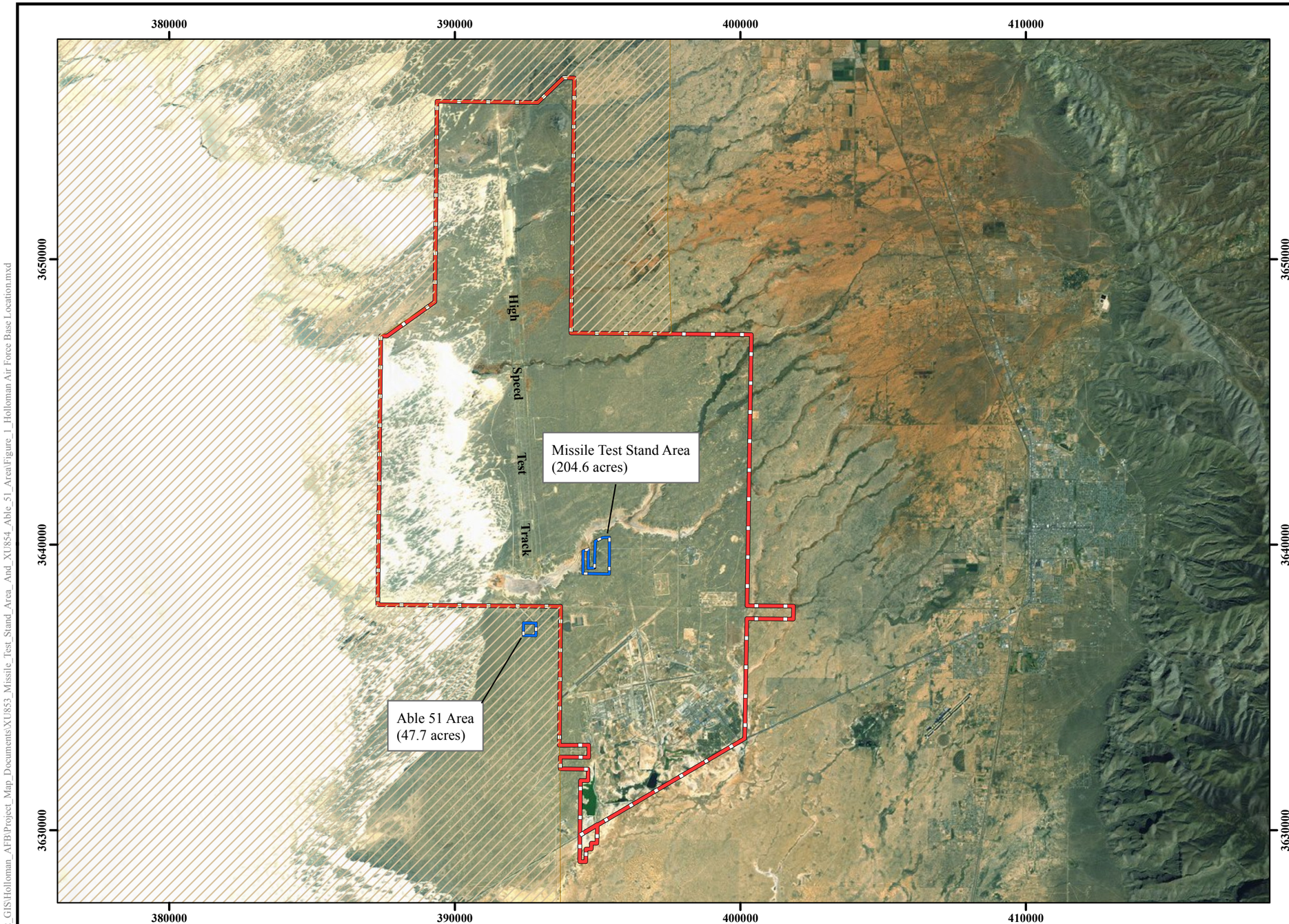
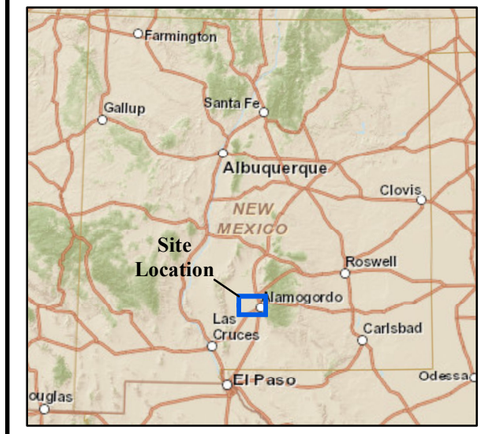
FIGURES
1 through 3





Legend

- MRA Boundary
- Installation Boundary
- White Sands Missile Range

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 1

Holloman AFB Location

FPM Remediations, Inc.

2014

NOTES:

Revision Date: 2/5/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

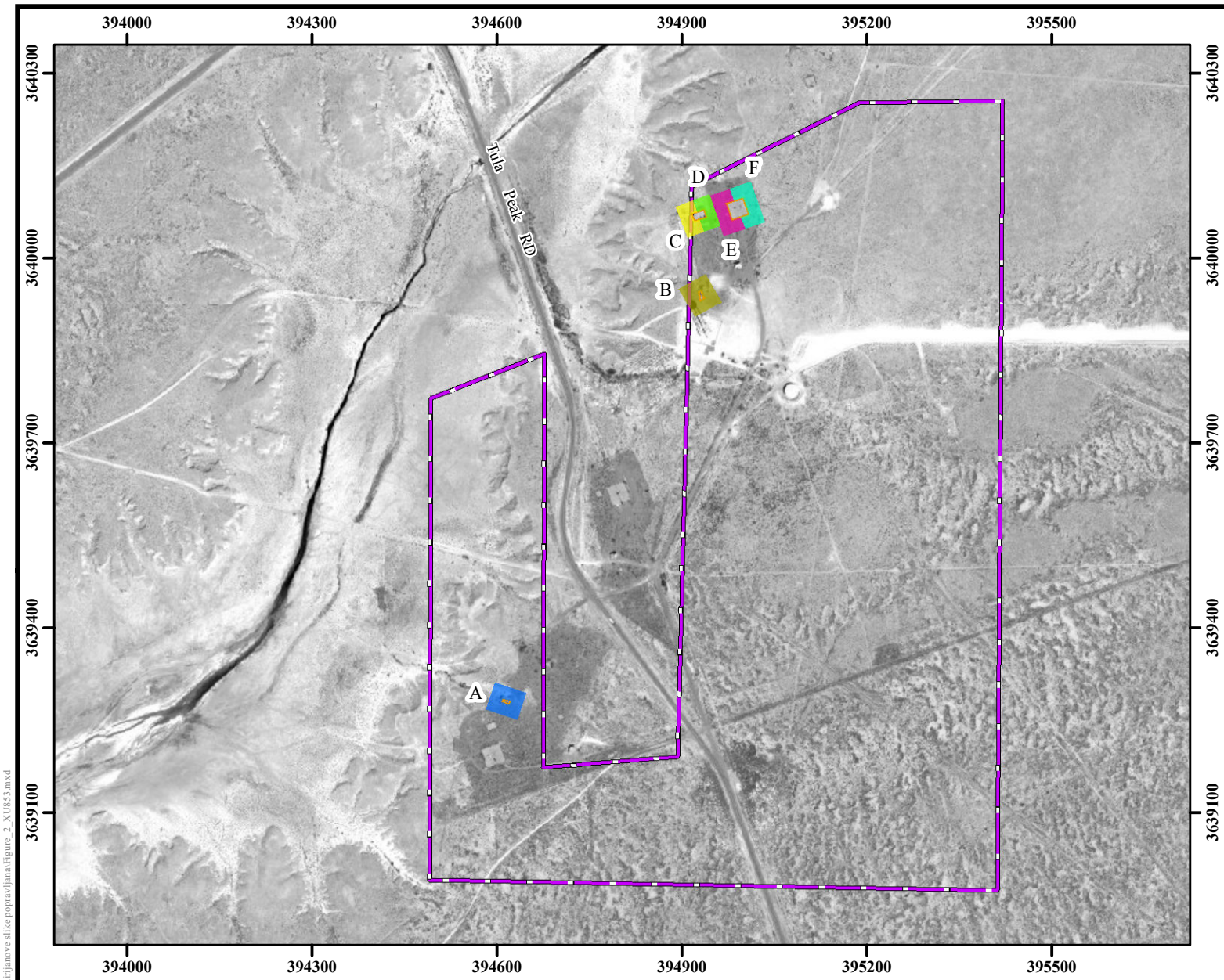
1 inch = 12,000 feet

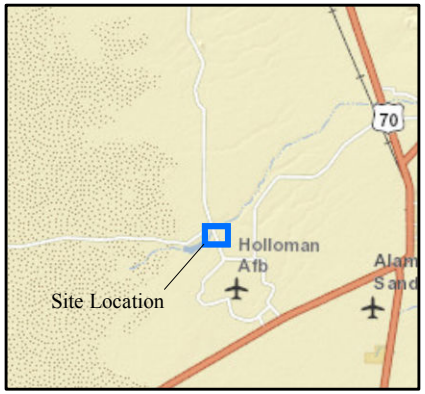
0 2,500 5,000 Meters

0 6,000 12,000 Feet

N W E S

Path: \\ssat\SAT_Clients\SAT_DATA\02_GIS\Holloman_AFB\Project_Map_Documents\XU853_Missile_Test_Stand_Area_And_XU854_Able_51_Area\Figure_1_Holloman Air Force Base Location.mxd





Legend

- IS A (0.60 acres)
- IS B (0.62 acres)
- IS C (0.36 acres)
- IS D (0.34 acres)
- IS E (0.50 acres)
- IS F (0.50 acres)
- Launch Pad
- EOD 50 lb Range
- XU853 MRS (204.6 acres)
- Installation Boundary

Note: IS=Incremental Sampling

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2

Incremental Sampling
Locations XU853 MRS

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 9/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 800 feet

0 120 240 Meters

0 400 800 Feet

N W E S

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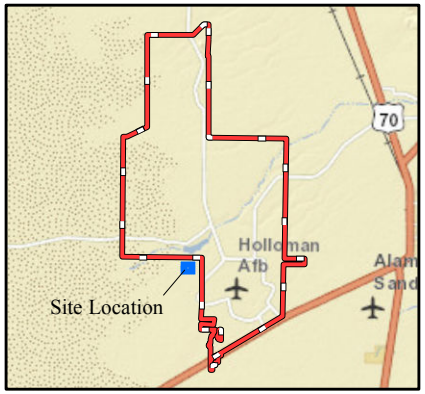

Legend

- IS G=0.54 acres
- IS H=0.55 acres
- IS I=0.39 acres
- IS J=0.41 acres
- Launch Pad
- Building 1442
- XU854 MRS Boundary
- Installation Boundary

Note: IS=Incremental Sampling

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 3

Incremental Sampling
Locations XU854 MRS

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 8/13/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 300 feet

0 45 90 Meters

0 150 300 Feet

N W E S

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APPENDIX A

Field Standing Operating Procedures

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1.0 SOP NO. 1 – SURFACE AND NEAR SURFACE SOIL SAMPLING

1.1 PURPOSE AND SCOPE

The purpose of this document is to define the Standard Operating Procedure (SOP) for collecting soil samples at Holloman Air Force Base (AFB) using hand tools. This SOP describes the equipment, field procedures, and Quality Assurance/Quality Control (QA/QC) procedures implemented for sample collection.

This SOP is intended to be used together with the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) and other appropriate SOPs. Health and safety procedures and equipment for the investigation are detailed in the project Health and Safety Plan (HASP).

Applicable SOPs are listed below:

- SOP No. 3 – Sample Handling, Documentation, and Tracking
- SOP No. 4 – Equipment and Personnel Decontamination
- SOP No. 5 – Global Positioning System (GPS) Measurements
- SOP No. 6 – Permits and Clearances
- SOP No. 8 – Investigation-Derived Waste

1.2 EQUIPMENT AND MATERIALS LIST

The following equipment and materials should be on site for soil sampling:

- Stainless steel hand auger or hand trowel
- Surveyor's stakes and flags
- Pick
- Field logbook
- Sample Collection Field Sheets
- Nitrile gloves
- Hard plastic disposable tools (i.e., polyethylene [PE] scoop)
- Sample containers
- Sample container labels
- Label tape (clear)
- Disposable sealed zip-type PE bag
- Paper towels
- Digital camera
- 100 foot hand tape
- Waterproof and permanent marking pens
- Plastic sheeting
- Trash bags
- Cooler with sufficient ice to maintain a temperature of 4°C
- Appropriate health and safety equipment, as specified in the HASP

- Appropriate decontamination supplies, as specified in SOP No. 4

Other materials and equipment may be needed based on field conditions.

1.3 LOCATING THE SAMPLING POINTS

Sampling locations will be determined in the field. At the time of locating each sampling point, the sampling point identification will be entered in the field logbook and the GPS coordinates recorded. Information concerning nearby landmarks, or other information that will help to re-locate the point in the future will be recorded. The sample locations will be marked using surveyor's stakes and flags (or lath), and the flags (or lath) will be labeled using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations into site landmarks if available (such as foundations). If the surveyor's stake is offset from the sample location, the offset will be noted on the field map or field logbook.

1.4 SURFACE AND NEAR SURFACE SOIL DISCRETE SAMPLING PROCEDURES

Discrete samples consist of soil collected for chemical analysis from a single location. Sampling sites will be located and marked using surveying stakes or flags. Discrete surface soil and subsurface soil samples will be collected as follows:

- At each location, clear an area approximately 12 inches in diameter of surface vegetation and debris from the vicinity where a sample is to be collected.
- Use a decontaminated stainless steel spoon or disposable spoon to collect the surface soil to a depth interval of 0 to 2 inches. A steel pick may be used as needed to loosen the soil prior to sampling.
- Use a decontaminated hand auger or direct push technology to collect the shallow soil from a depth of 2 inches to 3 feet below ground surface (bgs). When proper sample depth is reached, remove the cuttings from the borehole while keeping the core intact.
- To the extent possible, eliminate gravel size or larger particles or debris based on visual observation.
- Immediately fill the appropriate sample containers. Label and handle the containers as specified in SOP No. 3, Sample Handling, Documentation, and Tracking.
- Decontaminate the sampling equipment in accordance with SOP No. 4, Equipment and Personnel Decontamination.
- Once the sample is collected, the location will be documented and photographed; and GPS coordinates will be recorded.

1.5 INCREMENT SAMPLING PROCEDURES

The goal of Increment Sampling (IS) is to obtain an unbiased and reproducible estimate of the average concentration of analytes through the collection of soil sample increments distributed evenly throughout the decision unit/sampling area. Ideally, the target weight of an IS sample is

approximately 1 kilogram (kg) and is comprised of 30 (minimum) to 100 increments within the decision unit. IS samples will be collected as follows:

- Determine the appropriate size of the decision unit to fit the investigation objective. Decision unit size recommendations range from 33-ft x 33-ft to 165-ft x 165-ft and consist of 30 increments to 100 increments, respectively. The location and size of individual decision units are to be based on previous investigations, visual evidence of Munitions and explosives of concern (MEC) or Munitions Debris (MD), and/or type of MEC present.
- Using survey flags, delineate a decision unit boundary at each corner of the selected area. Note that the size and shape of the decision unit will be largely determined by the terrain features and the data quality objectives set forth in the UFP-QAPP.
- Once the boundary of the decision unit is defined, place nine flags at evenly spaced intervals along two opposite sides of the decision unit to define 10 lanes. Flags can then be used to fill in the remaining sides to create a visual sub-grid pattern. Additional flags can be placed within the interior of the decision unit if visual obstructions impede the visualization of evenly spaced increments throughout.
- With 100 increments established throughout the grid area, IS locations can then be selected. For 50-increment samples, every other flag will act as a sampling location. For 33-increment samples, every third flag will act as a sampling location. This pattern can be adjusted to satisfy the desired quantity of increments, as needed.
- Working in a team of two, one person will collect each increment while the other holds the sample container (clean plastic bag) and keeps track of the number of increments collected. The increments are sampled in a snake-like pattern from one corner of the decision unit to the corner adjacent to the starting corner.
- For the collection of QA/QC samples, the replicate samples should be collected from a sub-grid collection point offset from the original starting position and followed in the same snake-like pattern walked during the collection of the primary sample.
- Recommended sampling depths range from 1 inch to 4 inches at each increment location and are based on the overall depth distribution of anticipated analytes. The diameter of the sampling tool and the volume collected at each increment location will need to be adjusted to satisfy the 1 kg sample mass as it pertains to the selected quantity of increments in each decision unit.
- Once collected, the sample will be containerized as per the analytical laboratories requirements and labeled as specified in SOP No. 5, Sample Handling, Documentation, and Tracking.
- Once the sample collection is completed, the location will be documented and photographed; and GPS coordinates will be recorded at each of the four corners of the decision unit.

1.6 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All

QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

1.6.1 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. The initial sample containers for a particular parameter or set of parameters will be filled first, and then the duplicate sample containers for the same parameter(s) will be filled, and so on until all necessary sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. Duplicate samples will be blind to the laboratory. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

1.6.2 Matrix Spike and Matrix Spike Duplicates

Matrix spikes (MS) and matrix spike duplicates (MSD) are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the chain of custody (COC) form and on the containers. It may be necessary to increase the sample volume for samples where the MS/MSD designation is to be made. If additional volume is necessary, the additional sample container will be filled immediately after the initial sample. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

1.7 SAMPLE HANDLING

Sample containers, preservatives and analysis are specified in Worksheet #19. Samples will also be labeled and handled as described in SOP No. 3, Sample Handling, Documentation, and Tracking.

1.8 DOCUMENTATION

Documentation of observations and data acquired in the field will provide information on the activities concluded and also provide a permanent record of field activities. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets.

1.8.1 Field Sampling Data Sheet

A field sampling data sheet will be completed at each sampling location. Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location (and depths)

- Date and time of sampling
- Person(s) performing sampling
- Type of sample (grab or composite)
- Color (describe), odor (describe)
- Sample description
- Sample identification number
- Analyses required
- Number of sample bottles taken for each analyses
- Preservation of samples, if any
- Record of any QC samples from site
- Any irregularities or problems which may have a bearing on sample quality.

1.8.2 Field Notes

Field notes will also be kept during sampling activities. The following information will be recorded in the bound field logbook using waterproof ink:

- Names of personnel
- Weather conditions
- Date and time of sampling
- Locations, depths, and sample station numbers
- Times that procedures and measurements are completed
- Decontamination times
- Calibration information
- Calculations, if required.

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2.0 SOP NO. 2 - SUB-SURFACE SOIL SAMPLING

2.1 PURPOSE AND SCOPE

This SOP describes the equipment, materials, field procedures, and documentation procedures for collecting sub-surface soil samples using direct push or auger methods for soil characterization and chemical analysis.

Health and safety procedures and equipment to be used during soil sampling are described in a separate HASP. These SOPs are intended to be used with the UFP-QAPP and with other SOPs listed below:

- SOP No. 3 - Sample Handling, Documentation, and Tracking
- SOP No. 4 - Equipment and Personnel Decontamination
- SOP No. 6 – Permits and Clearances
- SOP No. 7 – Equipment Calibration
- SOP No. 8 – Investigation-Derived Waste

2.2 EQUIPMENT AND MATERIALS LIST

One of the following drilling equipment:

- Direct push rig (e.g., Geoprobe® rig or similar) with appropriate drilling and sampling tools (sub-surface soil)
- Hollow Stem Auger Kit and electric drill
- Hand Auger

The following equipment and materials should be on site for sub-surface soil sampling regardless of the drilling equipment used:

- Photoionization Detector (PID) (with 10.2 eV lamp)
- Weighted tape measure and ruler with 0.01-foot increments
- Surveyor's stakes and flags
- Field logbook
- Drilling Log form
- Sample Collection Field Form
- Stainless-steel bowl and spoon
- Sample containers
- Sample container labels
- Label tape (clear)
- Ziploc® bags
- Paper towels
- Digital Camera
- Waterproof and permanent marking pens
- Plastic sheeting

- Trash bags
- Ice chest with ice
- Appropriate health and safety equipment, as specified in the HASP
- Appropriate decontamination supplies, as specified in SOP No. 4
- Granular bentonite and potable water

2.3 LOCATING THE SAMPLING POINTS

The facilities designated for sampling are shown on figures provided in the UFP-QAPP (Worksheet #17). The approximate soil sampling locations will be identified on site figures before field work commences. The exact soil sampling locations will be determined in the field. Sampling coordinates will be mapped on the front of the Drilling Log in the Location Sketch/Comments Area. The sampling locations will be defined in the investigation specific work plan (WP) similar to previous investigation and long term monitoring locations.

When each soil sampling location is identified in the field, the sampling point identification will be entered in the field logbook and on the Drilling Log. Include any information concerning nearby landmarks, or other information that will help to re-locate the point in the future. Mark the sample locations using surveyor's stakes and flags, and label the flag using indelible ink with the sample point identification. A field map will be prepared as the sampling points are laid out to identify locations and tie the locations to site landmarks (such as foundations) if available. If the surveyor's stake is offset from the sample location, the offset will be noted on the field map and the field logbook.

2.4 SOIL SAMPLING PROCEDURES

Direct push samples will be collected using a dual tube sampling system or a discrete interval, piston-type sampler (Geoprobe®, MacroCore®, or equivalent). With a dual tube system, the outer rods remain in the ground while the inner rod and sample liner are extracted to retrieve a soil sample from the desired interval. Soil samples may be collected continuously throughout the depth of the direct push boring or from discrete intervals. The direct push rods will be decontaminated between boring locations, but not between samples at the same boring since a new acetate liner is used for each sample.

With a piston-type sampler, a four-foot or five-foot-long stainless steel sampler with an acetate liner is advanced to the top of the desired sampling interval. The sampler is closed to soil during advancement of the sampler to the desired sampling interval. When the top of the desired sampling interval is reached, a piston rod inside the sampler is unlocked through the drill rods, and the sampler is advanced to the bottom of the sampling interval. The sampler and all drill rods are then removed from the ground, and the acetate liner is removed from the piston sampler. Aside from the cutting shoe, the soil sampler never comes in contact with the soil sample. The cutting shoe is decontaminated after each sample is collected, and a new acetate liner is used for every sample interval. The outer sampling barrel is decontaminated after each boring is completed. The sampling will be documented in the field logbook and drill log.

With a hand auger or hollow stem auger kit, the auger head will be advanced manually to the depth. Auger extensions will be used when sampling at depths exceeding 4 feet. Once the desired depth is achieved, the auger is removed for sample collection as described below. Following collection, the hand auger or hollow stem auger kit will be decontaminated. When using manual samplers, the sampling will be documented in the field logbook and Soil/Sediment sampling form.

At each sampling location, the sampler will be advanced by a combination of hydraulic vertical pressure and percussion hammering. Once the target depth is achieved, the sample will be withdrawn and the liner filled with the soil sample is retrieved.

The following procedures will be followed once the soil sample has been retrieved:

- Don a clean pair of nitrile gloves.
- Cut acetate sleeve to provide access to the soil sample (direct push sampling only).
- Measure the recovery. Record the sampling interval and recovery on the drilling log.
- Remove soil smear from the outside of the acetate sleeve and examine the sample, with particular attention for visible evidence of staining, odors, or other evidence of contamination. Record the soil description on the Drilling Log or Soil/Sediment Sampling Form.
- Conduct PID screening of the soil. The soil with the highest PID levels will be collected for a sample.
- The soil from the sampling interval will be removed from the liner and homogenized in a stainless-steel bowl. Once the soil has been homogenized, fill the appropriate sample containers as specified in the UFP - QAPP (Worksheet #19). Record the sample interval and analysis requested on the Drilling Log or Soil/Sediment Sampling Form and the COC.
- Label, store, transport, and document the samples (depending on the use of the sample) according to SOP No. 3. The parameters for analysis and preservation are specified in UFP QAPP Worksheet #19.
- If no other samples will be collected from the boring, abandon the boring by backfilling the hole with hydrated granular bentonite. Pour the granular bentonite down the hole in approximate 1-foot to 2-foot lifts, and then pour approximately 0.5 gallon of potable water down the hole to hydrate the bentonite. Continue this from the bottom of the hole to the surface.

2.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples will be labeled with QA/QC identification numbers and sent to the laboratory with the other samples for analyses.

2.5.1 Field Blanks

Field blanks are QC samples collected to evaluate potential external contamination of samples and will consist of trip, ambient, and equipment blanks. The sample collection coordinator or the project QA/QC coordinator will designate these blanks. The blanks will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples.

A trip blank serves as a check on sample contamination originating from the container or sample transport. A trip blank consists of a volatile organic analysis (VOA) vial which was filled with VOA-free water at the lab, transported to the site, kept in the same cooler as the normal samples throughout the entire sampling day, and shipped back to the laboratory with the normal samples. One trip blank will be sent with each cooler containing water samples for volatile organic analyses.

The ambient blank serves as a check on sample contamination originating from ambient air during volatile organic compounds (VOCs) sample collection. An ambient blank consists of an empty VOA vial which is filled in the field with VOA free water. While pouring the sample, the water is given ample contact with ambient air conditions. The ambient blank is typically collected at the sampling location that potentially exhibits the largest ambient influence (near a busy road, airfield, etc.).

The equipment blank serves as a check on sample contamination originating from sampling equipment reuse during sample collection. The equipment blank consists of a set of sample bottles identical to the normal sample, which is filled with lab-grade water that is flushed over a decontaminated, reusable piece of equipment.

2.5.2 Duplicate Samples

Duplicate samples are samples collected to assess precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. All sampling containers will be filled in the following order: volatile or gaseous analyses first, then semi-volatile organic compounds (SVOCs), including polynuclear aromatic hydrocarbons (PAHs); metals; mercury; cyanide; total organic carbon; anions; other remaining analytes (no specific order). The initial sample containers will be filled first, and then the duplicate sample containers for the same parameter(s) and so on until all sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

2.5.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) analyses are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the COC form and on the containers. It may be necessary to increase the sample volume for MS/MSD samples. If

additional volume is necessary, the additional sample containers will be filled in the identical fashion as described above in the duplicate sample section. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

2.6 FIELD DOCUMENTATION

Field documentation for sub-surface soil sampling includes field logbooks and field forms. The most important aspect of field documentation is thorough, organized, and accurate record keeping. Two forms are used in the field during sub-surface soil sampling. These forms include the Drill Log and the Soil/Sediment Sampling Form. Each form is described in **Section 2.6.2**. An important factor of record keeping is the proper preservation and storage of all field documentation. To preserve the field documentation, the field notes and field forms are scanned and the electronic record of the field notes is stored in the project folder and backed up on additional hard drives to prevent data loss.

Additional forms including Health and Safety Meeting forms, Health and Safety Inspection forms, and COCs used during the sampling event are detailed in SOP No. 3.

2.6.1 Field Logbook

All information pertinent to soil sampling and not documented on the field forms will be recorded in a bound field logbook with consecutively numbered pages. The field logbook notes will be recorded in indelible ink. The field logbooks notes are entered to create an accurate record of the work performed so that the sampling activity can be reconstructed without relying on the memory of field personnel. Information documented in the field logbook may include information on date of notes, weather conditions, field personnel, site, mobilization, work performed including location and time, etc. After each day, field notes are reviewed by the field team leader or site responsible person for accuracy. Refer to SOP No. 3 for detailed procedures regarding documentation in the field logbook.

2.6.2 Field Forms

<u>Drill Log</u>

The Drilling Log contains the following minimum information:

- Project name and number
- Contractor company, field personnel
- Boring Identifier
- Drilling subcontractor company and name of drilling personnel
- Site Identifier
- Brand and model of drill rig
- Sizes and types of drilling and sampling equipment

- Surface elevation (if available, this may be entered later after the survey)
- Date drilling started and finished
- Overburden thickness, depth drilled into rock, and total depth of hole
- Depth to water during drilling and depth to water after drilling with elapsed time
- Number of geotechnical samples, type of samples, and core boxes (if cores are saved)
- Number of chemical samples and requested analyses
- Signature of field geologist who completed the Drilling Log field form
- Field sketch showing the boring location
- Sampling interval and measured sample recovery.
- A description of the recovered soil sample in accordance with the Unified Soil Classification method for unconsolidated geologic materials. The descriptions should include origin, grain size, sorting, texture, structure, bedding, color, moisture content, and consistency.
- Sample Identifier
- Sample Collection Time
- As applicable, field screening results, geotechnical samples, chemical samples, and blow counts (split-spoon sampling only).
- As applicable, record pertinent observations (such as odors, staining, colors, changes in drill rod advancement, chatter, water, etc.) in the "Remarks" column.
- If portions of the Drilling Log are not applicable (e.g., if samples are not collected for chemical analysis or if cores are not collected, etc.) record an "NA" in the appropriate location on the form.
- Bore hole abandonment (method of abandonment)

Soil/Sediment Sampling Form

The Soil/Sediment Sampling Form contains the following minimum information:

- Field personnel
- Project name and number
- Site Identifier
- Sample Location Identifier
- Sizes and types of sampling equipment
- Date of sample
- Sampling depth.
- A description of the recovered soil sample. The descriptions should include origin, grain size, texture, structure, color, and odor.
- Comments or Observations
- Sample Identifier
- Sample Collection Time

3.0 SOP NO. 3 – SAMPLE HANDLING, DOCUMENTATION, AND TRACKING

3.1 PURPOSE AND SCOPE

This SOP describes the procedures for sample handling, documentation, and tracking. This SOP is intended to be used with the UFP-QAPP, and with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling

3.2 SAMPLE IDENTIFICATION

The sampling locations, sample types, and naming conventions will be established prior to field activities for each sample to be collected. On-site personnel will obtain assistance in defining any special sampling requirements from the FPM Project Manager or designated Task Manager. Each sample will have a discrete, alpha-numeric sample identification (ID). A unique sample ID is needed to track each of the samples collected for analysis during the life of this project. In addition, the sample IDs will be used in the database to identify and retrieve the analytical results received from the laboratory. Each sample ID will be assigned at the time of sampling.

Sample ID

The sample ID will be designated as follows: Site Code, Sample Type and Sampling Location Indicator, Sample Location Number, Sample Depth Identifier, and Sample Type Qualifier.

Site Code

The first segment consists of two to five alphanumeric characters that designate the site code. Examples of site codes include:

- SR864 for Poorman Range
- ML865 for Ballistics Rain Field

For a soil sample designated “SR864SO0101A”, “SR864” indicates the sample is collected from the Ballistics Rain Field site.

Sample Type and Sampling Location Indicator

The second segment consists of one or two alphanumeric characters that indicate the sample type and sampling location indicator. Sample types are as shown below:

SO Surface Soil (0 to 2 inches)
SS Subsurface Soil (2 inches or greater)

For a soil sample designated "SR864SO0101A", "SO" indicates the sample is collected from surface soil.

Sample Location Number

The two-digit number following the sample indicator completes the identification of the sampling location at a specific site.

For a soil sample designated "SR864SO0101A", "01" indicates the sample is collected from sampling location 1.

Sample Depth Identifier

The fourth segment consists of two numerical characters that will be used to identify the depth in feet below top of inner casing in wells and feet bgs for soil samples.

For a soil sample designated "SR864SO0101A", "01" indicates the sample is collected 1 foot bgs.

Sample Type Qualifier

The fifth segment is one or two alphabetic characters used to designate the type of sample. The first letter denotes the round of sampling completed (e.g., "A" for first quarterly sampling round, "B" for second quarterly sampling round, etc.). The sample types will be identified by the second character as listed below:

- A = Primary sample
- B = Primary sample
- C = Field duplicate groundwater sample
- D = Matrix Spike Duplicate (MSD)
- E = Equipment blank
- F = Ambient blank
- R = Trip blank
- S = Matrix Spike (MS)

The letter A or B appearing at the end of a sample number indicates that the sample is a primary sample. These letters will be selected randomly to mask the predominance of primary samples over QA/QC samples. This system was devised to minimize the likelihood that the laboratory personnel can distinguish the primary samples from the QA/QC samples using the sample identification.

3.3 SAMPLE LABELS

Sample labels will be filled out as completely as possible by a designated member of the sampling team prior to beginning field sampling activities each day. All sample labels will be

filled out using waterproof ink. At a minimum, each label will contain the following information:

- Sampler's company affiliation
- Site location
- Sample ID
- Date and time of sample collection
- Analyses required
- Method of preservation (if any) used
- Sample matrix (i.e., soil, groundwater, surface water)
- Sampler's signature or initials

3.4 SAMPLE HANDLING PROCEDURES

This section discusses proper sample containers, preservatives, and handling and shipping procedures. The UFP-QAPP summarizes the information contained in this section and also includes the sample holding times for each analyte.

3.4.1 Sample Containers

Certified, commercially clean sample containers will be obtained from the contract analytical lab. The contract laboratory will label the containers to indicate the type of sample to be collected. Required preservatives will be prepared and placed in the containers at the laboratory prior to shipment to the site. Appropriate sample containers for the specific analyses required will be listed in the UFP-QAPP.

3.4.2 Sample Preservation

Sample preservation efforts will commence at the time of sample collection and will continue until analyses are performed. Samples will be stored on ice at 4°C in coolers immediately following collection. The ice will be double bagged in plastic storage bags. Additional sample preservation requirements are listed in the UFP-QAPP. Chemical preservatives, if necessary, will be added to the sample containers by the laboratory prior to shipment to the field, unless otherwise specified in the UFP-QAPP.

3.4.3 Sample Handling and Shipping

The sample containers will be wiped clean of all sample residue and then wrapped in protective packing material (bubble wrap) and taped. Samples will be double-bagged with plastic bags and then placed upright in an iced cooler. Additional packing material will be placed around the samples as necessary to protect them from damage and to keep them upright. A COC form will accompany each cooler. The COC will be placed in a plastic bag and attached to the inside lid of the cooler. The cooler lid will be taped closed with a custody seal.

Coolers will be hand delivered or shipped by overnight express carrier to the analytical laboratory. All samples must be shipped for laboratory receipt and analyses within specific

holding times. This may require daily shipment of samples with short holding times. The condition of all samples as received and temperature of all coolers will be reported by the laboratory.

3.4.4 Holding Times and Analyses

The holding time is specified as the maximum allowable time between sample collection and analysis and/or extraction, based on the analyte of interest and stability factors, and preservative (if any) used. Allowable holding times are listed in the UFP-QAPP.

3.5 SAMPLE DOCUMENTATION AND TRACKING

This section describes documentation required in the field notes, on the sample collection field sheets, on the daily QC reports, and on the sample COC forms.

3.5.1 Field Logbook

All entries in logbooks will be made in waterproof ink and corrections will consist of line-out deletions that are initialed and dated. Field investigation situations vary widely. No general rules can include each type of information that must be entered in a logbook for a particular site. A site-specific logging procedure will be developed to include sufficient information so that the sampling activity can be reconstructed without relying on the memory of field personnel. The logbooks will be kept in the field team member's possession or in a secure place during the investigation. Following the investigation, the logbooks will become a part of the final project file.

The following information (as applicable) shall be recorded in the field log book:

- Sampler’s printed name and signature
- Names of other field personnel (FPM and any FPM subcontractors) and site visitors
- Date (month, day, year)
- General weather conditions
- Time and location of sampling (including approximate distance to adjacent landmarks if possible)
- Level of personal protective equipment (PPE) used
- Brief description of sampling method with references to appropriate SOPs and WP
- Sample ID (includes location and matrix)
- Any QA/QC sample
- Number and volume of sample containers and requested analysis
- Sample handling and preservation
- Results of any field measurements, equipment used, and equipment calibration information
- Decontamination information
- Brief discussion of any field decisions, unusual conditions, problems encountered and corrective action taken, and/or changes required by field conditions

- Signature and date by person responsible for writing the field notes

3.5.2 Daily Quality Control Report

Each sampling crew will also maintain DQCRs to supplement the information recorded in the field logbook. DQCRs will be maintained by members of the field sampling team and cross-checked for completeness at the end of each day by the sampling team members and/or Field Manager. They will be signed and dated by individuals making entries and initials by the reviewer upon completion. Copies of the DQCR will be forwarded to the QA Officer for review. The DQCR will include the following information:

- Project name
- Project number
- Personnel on site
- Visitor on site
- Subcontractors on site
- Equipment on site
- Weather conditions
- Field work performed
- Quality control and health and safety activities
- Problem, down time, and standby time
- Name and title of person completing the DQCR

3.5.3 Sample Chain of Custody

During field sampling activities, traceability of the sample must be maintained from the time that the samples are collected until laboratory data are issued. Initial information concerning collection of the samples will be recorded in the field logbook as described above. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. The COC form used in the field is a one-page form.

The sampler will be responsible for initiating and filling out the COC form. The sampler will sign the COC when the sampler relinquishes the samples to anyone else. One COC form will be completed for each cooler of samples collected daily. The COC will contain the following information:

- Sampler's signature and affiliation
- Project number
- Date and time of collection
- Sample identification number
- Sample type
- Analyses requested
- Number of containers
- Signature of persons relinquishing custody, dates, and times
- Signature of persons accepting custody, dates, and times

- Method of shipment
- Shipping air bill number (if appropriate)

The person responsible for delivery of the samples to the laboratory will sign the COC form, and retain a copy of the COC form, document the method of shipment, and send the original and the second copy of the COC form with the samples. Upon receipt at the laboratory, the person receiving the samples will sign the COC form and return the second copy to the FPM Chemical Quality Control Coordinator. Copies of the COC forms documenting custody changes and all custody documentation will be received and kept in the central files. The original COC forms will remain with the samples until final disposition of the samples by the laboratory. The analytical laboratory will dispose of the samples in an appropriate manner 60 to 90 days after data reporting. After sample disposal, a copy of the original COC will be sent by the laboratory to the FPM Chemical Quality Control Coordinator to be incorporated into the central files.

4.0 SOP NO. 4 – EQUIPMENT AND PERSONNEL DECONTAMINATION

4.1 PURPOSE AND SCOPE

This SOP describes the equipment, materials, field procedures, and documentation procedures for decontaminating sampling equipment and personnel. Health and safety procedures and equipment to be used during soil sampling are described in a separate HASP. The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling
- SOP No. 8 – Investigation-Derived Waste

The overall objective of an environmental sampling program is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g. using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., all non-disposable equipment that will come in direct contact with samples) and field support equipment (e.g., drill rigs, vehicles) is, therefore, required prior to, between, and after uses to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

4.2 EQUIPMENT AND MATERIALS LIST

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Wash tubs
- Buckets
- Scrapers, flat bladed
- Hot water – high-pressure sprayer
- Sponges or paper towels
- Alconox detergent (or equivalent)
- Potable tap water or distilled water
- Laboratory-grade de-ionized water
- Garden-type water sprayers
- Appropriate Health and Safety equipment (i.e., nitrile gloves, safety glasses, etc.)
- Appropriate containers for Investigative Derived Waste (IDW)

4.3 DECONTAMINATION PROCEDURES

Site activities should be conducted with the general goal of preventing the contamination of personnel and equipment. However, some type of decontamination will always be required on site. A sample personnel decontamination will use remote sampling techniques, bag monitoring instruments, avoid contact with obvious contamination, and employ dust suppression methods as necessary to reduce the probability of becoming set-up guideline and a sample decontamination equipment and supplies list are included in the HASP.

4.3.1 Decontamination Solutions

A decontamination solution should be capable of removing, or converting to a harmless substance, the contaminant of concern without harming the object being decontaminated. The preferred solution is a mixture of detergent and water, which is a relatively safe option compared to chemical decontaminants. A solution recommended for decontaminating consists of 1 to 1.5 tablespoons of Alconox per gallon of warm water. Skin should be decontaminated by washing with hand soap and water. The decontamination solution must be changed when it no longer foams or when it becomes extremely dirty. Rinse water must be changed when it becomes discolored, begins to foam, or when the decontamination solution cannot be removed.

4.3.2 Personnel Decontamination

A temporary personnel decontamination line will be set up in the Contamination Reduction Zone, which is outside of the Exclusion Zone where intrusive work is being performed. If contamination is not encountered, a dry decontamination station may be established which consists of an area where disposable PPE can be donned and discarded. It is anticipated that all work at the Holloman AFB will be completed in Level D.

4.3.3 Sampling Equipment Decontamination

The following steps will be used to decontaminate sampling equipment:

- Personnel will dress in suitable safety equipment to reduce personal exposure as required by the HASP.
- Gross contamination on equipment will be scraped off at the sampling or construction site.
- Equipment that cannot be damaged by water will be placed in a wash tub containing Alconox or low-sudsing non-phosphate detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by a de-ionized or distilled water rinse.
- Equipment that may be damaged by water will be carefully wiped clean using a sponge and detergent water and rinsed with de-ionized or distilled water. Care will be taken to prevent equipment damage.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately after

decontamination, the equipment will be covered or wrapped in plastic sheeting, foil, or heavy-duty trash bags to minimize potential contact with contaminants.

4.3.4 Equipment Leaving the Site

Vehicles used for activities in non-contaminated areas shall be cleaned on an as-needed basis, as determined by the unexploded Ordnance (UXO) Site Safety Officer/QC Supervisor (UXOSO/QCS), using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles leaving the area.

4.3.5 Responsible Authority

Decontamination operations at each hazardous waste site shall be supervised by the UXOSO/QCS. The UXOSO/QCS is responsible for ensuring that all personnel follow decontamination procedures and that all contaminated equipment is adequately decontaminated. The UXOSO/QCS is also responsible for maintaining the decontamination zone and managing the wastes generated from the decontamination process.

4.3.6 Investigation Derived Waste

Liquid wastewater from decontamination will be removed from the site and properly disposal of. Solid waste, including sample liners and PPE, will be removed from the site and properly disposed of as well.

4.4 EMERGENCY DECONTAMINATION

Emergency decontamination procedures should be followed if necessary to prevent the loss of life or severe injury. In the case of threat to life, decontamination should be delayed until the victim is stabilized; however, decontamination should always be performed first, when practical, if it can be done without interfering with essential lifesaving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life. During an emergency, provisions must also be made for protecting medical personnel and disposing of contaminated clothing or equipment.

4.5 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination will include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions
- IDW handling

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5.0 SOP NO. 5 - GLOBAL POSITIONING SYSTEM MEASUREMENTS

5.1 PURPOSE AND SCOPE

This SOP provides technical guidance and methods that will be used to perform GPS measurements at the field site.

GPS surveying at the field site is used to record:

- Locations of MEC or MD
- Excavation footprints
- Sampling locations
- Injection locations
- Other surface and subsurface feature locations and elevations

The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Soil Sampling

5.2 PERSONNEL QUALIFICATIONS

GPS measurements at the field site will be performed by qualified field personnel. All personnel engaged in recording GPS measurements will be knowledgeable and experienced in methods and equipment use.

5.3 GPS SURVEYING

GPS equipment capable of achieving measurement precision of equal to or less than the specified accuracy without correction will be used. GPS equipment should collect data such that post-processing of spatial data can be performed to increase measurement precision, if needed. The equipment will be operated in accordance with manufacturer's specification, operations manual, and generally accepted surveying practices.

Surveying equipment will be field-verified each day before beginning surveying by establishing the coordinates of a known location (ie, temporary benchmark) using the GPS unit. The benchmark identification (or description) and measured coordinates will be recorded in the survey logbook.

5.3.1 Survey Points

GPS equipment will be used to record the grid corner and center-point coordinates, that will be marked for future reference during the investigation. GPS will be used to record other pertinent site feature data, for example the location of MEC or MD and anthropogenic material, if encountered. Prior to collecting the center-point sampling location coordinates, each location will be marked with a survey flag. The sample location ID will be recorded on each survey flag.

Sample locations will be measured from the center of the grid cell or grab location. For each GPS location recorded an identifier and the coordinates will be stored in the data logger.

If the coordinates at a survey location cannot be determined due to the presence of tree cover or other obstacles which prohibit adequate signal reception, coordinates will be obtained at a minimum of two alternate locations (offsets) close to the original survey location. The distance and bearing from each of the alternate locations to the original survey location will then be determined using a measuring tape and compass.

5.3.2 Coordinate Systems

It is assumed all GPS measurements will be recorded using the projected Universal Transverse Mercator (UTM) coordinate system and the World Geodetic System 1984 (WGS84) datum. The grid will be referenced to known National Geodetic Survey (NGS) benchmarks, if possible.

5.3.3 Required Accuracy

At a minimum, surveyed location coordinates will be determined to an accuracy of ±0.5 foot. Vertical elevations measured by GPS are suspect due to limited system accuracy. Accuracy will be assessed using the FGDC Geospatial Positioning Accuracy Standards. Data may be post-processed to increase accuracy, if required.

5.4 DOCUMENTATION

The field team is responsible for documenting all survey measurements. A complete and accurate record correlating the sample IDs to the instrument assigned stations IDs will be kept in the field logbook. The observations and data will be recorded with waterproof ink in a permanently bound weatherproof field logbook with consecutively numbered pages, and on field data sheets as applicable. Upon completion of each day's fieldwork, the electronic record will be downloaded from the instrument, correlated with the sample IDs, and uploaded into the project database.

6.0 SOP NO. 6 - PERMITS AND CLEARANCES

6.1 PURPOSE AND SCOPE

This document defines the SOP for obtaining all permits and clearances required for work at Holloman AFB. Permits and clearances are required for entrance onto the Base to complete fieldwork, for Base security, and to locate underground utilities for intrusive fieldwork. Additional permits may be required to access restricted areas. All required permits and clearances will be verified with Holloman AFB personnel. The procedures presented below are intended to be used with other SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Subsurface Soil Sampling

6.2 CONTRACTOR BADGES, VEHICLE PASSES, AND CAMERA PASS

6.2.1 Contractor Badges

A daily pass must be obtained from the visitor's center at the gate. The Holloman AFB Remedial Project Manager will be notified in advance of the list of contractor and subcontractor employees that will be entering the Base prior to arriving at the gate. Security personnel will issue daily passes to contractor and subcontractor employees. These passes are per vehicle and are issued for those employees riding in that vehicle. Once the pass is issued, the personnel listed on a single pass must stay together. All personnel entering the Base must present a valid driver's license to Base security once arriving on base. Vehicle registration and proof of insurance are required to obtain a Base pass. Contractor's passes are the property of the United States (U.S.) Air Force and will be returned to the Base Security Office when no longer needed. The pass will be kept with the contractor at all times while on Base property.

6.2.2 Vehicle Passes

All vehicles that enter the Base must be registered at the Base Security Office, and obtain and display a contractor pass\vehicle permit tag from Base Security. The registrant will furnish the vehicle registration, proof of insurance, rental agreement (if applicable), and valid driver's license. Vehicle passes serve as contractor badges and are issued on a daily basis only. Vehicle/contractor passes must be displayed (taped) on the lower corner of the windshield on the driver's side of the vehicle.

6.2.3 Photography

A camera pass is not required for taking any photographs on Base. However, contractors and subcontractors are not to photograph aircraft or other potentially sensitive items. Photography

will be limited to the site and site features, documentation of field activities, and field personnel. **At no time will personnel take pictures of the aircraft or maintenance bays.**

6.3 UTILITY CLEARANCES

Digging permits will be obtained for all machine-driven intrusive activities prior to initiating the work, in accordance with Part VII of Chapter 8 of Revised Statute Title 40. Digging permits are obtained by:

The planned drilling or digging areas at each site will be marked with white paint, tape or flagging. White is the only color allowed for marking excavations and borings.

A call will be placed to the statewide utility hotline New Mexico One Call at (800) 321-2537. The street address and the nearest street intersection along with a call-back telephone number will be provided. In addition, New Mexico One Call may request a faxed copy of a site map if multiple drilling locations require utility locates. Notice shall be given and will include a specific location request for excavation or demolition work to be performed at least forty-eight hours, but not more than one hundred twenty hours, excluding weekends and holidays, in advance of actual work commencement.

A utility locate request requires the name, address, and telephone number of the person filing the notice of intent, and, if different, the person responsible for the excavation or demolition, the starting date, anticipated duration, and description of the specific type of excavation or demolition operation to be conducted, the specific location of the proposed excavation or demolition and a statement as to whether directional boring or explosives are to be used. If the excavation or demolition is part of a larger project, the notice shall be confined to the actual area of proposed excavation or demolition that will occur during the ten-day time period under RS40:1749.14(C).

A Base Civil Engineering Work Clearance Request (AF Form 103) will be completed for each planned drilling or digging area and it will be provided to the Base Restoration Project Manager for signature and processing.

Await a return of the completed AF Form 103 to the Base Restoration Project Manager. A site meeting may be required in order to clarify the locations for intrusive work.

Permits are valid for a period of 10 days once approval has been given. If the work at the site is not initiated or completed within the 10 day period, the clearance process must be repeated starting with step number 1 above.

6.4 NOTICE TO AIRMEN (NOTAM)

NOTAMs for drilling, well installation, well sampling or other work activities on or near the Holloman AFB Flightline (i.e., parking ramp, between runways, revetments, etc.) will be

coordinated through FPM who will submit the NOTAMs to Base Operations for publishing. It is not anticipated that contractors will be required to work on or near the flightline.

6.5 FLIGHTLINE DRIVING PERMIT

Currently, access to the flightline requires escort to be provided by the Holloman AFB Restoration Project Manager. It is not anticipated that contractors will need flightline driver passes or badges.

6.6 HOT WORK PERMIT

A hot work permit is required for all work utilizing an open flame, including but not limited to, welding, cutting torch use, and kerosene-fired steam cleaners. A hot work permit must be obtained from the Holloman AFB Fire Department prior to the initiation of permit required activities. The Fire Department non-emergency phone number to call to obtain a hot work permit is **(575)-572-7228**.

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7.0 SOP NO. 7 - EQUIPMENT CALIBRATION

7.1 PURPOSE AND SCOPE

This SOP describes the procedures for equipment calibration and documentation. This SOP is intended to be used with the UFP-QAPP and with other SOPs listed below:

- SOP No. 2 – Subsurface Soil Sampling

7.2 EQUIPMENT AND MATERIALS LIST

The following section provides a list of equipment that may be needed to perform equipment calibration.

Horiba U-22 and Horiba U-52:

- Horiba U-22
- Horiba U-52
- Auto calibration solution pH 4
- Calibration cup
- Calibration log for Horibas

YSI 556

- YSI 556
- Calibration cup
- Calibration log for YSI
- DI water
- Conductivity solution (1.413 µS/cm)
- pH 4 solution
- pH 7 solution
- ORP solution (240 mV)
- PID, miniRAE
- Tedlar bag
- Isobutylene (100 ppm)
- Calibration log for PID

7.3 EQUIPMENT CALIBRATION PROCEDURES

The following provides the procedures for the calibration of the Horiba U-22 and U-52, YSI 556, and PID miniRAE.

Horiba U-22:

- Turn on Horiba.
- Place probe in auto calibration solution (pH 4.00).
- Press Cal button.
- Press Ent button, calibration begins.
- END appears when calibration is complete.
- Press MEAS button and collect pH reading.
- The acceptable pH range is 3.96 to 4.04.
- If any errors appear, refer to Horiba U-22 manual.

Horiba U-52:

- Turn on Horiba.
- Place probe in auto calibration solution (pH 4.00).
- Press Cal button.
- Press Ent button, calibration begins when the parameters on screen start to blink.
- When parameters stop blinking, calibration is complete.
- Collect pH reading.
- The acceptable pH range is 3.96 to 4.04.
- If any errors appear, refer to Horiba U-52 manual.

YSI 556:

- Turn on YSI 556.
- Press ESC which will lead to main menu.
- Scroll to Calibrate and press ENT.
- Scroll to DO, press enter, scroll to DO%
- Enter barometric pressure.
- Place probe in DI water (in calibration cup) and loosely tighten probe to calibration cup.
- Press enter, and then enter again.
- DO% is instantly calibrated.
- Acceptable range is 95% to 105%.
- Press ESC to return to calibration menu.
- Scroll to Conductivity, press enter, scroll to Conductivity in list and press enter
- Enter standard, 1.413 µs/cm.
- Fill calibration cup with conductivity solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- Conductivity is instantly calibrated.
- Acceptable range is 1.408 to 1.418 µs/cm.
- Press ESC to return to calibration menu.
- Scroll to pH, press enter, scroll to 2-point calibration and press enter

- Enter 1st standard, 4.00.
- Fill calibration cup with pH 4.00 solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- pH is instantly calibrated.
- Acceptable range is 3.95 to 4.05.
- Press enter.
- Enter 2nd standard, 7.00.
- Fill calibration cup with pH 7.00 solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- pH is instantly calibrated.
- Acceptable range is 6.95 to 7.05.
- Press ESC to return to calibration menu.
- Scroll to ORP, press enter
- Enter standard, 240 mV.
- Fill calibration cup with ORP solution.
- Place probe in solution and tighten probe to calibration cup.
- Press enter, and then enter again.
- Conductivity is instantly calibrated.
- Acceptable range is 235 to 245 mV.
- If any errors appear, refer to YSI 556 manual.

PID miniRAE:

Zero Calibration

- Turn on PID to Zero Calibration menu.
- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.
- Zero calibration starts.
- When Zero calibration is complete, you see this message: Zeroing is done!, Reading = 0.000 ppm.

Span Calibration

- Turn on PID to Scan Calibration menu.
- The span gas is first be filled into a Tedlar bag.
- Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.
- Press [Y/+] to enter Span calibration.
- Turn on your span calibration gas.
- Press [Y/+] to initiate calibration.

- Span calibration starts and displays this message: Calibrating...
- When Span calibration is complete, you see this message: Span 1 is done!, Reading = 100.0 ppm.

Per the Mini RAE manual, there is no set range of what is allowed above or below 100 ppm. The Manual simply states that the "reading should be very close to the span gas value".

7.4 DOCUMENTATION:

Documentation for equipment calibration forms which are included in the DQCRs. The calibration forms include:

- Equipment model and number
- Date
- Calibration personnel
- Standard calibration values
- Scan gas concentration for PID calibration
- Standard calibration solution parameters for water quality

8.0 SOP NO. 8 - INVESTIGATION-DERIVED WASTE

8.1 PURPOSE AND SCOPE

This document defines the SOP for the handling and disposal of investigation-derived waste (IDW) at Holloman AFB. IDW will include soil cuttings, decontamination fluids, well purge water, and personal protective equipment (PPE). These procedures are intended to be used with the WP or WP addenda as well as the applicable SOPs listed below:

- SOP No. 1 – Surface and Near Surface Soil Sampling
- SOP No. 2 – Sub-Surface Soil Sampling
- SOP No. 4 - Equipment and Personnel Decontamination
- SOP No. 7 – Equipment Calibration

8.2 EQUIPMENT LIST

The following equipment is required for handling IDW:

- Department of Transportation (DOT)-approved 55-gallon drums
- Photoionization Detector (PID) (10.2 eV lamp considered appropriate for most applications)
- Sampling equipment and sample containers [for Toxicity Characteristic Leaching Procedure (TCLP) sampling, if applicable]

8.3 FIELD PROCEDURES

8.3.1 IDW Handling

Soil cuttings from different borings at the same site will be combined in the same drum, but soil from different sites will be kept separate. If headspace results or visual or olfactory observations indicate potentially highly contaminated materials, cuttings from individual soil borings will be containerized separately from cuttings from other borings at the same site.

Fluids from heavy equipment and small tool equipment decontamination will be containerized for characterization. No fluids will be discharged directly into waterways or drainages leaving the site. All IDW determined to be characteristically hazardous will be disposed off-site using a licensed waste disposal firm.

PPE used during investigation activities (including nitrile gloves, paper towels, etc.) is expected to have minimal contamination, and will not be required to be containerized. All PPE will be treated as solid waste and will be placed in plastic trash bags and disposed of on site at a trash receptacle or dumpster identified by Holloman AFB personnel. Well materials from abandoned wells will be pulled from the ground, scraped clean, and disposed of as solid waste on Base.

Disposable sampling equipment, such as bailers, PE tubing, Terra Core soil samplers, etc., will also be discarded as solid waste.

8.3.2 Waste Storage

All IDW required to be containerized will be stored in 55-gallon drums. The drums will be marked with the following information:

- Installation identification (i.e., Holloman AFB)
- Site name and number
- Type of IDW (i.e., soil cuttings, purge water, decontamination fluids)
- Boring number(s) or sampling location number (s)
- Date(s) of accumulation
- Name and phone number of Holloman AFB contact (to be provided by Holloman AFB Restoration Project Manager at start of field activities)

All containerized IDW will be stored on site at a designated storage area identified by Holloman AFB personnel until the need for off-site disposal has been made, as described in the following subsection.

All water containerized as IDW will be stored in 55-gallon drums and will be transported to the central staging area for off-site disposal by a licensed waste disposal firm.

8.3.3 Determination of Disposal

All IDW that is determined to not be disposable on-Base will be properly disposed of at a licensed off-Base facility. The analytical results from the field sampling activities will be used to indicate the contamination levels of IDW from each site to determine an appropriate disposal facility. If analytical results indicate none or minimal contamination, IDW will disposed of off-site or at a location on base identified by the Holloman Restoration Project Manager.

If results indicate that IDW from a given site may be characteristically hazardous, a sample of containerized IDW will be collected and analyzed for the appropriate waste characteristic using the TCLP. Analytical test results will be compared to TCLP threshold criteria to determine if the material is characteristically hazardous. Characteristically hazardous IDW will be properly manifested and shipped to a licensed off-Base Subtitle C disposal facility. **A representative of Holloman AFB will sign all manifests for IDW shipped off site.**

9.0 SOP NO. 9 - GROUNDWATER SAMPLING

9.1 PURPOSE AND SCOPE

This section defines the SOP for the collection of groundwater samples. This procedure describes equipment, field procedures, and QA/QC procedures necessary to collect groundwater samples. The sample locations and frequency of collection are specified in the project UFP QAPP.

This SOP is intended to be used together with the UFP QAPP and other appropriate SOPs. Health and safety procedures and equipment that will be required during the investigation are detailed in the HASP. Applicable SOPs are listed below:

- SOP No. 3, Sample Handling, Documentation, and Tracking
- SOP No. 4, Decontamination

9.2 EQUIPMENT AND MATERIALS LIST

The following equipment will be used during well purging and sampling:

Bailer Sampling:
- Well lock keys (if required)
- Water level probe with 0.01-foot intervals
- Assorted tools (knife, screwdriver, etc.)
- Disposable bailers
- Nylon rope
- Multi-parameter water quality meter (Horiba U-52, YSI 556, or similar)
- Calibration fluids
- Plastic squeeze or spray bottle filled with de-ionized water
- Plastic or glass container (for field parameter measurements)
- Paper towels
- Calculator
- Field logbook
- Waterproof and permanent marker
- Appropriate containers for holding purged water
- Appropriate health and safety equipment, as specified in the HASP
- Well purging and sampling form for bailer sampling
- Appropriate decontamination supplies, as specified in **SOP No. 4.**
- Cooler with ice
- Garbage bag
- Sample labels
- Sample bottles with preservatives added will be obtained from the analytical laboratory
- Several extra sample bottles in case of breakage or other problems

Low Flow Sampling:

- Well lock keys (if required)
- Water level probe with 0.01-foot intervals
- Assorted tools (knife, screwdriver, etc.)
- Peristaltic Pump
- Marine battery
- Multi-parameter water quality meter (Horiba U-52, YSI 556, or similar)
- polyethylene tubing (assorted diameters); Teflon-lined tubing for sample withdrawal is preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs, and inorganics. PVE, polypropylene, or polyethylene tubing may be used when collecting samples for metals and other inorganic analyses.
- Flow-through cell
- Plastic, see-through measuring cup (2 cups size)
- Calibration fluids
- Plastic squeeze or spray bottle filled with de-ionized water
- PE or glass container (for field parameter measurements)
- Paper towels
- Garbage bags
- Calculator
- Field logbook
- Waterproof and permanent marker
- Appropriate containers for holding purge water
- Appropriate health and safety equipment, as specified in the HASP
- Well purging and sampling form for low-flow sampling
- Appropriate decontamination equipment, as specified in the **SOP No. 4**
- Cooler with ice
- Sample labels
- Sample bottles with preservatives added will be obtained from the analytical laboratory
- Several extra sample bottles in case of breakage or other problems

9.3 IDENTIFYING THE GROUNDWATER SAMPLING LOCATIONS

The groundwater sampling locations will be identified in the site-specific work plan. All existing monitoring wells have been surveyed by a certified surveyor and are included on maps and figures. All additional monitoring wells and temporary well locations will be surveyed after well completion and development.

9.4 GROUNDWATER SAMPLING PROCEDURES

This section summarizes the step-by-step procedures for collecting groundwater samples in the field. Groundwater purging and sampling will be conducted in accordance with the USEPA Region 4 Science and Ecosystem Support Division (SESD) Operating Procedure for

Groundwater Sampling (USEPA, 2013) and the USEPA Region 1 *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (USEPA Region I, 2010). Observations made during sample collection will be recorded in the field notebook and on the well purging and sampling form.

The purpose of well purging is to remove stagnant water from the well and obtain representative water from the geologic formation while minimizing disturbance to the collected samples. Before a sample is collected, the well will be purged as described in the subsections below. Evacuated groundwater shall be containerized for proper disposal, and necessary precautions shall be taken to prevent spilling of water. The following **Sections 9.5.1** and **9.5.2** describe sample collection using the bailer and low flow collection methods.

9.4.1 Bailer

Before well purging begins, the following set up procedures will be performed at each well:

- The condition of the outer well casing, concrete well pad, and any unusual conditions of the area around the well will be noted in the field logbook.
- The well will be opened.
- The condition of the inner well cap and casing will be noted.
- Newly-constructed wells will be checked for the presence of LNAPL or DNAPL before the initial sampling round, if site conditions and history warrant.
- The depth of static water level and total well depth will be measured (to nearest 0.01 foot) and recorded from a measuring point on the well casing. The measuring point should be identified, and time recorded in the field logbook.
- The volume of water in the well casing will be calculated in gallons based on water column height and casing diameter. Three casing volumes will be calculated.

The well will be purged prior to sampling according to the following procedure:

- Temperature, pH, conductivity, dissolved oxygen (DO), oxygen reduction potential (ORP), and turbidity measurements will be recorded initially and during purging, at a minimum of one set of readings per well casing volume purged.
- The purge will be considered adequate when three to five well volumes have been removed and the parameters have stabilized. Stabilization will have occurred when the following conditions have been met for three consecutive readings (USEPA Region 4, 2013):

    - pH remains constant within 0.1 pH unit.
    - Specific conductance varies no more than 5%.
    - Turbidity has stabilized or turbidity readings are below 10 nephelometric turbidity units (NTU)
    - Dissolved oxygen (DO) may also be used as a purge adequacy parameter. Normal goals for DO are 0.2 mg/L or 10% saturation, whichever is greater.

- If the parameters have not stabilized after three well volumes have been removed, additional well volumes will be removed up to five well volumes. If the parameters have not stabilized after five well volumes have been removed, it is up to the discretion of the project leader whether or not to collect a sample or to continue purging. If, after five well volumes, pH and conductivity have stabilized and the turbidity is still decreasing and approaching an acceptable level, additional purging should be considered to obtain the best sample possible, with respect to turbidity.
- If the well is purged dry, this generally constitutes an adequate purge and the well can be sampled following sufficient recovery (enough volume to allow filling all of the sample containers).

For wells with slow recovery, attempts should be made to avoid purging them to dryness. This can be accomplished, for example, by slowing the purge rate. As water enters a well that has been purged to dryness, it may cascade down the sand pack and/or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the column.

Wells will be sampled as soon as possible after purging. If adequate volume is available immediately upon completion of purging, the well will be sampled immediately. If not, sampling will occur as soon as adequate volume has recovered. The following sampling procedure will be followed when using disposable bailers:

- Typically, new disposable equipment (PE bailer and nylon rope) are used for each sampling location. Decontaminated sampling equipment will be assembled if necessary.
- All sample bottles for all analyses will be gathered and identification labels for each sample bottle will be completed for each sample and affixed to the bottles.
- The bailer will be lowered **slowly** and **gently** into contact with the water in the well. The well will be checked for light and dense NAPL. After checking for the presence of NAPL, the bailer will be lowered to the same depth in the well each time.
- The bailer will be retrieved **smoothly** and the water will be **slowly** drained into the sample containers through the bailer's bottom discharge control device.
- The individual sample bottles should be filled in the order given below:
  1. VOCs
  2. SVOCs
  3. Metals
  4. Other remaining analytes (no specific order)
- VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space remains in the vial. Turn the vial over and tap it to check for bubbles in the vial, which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.
- Fill bottles for SVOCs, metals and other analytes until almost full.
- Time of sampling will be recorded.
- The bailer and string will be removed from the well and placed in garbage bags for proper disposal as household waste.

- The well cap will be replaced and locked.
- Field documentation will be completed, including the COC.

9.4.2 Low Flow

According to USEPA Region 1 *Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (USEPA Region I, 2010), the goal of low-flow sampling is to collect water samples that reflect transport through the subsurface under ambient flow conditions, with minimal physical and chemical alteration from sampling operations. There is a need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns and by using low pumping rates during purging and sampling operations. The procedures in this section are in accordance with that guidance.

Before well purging begins, the following set up procedures will be performed at each well:

- The condition of the outer well casing, concrete well pad, and any unusual conditions of the area around the well will be noted in the field logbook.
- The well will be opened.
- The condition of the inner well cap, casing and associated tubing will be noted.
- Newly-constructed wells will be checked for the presence of LNAPL or DNAPL before the initial sampling round, if site conditions and history warrant.
- The depth of static water level will be measured (to nearest 0.01 foot) and recorded from a measuring point on the well casing. The measuring point should be identified, and time recorded in the field logbook.
- The low flow equipment will be set up at the well. The set-up includes:
  - The pump will be connected to the marine battery.
  - Teflon-lined polyethylene tubing will be run from the pump into the well, to form the pump intake. The pump intake will be located within the screened interval and at a depth that will remain underwater at all times. The pump intake will be at the same depth as used for previous sampling events, or at the midpoint or lowest historical mid-point of the saturated screen interval.
  - A multi-parameter water quality meter with flow-through cell will be connected with new disposable polyethylene tubing to the dedicated peristaltic or bladder pump and associated tubing. Samples for turbidity measurements will be obtained before water enters the flow-through cell.
  - If groundwater samples are to be analyzed for VOCs, the sampler will shade the equipment from sunlight using an umbrella or tent, in order to prevent groundwater in the tubing from heating up and losing VOCs.
- The water purge rate will be set within the range of 100 to 500 mL per minute.

The well will be purged prior to sampling according to the following procedure:

- Temperature, pH, conductivity, dissolved oxygen (DO), oxygen reduction potential (ORP), and turbidity measurements will be recorded initially and during purging. Measurements

will be recorded at a rate of one set of readings per flow-through cell volume purged, no more frequently than once every five minutes.

- During purging, depth to water will be measured continuously. Drawdown of less than 0.3 feet is considered ideal, but not mandatory.
- The pump will be started at low speed, and the speed will be slowly increased until discharge occurs. The pump speed will be adjusted until there is little or no water level drawdown. The time and discharge rate of any pumping rate adjustments will be recorded. If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, purging will continue.
- Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder pumps or peristaltic pumps). If the recovery rate to the well is less than 50 mL/minute, or the well is being essentially dewatered during purging, the well will be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. Samples in this specific situation may be collected without stabilization of indicator field parameters. If this type of problematic situation persists in a well, then water sample collection may be changed to a passive or no-purge method, if consistent with the site's data quality objectives, or a new well will be installed.
- Stabilization of field parameters will be used to indicate when conditions are suitable for sampling to begin. The final purge volume must be greater than the stabilized drawdown volume plus the pump's tubing volume. Parameters will be considered to have stabilized when the following conditions have been met for three consecutive readings:

  - pH remains constant within ±0.1 pH unit.
  - Specific conductance varies no more than 3%.
  - Turbidity has stabilized within 10% for values greater than 5 NTU, or three readings below 5 NTU.
  - DO has stabilized within 10% for values greater than 0.5 mg/L, or three readings below 0.5 mg/L.
  - ORP remains constant within ±10 millivolts (mV).

- If after two hours of purging, field parameters have not stabilized, one of three optional courses of action may be taken:

  1. Continue purging until stabilization is achieved;
  2. Discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization);
  3. Discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note that there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may reflect a sampling bias and therefore the data may not meet the data quality objectives of the sampling event.)

Wells will be sampled as soon as possible after purging. If adequate volume is available immediately upon completion of purging, the well will be sampled immediately. If not,

sampling will occur as soon as adequate volume has recovered. The following sampling procedure will be used when using the low-flow method:

- All sample bottles for all analyses for the sampling locations are organized and identification labels for all sample bottles will be completed.
- The discharge polyethylene tubing will be unhooked from the flow-through cell.
- Groundwater samples will be collected with water purge rates at or below 250 mL/min.
- The individual sample bottles should be filled in the order given below:
  i. VOCs
  ii. SVOCs
  iii. Metals
  iv. Other remaining analytes (no specific order)
- VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space remains in the vial. Turn the vial over and tap it to check for bubbles in the vial, which indicate air space. If air bubbles are observed in the sample vial, discard the sample vial and repeat the procedure until no air bubbles appear.
- Bottles for SVOCs, metals and other analytes will be filled until almost full.
- Time of sampling will be recorded.
- The sampling equipment will be turned off and disconnected from the well.
- The well cap will be replaced and locked.
- Field documentation will be completed, including the COC.

9.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

The well sampling order will be dependent on expected levels of contamination in each well, if known, and will be determined prior to sampling. Typically, the sampling order of the monitoring wells is from the least contaminated well to the most contaminated well. QA/QC samples will be collected during groundwater sampling.

Field QA/QC samples are designed to help identify potential sources of external sample contamination and evaluate potential error introduced by sample collection and handling. All QA/QC samples are labeled with QA/QC identification numbers and sent to the laboratory in the same batch as the normal samples for analyses.

9.5.1 Field Blanks

Field blanks are QC samples that check for potential external contamination of samples and will consist of trip, ambient, and equipment blanks. The sample collection coordinator or the project QA/QC coordinator will designate these blanks. The blanks will be assigned a QA/QC identification number, stored in an iced cooler, and shipped to the laboratory with the other samples.

A trip blank serves as a check on sample contamination originating from the container or sample transport. A trip blank consists of a VOA vial which was filled with VOA-free water at the lab,

transported to the site, kept in the same cooler as the normal samples throughout the entire sampling day, and shipped back to the laboratory with the normal samples. One trip blank will be sent with each cooler containing water samples for volatile organic analyses.

The ambient blank serves as a check on sample contamination originating from ambient air during VOCs sample collection. An ambient blank consists of an empty VOA vial which is filled in the field with VOA free water. While pouring the sample, the water is given ample contact with ambient air conditions. The ambient blank is typically collected at the sampling location that potentially exhibits the largest ambient influence (near a busy road, airfield, etc.).

The equipment blank serves as a check on sample contamination originating from sampling equipment reuse during sample collection. The equipment blank consists of a set of sample bottles identical to the normal sample, which is filled with lab-grade water that is flushed over a decontaminated, reusable piece of equipment.

9.5.2 Duplicate Samples

Duplicate samples are samples collected to assess the precision of sampling and analysis. Duplicate samples will be collected at the same time and for the same parameters as the initial samples. All sampling containers will be filled in the following order: volatile or gaseous analyses first, then SVOCs, including PAHs; metals; mercury; cyanide; total organic carbon; anions; other remaining analytes (no specific order). The initial sample containers will be filled first, and then the duplicate sample containers for the same parameter(s) and so on until all necessary sample containers for both the initial sample and the duplicate sample have been filled. The duplicate samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of duplicate sample collection is specified in the UFP-QAPP (Worksheet #20).

9.5.3 Matrix Spikes and Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) analyses are used to assess the potential for matrix effects. Samples will be designated for MS/MSD analysis on the COC form and on the containers. It may be necessary to increase the sample volume for MS/MSD samples. If additional volume is necessary, the additional sample container will be filled in the identical fashion as described above in the duplicate sample section. MS/MSD samples will be handled, preserved, stored, and shipped in the same manner as the primary samples. The rate of MS/MSD collection is specified in the UFP-QAPP (Worksheet #20).

9.6 FIELD DOCUMENTATION

Field documentation for groundwater sampling includes field logbooks and field forms. The most important aspect of field documentation is thorough, organized, and accurate record keeping. Two forms are used in the field during groundwater sampling. These forms include the Bailer Sampling Form and the Low-Flow Sampling Form. Each form is described in **Section 9.7.2**. An important factor of record keeping is the proper preservation and storage of all field

documentation. To preserve the field documentation, the field notes and field forms are scanned and the electronic record of the field notes is stored in the project folder and backed up on additional hard drives to prevent data loss. The field forms will also be provided in the Daily Chemical Quality Control Reports (CQCR).

9.6.1 Field Logbook

All information pertinent to groundwater sampling and not documented on the field forms will be recorded in a bound field logbook with consecutively numbered pages. The field logbook notes will be recorded in indelible ink. The field logbooks notes are entered to create an accurate record of the work performed so that the sampling activity can be reconstructed without relying on the memory of field personnel. Information documented in the field logbook may include information on date of notes, weather conditions, field personnel, site, mobilization, work performed including location and time, etc. After each day, field notes are reviewed by the field team leader or site responsible person for accuracy. Refer to **SOP No. 3** for detailed procedures regarding documentation in the field logbook.

9.6.2 Field Forms

<u>Bailer Sampling Form</u>

The Bailer Sampling Form contains the following minimum information:

- Project name and number
- Sampling personnel
- Site Identifier
- Date of sample
- Well number
- Well Diameter
- Weather conditions
- Depth to water and total depth of well
- Purge volume calculations
- Purge date
- Purge method
- Water characteristics and appearance
- Water parameter measurement results (pH, conductivity, temperature, turbidity, DO, and ORP)
- Sample ID
- Sample time
- Any QA/QC Samples

<u>Low-Flow Sampling Form</u>

The Low-Flow Sampling Form contains the following minimum information:

- Project name and number
- Sampling personnel
- Site Identifier
- Date of sample
- Well number
- Well Diameter
- Weather conditions
- Depth to water and total depth of well
- Pump intake depth
- Depth of water during purging
- Purge date
- Purge method
- Water characteristics and appearance
- Water parameter measurement results (pH, conductivity, temperature, turbidity, DO, and ORP)
- Purge rate
- Sample ID
- Sample time
- Any QA/QC Samples

Attachment 1 Field Forms

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SOIL / SEDIMENT SAMPLING FORM

Project: _____ Sampled by: _____

Site and Site Code (**SITEID**): _____

Sampling Location ID. (**LOCID**): _____

Date (**LOGDATE**): _____ Time: _____

FIELD OBSERVATIONS:

Sample Depth or Interval	Material Description/ Color

Comments/Observations:

_____

_____

_____

_____

Sample Time: _____ Sample ID: _____

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Equipment Calibration Log

Instrument Name: _____

Model Number: _____

Date	First Standard Concentration	First Standard Reading	Second Standard Concentration	Second Standard Reading	Comments

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WASTE INVENTORY TRACKING FORM

LOCATION : _____

PROJECT NAME:_____

ACTIVITIES: _____

Date Waste Generated	Activity Generating Waste (borehole # / well #)	Description of Waste	Field Evidence of Contamination	Estimated Volume	Type of Container (storage ID#)	Location of Container	Waste Characterization	Comments

Note: Describe whether soil or water samples have been collected for waste characterization, include date, if known.

Signature: _____

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WELL PURGING & SAMPLING FORM

Project: _____ Sampled by: _____

Location and Site Code (**SITEID**): _____

Well No. (**LOCID**): _____ Well Diameter (**SDIAM**): _____

Date (**LOGDATE**): _____ Weather: _____

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION:

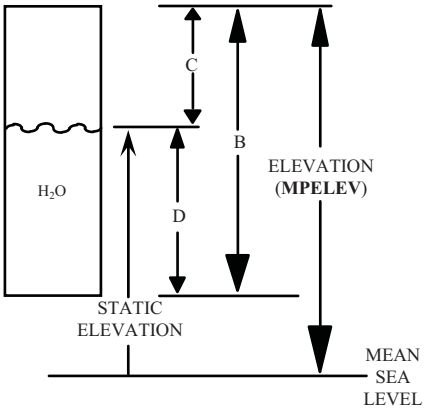
Measured Well Depth (B) (**TOTDEPTH**) _____ft.

Measured Water Level Depth (C) (**STATDEP**)_____ft.

Length of Static Water Column (D) = _____ - _____ = _____ ft.
(B) (C) (D)

Casing Water Volume (E) = _____ x _____ = _____ gal
(A) (D)

Minimum Purge Volume = _____ gal (3 well volumes)



Purge Date and Method: _____

Physical Appearance/Comments: _____

FIELD MEASUREMENTS:

Allowable Range: ± 0.1 ± 5% ±1°C

Time	Volume Removed (gal)	pH	EC (mS/cm)	Temp. (F or C)	Turbidity (NTU)	D.O. (mg/L)	ORP (mV)

Sample Time: _____ Sample ID: _____

Note: Attempt to get at least 5 sets of field measurements during purging. Sample may be collected after 3 to 5 well volumes have been removed and parameters have stabilized. Sample may be collected after 6 well volumes if parameters do not stabilize. VOC and gas sensitive (e.g. alkalinity, Fe^{2+}, CH_4, H_2S) parameters should be sampled first.

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WELL PURGING & SAMPLING FORM
(LOW FLOW)

Project: _____ Sampled by: _____

Location and Site Code (**SITEID**): _____

Well No. (**LOCID**): _____ Well Diameter (**SDIAM**): _____

Date (**LOGDATE**): _____ Weather: _____

CASING VOLUME INFORMATION:

Casing ID (inch)	1.0	1.5	2.0	2.2	3.0	4.0	4.3	5.0	6.0	7.0	8.0
Unit Casing Volume (A) (gal/ft)	0.04	0.09	0.16	0.2	0.37	0.65	0.75	1.0	1.5	2.0	2.6

PURGING INFORMATION:

Measured Well Depth (B) (**TOTDEPTH**) _____ft. (optional)

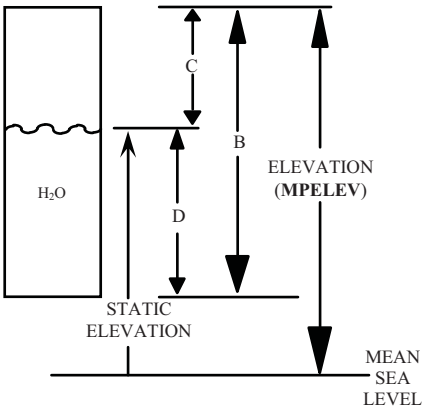
Measured Water Level Depth (C) (**STATDEP**) _____ft.

Length of Static Water Column (D) = _____ - _____ = _____ ft. (optional)
(B) (C) (D)

Pump Intake Depth (ft): _____

Depth during Purging/Sampling: _____ft
(provide range)

Comments (re: Depth during purging/sampling): _____



Purge Date and Method: _____

Physical Appearance/Comments: _____

Dissolved Ferrous Iron (mg/L): _____

FIELD MEASUREMENTS:

Allowable Range:		± 0.1	± 3%		± 10%	± 10%	± 10mV	
Time	Depth to Water (ft BTOC)	pH	EC (mS/cm)	Temp. (F or C)	Turbidity (NTU)	D.O. (mg/L)	ORP (mV)	Flow Rate (mL/min)

Sample Time: _____ Sample ID: _____

Note: Maintain a flow rate of 200-500 mL/min during purging. Collect samples at a flow rate between 100-250 mL/min. VOC and gas sensitive (e.g. alkalinity, Fe^{2+}, CH_4, H_2S) parameters should be sampled first.

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Appendix B
Laboratory Certifications and Standard Operating Procedures

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LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2229

Accutest Laboratories Southeast, Inc.

4405 Vineland Road, Suite C-15
Orlando FL 32811

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: December 15, 2015

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 29th of January 2013

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

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LABORATORY ACCREDITATION BUREAU

Certificate # L2229

Scope of Accreditation
For
Accutest Laboratories Southeast, Inc.

4405 Vineland Road, Suite C-15
Orlando, FL 32811
Svetlana Izosimova, Ph.D., QA Officer
407-425-6700

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Accutest Laboratories Southeast, Inc. to perform the following tests:

Accreditation granted through: December 15, 2015

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8011	1,2-Dibromoethane (EDB)
GC	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC	EPA 8015C	Diesel range organics (DRO)
GC	EPA 8015C	Oil Range Organics (ORO)
GC	EPA 8015C	Gasoline range organics (GRO)
GC	EPA 8015C	Ethanol
GC	EPA 8015C	2-Ethoxyethanol
GC	EPA 8015C	Isobutyl alcohol (2-Methyl-1-propanol)
GC	EPA 8015C	Isopropyl alcohol (2-Propanol)
GC	EPA 8015C	Methanol
GC	EPA 8015C	n-Butyl alcohol
GC	EPA 8015C	n-Propanol
GC	EPA 8015D	Diesel range organics (DRO)
GC	EPA 8015D	Oil Range Organics (ORO)
GC	EPA 8015D	Gasoline range organics (GRO)
GC	EPA 8015D	Ethanol
GC	EPA 8015D	2-Ethoxyethanol
GC	EPA 8015D	Isobutyl alcohol (2-Methyl-1-propanol)
GC	EPA 8015D	Isopropyl alcohol (2-Propanol)
GC	EPA 8015D	Methanol
GC	EPA 8015D	n-Butyl alcohol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8015D	n-Propanol
GC	EPA 8021B	Benzene
GC	EPA 8021B	Ethylbenzene
GC	EPA 8021B	Chlorobenzene
GC	EPA 8021B	Toluene
GC	EPA 8021B	1,2-Dichlorobenzene
GC	EPA 8021B	1,3-Dichlorobenzene
GC	EPA 8021B	1,4-Dichlorobenzene
GC	EPA 8021B	m-Xylene
GC	EPA 8021B	p-Xylene
GC	EPA 8021B	o-Xylene
GC	EPA 8021B	Methyl-tert-Butyl Ether
GC	EPA 8081B	4 4`-DDD
GC	EPA 8081B	4 4`-DDE
GC	EPA 8081B	4 4`-DDT
GC	EPA 8081B	Aldrin
GC	EPA 8081B	Chlordane (tech.)
GC	EPA 8081B	Dieldrin
GC	EPA 8081B	Endosulfan I
GC	EPA 8081B	Endosulfan II
GC	EPA 8081B	Endosulfan sulfate
GC	EPA 8081B	Endrin
GC	EPA 8081B	Endrin aldehyde
GC	EPA 8081B	Endrin ketone
GC	EPA 8081B	Heptachlor
GC	EPA 8081B	Heptachlor epoxide
GC	EPA 8081B	Methoxychlor
GC	EPA 8081B	Toxaphene (Chlorinated camphene)
GC	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC	EPA 8081B	alpha-Chlordane
GC	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC	EPA 8081B	delta-BHC
GC	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC	EPA 8081B	gamma-Chlordane
GC	EPA 8082A	Aroclor-1016 (PCB-1016)
GC	EPA 8082A	Aroclor-1221 (PCB-1221)
GC	EPA 8082A	Aroclor-1232 (PCB-1232)
GC	EPA 8082A	Aroclor-1242 (PCB-1242)
GC	EPA 8082A	Aroclor-1248 (PCB-1248)
GC	EPA 8082A	Aroclor-1254 (PCB-1254)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8082A	Aroclor-1260 (PCB-1260)
GC	EPA 8082A	Aroclor-1262 (PCB-1262)
GC	EPA 8082A	Aroclor-1268 (PCB-1268)
GC	EPA 8082A	2,4'-diCB bz8
GC	EPA 8082A	2,2',5-trCB bz18
GC	EPA 8082A	2,4,4'-trCB bz28
GC	EPA 8082A	2,2',3,5'-teCB bz44
GC	EPA 8082A	2,2',4,5'-teCB bz49
GC	EPA 8082A	2,2',5,5'-teCB bz52
GC	EPA 8082A	2,3'4,4'-teCB bz66
GC	EPA 8082A	3,3',4,4'-teCB bz77
GC	EPA 8082A	3,4,4',5-teCB bz81
GC	EPA 8082A	2,2',3,4,5'-peCB bz87
GC	EPA 8082A	2,2',3,4',5-peCB bz90
GC	EPA 8082A	2,2',4,5,5'-peCB bz101
GC	EPA 8082A	2,3,3',4,4'-peCB bz105
GC	EPA 8082A	2,3',4,4',5-peCB bz118
GC	EPA 8082A	2',3,4,4',5-peCB bz123
GC	EPA 8082A	3,3',4,4',5-peCB bz126
GC	EPA 8082A	2,2',3,3',4,4'-hxCB bz128
GC	EPA 8082A	2,2',3,4,4',5'-hxCB bz138
GC	EPA 8082A	2,2',3,5,5',6-hxCB bz151
GC	EPA 8082A	2,2',4,4',5,5'-hxCB bz153
GC	EPA 8082A	2,3,3',4,4',5-hxCB bz156
GC	EPA 8082A	2,3,3',4,4',5'-hxCB bz157
GC	EPA 8082A	2,3',4,4',5,5'-hxCB bz167
GC	EPA 8082A	3,3',4,4',5,5'-hxCB bz169
GC	EPA 8082A	2,2',3,3',4,4',5-hpCB bz170
GC	EPA 8082A	2,2',3,4,4',5,5'-hpCB bz180
GC	EPA 8082A	2,2',3,4,4',5',6-hpCB bz183
GC	EPA 8082A	2,2',3,4,4',6,6'-hpCB bz184
GC	EPA 8082A	2,2',3,4',5,5',6-hpCB bz187
GC	EPA 8082A	2,3,3',4,4',5,5'-hpCB bz189
GC	EPA 8082A	2,2',3,3',4,4',5,6-ocCB bz195
GC	EPA 8082A	2,2',3,3',4,4',5,5',6-noCB bz206
GC	EPA 8082A	Decachlorobiphenyl bz209
GC	EPA 8091	2 4-Dinitrotoluene (2 4-DNT)
GC	EPA 8091	2 6-Dinitrotoluene (2 6-DNT)
GC	EPA 8141B	Azinphos-methyl (Guthion)
GC	EPA 8141B	Bolstar (Sulprofos)
GC	EPA 8141B	Carbophenothion

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8141B	Chlorpyrifos
GC	EPA 8141B	Coumaphos
GC	EPA 8141B	Demeton-o
GC	EPA 8141B	Demeton-s
GC	EPA 8141B	Diazinon
GC	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC	EPA 8141B	Dimethoate
GC	EPA 8141B	Disulfoton
GC	EPA 8141B	EPN
GC	EPA 8141B	Ethion
GC	EPA 8141B	Ethoprop
GC	EPA 8141B	Famphur
GC	EPA 8141B	Fensulfothion
GC	EPA 8141B	Fenthion
GC	EPA 8141B	Malathion
GC	EPA 8141B	Merphos
GC	EPA 8141B	Methyl parathion (Parathion methyl)
GC	EPA 8141B	Mevinphos
GC	EPA 8141B	Monocrotophos
GC	EPA 8141B	Naled
GC	EPA 8141B	Parathion ethyl
GC	EPA 8141B	Phorate
GC	EPA 8141B	Ronnel
GC	EPA 8141B	Stirofos
GC	EPA 8141B	Sulfotepp
GC	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC	EPA 8141B	Thionazin (Zinophos)
GC	EPA 8141B	Tokuthion (Prothiophos)
GC	EPA 8141B	Trichloronate
GC	EPA 8141B	o o o-Triethyl phosphorothioate
GC	EPA 8151A	2 4 5-T
GC	EPA 8151A	2 4-D
GC	EPA 8151A	2 4-DB
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	Dichloroprop (Dichlorprop)
GC	EPA 8151A	Dinoseb (2-sec-butyl-4 6-dinitrophenol DNBP)
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Silvex (2 4 5-TP)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	RSK-175	Acetylene
GC	RSK-175	Methane
GC	RSK-175	Ethane
GC	RSK-175	Ethene
GC	RSK-175	Propane
GC	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC	MA-EPH	Diesel range organics (DRO)
GC	MA-VPH	Gasoline range organics (GRO)
GC	OA-1	Gasoline range organics (GRO)
GC	OA-2	Diesel range organics (DRO)
GC	TN-EPH	Diesel range organics (DRO)
GC	TN-GRO	Gasoline range organics (GRO)
GC	WI-DRO	Diesel range organics (DRO)
GC	AK-101	Gasoline range organics (GRO)
GC	AK-102	Diesel range organics (DRO)
GC	OK-GRO	Gasoline range organics (GRO)
GC	OK-DRO	Diesel range organics (DRO)
GC	TX 1005	Petroleum range organics
GC	TX 1005	Extractable petroleum hydrocarbans
GC/MS	EPA 8260B	1 1 1 2-Tetrachloroethane
GC/MS	EPA 8260B	1 1 1-Trichloroethane
GC/MS	EPA 8260B	1 1 2 2-Tetrachloroethane
GC/MS	EPA 8260B	1 1 2-Trichloroethane
GC/MS	EPA 8260B	1 1-Dichloroethane
GC/MS	EPA 8260B	1 1-Dichloroethylene
GC/MS	EPA 8260B	1 1-Dichloropropene
GC/MS	EPA 8260B	1 2 3-Trichlorobenzene
GC/MS	EPA 8260B	1 2 3-Trichloropropane
GC/MS	EPA 8260B	1 2 4-Trichlorobenzene
GC/MS	EPA 8260B	1 2 4-Trimethylbenzene
GC/MS	EPA 8260B	1 2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1 2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B	1 2-Dichlorobenzene
GC/MS	EPA 8260B	1 2-Dichloroethane
GC/MS	EPA 8260B	1 2-Dichloropropane
GC/MS	EPA 8260B	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B	1 3 5-Trimethylbenzene
GC/MS	EPA 8260B	1 3-Dichlorobenzene
GC/MS	EPA 8260B	1 3-Dichloropropane
GC/MS	EPA 8260B	1 4-Dichlorobenzene
GC/MS	EPA 8260B	1-Chlorohexane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	2 2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone
GC/MS	EPA 8260B	2-Nitropropane
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein (Propenal)
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Benzyl Chloride
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Carbon disulfide
GC/MS	EPA 8260B	Carbon tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Cyclohexanone
GC/MS	EPA 8260B	Di-isopropylether (DIPE)
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane
GC/MS	EPA 8260B	Diethyl ether
GC/MS	EPA 8260B	Ethanol
GC/MS	EPA 8260B	Ethyl acetate
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Ethylene Oxide
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane (Methyl iodide)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B	Isopropylbenzene
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B	Methylene chloride
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	Pentachloroethane
GC/MS	EPA 8260B	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	T-amylmethylether (TAME)
GC/MS	EPA 8260B	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B	Trichlorofluoromethane
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl chloride
GC/MS	EPA 8260B	Xylene (total)
GC/MS	EPA 8260B	m,p-Xylene
GC/MS	EPA 8260B	o-Xylene
GC/MS	EPA 8260B	cis-1 2-Dichloroethylene
GC/MS	EPA 8260B	cis-1 3-Dichloropropene
GC/MS	EPA 8260B	cis-1 4-Dichloro-2-butene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Dioxane
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	tert-Butyl alcohol
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	trans-1 2-Dichloroethylene
GC/MS	EPA 8260B	trans-1 3-Dichloropropylene
GC/MS	EPA 8260B	trans-1 4-Dichloro-2-butene
GC/MS	EPA 8260B	Ethyl tert-butyl alcohol
GC/MS	EPA 8260B	Isopropyl ether
GC/MS	EPA 8260B	tert-Amyl alcohol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	tert-Butyl formate
GC/MS	EPA 8260B	1 1 2-Trichloro-1 2 2-trifluoroethane
GC/MS	EPA 8260C	1 1 1 2-Tetrachloroethane
GC/MS	EPA 8260C	1 1 1-Trichloroethane
GC/MS	EPA 8260C	1 1 2 2-Tetrachloroethane
GC/MS	EPA 8260C	1 1 2-Trichloroethane
GC/MS	EPA 8260C	1 1-Dichloroethane
GC/MS	EPA 8260C	1 1-Dichloroethylene
GC/MS	EPA 8260C	1 1-Dichloropropene
GC/MS	EPA 8260C	1 2 3-Trichlorobenzene
GC/MS	EPA 8260C	1 2 3-Trichloropropane
GC/MS	EPA 8260C	1 2 4-Trichlorobenzene
GC/MS	EPA 8260C	1 2 4-Trimethylbenzene
GC/MS	EPA 8260C	1 2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260C	1 2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260C	1 2-Dichlorobenzene
GC/MS	EPA 8260C	1 2-Dichloroethane
GC/MS	EPA 8260C	1 2-Dichloropropane
GC/MS	EPA 8260C	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260C	1 3 5-Trimethylbenzene
GC/MS	EPA 8260C	1 3-Dichlorobenzene
GC/MS	EPA 8260C	1 3-Dichloropropane
GC/MS	EPA 8260C	1 4-Dichlorobenzene
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 8260C	2 2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein (Propenal)
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl Chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloroprene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	Di-isopropylether (DIPE)
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethanol
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Ethyl Acetate
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Hexane
GC/MS	EPA 8260C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl Acetate
GC/MS	EPA 8260C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	T-amylmethylether (TAME)
GC/MS	EPA 8260C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260C	Tetrahydrofuran

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride
GC/MS	EPA 8260C	Xylene (total)
GC/MS	EPA 8260C	m,p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	cis-1 2-Dichloroethylene
GC/MS	EPA 8260C	cis-1 3-Dichloropropene
GC/MS	EPA 8260C	cis-1 4-Dichloro-2-butene
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	p-Dioxane
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	trans-1 2-Dichloroethylene
GC/MS	EPA 8260C	trans-1 3-Dichloropropylene
GC/MS	EPA 8260C	trans-1 4-Dichloro-2-butene
GC/MS	EPA 8260C	Ethyl tert-butyl alcohol
GC/MS	EPA 8260C	Isopropyl ether
GC/MS	EPA 8260C	tert-Amyl alcohol
GC/MS	EPA 8260C	tert-Butyl formate
GC/MS	EPA 8260C	1 1 2-Trichloro-1 2 2-trifluoroethane
GC/MS	EPA 8270D	1 2 4 5-Tetrachlorobenzene
GC/MS	EPA 8270D	1 2 4-Trichlorobenzene
GC/MS	EPA 8270D	1 2-Dichlorobenzene
GC/MS	EPA 8270D	1 2-Diphenylhydrazine
GC/MS	EPA 8270D	1 3 5-Trinitrobenzene (1 3 5-TNB)
GC/MS	EPA 8270D	1 3-Dichlorobenzene
GC/MS	EPA 8270D	1 3-Dinitrobenzene (1 3-DNB)
GC/MS	EPA 8270D	1 4-Dichlorobenzene
GC/MS	EPA 8270D	1 4-Dithiane
GC/MS	EPA 8270D	1 4-Oxathiane
GC/MS	EPA 8270D	1 4-Naphthoquinone
GC/MS	EPA 8270D	1 4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D	1-Methylnaphthalene (added to method at FDEP request)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2 3 4 6-Tetrachlorophenol
GC/MS	EPA 8270D	2 4 5-Trichlorophenol
GC/MS	EPA 8270D	2 4 6-Trichlorophenol
GC/MS	EPA 8270D	2 4-Dichlorophenol
GC/MS	EPA 8270D	2 4-Dimethylphenol
GC/MS	EPA 8270D	2 4-Dinitrophenol
GC/MS	EPA 8270D	2 4-Dinitrotoluene (2 4-DNT)
GC/MS	EPA 8270D	2 6-Dichlorophenol
GC/MS	EPA 8270D	2 6-Dinitrotoluene (2 6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4 6-dinitrophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3 3`-Dichlorobenzidine
GC/MS	EPA 8270D	3 3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3-Methylphenol (m-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4 4’-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7 12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g h i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	Dibenz(a h)anthracene
GC/MS	EPA 8270D	Dibenz(a j)acridine
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1 2 3-cd)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloronitrobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	a-a-Dimethylphenethylamine
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2 2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	o o o-Triethyl phosphorothioate
GC/MS	EPA 8270D	1 4-Dioxane (1 4-Diethyleneoxide)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Biphenyl
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Simazine
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g h i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenz(a h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1 2 3-cd)pyrene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 610	1-Methylnaphthalene
HPLC	EPA 610	2-Methylnaphthalene
HPLC	EPA 610	Acenaphthene
HPLC	EPA 610	Acenaphthylene
HPLC	EPA 610	Anthracene
HPLC	EPA 610	Benzo(a)anthracene
HPLC	EPA 610	Benzo(a)pyrene
HPLC	EPA 610	Benzo(b)fluoranthene
HPLC	EPA 610	Benzo(g h i)perylene
HPLC	EPA 610	Benzo(k)fluoranthene
HPLC	EPA 610	Chrysene
HPLC	EPA 610	Dibenz(a h)anthracene
HPLC	EPA 610	Fluoranthene
HPLC	EPA 610	Fluorene
HPLC	EPA 610	Indeno(1 2 3-cd)pyrene
HPLC	EPA 610	Naphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 610	Phenanthrene
HPLC	EPA 610	Pyrene
HPLC	EPA 8330A	1 3 5-Trinitrobenzene (1 3 5-TNB)
HPLC	EPA 8330A	1 3-Dinitrobenzene (1 3-DNB)
HPLC	EPA 8330A	2 2’, 6 6’-Tetranitro-4 4’-azoxytoluene
HPLC	EPA 8330A	2 4 6-Trinitrotoluene (2 4 6-TNT)
HPLC	EPA 8330A	2 4-Dinitrotoluene (2 4-DNT)
HPLC	EPA 8330A	2 6-Dinitrotoluene (2 6-DNT)
HPLC	EPA 8330A	2-Amino-4 6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	3 5-Dinitroaniline
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	4-Amino-2 6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	Nitroglycerin
HPLC	EPA 8330A	Octahydro-1 3 5 7-tetranitro-1 3 5 7-tetrazocine (HMX)
HPLC	EPA 8330A	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	RDX (hexahydro-1 3 5-trinitro-1 3 5-triazine)
HPLC	EPA 8330A	Tetryl (methyl-2 4 6-trinitrophenylnitramine)
HPLC	EPA 8330A	2-amino-6-Nitrotoluene
HPLC	EPA 8330A	4-amino-2-Nitrotoluene
HPLC	EPA 8330A	2-amino-4-Nitrotoluene
HPLC	EPA 8330A	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A	DNX
HPLC	EPA 8330A	MNX
HPLC	EPA 8330A	TNX
HPLC	EPA 8330B	1 3 5-Trinitrobenzene (1 3 5-TNB)
HPLC	EPA 8330B	1 3-Dinitrobenzene (1 3-DNB)
HPLC	EPA 8330B	2 4 6-Trinitrotoluene (2 4 6-TNT)
HPLC	EPA 8330B	2 4-Dinitrotoluene (2 4-DNT)
HPLC	EPA 8330B	2 6-Dinitrotoluene (2 6-DNT)
HPLC	EPA 8330B	2-Amino-4 6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3 5-Dinitroaniline
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Amino-2 6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330B	Octahydro-1 3 5 7-tetranitro-1 3 5 7-tetrazocine (HMX)
HPLC	EPA 8330B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330B	RDX (hexahydro-1 3 5-trinitro-1 3 5-triazine)
HPLC	EPA 8330B	Tetryl (methyl-2 4 6-trinitrophenylnitramine)
HPLC	EPA 8330B	2-amino-6-Nitrotoluene
HPLC	EPA 8330B	4-amino-2-Nitrotoluene
HPLC	EPA 8330B	2-amino-4-Nitrotoluene
HPLC	EPA 8330B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8332	PETN
HPLC	EPA 8332	Nitroglycerin
LC/MS/MS	EPA 6850	Perchlorate
ICP	EPA 6010C	Aluminum
ICP	EPA 6010C	Antimony
ICP	EPA 6010C	Arsenic
ICP	EPA 6010C	Barium
ICP	EPA 6010C	Beryllium
ICP	EPA 6010C	Cadmium
ICP	EPA 6010C	Calcium
ICP	EPA 6010C	Chromium
ICP	EPA 6010C	Cobalt
ICP	EPA 6010C	Copper
ICP	EPA 6010C	Iron
ICP	EPA 6010C	Lead
ICP	EPA 6010C	Magnesium
ICP	EPA 6010C	Manganese
ICP	EPA 6010C	Molybdenum
ICP	EPA 6010C	Nickel
ICP	EPA 6010C	Potassium
ICP	EPA 6010C	Selenium
ICP	EPA 6010C	Silver
ICP	EPA 6010C	Sodium
ICP	EPA 6010C	Strontium
ICP	EPA 6010C	Thallium
ICP	EPA 6010C	Tin
ICP	EPA 6010C	Titanium
ICP	EPA 6010C	Vanadium
ICP	EPA 6010C	Zinc

Non-Potable Water		
Technology	**Method**	**Analyte**
CVAA	EPA 7470A	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium
UV/VIS	EPA 9012B	Cyanide, automated colorimetry with off-line distillation
IC	EPA 300	Bromide
IC	EPA 300	Chloride
IC	EPA 300	Fluoride
IC	EPA 300	Nitrate
IC	EPA 300	Nitrite
IC	EPA 300	Sulfate
IC	EPA 300	Total nitrate-nitrite
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Automated Colorimetry	EPA 353.2	Nitrate
Automated Colorimetry	EPA 353.2	Nitrite
Automated Colorimetry	EPA 353.2	Nitrate+Nitrite
Manual Colorimetry	EPA 365.3	Orthophosphate
Titrimetric	SM 2320B, 19th ed	Alkalinity, Total
Titrimetric	SM 4500 S^2-F, 20th ed.	Sulfide, Iodometric
Manual Colorimetry	SM 4500 NO2-B, 19th ed.	Nitrite as N,
Manual Colorimetry	SM 4500 NO3-E, 19th ed.	Nitrate as N,
Manual Colorimetry	SM 4500 NO3-E, 19th ed.	Nitrite+Nitrate,
Calculation	SM 4500 NO3-E, SM 4500 NO2-B, 19th ed.	Nitrate, calculation
Gravimetric Methods	EPA 1664A	Oil and Grease
Gravimetric Methods	EPA 9070A	Oil and Grease
Gravimetric Methods	SM2540B	Total Residue (Total Solids)
Gravimetric Methods	SM2540C	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM2540D	Non-Filterable Residue (Total Suspended Solids)
Electrometric Methods	SM4500H+B	Hydrogen Ion (pH)
Electrometric Methods	EPA 9040C	Hydrogen Ion (pH)
Combustion	EPA 9060A	Total Organic Carbon
Waste Characterization	SW-846 Chapter 7	Reactive Cyanide and Reactive Sulfide

Non-Potable Water		
Technology	**Method**	**Analyte**
Ignitability	EPA 1110A	Flash Point
Waste Characterization	SW-846 Chapter 7	Reactive Cyanide
Waste Characterization	SW-846 Chapter 7	Reactive Sulfide
Preparation	**Method**	**Type**
EPA 8011	EPA 8011	Microextraction
EPA 5030B	EPA 8015D/C	GRO, OA-1, TN-VPH, MA-VPH, Purge and Trap, aqueous
MA-EPH	MA-EPH	Diesel Range Organic, Liquid-liquid extraction and fractionation
EPA 3510C	EPA 8015D/C	DRO/ORO, FL-PRO, OA-2, TN-EPH, WI-DRO Liquid-Liquid Extraction
EPA 3510C	EPA 8015D/C	Non-Halogenated Organics (Alcohols), direct inject
EPA 5030B	EPA 8021B	Aromatic VOC, Purge and Trap, aqueous
EPA 3510C	EPA 8081B	Chlorinated Pesticides, Liquid-Liquid Extraction
EPA 3510C	EPA 8082A	PCBs and Congeners, Liquid-Liquid Extraction
EPA 3510C	EPA 8091	Nitroaromatics, Liquid-Liquid Extraction
EPA 3510C	EPA 8141B	Organophosphorus Pesticides, Liquid-Liquid Extraction
EPA 3535A	EPA 8141B	Organophosphorus Pesticides, Solid Phase Extraction
EPA 8151A	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
EPA 5030B	EPA 8260B/C	VOC by GC/MS, Purge and Trap, aqueous
EPA 3510C	EPA 8270D	BNA Extractables by GC/MS, Liquid-Liquid Extraction
EPA 3510C	EPA 8310	PAH, Liquid-Liquid Extraction
EPA 610	EPA 610	PAH, Liquid-Liquid Extraction
EPA 3535A	EPA 8330A/B	Explosives, Solid Phase Extraction
EPA 3535A	EPA 8332	Explosives, Solid Phase Extraction
Lachat MicroDistillation	EPA 9012B	Cyanide, Lachat MicroDistillation proprietary method, aqueous
EPA 3010A	EPA 6010C	Metals by ICP, Acid Digestion, aqueous
EPA 7470A	EPA 7470A	Hg by CVAA, digestion, aqueous

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8011	1,2-Dibromoethane (EDB)
GC	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC	EPA 8015C	Diesel range organics (DRO)
GC	EPA 8015C	Oil Range Organics (ORO)
GC	EPA 8015C	Gasoline range organics (GRO)
GC	EPA 8015C	Ethanol
GC	EPA 8015C	2-Ethoxyethanol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8015C	Isobutyl alcohol (2-Methyl-1-propanol)
GC	EPA 8015C	Isopropyl alcohol (2-Propanol)
GC	EPA 8015C	Methanol
GC	EPA 8015C	n-Butyl alcohol
GC	EPA 8015C	n-Propanol
GC	EPA 8015D	Diesel range organics (DRO)
GC	EPA 8015D	Oil Range Organics (ORO)
GC	EPA 8015D	Gasoline range organics (GRO)
GC	EPA 8015D	Ethanol
GC	EPA 8015D	2-Ethoxyethanol
GC	EPA 8015D	Isobutyl alcohol (2-Methyl-1-propanol)
GC	EPA 8015D	Isopropyl alcohol (2-Propanol)
GC	EPA 8015D	Methanol
GC	EPA 8015D	n-Butyl alcohol
GC	EPA 8015D	n-Propanol
GC	EPA 8081B	4 4`-DDD
GC	EPA 8081B	4 4`-DDE
GC	EPA 8081B	4 4`-DDT
GC	EPA 8081B	Aldrin
GC	EPA 8081B	Chlordane (tech.)
GC	EPA 8081B	Dieldrin
GC	EPA 8081B	Endosulfan I
GC	EPA 8081B	Endosulfan II
GC	EPA 8081B	Endosulfan sulfate
GC	EPA 8081B	Endrin
GC	EPA 8081B	Endrin aldehyde
GC	EPA 8081B	Endrin ketone
GC	EPA 8081B	Heptachlor
GC	EPA 8081B	Heptachlor epoxide
GC	EPA 8081B	Methoxychlor
GC	EPA 8081B	Toxaphene (Chlorinated camphene)
GC	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC	EPA 8081B	alpha-Chlordane
GC	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC	EPA 8081B	delta-BHC
GC	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC	EPA 8081B	gamma-Chlordane
GC	EPA 8082A	Aroclor-1016 (PCB-1016)
GC	EPA 8082A	Aroclor-1221 (PCB-1221)
GC	EPA 8082A	Aroclor-1232 (PCB-1232)
GC	EPA 8082A	Aroclor-1242 (PCB-1242)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8082A	Aroclor-1248 (PCB-1248)
GC	EPA 8082A	Aroclor-1254 (PCB-1254)
GC	EPA 8082A	Aroclor-1260 (PCB-1260)
GC	EPA 8082A	Aroclor-1262 (PCB-1262)
GC	EPA 8082A	Aroclor-1268 (PCB-1268)
GC	EPA 8082A	2,4’-diCB bz8
GC	EPA 8082A	2,2’,5-trCB bz18
GC	EPA 8082A	2,4,4’-trCB bz28
GC	EPA 8082A	2,2’,3,5’-teCB bz44
GC	EPA 8082A	2,2’,4,5’-teCB bz49
GC	EPA 8082A	2,2’,5,5’-teCB bz52
GC	EPA 8082A	2,3’4,4’-teCB bz66
GC	EPA 8082A	3,3’,4,4’-teCB bz77
GC	EPA 8082A	3,4,4’,5-teCB bz81
GC	EPA 8082A	2,2’,3,4,5’-peCB bz87
GC	EPA 8082A	2,2’,3,4’,5-peCB bz90
GC	EPA 8082A	2,2’,4,5,5’-peCB bz101
GC	EPA 8082A	2,3,3’,4,4’-peCB bz105
GC	EPA 8082A	2,3’,4,4’,5-peCB bz118
GC	EPA 8082A	2’,3,4,4’,5-peCB bz123
GC	EPA 8082A	3,3’,4,4’,5-peCB bz126
GC	EPA 8082A	2,2’,3,3’,4,4’-hxCB bz128
GC	EPA 8082A	2,2’,3,4,4’,5’-hxCB bz138
GC	EPA 8082A	2,2’,3,5,5’,6-hxCB bz151
GC	EPA 8082A	2,2’,4,4’,5,5’-hxCB bz153
GC	EPA 8082A	2,3,3’,4,4’,5-hxCB bz156
GC	EPA 8082A	2,3,3’,4,4’,5’-hxCB bz157
GC	EPA 8082A	2,3’,4,4’,5,5’-hxCB bz167
GC	EPA 8082A	3,3’,4,4’,5,5’-hxCB bz169
GC	EPA 8082A	2,2’,3,3’,4,4’,5-hpCB bz170
GC	EPA 8082A	2,2’,3,4,4’,5,5’-hpCB bz180
GC	EPA 8082A	2,2’,3,4,4’,5’,6-hpCB bz183
GC	EPA 8082A	2,2’,3,4,4’,6,6’-hpCB bz184
GC	EPA 8082A	2,2’,3,4’,5,5’,6-hpCB bz187
GC	EPA 8082A	2,3,3’,4,4’,5,5’-hpCB bz189
GC	EPA 8082A	2,2’,3,3’,4,4’,5,6-ocCB bz195
GC	EPA 8082A	2,2’,3,3’,4,4’,5,5’,6-noCB bz206
GC	EPA 8082A	Decachlorobiphenyl bz209
GC	EPA 8141B	Azinphos-methyl (Guthion)
GC	EPA 8141B	Bolstar (Sulprofos)
GC	EPA 8141B	Carbophenothion

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8141B	Chlorpyrifos
GC	EPA 8141B	Coumaphos
GC	EPA 8141B	Demeton-o
GC	EPA 8141B	Demeton-s
GC	EPA 8141B	Diazinon
GC	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC	EPA 8141B	Dimethoate
GC	EPA 8141B	Disulfoton
GC	EPA 8141B	EPN
GC	EPA 8141B	Ethion
GC	EPA 8141B	Ethoprop
GC	EPA 8141B	Famphur
GC	EPA 8141B	Fensulfothion
GC	EPA 8141B	Fenthion
GC	EPA 8141B	Malathion
GC	EPA 8141B	Merphos
GC	EPA 8141B	Methyl parathion (Parathion methyl)
GC	EPA 8141B	Mevinphos
GC	EPA 8141B	Monocrotophos
GC	EPA 8141B	Naled
GC	EPA 8141B	Parathion ethyl
GC	EPA 8141B	Phorate
GC	EPA 8141B	Ronnel
GC	EPA 8141B	Stirofos
GC	EPA 8141B	Sulfotepp
GC	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC	EPA 8141B	Thionazin (Zinophos)
GC	EPA 8141B	Tokuthion (Prothiophos)
GC	EPA 8141B	Trichloronate
GC	EPA 8141B	o o o-Triethyl phosphorothioate
GC	EPA 8151A	2 4 5-T
GC	EPA 8151A	2 4-D
GC	EPA 8151A	2 4-DB
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	Dichloroprop (Dichlorprop)
GC	EPA 8151A	Dinoseb (2-sec-butyl-4 6-dinitrophenol DNBP)
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Silvex (2 4 5-TP)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC	MA-EPH	Diesel range organics (DRO)
GC	MA-VPH	Gasoline range organics (GRO)
GC	OA-1	Gasoline range organics (GRO)
GC	OA-2	Diesel range organics (DRO)
GC	TN-EPH	Diesel range organics (DRO)
GC	TN-GRO	Gasoline range organics (GRO)
GC	AK-101	Gasoline range organics (GRO)
GC	AK-102	Diesel range organics (DRO)
GC	AK-103	Residual Oil range organics (RPO)
GC	OK GRO	Gasoline range organics (GRO)
GC	OK DRO	Diesel range organics (DRO)
GC	TX 1005	Petroleum range organics
GC	TX 1005	Extractable petroleum hydrocarbons
GC/MS	EPA 8260B	1 1 1 2-Tetrachloroethane
GC/MS	EPA 8260B	1 1 1-Trichloroethane
GC/MS	EPA 8260B	1 1 2 2-Tetrachloroethane
GC/MS	EPA 8260B	1 1 2-Trichloroethane
GC/MS	EPA 8260B	1 1-Dichloroethane
GC/MS	EPA 8260B	1 1-Dichloroethylene
GC/MS	EPA 8260B	1 1-Dichloropropene
GC/MS	EPA 8260B	1 2 3-Trichlorobenzene
GC/MS	EPA 8260B	1 2 3-Trichloropropane
GC/MS	EPA 8260B	1 2 4-Trichlorobenzene
GC/MS	EPA 8260B	1 2 4-Trimethylbenzene
GC/MS	EPA 8260B	1 2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1 2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B	1 2-Dichlorobenzene
GC/MS	EPA 8260B	1 2-Dichloroethane
GC/MS	EPA 8260B	1 2-Dichloropropane
GC/MS	EPA 8260B	1 2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B	1 3 5-Trimethylbenzene
GC/MS	EPA 8260B	1 3-Dichlorobenzene
GC/MS	EPA 8260B	1 3-Dichloropropane
GC/MS	EPA 8260B	1 4-Dichlorobenzene
GC/MS	EPA 8260B	1-Chlorohexane
GC/MS	EPA 8260B	2 2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	2-Nitropropane
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein (Propenal)
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Benzyl chloride
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Carbon disulfide
GC/MS	EPA 8260B	Carbon tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Cyclohexanone
GC/MS	EPA 8260B	Di-isopropylether (DIPE)
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane
GC/MS	EPA 8260B	Diethyl ether
GC/MS	EPA 8260B	Ethanol
GC/MS	EPA 8260B	Ethyl acetate
GC/MS	EPA 8260B	Ethylene oxide
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B	Isopropylbenzene
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl bromide (Bromomethane)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B	Methylene chloride
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	Pentachloroethane
GC/MS	EPA 8260B	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	T-amylmethylether (TAME)
GC/MS	EPA 8260B	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B	Trichlorofluoromethane
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl chloride
GC/MS	EPA 8260B	Xylene (total)
GC/MS	EPA 8260B	m,p-Xylene
GC/MS	EPA 8260B	o-Xylene
GC/MS	EPA 8260B	cis-1 2-Dichloroethylene
GC/MS	EPA 8260B	cis-1 3-Dichloropropene
GC/MS	EPA 8260B	cis-1 4-Dichloro-2-butene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	p-Dioxane
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	tert-Butyl alcohol
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	trans-1 2-Dichloroethylene
GC/MS	EPA 8260B	trans-1 3-Dichloropropylene
GC/MS	EPA 8260B	trans-1 4-Dichloro-2-butene
GC/MS	EPA 8260B	Ethyl tert-butyl alcohol
GC/MS	EPA 8260B	Isopropyl ether
GC/MS	EPA 8260B	tert-Amyl alcohol
GC/MS	EPA 8260B	tert-Butyl formate
GC/MS	EPA 8260B	1 1 2-Trichloro-1 2 2-trifluoroethane
GC/MS	EPA 8260C	1 1 1 2-Tetrachloroethane
GC/MS	EPA 8260C	1 1 1-Trichloroethane
GC/MS	EPA 8260C	1 1 2 2-Tetrachloroethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	1 1 2-Trichloroethane
GC/MS	EPA 8260C	1 1-Dichloroethane
GC/MS	EPA 8260C	1 1-Dichloroethylene
GC/MS	EPA 8260C	1 1-Dichloropropene
GC/MS	EPA 8260C	1 2 3-Trichlorobenzene
GC/MS	EPA 8260C	1 2 3-Trichloropropane
GC/MS	EPA 8260C	1 2 4-Trichlorobenzene
GC/MS	EPA 8260C	1 2 4-Trimethylbenzene
GC/MS	EPA 8260C	1 2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260C	1 2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260C	1 2-Dichlorobenzene
GC/MS	EPA 8260C	1 2-Dichloroethane
GC/MS	EPA 8260C	1 2-Dichloropropane
GC/MS	EPA 8260C	1 2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260C	1 3 5-Trimethylbenzene
GC/MS	EPA 8260C	1 3-Dichlorobenzene
GC/MS	EPA 8260C	1 3-Dichloropropane
GC/MS	EPA 8260C	1 4-Dichlorobenzene
GC/MS	EPA 8260C	1-Chlorohexane
GC/MS	EPA 8260C	2 2-Dichloropropane
GC/MS	EPA 8260C	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260C	2-Chlorotoluene
GC/MS	EPA 8260C	2-Hexanone
GC/MS	EPA 8260C	2-Nitropropane
GC/MS	EPA 8260C	4-Chlorotoluene
GC/MS	EPA 8260C	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 8260C	Acetone
GC/MS	EPA 8260C	Acetonitrile
GC/MS	EPA 8260C	Acrolein (Propenal)
GC/MS	EPA 8260C	Acrylonitrile
GC/MS	EPA 8260C	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260C	Benzene
GC/MS	EPA 8260C	Benzyl chloride
GC/MS	EPA 8260C	Bromobenzene
GC/MS	EPA 8260C	Bromochloromethane
GC/MS	EPA 8260C	Bromodichloromethane
GC/MS	EPA 8260C	Bromoform
GC/MS	EPA 8260C	Carbon disulfide
GC/MS	EPA 8260C	Carbon tetrachloride
GC/MS	EPA 8260C	Chlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Chloroethane
GC/MS	EPA 8260C	Chloroform
GC/MS	EPA 8260C	Chloroprene
GC/MS	EPA 8260C	Cyclohexane
GC/MS	EPA 8260C	Cyclohexanone
GC/MS	EPA 8260C	Di-isopropylether (DIPE)
GC/MS	EPA 8260C	Dibromochloromethane
GC/MS	EPA 8260C	Dibromomethane
GC/MS	EPA 8260C	Dichlorodifluoromethane
GC/MS	EPA 8260C	Diethyl ether
GC/MS	EPA 8260C	Ethanol
GC/MS	EPA 8260C	Ethyl acetate
GC/MS	EPA 8260C	Ethylene oxide
GC/MS	EPA 8260C	Ethyl methacrylate
GC/MS	EPA 8260C	Ethyl-t-butylether (ETBE)
GC/MS	EPA 8260C	Ethylbenzene
GC/MS	EPA 8260C	Hexachlorobutadiene
GC/MS	EPA 8260C	Hexane
GC/MS	EPA 8260C	Iodomethane (Methyl iodide)
GC/MS	EPA 8260C	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260C	Isopropylbenzene
GC/MS	EPA 8260C	Methacrylonitrile
GC/MS	EPA 8260C	Methyl Acetate
GC/MS	EPA 8260C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260C	Methylcyclohexane
GC/MS	EPA 8260C	Methyl methacrylate
GC/MS	EPA 8260C	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260C	Methylene chloride
GC/MS	EPA 8260C	Naphthalene
GC/MS	EPA 8260C	Pentachloroethane
GC/MS	EPA 8260C	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260C	Styrene
GC/MS	EPA 8260C	T-amylmethylether (TAME)
GC/MS	EPA 8260C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260C	Tetrahydrofuran
GC/MS	EPA 8260C	Toluene
GC/MS	EPA 8260C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260C	Trichlorofluoromethane
GC/MS	EPA 8260C	Vinyl acetate
GC/MS	EPA 8260C	Vinyl chloride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260C	Xylene (total)
GC/MS	EPA 8260C	m,p-Xylene
GC/MS	EPA 8260C	o-Xylene
GC/MS	EPA 8260C	cis-1 2-Dichloroethylene
GC/MS	EPA 8260C	cis-1 3-Dichloropropene
GC/MS	EPA 8260C	cis-1 4-Dichloro-2-butene
GC/MS	EPA 8260C	n-Butylbenzene
GC/MS	EPA 8260C	n-Propylbenzene
GC/MS	EPA 8260C	p-Dioxane
GC/MS	EPA 8260C	p-Isopropyltoluene
GC/MS	EPA 8260C	sec-Butylbenzene
GC/MS	EPA 8260C	tert-Butyl alcohol
GC/MS	EPA 8260C	tert-Butylbenzene
GC/MS	EPA 8260C	trans-1 2-Dichloroethylene
GC/MS	EPA 8260C	trans-1 3-Dichloropropylene
GC/MS	EPA 8260C	trans-1 4-Dichloro-2-butene
GC/MS	EPA 8260C	Ethyl tert-butyl alcohol
GC/MS	EPA 8260C	tert-Amyl alcohol
GC/MS	EPA 8260C	tert-Butyl formate
GC/MS	EPA 8260C	1 1 2-Trichloro-1 2 2-trifluoroethane
GC/MS	EPA 8270D	1 2 4 5-Tetrachlorobenzene
GC/MS	EPA 8270D	1 2 4-Trichlorobenzene
GC/MS	EPA 8270D	1 2-Dichlorobenzene
GC/MS	EPA 8270D	1 2-Diphenylhydrazine
GC/MS	EPA 8270D	1 3 5-Trinitrobenzene (1 3 5-TNB)
GC/MS	EPA 8270D	1 3-Dichlorobenzene
GC/MS	EPA 8270D	1 3-Dinitrobenzene (1 3-DNB)
GC/MS	EPA 8270D	1 4-Dichlorobenzene
GC/MS	EPA 8270D	1 4-Dithiane
GC/MS	EPA 8270D	1 4-Oxathiane
GC/MS	EPA 8270D	1 4-Naphthoquinone
GC/MS	EPA 8270D	1 4-Phenylenediamine
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D	1-Methylnaphthalene (added to method at FDEP request)
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2 3 4 6-Tetrachlorophenol
GC/MS	EPA 8270D	2 4 5-Trichlorophenol
GC/MS	EPA 8270D	2 4 6-Trichlorophenol
GC/MS	EPA 8270D	2 4-Dichlorophenol
GC/MS	EPA 8270D	2 4-Dimethylphenol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	2 4-Dinitrophenol
GC/MS	EPA 8270D	2 4-Dinitrotoluene (2 4-DNT)
GC/MS	EPA 8270D	2 6-Dichlorophenol
GC/MS	EPA 8270D	2 6-Dinitrotoluene (2 6-DNT)
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methyl-4 6-dinitrophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D	3 3`-Dichlorobenzidine
GC/MS	EPA 8270D	3 3`-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3-Methylphenol (m-Cresol)
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenyl phenylether
GC/MS	EPA 8270D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	4 4’-methylene-bis(2-chloroaniline)
GC/MS	EPA 8270D	5-Nitro-o-toluidine
GC/MS	EPA 8270D	7 12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Benzo(g h i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Butyl benzyl phthalate
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Di-n-butyl phthalate
GC/MS	EPA 8270D	Di-n-octyl phthalate
GC/MS	EPA 8270D	Dibenz(a h)anthracene
GC/MS	EPA 8270D	Dibenz(a j)acridine
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethyl phthalate
GC/MS	EPA 8270D	Dimethyl phthalate
GC/MS	EPA 8270D	Diphenyl Ether
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachlorophene
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indeno(1 2 3-cd)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Methapyrilene
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Nicotine
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	Nitroquinoline-1-oxide
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pronamide (Kerb)
GC/MS	EPA 8270D	Pyrene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Resorcinol
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	a-a-Dimethylphenethylamine
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D	bis(2-Chloroisopropyl) ether (2 2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiethylamine
GC/MS	EPA 8270D	n-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D	n-Nitrosomethylethylamine
GC/MS	EPA 8270D	n-Nitrosomorpholine
GC/MS	EPA 8270D	n-Nitrosopiperidine
GC/MS	EPA 8270D	n-Nitrosopyrrolidine
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	Anilazine
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D	Parathion ethyl
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Sulfotepp
GC/MS	EPA 8270D	Thionazin (Zinophos)
GC/MS	EPA 8270D	o o o-Triethyl phosphorothioate
GC/MS	EPA 8270D	1 4-Dioxane (1 4-Diethyleneoxide)
GC/MS	EPA 8270D	Propazine
GC/MS	EPA 8270D	Benzaldehyde
GC/MS	EPA 8270D	Biphenyl
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Atrazine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Simazine
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g h i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenz(a h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1 2 3-cd)pyrene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A	1 3 5-Trinitrobenzene (1 3 5-TNB)
HPLC	EPA 8330A	1 3-Dinitrobenzene (1 3-DNB)
HPLC	EPA 8330A	2 2’, 6 6’-Tetranitro-4 4’-azoxytoluene
HPLC	EPA 8330A	2 4 6-Trinitrotoluene (2 4 6-TNT)
HPLC	EPA 8330A	2 4-Dinitrotoluene (2 4-DNT)
HPLC	EPA 8330A	2 6-Dinitrotoluene (2 6-DNT)
HPLC	EPA 8330A	2-Amino-4 6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	3 5-Dinitroaniline
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	4-Amino-2 6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	Nitroglycerin
HPLC	EPA 8330A	Octahydro-1 3 5 7-tetranitro-1 3 5 7-tetrazocine (HMX)
HPLC	EPA 8330A	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A	RDX (hexahydro-1 3 5-trinitro-1 3 5-triazine)
HPLC	EPA 8330A	Tetryl (methyl-2 4 6-trinitrophenylnitramine)
HPLC	EPA 8330A	Nitroglycerin
HPLC	EPA 8330A	2-amino-6-Nitrotoluene
HPLC	EPA 8330A	4-amino-2-Nitrotoluene
HPLC	EPA 8330A	2-amino-4-Nitrotoluene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A	DNX
HPLC	EPA 8330A	MNX
HPLC	EPA 8330A	TNX
HPLC	EPA 8330B	1 3 5-Trinitrobenzene (1 3 5-TNB)
HPLC	EPA 8330B	1 3-Dinitrobenzene (1 3-DNB)
HPLC	EPA 8330B	2 4 6-Trinitrotoluene (2 4 6-TNT)
HPLC	EPA 8330B	2 4-Dinitrotoluene (2 4-DNT)
HPLC	EPA 8330B	2 6-Dinitrotoluene (2 6-DNT)
HPLC	EPA 8330B	2-Amino-4 6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3 5-Dinitroaniline
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Amino-2 6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	Octahydro-1 3 5 7-tetranitro-1 3 5 7-tetrazocine (HMX)
HPLC	EPA 8330B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330B	RDX (hexahydro-1 3 5-trinitro-1 3 5-triazine)
HPLC	EPA 8330B	Tetryl (methyl-2 4 6-trinitrophenylnitramine)
HPLC	EPA 8330B	Nitroglycerin
HPLC	EPA 8330B	2-amino-6-Nitrotoluene
HPLC	EPA 8330B	4-amino-2-Nitrotoluene
HPLC	EPA 8330B	2-amino-4-Nitrotoluene
HPLC	EPA 8330B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330B	DNX
HPLC	EPA 8330B	MNX
HPLC	EPA 8330B	TNX
HPLC	EPA 8332	PETN
HPLC	EPA 8332	Nitroglycerin
LC/MS/MS	EPA 6850	Perchlorate
ICP	EPA 6010C	Aluminum
ICP	EPA 6010C	Antimony
ICP	EPA 6010C	Arsenic
ICP	EPA 6010C	Barium
ICP	EPA 6010C	Beryllium
ICP	EPA 6010C	Cadmium
ICP	EPA 6010C	Calcium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010C	Chromium
ICP	EPA 6010C	Cobalt
ICP	EPA 6010C	Copper
ICP	EPA 6010C	Iron
ICP	EPA 6010C	Lead
ICP	EPA 6010C	Magnesium
ICP	EPA 6010C	Manganese
ICP	EPA 6010C	Molybdenum
ICP	EPA 6010C	Nickel
ICP	EPA 6010C	Potassium
ICP	EPA 6010C	Selenium
ICP	EPA 6010C	Silver
ICP	EPA 6010C	Sodium
ICP	EPA 6010C	Strontium
ICP	EPA 6010C	Thallium
ICP	EPA 6010C	Tin
ICP	EPA 6010C	Titanium
ICP	EPA 6010C	Vanadium
ICP	EPA 6010C	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium
UV/VIS	EPA 9012B	Cyanide, automated colorimetry with off-line distillation
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Gravimetric Methods	EPA 9071B	Oil and Grease
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Combustion	EPA 9060A	Total Organic Carbon
TCLP Extraction	EPA 1311	TCLP
SPLP Extraction	EPA 1312	SPLP
Waste Characterization	EPA 1110A	Corrosivity Towards Steel
Waste Characterization	SW-846 Chapter 7	Reactive Cyanide and Reactive Sulfide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Ignitability	EPA 1110A	Flash Point
Waste Characterization	SW-846 Chapter 7	Reactive Cyanide
Waste Characterization	SW-846 Chapter 7	Reactive Sulfide
Preparation	**Method**	**Type**
EPA 8011	EPA 8011	Microextraction
EPA 5035	EPA 8015D/C	GRO, OA-1, TN-GRO, MA-VPH, Purge and Trap, solid
EPA 5035A	EPA 8015D/C	GRO, OA-1, TN-GRO, MA-VPH, Purge and Trap, solid
MA-EPH	MA-EPH	Diesel Range Organic, Ultrasonic extraction and fractionation
EPA 3550C	EPA 8015D/C	DRO/ORO, FL-PRO, OA-2, TN-EPH, WI-DRO Ultrasonic Extraction
EPA 3546	EPA 8015 C/D	Diesel and Oil range organics (DRO/ORO), Microwave Extraction
EPA 3546	EPA 8081 B	Chlorinated Pesticides, Microwave Extraction
EPA 3546	EPA 8082A	PCBs, Ultrasonic Extraction
EPA 3546	EPA 8151A	Chlorinated Herbicides, Microwave Extraction
EPA 3546	EPA 8141B	Organophosphorus Pesticides, Microwave Extraction
EPA 3550C	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct inject , DI water leach
EPA 3550C	EPA 8081B	Chlorinated Pesticides, Ultrasonic Extraction
EPA 3550C	EPA 8082A	PCBs and Congeners, Ultrasonic Extraction
EPA 3550C	EPA 8141B	Organophosphorus Pesticides, Ultrasonic Extraction
EPA 8151A	EPA 8151A	Chlorinated Herbicides, Ultrasonic Extraction
EPA 5035	EPA 8260B,C	VOC by GC/MS, Purge and Trap, solid
EPA 5035A	EPA 8260B,C	VOC by GC/MS, Purge and Trap, solid
EPA 5030B	EPA 8260B,C	VOC by GC/MS, Purge and Trap, TCLP Extracts
EPA 3550C	EPA 8270D	BNA Extractables by GC/MS, Ultrasonic Extraction
EPA 3550C	EPA 8310	PAH, Ultrasonic Extraction
EPA 8330A EPA8332	EPA 8330A EPA 8332	Explosives, Ultrasonic Extraction
EPA 8330B	EPA 8330B	Explosives, Shaker Table Extraction
EPA 3010A	EPA 6010C	Metals by ICP, Acid Digestion, TCLP extracts

LABORATORY ACCREDITATION BUREAU

Certificate # L2229

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
EPA 3050B	EPA 6010C	Metals by ICP, Acid Digestion, solid
EPA 7470A	EPA 7470A	Hg by CVAA, TCLP extracts
EPA 7471B	EPA 7471B	Hg by CVAA, solid
EPA 3060A	EPA 7196A	Cr6+, Alkaline Digestion
Lachat MicroDistillation	EPA 9012B	Cyanide, Lachat MicroDistillation proprietary method, solids
EPA 3580A	EPA 8081B; EPA 8141B EPA 8082A; EPA 8270D EPA 8015D/C	Waste Dilution, Extractables
EPA 3585	EPA 8260B/D EPA 8015D/C	Waste Dilution for Volatile Organics
EPA 3510C	EPA 8081B; EPA 8270D EPA 8151A	TCLP parameters

Notes:

1) This laboratory offers commercial testing service.

Approved by: _____ Date: January 29, 2013

R. Douglas Leonard
Chief Technical Officer

Issued: 1/29/13

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Quality Systems Manual

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Harry Behzadi, Ph.D., VP Southeast Operations

_____

Norman D. Farmer, Regional Technical Director

_____

Rick Watkins, Laboratory Manager, Technical Director

_____

Svetlana Izosimova, Ph.D., Quality Assurance Officer

Accutest Laboratories Southeast, Inc.
4405 Vineland Road, Suite C-15
Orlando, Florida 32811
407.425.6700

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INTRODUCTION

The Accutest Laboratories Southeast, Inc. (Accutest SE) Quality Assurance Program, detailed in this plan, has been designed to meet the quality program requirements of the National Environmental Laboratories Accreditation Conference (TNI), DoD QSM Ver 4.2, 2010 and ISO 17025. The plan establishes the framework for documenting the requirements of the quality processes regularly practiced by the Laboratory. The Quality Assurance Officer is responsible for changes to the Quality Assurance Program, which are appended to the LQSM as they occur. The plan is reviewed annually for compliance purposes by the Laboratory Director and Technical Director and edited if necessary. Changes that are incorporated into the plan are summarized in the plan introduction. Changes to the plan are communicated to the general staff in a meeting conducted by the Quality Assurance Officer following the plan's approval.

The Accutest SE plan is supported by standard operating procedures (SOPs), which provide specific operational instructions on the execution of each quality element and assure that compliance with the requirements of the plan are achieved. Accutest SE employees are responsible for knowing the requirements of the SOPs and applying them in the daily execution of their duties. These documents are updated as changes occur and the staff is trained to apply the changes.

At Accutest, we believe that satisfying client requirements and providing a product that meets or exceeds the standards of the industry is the key to a good business relationship. However, client satisfaction cannot be guaranteed unless there is a system that assures the product consistently meets its design requirements and is adequately documented to assure that all procedural steps are executed and are traceable.

This plan has been designed to assure that this goal is consistently achieved and the Accutest product withstands the rigors of scrutiny that are routinely applied to analytical data and the processes that support its generation.

Accutest Laboratories Southeast is a permanent location facility and is part of Accutest Laboratories, Inc.

Summary of Changes
Accutest SE Quality System Manual –October 2012

Section	**Description**	Page #
Title Page	new revision number	Title
OrgChart	Lillian Torres replaced with Angel Rivera as WetChem supervisor; removed Paul Konnik from Sales.	8
1	Management commitment ro constant process improvement spelled out	5
16	Complete rewrite with detail and hierarchy of non-conforming products	63
App II	DoD certified methods specified in both TNI and non-TNI tables Added Perchlorate, Nitrate/Nitrite, 1,4-Dioxane,	80-83
App IV	Added 2 MS SOPs and 1 Sample Management SOP	99-101

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1.0 QUALITY POLICY

1.1 ***Accutest Mission***:

Accutest Laboratories provides analytical services to commercial and government clients in support of environmental monitoring and remedial activities as requested. The Laboratory's mission is dedicated to providing reliable data that satisfies clients requirements as explained in the following: "Provide easy access, high quality, analytical support to commercial and government clients which meet or exceeds data quality objectives and provides them with the data needed to satisfy regulatory requirements and/or make confident decisions on the effectiveness of remedial activities."

These services are provided impartially and are not influenced by undue commercial or financial pressures, which might impact the staff's technical judgment. Coincidentally, Accutest does not engage in activities that endanger the trust in our independent judgment and integrity in relation to the testing activities performed.

1.2 ***Policy Statement*:**

The management and staff of Accutest Laboratories share the responsibility for product quality and continually strive for its systematic improvement. Accordingly, Accutest's quality assurance program is designed to assure that all processes and procedures, which are components of environmental data production, meet established industry requirements, are adequately documented from a procedural and data traceability perspective, and are consistently executed by the staff. It also assures that analytical data of known quality, meeting the quality objectives of the analytical method in use and the data user's requirements, is consistently produced in the laboratory. This assurance enables the data user to make rational, confident, cost-effective decisions on the assessment and resolution of environmental issues.

The laboratory Quality System also provides the management staff with data quality and operational feedback information. This enables them to determine if the laboratory is achieving the established quality and operational standards, which are dictated by the client or established by regulation, such as TNI, ISO 17025 or DoD QSM. The information provided to management, through the QA program, is used to assess operational performance from a quality perspective and to perform corrective action as necessary.

All employees of Accutest Laboratories participating in environmental testing receive quality system training and are responsible for knowing and complying with the system requirements. The entire staff shares Accutest's commitment to good professional practice.

Harry Behzadi, Ph.D.
VP Southeast Operations

2.0 ORGANIZATION

2.1 ***Organizational Entity***. Accutest Laboratories, Inc. is a testing laboratory founded in 1956 and registered as a New Jersey Corporation. In 2007 the laboratory has changed ownership to Accutest Holdings, Inc. Operations, staff and physical locations were not affected by the change. The laboratory headquarters are located in Dayton, New Jersey where it has conducted business since 1987. Satellite laboratories are maintained in Marlborough, Massachusetts; Orlando, Florida; San Jose, California; Denver, Colorado; Lafayette, Louisiana; and Houston, Texas.

2.2 ***Management Responsibilities***

Requirement: Each laboratory facility will have an established chain of command. The duties and responsibilities of the management staff are linked to the President/CEO of Accutest Laboratories who establishes the agenda for all company activities.

President/CEO*.* Primarily responsible for all operations and business activities. Delegates authority to laboratory directors, general managers, and quality assurance director to conduct day-to-day operations and execute quality assurance duties. Each of the individual operational entities (New Jersey, Massachusetts, Florida,, Texas, California, Colorado, and Louisiana) reports to the President/CEO.

Corporate Quality Assurance Director*.* Responsible for design, oversight, and facilitation of all quality assurance activities established by the Quality Program. Directly reports to the President/CEO.

Vice President Operations/Laboratory Director*.* There is a Laboratory Director assigned to each of the following operational entities: New Jersey, Massachusetts Florida, Louisiana, and West (Texas, California, and Colorado). The Laboratory Director executes day-to-day responsibility for laboratory operations including technical aspects of production activities and associated logistical procedures. Directly reports to the President/CEO.

Quality Assurance Officer *(on location).* Responsible for oversight, implementation and facilitation of all quality assurance activities established by the Quality Program. Directly reports to the Laboratory Director. Also exchanges information with and submits laboratory performance data (PE scores, audit reports, accreditation changes, etc.) to Corporate QA Director. Takes program directions from Corporate QA Director.

Technical Director. Responsible for oversight and implementation of technical aspects of production activities in the environmental testing laboratory. In the event that the technical director, quality assurance director, or laboratory manager is absent for a period of time that exceeds 15 consecutive calendar days, the designated appointees shall temporarily perform the technical director, quality assurance director, or laboratory manager's job function. If this absence exceeds 65 consecutive calendar days, the Accreditation Body(ies), including DoD ELAP, is to be notified in writing.

Current list of appointed deputies located in restricted access controlled document directory

Department Managers. Executes day-to-day responsibility for specific laboratory areas including technical aspects of production activities and associated logistical procedures. Directly report to the Laboratory Director.

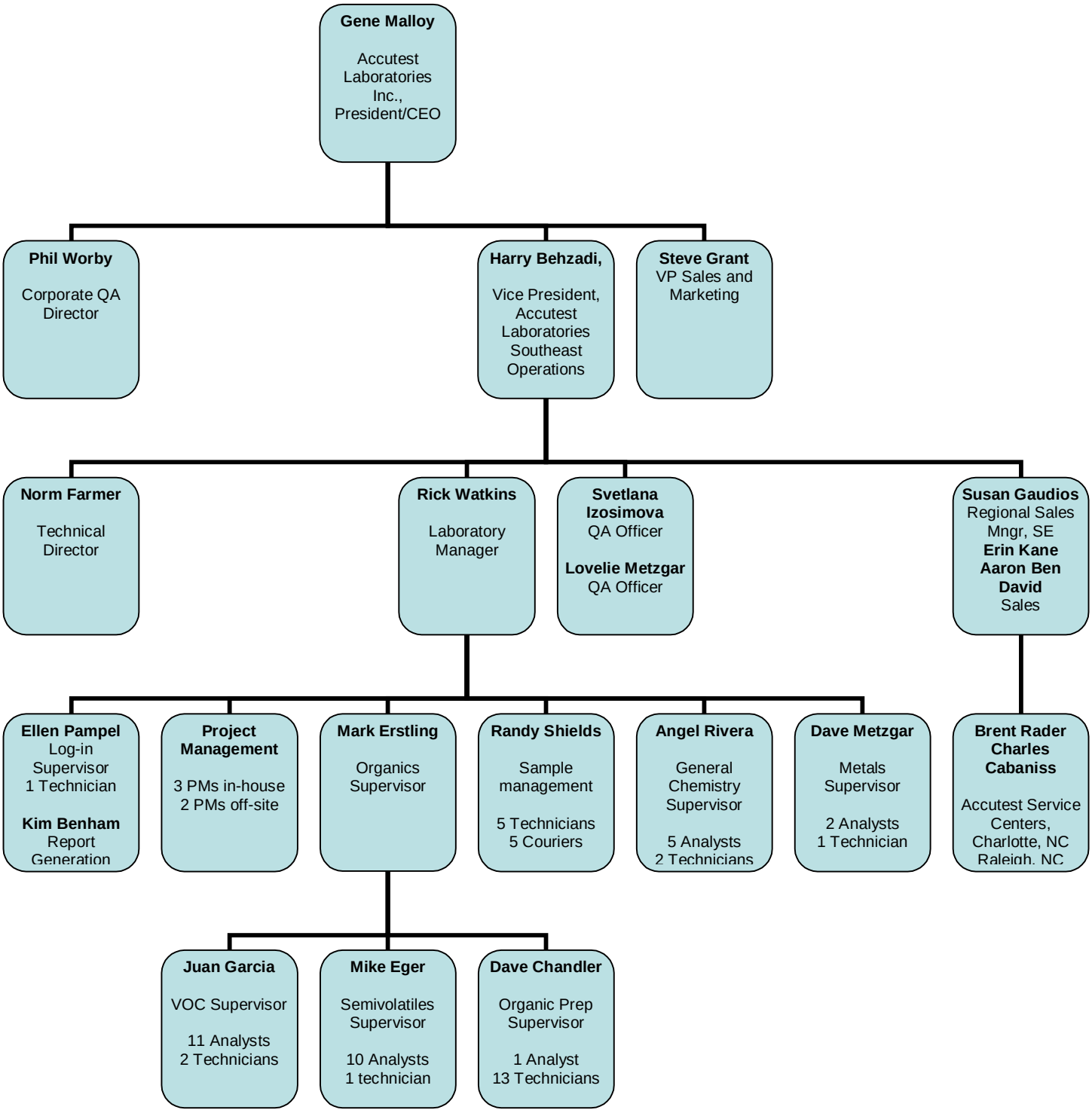
Section Supervisors. Executes day-to-day responsibility for specific laboratory units including technical aspects of production activities and associated logistical procedures. Directly report to the Department Manager.

2.3 ***Chain of Command***

The responsibility for managing all aspects of the Company's operation is delegated to specific individuals, who have been assigned the authority to act in the absence of the senior staff. These individuals are identified in the following Chain of Command:

Harry Behzadi, Ph.D., VP, Southeast Operations
Norm Farmer, Technical Director (Operations and IT)
Rick Watkins, Laboratory Manager (Operations)
Heather Wandrey, Project Manager (Client Services)

Accutest Laboratories Southeast Organizational Chart



3.0 QUALITY RESPONSIBILITIES OF THE MANAGEMENT TEAM

3.1 ***Requirement*:** Each member of the management team has a defined responsibility for the Quality Program. Program implementation and operation is designated as an operational management responsibility. Program design and implementation is designated as a Quality Assurance Responsibility.

President/CEO*:* Primary responsibility for all quality activities. Delegates program responsibility to the Quality Assurance Director. Serves as the primary alternate in the absence of the Quality Assurance Director. Has the ultimate responsibility for implementation of the Quality Program.

Vice President Operations/Laboratory Director*.* Responsible for implementing and operating the Quality Program in all laboratory areas. Responsible for the design and implementation of corrective action for defective processes. Has the authority to delegate Quality Program implementation responsibilities.

Corporate Quality Assurance Director*.* Responsible for design, implementation support, training, and monitoring of the quality system. Identifies product, process, or operational defects using statistical monitoring tools and processes audits for elimination via corrective action. Empowered with the authority to halt production if warranted by quality problems. Monitors implemented corrective actions for compliance.

Quality Assurance Officer *(on location).* Responsible for design support, implementation support, and monitoring support of the quality system. Training personnel in various aspects of quality system. Conducts audits and product reviews to identify product, process, or operational defects using statistical monitoring tools and processes audits for elimination via corrective action. Empowered with the authority to halt production if warranted by quality problems. Monitors implemented corrective actions for compliance.

Technical Director. Responsible for oversight and implementation of technical aspects of Quality System as they are integrated into method applications and employed to assess analytical controls on daily basis. The Technical Director reviews and acknowledges the technical feasibility of proposed quality system involving technical applications.

Department Managers*.* Responsible for applying the requirements of the Quality Program in their section and assuring subordinate supervisors and staff apply all program requirements. Initiates, designs, documents, and implements corrective action for quality deficiencies.

Group Leaders*.* Responsible for applying the requirements of the Quality Program to their operation and assuring the staff applies all program requirements. Initiates, designs, documents, and implements corrective action for quality deficiencies.

Bench Analysts. Responsible for applying the requirements of the Quality Program to the analyses they perform, evaluating QC data and initiating corrective action for quality control deficiencies within their control. Implements global corrective action as directed by superiors.

3.2 ***Program Authority***:

Authority for program implementation on corporate level originates with the President/CEO who bears ultimate responsibility for program design, implementation, and enforcement of requirements. This authority and responsibility is delegated to the Director of Quality Assurance who performs quality functions independently without the encumbrances or biases created by operational or production responsibilities to ensure an honest, independent assessment of quality issues.

Laboratory Director and Quality Assurance Officer mirror this authority on location.

3.3 ***Data Integrity Policy***:

The Accutest Data Integrity Policy reflects a comprehensive, systematic approach for assuring that data produced by the laboratory accurately reflects the outcome of the tests performed on field samples and has been produced in a bias free environment by ethical professionals. The policy includes a commitment to technical ethics, staff training in ethics and data integrity, an individual attestation to data integrity and procedures for evaluating data integrity. Senior management assumes the responsibility for assuring compliance with all technical ethics elements and operation of all data integrity procedures. The staff is responsible for compliance with the ethical code of conduct and for practicing data integrity procedures.

The Accutest Data Integrity Policy is as follows:

"Accutest Laboratories is committed to producing data that meets the data integrity requirements of the environmental regulatory community. This commitment is demonstrated through the application of a comprehensive data integrity program that includes ethics and data integrity training, data integrity evaluation procedures, staff participation and management oversight. Adherence to the specifications of the program assures that data provided to our clients is of the highest possible integrity and can be used for decision making processes with high confidence."

Data Integrity Responsibilities

***Management*.** Senior management retains oversight responsibility for the data integrity program and retains ultimate responsibility for execution of the data integrity program elements. Senior management is responsible for providing the resources required to conduct ethics training and operate data integrity evaluation procedures. They also include responsibility for creating an environment of trust among the staff and being the lead advocate for promoting the data integrity policy and the importance of technical ethics.

***Staff*.** The staff is responsible for adhering to the company ethics policy as they perform their duties and responsibilities associated with sample analysis and reporting. By executing this responsibility, data produced by Accutest Laboratories retains its high integrity characteristics and withstands the rigors of all data integrity checks.

The staff is also responsible for adhering to all laboratory requirements pertaining to manual data edits, data transcription and data traceability. These include the application of approved manual peak integration and documentation procedures. It also includes establishing traceability for all manual results calculations and data edits.

***Ethics Statement*.** The Accutest ethics statement reflects the standards that are expected for businesses that provide environmental services to regulated entities and regulatory agencies on a commercial basis. The Ethics Policy is comprised of key elements that are essential to organizations that perform chemical analysis for a fee. As such, it focuses on elements related to personal, technical and business activities.

Accutest Laboratories provides analytical chemistry services on environmental matters to the regulated community. The data the company produces provides the foundation for determining the risk presented by a chemical pollutant to human health and the environment. The environmental industry is dependent upon the accurate portrayal of environmental chemistry data. This process is reliant upon a high level of scientific and personal ethics.

It is essential to the Company that each employee understands the ethical and quality standards required to work in this industry. Accordingly, Accutest has adopted a code of ethics, which each employee is expected to adhere to as follows:

- Perform chemical and microbiological analysis using accepted scientific practices and principles.
- Perform tasks in an honest, principled and incorruptible manner inspiring peers & subordinates.
- Maintain professional integrity as an individual.
- Provide services in a confidential, honest, and forthright manner.
- Produce results that are accurate and defensible.

- Report data without any considerations of self-interest.

- Comply with all pertinent laws and regulations associated with assigned tasks and responsibilities.

Data Integrity Procedures.

Four key elements comprise the Accutest data integrity system:
1) data integrity training,
2) signed data integrity documentation for all laboratory employees,
3) in-depth, periodic monitoring of data integrity, and
4) data integrity procedure documentation.
Procedures have been implemented for conducting data integrity training and for documenting that employees conform to the Accutest Data Integrity and Ethics policy.

The data integrity program consists of routine data integrity evaluation and documentation procedures to periodically monitor and document data integrity. These procedures are documented in SOPs. SOPs are approved and reviewed annually following the procedures employed for all Accutest SOPs. Documentation associated with data integrity evaluations is maintained on file and is available for review.

Data Integrity Training, .Accutest employees receive technical ethics training during new employee orientation. Employees are also required to attend annual ethics refreshment training and sign an ethical conduct agreement annually, which verifies their understanding of Accutest's technical ethics policy and their ethical responsibilities. The agreement is refreshed annually and appended to each individual's training file.

The training focuses on the reasons for technical ethic training, explains the impact of data fraud on human health and the environment, and illustrates the consequences of criminal fraud on businesses and individual careers. Multiple examples of prohibited practices are reviewed and discussed. Accutest's ethics policy and code of ethics are reviewed and explained for each new employee. Employees receive Accutest's technical ethics brochure for further review.

Training on department-specific data integrity procedures are conducted by individual departments for groups involved in data operations. These include procedures for manual chromatographic peak integration, standards traceability, etc.

Data Integrity Training Documentation. Records of all data integrity training are maintained in individual training folders. Attendance at all training sessions is documented and appended to the training file.

Accutest Data Integrity and Ethical Conduct Agreement. All employees are required to sign a Data Integrity and Ethical Conduct Agreement annually. This document is archived in individual training files, which are retained for duration of employment.

The Data Integrity and Ethical Conduct Agreement is as follows**:**

I. *I understand the high ethical standards required of me with regard to the duties I perform and the data I report in connection with my employment at Accutest Laboratories.*

II. *I have received formal instruction on the code of ethics that has been adapted by Accutest Laboratories and agree to comply with these requirements.*

III. *I have received formal instruction on the elements of Accutest Laboratories' Data Integrity Policy and have been informed of the following specific procedures:*

   a. *Routine data integrity monitoring is conducted on sample data, which may include an evaluation of the data I produce,*

   b. *Formal procedures for the confidential reporting of data integrity issues are available, which can be used by any employee,*

   c. *A data integrity investigation is conducted when data issues are identified that may negatively impact data integrity.*

IV. *I am aware that data fraud is a punishable crime that may include fines and/or imprisonment upon conviction.*

V. *I also agree to the following:*

   a. *I shall not intentionally report data values, which are not the actual values observed or measured.*

   b. *I shall not intentionally modify data values unless the modification can be technically justified through a measurable analytical process.*

   c. *I shall not intentionally report dates and times of data analysis that are not the true and actual times the data analysis was conducted.*

   d. *I shall not condone any accidental or intentional reporting of inauthentic data by other employees and immediately report it's occurrence to my superiors.*

   e. *I shall immediately report any accidental reporting of inauthentic data by myself to my superiors.*

Data Integrity Monitoring. Several documented procedures are employed for performing data integrity monitoring. These include regular data review procedures by supervisory and management staff (Section 12.7), supervisory review and approval of manual integrations and periodic reviews of data audit trails from the LIMS and all computer controlled analysis.

Data Review. All data produced by the laboratory undergoes several levels of review, which includes two levels of management review. Detected data anomalies that appear to be related to data integrity issues are isolated for further investigation. The investigation is conducted following the procedures described in this section.

Manual Peak Integration Review and Approval. Routine data review procedures for all chromatographic processes includes a review of all manual chromatographic peak integrations. This review is performed by the management staff and consists of a review of the machine integration compared to the manual integration. Manual integrations, which have been performed in accordance with Accutest's manual peak integration procedures are approved for further processing and release. Manual integrations which are not performed to Accutest's specifications are set aside for corrective action, which may include analyst retraining or further investigation as necessary.

Data Audit Trail Review. Data integrity audits are comprehensive data package audits that include a review of raw data, process logbooks, processed data reports and data audit trails from individual instruments and LIMS. Data audit trails, which record all electronic data activities, are available for the majority of computerized methodology and the laboratory information management system (LIMS). These audit trails are periodically reviewed to determine if interventions performed by technical staff constitute an appropriate action. The review is performed on a recently completed job and includes interviews with the staff that performed the analysis. Findings indicative of inappropriate interventions or data integrity issues are investigated to determine the cause and the extent of the anomaly.

Confidential Reporting Of Data Integrity Issues. Data integrity concerns may be raised by any individual to their supervisor. Employees with data integrity concerns should always discuss those concerns with their immediate supervisors as a first step unless the employee is concerned with the confidentiality of disclosing data integrity issues or is uncomfortable discussing the issue with their immediate supervisors. The supervisor makes an initial assessment of the situation to determine if the concern is related to a data integrity violation. Those issues that appear to be violations are documented by the supervisor and referred to the QA Officer (local) for investigation.

Documented procedures for the confidential reporting of data integrity issues in the laboratory are part of the data integrity policy. These procedures assure that laboratory staff can privately discuss ethical issues or report items of ethical concern without fears of repercussions with senior staff.

Employees with data integrity concerns that they consider to be confidential are directed to the Corporate Human Resources Manager in Dayton, New Jersey. The HR Manager acts as a conduit to arrange a private discussion between the employee and the Corporate QA Director or a local QA Officer.

During the employee - QA discussion, the QA representative evaluates the situation presented by the employee to determine if the issue is a data integrity concern or a legitimate practice. If the practice is legitimate, the QA representative clarifies the

process for the employee to assure understanding. If the situation appears to be a data integrity concern, the QA representative initiates a Data Integrity Investigation following the procedures specified in SOPs QA038-QA041.

Data Integrity Investigations. Follow-up investigations are conducted for all reported instances of ethical concern related to data integrity. Investigations are performed in a confidential manner by senior management according to a documented procedure. The outcome of the investigation is documented and reported to the company president who has the ultimate responsibility for determining the final course of action in the matter. Investigation documentation includes corrective action records, client notification information and disciplinary action outcomes, which is archived for a period of five years.

The investigations are conducted by the senior staff and supervisory personnel from the affected area. The investigation team includes the Laboratory Director and the Quality Assurance Officer. Investigations are conducted in a confidential manner until it is completed and resolved.

The investigation includes a review of the primary information in question by the investigations team. The team performs a review of associated data and similar historical data to determine if patterns exist. Interviews are conducted with key staff to determine the reasons for the observed practices.

Following data compilation, the investigations team reviews all information to formulate a consensus conclusion. The investigation results are documented along with the recommended course of action.

Corrective Action, Client Notification & Discipline. Investigations that reveal systematic data integrity issues will go through corrective action for resolution and disposition (Section 13). If the investigation indicates that an impact to data has occurred and the defective data has been released to clients, client notification procedures will be initiated following the steps in Section 17.6.

In all cases of data integrity violations, some level of disciplinary action will be conducted on the responsible individual. The level of discipline will be consistent with the violation and may range from retraining and/or verbal reprimand to termination.

4.0 JOB DESCRIPTIONS OF KEY STAFF

4.1 ***Requirement*:** Descriptions of key positions within the organization must be defined to ensure that clients and staff understand duties and the responsibilities of the management staff and the reporting relationships between positions.

President/Chief Executive Officer. Responsible for all laboratory operations and business activities. Establishes the company mission and objectives in response to business needs. Direct supervision of the Vice President of Operations, each laboratory director, client services, management information systems, and quality assurance.

Vice President, Operations/Laboratory Director. Reports to the company president. Establishes regional laboratory operations strategy and business development. Authorized to enter into contractual agreements on Company's behalf.

Director, Quality Assurance. Reports to the company president. Establishes the company quality agenda, develops quality procedures, provides assistance to operations on quality procedure implementation, coordinates all quality control activities monitors the quality system and provides quality system feedback to management to be used for process improvement.

Vice President, Information Technlogies Reports to the company president. Develops the MIS software and hardware agenda. Provides system strategies to compliment company objectives. Maintains all software and hardware used for data handling.

Client Services, Sales, Account Manager(s). Reports to the company president. Establishes and maintains communications between clients and the laboratory pertaining to client requirements which are related to sample analysis and data deliverables. Initiates client orders and supervises sample login operations.

Quality Assurance Officer *(on location)*. Reports to the Laboratory Director. Develops quality procedures, provides assistance to operations on quality procedure implementation, coordinates all quality control activities, monitors the quality system, and provides quality system feedback to management to be used for process improvement. In the event of prolonged absence QAO also designated a Deputy Technical Director, unless otherwise specified by internal memo from Laboratory Director.

Manager Client Services *(on location)*. Reports to the Laboratory Director. Establishes and maintains communications between clients and the laboratory pertaining to client requirements which are related to sample analysis and data deliverables. Initiates client orders and supervises sample login operations.

Technical Director (On Location). Reports to the laboratory director. Establishes laboratory operations strategy. Direct supervision of organic chemistry and inorganic

chemistry. Directs the operations, preparation and instrumental analysis. Responsible for following Quality Program requirements. Assumes operational responsibilities of Lab Director in his absence.

Laboratory Manager. Reports to the Laboratory Director. Directs the day-to day operations of entire laboratory, direct supervision of organic chemistry, inorganic chemistry, field services, and sample management.
Oversees daily work schedule as developed by respective departments. Supervises method implementation. Responsible for following Quality Program requirements. Maintains laboratory instrumentation in an operable condition.

Supervisors, Shipping and Receiving Departments. Reports to the Laboratory Manager. Develops, maintains and executes all procedures required for transport and receipt of samples, verification of preservation, and chain of custody documentation. Responsible for maintaining and documenting secure storage, delivery of samples to laboratory units on request, and disposal following completion of all analytical procedures.

Supervisor, Wet Chemistry. Reports to the Laboratory Manager. Directs the operations of the wet chemistry group. Establishes and executes daily work schedule. Supervises method implementation, application, and data production. Supervises the analysis of samples for wet chemistry parameters using valid, documented methodology. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Responsible for following Quality Program requirements.

Supervisor, Metals. Reports to the Laboratory Manager. Directs the operations of the metals group. Establishes and executes daily work schedule. Supervises method implementation, application, and data production. Supervises the analysis of samples for metallic elements using valid, documented methodology. Documents all procedures and data production activities. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Responsible for following Quality Program requirements

Supervisor, Organic Preparation. Reports to the Laboratory Manager. Directs the operations of the sample preparation group. Establishes and executes daily work schedule. Supervises method implementation, and application. Supervises the preparation of samples for organic compounds using valid, documented methodology. Documents all procedures and data production activities. Maintains laboratory equipment in an operable condition. Reviews records for compliance to quality and methodological requirements. Responsible for following Quality Program requirements.

Volatile and Semivolatie Supervisors, Organics. Reports to the Laboratory Manager. Directs the operations of the respective organics group. Establishes and executes daily work schedule. Supervises method implementation, application, and data production. Supervises the analysis of samples for organic compounds using valid, documented methodology. Documents all procedures and data production

activities. Maintains instrumentation in an operable condition. Reviews data for compliance to quality and methodological requirements. Responsible for following Quality Program requirements

Report Generation Supervisor. Reports to Laboratory Manager. Oversees report generation and fulfillment of client specifications as applied to data deliverables. Responsible for data delivery in timely manner.

Detailed Job descriptions of lab personnel are found in training folders

4.2 ***Employee Screening, Orientation, and Training***.

All potential laboratory employees are screened and interviewed by human resources and technical staff prior to their hire. The pre-screen process includes a review of their qualifications including education, training and work experience to verify that they have adequate skills to perform the tasks of the job. Minimum qualifications for non-technical personnel require High School diploma (couriers also shall posses clean driving record), technical personnel must also demonstrate basic laboratory experience, such as balance and syringe use, aseptic practices, etc. College-level science coursework is favored.

Newly hired employees receive orientation training beginning the first day of employment by the Company. Orientation training consists of initial health and safety training and a detailed review of the personal protection policies, technical ethics training and data integrity procedures and quality assurance program training (including Company's goals, objectives, mission, and vision).

All technical staff receives training to develop and demonstrate proficiency for the methods they perform. New analysts work under supervision until the supervisory staff is satisfied that a thorough understanding of the method is apparent. Organics/Inorganics analysts are required to demonstrate method proficiency through a precision and accuracy study. Data from the study is compared to method acceptance limits. If the data is unacceptable, additional training is required. The analyst must also demonstrate the ability to produce acceptable data through the analysis of an independently prepared proficiency sample.

Proficiency is demonstrated annually. Data from initial and continuing proficiency demonstration is archived in the individual's training folder. In the instance where analyte can not be spiked in the clean matrix, such as TSS or pH, the results of an external Performance Evaluation (PE) sample may be used to document analyst's proficiency.

Minimum training required for administrative staff consists of laboratory safety and ethical conduct.

4.3 ***Training Documentation***. The QA Officer prepares a training file for every new employee. All information related to qualifications, experience, external training courses, and education are placed into the file. Verification documentation for

orientation, health & safety, quality assurance, and ethics training is also included in the file.

Additional training documentation is added to the file as it occurs. This includes data for initial and continuing demonstrations of proficiency, performance evaluation study data and notes and attendance lists from group training sessions.

The Quality Assurance Department maintains the employee training database. This database is a comprehensive inventory of training documentation for each individual employee. The database enables supervisors to obtain current status information on training data for individual employees on a job specific basis. It also enables the management staff to identify training documentation in need of completion.

Employee specific database records are created by human resources on the date of hire. Data base fields for job specific requirements such as SOP documentation of understanding and annual demonstration of analytical capability are automatically generated when the supervisor assigns a job responsibility. Employees acknowledge that their SOP responsibilities have been satisfied using a secure electronic process, which updates the database record. Reports are produced which summarize the qualifications of individual employees or departments.

5.0 SIGNATORY APPROVALS

Requirement: Procedures are required for establishing the traceability of data and documents. The procedure consists of a signature hierarchy, indicating levels of authorization for signature approvals of data and information within the organization. Signature authority is granted for approval of specific actions based on positional hierarchy within the organization and knowledge of the operation that requires signature approval. A log of signatures and initials of all employees is maintained for cross-referencing purposes.

5.1 *Signature Hierarchy*.

President/Chief Executive Officer. Authorization for contracts and binding agreements with outside parties. Approval of final reports, quality assurance policy, SOPs, project specific QAPs, data review and approval in lieu of technical managers. Contract signature authority resides with Company Officers only, which include the President/CEO, CFO and VP Administration.

Vice President, Operations/Laboratory Director. Approval of final reports and quality assurance policy in the absence of the President. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers. Technical policy.

Technical Director (on location): Approval of final reports and quality assurance policy in the absence of the Laboratory Director. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers. Technical policy review. In the event of prolonged absence refer to list of approved deputies – sec 2.2.

Director, Quality Assurance. Approval of final reports and quality assurance policy in the absence of the President. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers.

Quality Assurance Officer (on location). Approval of final reports and quality assurance policy in the absence of the Laboratory Director. Approval of SOPs, project specific QAPs, data review and approval in lieu of technical managers. In the event of prolonged absence refer to list or appointed deputies – see sec. 2.2.

Manager, Sample Management. Initiation of laboratory sample custody and acceptance of all samples. Approval of department policies and procedures. Department specific supplies purchase. Waste manifesting and disposal.

Project Manager, Client Services. QAP and sampling and analysis plan approval. Project specific contracts, pricing, and price modification agreements. Approval and acceptance of incoming work, Client services policy.

Supervisors, Technical Departments. Methodology and department specific QAPs. Data review and approval, department specific supplies purchase. Technical approval of SOPs.

Supervisors, Technical Departments. Data review approval, purchasing of expendable supplies.

5.2 ***Signature Requirements***. All laboratory activities related to sample custody and generation or release of data must be approved using either initials or signatures. The individual, who applies his signature or initial to an activity or document, is authorized to do so within the limits assigned to them by their supervisor. All signatures and initials must be applied in a readable format that can be cross-referenced to the signatures and initials log if necessary.

5.3 ***Signature and Initials Log***. The QA Officer maintains a signature and initials log. New Employee signatures and initials are appended to the log on the first day of employment. Signature of individuals no longer employed by the company are retained**.**

6.0 DOCUMENTATION and DOCUMENT CONTROL

Requirement: Document control policies have been established which specify that any document used as an information source or for recording analytical or quality control information must be managed using defined document control procedures. Accordingly, policies and procedures required for the control, protection, and storage of any information related to the production of analytical data and the operation of the quality system to assure its integrity and traceability have been established and implemented in the laboratory. The system contains sufficient controls for managing, archiving and reconstructing all process steps, which contributed to the generation of an analytical test result. Using this system, an audit trail for reported data can be produced, establishing complete traceability for the result.

6.1 Administrative Records. The Quality Assurance Officer manages Administrative (non-analytical) records. These records consist of electronic documents that are retained in a limited access electronic directory, which are released to the technical staff upon specific request.

Form Generation & Control. The Quality Assurance Officer approves all forms used as either stand-alone documents or in logbooks to ensure their traceability. Forms are generated as computer files only and maintained in a limited access master directory. Access to the electronic forms and applications is granted to QA Officer, Laboratory Manager and Technical Director(s) (local and regional). Approved forms must display the date of current revision and initials of person who revised the form. Modifications to existing forms are approved by QA, obsolete forms moved to archive directory and retained for minimum of five years.

New forms must include Accutest SE identification and appropriate spaces for signatures of approvals and dates. Further design specifications are the responsibility of the originating department.

Technical staff is required to complete all forms to the maximum extent possible. If information for a specific item is unavailable, the analyst is required to cross out the information block. The staff is also required to cross out the uncompleted portions of a logbook or logbook form if the day's analysis does not fill the entire page of the form.

Logbook Control. All laboratory logbooks are controlled documents that are comprised of approved forms used to document specific processes. Logbook control is maintained by QA staff.

New logs are numbered and issued to a specific individual who is assigned responsibility for the log. Supervisor performs periodical review of the logbooks. Old logs are returned to QA for entry into the document archive system where they are retained for minimum of five (5) years. Laboratory staff may hold a maximum of two consecutively dated logbooks of the same type in the laboratory, not including the most recently issued book to simplify review of recently completed analysis.

Controlled Documents. Key laboratory documents are designated for controlled document status to assure that identities of individuals receiving copies and the number of copies that have been distributed are known. Controlled status simplifies document updates and **retrieval** of outdated documents. Control is maintained through a document numbering procedure and document control logbook designating the individual receiving the controlled document. Document control is also maintained by pre-designating the numbers of official copies of documents that are placed into circulation within the laboratory.

Quality Systems Manual (QSM). All QSMs are assigned a number prior to distribution. The QSMs are distributed as controlled documents i.e. ones that will be collected back and replaced with next version (documents distributed to the Accutest Inc. staff). QSMs distributed to outside entities are considered tracked documents – since there is no possibility of collecting them back and ensuring that current revision is in use. These situation include bid submissions, client requests, etc. These copies are watermarked as "Uncontrolled Documents" The control/tracking number, date of distribution, and identity of the individual receiving the document are recorded in the document control spreadsheet. QA staff maintains tracking spreadsheet. The numbering system is continuous.

Standard Operating Procedures (SOPs). SOPs are maintained by pre-designating the numbers of official copies of documents that are placed into circulation within the laboratory. Official documents are printed and placed into the appropriate laboratory section as follows:

Sample Management: One copy for the sample receiving file
Bottle preparation area – One copy for shipping area
Organics Laboratories: One for the affected laboratory area.
Inorganics Laboratories: One for the affected laboratory area.

The original, signed copy of the SOP is maintained in the master SOP binder by the QA staff.

Documents are controlled using an "Official Copy" stamp in red ink. Additional copies could be issued to individuals for training purposes. Distribution is documented on SOP cover page. Superceded copies collection is conducted accordingly to cover page distribution list.

SOPs distributed to clients as part of bid submission, pre-audit evaluation, etc. are watermarked as "Proprietary Information".

Quick reference cards: These documents are compiled for lab staff convenience and are based on current SOP revision and/or recent regulatory updates. These one- or two-sided documents are footnoted with reference to SOP/regulatory standard, stamped with "Official Copy" stamp in red ink and laminated for durability. *Use of these quick references does not substitute reading and acknowledging the parent SOP.*

Operators' Manuals are considered controlled documents and stored in appropriate departments.

6.2 ***Technical Records***. All records related to the analysis of samples and the production of analytical results are archived in secure document storage or on electronic media and contain sufficient detail to produce an audit trail, which re-creates the analytical result. These records include information related to the original client request, bottle order, sample login and custody, storage, sample preparation, analysis, data review and data reporting.

Records that can not be maintained on electronic media are considered irretrievable records, segregated into separate secured storage and access controlled with access log maintained by QA Staff. Examples of such records are employee training files, obsolete SOPs and acknowledgement form originals, training files, logbooks, etc.

Each department involved in this process maintains controlled documents, which enable them to maintain records of critical information relevant to their department's process.

6.3 ***Quality Assurance Directory.*** All Quality Assurance documentation and quality control limit data is stored in a restricted QA directory on the network server. The directory has been designated as read only. The QA staff, technical director and the laboratory manager have write capability in this directory. Information on this directory is backed-up daily.

This directory contains all current and archived Quality System Manuals, SOPs, control limits, MDL studies, precision and accuracy data, internal and external audit reports, official forms, Health and Safety materials, PT scores, State Certifications and metrics calibration information.

6.4 ***Analytical Records***. All data related to the analysis of field samples are retained as either paper or electronic records that can be retrieved to compile a traceable audit trail for any reported result. All information is linked to the client job and sample number, which serves as a reference for all sample related information tracking.

Critical times in the life of the sample from collection through analysis to disposal are documented. This includes date and time of collection, receipt by the laboratory, preparation times and dates, analysis times and dates and data reporting information. Analysis times are calculated in hours for methods where holding time is specified in hours (≤72 hours).

Sample preparation information is recorded in a separate controlled logbook or on controlled forms in three-ring binder. It includes sample identification numbers, types of analysis, preparation and cleanup methods, sample weights and volumes, reagent lot numbers and volumes and any other information pertinent to the preparation procedure.

Information related to the identification of the instrument used for analysis is permanently attached to the electronic record. The record includes an electronic data file that indicates all instrument conditions employed for the analysis, including the type of analysis conducted. The analyst's identification is electronically attached to the record. The instrument tuning and calibration data is electronically linked to the sample or linked though paper logs, which were used in the documentation of the analysis. Quality control and performance criteria are permanently linked to the paper archive or electronic file.

Paper records for the identity, receipt, preparation and evaluation of all standards and reagents used in the analysis are documented in prepared records and maintained in controlled documents or files. Lot number information linking these materials to the analysis performed is recorded in the logbooks associated with the samples in which they were used.

Manual calculations or peak integrations that were performed during the data review are retained as paper or electronically generated PDF documents and included as part of the electronic archive. Signatures for data review are retained on paper or as electronic stamps on PDF versions of the paper record for the permanent electronic file.

6.5 ***Confidential Business Information (CBI).*** Operational documents including SOPs, Quality Manuals, personnel information, internal operations statistics, and laboratory audit reports are considered confidential business information. Strict controls are placed on the release of this information to outside parties.

Release of CBI to outside parties or organizations may be authorized upon execution of a confidentiality agreement between Accutest and the receiving organization or individual. CBI information release is authorized for third party auditors and commercial clients in electronic mode as Adobe Acrobat .PDF format only.

6.6 ***Software Change Documentation & Control.*** Changes to software are documented as text within the code of the program undergoing change. Documentation includes a description of the change, reason for change and the date the change was placed into effect. Documentation indicating the adequacy of the change is prepared following the evaluation by the user who requested the change.

6.7 ***Report and Data Archiving***. Accutest Laboratories maintains electronic image file copies of original reports in archive for a minimum period of five (5) years. After five years, the files are automatically discarded unless contractual arrangements exist which dictate different requirements. Client specific data retention practices are employed for government organizations such as the Department of Defense Agencies and MA DEP that require a retention period of ten (10) years, as well as commercial clients upon contractual requirements agreement.

Complete date and time stamped client reports are generated from LIMS using the source documents archived on Document server. These source documents are maintained on document server and backed up to primary and clone tapes. Accutest

archives the original report (organized by job number) and the organic and inorganic support data. Organic support data is archived according to instrument batch numbers. All organics data is backed up to the tape or archive drive via Networker Backup software and/or AccuBack backup software. Data from the archive drive is then written to tape at periodic intervals.

Wet chemistry support data is archived by analytical batch (GN…). Metals support data is archived by instrument batch (MA…). Metals digestion data is archived as digestion logbooks.

The reports generation group electronically scans completed reports and stores them by job number on the document server. The document server is backed up daily to a digital tape. Copies of these files remain active on the document server for easy review access. The digital tapes remain in secure storage for the remainder of the archive period.

6.8 ***Training***. Ongoing training ensures competence of all relevant personnel. At the minimum personnel should possess knowledge of the technology used in the testing, general requirements expressed in legislature and industry standards, and understand the significance of deviations with regard to approved procedures. The company maintains a training record for all employees that documents that they have received instruction on administrative and technical tasks that are required for the job they perform. Training records for individuals employed by the company are retained for a period of five years following their termination of employment.

Training File Origination. The Quality Assurance Officer (QAO) initiates training files. Quality Assurance officer retains the responsibility for the maintenance and tracking of all training related documentation in the file. The file is begun on the first day of employment. Information required for the file includes a copy of the individual's most current resume, detailing work experience and a copy of any college diplomas or transcript(s). Information added on the first day includes documentation of health and safety training and a signed Ethics and Data Integrity agreement. These two constitute minimal necessary training for Project Management and Administrative staff. Training documentation, training requirements, analyst proficiency information and other training related support documentation is tracked using a customized database application. Database extracts provide an itemized listing of specific training requirements by job function. Training status summaries for individual analysts portray dates of completion for job specific training requirements.

Technical Training. The supervisor of each new employee is responsible for developing a training plan for each new employee. The supervisor updates the outline, adding signatures and dates as training elements are completed at regular frequency. Supporting documentation, such as precision and accuracy studies, which demonstrate analyst capability for a specific test, are added as completed. When analyte can not be spiked, such as pH or TSS, external PE sample is purchased and analyzed. Where no external PE sample is available, sample duplicates must be successfully analyzed. Method review records are retained where analysis of duplicates is not possible. Employees and supervisors verify documentation of

understanding (DOU) for all assigned standard operating procedures in the training database. Certificates or diplomas for any off-site training are added to the file.

7.0 REFERENCE STANDARD TRACEABILITY

Requirement: Documented procedures, which establish traceability between any measured value and a national reference standard, must be in place in the laboratory. All metric measurements must be traceable to NIST reference weights or thermometers that are calibrated on a regular schedule. All chemicals used for calibration of a quantitative process must be traceable to an NIST reference that is documented by the vendor using a certificate of traceability. The laboratory maintains a documentation system that establishes the traceability links. The procedures for verifying and documenting traceability must be documented in standard operating procedures.

7.1 ***Traceability of Metric Measurements - Thermometers***. Accutest uses NIST-traceable thermometers to calibrate commercially purchased working laboratory thermometers prior to their use in the laboratory and annually thereafter for liquid in glass thermometers or quarterly for electronic temperature measuring devices. If necessary, these working thermometers are assigned correction factors that are determined during their calibration using an NIST-traceable thermometer as the standard. The correction factor is documented in a thermometer log and on a tag attached to the working thermometer. Both original observation and corrected measurement are recorded in the temperature log. The NIST-traceable reference thermometer is checked for accuracy by an outside vendor minimum every five (5) years following the specifications for NIST-traceable thermometer calibration verification detailed in the United States Environmental Protection Agency's "Manual for the Certification of Laboratories Analyzing Drinking Water", Fifth Edition, January 2005. Currently the NIST thermometer is verified by outside vendor on triennial basis due to contract-specific requirements. Calibration log and Certificate(s) of calibration are maintained on file with QAO.

7.2 ***Traceability of Metric Measurements – Calibration Weights***. Accutest uses calibrated weights, which are traceable to NIST standard weights to calibrate all balances used in the laboratory. Balances must be calibrated to specific tolerances within the intended use range of the balance. Calibration checks are required on each day of use. If the tolerance criteria are not achieved, corrective action specified in the balance calibration SOP must be applied before the balance can be used for laboratory measurements. All weights are recalibrated by outside vendor every five years following the specifications for weight calibration verification detailed in the United States Environmental Protection Agency's "Manual for the Certification of Laboratories Analyzing Drinking Water", Fifth Edition, January 2005. Certificate(s) of calibration are maintained on file with QAO. Balances are inspected and maintained by professional service technicians annually. Certificate(s) of inspection are maintained with QAO.

7.3 ***Traceability of Chemical Standards and Reagents***. All chemicals and reagents, with the exception of bulk dry Na2SO4 and solvents purchased as reference standards for use in method calibration must establish traceability to NIST referenced material through a traceability certificate (Certificate of Analysis, CoA). Process links are

established that enable a calibration standard solution to be traced to its NIST reference certificate. Solvents, acids and other supplies are being tested to verify their suitability for the analytical process.

7.4 ***Assignment Of Reagent and Standard Expiration Dates.*** Expiration date information for all purchased standards and reagents is provided to Accutest with all prepared standard solutions and unstable reagents as a condition of purchase. Neat materials and inorganic reagents are not required to be purchased with expiration dates. Certified prepared solutions are labeled with the expiration date provided by the manufacturer. In-house prepared solutions are assigned expiration dates that are consistent with the method that employs their use unless documented experience indicates that an alternate date can be applied. If alternate expiration dates are employed, their use is documented in the method SOP. Expiration dates for prepared inorganic reagents, which have not exhibited instability, are established at two years form the date of preparation for tracking purposes. All containers shall be labeled with the date of preparation and expiration date clearly indicated.

The earliest expiration date is always the limiting date for assigning expiration dates to prepared solutions. Expiration dates that are later than the expiration date of any derivative solution or material are prohibited.

7.5 ***Documentation of Traceability***. Traceability information is documented in individual logbooks designated for the measurement process in use. The QA Officer maintains calibration documentation for metric references in pertinent folders and logbooks.

Balance calibration verification is documented in logbooks that are assigned to each balance. The individual conducting the verification is required to initial and date all calibration activities. Any defects that occur during verification are also documented along with the corrective action applied and a demonstration of return to control. Annual service and calibration reports and certificates retained on file with QA staff.

Temperature control is documented in logbooks assigned to the equipment being monitored. A verified (see 7.1) thermometer is assigned to each individual item. Measurements are recorded along with date and initials of the individual conducting the measurement on a daily or as used basis. Corrective action, if required, is also documented including the demonstration of return to control.

Initial traceability of chemical standards and reagents is documented via a vendor-supplied certificate (see also 7.3) that includes lot number and expiration date information. Solutions prepared using the vendor supplied chemical standard are documented in logbooks assigned to specific analytical processes. Alternatively, documentation may be entered into the electronic standards and reagent tracking log The documentation includes links to the vendors lot number, an internal lot number, dates of preparation, and the preparer's initials. Standards received without certificate of analysis can not be used for calibration or calibration verification and are rejected.

Supervisors conduct regular reviews of logbooks, which are verified using a word rev'd", signature and date. QA Staff monitors the process and documents it in the same manner.

8.0 TEST PROCEDURES, METHOD REFERENCES, AND REGULATORY PROGRAMS

Requirements: The laboratory must use client specified or regulatory agency approved methods for the analysis of environmental samples. The laboratory maintains a list of active methods, which specifies the type of analysis performed, and cross-references the methods to applicable environmental regulation. Routine procedures used by the laboratory for the execution of a method must be documented in a standard operating procedure. Method performance and sensitivity must be demonstrated annually where required. Defined procedures for the use of method sensitivity for data reporting purposes must be established by the Director of Quality Assurance and used consistently for all data reporting purposes.

8.1 ***Method Selection.*** Accutest employs methods for environmental sample analysis that are consistent with the client's application, which are appropriate and applicable to the project objectives. Accutest informs the client if the method proposed is inappropriate or outdated and suggests alternative approaches.

Accutest employs documented, validated regulatory methods in the absence of a client specification and informs the client of the method selected. These methods are available to the client and other parties as determined by the client. Documented and validated in-house methods may be applied if they are appropriate to the project. The client is informed of the method selection.

8.2 ***Method Validation***. Standard methods from regulatory sources are primarily used for all analysis. Standard methods do not require validation by the laboratory. Non-standard, in-house methods are validated prior to use. Validation is also performed for standard methods applied outside their intended scope of use. Validation is dependent upon the method application and may include analysis of quality control samples to develop precision and accuracy information for the intended use. A final method validation report is generated, which includes all data in the validation study. A statement of adequacy and/or equivalency is included in the report. A copy of the report is archived in the quality assurance directory of the company server.

Non-standard methods are validated prior to use. This includes the validation of modified standard methods to demonstrate comparability with existing methods. Demonstrations and validations are performed and documented prior to incorporating technological enhancements and non-standard methods into existing laboratory methods used for general applications. The demonstration includes method specific requirements for assuring that significant performance differences do not occur when the enhancement is incorporated into the method. Validation is dependent upon method application and may include the analysis of quality control samples to develop precision and accuracy information for intended use.

The study procedures and specifications for demonstrating validation include comparable method sensitivity, calibration response, method precision, method accuracy and field sample consistency for several classes of analytical methods are

detailed in this document. These procedures and specifications may vary depending upon the method and the modification.

8.3 ***Standard Operating Procedures***. Standard operating procedures (SOP) are prepared for routine methods executed by the laboratory and processes related to sample or data handling. The procedures describe the process steps in sufficient detail to enable an individual, who is unfamiliar with the procedure to execute it successfully. SOPs are reviewed annually and edited if necessary. SOPs can be edited on a more frequent basis if systematic errors dictate a need for process change or the originating regulatory agency promulgates a new version of the method. Procedural modifications are indicated using a revision number. SOPs are available for client review at the Accutest facility upon request.

8.4 ***Method Detection Limit Determination and verification***. Annual method detection limit (MDL) studies are performed as appropriate for routine methods used in the laboratory. MDL studies are also performed when there is a change to the method that affects how the method is performed or when an instrumentation change that impacts sensitivity occurs. The procedure used for determining MDLs is described in 40 CFR, Part 136, Appendix B. Studies are performed for each method on water, soil and air matrices for every instrument that is used to perform the method. MDLs are established at the instrument level. The highest MDL of the pooled instrument data is used to establish a laboratory MDL. MDLs are experimentally verified through the analysis of spiked quality control samples at 2-3 times the concentration of the experimental MDL, or 1-4 times for multicomponent methods. The verification is performed on every instrument used to perform the analysis. The quality assurance staff manages the annual MDL determination process and is responsible for retaining MDL data on file. Approved MDLs are appended to the LIMS and used for data reporting purposes. MDL values are used as DL values for DOD projects and verification spiking concentrations are listed ad LOD values.

Methods certified under DOD ELAP requirements must undergo verification procedure on quarterly basis – see DOD QSM 4.2, Gray Box D-13.

8.5 ***Method Reporting Limit.*** The method reporting limit is established at the lowest concentration calibration standard in the calibration curve. The low calibration standard is selected by department managers as the lowest concentration standard that can be used while continuing to meet the calibration linearity criteria of the method being used. The validity of the Method Reporting Limits is confirmed via analysis of a spiked quality control sample at 1 – 2x Method reporting limit concentration. RL values are referred to as LOQ for DOD projects.

By definition, detected analytes at concentrations below the low calibration standard cannot be accurately quantitated and must be qualified accordingly.

Methods certified under DOD ELAP requirements must undergo verification procedure on quarterly basis – see DOD QSM 4.2, Gray Box D-14.

8.6 ***Reporting of Quantitative Data.*** Analytical data for all methods is reported without qualification to the reporting limit established for each method. Data may be reported to MDL depending upon the client's requirements provided that all qualitative identification criteria for the parameter have been satisfied. All parameters reported at concentrations between the reporting limit and MDL are qualified as an estimated concentration.

Measured concentrations of detected analytes that exceed the upper limit of the calibration range are either diluted into the range and reanalyzed or qualified as an estimated value. The only exception to this applies to ICP and ICP/MS analysis, which can be reported to the upper limit of the experimentally determined linear range without qualification.

8.7 ***Estimated Uncertainty.*** A statement of the estimated uncertainty of an analytical measurement accompanies the test result when required. Estimated uncertainty is derived from the performance limits established for spiked samples of similar matrices. The degree of uncertainty is derived from the negative or positive bias for spiked samples accompanying a specific parameter. When the uncertainty estimate is applied to a measured value, the possible quantitative range for that specific parameter at that measured concentration is defined. Well recognized regulatory methods that specify values for the major sources of uncertainty and specify the data reporting format do not require a further estimate of uncertainty.

8.8 ***Precision and Accuracy Studies***. Annual precision and accuracy (P&A) studies, which demonstrate the laboratories ability to generate acceptable date, are performed for all routine methods used in the laboratory. The procedure used for generating P&A data is referenced in the majority of the regulatory methodology in use. The procedure requires quadruplicate analysis of a sample spiked with target analytes at a concentration in the working range of the method. This data may be compiled from a series of existing blank spikes or laboratory control samples. Accuracy (percent recovery) of the replicate analysis is averaged and compared to established method performance limits. Values within method limits indicate an acceptable performance demonstration. (See also Sec 4, Training, Demonstration of capability)

8.9 ***Method Sources, References and Update Mechanism.*** The Quality Assurance Staff maintains a list of active methods used for the analysis of samples. This list includes valid method references such as EPA, American Society of Testing and Materials (ASTM) or Standard Methods designations and the current version and version date.

Updated versions of approved reference methodology are placed into use as changes occur. The Quality Assurance Director informs operations management of changes in method versions as they occur. The operations management staff selects an implementation date. The operations staff is responsible for completing all method requirements prior to the implementation date. This includes modification to SOPs, completion of MDL and precision and accuracy studies and staff training. Documentation of these activities is provided to the QA staff who retains this information on file. The updated method is placed into service on the implementation date and the old version is de-activated.

Multiple versions of selected methods may remain in use to satisfy client specific needs. In these situations, the default method version becomes the most recent version. Client specific needs are communicated to the laboratory staff using method specific analytical codes method, which clearly depict the version to be used. The old method version is maintained as an active method until the specified client no longer requires the use of the older version.

Accutest will not use methodology that represents significant departures from the reference method unless specifically directed by the client. In cases where clients direct the laboratory to use a method modification that represents a significant departure from the reference method, the request will be documented in the project file. The LQSM lists active methods used for the analysis of samples in Table 8.1. This list includes valid method references from sources such as USEPA, ASTM or Standard Methods designations and the current version and version date.

8.10 ***Analytical Capabilities***. Appendix II provides a detailed listing of the methodology employed for the analysis of test samples.

9.0 SAMPLE MANAGEMENT, LOGIN, CUSTODY, STORAGE AND DISPOSAL

Requirement: A system to ensure that client supplied product is adequately evaluated, acknowledged, and secured upon delivery to the laboratory must be practiced by the laboratory. The system must assure that chain of custody is maintained and that sample receipt conditions and preservation status are documented and communicated to the client and internal staff. The login procedure must assign, document, and map the specifications for the analysis of each unique sample to assure that the requested analysis is performed on the correct sample and enables the sample to be tracked throughout the laboratory analytical cycle. The system must include procedures for reconciling defects in sample condition or client provided data, which occur at sample arrival. The system must specify the procedures for proper sample storage, transfer to the laboratory, and disposal after analysis. The system must be documented in a standard operating procedure.

9.1 ***Order Receipt and Entry***. New orders are initiated and processed by the client services group (See Chapter 14, Procedures for Executing Client Specifications). The new order procedure includes mechanisms for providing sampling containers to clients. These containers must meet the size, cleanliness, and preservation specifications for the analysis to be performed.

For new orders, the project manager prepares a bottle request form, which is submitted to sample management department. This form provides critical project details to the sample management staff, which are used to prepare and assemble the sample bottles for shipment to the client prior to sampling.

The bottle order is assembled using bottles that meet USEPA specifications for contaminant-free sample containers. Accutest-SE checks all sample containers for cleanliness. Data are reviewed by both the analyst and sample management technician. Results of bottle analyses are retained for minimum of 5 years.

All preservative solutions are prepared in the laboratory and are checked to assure that they are free of contamination from analytes of interest before being released for use. Sample management department retains a copy of the documentation of in-house contamination checks.

Reagent water for trip and field blanks is poured into appropriately labeled containers. Sample bottleware is labeled with durable labels printed on waterproof printing medium with indelible laser or heat transfer printer ink. All bottles are packed into ice chests with blank chain of custody forms and the original bottle order form. Completed bottle orders are delivered to clients using Accutest couriers or commercial carriers for use in field sample collection.

9.2 ***Sample Receipt and Custody***. Samples are delivered to the laboratory using a variety of mechanisms including Accutest couriers, commercial shippers, and client self-delivery. Documented procedures are followed for arriving samples to assure that

custody and integrity are maintained and that handling and preservation requirements are documented and continued.

Sample custody documentation is initiated when the individual collecting the sample collects field samples. Custody documentation includes all information necessary to provide an unambiguous record of sample collection, sample identification, and sample collection chronology. Initial custody documentation employs either Accutest or client generated custody forms.

Accutest generates a Sample Receipt Confirmation form in situations where the individuals who collected the sample did not generate custody documentation in the field. Accutest SE Project Manager then contacts the client for the CoC information to be faxed or e-mailed from the client to the lab.

Accutest defines sample custody as follows:

- The sample is in the actual custody or possession of the assigned responsible person,
- The sample is in a secure area.

The Accutest facility is defined as a secure facility. Perimeter security has been established, which limits access to authorized individuals only. Visitors enter the facility through the building lobby and must register with the receptionist prior to entering controlled areas. While in the facility, visitors must be accompanied by their hosts at all times. After hours, building access is controlled using a computerized pass-key reader system. This system limits building access to individuals with a pre-assigned authorization status. After hours visitors are not authorized to be in the building. Clients delivering samples after hours must make advanced arrangements through client services and sample management to assure that staff is available to take delivery and maintain custody.

Upon arrival at Accutest, the sample custodian reviews the chain of custody and generates Sample Receipt Confirmation form for the samples received to verify that the information on the form corresponds with the samples delivered. This includes verification that all listed samples are present and properly labeled, checks to verify that samples were transported and received at the required temperature, verification that the sample was received in proper containers, verification that sufficient volume is available to conduct the requested analysis, and a check of individual sample containers to verify test specific preservation requirements including the absence of headspace for volatile compound analysis.

9.3 Sample conditions and other observations are documented on the Sample Receipt Confirmation form by the sample custodian prior to completing acceptance of custody. The sample custodian accepts sample custody upon verification that the custody document is correct. Discrepancies or non-compliant situations are documented, flagged and communicated to the Accutest project manager, who contacts the client

for resolution. The resolution is documented and communicated to sample management for execution.

9.4 ***Laboratory preservation of Improperly preserved field samples.*** Accutest extends every effort to preserve samples which were received without proper field preservation.

Field/Equipment negative controls also receive the same amount of preservation as incorrectly preserved samples, and record made in the preservation logbook.

9.5 ***Sample Tracking Via Status Change.*** An automated, electronic LIMS procedure records sample exchange transactions between departments and changes in analytical status. This system tracks all preparation, analytical, and data reporting procedures to which a sample is subjected while in the possession of the laboratory. Each individual receiving samples must acknowledge the change in custody and operational status in the LIMS. This step is required to maintain an accurate electronic record of sample status, dates of analytical activity, and custody throughout the laboratory.

Sample tracking is initiated at login where all chronological information related to sample collection dates and holding times are entered into the LIMS. This information is entered on an individual sample basis

9.6 ***Sample Acceptance Policy***. Incoming samples must satisfy Accutest's sample acceptance criteria before being logged into the system. Sample acceptance is based on the premise that clients have exercised proper protocols for sample collection. This includes sufficient volume, proper chemical preservation, temperature preservation, sample container sealing and labeling, and appropriate shipping container packing.

The sample management staff will make every attempt to preserve improperly preserved samples upon arrival. However, if preservation is not possible, the samples may be refused unless the client authorizes analysis. No samples will be accepted if holding times have been exceeded or will be exceeded before analysis can take place unless the client authorizes analysis.

Sample acceptance criteria include proper custody and sample labeling documentation. Proper custody documentation includes an entry for all physical samples delivered to the laboratory with an identification code that matches the sample bottle and a date and signature of the individual who collected the sample and delivered them to the laboratory. Labeling is done using durable waterproof labels printed with indelible heat-transfer ink.

Accutest reserves the right to refuse any sample which in its sole and absolute discretion and judgement is hazardous, toxic and poses or may pose a health, safety or environmental risk during handling or processing. The company will not accept samples for analysis using methodology that is not performed by the laboratory or for methods that lab does not hold valid accreditation unless arrangements have been made to have the analysis conducted by a qualified subcontractor.

9.7 ***Assignment of Unique Sample Identification Codes***. Unique identification codes must be assigned to each sample bottle to assure traceability and unambiguously identify the tests to be performed in the laboratory.

The sample identification coding process begins with the assignment of a unique alphanumeric job number. A job is defined as a group of samples received on the same day, from a specific client pertaining to a specific project. A job may consist of groups of samples received over multi-day period. The first character of the job number is an alpha-character that identifies the laboratory facility. The next characters are numeric and sequence by one number with each new job.

Unique sample numbers are assigned to each bottle collected as a discrete entity from a designated sample point. This number begins with the job number and incorporates a second series of numbers beginning at one and continuing chronologically for each point of collection. The test to be performed is clearly identified on the bottle label.

Alpha suffixes may be added to the sample number to identify special designations such as subcontracted tests, in-house QC checks, or re-logs. Multiple sample bottles for a specific analysis are labeled Bottle 1, Bottle 2, etc.

9.8 ***Subcontracted Analysis***. Subcontract laboratories are employed to perform analysis not performed by Accutest. The quality assurance staff evaluates subcontract laboratories to assure their quality processes meet the standards of the environmental laboratory industry prior to engagement. Throughout the subcontract process, Accutest follows established procedures to assure that sample custody is maintained and the data produced by the subcontractor meets established quality criteria.

Accutest network laboratories are considered primary subcontractors.

*Subcontracting Procedure***.** Subcontracting procedures are initiated through several mechanisms, which originate with sample management. Samples for analysis by a subcontractor are logged into the Accutest system using regular login procedures. If subcontract parameters are part of the project or sample management has received subcontracting instructions for a specific project, a copy of the chain of custody is given to the appropriate project manager with the subcontracted parameters highlighted. This procedure triggers the subcontract process at the project management level. The Sample Management supervisor contacts an approved subcontractor to place the subcontract order. Subcontract chain of custody is processed in Sample Management Department and copy is filed with the original CoC. Sample management signs the subcontract chain of custody and ships the sample(s) to the subcontractor. The subcontract COC is filed with the original COC and the request for subcontract. Copies are distributed to the login department, the project manager, and sample management.

Client is verbally notified by Project Manager of the requirement to subcontract to the outside laboratory as soon as need Is identified by the Accutest staff. Client notification

must be verified in writing, i.e. by e-mail. Client notification may take place during the initial project set-up, or at the time of sample receipt and login.

Subcontractor data packages are reviewed by the QA Staff to assess completeness and quality compliance. If completeness defects are detected, the subcontractor is asked to immediately upgrade the data package. If data quality defects are detected, the package is forwarded to the QA staff for further review. The QA staff will pursue a corrective action solution before releasing data to the client.

Approved subcontract data is entered into the laboratory information management system (LIMS) if possible and incorporated into the final report. All subcontract data is footnoted to provide the client with a clear indication of its source. Copies of original subcontract data are always included in the data report whether in hardcopy or PDF file, depending on the data submission requirements.

*Subcontract Laboratory Evaluation***.** The QA staff evaluates subcontract laboratories prior to engagement. As a minimum, the subcontract laboratory must provide Accutest with proof of a valid certification to perform the requested analysis for the venue where they were collected, QC criteria summary (LOD/LOQ, LCS, MS/MSD, %RPD, etc.), copy of the most recent regulatory agency audit report, and a copy of the laboratory's Summary of Qualifications (SOQ). Other beneficial materials are QSM, copies of SOPs used for the subcontracted analysis, a copy of the most recent performance evaluation study for the subcontracted parameter, and copies of the most recent third party accreditor's audit report.

Certification verification must be submitted to Accutest annually. If possible, the QA staff may conduct a site visit to the laboratory to inspect the quality system. Accutest Laboratories Southeast assumes the responsibility for the performance of all subcontractors who have successfully demonstrated their qualifications. When selecting a subcontractor for analysis not performed by Accutest, assure qualifications of the subcontractor through local QA officer.

Qualification process of a subcontract laboratory may be bypassed if the primary client directs Accutest to employ a specific subcontractor

Subcontract Laboratory Database. Accutest Laboratories Inc. maintains centralized database of preferred contractors in order to optimize sample handling and data submission process, as well as obtain competitive priced services of uniform quality throughout the network. Individual Accutest laboratories are assigned "Center of Expertise" status according to unique capabilities.

9.9 ***Sample Storage***. Following sample custody transfer, samples are assigned to various refrigerated storage areas by the sample management staff depending upon the test to be performed and the matrix of the samples. The location (refrigerator and shelf) of each sample is entered into sample location database on the line corresponding to each sample number. Samples remain in storage until the laboratory technician retrieves them into the laboratory for analysis.

Samples for volatile organics analysis are placed in storage in designated refrigerators by the sample management staff and immediately transferred to the organics group control. Sample custody is transferred to the VOC department staff. These samples are segregated according to matrix to limit opportunities for cross contamination to occur.

Organics staff is authorized to retrieve samples from these storage areas for analysis. When analysis is complete, the samples are placed back into storage.

9.10 ***Sample Login***. Following sample custody transfer to the laboratory, the documentation that describes the clients analytical requirements are delivered to the sample login group for coding and entry to the Laboratory Information management System (LIMS). This process translates all information related to collection time, turnaround time, sample analysis, and deliverables into a code which enables client requirements to be electronically distributed to the various departments within the laboratory for scheduling and execution.

The technical staff is alerted to client or project specific requirements through the use of a unique project code that is electronically attached to the job during login. The unique project code directs the technical staff to controlled specifications documents detailing the unique requirements.

9.11 ***Sample Retrieval for Analysis***. It is a responsibility of individual analyst to retrieve samples for analysis. Sample Management employs a program to facilitate sample placement and retrieval. Sample is traced around the laboratory using Status feature of LIMS.

After sample analysis has been completed, the analyst places the sample back into the storage and updates sample status.

9.12 ***Sample Disposal***. Accutest retains all samples under proper storage for a minimum of 30 days following completion of the analysis report. Longer storage periods are accommodated on a client specific basis if required. Samples may also be returned to the client for disposal.

Accutest disposes of all laboratory wastes following the requirements of the Resource Conservation and Recovery Act (RCRA). The Company has obtained and maintains a waste generator identification number, FLR00001263309002 (FLR designates State of Florida).

Sample management generates a sample disposal dump sheet from the LIMS tracking system each week, which lists all samples whose holding period has expired. Data from each sample is compared to the hazardous waste criteria established by the Florida Department of Environmental Protection (FDEP).

Samples containing constituents at concentrations above the criteria are labeled as hazardous and segregated into the following waste categories for disposal as follows:

Chlorinated Waste (Closed Top Steel Drum)- Methylene Chloride

Non-Chlorinated Waste (Closed Top Steel Drum)- Hexane, Methanol, and mixed solvents

Sodium Sulfate/Used Charcoal (Open Top Steel Drum)- Charcoal and paper filters used in the filtering of samples.

Hazardous Flammable Vials (Open Top Polypropylene Drum)- Methylene Chloride, Hexane.

Hazardous Aqueous waste (Closed Top Polypropylene Drum)- High Odor Samples, Lachat Waste.

Non Hazardous Soil (Open Top Steel Drum)- Soils.

Hazardous Solid Waste- (Open Top Steel Drum).

Non-Aqueous/Oil Samples- (Closed Top Steel Drum)

Difference between Open and Closed type of drums is whether it is possible to remove entire lid or just threaded stopper. Drums are closed at all times while in storage.

Non-hazardous aqueous samples are neutralized and collected in HDPP 500 Gal holding tank to be removed by waste company.

Non-hazardous solids are drummed and disposed of by contract waste company. Sample bottles are disposed of as recyclable waste in order to crush the bottles and destroy the labels. VOC vials are crushed on site using PRODEVA glass crusher. Supernatant liquid is siphoned off into the HDPP holding tank and solid residue drummed separately.

Laboratory wastes are collected by waste stream in designated areas throughout the laboratory. Waste streams are consolidated twice a week by the waste custodian and transferred to stream specific drums for disposal through a permitted waste management contractor. Filled, consolidated drums are tested for hazardous characteristics and scheduled for removal from the facility for appropriate disposal based on the laboratory data.

10.0 LABORATORY INSTRUMENTATION AND MEASUREMENT STANDARDS

Requirement: Procedures, which assure that instrumentation is performing to a pre-determined operational standard prior to the analysis of any samples, must be established by the laboratory. In general, these procedures will follow the regulatory agency requirements established in promulgated methodology. The instrumentation selected to perform specified analysis is capable of providing the method-specified uncertainty and sufficient sensitivity of measurement needed. These procedures must be documented and incorporated into the standard operating procedures for the method being executed. ALSE Equipment List attached as Appendix III.

10.1 ***Mass Tuning – Mass Spectrometers***. The mass spectrometer tune and sensitivity must be monitored to assure that the instrument is assigning masses and mass abundances correctly and that the instrument has sufficient sensitivity to detect compounds at low concentrations. This is accomplished by analyzing a specific mass tuning compound at a fixed concentration. If the sensitivity is insufficient to detect the tuning compound, corrective action must be performed prior to the analysis of standards or samples. If the mass assignments or mass abundances do not meet criteria, corrective action must be performed prior to the analysis of standards or samples.

10.2 ***Wavelength Verification – Spectrophotometers***. Spectrophotometer detectors are checked on a regular schedule to verify proper response to the wavelength of light needed for the test in use. If the detector response does not meet specifications, corrective action (detector adjustment or replacement) is performed prior to the analysis of standards or samples.

10.3 ***Inter-element Interference Checks (Metals)***. Inductively Coupled Plasma Emission Spectrophotometers (ICP) are subject to a variety of spectral interferences, which can be minimized or eliminated by applying interfering element correction factors and background correction points. Interfering element correction factors are checked on a specified frequency through the analysis of check samples containing high levels of interfering elements. Analysis of single element interferent solutions is also conducted at a specified frequency.

If the check indicates that the method criteria has not been achieved for any element in the check standard, the analysis is halted and data from the affected samples are not reported. Sample analysis is resumed after corrective action has been performed and the correction factors have been re-calculated.

New interfering element correction factors are calculated and applied whenever the checks indicate that the correction factors are no longer meeting criteria. At a minimum, correction factors are replaced once a year.

10.4 ***Calibration and Calibration Verification***. Many tests require calibration using a series of reference standards to establish the concentration range for performing quantitative analysis. Method specific procedures for calibration are followed prior to any sample analysis.

Calibration is performed using a linear or quadratic regression calculation or calibration factors calculated from the curve. The calibration must meet method specific criteria for linearity or precision. If the criteria are not achieved, corrective action (instrument maintenance or re-calibration) is performed. The instrument must be successfully calibrated before analysis of samples can be conducted.

Initial calibration for metals analysis performed using inductively coupled plasma (ICP) employs the use of two standards and a calibration blank to establish linearity. The calibration blank contains all reagents that are placed into the calibration standard with the exception of the target elements. Valid calibration blanks must not contain any target elements.

Initial calibrations must be initially verified using a single concentration calibration standard from a second source (i.e. separate lot or different provider). The continuing validity of an existing calibration must be regularly verified using a single concentration calibration standard. The response to the standard must meet pre-established criteria that indicate the initial calibration curve remains valid. If the criteria are not achieved corrective action (re-calibration) is performed before any additional samples may be analyzed.

10.5 ***Linear Range Verification and Calibration*** Linear range verification is performed for all ICP instrumentation and select General Chemistry methods. The regulatory program or analytical method specifies the verification frequency. A series of calibration standards are analyzed over a broad concentration range. The data from these analyses are used to determine the valid analytical range for the instrument.

Some methods or analytical programs require a low concentration calibration check to verify that instrument is sufficient to detect target elements at the reporting limit. The analytical method or regulatory program defines the criteria used to evaluate the low concentration calibration check. If the low calibration check fails criteria, corrective action is performed and verified through reanalysis of the low concentration calibration check before continuing with the field sample analysis.

In accordance with TNI standards minimum number of calibration points in the absence of method-specific requirements is two calibration points and a blank.

10.6 ***Retention Time Verification (GC/HPLC/IC)***. Chromatographic retention time windows are developed for all analysis performed using gas chromatographs with conventional detectors. An initial experimental study is performed, which establishes the width of the retention window for each compound. The retention time range of the window defines the time ranges for elution of specified target analytes on the primary and

confirmation columns. Retention time windows are established upon initial calibration, applying the retention time range from the initial study to each target compound. Retention times are regularly confirmed through the analysis of an authentic standard during calibration verification. If the target analytes do not elute within the defined range during calibration verification, the instrument must be recalibrated and new windows defined. New studies are performed when major changes, such as column replacement are made to the chromatographic system.

11.0 INSTRUMENT MAINTENANCE

***Requirement*.** Procedures must be established for equipment maintenance. The procedure may include a maintenance schedule if required or documentation of daily maintenance related activities. All instrument maintenance activities must be documented in instrument specific logbooks. All equipment out of service (both analytical and auxiliary) must be clearly marked "Out of Order".

11.1 ***Routine, Daily Maintenance***. Routine, daily maintenance is required on an instrument specific basis. It is performed each time the instrument is used. Daily maintenance traditionally includes activities to insure a continuation of good analytical performance. In some cases, they include performance checks that indicate whether non-routine maintenance is required. If the performance check indicates a need for higher level maintenance, the equipment is taken out of service until maintenance is performed. Analysis cannot be continued until the performance checks meet established criteria. Document return to control. Daily maintenance is the responsibility of the individual assigned to the instrument used for the analysis he is performing.

11.2 ***Non-routine Maintenance***. Non-routine maintenance is reserved for catastrophic occurrences such as instrument failure. The need for non-routine maintenance is indicated by failures in general operating systems that result in an inability to conduct required performance checks or calibration. Equipment in this category are taken out of service and repaired before attempting further analysis. Analysis cannot continue until the instrument meets all performance check criteria and is capable of being calibrated. Section supervisors are responsible for identifying non-routine maintenance episodes and initiating repair activities to bring the equipment on-line. This may include initiating telephone calls to maintenance contractors if necessary. They are also responsible for documenting all details related to the occurrence and the repair.

11.3 ***Scheduled Maintenance***. Modern laboratory instrumentation rarely requires regular preventative maintenance. Where required, the equipment is placed on a schedule, which dictates when maintenance is required. Examples include annual balance calibration by an independent provider and optical alignment of the ICP. Section supervisors are responsible for initiating scheduled maintenance on equipment that requires scheduled preventative attention. Scheduled maintenance is documented using routine documentation practices.

11.4 ***Maintenance Documentation***. Routine and non-routine maintenance activities are documented in logbooks assigned to instruments and equipment used for analytical measurements. The logbooks contain preprinted forms, which specify the maintenance activities required with each use. Accutest Laboratories Southeast has adopted a problem – action – follow-up format to conduct instrument maintenance. The analyst or supervisor who performs or initiates the maintenance activity is required to check the activity upon its completion, verify complete statement of return to normal conditions and initial the form. Non-routine maintenance (i.e. repairs, upgrades, etc.) is documented as well either electronically via e-mail from the service provider or receipt attached to the maintenance log.

12.0 QUALITY CONTROL PARAMETERS, PROCEDURES, AND CORRECTIVE ACTION

Requirement: All procedures used for test methods must incorporate quality control parameters to monitor elements that are critical to method performance. Each quality parameter includes acceptance criteria that have been established by regulatory agencies for the methods in use. Criteria may also be established through client dictates or through the accumulation and statistical evaluation of internal performance data. Data obtained from these parameters must be evaluated by the analyst, and compared to established method criteria. If the criteria are not achieved, the procedures must specify corrective action and conformation of control before proceeding with sample analysis. QC parameters, procedures, and corrective action must be documented within the standard operating procedures for each method. In the absence of client specific objectives the laboratory must define qualitative objectives for completeness and representativeness of data.

12.1 ***Procedure***. Bench analysts are responsible for methodological quality control and sample specific quality control. Each method specifies the control parameters to be employed for the method in use and the specific procedures for incorporating them into the analysis. These control parameters are analyzed and evaluated with every designated sample group (batch).

The data from each parameter provides the analyst with critical decision making information on method performance. The information is used to determine if corrective action is needed to bring the method or the analysis of a specific sample into compliance. These evaluations are conducted throughout the course of the analysis. Each parameter being indicative of a critical control feature. Failure of a methodological control parameter is indicative of either instrument or batch failure. Failure of a sample control parameter is indicative of control difficulties with a specific sample or samples.

Sample Batch. All samples analyzed in the laboratory are assigned to a designated sample batch, which contains all required quality control samples and a defined maximum number of field samples that are prepared and/or analyzed over a defined time period. The maximum number of investigative and field QC samples in the batch is 20. Accutest has incorporated the NELAP batching policy as the sample-batching standard. This policy incorporates the requirement for blanks and spiked blanks as a time based function as defined by NELAP. The typical batch contains a blank, laboratory control sample (LCS or spiked blank), matrix spike and matrix spike duplicate. Batch documentation includes lot specifications for all reagents and standards used during preparation of the batch.

12.2 ***Methodological Control Parameters and Corrective Action***. Prior to the analysis of field sample the analyst must determine that the method is functioning properly. Specific control parameters indicate whether critical processes meet specified requirements before continuing with the analysis. Method specific control parameters must meet criteria before sample analysis can be conducted. Each of these

parameters is related to processes that are under the control of the laboratory and can be adjusted if out of control.

Method Blank. A method blank is analyzed during the analysis of any field sample. The method blank is defined as a sample. It contains the same standards (internal standards, surrogates, matrix modifiers, etc.) and reagents that are added to the field sample during analysis, with the exception of the sample itself. If the method blank contains target analyte(s) at concentrations that exceed method or client requirements (typically defined as 1/2 RL concentrations), the source of contamination is eliminated before proceeding with sample analysis. Systematic contamination is documented for corrective action and resolved following the established corrective action procedures. In specific cases, contamination detected in the method blank may be acceptable if the concentrations do not exceed regulatory limits or client defined reporting limits.

Laboratory Control Samples (LCS or Spiked Blanks). A laboratory control sample (spiked blank or commercially prepared performance evaluation sample) is analyzed along with field samples to demonstrate that the method accuracy is within acceptable limits. These spike solutions are derived from different sources than the solutions used for method calibration. The performance limits are derived from published method specifications or from statistical controls generated from laboratory method performance data. Spiked blanks are blank matrices (reagent water or clean sand) spiked with the targeted parameters and analyzed using the same method used for samples. Accuracy data is compared to laboratory experimentally derived limits to determine if the method is in control. Laboratory control samples (LCS) are commercially prepared spiked samples in an inert material. Performance criteria for recovery of spiked analytes is pre-established by the commercial entity preparing the sample. This sample is analyzed in the laboratory as an external reference.

Accuracy data is compared to the applicable performance limits. If the spike accuracy exceeds the performance limits, corrective action, as specified in the SOP for the method is performed and verified before continuing with a field sample analysis. In some cases, decisions are made to continue with sample analysis if performance limits are exceeded; provided the unacceptable result has no negative impact on the sample data.

Marginal exceedance (ME) values are calculated for methods containing more than eleven (11) targeted analytes. The ME is calculated as $\pm$ 4 standard deviations about the mean. MEs are considered for multi-analyte methods because of the increased likelihood of LCS failure as the number of analytes in the method increase. The number of allowable MEs is based on the number of target analytes in the method. Analytes that regularly fall into the ME category are treated as systematic problems, which are resolved using established trend monitoring and corrective action procedures. Marginal Exceedances are not applied to parameters that are detected in field samples. Routine corrective action is initiated for all cases where LCS spike accuracy criteria is beyond the established control limits and the parameter is detected in field samples corresponding to the unacceptable LCS.

Blanks and spikes are routinely evaluated before samples are analyzed. However, in situations where sample analysis is performed using an autosampler, they may be evaluated after sample analysis has occurred. If the blanks and spikes do not meet criteria, sample analysis is repeated.

Proficiency Testing. Performance Evaluation (Proficiency Testing) samples (PEs, PTs) are single or double blind samples spiked with know amount of analytes on interest and introduced to the laboratory to assess method performance. PEs may be introduced as double blinds submitted by commercial clients, single or double blinds from regulatory agencies, or internal blinds submitted by the QA group.

A minimum of two single blind studies must be performed each year for every parameter in aqueous and solid matrices for each field of proficiency testing (FOPT) for which the laboratory maintains accreditation. Proficiency Testing samples must be purchased as blinds from an accredited vendor. Data from these studies are provided to the laboratory by the vendor and reported to accrediting agencies. If unsatisfactory performance is noted, corrective action is performed to identify and eliminate any sources of error. A new PT must be analyzed to demonstrate continuing proficiency.

PE samples performed for accrediting agencies or clients, which do not meet performance specifications, require a written summary that documents the corrective action investigation, findings, and corrective action implementation.

Single or double blind PT samples are employed for self-evaluation purposes. Data from these analyses are compared to established performance limits. If the data does not meet performance specifications, the system is evaluated for sources of acute or systematic error. If required, corrective action is performed and verified before initiating or continuing sample analysis.

Trend Analysis for Control Parameters. Accuracy data for selected spiked parameters from the laboratory control sample (LCS) is statistically evaluated daily for trends. Data from selected LCS parameters and surrogates are pooled on a method, matrix, and instrument basis. This data is evaluated by comparison to existing control and warning limits. Trend analysis is performed automatically as follows:

- Any point outside the control limit
- Any three consecutive points between the warning and control limits
- Any eight consecutive points on the same side of the mean
- Any six consecutive points increasing or decreasing

The results of the trend analysis are printed for supervisory evaluation prior to sample analysis. Trends that indicate the potential loss of statistical control are further evaluated to determine the impact on data quality and to determine if corrective action is necessary. If corrective action is indicated, the supervisor informs the analysts of

the corrective actions to be performed. Return to control is demonstrated before analysis resumes.

12.3 ***Sample Control Parameters and Corrective Action***. The analysis of samples can be initiated following a successful demonstration that the method is operating within established controls. Additional controls are incorporated into the analysis of each sample to determine if the method is functioning within established specifications for each individual sample. Sample QC data is evaluated and compared to established performance criteria. If the criteria are not achieved the method or the SOP specifies the corrective action required to continue sample analysis. In many cases, failure to meet QC criteria is a function of sample matrix and cannot be remedied. Each parameter is designed to provide quality feedback on a defined aspect of the sampling and analysis episode.

Duplicates. Duplicate sample analysis is used to measure analytical precision. This can also be equated to laboratory precision for homogenous samples. Precision criteria are method dependent. If precision criteria are not achieved, corrective action or additional action may be required. Recommended action must be completed before sample data can be reported.

Laboratory Control Duplicate, Spikes & Spiked Duplicates. Spikes and spiked duplicates are used to measure analytical precision and accuracy for the sample matrix selected. Precision and accuracy criteria are method dependent. If precision and accuracy criteria are not achieved, corrective action or additional action may be required. Recommended action must be completed before sample data can be reported.

Serial Dilution (Metals). Serial dilutions of metals samples are analyzed to determine if analytical matrix effects may have impacted the reported data. If the value of the serially diluted samples does not agree with the undiluted value within a method-specified range, the sample matrix may be causing interference, which may lead to either a high or low bias. If the serial dilution criterion is not achieved, it must be flagged to indicate possible bias from matrix effects. *Accutest-SE uses this procedure as opposed to post-digestion spike unless contractual obligations absolutely require latter*

Post Digestion Spikes. Digested samples are spiked and analyzed to determine if matrix interferences are creating biases in the results. It may also be used to determine potential interferences per client's specification. Spike concentration is determined as per analytical method. No action is necessary if the post digestion spike is outside of the method criteria, unless a preparation problem is suspected with the spike, in which case the post digestion spike should remade and reanalyzed.

Surrogate Spikes (Organics). Surrogate spikes are organic compounds that are similar in behavior to the target analytes but unlikely to be found in nature. They are added to all quality control and field samples to measure method performance for each individual sample. Surrogate accuracy limits are derived from published method

specifications or by statistical evaluation of laboratory generated surrogate accuracy data. Accuracy data is compared to the applicable performance limits. If the surrogate accuracy exceeds performance limits, corrective action, as specified in the method or SOP is performed before sample data can be reported.

Internal Standards (Organic Methods). Internal standards are retention time and instrument response markers added to every sample to be used as references for quantitation. Their response is compared to reference standards and used to evaluate instrument sensitivity on a sample specific basis. Internal standard retention time is also compared to reference standards to assure that target analytes are capable of being located by their individual relative retention time.

If internal standard response criteria are not achieved, corrective action or additional action may be required. The recommended action must be completed before sample data can be reported.

If the internal standard retention time criteria are not achieved corrective action or additional action may be required. This may include re-calibration and re-analysis. Additional action must be completed before sample data is reported.

Internal Standards (ICP Metals). Internal standards are used on ICP instruments to compensate for variations in response caused by differences in sample matrices. This adjustment is performed automatically during sample analysis. The internal standard response of replicated sample analysis is monitored to detect potential analytical problems. If analytical problems are suspected, then the field samples are reanalyzed.

12.4 ***Laboratory Derived Quality Control Criteria.*** Control criteria for in-house methods and client specific modifications that exceed the scope of published methodology are defined and documented prior to the use of the method. The Quality Assurance staff identifies the responsibility for control criteria needs. Control parameters and criteria, based on best technical judgement are established using input provided by the operations staff. These control parameters and criteria are documented and incorporated into the method.

The laboratory derived criteria are evaluated for technical soundness on spiked samples prior to the use of the method on field samples. The technical evaluation is documented and archived by the Quality Assurance staff.

When sufficient data form the laboratory developed control parameter is accumulated, the data is statistically processed and the experimentally derived control limits are incorporated into the method.

12.5 ***Bench Review & Corrective Action***. The bench chemists are responsible for all QC parameters. Before proceeding with sample analysis, they are required to successfully meet all instrumental QC criteria. They have the authority to perform any necessary corrective action before proceeding with sample analysis. Their authority

includes the responsibility for assuring that departures from documented policies and procedures do not occur.

The bench chemists are also responsible for all sample QC parameters. If the sample QC criteria are not achieved, they are authorized and required to perform the method specified corrective action before reporting sample data.

***Data Qualifiers*.** An alpha character coding system is employed for defining use limitations for reported data. These limitations are applied to analytical data by the analyst to clarify the usefulness of the reported data for data user. Accutest Laboratories Southeast qualifies data in accordance with program-specific requirements, such as State of Florida DEP, AFCEE, etc., and these qualifiers are hard-coded in the LIMS on project level. Definitions of common qualifiers could be found at the bottom of the sample report form.

12.6 ***QA Monitoring***. The QA staff prior to client release conducts a spot review of completed data packages. This review includes an examination of QC data for compliance and trends indicative of systematic difficulties. If non-conformances are detected, the QA staff places an immediate stop on the release of the data and initiates corrective action to rectify the situation. The data package is released when the package becomes compliant with all quality requirements.

If the review reveals trends indicative of systematic problems, QA initiates an investigation to determine the cause. If process defects are detected, a corrective action is implemented and monitored for effectiveness.

Performance Limits. The Technical Director is responsible for compilation and maintenance of all precision and accuracy data used for performance limits. Quality control data for all test methods are accumulated and stored in the laboratory information management system (LIMS). Parameter specific QC data is extracted annually and statically processed to eliminate outliers and develop laboratory specific warning limits and confidence limits. The new limits are reviewed and approved by the supervisory staff prior to their use for data assessment. The new limits are used to evaluate QC data for compliance with method requirements for a period of one year. Laboratory generated limits appear on all data reports unless method specifies hard-coded limits (mostly General Chemistry and Metals)

12.7 ***Data Package Review***. Accutest employs multiple levels of data review to assure that reported data has satisfied all quality control criteria and that client specifications and requirements have been met. Production departments have developed data review procedures which must be conducted before data is released to the client.

Analytical Review. The analyst conducts the primary review of all data. This review begins with a check of all instrument and method quality control and progresses through sample quality control concluding with a check to assure that the client's requirements have been executed. Analyst checks focuses on a review of qualitative

determinations and checks of precision and accuracy data to verify that existing laboratory criteria have been achieved. Checks at this level may include comparisons with project specific criteria if applicable. The analyst has the authority and responsibility to perform corrective action for any out-of-control parameter or nonconformance at this stage of review.

Secondary data reviews are performed at the peer level by analysts who have met the qualification criteria for the method in use. Qualification requirements include a valid demonstration of capability and demonstrated understanding of the method SOP. Section supervisors may perform secondary review in-lieu of a peer review Secondary review is performed on 100% of the data produced by their department. It includes a check of all manual calculations; an accuracy check of manually transcribed data from bench sheets to the LIMS, a check of all method and instrument QC criteria, baseline manipulations (if applicable) and a comparison of the data package to client specified requirements. Also included are checks to assure the appropriate methodology was applied and that all anomalous information was properly flagged for communication in the case narrative. Supervisors have the authority to reject data and initiate re-analysis, corrective action, or reprocessing.

All laboratory data requiring manual entry into LIMS system is double-checked by the analysts performing initial data entry and the section supervisor. Verification of supervisory review is indicated on the raw data summary by the supervisor's initials and date.

Electronic data that is manually edited at the bench by the primary analysts is automatically flagged by the instrument data system indicating an override by the analyst. All manual overrides must be verified and approved by a supervisor who initials and dates all manual changes.

Hard copies of manually integrated chromatographic peaks are printed that clearly depict the manually drawn baseline. The hard copy is reviewed and approved by the reviewer (initialed and dated) and included in the data package of all full tier reports or the archived batch records of commercial report packages.

Electronic data that has been committed to the LIMS can only be edited by a manager or supervisor. These edits may be required if needs for corrections are indicated during the final review. An audit record for all electronic changes in the LIMS is automatically appended to the record.

The group manager performs a tertiary review on a spot check basis. This review includes an evaluation of QC data against acceptance criteria and a check of the data package contents to assure that all analytical requirements and specifications were executed.

Report Generation Review. The report generation group reviews all data and supporting information delivered by the laboratory for completeness and compliance

with client specifications. Missing deliverables are identified and obtained from the laboratory. The group also reviews the completed package to verify that the delivered product complies with all client specifications. Non-analytical defects are corrected before the package is sent to the client.

Project Management/Quality Assurance Review. Spot-check data package reviews are performed by the project manager. Project management reviews focus on project specifications. If the project manager identifies defects in the product prior to release, he initiates immediate corrective action to rectify the situation.

The QA Staff reviews approximately 10% of the data produced. The QA review focuses on all elements of the deliverable including the client's specifications and requirements, analytical quality control, sample custody documentation and sample identification. QA reviews at this step in the production process are geared towards systematic process defects, which require procedural changes to effect a corrective action. However, if defects are identified that can be corrected prior to data release, the QA staff returns the package to the laboratory for corrective action. QA data review cannot be used in lieu of a peer level review or a supervisory review.

Data Reporting. Analytical data is released to clients following secondary departmental review. Data release at this stage of the process is limited to electronic information, which is released to clients through a secure, encrypted, password protected, Internet connection.

Hard copy support data is compiled by the report generation group and assembled into the final report. The report is sent to the client following reviews by report generation, and spot-check by QA staff.

All data reports include specified information, which is required to identify the report and its contents. This information includes a title, name and address of the laboratory, a unique report number, total number of pages in the report, clients name and address, analytical method identification, arriving sample condition, sample and analysis dates, test results with units of measurement, authorized signature of data release, statement of applicability, report reproduction restrictions and TNI requirements certification. Subcontracted data is clearly identified.

In the event of report revision date of the revision, nature of revision and identity of the person revising the report must be clearly stated in the body of the report. Depending on the level of the deliverables it could be either stated in the Case Narrative or Case Narrative generated specifically for this purpose. Case Narrative must state "supercedes all previous reports".

12.8 ***Electronic Data Reduction.*** Raw data from sample analysis is entered into the laboratory information management system (LIMS) using automated processes or manual entry. Final data processing is performed by the LIMS using procedures developed by the Company.

All LIMS programs and internally developed software (including Excel spreadsheets) are tested and validated prior to use to assure that they consistently produce correct results. Validation testing is performed by the Information Technology Staff. The testing procedures are documented in an SOP. Programs are not approved for use until they have demonstrated that they are capable of performing the required calculations.

12.9 ***Representativeness***. Data representativeness is based on the premise that qualitative and quantitative information developed for field samples is characteristic of the sample that was collected by the client and analyzed in the laboratory. The laboratory objective for representativeness defines data as representative if the criteria for all quality parameters associated with the analysis of the sample are achieved.

12.10 ***Comparability***. Analytical data is defined as comparable when data from a sample set analyzed by the laboratory is representatively equivalent to other sample sets analyzed separately regardless of the analytical logistics. The laboratory will achieve 100% comparability for all sample data which meets the criteria for the quality parameters associated with its analysis using the method requested by the client.

13.0 CORRECTIVE ACTION SYSTEM

Requirement. The laboratory must have polices and procedures for correcting defective processes, systematic errors, and quality defects, which enables the staff to systematically improve product quality. The system must include procedures for communicating items requiring corrective action, corrective action tracking procedures, corrective action documentation, monitoring of effectiveness, and reports to management. The system must be documented in a standard operating procedure.

13.1 ***Procedure***. Corrective action is the step that follows the identification of a process defect. The type of defect determines the level of documentation, communication, and training necessary to prevent re-occurrence of the defect or non-conformance.

Routine Corrective Action. Routine corrective action is defined as the procedures used to return out of control analytical systems back to control. This level of corrective action applies to all analytical quality control parameters or analytical system specifications.

Bench analysts have full responsibility and authority for performing routine corrective action. The resolution of defects at this level does not require a procedural change or staff re-training. The analyst is free to continue work once corrective action is complete and the analytical system has been returned to control. Documentation of routine corrective action is limited to bench logbook or maintenance logbook comment.

Process Changes. Corrective actions in this category require procedural modifications. They may be the result of systematic defects identified during audits, the investigation of client inquiries, failed proficiency tests, product defects identified during data review, or method updates. Resolution of defects of this magnitude requires formal identification of the defect, development and documentation of a corrective action plan, and staff training to communicate the procedural change.

Technical Corrective Action. Technical corrective action encompasses routine corrective action performed by bench analysts for out of control systems and corrective actions performed for data produced using out of control systems. Technical corrective action for routine situations is conducted using the procedures detailed above.

Non-routine corrective actions apply to situations where the bench analysts failed to perform routine corrective action before continuing analysis. Supervisors and Department Managers perform corrective action in these situations. Documentation of all non-routine corrective actions is performed using the corrective action system.

Sample re-analysis is conducted if sufficient sample and holding time remain to repeat the analysis using an in-control system. If insufficient sample or holding time remains, the data is processed and qualifiers applied that describe the out of control situation. The occurrence is further documented in the case narrative and in the corrective

action response. The corrective action must include provisions for retraining the analysts who failed to perform routine corrective action.

13.2 ***Documentation & Communication***. Routine corrective actions are documented as part of the analytical record. Notations are made in the comments section of the analytical chronicle or data sheet detailing the nonconformance. Continuation of the analysis indicates that return to control was successful.

Corrective actions for process changes are documented, tracked and monitored for effectiveness. Corrective actions may be initiated by any supervisor or senior staff member by completing the corrective action form in Corrective Action database

The corrective action database is an Access application. The initiator generates the corrective action investigation form, which is documented, tracked, distributed to responsible parties and archived through the application. The application assigns a tracking number initiation data and due date to each corrective action initiated and copies the corrective action form to the corrective action database. The application also distributes an E-mail message containing the form to the responsible parties for resolution.

Corrective Action system employs Deficiency – Root Cause – Immediate Fix – Corrective action approach, further divided into categories of Analytical Error, Omission Error, Random Error, Systemic Error and Training Issue.

The responsible party develops and implements the procedural change. Existing documentation such as SOPs are edited to reflect the change. The affected staff is informed of the procedural change through a formal training session. The training is documented and copies are placed into individual training files. The corrective action form is completed and closed in CA database.

Initial and completed corrective action forms are maintained in the Corrective Action directory. This information is archived daily. Copies of training records describing corrective actions are appended to the involved individuals training files.

Monitoring. The QA Staff monitors the implemented corrective action until it is evident that the corrective action has been effective and the systematic deficiency has been eliminated. The corrective action database is updated by QA to reflect closure of the corrective action. The QA staff also assigns an error code to the corrective action for classification of the type of errors being committed.

If QA determines that the corrective action procedure has not effectively remedied the deficiency, the process continues with a re-initiation of the corrective action. Corrective action continues until the defective process is eliminated. If another procedural change is required, it is treated as a new corrective action, which is documented and monitored using established procedures.

Client Notification. Defective processes, systematic errors, and quality defects, detected during routine audits may have negative impacts on data quality. In some cases, data that has been released to clients may be affected. If defective data has been released for use, Accutest will notify the affected clients of the defect and provide specific details regarding the magnitude of the impact to their data.

14.0 PROCEDURES FOR EXECUTING CLIENT SPECIFICATIONS

***Requirement*.** Systems must be established for evaluating and processing client specifications for routine and non-routine analytical services. The systems must enable the client services staff to identify, evaluate, and document the requested specifications to determine if adequate resources are available to perform the analysis. The system must include procedures for communicating the specifications to the laboratory staff for execution and procedures for verifying the specifications have been executed.

14.1 ***Client Specific Requirements***. The project manager is the primary contact for clients requesting laboratory services. Client specifications are communicated using several mechanisms. The primary source of information is the client's quality assurance project plan (QAPP) which details analytical and quality control specifications for the project. In the absence of a QAPP, projects specifications can also be communicated using contracts, letters of authorization, or letters of agreement, which may be limited to a brief discussion of the analytical requirements and the terms and conditions for the work. These documents may also include pricing information, liabilities, scope of work, in addition to the analytical requirements. QAPPs include detailed analytical requirements and data quality objectives, which supersede those found in the referenced methods. This information is essential to successful project completion.

Laboratory also reviews its Accreditation status to evaluate whether it is possible to accept proposed project. Discrepancies must be resolved before the work commences.

The client services staff provides additional assistance to clients who are unsure of the specifications they need to execute the sampling and analysis requirements of their project. They provide additional support to clients who require assistance in results interpretation as needed, provided they possess the expertise required to render an opinion.

The project manager is responsibility for obtaining project documents, which specify the analytical requirements. Following project management review, copies are distributed to the QA staff and the appropriate departmental managers for review and comment. The original QAPP is numbered with a document control number and filed in a secure location.

14.2 ***Requirements for Non-Standard Analytical Specifications***. Client requirements that specify departures from documented policies, procedures, or standard specifications must be submitted to Accutest in writing. These requirements are reviewed and approved by the technical staff before the project is accepted. Once accepted, the non-standard requirements become analytical specifications, which follow the routine procedure for communicating client specifications. Departures from documented policies, procedures, or standard specifications that do not follow this procedure are not permitted.

Exception Policy: With respect to the quality system, incoming non-conforming product refers to received samples that do not meet requirements of custody documentation, are improperly packaged or stored or are contaminated. An internal non-conformance refers to a problem, caused internally due to improper handling of samples, improper sampling methods, and equipment malfunction or data management errors. The individual who identifies the incoming non-conformance is responsible for notifying the project manager. The project manager resolves the issue with the client. The individual who recognizes an internal non-conformance is responsible for initiating corrective action

Departures from standard practices, policies and specifications are reviewed and approved by Technical Director, QA Officer and by Project Manager of the project affected.

Corrective & Preventative Action: Once a quality problem has been identified, the analytical or review process stops, until the reason is identified. Primary responsibility for identifying the cause of the problem rests with the instrument operator. Other staff may be called on to assist in reaching the root cause. The problem prevention tracking system, using Corrective Action Tracking Records, provides a method to track systemic problems until resolved/removed. The QA Officer is responsible for the record management with respect to the disposition of problems.

Deviations that do not limit themselves to a single department and/or client are cited on Corrective Action Record. This may include but not limited to: sample arrival outside of EPA specified holding time, analysis completion outside of EPA specified holding time (with explanation of the reason), inconsistencies between chain of custody and cooler contents, including labeling errors, improper preservation, etc.

Deviations from analytical methods' SOP's are reported by the Analyst to the Section Leader. Single occurrences warrant completion of Corrective Action Tracking record, repetitive occurrences may indicate that either an additional training session is in order, or the SOP does not reflect proper laboratory practice. Training session is conducted by the Technical Director or by QA Officer. In case where SOP does not reflect current laboratory practice, SOP review and correction process may be initiated.

14.3 ***Evaluation of Resources.*** A resource evaluation is completed prior to accepting projects submitted by clients. The evaluation is initiated by the client services staff receives project requirements (usually in the form of QAPjP) and distributes these requirements to the laboratory departments affected. The specifications are evaluated by the department managers from a scheduling and hardware resources perspective. The project is not accepted unless the department managers have the necessary resources to execute the project according to client specifications.

14.4 ***Documentation***. New projects are initiated using a project set up form, which is completed prior to the start of the project. This form details all of the information needed to correctly enter the specifications for each client sample into the laboratory information management system (LIMS, see example). The form includes data reporting requirements, billing information, data turnaround times, QA level, state of origin, and comments for detailing project specific requirements. The project manager is responsible for obtaining this information from the client and completing the form prior to sample arrival and login.

Sample receipt triggers project creation and the login process. The information on the set-up form is entered into the LIMS immediately prior to logging in the first sample. The set up form may be accompanied by a quotation, which details the analytical product codes and sample matrices. These details are also entered into the LIMS during login.

Special information is distributed to the laboratory supervisors and login department in electronic or hardcopy format upon project setup. All project specific information is retained by the project manager in a secure file. The project manager maintains a personal telephone log, which details conversations with the client regarding the project.

14.5 ***Communication***. A pre-project meeting is held between client services and the operations managers to discuss the specifications described in the QAPjP and/or related documents. Project logistics are discussed and finalized and procedures are developed to assure proper execution of the client's analytical specifications and requirements. Questions, raised in the review meeting, are discussed with the client for resolution. Exceptions to any requirements, if accepted by the client, are documented and incorporated into the QAPjP or project documentation records.

Non-standard specifications for individual clients are documented in the LIMS at the client account level. Once entered into the LIMS, these specifications become memorialized for all projects related to the client account. Upon sample arrival, these specifications are accessed through a terminal or printed as a hard copy and stored in a binder for individuals who require access to the specification. Specifications that are not entered into the LIMS are prohibited unless documented in an interdepartmental memo, which clearly identifies the project, client and effective duration of the specification.

14.6 ***Operational Execution***. A work schedule is prepared for each analytical department on a daily basis. Analytical specifications from recently arrived samples have now been entered into the LIMS database. The database is sorted by analytical due date and holding time, into product specific groups. Samples are scheduled for analysis by due date and holding time. The completed schedule, which is now defined as a work list, is printed. The list contains the client requested product codes and specifications required for the selected sample(s). Special requirements are communicated to the analyst using the comments section or relayed through verbal instructions provided by

the supervisor. The bench analyst assumes full responsibility for performing the analysis according to the specifications printed on the work sheet.

14.7 ***Verification***. Prior to the release of data to the client, laboratory section managers and the report generation staff review the report and compare the completed product to the client specifications documentation to assure that all requirements have been met. Project managers perform a spot check of projects with unique requirements to assure that the work was executed according to specifications.

15.0 CLIENT COMPLAINT RESOLUTION PROCEDURE

Requirement. A system for managing and reconciling client complaints must be implemented in the laboratory. The system must include procedures for documenting client complaints and communicating the complaint to the appropriate department for resolution. The system must also include a quality assurance evaluation to determine if the complaint is related to systematic defects requiring process changes.

15.1 ***Procedure***. Client complaints are communicated to client services representatives, quality assurance staff, or senior management staff for resolution. The individual receiving the complaint retains the responsibility for documentation and communicating the nature of the complaint to the responsible department(s) for resolution. The responsible party addresses the complaint. The resolution is communicated to quality assurance (QA) and the originator for communication to the client. QA reviews the complaint and resolution to determine if systematic defects exist. If systematic defects are present, QA works with the responsible party to develop a corrective action that eliminates the defect.

Documentation. Client's complaints are documented by the client service representative receiving the complaint. A record of the telephone conversation is maintained by client services. Client service staff enters the complaint into Data Challenge database or Client Complaint database, depending on the nature of complaint. These databases are cross-linked with corrective action database – see sec. 13. Complaint is communicated to the production departments concerned via auto e-mail. The complaint resolution is documented in the database by the responsible party and resultant e-mail returned to the originator. QA staff is copied on the correspondence.

15.2 ***Corrective Action***. Responses to Data Challenges/Client Complaints are required from the responsible party. At a minimum, the response addresses the query and provides an explanation to the complaint. Corrective action may focus on the single issue expressed in the complaint. Corrective action may include job case narrative generation, reprocessing of data, editing of the initial report, and re-issue to the client. If the QA review indicates a systematic error, process modification is required. The defective process at the root of the complaint is changed. SOPs are either created or modified to reflect the change. The party responsible for the process implements process changes.

15.3 ***QA Monitoring***. Process changes, implemented to resolve systematic defects, are monitored for effectiveness by QA. If monitoring indicates that the process change has not resolved the defect, QA works with the department management to develop and implement an effective process. If monitoring indicates that the defect has been resolved, monitoring is slowly discontinued. Continued monitoring is incorporated as an element of the annual system audit and annual Management Report (see 18.8).

16.0 CONTROL OF NONCONFORMING PRODUCT

Requirement: Policies and procedures have been developed and implemented that describe the procedures employed by the laboratory when any aspect of sample analysis or data reporting do not conform to established procedures or client specifications. These procedures include steps to ensure that process defects are corrected and affected work is evaluated to assess its impact to the client.

Procedure. Nonconforming product is identified through multiple channels, such as second level analytical data review, routine internal review and audit practices, external auditing or through client inquiry. Responsibility and authority for the management of the non-conforming product directly defined by a nature of a non-conformance. For example, non-conformances resulting from internal and external reviews are evaluated and managed by QA Staff. Corrective Action items are issued and followed to completion and verification that defect is prevented from reoccurring. Non-conformances stemming from client inquiry are managed by Project Management staff with QA staff oversight.
Data associated with out-of compliance QC are evaluated by bench personnel and section supervisors. The analyst has the authority and responsibility to perform corrective action for any out-of-control parameter or nonconformance at this stage of review.
If non-conformances are detected, the QA staff places an immediate stop on the release of the data and initiates corrective action to rectify the situation

Non-conformances and their significance are communicated in case narrative and sample report footnotes. Case narrative comments and sample repot footnotes must state the impact on data quality.

Corrective Action. The outcome of the evaluation dictates the course of action. The type of defect determines the level of documentation, communication, and training necessary to prevent re-occurrence of the defect or non-conformance This may include at a minimum client notification, but may also include corrective action. Immediate corrective action is performed using the SOP-specified procedures. However, additional action may be required including cessation of analysis and withholding and/or recalling data reports. If the evaluation indicates that nonconforming data may have been issued to clients, the client is immediately notified and data may be recalled following the procedures specified in respective SOPs. If work has been stopped because of a nonconformance, the Laboratory Director is the only individual authorized to direct a resumption of analysis.
Nonconformances caused by systematic process defects require retraining of the personnel involved as an element of the corrective action solution. Routine corrective actions are documented as part of the analytical record.

17.0 CONFIDENTIALITY PROTECTION PROCEDURES

Requirements: Policies and procedures are required to protect client data from release to unauthorized parties or accidental release of database information through accidental electronic transmission or illegal intrusion. These policies must be communicated to clients and staff. Electronic systems must be regularly evaluated for effectiveness.

17.1 ***Client Anonymity***. Information related to the Company's clients is granted to employees on a "need to know" basis. An individual's position within the organization defines his "need to know". Individuals with "need to know" status are given password access to systems that contain client identity information and access to documents and document storage areas containing client reports and information. Access to client information by individuals outside of the Company is limited to the client and individuals authorized by the client.

Individuals outside of the Company may obtain client information through subpoena issued by a court of valid jurisdiction. Clients are informed when subpoenas are received ordering the release of their information.

17.2 ***Documents***. Access to client documents is restricted to employees in need to know positions. Copies of all client reports are stored in secure archive with restricted access. Reports and report copies are distributed to individuals who have been authorized by the client to receive them. Documents are not released to third parties without verbally expressed or written permission from the client.

17.3 **Confidential Business Information (CBI).** Operational documents including SOPs, Quality Manuals, personnel information, internal operations statistics, and laboratory audit reports are considered confidential business information. Strict controls are placed on the release of this information to outside parties.

Release of CBI to outside parties or organizations may be authorized upon execution of a confidentiality agreement between Accutest and the receiving organization or individual. CBI information release is authorized for third party auditors and commercial clients in electronic mode as Adobe Acrobat .PDF format only. See also Sec. 6.5.

17.4 ***Electronic Data***.

Database Intrusion. Direct database entry is authorized for employees of Accutest only on a need to know basis. Entry to the database is restricted through a user specific multiple password entry system. Direct access to the database outside of the facility is possible through a VPN connection. A unique password is required for access to the local area network. A second unique password is required to gain access to the database. The staff receives read or write level authorization on a hierarchical privilege basis.

Internet Access. Access to client information is through an HTTP Web application only. It does not contain a mechanism that allows direct access to the database. Clients can gain access to their data only using a series of Accutest assigned accounts, and client specific passwords. The viewable data, which is encrypted during transmission, consists of an extraction of database information only.

Client Accessibility. Accessibility to client data delivered via electronic means follows strict protocols to insure confidentiality. Clients accessing electronic data are assigned a company account. The account profile, which is established by the MIS staff, grants explicit access to explicit information pertaining to the clients project activity. Passwords are assigned on an individual basis within a client account. These accounts can be activated or deactivated by the MIS staff only.

17.5 ***Information Requests***. Client specific data or information is not released to third parties without verbally expressed or written permission from the client. Written permission is required from third parties, who contact the Company directly for the release of information. Verbal requests will be honored only if they are received directly from the client. These requests must be documented in a record of communication maintained by authorized recipient.

17.6 ***Transfer of Records***. Archived data, which has previously been reported and transmitted to clients, is the exclusive property of Accutest Laboratories. In the event of a cessation of business activities due to business failure or sale, The Company's legal staff will be directed to arrange for the final disposition of archived data.

The final disposition of archived data will be accomplished using the approach detailed in the following sequence:

1. All data will be transferred to the new owners for the duration of the required archive period as a condition of sale.

2. If the new owners will not accept the data or the business has failed, letters will be sent to clients listed on the most recent active account roster offering them the option to obtain specific reports (identified by Accutest Job Number) at their own expense.

3. A letter will be sent to the TNI accrediting authority with organizational jurisdiction over the company offering them the option to obtain all unclaimed reports at their own expense.

4. All remaining archived data will be recycled using the most expedient means possible.

18.0 QUALITY AUDITS AND SYSTEM REVIEWS

Requirement: The quality assurance group will conduct regularly scheduled audits of the laboratory to assess compliance with quality system requirements, technical requirements of applied methodology, and adherence to documentation procedures. The information gathered during these audits will be used to provide feedback to senior management and perform corrective action where needed for quality improvement purposes.

18.1 ***Quality Systems Review***. Quality system audits are performed annually by the Quality Assurance Director for the Company President. In this audit, the laboratory is evaluated for compliance with the Laboratory Quality Systems Manual (LQSM) and the quality system standards of the National Environmental Laboratory Accreditation Conference. Findings, which indicate non-compliance or deviation from the LQSM, are flagged for corrective action. Corrective actions require either a return to compliance or a plan change to reflect an improved quality process. The QA Officer is responsible for making and documenting changes to the LQSM. These changes are reviewed by the Laboratory Director and Technical Director prior to the approval of the revised system.

18.2 ***Quality System Audits.*** Quality system audits are conducted to evaluate the effectiveness and laboratory compliance with individual quality system elements. These audits are conducted on an established schedule. Audit findings are documented and communicated to the management staff and entered into the corrective action system for resolution. If necessary, retraining is conducted to assure complete understanding of the system requirements.

18.3 ***Technical Compliance Audits***. Technical compliance audits are performed throughout the year following the established schedule. Selected analytical procedures are evaluated for compliance with standard operating procedures (SOPs) and method requirements. If non-conformances exist, the published method serves as the standard for compliance. SOPs are edited for compliance if the document does not reflect method requirements. Analysts are trained to the new requirements and the process is monitored by quality assurance. Analysts are retrained in method procedures if an evaluation of bench practices indicates non-compliance with SOP requirements.

18.4 ***Documentation Audits***. Documentation audits are conducted periodically. This audit includes a check of measurement processes that require manual documentation and non-analytical logbook review. It also includes checks of data archiving systems and a search to find and remove any inactive versions of SOPs that may still be present in the laboratory and being accessed by the analysts. Non-conformances are corrected on the spot. Procedural modifications are implemented if the evaluation indicates a systematic defect.

18.5 ***Corrective Action Monitoring***. Defects or non-conformances that are identified during client or internal audits are shared with management and entered into CA

database for attention by the responsible party. Audit findings are corrected through process modifications and/or retraining. Once a corrective action has been designed and implemented, it is monitored for compliance on a regular basis by the QA staff. Monitoring of the corrective action continues until satisfactory implementation has been verified.

18.6 ***Preventive Action.*** Laboratory systems or processes, which may be faulty and pose the potential for nonconformances, errors, confusing reports or difficulties establishing traceability may be identified during internal audits. These items are highlighted for systematic change using the corrective action system and managed to resolution using appropriate procedures for corrective action.

18.7 ***Client Notification.*** Defective processes, systematic errors, and quality defects detected during routine audits may have negative impact on data quality. In some cases, data that has been released to the client may be affected. If defective data has been released for use, Accutest will immediately notify the affected clients of the defect and provide specific details regarding the magnitude of the impact to their data.

18.8 ***Management Reports***. Formal reports of all audit activities are prepared for the management staff. These reports are prepared annually. The report details the status of the Quality System

The formal report also addresses the following topics:

- *the suitability of policies and procedures;*
- *reports from managerial and supervisory personnel;*
- *the outcome of recent internal audits;*
- *corrective and preventive actions;*
- *assessments by external bodies;*
- *the results of interlaboratory comparisons or proficiency tests;*
- *changes in the volume and type of the work;*
- *customer feedback;*
- *complaints;*
- *recommendations for improvement;*
- *other relevant factors, such as quality control activities, resources, and staff training.*

19.0 HEALTH AND SAFETY

Requirement. The company operates a formal health and safety program that complies with the requirements of the Occupational Health and Safety Administration. The program consists of key policies and practices that are essential to safe laboratory operation. All employees are required to receive training on the program elements. Job specific training is conducted to assure safe practices for specific tasks. All employees are required to participate in the program, receive initial and annual training, and comply with the program requirements. All plan and program requirements are detailed in the Health and Safety Program Manual.

19.1 **Policy.** Accutest Laboratories will provide a safe and healthy working environment for its employees and clients while protecting the public and preserving the Company's assets and property. The company will comply with all applicable government regulations pertaining to safety and health in the laboratory and the workplace.

The objective of the Accutest Health and Safety Program is to promote safe work practices that minimize the occurrence of injuries and illness to the staff through proper health and safety training, correct laboratory technique application and the use of engineering controls.

19.2 **Responsibilities.** The Health and Safety Program assists managers, supervisors and non-supervisory employees in control of hazards and risks to minimize the potential for employee and client injuries, damage to client's property and damage or destruction to Accutest's facility.

The Health and Safety Officer is responsible for implementing the Program's elements and updating its contents as necessary. He also conducts periodic audits to monitor compliance and assess the program's effectiveness and is also responsible for creating and administering safety training for all new and existing employees.

The employee is responsible for following all safety rules established for their protection, the protection of others and the proper use of protective devices provided by the Company. The employee is also expected to comply with the requirements of the program at all times. Department Managers and Supervisors are responsible for ensuring the requirements of the Safety Program are practiced daily. The Company President retains the ultimate responsibility for the program design and implementation.

19.3 **Program Elements.** The Accutest Health and Safety Program consists of key program elements that compliment the company's health and safety objective. These elements form the essence of the health and safety policy and assure that the objectives of the program are achieved.

Safety Education and Training and Communication. Training is conducted to increase the staff's awareness of laboratory hazards and their knowledge of the safety

practices and procedures required to protect them from those hazards. It is also used to communicate general safety procedures required for safe operation in a chemical laboratory.

Initial health and safety training for new employees is conducted during orientation. The training focuses on the Accutest Safety and Health Program and includes specific training for the hazards that may be associated with the employees' duties. Training is also conducted for all program elements focusing on general, acceptable, laboratory safety procedures. Targeted training is conducted to address hazards or safety procedures that are specific to individual employee's work assignments. All training activities are documented and archived in individual training folders. A health and safety training inventory is maintained in the training database.

Accutest Laboratories Southeast maintains personnel trained in HAZWOPER, DOT and HazMat operations, as well as respirator certified.

Safety Officer. The safety officer provides the employees with an opportunity to express their views and concerns on safety issues in an environment where those concerns will be addressed to ensure that the interests of the company and the well being of the employee are protected. Safety Officer is entrusted with elevating the level of safety awareness among their peers.

***Hazard Identification and Communication*.** The hazard communication program enables employees to readily identify laboratory hazards and the procedures to protect themselves from those hazards. This program complies with OSHA's Hazard Communication Standard, Title 29 Code of Federal Regulations 1910.1200 that requires the company to adopt and adhere to the following key elements:

- Material Safety Data Sheets (MSDS) and/or Safety Data Sheets (SDS) must be available to any employee wishing to view them,
- The Company must maintain a Hazardous Chemicals Inventory (by location), which is updated on an annual basis,
- Containers are properly labeled,
- All employees must be provided with annual Personal Protection, Hazard Communication and Right to Know training,

Chemical Hygiene Plan. The Chemical Hygiene Plan complies with the requirements of the Occupational Safety and Health Administration's Occupational Exposure to Hazardous Chemicals in the Laboratory Standard, 29 CFR 1910.1450. This plan establishes procedures, identifies safety equipment, personal protective equipment, and work practices that protect employees from the potential health hazards presented by hazardous chemicals in the laboratory if properly used and/or applied.

Emergency Action & Evacuation Plan. The Emergency Action and Evacuation Plan details the procedures used to protect and safeguard Accutest's employees and property during emergencies. Emergencies are defined as fires or explosions, gas leaks, building collapse, hazardous material spills, emergencies that immediately threaten life and health, bomb threats and natural disasters such as floods, hurricanes or tornadoes. The plan identifies and assigns responsibility for executing specific roles in situations requiring emergency action.

Lockout/Tagout Plan. Lockout/tagout procedures have been established to assure that laboratory employees and outside contractors take steps to render equipment inoperable and/or safe before conducting maintenance activities. The plan details the procedures for conducting maintenance on equipment that has the potential to unexpectedly energize, start up, or release energy or can be operated unexpectedly or accidentally resulting in serious injury to employees. The plan ensures that employees performing maintenance render the equipment safe through lock out or tag out procedures.

Personal Protection Policy. Policies have been implemented which detail the personal protection requirements for employees. The policy includes specifications regarding engineering controls, personal protective equipment (PPE), hazardous waste, chemical exposures, working with chemicals and safe work practices. Safety requirements specific to processes or equipment are reviewed with the department supervisor or the Health and Safety Officer before beginning operations.

Emergency Preparedness Plan. This plan identifies the actions to be taken by Accutest Laboratory's staff in the event of terrorism or terrorist actions, to ensure the safety of the employees and the facility. The plan describes the building security actions coinciding with the "Alert Condition", designated by the Department of Homeland Security.

Appendix I

Glossary of Terms

GLOSSARY OF TERMS

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents.

Accreditation: the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyst: the designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis.

Audit: a systematic evaluation to determine the conformance to quantitative *and qualitative* specifications of some operational function or activity.

Batch: environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same quality-system matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples.

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.

Blind Sample: a sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.

Case Narrative: a statement of non-conformances associated with particular data report

Calibration: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements.

Calibration Curve: the mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.

Calibration Method: a defined technical procedure for performing a calibration.

Calibration Standard: a substance or reference material used to calibrate an instrument.

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body.

Chain of Custody: an unbroken trail of accountability that ensures the physical security of samples and includes the signatures of all who handle the samples.

Clean Air Act: the enabling legislation in 42 U.S.C. 7401 *et seq.*, Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and to enforce them.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund): the enabling legislation in 42 U.S.C. 9601-9675 *et seq*., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601*et seq.*, to eliminate the health and environmental threats posed by hazardous waste sites.

Confirmation: verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors or, additional cleanup procedures.

Conformance: an affirmative indication or judgement that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements.

Corrective Action: the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence.

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form.

Demonstration of Capability: a procedure to establish the ability of the analyst to generate acceptable accuracy.

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.

Duplicate Analyses: the analyses or measurements of the variable of interest performed identically on two sub-samples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory.

Federal Water Pollution Control Act (Clean Water Act, CWA): the enabling legislation under 33 U.S.C. 1251 *et seq.*, Public Law 92-50086 Stat. 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance.

Field of Testing: TNI's approach to accrediting laboratories by program, method and analyte. Laboratories requesting accreditation for a program-method-analyte combination or for an up-dated/improved method are required submit to only that portion of the accreditation process not previously addressed (see TNI, section 1.9ff).

Holding Times (Maximum Allowable Holding Times) the maximum times that samples may be held prior to analysis and still be considered valid or not compromised.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes from a source independent of the calibration standards or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

Matrix (or Quality System Matrix): the component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated a potable or potential potable water source. Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake. Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue, Biota: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device.

Matrix Spike (spiked sample or fortified sample): a sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of Target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): a second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest, which is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

National Institute of Standards and Technology (NIST): an agency of the US Department of Commerce's Technology Administration that is working with EPA, States, TNI, and other public and commercial entities to establish a system under which private sector companies and interested States can be accredited by NIST to provide NIST-traceable proficiency testing (PT) to those laboratories testing drinking water and wastewater.

The NELAC institute (TNI): a voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories.

TNI Standards: the plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the The NELAC Institute.

Performance Audit: the routine comparison of independently obtained *qualitative and quantitative* measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

Preservation: refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

PT Fields of Testing: TNI's approach to offering proficiency testing by regulatory or environmental program, matrix type, and analyte.

Proficiency Testing: a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source.

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria.

Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence.

Quality Control: the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users.

Quality Manual: a document stating the management policies, objectives, principles, oganizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users.

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC.

Quantitation Limits: the maximum or minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be quantified with the confidence level required by the data user.

Range: the difference between the minimum and the maximum of a set of values.

Raw Data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.

Reagent Blank (method reagent blank or method blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps.

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

Replicate Analyses: the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval.

Requirement: denotes a mandatory specification; often designated by the term “shall”.

Resource Conservation and Recovery Act (RCRA): the enabling legislation under 42 USC 321 *et seq.* (1976), that gives EPA the authority to control hazardous waste from the “Cradle-to-grave”, including its generation, transportation, treatment, storage, and disposal.

Safe Drinking Water Act (SDWA): the enabling legislation, 42 USC 300f *et seq.* (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations.

Sample Duplicate: two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method including sampling and analysis.

Spike: a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: the document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of TNI and meets the approval requirements of TNI procedures and policies.

Toxic Substances Control Act (TSCA): the enabling legislation in 15 USC 2601 *et seq.*, (1976), that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture.

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.

United States Environmental Protection Agency (EPA): the federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends.

Validation: the process of substantiating specified performance criteria.

Verification: confirmation by examination and provision of evidence that specified requirements have been met.
NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Appendix II

Analytical Capabilities

TNI-Accredited Fields of Testing

Method Type	Method Number	Regulatory Program
Organics		
EDB and DBCP	EPA 504.1	Drinking Water
1,4-Dioxane	EPA 522	Drinking Water
Metals		
ICP: General	EPA 200.7, 1994	Drinking Water
Cold Vapor Mercury	EPA 245.1, 1994	Drinking Water
Inorganic WetChem		
Perchlorate by Ion Chromatography	EPA 314.0	Drinking Water
Organics		
EDB and DBCP	EPA 504, SW846 8011**	Non-Potable Water
Volatile Organics	EPA 624, SW846 8260B**	Non-Potable Water
Semi-Volatile Organics	EPA 625, SW846 8270D**	Non-Potable Water
Semi-Volatile Organics	SW846 8270D SIM**	Non-Potable Water
Purgeable Aromatics	EPA 602, SW846 8021A**	Non-Potable Water
Chlorinated Pesticides & PCBs	EPA 608, SW846 8081B**, 8082A**	Non-Potable Water
Poly-Aromatic Hydrocarbons	EPA 610, SW846 8310**	Non-Potable Water
Nitroaromatics	SW846 8091**	Non-Potable Water
Explosives	SW846 8330A**, 8332**	Non-Potable Water
Explosives	SW846 8330B**,	Non-Potable Water
Chlorinated Herbicides	SW846 8151A**	Non-Potable Water
Organophosphorus Pesticides	SW846 8141B**	Non-Potable Water
Perchlorate	SW-846 6850	Non-Potable Water
Dissolved Gases	RSK SOP 147-175**	Non-Potable Water
Alcohols	SW846 8015C,D**	Non-Potable Water
Gasoline Range Organics	SW846 8015C,D**	Non-Potable Water
Diesel Range Organics	SW846 8015C,D**	Non-Potable Water
Total Petroleum Hydrocarbons	FLPRO**	Non-Potable Water
Tennessee EPH	TN-EPH**	Non-Potable Water
Tennessee GRO	TN-GRO**	Non-Potable Water
Wisconsin DRO	WI-DRO**	Non-Potable Water
Petroleum Hydrocarbons	Iowa OA-1**	Non-Potable Water
Petroleum Hydrocarbons	Iowa OA-2**	Non-Potable Water
Volatile Petro. Hydrocarbons	Massachusetts VPH, 2004**	Non-Potable Water

Method Type	Method Number	Regulatory Program
Extractable Petro. Hydrocarbons	Massachusetts EPH, 1998**	Non-Potable Water
Total Petroleum Hydrocarbons	TX-1005**	Non-Potable Water
Acrylamide	SW846 8316	Non-Potable Water
Metals		
ICP: General – EPA WW	EPA 200.7, 1994; SW-846 6010C**	Non-Potable Water
Cold Vapor Mercury – EPA WW	EPA 245.1, 1994; SW-846 7470A**	Non-Potable Water
Inorganic WetChem		
Alkalinity	SM2320B**	Non-Potable Water
CBOD	SM 5210B	Non-Potable Water
COD	SM5220C	Non-Potable Water
BOD	SM5210B	Non-Potable Water
Color, Apparent	SM2120B	Non-Potable Water
Ion Chromatography (Bromide, Fluoride, Chloride, Sulfate, Nitrite, Nitrate,) – Aqueous	EPA 300.0**, SW846 9056A**	Non-Potable Water
Nitrate/Nitrite	EPA 353.2**	Non-Potable Water
Total Kjeldahl Nitrogen	EPA 351.2**	Non-Potable Water
Ammonia	EPA 350.1**	Non-Potable Water
Oil & Grease, Gravimetric – AQ	EPA 1664A**, SW846 9070A**	Non-Potable Water
Orthophosphate	EPA 365.3**	Non-Potable Water
Nitrate	SM 4500NO2-B	Non-Potable Water
pH by electrode (Waters)	SM4500H+B**; SW846 9040C**	Non-Potable Water
Specific Conductance	EPA 120.1	Non-Potable Water
Nitrate-Nitrite	SM 4500 NO3-E	Non-Potable Water
Sulfide	SM4500S=F**	Non-Potable Water
Chloride	SM 4500 Cl-B	Non-Potable Water
Total Dissolved Solids	SM2540C**	Non-Potable Water
Total Organic Carbon	SM5310B**, SW846 9060A**	Non-Potable Water
Total Phosphorus	EPA 365.3	Non-Potable Water
Total Solids	SM2540B**	Non-Potable Water
Total Suspended Solids	SM2540D**	Non-Potable Water
Turbidity	EPA 180.1	Non-Potable Water
Total CN	EPA 335.4, SW846 9012B**	Non-Potable Water
Un-Ionized Ammonia - calculation	FDE SOP10/03/83	Non-Potable Water
Perchlorate	EPA 314	Non-Potable Water
Calcium Hardness by Calculation	SM18 2340B	Non-Potable Water
Hardness, Total by Calculation	SM18 2340B	Non-Potable Water
MBAS (Anionic Surfactants as)	SM5540C	Non-Potable Water

Method Type	Method Number	Regulatory Program
Corrosivity & pH – aqueous	SW846 9040C**	Non-Potable Water
Hexavalent Chromium	SW846 7196A**	Non-Potable Water
Organics		
EDB and DBCP	SW846 8011 Mod**	Solid and Chemical Material
Volatile Organics	SW846 8260B**	Solid and Chemical Material
Semi-Volatile Organics	SW846 8270D**	Solid and Chemical Material
Semi-Volatile Organics	SW846 8270D SIM**	Solid and Chemical Material
Gasoline Range Organics	SW846 8015C,D**	Solid and Chemical Material
Diesel Range Organics	SW846 8015C,D**	Solid and Chemical Material
Alcohols	SW846 8015C,D**	Solid and Chemical Material
Polynuclear-Aromatic Hydrocarbons	SW846 8310**	Solid and Chemical Material
Explosives	SW846 8330A**, 8332**	Solid and Chemical Material
Explosives	SW846 8330B**	Solid and Chemical Material
Organochlorine Pesticides	SW846 8081B**	Solid and Chemical Material
Polychlorinated Biphenyls	SW846 8082A**	Solid and Chemical Material
Chlorinated Herbicides	SW846 8151A**	Solid and Chemical Material
Organophosphorus Pesticides	SW846 8141B**	Solid and Chemical Material
Perchlorate	SW-846 6850	Solid and Chemical Material
Total Petroleum Hydrocarbons	FLPRO**	Solid and Chemical Material
Tennessee EPH	TN-EPH**	Solid and Chemical Material
Tennessee GRO	TN-GRO**	Solid and Chemical Material
Wisconsin DRO	WI-DRO**	Solid and Chemical Material
Petroleum Hydrocarbons	Iowa OA-1**	Solid and Chemical

Method Type	Method Number	Regulatory Program
		Material
Petroleum Hydrocarbons	Iowa OA-2**	Solid and Chemical Material
Volatile Petro. Hydrocarbons	Massachusetts VPH, 2004**	Solid and Chemical Material
Extractable Petro. Hydrocarbons	Massachusetts EPH, 1998**	Solid and Chemical Material
Total Petroleum Hydrocarbons	TX-1005**	Solid and Chemical Material
Acrylamide	SW846 8316	Solid and Chemical Material
Metals		
ICP: General – EPA WW	SW846 6010C**	Solid and Chemical Material
Cold Vapor Mercury – EPA DW	SW846 7471B**	Solid and Chemical Material
Inorganic WetChem		
Ion Chromatography (Bromide, Fluoride, Chloride, Sulfate, Nitrite, Nitrate,) – Aqueous	SW846 9056A**	Solid and Chemical Material
Oil & Grease, Gravimetric – Solid	SW846 9071A**	Solid and Chemical Material
Total CN	SW846 9012B**	Solid and Chemical Material
Total Organic Carbon	SW846 9060A**	Solid and Chemical Material
Ammonia	EPA 350.1	Solid and Chemical Material
Total Kjeldahl Nitrogen	EPA 351.2	Solid and Chemical Material
Total Phosphorus	EPA 365.3	Solid and Chemical Material
Waste Ignitability	SW846 1010A**	Solid and Chemical Material
Hexavalent Chromium/soils	SW846 7196A**	Solid and Chemical Material
Corrosivity & pH – aqueous	SW846 9040C**	Solid and Chemical Material
Corrosivity & pH – solid	SW846 9045D**	Solid and Chemical Material

Method Type	Method Number	Regulatory Program
Cyanide Reactivity	SW846 Chapter 7**	Solid and Chemical Material
Sulfide Reactivity	SW846 Chapter 7**	Solid and Chemical Material
Organics		
Volatile Organics	TO-3	Air and Emissions
Preparation Methods*		
Liquid/Liquid Extraction, Water	SW846 3510C	
Solid Phase Extraction, Water	SW846 3535A	
Solids Extraction by Sonication	SW846 3550B	
Microwave-assisted extraction, solids	SW846 3546	
Acid/Base Partitioning	SW846 3650B	
Sulfur Cleanup of Extracts	SW846 3660B	
Sulfuric Acid Cleanup	SW846 3665A	
Purge & Trap - Aqueous	SW846 5030B	
Purge & Trap – Solids	SW846 5035A	
Total Recoverable Metals Digestion	EPA 200.7	
Non-Pot. Water Digest: ICP	SW846 3010A	
Alkaline Digestion of Soils for Hexavalent Chromium	SW846 3060A	
Digestion of Soils for ICP	SW846 3050B	
TCLP	SW846 1311	
SPLP	SW846 1312	

* Preparation methods are not listed on Primary TNI Accreditation per State of Florida DOH rules. However, for the benefit of other accrediting authorities, these methods are inspected during FDOH visits. Listing of surveyed and approved preparation methods is available from on-site inspection report.
** Methods certified by DoD ELAP

Non-TNI-Accredited Fields of Testing

Method Type	Method Number	Regulatory Program
Organics		
Thiodiglycol	Accutest in-house method (HPLC)	Solid and Chemical Material
N-Nitroso-N-Ethylurea	Accutest in-house method (HPLC)	Solid and Chemical Material
Volatile Petroleum Hydrocarbons	Missouri Gasoline Range Organics	Solid and Chemical Material
Extractable Hydrocarbons	Missouri Diesel Range Organics	Solid and Chemical Material
Extractable Hydrocarbons	Missouri Oil Range Organic	Solid and Chemical Material
Volatile Petroleum Hydrocarbons	Alaska AK-101**	Solid and Chemical Material
Extractable Hydrocarbons	Alaska AK-102**	Solid and Chemical Material
Extractable Hydrocarbons	Alaska AK-103**	Solid and Chemical Material
Volatile Petroleum Hydrocarbons	OK GRO**	Solid and Chemical Material
Extractable Hydrocarbons	OK DRO**	Solid and Chemical Material
Inorganic WetChem		
Oxidation-Reduction Potential	ASTM D1498-76, mod. for solids	Solid and Chemical Material
Percent Ash (dry basis)	ASTM D2974-87, D482-91	Solid and Chemical Material
Grain Size (hydrometer)	ASTM D422-63	Solid and Chemical Material
Sieve Testing	ASTM D422-63	Solid and Chemical Material
Specific Gravity	ASTM D1298-85	Solid and Chemical Material
Acidity	SM2310B	Non-Potable Water
Dissolved Oxygen	EPA 360.1	Non-Potable Water
Mineral Suspended Solids	EPA 160.2/160.4	Non-Potable Water
Organophosphonic Acids	Accutest in-house method (IC)	Solid and Chemical Material

Method Type	Method Number	Regulatory Program
Perchlorate	EPA 314MOD	Solid and Chemical Material
Percent Solids	SM19 2540G	Solid and Chemical Material
Settleable Solids	EPA 160.5	Non-Potable Water
Total Mineral Solids	EPA 160.4	Non-Potable Water
Total Residual Chlorine	EPA 330.5	Non-Potable Water
Total Volatile Solids	EPA 160.4	Non-Potable Water
Volatile Suspended Solids	EPA 160.2/160.4	Non-Potable Water
CÑ Amenable to Chlorination	EPA 335.4	Solid and Chemical Material
Bicarbonate, Carbonate, CO2 - calculation	SM19 4500 CO2D	Non-Potable Water
Ferrous Iron	SM19 3500 FE-D	Non-Potable Water
Salinity - calculation	SM19 2520B	Non-Potable Water
Paint Filter Test	SW846 9095	Solid and Chemical Material
Corrosivity towards steel	SW846 1110	Solid and Chemical Material
Corrosivity & pH – aqueous	SW846 9040C	Solid and Chemical Material

Appendix III

Equipment List

ORGANIC INSTRUMENTATION

Instrument	Model	Location	Serial #	Year
GC/MS	Agilent 5975C MSD/OI 4551/4660	MS-VOA	US11172705	2011
GC/MS	Agilent 5975C MSD/OI 4551/4660	MS-VOA	US11322911	2011
GC/MS	Agilent 5975C MSD/OI 4551/4660	MS-VOA	US10102029	2010
GC/MS	Agilent 5975C MSD/OI 4551/4660	MS-VOA	US83120965	2008
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US71225975	2007
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US62724401	2006
GC/MS	Agilent 5975N MSD/Agilent 7683 AS	SVOC Lab	US53921303	2005
GC/MS	Agilent 5973N MSD/Agilent 7683 AS	SVOC Lab	US40620599	2004
GC/MS	Agilent 5973 MSD/OI 4660/4552 Archon	MS-VOA	US41746628	2004
GC/MS	Agilent 5973 MSD/OI 4660/4552 Archon	MS-VOA	US41746633	2004
GC/MS	Agilent 5973 MSD/OI 4560/4552 Archon	Soil VOA	US21843765	2002
GC/MS	Agilent 5973 MSD/OI 4551/4660	MS-VOA	US21844034	2002
GC/MS	Agilent 5973 MSD/OI 4660/4552 Archon	MS-VOA	US02440350	2000
GC/MS	Agilent 5973 MSD/OI 4560/4552 Archon	MS-VOA	US94240108	1999
GC/MS	Agilent 5973 MSD/Agilent 7683 AS	SVOC Lab	US82311290	1998
GC/MS	Agilent 5973 MSD/Agilent 7683 AS	SVOC Lab	US81211109	1998
GC/MS	Hewlett-Packard 5970 MSD/OI 4560/4552 Archon	Soil VOA	3034A12782	1989
GC/MS	Hewlett-Packard 5970 MSD/OI 4560/4552 Archon	Soil VOA	2905A11904	1987
GC/MS	Hewlett-Packard 5970 MSD/OI 4560/4552 Archon	Soil VOA	2716A10454	1987
GC	Agilent 7890A/Dual ECD/7683B AS	SVOC Lab	CN10842133	2008
GC	Agilent 7890A/Dual FID/7683B AS	SVOC Lab	CN10902149	2009
GC	Agilent 7890A/Dual FID/7683B AS	SVOC Lab	CN10716029	2009
GC	Agilent 7890A/Dual ECD/7683B AS	SVOC Lab	CN10741128	2007

Instrument	Model	Location	Serial #	Year
GC	Agilent 6890/Dual FPD/7683B AS	SVOC Lab	US10643024	2006
GC	Agilent 6890/Dual FID/7683B AS	SVOC Lab	CN10641049	2006
GC	Agilent 6890/Dual ECD/7683B AS	SVOC Lab	CN10641081	2006
GC	Agilent 6890/Dual ECD/7683B AS	SVOC Lab	US10613003	2006
GC	Agilent 6890/PID/PID/OI 4560/4552 Archon	GC VOA	CN10421047	2004
GC	Agilent 6890/PID/FID/ENTECH 7032A-LB	GC VOA	US10239007	2002
GC	Agilent 6890N/Dual FID/HP 7683 AS	SVOC Lab	CN10425061	2004
GC	Agilent 6890N/Dual ECD/HP 7683 AS	SVOC Lab	US10333015	2003
GC	Agilent 6890/Dual ECD/HP 7683 AS	SVOC Lab	US00036916	2000
GC	Agilent 6890/Dual ECD/HP 7683 AS	SVOC Lab	US00028304	1999
GC	Hewlett-Packard 5890/PID/FID/ OI 4560/4552 Archon	GC VOA	3336A60617	1993
GC	Hewlett-Packard 5890/Dual FID/HP 7673 AS	SVOC Lab	3336A59489	1993
GC	Hewlett-Packard 5890/PID/FID/ OI 4560/4552 Archon	GC VOA	3336A51045	1993
GC	Hewlett-Packard 5890/PID/FID/OI 4560/4552 Archon	GC VOA	3203A41646	1992
GC	Hewlett-Packard 5890/PID/FID/OI 4560/4552 Archon (screening instrument)	GC VOA	3223A4267	1992
GC	Hewlett-Packard 5890/Dual FID/HP 7673 AS	SVOC Lab	3126A51085	1991
GC	Hewlett-Packard 5890/PID/FID/ dual MPM 16	Soil VOA	3029A29748	1990
GC	Hewlett-Packard 5890/FID	Soil VOA	2843A20183	1988
GC	Hewlett-Packard 5890/Dual FID	GC VOA	2728A12705	1987
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE91606857	1999
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE23917648	2002
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE01608404	2000
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE40522115	2004
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE03000863	2003

Instrument	Model	Location	Serial #	Year
HPLC	Agilent 1100 Automated LC System	HPLC Room	DE61800775	2006
O-Prep	ESSA LM2-P Ring and Puck mill	Explosives Prep Lab	215090-004	2008
O-prep	Microwave extractor	Organic Prep Lab	MD3482	2010
O-Prep	TurboVap 4 units	Organic Prep Lab		2001
O-Prep	TurboVap 3 units	Organic Prep Lab		2004
O-Prep	TurboVap 1 unit	Organic Prep Lab		2007
O-Prep	Sonicator 2 units	Organic Prep Lab		2004
O-Prep	Sonicator 3 units	Organic Prep Lab		2007
O-Prep	Midi-Vap 2000 Kontes	Organic Prep Lab	479200-2000	2000
Data System	Hewlett-Packard/MS ChemStation	Labwide		1999, with subsequent upgrades

Inorganic Instrumentation

Instrument	Model	Location	Serial #	Year
ICP	Thermo ICAP 6000 Series	Metals Lab	20100903	2010
ICP	Thermo ICAP 6000 Series	Metals Lab	20103825	2010
Mercury Analyzer	Leeman Hydra AA	Metals Lab	HA-2022	2002
Mercury Analyzer	Leeman Hydra AA II	Metals Lab	2004	2012
TOC Analyzer	Shimadzu	WetChem IC room	H51404235007	2004
TOC Analyzer	Shimadzu	WetChem IC room	H51404735099	2010
IC	Dionex IC-2100	WetChem IC room	10110002	2010
IC	Dionex IC-2000	WetChem IC room	04070250	2004
Auto Analyzer	QuickChem 8500 Series	WetChem main room	050500000130	2005
Auto Analyzer	QuickChem 8500 Series 2	WetChem main room	111200001380	2011
Spectrophotometer	Milton-Roy Spectronic 200	WetChem main room	2 units	2000
Digestion block	DigiPrep	WetChem main room	4 units	2005

Centrifuge	CentraCL2	WetChem main room	42613052	2003
MicroDistillation Block	Lachat	WetChem main room	2 units	2005

LIMS		
Instrument	**Model**	**Year**
LIMS	HP True 64	1999

Appendix IV

Certification Summary

Certifying Authority	**Certification Program**	**Registration No.**
Alaska	Contaminated Sites	UST-088
Arkansas	Solid/Hazardous Wastes, Non-Potable Water	88-0620
California (NELAP)	Potable Water, Solid/Hazardous Waste	04226CA
Department of Defense (DoD)	Non-Potable Water, Solid and Chemical Materials	L-2229
Florida (NELAP)	Potable, Non-Potable, Solid Waste, UST, Air Toxics	E83510
Georgia	Solid/Hazardous Wastes	Not Applicable
Illinois	Solid/Hazardous Wastes, Non-Potable Water	
Iowa	UST, Solid/Hazardous Wastes, Non-Potable Water	IA366
Kansas (NELAP)	Solid/Hazardous Wastes, Non-Potable Water	E-10327
Kentucky	Underground Storage Tank Program	0065
Louisiana (NELAP)	Solid/Hazardous Wastes	38582
Massachusetts	Non-Potable Water	M-FL946
Mississippi	Potable Water	Not Applicable
Nevada	Non-Potable Water, Solid/Hazardous Wastes	FL009462008A
New Jersey (NELAP)	Solid/Hazardous Wastes, Non-Potable Water	FL002
North Carolina	Solid/Hazardous Wastes, Non-Potable Water	573
Oklahoma	Non-Potable Water, Solid/Hazardous Waste	9959
South Carolina	Solid/Hazardous Wastes, Non-Potable Water	96038001
Texas (NELAP)	Non-Potable Water, Solid/Hazardous Waste	T104704040-08-TX
US Dept. of Agriculture	Foreign Soils Permit	S-56027
Utah (NELAP)	Potable, Non-Potable, Solid/Chemical Materials	FL009462008A
Virginia (NELAP)	Potable, Non-Potable, Solid/Chemical Materials	460177
Washington	Potable, Non-Potable, Solid/Chemical Materials, Air	C2046
Wisconsin	Solid/Hazardous Wastes, Non-Potable Water	399043370

Appendix V

SOP List

SOP #	TITLE
	Organic Preparation Department
OP002	SOP for Glassware Cleaning and Storage
OP003	SOP for Reagent Prep
OP006	SOP for the Extraction of Semi-volatile Organics (BNAs) from Aqueous Samples
OP007	SOP for the Extraction of Semi-volatile Organics (BNAs) from Solid Samples
OP008	SOP for the Extraction of Pesticides/PCBs from Aqueous Samples
OP009	SOP for the Extraction of Pesticides/PCBs from Solid Samples
OP009MW	SOP for the Extraction of Pesticides/PCBs from Solid Samples, microwave
OP010	SOP for the Extraction of Diesel Range Organics (DRO) from Aqueous Samples
OP011	SOP for the Extraction of Diesel Range Organics (DRO) from Solid Samples
OP011MW	SOP for the Extraction of Diesel Range Organics (DRO) from Solid Samples
OP012	SOP for the Extraction of Petroleum Related Organics (FL-PRO) from Aqueous Samples
OP013	SOP for the Extraction of Petroleum Related Organics (FL-PRO) from Solid Samples
OP014	SOP for the Extraction of PAHs from Aqueous Samples (HPLC)
OP015	SOP for the Extraction of PAHs from Solid Samples (HPLC)
OP016	SOP for the Extraction of EDB/DBCP from Aqueous Samples
OP017	SOP for the Extraction of EDB/DBCP from Solid Samples
OP018	SOP for the Extraction of Explosives from Aqueous Samples
OP019	SOP for the Extraction of Explosives from Solid Samples
OP020	SOP for Sample Introduction via SW846-5035
OP021	SOP for Sample Introduction via SW846-5030B
OP022	SOP For The Extraction Of Nitroglycerine And Pentaerythritoltetranitrate (PETN) From Water Samples (HPLC Analysis)
OP023	SOP For The Extraction Of Nitroglycerine And Pentaerythritoltetranitrate (PETN) From Solid Samples (HPLC Analysis)
OP024	Standard Operating Procedure For The Extraction Of Nitroaromatics From Water Samples
OP025	SOP For Sample Preparation For Dissolved Gases In Aqueous Samples
OP026	SOP For The Extraction Of Extractable Petroleum Products (OA-2) From Water Samples
OP027	SOP For The Extraction Of Extractable Petroleum Products (OA-2) From Solid Samples
OP028	SOP For The Extraction Of Diesel And Oil Range Organics From Water Samples
OP029	SOP For The Extraction Of Diesel And Oil Range Organics From Solid Samples
OP030	SOP For The Extraction Of Extractable Petroleum Hydrocarbons From

SOP #	TITLE
	Water Samples (Tennessee EPH)
OP031	SOP For The Extraction Of Extractable Petroleum Hydrocarbons From Solid Samples (Tennessee EPH)
OP032	SOP For The Extraction Of Volatile Petroleum Hydrocarbons From Soil Samples, MA-VPH
OP033	SOP For The Extraction Of PCBs From Wipes
OP034	SOP For The Extraction Of Diesel Range Organics (DRO) From Aqueous Samples WI-DRO
OP035	SOP For The Extraction Of Massachusetts Extractable Petroleum Hydrocarbons From Water Samples
OP036	SOP For The Extraction Of Massachusetts Extractable Petroleum Hydrocarbons From Solid Samples
OP037	SOP For The Extraction Of Chlorinated Herbicides From Water Samples
OP038	SOP For The Extraction Of Chlorinated Herbicides From Soil Samples
OP038MW	SOP For The Extraction Of Chlorinated Herbicides From Soil Samples, microwave
OP039	SOP For The Solid Phase Extraction (SPE) Cartridge Cleanup Of Pesticide Extracts
OP040	SOP For SPLP Leaching Of SVOC And Metals
OP041	SOP For TCLP Leaching Of VOC
OP042	SOP For SPLP Leaching Of SVOC And Metals
OP043	SOP For SPLP Leaching Of VOC
OP044	SOP For The Extraction Of Organophosphorus Pesticides From Water Samples
OP044SP	SOP For The Extraction Of Organophosphorus Pesticides From Water Samples, Solid Phase Extraction
OP045	SOP For The Extraction Of Organophosphorus Pesticides From Soil Samples
OP045MW	SOP For The Extraction Of Organophosphorus Pesticides From Soil Samples, microwave
OP046	SOP for the Extraction of Explosives from Solid Samples, SW-8330B
OP047	SOP for the Extraction of Explosives from Aqueous Samples, SW-8330B
OP048	SOP for the Extraction of PCB Congeners from Aqueous Samples
OP049	SOP for the Extraction of PCB Congeners from Solid Samples
OP050	SOP For The Extraction Of Alaska Extractable Petroleum Hydrocarbons From Water Samples
OP051	SOP For The Extraction Of Alaska Extractable Petroleum Hydrocarbons From Solid Samples
OP052	SOP For The Extraction Of Oklahoma Extractable Petroleum Hydrocarbons From Water Samples
OP053	SOP For The Extraction Of Oklahoma Extractable Petroleum Hydrocarbons From Solid Samples
OP054	SOP For The Extraction Of 1,4-Dioxane From Water Samples
OP055	SOP For The Extraction Of Petroleum Hydrocarbons From Water Samples,

SOP #	TITLE
	TX-1005
OP056	SOP For The Extraction Of Petroleum Hydrocarbons From Solid Samples, TX-1005
OP057	SOP for Sample Introduction via AK-101

Gas Chromatography/ HPLC SOPs

GC002	Analysis Of 1,2-Dibromoethane (EDB) And 1,2-Dibromo-3-Chloropropane (DBCP) By Gas Chromatography, Electron Capture Detector
GC004	Aromatic Volatiles By Gas Chromatography Using PID Detectors EPA 602
GC005	Analysis Of Organochlorine Pesticides By Gas Chromatography, Electron Capture Detector EPA 608
GC006	Analysis Of Polychlorinated Biphenyls By Gas Chromatography, Electron Capture Detector EPA 608
GC007	Analysis Of Polynuclear Aromatic Hydrocarbons By Gas Chromatography, Flame Ionization Detector EPA 610
GC008	Analysis Of Petroleum Range Organics By Gas Chromatography Using Flame Ionization Detector
GC009	Analysis Of 1,2-Dibromoethane (EDB) And 1,2-Dibromo-3-Chloropropane (DBCP) By Gas Chromatography, Electron Capture Detector SW-846 8011
GC010	Analysis Of Gasoline Range Organics By Gas Chromatography Using Flame Ionization Detector
GC011	Analysis Of Diesel Range Organics By Gas Chromatography Using Flame Ionization Detector
GC014	Analysis Of Polychlorinated Biphenyls By Gas Chromatography, Electron Capture Detector SW-846 8082
GC015	Analysis Of Organochlorine Pesticides By Gas Chromatography, Electron Capture Detector SW-846 8081
GC016	Analysis Of Nitroaromatics And Nitramines By HPLC
GC017	Aromatic Volatiles By Gas Chromatography Using PID Detectors SW-8021
GC018	Analysis Of Polynuclear Aromatic Hydrocarbons By HPLC SW-846 8310
GC019	Analysis Of Dissolved Gases By Gas Chromatography, Flame Ionization Detector
GC020	Analysis Of Nitroglycerine And PETN By HPLC
GC021	Analysis Of Volatile Petroleum Hydrocarbons By Gas Chromatography
GC022	Analysis Of Extractable Petroleum Products By Gas Chromatography Using Flame Ionization Detector OA-2
GC023	Analysis Of Diesel And Oil Range Organics By Gas Chromatography Using Flame Ionization Detector
GC024	Analysis Of Petroleum Hydrocarbons By Gas Chromatography Using Flame Ionization Detector (Tennessee EPH)
GC025	Analysis Of Nitroaromatics By Gas Chromatography Using Electron Capture Detector
GC026	Method For Determination Of Volatile Petroleum Hydrocarbons By GC-

SOP #	TITLE
	PID/FID
GC027	Analysis Of Non-Halogenated Organics By Gas Chromatography Using Flame Ionization Detector
GC028	Analysis Of Gasoline Range Organics By Gas Chromatography Using Flame Ionization Detector TDEC GRO
GC029	Analysis Of Diesel Range Organics By Gas Chromatography Using Flame Ionization Detector Wi DRO
GC030	Analysis Of Extractable Petroleum Hydrocarbons By Gas Chromatography Using Flame Ionization Detector MA-EPH
GC031	Analysis Of Chlorinated Herbicides Using GC-ECD
GC032	Analysis Of Organophosphorus Pesticides Using GC-NPD Or FPD
GC033	Air Analysis By GC-PID/FID
GC034	Analysis Of Nitroaromatics, Nitramines And Nitrate Esters By HPLC Method 8330b
GC035	Screening Of Volatile Organics By GC-PID/FID
GC036	Analysis of PCB Congeners by ECD
GC037	Analysis of Diesel and Oil Range Organics by GC/FID, AK-102, AK-103
GC038	Analysis of Gasoline Range Organics by GC/FID, AK-101
GC039	Analysis of Diesel Range Organics by GC/FID, OK-GRO
GC040	Analysis of Gasoline Range Organics by GC/FID, OK-GRO
GC041	Analysis of N-Nitroso-N-Ethylurea by HPLC
GC042	Analysis of Thiodiglycol by HPLC
GC043	Analysis of Acrylamide by HPLC
GC044	Analysis of Petroleum Organics by TX-1005

Mass-Spectrometry SOPs

MS003	Analysis of Volatile Organics by EPA Method 624
MS004	Analysis of Semi-volatile Organics by EPA Method 625
MS005	Analysis of Volatile Organics by EPA Method 8260B
MS006	Analysis of Semi-volatile Organics by EPA Method 8270C
MS008	Analysis of Semi-volatile Organics by EPA Method 8270C SIM
MS009	Analysis of Volatile Organics by GC/MS
MS010	Analysis of Volatile Organics by GC/MS SIM
MS011	Analysis of Semi-volatile Organics by EPA Method 8270D
MS012	Analysis of 1,4-Dioxane by EPA 522
MS013	Analysis of Perchlorate by SW-846 6850

Quality Assurance SOPs

QA001	Preparation, Approval, Distribution & Archiving Of Standard Operating Procedures (SOPs)
QA002	Calibration Of Thermometers
QA003	Personnel Training And Analyst Proficiency

SOP #	TITLE
QA004	Temperature Monitoring
QA005	Calibration Of Analytical Balances
QA006	Eppendorf Pipette Calibration
QA007	Sample Batching Procedure
QA008	Creating New Accounts
QA009	Creating New Projects
QA010	Confidentiality Protection Procedures
QA011	Signature Authority
QA012	Employee Technical Ethics Responsibilities
QA013	Client Complaint Resolution Procedure
QA014	Procedures For The Purchase Of Laboratory Supplies
QA015	Procedures For The Preparation, Distribution, Use And Archiving Of Laboratory Logbooks
QA016	Corrective Action Procedure
QA017	Standards Traceability Documentation Procedure
QA018	Procedure For Login, Management, Handling, And Reporting Of Proficiency Test (Pt) Samples
QA019	Quality System Review
QA020	Procedure For Developing Method Performance Criteria And Experimental Method Detection Limits
QA021	Subcontracting Procedures
QA022	Internal Audit Procedure
QA023	Fume Hood Inspection
QA027	Review Of Inorganics Data
QA028	Review Of Organics Data
QA029	Manual Integration Of Chromatographic Peaks
QA030	Procedure For The Development And Use Of in-house Quality Control Criteria
QA031	Air Quality Monitoring Of Extraction Laboratory
QA032	Routine Maintenance For Major Analytical Instrumentation
QA033	Laboratory Safety
QA034	Sample Homogenizing
QA035	Solvent Testing And Approval
QA036	Data Package Generation
QA037	Deionized Water Quality Control Procedure
QA038	Data Integrity Training Procedure
QA039	Data Integrity Monitoring Procedure
QA040	Procedure For Conducting Data Integrity Investigations
QA041	Procedure For The Confidential Reporting Of Data Integrity Issues
QA042	Basic Calculations For General Chemistry Methods
QA043	Data Qualifier SOP
QA044	Calibration Of Micro-Distillation Tubes
QA045	Estimation of Uncertainty
QA046	Document Control

SOP #	TITLE
QA047	Management of Client Project
QA048	Data Entry for Log-In

General Chemistry SOPs

GNSOP: 101	Acidity (pH 8.2)
GNSOP: 102	Alkalinity, Total (pH 4.5)
GNSOP: 103	Ammonia – Distillation Procedure
GNSOP: 104	Nitrogen, Ammonia
GNSOP: 105	Bicarbonate, Carbonate, Free Carbon Dioxide
GNSOP: 106	Chemical Oxygen Demand
GNSOP: 107	Chloride by Titration
GNSOP: 109	Color, Apparent
GNSOP: 110	Chromium, Hexavalent (Water)
GNSOP: 113	Cyanide Distillation/Aqueous And Solid Samples
GNSOP: 115	Cyanide, Total
GNSOP: 116	Dissolved Oxygen
GNSOP: 121	Ignitability
GNSOP: 122	Anionic Surfactants As MBAS
GNSOP: 123	Nitrogen, Nitrite
GNSOP: 126	Ortho Phosphate
GNSOP: 127	Paint Filter Liquids Test
GNSOP: 128	Phenols Distillation, Soil And Water Samples
GNSOP: 130	Phenols, Total Recoverable
GNSOP: 133	Settleable Solids
GNSOP: 134	Total Suspended Solids (Non Filterable Residue)
GNSOP: 135	Total Dissolved Solids (Total Filterable Residue)
GNSOP: 136	Reactive Sulfide And Reactive Cyanide
GNSOP: 137	pH By Electrode - Water
GNSOP: 140	Sulfide
GNSOP: 144	Total Phosphorus
GNSOP: 145	Turbidity
GNSOP: 147	Winkler Titration For DO Standardization
GNSOP: 161	Percent Solids
GNSOP: 163	Specific Conductance At 25 C.
GNSOP: 166	pH By Electrode – Soil
GNSOP: 167	Biochemical Oxygen Demand (BOD)
GNSOP: 171	Hexachromium In Soils
GNSOP: 179	Corrosivity (Soil pH By Electrode)
GNSOP: 182	Total Kjeldahl Nitrogen
GNSOP: 189	Corrosivity Toward Steel
GNSOP: 190	Total Nitrogen, Organic Nitrogen
GNSOP: 191	Nitrogen, Nitrate
GNSOP: 192	Carbonaceous Biochemical Oxygen Demand (CBOD)

SOP #	TITLE
GNSOP: 193	Oxidation-Reduction Potential
GNSOP: 194	Ferrous Iron
GNSOP: 196	Glassware Cleaning
GNSOP: 197	Anions By Ion Chromatography
GNSOP: 211	Oil & Grease And PHC By 1664
GNSOP: 212	Fractional Organic Carbon
GNSOP: 213	Walkley-Black Total Organic Carbon
GNSOP: 214	Particle Size By Sieve
GNSOP: 215	TOC In Water
GNSOP: 216	Particle Size By Hydrometer
GNSOP: 218	Perchlorate
GNSOP: 219	Bulk Density
GNSOP: 222	Un-Ionized Ammonia Calculation
GNSOP: 224	Hardness By Calculation
GNSOP: 225	Cation Exchange Capacity Of Soils (Sodium Acetate)
GNSOP: 226	TOC In Soil
GNSOP: 227	Oil And Grease – Gravimetric Analysis (Soils)
GNSOP: 228	Anions By Ion Chromatography - IC 2000
GNSOP: 229	Determination Of Nitrocellulose In Water
GNSOP: 230	Determination Of Nitrocellulose In Soil
GNSOP: 231	% Ash
GNSOP: 232	Determination Of Nitrate and Nitrite by Lachat

Metals SOPs

MET 100	Metals By Inductively Coupled Plasma
MET 103	Digestion Of Water Samples For Flame And ICP Analysis
MET 104	Digestion Of Soils For ICP Analysis
MET 105	Cold Vapor Analysis Of Mercury For Soils
MET 106	Cold Vapor Analysis Of Mercury For Water Samples

Sample Management SOPs

SAM101	Sample Receipt And Storage
SAM102	Procedure For Sample Bottle Preparation And Shipment
SAM104	Sample Container Quality Control
SAM108	Sample And Laboratory Waste Disposition
SAM109	Foreign Soil receipt and Handling

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STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF NITROAROMATICS AND NITRAMINES (EXPLOSIVES) FROM SOLID SAMPLES FOR HPLC ANALYSIS

Prepared by:	Norm Farmer	Date:	08/26/13
Reviewed by:	Mike Eger	Date:	09/04/13

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TEST NAME: **STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF NITROAROMATICS AND NITRAMINES (EXPLOSIVES) FROM SOLID SAMPLES FOR HPLC ANALYSIS**

Method: SW846 8330A

Dept: OP

Revised Sections: 3.2.1, 6.1, 7.1-7.3, 7.8-7.10, 7.18 and 9.1.6

1.0 Summary, Scope and Application

1.1 Summary

Solid samples are extracted with acetonitrile in a chilled ultrasonic bath. The extracts are filtered and stored in amber glass vials with Teflon lined screw caps.

1.2 Scope and Application

This procedure is applicable to solid samples, including soils and sediments, submitted for Explosives analysis by HPLC method SW-846 8330A. It is not applicable to samples submitted for Explosives analysis by method SW-846 8330B. For samples that require SW-846 8330B, see SOP 046. Samples for 8330A and 8330B can NOT be batched together.

2.0 Discussion and Comments

This procedure is adapted from SW-846 method 8330A. The method outlined in this SOP is designed for low and high concentration samples. Samples expected to contain high levels of explosives should be screened using method 8510 or 8515. If the samples contain more than 2% explosives, they should not be ground by mortar and pestle.

The HPLC detector is extremely sensitive and will respond to many organic compounds. It is important to minimize extraneous contaminants and carryover by scrupulously cleaning all glassware and by using only high purity reagents. Additionally, all extraction items that come in contact with the sample must be made from glass, stainless steel, wood, or Teflon.

3.0 Preservation and Holding Times

3.1 Preservation

3.1.1 Samples shall be collected in glass jars with Teflon lined caps. 250ml jars are recommended for solid samples.

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3.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be refrigerated at ≤ 6°C until analysis.

3.2 Holding Time

3.2.1 Solid samples must be extracted within 14 days of collection. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.

3.2.2 Extracts should be analyzed as soon as possible, but must be analyzed within 40 days of extraction.

4.0 Definitions

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples that are extracted at the same time.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.7 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

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4.8 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.9 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 Reagents

5.1 Acetonitrile – HPLC grade or equivalent

5.2 Methanol – HPLC grade or equivalent

5.3 Calcium Chloride Solution – prepared by dissolving 5 grams of calcium chloride in one liter of HPLC grade water

5.4 Blank Sand – precleaned to remove contaminants

5.5 Explosives **8330** Surrogate Solution – prepared in acetonitrile at a concentration specified by the HPLC analyst. All surrogate solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.6 Explosives **8330** Spike Solution – prepared in acetonitrile at a concentration specified by the HPLC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

6.0 Glassware and Apparatus

6.1 Aluminum weighing dishes

6.2 16ml amber screw top vials with Teflon lined caps

6.3 Spatula – stainless steel, wooden, or Teflon

6.4 0.5ml or 1.0ml syringes

6.5 Mortar and Pestle – Glass or ceramic

6.6 10.0ml graduated pipette or graduated cyinder

6.7 Desiccator or Drying cabinet

6.8 2.0ml amber glass screw cap vials – caps must have Teflon lined septa

6.9 Ultrasonic water bath capable of running continuously

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6.10 Chiller capable of maintaining the ultrasonic bath temperature at less than 20 ^{o}C

6.11 Hi-Lo Thermometer

6.12 Disposable 3.0ml syringes

6.13 0.45um Teflon syringe filters

6.14 Top loading balance – capable of weighing samples to +/- 0.01 grams

7.0 Procedure

7.1 The extraction of all samples must be documented on a "prep sheet". The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the HPLC analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

7.2 Decant any free liquid from the solid sample. Remove any foreign objects such as twigs, rocks, or metal fragments. Thoroughly mix the sample with a wooden spatula. Samples that are tightly packed or contain obvious layers may need to be transferred to a larger container for proper mixing. Refer to SOP QA034 for more information on sample homogenization.

7.3 Transfer 20 to 50 grams of each sample to the appropriately labeled weighing dish. Use a clean spatula for each sample. Record the sample ID and bottle number on the prep sheet.

7.4 Place the samples in the desiccator or drying cabinet, and allow them to dry at room temperature. Samples must not be heated and should not be exposed to direct sunlight. Samples for this method do not need to be dried to a constant weight; they just need to crumble easily.

7.5 Use a ceramic or glass pestle to grind each sample in the weighing dish. If the sample is difficult to breakup, transfer it to a ceramic or glass mortar for additional grinding. Soil samples that are known to contain high concentrations or explosives should not be ground. They may DETONATE.

7.6 Transfer approximately 2.0 grams of each of the samples to the appropriately labeled amber 16ml vials. Be sure to label the vial cap, because the ultrasonic bath may remove any labels from the sides of the vials. Record the weight to the nearest 0.01 gram on the prep sheet.

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7.7 Transfer approximately 2.0 grams of each of the QC samples to the appropriately labeled vials. This includes the method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD). Use 2.0 grams of clean sand for the MB and BS. Use additional 2.0 gram aliquots of a sample for the MS, MSD, and DUP. Record the sample ID, bottle number, and weight on the prep sheet.

7.8 Using the dedicated spike syringe add 0.5ml of spike solution to the BS, MS, and MSD. Record the spike lot number on the prep sheet.

7.9 Using the dedicated surrogate syringe add 0.5ml of surrogate solution to each of the samples including the QC samples. Record the surrogate lot number on the prep sheet.

7.10 Using a graduated pipette or cylinder, add **4.5ml** of acetonitrile to each of the sample vials, the method blank (MB) and sample duplicate (DUP). Add **4.0ml** of acetonitrile to the BS, MS, and MSD. This will result in **5.0ml** of acetonitrile in each of the vials.

7.11 Put the cap on each vial and shake briefly to mix.

7.12 Place the vials in the rack inside the chilled ultrasonic bath.

7.13 Place the Hi-Lo thermometer probe in the bath. Reset the temperature.

7.14 Sonicate the sample for a minimum of 8 hours, but not more than 18 hours.

7.15 After sonication, remove the vials from the bath and allow them to settle for 30 minutes.

7.16 Record the maximum temperature of the bath on the prep sheet. The temperature should not have exceeded 20 ^{o}C. Notify the analyst if this temperature was exceeded.

7.17 Using a disposable 3.0ml syringe, remove 1.0ml of supernatant and combine it with 3.0ml of calcium chloride solution in a 16ml vial. Shake and let stand for 15 minutes. This resultant final volume is equivalent to 20ml.

7.18 Transfer ~3ml of extract to disposable syringe. Attach a Teflon syringe filter to the disposable syringe.

7.19 Filter the extract into an appropriately labeled amber 2.0ml screw cap vial.

CAUTION: WEAR SAFETY GLASSES, THE EXTRACT MAY SPRAY IF THE FILTER CLOGS.

7.20 Store the extracts in the “extract refrigerator” until they are needed for analysis.

8.0 Quality Assurance and Quality Control

8.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. Samples can not be added to the batch after the sonication procedure has started.

8.2 A method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) must be extracted with each new batch of samples.

9.0 Safety and Waste Disposal

9.1 Safety

9.1.1 Safety glasses, gloves and lab coats should be worn when handling samples, standards or solvents.

9.1.2 Avoid grinding samples that may contain high levels of explosives. The grinding action may cause them to DETONATE.

9.1.3 **Hearing protection** must be worn while operating the ultrasonic bath. The high frequency could cause permanent hearing loss.

9.1.4 Avoid touching the ultrasonic bath while it is active. Contact may cause tissue damage.

9.1.5 Avoid touching the chiller probe. Contact may cause tissue damage.

9.1.6 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

9.1.7 Acetonitrile is an inhalation hazard and suspected carcinogen. Use in well ventilated area.

9.2 Waste Disposal

9.2.1 Waste acetonitrile is placed in the “non-chlorinated waste” container.

9.2.2 Extracted soil samples and residual acetonitrile may be poured into the “non-chlorinated waste” container or the entire vial may be lab packed with the “extract waste”.

9.2.3 Waste soil from the homogenizing process should be place in the “soil waste” container. **NOTE:** Waste soil from foreign soils must follow “foreign soil” disposal requirements.

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9.2.4 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining soil samples are transferred to the appropriate drums for disposal.

10.0 References

SW-846 Method 8330A, Rev. 1, 01/98

SW-846 Method 8332, Rev. 0, 12/96

SW-846 Method 8330B, Rev. 2, 10/06

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ANALYSIS OF NITROAROMATICS AND NITRAMINES BY HPLC

Prepared by:	Norm Farmer	Date:	09/07/13
Reviewed by:	Mike Eger	Date:	09/11/13

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TEST NAME: ANALYSIS OF NITROAROMATICS AND NITRAMINES BY HPLC

METHOD REFERENCE: SW846 8330A

DEPT: HPLC

Revised Sections: 6.2, 6.3, 7.1, 7.2.1-7.2.3, 7.3.3, 7.5-7.5.4 and 11.1

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of specific nitroaromatics and nitramines in water and solid matrices utilizing an HPLC equipped with a diode array detector.

1.1.2 The following compounds can be reported by this method:

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	
1,3-Dinitrobenzene	1,3,5-Trinitrobenzene
2,6-Dinitrotoluene	2,4,6-Trinitrotoluene
2,4-Dinitrotoluene	2,4-diamino-6-Nitrotoluene
2-amino-4,6-Dinitrotoluene	2,6-diamino-4-Nitrotoluene
4-amino-2,6-Dinitrotoluene	2-amino-6-Nitrotoluene
Nitrobenzene	2-amino-4-Nitrotoluene
o-Nitrotoluene	4-amino-2-Nitrotoluene
m-Nitrotoluene	2,4-Diaminotoluene
p-Nitrotoluene	2,6-Diaminotoluene
DNX	3,5-Dinitroaniline
MNX	Nitroglycerine
TNX	PETN

*See SOP GC020 for additional information on the analysis of Nitroglycerine and PETN.

1.1.3 The reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. Reporting limits may vary depending on matrix complications and volumes. Reporting limits for this method are in the range of 0.2 to 2.0 ug/l for extracted aqueous samples, 50 ug/l for direct injection aqueous samples, and 200 to 2000 ug/kg for solid samples.

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1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

1.1.5 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.

1.2 Summary

1.2.1 This method is adapted from SW846 Method 8330A and 8332.

1.2.2 Samples are received, stored and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with Accutest SOP OP018 and OP019.

1.2.4 The extracts are analyzed on an HPLC equipped with a diode array detector.

1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in amber glass bottles with Teflon lined caps. One-liter bottles are recommended for aqueous samples and 300ml jars are recommended for solid samples.

2.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be stored at ≤ 6°C until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 7 days of collection.

2.2.2 Solid and waste samples must be extracted within 14 days of collection.

2.2.3 Extracts should be analyzed as soon as possible, but must be analyzed within 40 days of extraction.

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3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences.

3.2 Method interferences may be caused by contaminants in solvents, reagents, or glassware. All of these materials must be demonstrated to be free from interferences.

3.3 Tetryl decomposes rapidly in methanol/water solutions, as well as with heat. All aqueous samples expected to contain tetryl should be diluted with acetonitrile prior to filtration and acidified to pH < 3. Samples and extracts should not be exposed to temperatures above room temperature.

3.4 Nitroglycerine and PETN may co-elute with various analytes on the C-18 and RP columns. It may be best to analyze these compounds separately. See SOP GC020 for additional information on the analysis of Nitroglycerine and PETN.

3.5 High levels of 4-amino-2-nitrotoluene may interfere with the surrogate 3,4-dinitrotoluene on the (Zorbax Extend C-18) primary column. In such instances, the surrogate recovery should be calculated from the confirmation column.

3.6 When analyzing the RDX breakdown analytes, TNX may partially coelute with HMX on the primary column and DNX may partially coelute with HMX on the confirmation columns.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

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4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.12 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

5.1 Water – HPLC grade or equivalent

5.2 Acetonitrile – HPLC grade or equivalent

5.3 Methanol – HPLC grade or equivalent

5.4 Calcium chloride solution – prepared by dissolving 5 grams of calcium chloride in 1 liter of HLPC grade water.

5.5 Explosives stock standards – Traceable to Certificate of Analysis

5.6 Surrogate standards – 3,4-Dinitrotoluene

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6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1100

Suitable HPLC equipped with an autosampler, pump, and diode array detector.

Autosampler allows for unattended sample and standard injection throughout the analytical run.

6.2 Data System – Agilent Technologies LC Chemstation rev. A 10.01
Agilent Technologies MS Chemstation rev. DA 00.01

6.2.1 A computer system interfaced to the HPLC that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.2.2 The software should allow for the viewing of the entire UV Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.2.3 Data is archived to a backup server for long term storage.

6.3 Primary Column – Zorbax Extend C-18 3.5u – 4.6mm X 100mm or equivalent

6.4 Confirmation Column– Zorbax Bonus RP (amine bonded C-18) 5u - 4.6mm X 250mm or equivalent

6.5 Gas-tight syringes, syringe filters, and class “A” volumetric glassware for dilutions of standards and extracts.

7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, and vendor part numbers can be found in the HPLC STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a “Certificate of Analysis” with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor’s expiration date. Once opened, the hold

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time is reduced to one year or the vendor's expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with acetonitrile. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicates analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the explosives are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in 75/25 (v/v) water/acetonitrile. The low standard is at a concentration at or below the RL and the remaining standards define the working range of the detector.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC Conditions

7.2.1 HPLC-BB Conditions - Primary Column – (Extend C-18)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-1.0	78%	22%
1.0-6.0	71%	29%
6.0-27.0	71%	29%
27.0-29.0	78%	22%
29.0-33.0	78%	22%

Column temperature – 43.0 °C

Constant Flow – 2.0 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. The 254-nm wavelength switches to 270-nm just prior to the elution of the nitrotoluenes. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

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7.2.2 HPLC-PP Conditions - Primary Column – (Extend C-18)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-1.0	78%	22%
1.0-6.0	71%	29%
6.0-24.5	71%	29%
24.5-24.6	78%	22%
24.6-29.5	78%	22%

Column temperature – 41.0 °C

Constant Flow – 2.0 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. The 254-nm wavelength switches to 270-nm just prior to the elution of the nitrotoluenes. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.2.3 HPLC-GG/PP Conditions - Confirmation Column – (Bonus RP)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-0.15	38%	62%
0.15-0.85	48%	52%
0.85-19.0	48%	52%
19.0-19.5	38%	62%
19.5-25.0	38%	62%

Column temperature – 20.0 °C

Constant Flow – 0.9 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

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HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3. Sample Preparation

7.3.1 Water Samples (extracted)

A 1000ml aliquot of sample is extracted utilizing a solid phase extraction cartridge. The cartridge is eluted with 3ml of acetonitrile. The final volume is then adjusted to 10ml with reagent water.

7.3.2 Water Samples (direct inject)

A 5ml aliquot of sample is mixed with 5ml of acetonitrile. The extract is filtered through a .45um Teflon syringe filter to remove any particulate.

7.3.3 Solid Samples

A 2-gram aliquot of sample is extracted with acetonitrile utilizing a chilled ultrasonic bath. A 1ml aliquot of extract is mixed with 3ml of calcium chloride solution. The extract is filtered through a .45um Teflon syringe filter to remove any particulate.

7.4. HPLC Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures
Continuing Calibration Verification

7.4.1 Initial Calibration Procedures

Before samples can be run, the HPLC system must be calibrated, and retention time windows must be determined.

7.4.1.1 External Standard Calibration

A minimum 5-point calibration curve is created for the explosives and surrogates.

Calibration factors (CF) for the explosives and surrogates are determined at each concentration by dividing the area of each compound by the concentration of the standard.

The mean CF and standard deviation of the CF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

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%RSD = (Standard Deviation of CF X 100) / Mean CF

If the %RSD ≤ 20%, linearity through the origin can be assumed and the mean CF can be used to quantitate target analytes in the samples. Alternatively if the %RSD > 20% a calibration curve of response vs. amount can be plotted. If the correlation coefficient (r) is ≥0.995 (r^2 ≥0.990) then the curve can be used to quantitate target analytes in the samples.

7.4.1.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be ≤ 15%. If the ICV does not meet this criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

NOTE: Second source standards may not be available for TNX, DNX, and MNX.

7.4.1.3 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

Retention time windows are crucial to the identification of target compounds. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined

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as ± 3 times the standard deviation of the mean absolute retention time or 0.03 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (surrogates) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations. HPLC retention times tend to shift more than GC retention times.

The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known peaks (standards and surrogates) throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.03 minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential “hits”. The analyst will then review these “hits” and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

7.4.2 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the explosives are prepared at various concentrations; at least one CCV must be below the mid-point of the calibration curve. A continuing calibration standard must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally a CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 15% for each analyte. If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated.

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If the |%D| is greater than 15%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reported. i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed or the data must be qualified.

7.4.3 Sample Extract Analysis

7.4.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV)
QC Extracts
Sample Extracts
CCV Standards

7.4.3.2 One hundred microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.3.3 Tentative identification of an analyte occurs when the peaks from the sample extract fall within the established retention time windows for a calibrated compound.

7.4.3.4 The diode array detector is capable of spectral evaluation; second column confirmation may not be necessary in some instances. Peak spectra can be compared to a spectral library that has been created for the target analytes. However, the UV spectra for some of the analytes are not very unique. **If there is any doubt to the presence of a compound, it must be confirmed on the confirmation column.**

7.4.3.5 If the peaks of interest fall within the retention time windows on the confirmation column, the identification is confirmed. Quantitation of the analyte on the primary and confirmation column should agree within 40%. If the difference is greater than 40% and no obvious reason can be found, the higher result should be reported and flagged as “estimated”; otherwise, the result from the primary column should be reported.

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If doubt over the identity of the analyte exists after primary and confirmation analysis, it may be appropriate to report the analyte as non-detect with an elevated RL and MDL. This should be discussed with the client and documented on the result page.

7.4.3.6 If the compound identification does not confirm, then the result should be reported as ND or "U".

7.4.3.7 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.4.3.8 If peak identification is prevented by the presence of interferences, further cleanup may be required or the extract must be diluted so that the interference does not mask any analytes. Analysis on the confirmation column may also be beneficial.

7.5. Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is

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regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD).

9.1 Surrogates

9.1.1 3,4-Dinitrotoluene is used as the surrogate standard to monitor the efficiency of the extraction.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

% Recovery = (Sample Amount / Amount Spiked) X 100

The percent recovery must fall within the established control limits for the results to be acceptable.

9.1.2 If the surrogate recovery is not within the established control limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or surrogate solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.1.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.2.3 If no problem is found, re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

9.1.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates

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from both sets of analysis should be reported on the final report.

9.2 Method Blank

9.2.1 The method blank is either de-ionized water or cleaned sand (depending upon sample matrix) to which the surrogate standard has been added. The method blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high level samples. The method blank must be free of any analytes of interest or interferences at ½ the required reporting level to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

9.3.1 The blank spike is either de-ionized water or cleaned sand (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable. The large

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number of analytes in this method presents a substantial probability that a few of the analytes will fall outside of the established control limits. This may not indicate that the system is out of control; therefore, corrective action may not be necessary.

Upper and lower marginal exceedance (ME) limits can be established to determine when corrective action is necessary. A marginal exceedance in the Blank Spike is defined as a recovery being outside of 3 standard deviations but within 4 standard deviations of the mean.

The number of allowable marginal exceedances is based on the number of analytes in the Blank Spike. Marginal Exceedances must be random. If the same analyte exceeds the BS control limits repeatedly, it is an indication of a systematic problem and corrective action must be taken.

The number of allowable marginal exceedances is as follows:

1) 11-30 analytes in BS, 1 analyte allowed in ME range;

2) < 11 analytes in BS, no analytes allowed in ME range

9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.3.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary and the sample results can be reported without qualification.

9.3.2.4 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable.

9.3.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

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9.3.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Matrix Spike and Matrix Spike Duplicate

9.4.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.4.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.4.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are an indication of the sample matrix effects.

9.4.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for each analyte should fall within the established control limits. If more than 33% of the RPDs fall outside of the established control limits,

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the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

10.0 CALCULATIONS

The concentration of each explosive in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst}) \times (V_F / V_I) \times DF$

Soil (ug/kg) = $[(CONC_{inst}) \times (V_F / W_I) \times DF]$

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean CF, linear curve, or quadratic curve
DF	=	Dilution Factor
V_F	=	Volume of final extract (ml)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)

Soils are air dried prior to extraction; therefore, %solids is not used in the calculation.

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Wastewater, methanol, and acetonitrile from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

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Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000C Revision 3, March 2003

SW846 Method 8330 Revision 0, September 1994

SW846 Method 8330A Revision 1, January 1998

SW846 Method 3535A Draft Revision 1A, November 1998

SW846 Method 8332 Revision 0, December 1996

SW846 Method 8330B Revision 2, October 2006

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STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF NITROAROMATICS AND NITRAMINES (EXPLOSIVES) FROM SOLID SAMPLES FOR HPLC ANALYSIS BY SW-846 8330B

Prepared by:	Norm Farmer	Date:	08/26/13
Reviewed by:	Mike Eger	Date:	09/04/13

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TEST NAME: **STANDARD OPERATING PROCEDURE FOR THE EXTRACTION OF NITROAROMATICS AND NITRAMINES (EXPLOSIVES) FROM SOLID SAMPLES FOR HPLC ANALYSIS BY SW-846 8330B**

Method: SW846 8330B

Dept: OP

Revised Sections: 3.2.1, 5.6-5.8, 6.9, 7.1, 7.3, 7.5, 7.10, 7.24-7.26, 9.1.4 and 10.0

1.0 Summary, Scope and Application

1.1 Summary

Solid samples are air dried, sieved, and ground to a fine powder. Samples are then extracted with acetonitrile for 18 hours using a platform shaker table. The extracts are filtered and stored in amber glass vials with Teflon lined screw caps.

1.2 Scope and Application

This procedure is applicable to solid samples, including soils and sediments, submitted for Explosives analysis by HPLC method SW-846 8330B. For additional Department of Defense requirements see Appendix A. It is not applicable to samples submitted for analysis by SW-846 8330A.

2.0 Discussion and Comments

This procedure is adapted from SW-846 method 8330B. The method outlined in this SOP is designed for low and high concentration samples. Samples expected to contain high levels of explosives should be screened using method 8510, 8515 or other applicable methods. If the samples contain more than 2% explosives, they should not be ground.

The HPLC detector is extremely sensitive and will respond to many organic compounds. It is important to minimize extraneous contaminants and carryover by scrupulously cleaning all glassware, trays, and grinding equipment and by using only high purity reagents. Additionally, all extraction items that contact the sample should be made from glass, steel, wood, or Teflon.

3.0 Preservation and Holding Times

3.1 Preservation

3.1.1 This method utilizes multi-incremental sampling or the collection of large volume discreet samples. This can result in sample sizes of one to two kilograms. Samples shall be collected in heavy duty 1 or 2 gallon ziplock

bags. It is recommended that the samples be double bagged to prevent punctures.

3.1.2 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until drying. Once the samples have been air dried, they can be stored at room temperature. Samples should still be protected from light. The extracts must be refrigerated at ≤ 6°C until analysis.

3.2 Holding Time

3.2.1 Solid samples must be extracted within 14 days of collection. The Date/Time that the extraction is started and completed must be recorded on the prep sheet.

3.2.2 Extracts should be analyzed as soon as possible but must be analyzed within 40 days of extraction.

4.0 Definitions

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples that are extracted at the same time.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. For this method, the spiked analytes are added after grinding. Blank Spike recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still are considered valid.

4.4 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. For this method, the spiked analytes are added after grinding. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.5 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. For this method, the spiked analytes are added after grinding. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.6 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank

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is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.7 Proficiency Test Sample (PT): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The PT sample is generally prepared by an outside vendor. This method requires that the PT sample go through the entire preparatory procedure including sieving and grinding. PT sample recoveries are used to document laboratory and method performance.

4.8 Sample Duplicate (DUP): A replicate sample taken after grinding which is used to document the precision of a method in a given sample matrix.

4.9 Sample Triplicate (TRP): A replicate sample taken after grinding which is used to document the precision of a method in a given sample matrix. DoD projects require the analysis of the sample triplicate.

4.10 Grinding Blank (GB): An aliquot of blank sand that is processed through the ring and puck mill between different samples. It is used to monitor for carry over between samples ground with the same bowl set.

4.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.12 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 Reagents

5.1 Acetonitrile – HPLC grade or equivalent

5.2 Methanol – HPLC grade or equivalent

5.3 Water – HPLC grade or equivalent

5.4 Blank Sand – precleaned to remove contaminants

5.5 Soil PT Sample – Environmental Resource Associates or Equivalent to meet DoD QSM requirements.

5.6 Explosives **8330** Surrogate Solution – prepared in acetonitrile at a concentration specified by the HPLC analyst. All surrogate solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

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5.7 Explosives **8330** Spike Solution – prepared in acetonitrile at a concentration specified by the HPLC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

5.8 Explosives **8332** Spike Solution – Contains PETN and NG and is prepared in acetonitrile at a concentration specified by the HPLC analyst. All spike solutions must be logged in the Spike and Surrogate Logbook and each solution must be verified prior to use.

6.0 Glassware and Apparatus

6.1 Aluminum baking trays – Half pan 18” x 13” or Full pan 18” x 26”

6.2 Aluminum foil and weigh dishes

6.3 Drying Cabinet

6.4 #10 Stainless Steel Sieve #200 Brass Sieve

6.5 Large mixing bowls

6.6 Spatula – stainless steel, wooden, or Teflon

6.7 Ring and Puck Mill

6.8 800cc or 1000cc bowls and pucks for Mill

6.9 0.5ml, 1.0ml, and 2.5ml syringes

6.10 4 ounce glass jars with Teflon lined caps

6.11 10.0-50.0ml repeat pipettor

6.12 Platform Shaker Table

6.13 Disposable 3.0ml or 5.0ml syringes

6.14 0.20um or 0.45um Teflon syringe filters

6.15 2.0ml amber glass screw cap vials – caps must have Teflon lined septa

6.16 Heavy Duty 1 and 2 gallon Ziplock bags

6.17 Nitrile Gloves – shown to be interference free

6.18 Hi-Lo Thermometer

6.19 Downdraft Tables with Vacuum Filtration System

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6.20 Top loading balance – capable of weighing samples to +/- 0.01 grams

6.21 Top loading balance – capable of weighing 2 kilogram samples to +/- 0.1 grams

7.0 Procedure

7.1 The extraction of all samples must be documented on a "prep sheet". The prep sheet will include such items as: batch number, sample ID, bottle number, initial amount, final volume, solvent lot numbers, spike and surrogate lot numbers, batch numbers, extraction dates and times, and extraction technician.

The extraction technician is responsible for filling out all the required information on the prep sheet. A copy of the prep sheet will be submitted to the HPLC analyst with the extracts. The Batch number, extraction technician, and extraction start Date and Time are entered into LIMS.

7.2 This method requires that the entire soil sample be processed prior to the final extraction procedure. Sample volumes received should typically be around 1 kilogram. The minimum sample volume that may be ground is 200 grams. If small sample volumes are received, or if there are additional analysis requested, notify the department supervisor. Department supervisor will need to confirm with Technical Director and/or Project Managers.

7.3 Label the side of an aluminum baking tray with the sample ID. Transfer the entire sample to tray, taking care to remove as much sample residue from the container as possible. Use a clean spatula and new pair of gloves for each sample. Spread the sample out to facilitate drying. Breakup any large clumps as much as possible. If the samples appears to contain a lot of clay, score the sample to facilitate breaking it into smaller pieces later.

7.4 Repeat this procedure for all of the samples in the batch. Prepare one tray with approximately 500 grams of clean sand. The amount of sand used for the method blank and blank spike should be similar to the mass of a typical sample that is ground in one aliquot. This will be dried, sieved and ground for use as the method blank (MB) and blank spike (BSP).

7.5 Samples must not be heated and should not be exposed to direct sunlight. Place the samples in the drying cabinet. Turn on the fans in the cabinet. Flow should be set high enough to keep air circulating, but not so high that sample would be drawn across the trays. Allow the samples to dry at room temperature, generally 2 to 5 days.

7.6 Record the room temperature in the appropriate logbook during each day of drying. If room temperature exceeds 27°C, notify the department supervisor. Department supervisor will need to notify the Technical Director and/or Project Managers who will notify the client.

7.7 A sample is generally considered dry when it is free flowing and any large clumps crumble easily. To test for dryness, transfer approximately 10 grams of sample to a labeled aluminum weigh dish. Weigh the sample and dish. Record this in the 8330B Air Drying Log. Return the sample and weigh dish to the drying cabinet. After a minimum of two hours, reweigh the sample and dish. If the weight did not change by more than 0.1 grams, the sample is considered dry.

7.7.1 If the weight changed by more than 0.1 grams, return the sample and weigh dish to the drying cabinet and check again after a minimum of two hours. If the weight did not change by more than 0.1 grams, the sample is considered dry.

7.7.2 If the weight is not constant after the 3rd weighing, the sample needs to dry longer. Repeat the process after and an additional 24 to 48 hours.

7.8 **NOTE**: The sieving and grinding procedures can generate a lot of dust. Utilize the downdraft tables when working with the samples to minimize dust transfer. Samples should be covered with aluminum foil or stored in the drying cabinet when not being processed. This reduces chances of cross contamination from other samples and degradation from light.

7.9 Once the samples are dry, transfer each one to an appropriately labeled mixing bowl. Record the weight of the entire sample to the nearest gram in the 8330B Weight Log.

7.10 The samples are sieved through a #10 stainless steel sieve. Breakup any clumps of soil with gloved hands (use a new pair of gloves for each sample). Do not intentionally include vegetation unless it is part of the project requirement. Excess vegetation should be stored with the portion that is unable to pass through the sieve.

NOTE: Samples with high clay content tend to form “bricks” when dried. It may not be possible to sieve this type of sample. Use the scored lines to break the sample into small pieces. The smaller pieces will be processed as if they had passed through the sieve. Note this in the prep log.

7.11 Collect and weigh any portion unable to pass through the sieve. Record the weight to the nearest gram. Record a brief description of the material. Store this fraction in a labeled ziplock bag.

7.12 If samples are to be analyzed for metals prior to grinding, please see Appendix A for subsampling procedure.

CAUTION: DO NOT OPERATE RING AND PUCK MILL WITHOUT PROPER TRAINING.

7.13 Once the samples have been sieved, they must be ground to a fine powder. The 800cc can accommodate up to 600 gram sample aliquots and the 1000cc bowls can accommodate up to 800 gram sample aliquots. Do not overload the bowls,

as this will decrease the grinding efficiency. Large sample volumes may require that multiple aliquots be ground. Use one bowl, puck and lid set for each sample. Do not use multiple sets per sample.

7.14 **NOTE:** Do not grind aliquots less than 100 gram because this will cause excessive wear on the bowl and puck.

CAUTION: SAMPLES EXPECTED TO CONTAIN HIGH LEVELS OF EXPLOSIVES SHOULD BE SCREENED USING METHOD 8510, 8515 OR OTHER APPLICABLE METHODS. IF THE SAMPLES CONTAIN MORE THAN 2% EXPLOSIVES, THEY SHOULD NOT BE GROUND.

7.15 Process one sample at a time. Place the appropriate puck in the appropriate bowl. Transfer 500 to 600 grams of a sample to the bowl. Place the appropriate lid on the bowl. Use the pneumatic lift to load the bowl into the mill. Record the grinding order in the Grinding Log.

7.16 Close the lid to the mill. The mill will not operate with the lid open. Press and hold the green start button. Once the mill starts, release the button. The mill is programmed to run for 1 minute. Samples suspected of containing crystalline energetic residues (TNT, RDX, HMX, and their breakdowns) can be adequately ground using 2 one minute cycles. Samples suspected of containing polymeric residues (propellants and nitrocellulose) can be adequately ground using 5 one minute cycles. Accutest grinds all samples for a minimum of 5 one minute cycles to ensure adequate grinding regardless of residue type. Allow the sample and bowl to cool between each grind. See Appendix A for additional DOD requirements.

7.17 Repeat the grinding procedure for each sample aliquot until the entire sample has been processed. The bowl, puck and lid must be thoroughly cleaned between different samples; however, it is not necessary to clean the bowl, puck and lid between multiple aliquots of the same sample.

The bowls, pucks, and lids are cleaned with water and detergent solution. Brushes are used to facilitate the process. Particular attention must be paid to the grinding edges and handle of the puck. The bowls, pucks, and lids are then rinsed with tap water and DI water. The bowls, pucks, and lids can not be allowed to air dry. The low chrome content of material will cause surface rusting. The bowls, pucks, and lids should be rinsed with methanol and then dried with disposable towels.

See Appendix A for additional DOD requirements including the preparation of grinding blanks between each sample.

7.18 Document the sample ID, bowl set, and grinding order in the appropriate logbook.

7.19 Transfer all of the aliquots of a sample to a large ziplock bag. Sample should be transferred over the downdraft tables to minimize dust contamination. Seal the bag and thoroughly mix the sample.

7.20 Place a baking tray on the downdraft table. Spread out the sample on a baking tray so that it is approximately 1 cm thick.

7.21 Using a spatula, collect at least 30 different increments (~0.3 gram each) from randomly chosen locations in the sample. Combine the increments in a appropriately labeled 4 ounce jar. Nominal sample size should be 10 grams. Record the weight to the nearest 0.01 gram on the prep sheet.

7.22 Close the jar and repeat this procedure for each sample including the QC samples. This includes the method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD) and duplicate (DUP). Use 10.0 gram aliquots of clean sand for the MB and BS. Use additional 10.0 gram aliquots of a sample for the MS, MSD, and DUP. Record the sample ID, bottle number, and weight on the prep sheet.

7.23 Appendix A lists additional QC sample requirements for DoD projects. These include triplicate (TRP) and proficiency test samples (PT) per batch.

7.24 Using the dedicated spike syringe add 1.25ml of 8330 and 8332 spike solution to the BS, MS, and MSD. Record the spike lot number on the prep sheet.

7.25 Using the dedicated surrogate syringe add 1.25ml of 8330 surrogate solution to each of the samples including the QC samples. Record the surrogate lot number on the prep sheet.

7.26 Using a graduated pipettor or cylinder, add **18.75ml** of acetonitrile or each of the sample vials, the method blank (MB) and sample duplicate (DUP). Add **16.25ml** of acetonitrile to the BS, MS, and MSD. This will result in **20.0ml** of acetonitrile in each of the jars.

7.27 Put the cap on each jar and shake briefly to mix.

7.28 Place the jars in the covered rack on the platform shaker.

7.29 Shake the samples at a rate of 100 rpm for 18 hours. After 18 hours, turn off the shaker and remove the jars.

7.30 Using a repeat pipettor add 30.0ml of water to each of the samples including the QC samples.

7.31 Put the cap on each jar and shake briefly to mix. This results in a final volume of 50.0 ml.

7.32 Transfer 3-5ml of extract to disposable syringe. Attach a Teflon syringe filter to the disposable syringe.

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7.33 Filter the extract into appropriately labeled amber 2.0ml screw cap vial.

CAUTION: WEAR SAFETY GLASSES, THE EXTRACT MAY SPRAY IF THE FILTER CLOGS.

7.34 Store the extracts in the "extract refrigerator" until they are needed for analysis.

8.0 Quality Assurance and Quality Control

8.1 An extraction batch is defined as samples of a similar matrix that are prepared for a particular parameter. The batch size is limited to 20 samples. Samples can not be added to the batch after the grinding procedure has started.

8.2 A method blank (MB), blank spike (BS), matrix spike (MS), matrix spike duplicate (MSD), and duplicate (DUP) must be extracted with each new batch of samples.

8.3 Additional QA/QC requirements are listed in Appendix A.

9.0 Safety and Waste Disposal

9.1 Safety

9.1.1 Safety glasses, gloves and lab coats should be worn when handling samples, standards or solvents.

9.1.2 Avoid grinding samples that may contain high levels of explosives. The grinding action may cause them to DETONATE.

9.1.3 **Hearing protection** should be worn while operating the ring and puck mill.

9.1.4 Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and solvents used in the lab. Technicians should review the MSDS or SDS prior to using any new reagents or solvents.

9.1.5 Acetonitrile is an inhalation hazard and suspected carcinogen. Use in well ventilated area.

9.1.6 The fine dust created during the drying, sieving, and grinding procedures is an inhalation hazard. Fume hoods or downdraft tables should be used to minimize exposure to dust.

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9.2 Waste Disposal

9.2.1 Waste acetonitrile is placed in the “non-chlorinated waste” container.

9.2.2 Extracted soil samples and residual acetonitrile may be poured into the “non-chlorinated waste” container or the entire jar may be lab packed with the “extract waste”.

9.2.3 The remaining processed soil samples and material that did not pass through the #10 sieve should be bagged, labeled, and stored until time of disposal. **NOTE:** Soils from foreign soils must follow additional “foreign soil” disposal requirements.

9.2.4 Samples are archived and stored for 30 days after analysis. After the storage time has elapsed, the remaining soil samples are transferred to the appropriate drums for disposal.

10.0 References

SW-846 Method 8330A, Rev. 1, 01/98

SW-846 Method 8332, Rev. 0, 12/96

SW-846 Method 8330B, Rev. 2, 10/06

Extraction Kinetics of Energetic Compounds from Training Range and Army Ammunition Plant Soils: Platform Shaker versus Sonic Bath Methods, M.E. Walsh and D.J. Lambert, ERDC/CRREL TR06-6, 2006

DoD Environmental Data Quality Workgroup, Guide for Implementing EPA SW-846 Method 8330B, Draft July 2008

Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities, ASTM D 6323, 1998 (Reapproved 2003)

ESSA Mill Instruction Manual

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APPENDIX A

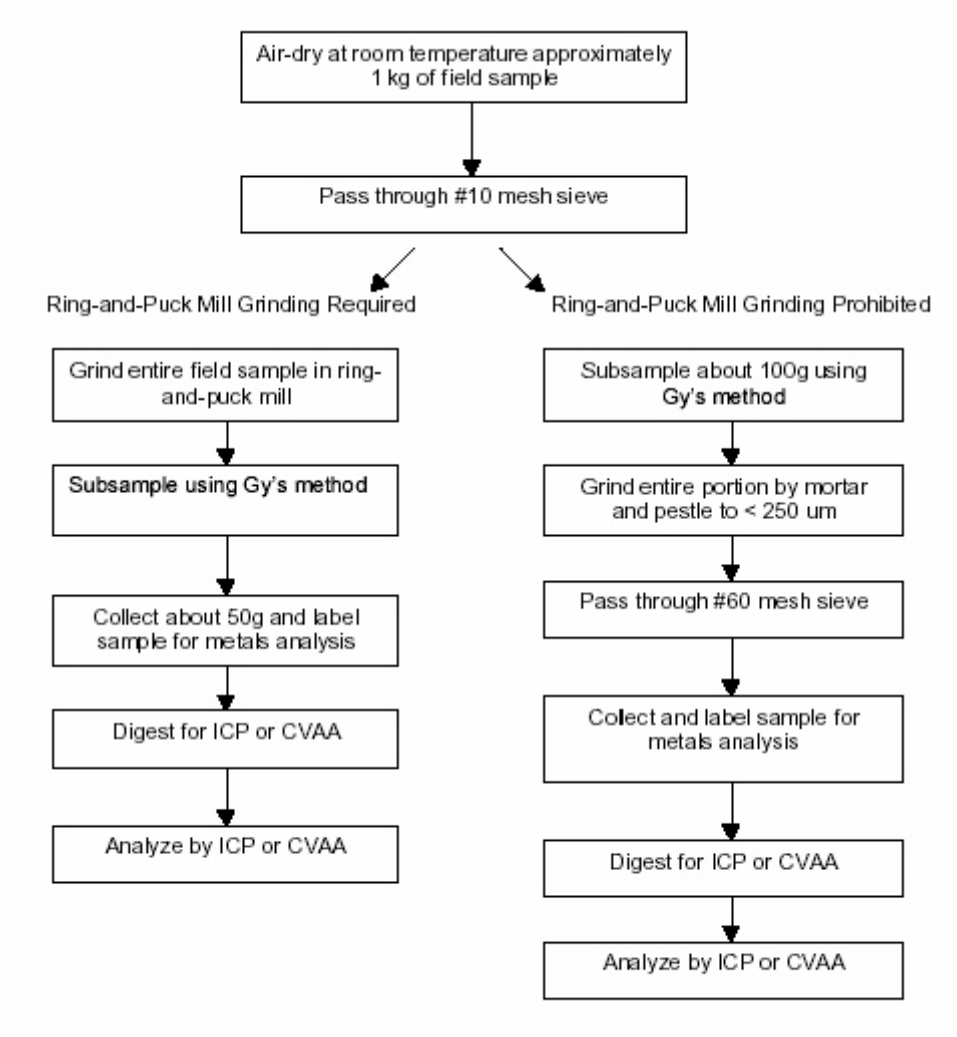
A1.0 Application

Appendix A is designed to supplement SOP OP046.x for the preparation of soil samples for SW-846 8330B. This appendix outlines additional requirements for compliance with Department of Defense QSM 4.2 projects.

A2.0 Sub-sampling for Metals

Some projects require that metals analysis be performed on the multi-incremental sample that was collected for 8330B. The technique used should be listed in the project QAPP or SOW. Consult the client if this information is not available.

See flow chart below for various subsampling techniques:



If Ring and Puck Mill grinding is required, then proceed with the grinding procedure listed in this SOP for explosives. The metallic components from the Ring and Puck Mill may introduce chromium and iron into the sample.

After grinding, place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick. Using a rectangular scoop, collect multiple top-to-bottom cuts across the sample (see figure below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Transfer the samples to the metals department for analysis.

If Ring and Puck Mill grinding is not required then follow the procedure listed below.

Transfer the sample to a large ziplock bag after it has been air dried and sieved. Sample should be transferred over the downdraft tables to minimize dust contamination. Seal the bag and thoroughly mix the sample.

Place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick. Using a rectangular scoop, collect multiple top-to-bottom cuts across the sample (see figure below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

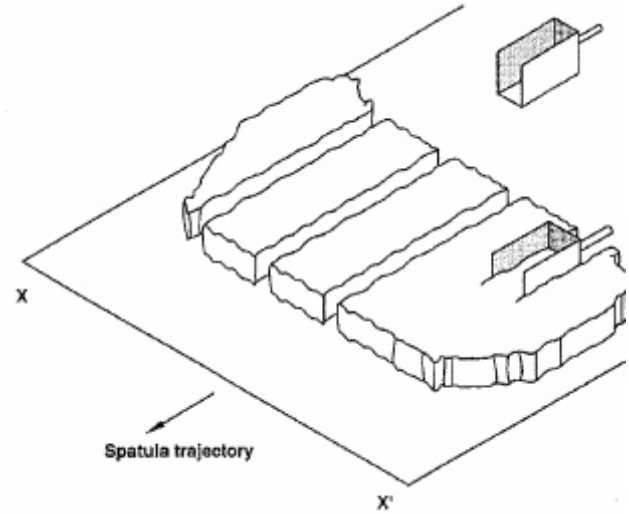


FIG. 1 Transversal Subsampling

Return the remaining sample to the ziplock bag or mixing bowl.

Grind each sample and MB to a particle size less than 250 um with a non-metallic mortar and pestle.

Place a baking tray on the downdraft table. Sieve each sample through a #60 sieve onto a tray.

Collect and label the samples. Transfer the samples to the metals department for analysis.

A3.0 Sample Grinding Cycles

Samples for DoD projects require that all samples be ground for **5** one minute cycles. Samples should be allowed to cool for at least two minutes between cycles. DoD guidelines require that the puck be removed from the sample between grinding cycles; however, this is not necessary since the heat generated is far less than expected. Results of an in-house temperature study are shown in Table 1:

TABLE 1

4/24/2008	Sample at Puck Grinding Area	Lid	Outer Bowl at Contact Area
Starting Temperature	22.4	22.8	22.8
After 1st minute	24.6	23.6	23.8
After 2nd minute	24.8	23.4	25.2
After 3rd minute	25.4	23.6	25.2
After 4th minute	25.8	24.2	25.2
After 5th minute	26.0	24.6	25.2

Temperatures in Degree C by IR thermometer.

At the end of each minute, the grinding bowl was removed from the ring and puck mill to measure the temperature of the lid and outer bowl, and then opened briefly to measure the temperature of the sample at the puck. Total time between grinds was approximately 15 seconds.

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A4.0 Cleaning Process and Grinding Blanks

The aluminum baking trays, mixing bowls, stainless steel sieves and grinding equipment must be completely cleaned between samples. The trays, bowls, and sieves are cleaned with water and detergent solution. Brushes are used to facilitate the process. The trays, bowls, and sieves are then rinsed with tap water and DI water. These items are allowed to air dry or they can be rinsed with methanol to speed up the drying process.

The bowls, pucks, and lids are cleaned in a similar fashion. Particular attention must be paid to the grinding edges and handle of the puck. It is not necessary to clean the bowl, puck and lid between multiple aliquots of the same sample. The bowls, pucks, and lids can not be allowed to air dry. The low chrome content of material will cause surface rusting. The bowls, pucks, and lids should be rinsed with methanol and then dried with disposable towels.

Bowls, pucks, and lids are numbered as sets. In order to properly track and assess potential cross-contamination, the bowl sets must not be mixed. The grinding order must be documented and a grinding blank must be prepared on each bowl set prior to use and between each sample. It is not necessary to prepare a grinding blank between multiple aliquots of the same sample. See Grinding Log for numbering instructions.

To prepare a grinding blank, place the appropriate puck in the appropriate bowl. Transfer a volume of blank sand similar to that used for the samples (500 gram) to the bowl. Place the appropriate lid on the bowl. Use the pneumatic lift to load the bowl into the mill. Record the grinding order in the Grinding Log.

Close the lid to the mill. The mill will not operate with the lid open. Press and hold the green start button. Once the mill starts, release the button. The mill is programmed to run for 1 minute. The grinding blank can be adequately ground using 2 one minute cycles.

Transfer the grinding blank to an appropriately labeled ziplock bag. This should be transferred over the downdraft tables to minimize dust contamination. Seal the bag and thoroughly mix the sample.

Each Grinding blank can be sub-sampled and composited to prior to extraction.

A5.0 Additional QC Sample Requirements

Samples for DoD projects require two additional QC samples, a batch triplicate (TRP) and a proficiency test (PT) sample. The triplicate is an additional replicate performed on the same sample that was used for the batch duplicate.

The PT sample differs from the blank spike in two ways. An outside vendor generally prepares the PT sample. The PT sample must be processed through all preparatory steps, including grinding.

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The batch triplicate and PT sample are then extracted with the rest of the batch.

A6.0 Grinding Demonstration

The adequacy of the grinding by the ring and puck mill can be checked by periodically placing a small aliquot of a grinding blank on a #200 sieve and checking to see if the material passes through the sieve. Since this is a 75um sieve, it would take a long time to process a large aliquot.

A7.0 Ring and Puck Mill Maintenance

Refer to equipment manual for details on scheduled maintenance items.

Daily Maintenance

Press drain buttons to expel any water in pneumatic lines.

Check air pressure supply is a minimum of 80 psi.

Weekly Maintenance

Check floor mounting bolts for signs of corrosion or fatigue.

Inspect bowl lid o-rings for signs of wear. Replace o-rings as needed.

Monthly Maintenance

Inspect platform insert for signs of wear on load bearing surfaces. Replace insert when wear exceeds 2mm.

Empty dust tray.

Other Maintenance

Lubricate motor plate bearings and drive shaft every 150 hours of use.

Check belt tension every 150 hours of use.

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ANALYSIS OF NITROAROMATICS, NITRAMINES, AND NITRATE ESTERS BY HPLC METHOD SW-846 8330B

Prepared by:	Norm Farmer	Date:	09/07/13
Reviewed by:	Mike Eger	Date:	09/11/13

Annual Review

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TEST NAME: ANALYSIS OF NITROAROMATICS, NITRAMINES, AND NITRATE ESTERS BY HPLC METHOD SW-846 8330B

METHOD REFERENCE: SW846 8330B

DEPT: HPLC

Revised Sections: 6.2, 6.3, 7.1, 7.2.1-7.2.3, 7.5-7.5.4 and 11.1

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of specific nitroaromatics, nitramines, and nitrate esters in water and solid matrices utilizing an HPLC equipped with a diode array detector. For the purpose of this SOP, "DoD Projects" refers to projects for various Department of Defense Agencies for compliance with the DoD QSM.

1.1.2 The following compounds can be reported by this method:

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	
1,3-Dinitrobenzene	1,3,5-Trinitrobenzene
2,6-Dinitrotoluene	2,4,6-Trinitrotoluene
2,4-Dinitrotoluene	2,4-diamino-6-Nitrotoluene
2-amino-4,6-Dinitrotoluene	2,6-diamino-4-Nitrotoluene
4-amino-2,6-Dinitrotoluene	2-amino-6-Nitrotoluene
Nitrobenzene	2-amino-4-Nitrotoluene
o-Nitrotoluene	4-amino-2-Nitrotoluene
m-Nitrotoluene	2,4-Diaminotoluene
p-Nitrotoluene	2,6-Diaminotoluene
DNX	3,5-Dinitroaniline
MNX	Nitroglycerine
TNX	PETN

1.1.3 The reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. Reporting limits may vary depending on matrix complications and volumes. Reporting limits for this method are in the range of 0.2 to 2.0 ug/l for extracted aqueous samples, 50 to 500 ug/l for direct injection aqueous samples, and 100 to 1000 ug/kg for solid samples.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are

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stored in the LIMS and should be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL. Note: MDL verifications for 8330B soils must be spiked prior to grinding.

1.1.5 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.

1.2 Summary

1.2.1 This method is adapted from SW846 Method 8330B.

1.2.2 Samples are received, stored and extracted within the appropriate holding times.

1.2.3 Sample preparation is performed in accordance with Accutest SOP OP047 and OP046.

1.2.4 The extracts are analyzed on an HPLC equipped with a diode array detector.

1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Aqueous samples shall be collected in amber glass bottles with Teflon lined caps. One-liter bottles are recommended for aqueous samples.

2.2.1 Soil samples shall be collected by multi-incremental sampling or by the collection of large volume discreet samples. This can result in sample sizes of one to two kilograms. Samples shall be collected in heavy duty 1 or 2 gallon ziplock bags. It is recommended that the samples be double bagged to prevent punctures.

2.1.3 The samples must be protected from light and refrigerated at ≤ 6°C from the time of collection until extraction. Soil samples can be stored at room temperature after they have been air dried. The extracts must be stored at ≤ 6°C until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be extracted within 7 days of collection.

2.2.2 Solid and waste samples must be extracted within 14 days of collection.

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2.2.3 Extracts should be analyzed as soon as possible but must be analyzed within 40 days of extraction.

3.0 INTERFERENCES

3.2 Data from all blanks, samples, and spikes must be evaluated for interferences.

3.3 Method interferences may be caused by contaminants in solvents, reagents, or glassware. All of these materials must be demonstrated to be free from interferences.

3.4 Tetryl decomposes rapidly in methanol/water solutions, as well as with heat. All aqueous samples expected to contain tetryl should be diluted with acetonitrile prior to filtration and acidified to pH < 3. Samples and extracts should not be exposed to temperatures above room temperature.

3.5 High levels of 4-amino-2-nitrotoluene may interfere with the surrogate 3,4-dinitrotoluene on the (Zorbax Extend C-18) primary column. In such instances, the surrogate recovery should be calculated from the confirmation column.

3.6 3,5-dinitroaniline partially coelutes with o-nitrotoluene and p-nitrotoluene on the confirmation column.

3.7 When analyzing the RDX breakdown analytes, TNX may partially coelute with HMX on the primary column and DNX may partially coelute with HMX on the confirmation columns.

3.8 Primary and confirmation column selection should be based on compounds of concern for each specific project.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

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4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.10 Proficiency Test Sample (PT): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The PT sample is generally prepared by an outside vendor. This method requires that the PT sample go through the entire preparatory procedure including sieving and grinding. PT sample recoveries are used to document laboratory and method performance.

4.11 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.12 Sample Triplicate (TRP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.13 Grinding Blank (GB): An aliquot of blank sand that is processed through the ring and puck mill between different samples. It is used to monitor for carry over between samples ground with the same bowl set.

4.14 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

4.15 Surrogate: An organic compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in

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environmental samples. Surrogates are used to measure the extraction efficiency.

5.0 REAGENTS

5.1 Water – HPLC grade or equivalent

5.2 Acetonitrile – HPLC grade or equivalent

5.3 Methanol – HPLC grade or equivalent

5.4 Explosives stock standards – Traceable to Certificate of Analysis

5.5 Surrogate standards – 3,4-Dinitrotoluene

6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1100

Suitable HPLC equipped with an autosampler, pump, and diode array detector.

Autosampler allows for unattended sample and standard injection throughout the analytical run.

6.2 Data System – Agilent Technologies LC Chemstation rev. A 10.01
Agilent Technologies MS Chemstation rev. DA 00.01

6.2.1 A computer system interfaced to the HPLC that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.2.2 The software must allow for quantitation at multiple wavelengths. Additionally the software should allow for the viewing of the entire UV Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.2.3 Data is archived to a backup server for long term storage.

6.3 Primary Column – Zorbax Extend C-18 3.5u – 4.6mm X 100mm or equivalent

6.4 Confirmation Column– Zorbax Bonus RP (amine bonded C-18) 5u - 4.6mm X 250mm or equivalent

6.5 Gas-tight syringes, syringe filters, and class “A” volumetric glassware for dilutions of standards and extracts.

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7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, and vendor part numbers can be found in the HPLC STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from several commercial vendors. All vendors must supply a "Certificate of Analysis" with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor's expiration date. Once opened, the hold time is reduced to one year or the vendor's expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with acetonitrile. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparison to other standards indicate analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for the explosives are prepared at a minimum of five concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in 75/25 (v/v) water/acetonitrile. The low standard is at a concentration at or below the RL and the remaining standards define the working range of the detector.

Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC Conditions

7.2.1 HPLC-BB Conditions - Primary Column – (Extend C-18)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

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Time (min)	Solvent A	Solvent B
0-1.0	78%	22%
1.0-6.0	71%	29%
6.0-27.0	71%	29%
27.0-29.0	78%	22%
29.0-33.0	78%	22%

Column temperature – 43.0 °C

Constant Flow – 2.0 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. The 254-nm wavelength switches to 270-nm just prior to the elution of the nitrotoluenes. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.2.2 HPLC-PP Conditions - Primary Column – (Extend C-18)

100 ul autosampler injection

Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-1.0	78%	22%
1.0-6.0	71%	29%
6.0-24.5	71%	29%
24.5-24.6	78%	22%
24.6-29.5	78%	22%

Column temperature – 41.0 °C

Constant Flow – 2.0 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. The 254-nm wavelength switches to 270-nm just prior to the elution of the nitrotoluenes. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.2.3 HPLC-GG/PP Conditions - Confirmation Column – (Bonus RP)

100 ul autosampler injection

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Mobile phase – Gradient: Water (A), Methanol (B)

Time (min)	Solvent A	Solvent B
0-0.15	38%	62%
0.15-0.85	48%	52%
0.85-19.0	48%	52%
19.0-19.5	38%	62%
19.5-25.0	38%	62%

Column temperature – 20.0 °C

Constant Flow – 0.9 ml/min

Diode Array Detector – Set to acquire and process data at 254-nm wavelengths using a 10-nm bandwidth. Secondary wavelength may be set to 214-nm. All data from 200-nm to 450-nm wavelengths is stored for spectral evaluation.

HPLC conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3. Sample Preparation

7.3.1 Water Samples (extracted)

A 1000ml aliquot of sample is extracted utilizing a solid phase cartridge. The cartridge is eluted with 3ml of acetonitrile. The final volume is then adjusted to 10ml with reagent water. The extract is filtered through a .45um Teflon syringe filter to remove any particulate.

7.3.2 Water Samples (direct inject)

A 1ml aliquot of sample is mixed with 1ml of acetonitrile. The extract is filtered through a .45um Teflon syringe filter to remove any particulate.

7.3.3 Solid Samples

A 10-gram aliquot of sample is extracted with 20ml of acetonitrile utilizing a platform shaker. The final volume is then adjusted to 50ml with reagent water. The extract is filtered through a .45um Teflon syringe filter to remove any particulate.

7.4. HPLC Analysis

Instrument calibration consists of two major sections:

Initial Calibration Procedures
Continuing Calibration Verification

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7.4.1 Initial Calibration Procedures

Before samples can be run, the HPLC system must be calibrated, and retention time windows must be determined.

7.4.1.1 External Standard Calibration

A minimum 5-point calibration curve is created for the explosives and surrogates.

Calibration factors (CF) for the explosives and surrogates are determined at each concentration by dividing the area of each compound by the concentration of the standard.

The mean CF and standard deviation of the CF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of CF X 100) / Mean CF

If the %RSD $\leq$ 20%, linearity through the origin can be assumed and the mean CF can be used to quantitate target analytes in the samples.

Alternatively if the %RSD > 20% a calibration curve of response vs. amount can be plotted. If the correlation coefficient (r) is $\geq$0.995 ($r^2 \geq 0.990$) then the curve can be used to quantitate target analytes in the samples.

Two curve fit types may be may be plotted. A “linear” curve must contain at least 5 calibration levels and uses the equation $y = mx + b$. A “quadratic” curve must contain at least 6 calibration levels and uses the equation $y = ax^2 + bx + c$. Details for both curve fits can be found in the Agilent Software Users Guide.

Do not include the origin (0,0) as an extra calibration point. However, the Agilent software will allow the analyst to "force" the regression through zero. Forcing the curve through zero is not the same as including the origin as a fictitious point in the calibration. In essence, if the curve is forced through zero, the intercept is set to 0 *before* the regression is calculated, thereby setting the bias to favor the low end of the calibration range by “pivoting” the function around the origin to find the best fit and resulting in one less degree of freedom. It may be appropriate to force the regression though zero for some calibrations.

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However, the use of forcing the regression through zero may NOT be used as a rationale for reporting results below the calibration range demonstrated by the analysis of the standards. If it is necessary to report results at lower concentrations, then the analyst should run a calibration that reaches those lower concentrations or the values should be flagged as estimated.

7.4.1.2 Reporting Level Verification (DoD projects)

Once the calibration curve has been generated, the reporting limit must be verified. Reanalyze the lowest calibration standard. The %D for all analytes of interest should be ≤ 20% and the apparent signal to noise ratio must be at least 5:1.

If the RL verification does not meet this criteria, a second standard should be prepared. If that standard meets criteria, proceed with sample analysis. If the RL verification still does not meet criteria, the system may require maintenance. Notify the Department Supervisor.

Once the sensitivity issue has been resolved, recalibrate the instrument.

7.4.1.3 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for all analytes of interest should be ≤ 20%. If the ICV does not meet this criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

NOTE: Second source standards may not be available for TNX, DNX, and MNX.

7.4.1.4 Retention Time Windows

Retention time windows must be established whenever a new column is installed in an instrument or whenever a major change has been made to an instrument.

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Retention time windows are crucial to the identification of target compounds. Absolute retention times are used for compound identification in all GC and HPLC methods that do not employ internal standard calibration. Retention time windows are established to compensate for minor shifts in absolute retention times that result from normal chromatographic variability. The width of the retention time window should be carefully established to minimize the occurrence of both false positive and false negative results.

Retention time windows are established by injecting all standard mixes three times over the course of 72 hours. The width of the retention time window for each analyte, surrogate, and major constituent in multi-component analytes is defined as ± 3 times the standard deviation of the mean absolute retention time or 0.03 minutes, whichever is greater.

Establish the center of the retention time window for each analyte and surrogate by using the absolute retention time for each analyte and surrogate from the calibration verification standard at the beginning of the analytical shift. For samples run during the same shift as an initial calibration, use the retention time of the mid-point standard of the initial calibration.

Peak identification is based on the retention time of a peak falling within the retention time window for a given analyte. Time reference peaks (surrogates) are used to correct for run-to-run variations in retention times due to temperature, flow, or injector fluctuations. HPLC retention times tend to shift more than GC retention times.

The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known peaks (standards and surrogates) throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.03 minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential “hits”. The analyst will then review these “hits” and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

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7.4.2 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for the explosives are prepared at various concentrations; at least one CCV must be below the mid-point of the calibration curve. A continuing calibration standard must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally a CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 20% for each analyte. If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated.

If the |%D| is greater than 20%, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reportable. i.e. The CCV failed high, the associated QC passed, and the samples were ND. However, any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed or the data must be qualified.

NOTE: For DoD projects, samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed. If reanalysis is not possible, the laboratory must notify the client and qualify the associated sample results.

7.4.3 Sample Extract Analysis

7.4.3.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV)
QC Extracts
Sample Extracts
CCV Standards

7.4.3.2 One hundred microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.4.3.3 Tentative identification of an analyte occurs when the peaks from the sample extract fall within the established retention time windows for a calibrated compound.

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7.4.3.4 The diode array detector is capable of spectral evaluation; second column confirmation may not be necessary in some instances. Peak spectra can be compared to a spectral library that has been created for the target analytes. However, the UV spectra for some of the analytes are not unique. Spectral confirmation should only be used for high level hits at sites with previous analytical history. DoD requires that all hits be confirmed by secondary column. The confirmation column analysis must meet the same criteria as the primary column.

7.4.3.5 If the peaks of interest fall within the retention time windows on the confirmation column, the identification is confirmed. Quantitation of the analyte on the primary and confirmation column should agree within 40%. If the difference is greater than 40% and no obvious reason can be found, the higher result should be reported and flagged as "estimated"; otherwise, the result from the primary column should be reported.

If doubt over the identity of the analyte exists after primary and confirmation analysis, it may be appropriate to report the analyte as non-detect with an elevated RL and MDL. This should be discussed with the client and documented on the result page.

7.4.3.6 If the compound identification does not confirm, then the result should be reported as ND or "U".

7.4.3.7 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.4.3.8 If peak identification is prevented by the presence of interferences, further cleanup may be required or the extract must be diluted so that the interference does not mask any analytes. Analysis on the confirmation column may also be beneficial.

7.5. Maintenance and Trouble Shooting

7.5.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.5.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

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7.5.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.5.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to statistically generated control limits. These control limits are reviewed and updated annually. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), matrix spike duplicate (MSD), and sample duplicate (DUP). DoD projects require the analysis of a sample triplicate (TRP), a proficiency test sample (PT) and equipment grinding blanks (GB).

9.1 Surrogates

9.1.1 3,4-Dinitrotoluene is used as the surrogate standard to monitor the efficiency of the extraction.

A known amount of surrogate standard is added to each sample including the QC set prior to extraction. The percent recovery for each surrogate is calculated as follows:

% Recovery = (Sample Amount / Amount Spiked) X 100

The percent recovery must fall within the established control limits for the results to be acceptable.

9.1.2 If the surrogate recovery is not within the established control limits, the following are required.

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9.1.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or surrogate solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.1.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.2.3 If no problem is found, re-extract and reanalyze the sample. **NOTE:** If the recoveries are high and the sample is non-detect, then re-extraction may not be necessary. If there is insufficient sample for re-extraction, reanalyze the sample and footnote this on the report.

9.1.2.4 If upon reanalysis, the recovery is still not within control limits, the problem is considered matrix interference. Surrogates from both sets of analysis should be reported on the final report.

9.2 Method Blank

9.2.1 The method blank is either de-ionized water or cleaned sand (depending upon sample matrix) to which the surrogate standard has been added. The method blank is then extracted and taken through all cleanup procedures along with the other samples to determine any contamination from reagents, glassware, or high level samples. The method blank must be free of any analytes of interest or interferences at ½ the required reporting level to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate “B” or “V” qualifier. This must be approved by the department supervisor.

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9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

9.3.1 The blank spike is either de-ionized water or cleaned sand (depending upon sample matrix) to which the surrogate standard and spike standard have been added. The blank spike is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest should fall within the established control limits for the results to be acceptable. The large number of analytes in this method presents a substantial probability that a few of the analytes will fall outside of the established control limits. This may not indicate that the system is out of control; therefore, corrective action may not be necessary.

Upper and lower marginal exceedance (ME) limits can be established to determine when corrective action is necessary. A marginal exceedance in the Blank Spike is defined as a recovery being outside of 3 standard deviations but within 4 standard deviations of the mean.
The number of allowable marginal exceedances is based on the number of analytes in the Blank Spike. Marginal Exceedances must be random. If the same analyte exceeds the BS control limits repeatedly, it is an indication of a systematic problem and corrective action must be taken.

The number of allowable marginal exceedances is as follows:

1) 11-30 analytes in BS, 1 analyte allowed in ME range;

2) < 11 analytes in BS, no analytes allowed in ME range

9.3.2 If the blank spike recoveries are not within the established control limits, the following are required.

9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

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9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.3.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary and the sample results can be reported without qualification.

9.3.2.4 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable. However, DoD Projects require that the client be notified and the results flagged.

9.3.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.3.2.6 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Proficiency Test Sample (DoD soil projects)

9.4.1 The proficiency test sample is a bulk volume soil sample. The PT sample is prepared by an outside vendor at specific analyte concentrations. The PT sample is taken through all preparatory procedures including drying, sieving, grinding, and subsampling.

The surrogate standard is added prior, and the PT sample is then extracted and taken through all cleanup procedures along with the other samples to monitor the efficiency of the entire procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (PT Sample Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest should fall within the Vendors established control limits for the results to be acceptable.

9.4.2 If the PT sample recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found,

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recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 Check to see if the recoveries that are outside of control limits are analytes of concern. If the analytes are not being reported, additional corrective action is not necessary and the sample results can be reported without qualification.

9.4.2.4 If the recovery of an analyte in the PT sample is high and the associated sample is non-detect, the data may be reportable. However, DoD Projects require that the client be notified and the results flagged.

9.4.2.5 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.4.2.6 If the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.5 Matrix Spike and Matrix Spike Duplicate

9.5.1 Matrix spike and spike duplicates are replicate sample aliquots to which the surrogate standard and spike standard have been added. The matrix spike and spike duplicate are then extracted and taken through all cleanup procedures along with the other samples to monitor the precision and accuracy of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within the established control limits for the results to be acceptable.

9.5.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

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9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.5.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are an indication of the sample matrix effects.

9.5.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for each analyte should fall within the established control limits. (For DoD projects, the RPD should be less than 20%.) If more than 33% of the RPDs fall outside of the established control limits, the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary.

9.6 Sample Duplicate

The sample duplicate is a replicate sample aliquot to which the surrogate standard has been added. Sample duplicate is then extracted and taken through all cleanup procedures along with the other samples to monitor the precision of the extraction procedure.

Sample and sample duplicate results for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| Sample Result – DUP Result | / Average Result] X 100

The RPD for each analyte should fall within the established control limits. If the RPDs fall outside of the established control limits, the sample and/or DUP should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary.

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9.7 Sample Triplicate (DoD soil projects)

The sample triplicate is an additional replicate sample aliquot to which the surrogate standard has been added. Sample triplicate is then extracted and taken through all cleanup procedures along with the other samples to monitor the precision of the extraction procedure.

Sample, sample duplicate, and sample triplicate results for each analyte are used to calculate the percent relative standard deviation (%RSD) for each compound.

%RSD = [Standard Deviation of the Result / Average Result] X 100

The %RSD for results above the reporting limit must not be greater than 20%. If the %RSD is greater than 20%, the sample, DUP, and/or TRP should be reanalyzed to ensure that there was no injection problem. If upon reanalysis the %RSD is still greater than 20%, the department supervisor shall review the data and determine if any further action is necessary.

9.8 Grinding Blanks (DoD soil projects)

9.8.1 The grinding blanks (GB) are aliquots of blank sand that are processed through the ring and puck mill between different samples. They are used to monitor for carry over between samples ground with the same bowl set. The grinding blanks for each bowl set may be composited prior to analysis.

9.8.2 The grinding blanks must be free of any analytes of interest or interferences at ½ the required reporting level to be acceptable. If the grinding blanks are not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated grinding blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the individual grinding blanks (non-composited), reanalyzing the samples or qualifying the results with a “B” or “V” qualifier. This must be approved by the department supervisor.

9.8.3 If the grinding blank is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

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10.0 CALCULATIONS

The concentration of each explosive in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst}) \times (V_F / V_I) \times DF$

Soil (ug/kg) = $[(CONC_{inst}) \times (V_F / W_I) \times DF]$

$CONC_{inst}$	=	Instrument concentration calculated from the initial calibration using mean CF, linear curve, or quadratic curve
DF	=	Dilution Factor
V_F	=	Volume of final extract (ml)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)

Soils are air dried prior to extraction; therefore, %solids is not used in the calculation.

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Wastewater, methanol, and acetonitrile from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 60 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

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12.0 REFERENCES

SW846 Method 8000C Revision 3, March 2003

SW846 Method 8330A Revision 1, January 1998

SW846 Method 3535A Draft Revision 1A, November 1998

SW846 Method 8332 Revision 0, December 1996

SW846 Method 8330B Revision 2, October 2006

DoD Quality System Manual, Version 4.1, April 2009

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METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP)

Prepared by:	Dave Metzgar	Date:	08/28/2013
Reviewed by:	Svetlana Izosimova	Date:	09/13/2013

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Effective 7 days after "*" date

TEST NAME: METALS BY INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY

INSTRUMENT: THERMO 6500, SERIAL # 20100903 SSTRACE 1
INSTRUMENT: THERMO 6500, SERIAL # 20103825 SSTRACE 2
AUTOSAMPLER: CETAC 240 POSITION, SERIAL # 031038A520 SSTRACE 1
AUTOSAMPLER: CETAC 240 POSITION, SERIAL # 041048A520 SSTRACE 2

SUGGESTED WAVELENGTH (S): TABLE 2

METHOD REFERENCES: SW846 6010C, EPA 200.7 Rev 4.4 1994

DEPARTMENT: Metals

REVISIONS: Section 2.0: added pH is checked within metals department
Section 3.0: added detail
Section 5.8: added PCOS and instrument software information
Section 6.6.2: changed “values” to “concentrations” and added detail
Section 6.7: remove references to CRI
Section 7.12: removed reference to CRI
Section 7.13: removed entire section
Section 8.5: removed entire section
Table 6: removed CRI section

1.0 SCOPE AND APPLICATION SUMMARY

1.1 This method is applicable for the determination of metals in water, sludges, sediments, and soils. Elements that can be reported by this method include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Titanium, Thallium, Tin, Vanadium, and Zinc.

1.2 Sample matrices are pretreated following SW846 and EPA methods for digestion of soil, sediment, sludge or water samples. Refer to specific metals department digestion SOP's for more information on digestion techniques.

1.3 This inductively coupled argon plasma optical emission spectrometer (s) (ICP-OES) uses an Echelle optical design and a Charge Injection Device (CID) solid-state detector to provide elemental analysis. Control of the spectrometer is provided by PC based iTEVA software. In the instrument, digested samples are introduced into the Thermo 6500 ICP, passed through a nebulizer and transported to a plasma torch. The element-specific emission spectra are produced by a radio frequency inductively coupled plasma. The spectra are dispersed by a spectrometer, and the intensities of the emission lines are monitored with the solid state detector.

1.4 Reporting limits (RL) are based on the extraction procedure. Reporting limits may vary depending on matrix complications, volumes and by client needs, but the reporting limits must always be verified with a low check which meets the criteria outlined in this SOP. Solid matrices are reported on a dry weight basis. Refer to table 1 of this SOP for Accutest Southeast typical reporting limits. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits.

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1.5 MDLs must be established for all analytes, using a solution spiked at approximately 3 times the estimated detection limit. To determine the MDL values, take seven replicate aliquots of the spiked sample and process through the entire analytical method. The MDL is calculated by multiplying the standard deviation of the replicate analyses by 3.14, which is the student's t value for a 99% confidence level. MDLs must be determined approximately once per year for each matrix and instrument. Please refer to Accutest QA SOP QA020, current version for further information regarding method performance criteria and experimental method detection limits.

1.6 An MDL check standard will be analyzed at the time of the annual MDL study and on a quarterly basis for verification. The concentration of the MDL check standard must be 1x-4x the statistical MDL. The MDL Check Standard is carried through the entire preparation and analytical procedure. This is a qualitative check; therefore, the analyte needs to be detected only. If the analyte is not detected, the concentration of the MDL check standard must be increased to a level where the analyte is detected. This then becomes the current MDL.

1.7 Lower limit of quantitation check sample. The lower limit of quantitation check (LLQC) sample should be analyzed after establishing the lower laboratory reporting limits and on a quarterly basis to demonstrate the desired detection capability. The LLQC sample is carried through the entire preparation and analytical procedure. Lower limits of quantitation are verified when all analytes in the LLQC sample are detected within 20 percent of their true value.

1.8 MDLs are generated for each matrix on both ICP instruments. The higher of the two statistically calculated MDL's is entered into LIMS as the MDL. The verified MDLs are stored in the LIMS and must be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

1.9 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a "J" or "I" qualifier. Some program or project specifications may require that no values below the RL be reported.

1.10 Instrument Detection Limits (IDL). It is suggested that IDL's be completed upon initial instrument installation and whenever instrument conditions have significantly changed. The Instrument Detection Limits (in ug/L) are determined by analyzing 7 replicates of a reagent blank solution on 3 non consecutive days. The IDL is defined as 3 times the average of the standard deviation of the 3 days. Each IDL measurement shall be performed as though it were a separate analytical sample. IDLs shall be determined and reported for each wavelength used in the analysis of the samples.

2.0 PRESERVATION AND BOTTLEWARE

All samples should be preserved with nitric acid to a pH of <2 at the time of collection. All sample pH are checked in sample receiving and within the metals department. Samples that are received with a pH >2 must be preserved to pH <2 and held for 24 hours prior to metals digestion to dissolve any metals that absorb to the container walls. Refer to SOP SAM101, current revision for further instruction. Final pH of TCLP extracts are checked and recorded in Accutest Southeast Extractions Department. Please refer to TCLP (1311) fluid determination logbook and SPLP (1312) fluid determination logbook for further information. TCLP extracts

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received from Accutest Southeast Extractions Department are prepared as soon as possible, no longer than 24 hours from time of receipt. If precipitation is observed during the sample preparation process the sample(s) are immediately re-prepped on dilution until no precipitation is observed. Samples received for dissolved metals analysis should be filtered and preserved to pH<2 within 72 hours of collection. Refer to Accutest Southeast Sample Filtration Logbook for further information.

All soil samples must be stored in a refrigerator at $\leq 6^{o}C$ upon receipt. Refer to SOP SAM101, current revision for further instruction.

All bottleware used by Accutest Southeast is tested for cleanliness prior to shipping to clients. Analysis results must be less than one half the reporting limit to be acceptable. Refer to SOP SAM104, current revision for further instruction.

3.0 HOLDING TIME AND BATCH SIZE

All samples must be prepared and analyzed within 6 months of the date of collection. Refer to appropriate Accutest Southeast digestion SOP, current revision for batch size criteria.

4.0 INTERFERENCES

Several types of interferences can cause inaccuracies in trace metals determinations by ICP. These interferences are discussed below.

4.1 Spectral interferences are caused by overlap of a spectral line from another element, unresolved overlap of molecular band spectra, background contribution from continuous or recombination phenomena, and background contribution from stray light from the line emission of high concentration elements. Corrections for these interferences can be made by using interfering element corrections, by choosing an alternate analytical line, and/or by applying background correction points. The locations selected for the measurement of background intensity will be determined by the complexity of the spectrum adjacent to the wavelength peak. The locations used for routine measurement must be free of off-line spectral interference or adequately corrected to reflect the same change in background intensity as occurs at the wavelength peak.

Note: Refer to section 17.0 of this SOP for further instruction regarding interfering element correction factor generation.

4.2 Physical interferences can be caused by changes in sample viscosity or surface tension, by high acid content in a sample, or by high dissolved solids in a sample. These interferences can be reduced by making sample dilutions.

4.3 Matrix interferences in high solid samples can be overcome by using an internal standard. Yttrium/Indium mix is used for the Thermo 6500 ICP. The concentration must be sufficient for optimum precision but not so high as to alter the salt concentration of the matrix. The element intensity is used by the instrument as an internal standard to ratio the analyte intensity signals for both calibration and quantitation.

4.4 Chemical interferences are not pronounced with ICP due to the high temperature of the plasma, however if they are present, they can be reduced by optimizing the analytical conditions (i.e. power level, torch height, etc.).

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5.0 APPARATUS

5.1 Currently there are two solid state ICPs available for use in the lab. Both are Thermo 6500 ICP units. These units have been optimized to obtain lower detection limits for a wide range of elements. Since they are solid state systems, different lines may be included for elements to obtain the best analytical results. However, the lines which are normally included in the normal analysis program are shown in Table 2.

5.2 Instrument auto samplers. For random access during sample analysis.

5.3 Class A volumetric glassware and pipettes.

5.4 Polypropylene auto sampler tubes.

5.5 Eppendorf Pipette (s) - Pipette (s) are checked for accuracy and to ensure they are in good working condition. Volumes are checked at 100% of maximum volume, the 50% (mid-range) and between 10% and 25% at the low range, whichever constitutes most frequently used volume for a particular pipette. Pipettes are checked within the metals department approximately once per week and stored electronically in the “Eppendorf Calibration Log”. Refer to SOP QA006, current revision for further information regarding pipette calibration.

5.6 Fisher Brand 0.45 micron (um) filter or equivalent. Filter lots are checked for cleanliness through the Method Blank process. All Method Blank analytical results must be less than one half the reporting limit to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated filters must be re-filtered through acceptable filters.

5.7 Fisher Brand disposable 10 ml syringes or equivalent. Syringe lots are checked for cleanliness through the Method Blank process. All Method Blank results must be less than one half the reporting limit to be acceptable, if not , the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated syringes must be re-filtered through acceptable syringes.

5.8 Data System

Microsoft Windows XP Professional Version 2002
Instrument software – Thermo iTEVA version 2.5.0.84

5.8.1 A computer system interfaced to the Thermo 6500 ICP that allows for the continuous acquisition and storage of all data obtained throughout the duration of the analytical run sequence.

5.8.2 Data is archived to a backup server for long term storage.

6.0 REAGENTS

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All chemicals listed below are trace metal grade unless otherwise specified. Refer to Acid Certificate of Analysis logbook for Certificates of Analysis and compliance with the specifications of the grade listed. Accutest Laboratories produces DI water to the specifications for the ASTM Type II standard designation based on the system manufacturer's performance specifications. The DI water is used exclusively for laboratory purposes. De-ionized (DI) water should be used whenever water is required. Refer to SOP QA037, current revision for more information regarding testing and monitoring. Refer to the Metals Department Standard Prep Logbook for the make-up and concentrations of standards and stock solutions being used within this SOP. Some of the information included in the logbook is as follows: standard name, elements in mix, manufacturer, lot number, parent expiration date, acid matrix, stock concentration, volume of standard added, total volume, final prepared concentration, prep date, initials, MET number, and prepared standard expiration date. Standards and prepared reagents must be prepared every 6 months or before stock standard expiration date, whichever comes first**.** Refer to tables 3 through 7 of this SOP for concentration levels of standards used. Unless otherwise approved, the calibration curve must contain 3 points determined by a blank and a series of standards representing the elements of interest.

6.1 2.5 ppm Yttrium and 10 ppm Indium internal standard, made from ICP quality standard.

6.2 Hydrochloric acid, trace metals grade.

6.3 Nitric Acid, trace metals grade.

6.4 ICP quality standard stock solutions are available from Inorganic Ventures, Spex, Plasma Pure, Ultra, Environmental Express, or equivalent.

6.5 Calibration Standards. These can be made up by diluting the stock solutions to the appropriate concentrations. The calibration standards should be prepared using the same type of acid (s) and at approximately the same concentration as will result in the samples following sample preparation.

6.5.1 For calibration and quantitation an internal standard (Yttrium/Indium) is used to limit nebulization problems. If it is known that the samples contain a significantly different acid matrix, the samples must be diluted so that they are in a similar matrix to the curve. All sample results are referenced to the initial calibration blank (ICB) Internal Standard counts. The criteria is 60-125 percent of the initial calibration blank (ICB) counts. If the internal standard counts fall outside these criteria matrix effects must be suspected and the sample diluted until it meets the criteria or footnoted in LIMS as suspected matrix interference.

6.5.2 Standards must be prepared so that there is minimal spectral interference between analytes.

Note: All Ag stock and intermediate solutions must be stored away from direct sunlight.

6.6 Analytical Quality Control Solutions.

All of the solutions below are prepared by adding either mixed or single element metals solutions to a solution prepared using the same type of acid (s) and at approximately the same concentration as will result in the samples following sample preparation.

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6.6.1 Blank (Calibration, ICB, CCB)

This reagent blank contains Nitric Acid at 3 percent and Hydrochloric Acid at 5 percent.

6.6.2 Initial Calibration Verification solution.

This standard solution must be made from a different source than the calibration curve. The concentrations for each element must be within the range of the calibration curve and should be approximately at the midpoint of the curve. This solution is used to verify the accuracy of the initial calibration. Levels for the ICV standard are shown in Table 4.

6.6.3 Continuing Calibration Verification solution.

The metals concentrations for this standard should be at approximately the mid point of the calibration curve for each element. This standard should be prepared from the same source that is used for the calibration curve. Levels for the CCV standard are shown in Table 5.

6.6.4 Interference Element Check Solutions.

These solutions must be analyzed to check the interfering element correction factors (IEC's) on the ICP instruments. Refer to section 17.0 of this SOP for further information regarding generation of IEC's.

6.6.4.1 ICSA Solution.

The ICSA solution contains only the interfering elements. Levels for the ICSA are shown in Table 9.

6.6.4.2 ICSAB Solution.

The ICSAB solution contains both the interferents and the analytes of interest. Levels for the ICSAB are shown in Table 10.

6.6.4.3 Single element interference check solutions

Prepared as single solutions. Levels for the single element interference solutions are shown in Table 11.

6.7 CRIA Standard Solution (Also referred to as LLCCV)

The CRIA standard contains the elements of interest at levels equal to Accutest Southeast quantitation limits (RL). Please refer to Table 6 for list of elements of interest and concentration levels for the CRIA. If special client reporting limits are requested, then low checks corresponding to those reporting limits must also be analyzed.

6.8 Matrix Spike, Matrix Spike duplicate, and Spike Blank Solution.

This solution is prepared by adding either mixed or single element metals solutions to a solution containing 3 percent nitric acid and 5 percent hydrochloric acid and diluting to a fixed

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final volume with this acid mixture. Spiking solution (s) must be added to the spike blank, matrix spike, and the matrix spike duplicate prior to digestion. Levels for the MS and MSD and Spike Blank standard are shown in Table 7.

6.9 Liquid Argon or Argon Gas. (99.999% purity)

7.0 ANALYTICAL PROCEDURE

Note: Please refer to section 8 of this SOP for further detail on quality control standards. Please refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

7.1 General procedure on how to operate the Thermo 6500 is described below. Refer to the Thermo 6500 operation manual for further details.

7.2 Before starting up the instrument, make sure that the pump tubing is in good condition, the torch assembly, the nebulizer, and the spray chamber are clean, the dehumidifier (if used) is filled with DI water up to the level between Minimum and Maximum, and that there are no leaks in the torch area.

7.3 Turn on the recirculating cooler. Verify that the argon is turned on and there is enough for the entire days analytical run.

7.4 Tighten the pump platens and engage the peristaltic pump. Make sure sample and internal standard solutions are flowing smoothly.

7.5 Put a new solution of acid rinse into the rinse reservoir. The composition of the rinse solution may be periodically changed to minimize sample introduction problems and sample carryover. If internal standard is being used, make sure that sufficient amount of internal standard is prepared for the entire analytical run.

7.6 Start up the instrument following the sequence show below.

7.6.1 Double click the **iTEVA Control Center** Icon on the desktop. Type ***admin*** in User Name field, and then click **OK**.

7.6.2 Once the iTEVA Control Center window is opened, click on **Plasma** Icon at status bar area. Then click on **Instrument Status** to check the interlock indicators (torch compartment, purge gas supply, plasma gas supply, water flow and exhaust should be in green; drain flow and busy should be in gray) and the Optics Temperature. (It should be around 38°C.) Click on the Close box.

7.6.3 Click **Plasma On**. When the plasma is on, click close. Let the instrument warm up for 15 to 20 minutes before starting the analysis. New tubing may take an hour to stabilize.

7.7 Torch Alignment and Auto Peak

7.7.1 If the torch has been cleaned, then the torch alignment procedure must be performed.

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7.7.2 Open the method and then click on **Sequence** tab, then click on **List View** Icon until you reach rack display.

7.7.3 Go to S-6 position (you can assign any position in the rack for torch alignment), then right click to select **Go** to empty sample S:6. (Now, the auto sampler tip moves from Rinse to this position).

7.7.4 Click on **Analysis** tab, then select **Torch Alignment** from Instrument drop down menu. There will be a pop up dialog box present. Click **Run**. Then there will be another dialog pop up box (This is a reminder for Torch Alignment Solution (2 ppm Zn)), click **Ok**. Now, the instrument is initializing an automated torch alignment. It takes about 7 minutes to complete this step. Progress is indicated in the progress bar.

7.7.5 After torch alignment is complete, click **Close**. Click on **Sequence** tab, then followed by **List View** Icon.

7.7.6 Go to Rinse position at rack display, right click to select Go to rinse and let it rinse for approximately 5 minutes.

7.7.7 Perform Auto Peak

7.7.8 It is recommended that the Auto Peak Adjust procedure be performed daily prior to calibration. A standard that contains all of the lines of interest is used and the system automatically makes the appropriate fine adjustments. (High standard solution should be used for this process.)

7.7.9 Click **Sequence** tab, then click on **List View** Icon until the rack is displayed.

7.7.10 Go to S-5 position (you can assign any position in the rack for auto peak adjust), then right click to select **Go** to empty sample S:5. (Now, the auto sampler tip moves from the Rinse position to this position). Click on **Analysis** tab. All elements result is shown in the display area. From Instrument drop down menu, select **Perform Auto Peak**. There will be a pop up dialog box present. Highlight “All Elements”, and then click **Run**. Then there will another pop up dialog box (This is a reminder for Auto Peak Solution), click **Ok**. Now, the instrument is performing auto peak adjust. It takes about 5 minutes to complete this process. The Auto Peak dialog box will show a green check mark in front of “All Elements”, which indicates Auto Peak is complete.

7.8 Open the method and start up the run.

7.8.1 Click on **Analyst** Icon at the workspace. Go to the method and choose Open from the drop down menu. Select the method with the latest revision number.

7.8.2 Go to **Method** tab at the bottom of left hand corner to click on **Automated Output** at the workspace area. Type a filename in Filename field in the data display area (i.e. : SA101010M1, starts with SA, then followed by MM-DD-YY, then M1; M1 indicates the first analytical run for that day, then followed by M2, M3 and so on for the second and third runs.) Click on **Apply To All Sample Types**.

7.8.3 Click on **Sequence** tab at the bottom of left hand corner. From Auto Session drop down menu bar, click on **New Auto sampler** to create a sequence. This will pop up a

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dialog box, then click on **New** and fill in number of samples (i.e.: 100) in the Number of Samples field and the sample I.D. (leave this field empty) in Sample Name field. Type a sequence name (i.e. : SEQ101010M1, starts with SEQ, then MM-DD-YY, then M1; M1 indicates the first analytical run for that day, then followed by M2, M3 and so on for the second and third runs) in the Sequence Name field. Click Ok, then put in "0" as settle time between between sequences, and click **Ok**.

7.8.4 Right click on **Untitled** (Cetac ASX-520 Enviro 5 Named Rack is the rack that is currently used) at the workspace area, click on **Auto-Locate All** to locate all sample positions.

7.8.5 Double click on **Untitled** again, then click on the sequence name (i.e. : SEQ101010M1), on the data display area, type the sequence in Samplename column, dilution factor (if needed) in CorrFact column, check the box in front of Check column, and select an appropriate check table.

7.8.6 Once done with creating sequence, go to **Method** drop down menu and save all changes as **Save As**. There will be a Save a Method dialog box present, go to the save option to check on "Overwrite Method and bump revision number" box, and then click **Ok**.

7.8.7 Go to Sequence tab, click on List View Icon from tool bar, then click on Connect Autosampler to PC and Initialize Icon.

7.8.8 See table 8 for a typical run sequence.

7.9 Calibrate the instrument as outlined below. See table 3 for calibration standards concentrations. This calibration procedure is done a minimum of once every 24 hours. The calibration standards may be included in the auto sampler program or they may be run manually from the **Calibrate Instrument (graduated cylinder)** icon located on the Analyst tab. All curves must be determined from a linear calibration prepared in the normal manner using the established analytical procedure for the instrument. Refer to instrument manual for further detail. Unless otherwise approved, the calibration curve must be determined by a blank and a series of three standards representing the elements of interest. Three exposures will be used with a percent relative standard deviation of less than 5 percent. The resulting correlation coefficient must be $\geq$0.998. If the calibration curves do not meet these criteria, analysis must be terminated, the problem corrected, and instrument re-calibrated. Correlation coefficients, slopes, and y-intercepts for each wavelength are printed and included in each analytical data package.

7.10 After the instrument is properly calibrated, begin by reanalyzing the high standard(s) for each element. The standards can be combined into one solution for this analysis. The analyzed value must be within 5 percent of the true value or that element must be re-calibrated. The High Standard Check shall be used for 200.7 only. After the high standards are analyzed, the ICV check standard shall be run. For the ICV, all elements to be reported must be within 5 percent of the true value for 200.7 and 10 percent of the true value for 6010C. If the ICV fails, analysis shall be terminated, problem corrected, and the instrument re-calibrated.

7.11 After analyzing the ICV, the ICB must be analyzed. The results of the ICB must be less than one half the reporting limit. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a "B" or "V" qualifier, or

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raising the reporting limit for all samples to greater than two times the background concentration.

7.12 Before analyzing any real samples the CRIA (also referred to as LLCCV) must be analyzed. The CRIA contains elements of interest at the reporting limit. The CRIA will be analyzed at the beginning and end of each analytical run. For all elements the results must be within 20 percent of the true value for client specific reporting limits (CRIA Requirement). For all others a 30 percent criterion will be applied. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits (CRIA Requirement). If the initial CRIA fails no samples associated with the failing CRIA can be reported, and the CRIA should be reanalyzed for the failing elements. If the closing CRIA fails the criteria, the samples associated with the CRIA shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the CRIA, or qualifying the results in LIMS.

7.13 Before analyzing any real samples, the interference check standards (ICSA, ICSAB) must be analyzed. For all spiked elements, the analyzed results must be within 20 percent of the true value. For non-spiked elements, the interfering element solutions must be $\pm$ the absolute value of the reporting limit for each element. Also, on an as needed basis (i.e.: instrument repair), analyze the single element interference check solutions (SIC). The same criteria as outlined above apply. If the ICSA and/or the ICSAB fall outside this criterion the problem must be corrected and the instrument re-calibrated or data footnoted in LIMS system. If the closing ICSA/ICSAB fails the criteria, the samples associated with the ICSA/ICSAB shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the ICSA/ICSAB, or qualifying the results in LIMS. Refer to section 17.0 of this SOP for Interfering Element Correction (IEC) procedure.

7.14 After the initial analytical quality control has been analyzed, the samples and the preparation batch matrix quality control shall be analyzed. Each sample analysis must be a minimum of 3 readings using at least a 5 second integration time. Between each sample, flush the nebulizer and the solution uptake system with a blank rinse solution for at least 60 seconds or for the required period of time to ensure that analyte memory effects are not occurring.

7.15 Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run. If the CCV solution is not within 10 percent of the true value for method 6010C and 5 percent for method 200.7 (for the initial CCV (ICCV)), the CCV shall be reanalyzed to confirm the initial value. If the CCV is not within criteria after the reanalysis, no samples can be reported in the area bracketed by the failing CCV. Immediately following the analysis of the CCV the CCB shall be analyzed. The results of the CCB must be less than one half the reporting limit for all elements. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a “B” or “V” qualifier, or raising the reporting limit for all samples to greater than two times the background concentration.

7.16 One sample per preparation batch, or whenever matrix interferences are suspected for a batch of samples, a serial dilution (SDL) must be prepared. For the serial dilution, a 1:5 dilution must be made on the sample. The results of the 1:5 dilution shall agree within 10 percent of the true value as long as the sample and the dilution result are greater than 10 times the method detection limit or greater than 50 times the IDL. If the results are outside these criteria then matrix interference should be suspected and the proper footnote entered into LIMS. A post digestion spike (PDS) must be performed if the SDL fails. The PDS must

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recover within ± 20 percent for method SW846-6010C and ± 15 percent for method EPA 200.7. If the PDS is outside these limits then matrix interference must be suspected and the proper footnote entered into LIMS.

7.17 The upper limit of quantitation may exceed the highest concentration calibration point and can be defined as the "linear dynamic" range. Sample results above the linear dynamic range shall be diluted under the linear dynamic range and reanalyzed. Samples following a sample with high concentrations of analyte (s) must be examined for possible carryover. Verification may be done by rinsing the lines with an acid solution and then reanalyzing the sample. A limit check table is built into the autosampler file so that samples exceeding the standardization range are flagged on the raw data.

7.18 After the instrument is optimized and all initial QC has been run, click on **Run Auto-Session** Icon to start the analytical run sequence.

7.18.1 If you need to add or delete samples once the run is started, follow the steps shown below.

7.18.2 Click on **Sequence** tab, then click on **List View** Icon at the tool bar. There is the sequence table shown on the display area.

7.18.3 Click on **Add Samples** Icon. This will pop up a dialog box, and then fill in number of samples that need to be added. Click **Ok**. By doing this, samples will be added to the end of the current sequence without a rack location.

7.18.4 On the Samplename column type in the sample I.D., correction factors, and check tables. **Click on Auto Locate All.**

7.18.5 The added samples will be analyzed at the end of the original sequence run order unless they are assigned a different run order.

7.18.6 Deleting Samples

7.18.7 Click on **Sequence** tab, and then click on **List View** Icon under the sequence display area.

7.18.8 Highlight all samples that need to be deleted and then click on the **Delete Samples** icon.

7.19 When the analysis is completed export the data to LIMS following the procedure outlined below.

7.19.1 Double click on **ePrint** Icon on desktop. There will be a **LEADTOOLS ePRINT** pop up box, click on **Finish Jobs** and **OK** boxes.

7.19.2 Double click the **PDF** Icon on the desktop; the PDF file will be present as Document_#. Right click on that file, select **rename** to change the filename to an assigned analytical run I.D. (i.e.: MA9000). This is the raw data file for MA9000.

7.19.3 Drop the raw data to the **LIMS Data Drop** icon located on the desktop.

7.19.4 By completing the above steps, the raw data (i.e.: MA9000) can be viewed and/or printed from the Raw Data Search function.

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7.19.5 Go to **Analysis** tab, right click on sample header, and select export all samples. A pop up dialog box will come up, type in the analytical run I.D. (i.e.: SA101010M1) and click **Ok**. Go to **Lims Export** folder located on the desktop, right click on analytical run and change extension from .TXT to .ICP. Open the analytical file and make any necessary changes, such as deleting any samples that need to be re-run on dilution. **Save** the file. Drop the data file to the **LIMS Data Drop** icon located on the desktop. This will then send the export file to LIMS for review.

7.20 The data can be evaluated by running an automated data evaluation program, which will help to generate quality control summary pages. Each run must be evaluated as quickly as possible to make sure that all required quality control has been analyzed. With each data package include: cover sheet, copies of all prep sheets, autosampler run sequence, dilution sheets, and raw data. Label each folder with MA#, instrument run I.D., instrument used, and date.

7.21 At the end of the analysis day the ICP must be shutdown using the following sequence.

7.21.1 Place the auto sampler tip in the rinse cup and rinse in a mixed solution of approximately 5 percent nitric acid and 5 percent hydrochloric acid for 10 minutes and then in DI water for 20 minutes.

7.21.2 Turn off the plasma by clicking on the **Plasma** Icon and then by clicking **Plasma Off.**

7.21.3 Close all iTeva programs/windows.

7.21.4 Release the tension on the sample pump platens.

7.21.5 Turn off recirculating chiller.

8.0 QUALITY CONTROL

This section outlines the QA/QC operations necessary to satisfy the analytical requirements for method SW846 6010C. Please refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements. Check with the area supervisor or lab manager for any non compliant quality control for further information.

8.1 High Standard Check.

After the instrument is properly calibrated, the high standard(s) shall be reanalyzed for each element. The analyzed value must be within 5 percent of the true value. If the High Standard falls outside this criteria analysis shall be terminated, problem corrected, and the instrument re-calibrated.

Note: High Standard Check is for method 200.7 only. The standards can be combined into one solution for this analysis.

8.2 Initial Calibration Verification Standard (ICV).

After each calibration, a standard from a different source than the calibration standard shall be analyzed. For the ICV, all elements to be reported must be within 10 percent of the true value for 6010C and within 5 percent for 200.7. If the ICV is outside these

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criteria then the analysis must be terminated, problem corrected, and the instrument re-calibrated.

8.3 Continuing Calibration Blank/Initial Calibration Blank.

Analyze the Initial calibration blank solution at the beginning of each run and the continuing calibration blank after every tenth sample and at the end of the sample run. The ICB/CCB must be less than one half the reporting limit for each element. The instrument blank may be failing the criteria due to contamination or instrument drift. Samples associated with the failing blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples bracketed by the failing blank, qualifying the results with a “B” or “V” qualifier, or raising the reporting limit for all samples to greater than two times the background concentration.

8.4 Low Standard Check (CRIA).

The CRIA (also referred to as LLCCV) contains elements of interest at the reporting limit. The CRIA will be analyzed at the beginning and end of each analytical run. For all elements the results must be within 20 percent of the true value for client specific reporting limits (CRIA Requirement). For all others a 30 percent criterion will be applied. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific reporting limits (CRIA Requirement). If the initial CRIA fails no samples associated with the failing CRIA can be reported, and the CRIA should be reanalyzed for the failing elements. If the closing CRIA fails the criteria, the samples associated with the CRIA shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the CRIA, or qualifying the results in LIMS.

8.5 ICSA and ICSAB and Single Element Interference Solutions

Analyze the ICSA and ICSAB at the beginning and end of each run following the analysis of the CRIA. Also, on an as needed basis (i.e.: instrument repair), analyze the single element interference check solutions (SIC). For all spiked elements, the analyzed results must be within 20 percent of the true value. For non-spiked elements, the interfering element solutions must be $\pm$ the absolute value of the reporting limit for each element. If the ICSA and/or the ICSAB fall outside this criterion the problem must be corrected and the instrument re-calibrated or data footnoted in LIMS system. If the closing ICSA/ICSAB fails the criteria, the samples associated with the ICSA/ICSAB shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples associated with the ICSA/ICSAB, or qualifying the results in LIMS. Refer to section 17.0 of this SOP for Interfering Element Correction (IEC) procedure.

8.6 Continuing Calibration Verification.

Analyze the continuing calibration verification solution and the continuing calibration blank after every tenth sample and at the end of the sample run. If the CCV solution is not within 10 percent of the true value for method 6010C and 5 percent for method 200.7 (for the initial CCV (ICCV)) the CCV must be reanalyzed to confirm the initial value. If the CCV is not within criteria after reanalysis no samples can be reported in the area bracketed by the failing CCV.

8.7 Method Blank.

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The laboratory must digest and analyze a method blank with each batch of samples. The method blank must contain elements at less than one half the reporting limit for each element. The exception to this rule is when the samples to be reported contain greater than 10 times the method blank level. In addition, if all the samples are less than a client required limit and the method blank is also less than that limit, then the results can be reported as less than that limit. Samples associated with the contaminated blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-digesting and reanalyzing the samples, qualifying the results with a "B" or "V" qualifier, or raising the reporting limit to greater than two times the background concentration,

8.8 Blank Spike Sample.

The laboratory must digest and analyze a spike blank sample with each batch of samples. Blank Spikes must be within 20 percent of the true value for method SW846-6010C and within 15 percent for method EPA 200.7. If the lab control is outside of the control limits for a reportable element, all samples must be re-digested and reanalyzed for that element. The exception is if the lab control recovery is high and the results of the samples to be reported are less than the reporting limit. In that case, the sample results may be reported with no flag. For solid standard reference materials (SRMs) $\pm$ 20 percent accuracy may not be achievable and the manufacturer's established acceptance criterion should be used for all soil SRMs.

8.9 Matrix Spike and Matrix Spike Duplicate Recovery.

The laboratory must digest and analyze a matrix spike and matrix spike duplicate with each batch of samples. The matrix spike recovery is calculated as shown below and must be within 20 percent of the true value for method SW846-6010C and within 30 percent for method EPA 200.7. If a matrix spike is out of control, then the results must be flagged with the appropriate footnote. If the matrix spike amount is less than one fourth of the sample amount, then the sample cannot be assessed against the control limits and must be footnoted to that effect.

Note: Both the matrix spike amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

$$\frac{\text{(Spiked Sample Result - Sample Result)}}{\text{Amount Spiked}} \times 100 = \text{matrix spike recovery}$$

8.10 Matrix Duplicate/Matrix Spike Duplicate Relative Percent Difference.

The laboratory must digest a duplicate with each batch of samples. The relative percent difference (RPD) between the duplicate and the sample must be assessed and must be $\leq$ 20 percent for sample results at or above the reporting limit. If the RPD is outside the 20 percent criteria the results must be qualified in LIMS. RPD's are also calculated in LIMS for sample results below the reporting limit. RPD's outside the 20 percent criteria are not considered failing and LIMS automatically footnotes these as "RPD acceptable due to low duplicate and sample concentrations."

Note: Both the duplicate amount and the sample amount are calculated to the IDL for any given element. Any value less than the IDL is treated as zero.

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8.11 Serial Dilution Analysis and Post Digestion Spike.

For one sample per preparation batch, or whenever matrix interferences are suspected for a batch of samples, a serial dilution must be prepared. For the serial dilution, a 1:5 dilution must be made on the sample. The results of the 1:5 dilution must agree within 10 percent of the true value as long as the sample and the dilution result are greater than 10 times the method detection limit and/or greater than 50 times the IDL. If the dilution does not agree, then the sample must be post digestion spiked (PDS) at a level no less than 10 times but no greater than 100 times the MDL concentration. The PDS must recover within ± 20 percent for method SW846-6010C and ± 15 percent for method EPA 200.7. If the PDS is outside these limits then matrix interference must be suspected and the proper footnote entered into LIMS.

$$\frac{\text{(Sample Result - Serial Dil. Result)}}{\text{Sample Result}} \times 100 = \text{Serial Dilution RPD}$$

8.12 Linear Calibration ranges.

The upper limit of the linear calibration ranges must be established for all elements by determining the signal responses from a minimum of three concentration standards, one of which is close to the upper limit of the linear range. The linear calibration range, which may be used for the analysis of samples must be judged by the analyst from the resulting data. The upper range limit should be an observed signal no more than 10% below the level extrapolated from lower standards. Linear calibration ranges must be determined whenever there is a significant change in instrument response or at a minimum, every 6 months.

8.13 Sample RSD

For samples containing levels of elements greater than five times the reporting limits, the relative standard deviation for the replicates should be less than 5%. If not, reanalyze the sample. If upon reanalysis, the RSD's are acceptable then report the data from the reanalysis. If RSD's are not acceptable upon reanalysis, then the results for that element should be footnoted that there are possible analytical problems and/or matrix interference indicated by a high RSD between replicates.

8.14 Interelement Spectral Interference Correction Validity

For the interelement spectral interference corrections to remain valid during sample analysis, the interferent concentration must not exceed its linear range. If the interferent concentration exceeds its linear range or its correction factor is big enough to affect the element of interest even at lower concentrations, sample dilution with reagent blank and reanalysis is required. In these circumstances, analyte dilution limits are raised by an amount equivalent to the dilution factor.

8.15 Internal Standard (Yttrium/Indium)

For any readings where the internal standard is outside of the range 60-125 percent of the internal standard level in the reference standard (Initial Calibration Blank), then the sample must be diluted until the internal standard is within range and all sample results must be footnoted in LIMS.

8.16 MSA (Method of Standard Additions)

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Accutest Southeast uses the internal standard technique as an alternative to the MSA per SW846-6010C section 4.4.2. However, in certain circumstances MSA may be needed by some project specific requirements. Accutest Southeast may perform an MSA when sample matrix interference is confirmed through the post digestion spike process or may qualify the results in LIMS. Accutest Southeast will use a single addition method as described in SW846-7000B.

9.0 GLASSWARE CLEANING

All glassware must be washed with soap and tap water and then rinsed with 5 percent nitric acid. It must then be rinsed at least 3 times with DI water. Refer to SOP GN196, current revision for further information regarding glassware cleaning.

10.0 DOCUMENTATION REQUIREMENTS

Refer to the Laboratory Quality Assurance Manual for documentation requirements. All raw data is printed to .PDF format and archived to a backup server for long term storage.

11.0 SAFETY

The analyst must follow normal safety procedures as outlined in the Accutest Laboratory Safety Manual which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and must be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor. Follow proper safety precautions when working with gas cylinders.

12.0 CALCULATIONS

For water samples, the following calculations must be used. Refer to the QC section for the calculations to be used for the QC samples.

Original sample concentration of metal (ug/l) =

$$\frac{\text{(conc. in the digestate (ug/l)) x (final digestate volume (ml))}}{\text{(initial sample volume (ml))}}$$

For soil samples, the following calculations must be used.

Concentration of the metal in the dry sample (mg/kg) =

$$\frac{\text{(conc. in the digestate (mg/l) x final digestate volume(L))}}{\text{(sample wt. (kg)) x (\% solids/100)}}$$

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13.0 INSTRUMENT MAINTENANCE

Recommended periodic maintenance includes the items outlined below. All maintenance must be recorded in the instrument maintenance log.

13.1 Change the pump tubing as needed.

13.2 Clean the filter on the recirculating pump approximately once a month and dust off the power supply vents as needed.

13.3 Clean or replace the nebulizer, torch assembly, and injector tube as needed.

13.4 Change the sampler tip as needed.

13.5 Clean the recirculating pump lines and internal sock filter every 3 months or as needed.

13.6 Clean the radial view quartz surface weekly or more often if needed.

14.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

14.1 Pollution Prevention

Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids must be followed. All method users must be familiar with the waste management practices described in Section 14.2.

14.2 Waste Management

Individuals performing this method must follow established waste management procedures as described in the Sample and Laboratory Waste Disposal SOP SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

15.0 GENERIC DEFINITIONS

15.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 24 hours which ever comes first.

15.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

15.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. A CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

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15.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

15.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point must be at a level equal to or below the reporting level.

15.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor must be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

15.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the performance of a method in a given sample matrix.

15.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the precision and performance of a method in a given sample matrix.

15.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

15.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

15.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

16.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Statistical control limits are stored in the LIMS for QA purposes only. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

17.0 GENERATION OF INTERFERING ELEMENT CORRECTION FACTORS

17.1 It is recommended that all IEC's be verified and updated approximately every 6 months or whenever instrument conditions change significantly. It is also recommended that elements with frequent high concentrations or with large IEC's should be checked more frequently.

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17.2 Calculate the IEC correction factors and enter them into the method (refer to Thermo 6500 instrument manual). Calculate the correction factor using the equation shown below. This correction factor must be added to the correction factor already in place in the method for a given element.

$$\text{IEC} = \frac{\text{Concentration Result of the element with the interference}}{\text{Concentration result of the interfering element}}$$

17.3 Verify the new correction factors by reanalyzing the ICSA/ICSAB solutions and/or the SIC solutions or by reloading and recalculating the previously stored results. If the reanalysis is not within QC limits, make additional changes to the IEC factors and then re-verify both the individual and combined solution values.

17.4 Save and update the method.

17.5 Interfering element correction factors are saved as raw data along with the run printouts on a daily basis so that the IEC's for a given run are traceable.

TABLE 1: REPORTING LIMIT BY ELEMENT

	Water	Soil	TCLP
Analyte	**Reporting Limit (ug/L)**	**Reporting Limit (mg/kg)**	**Reporting Limit (mg/L)/MCL**
Tin	50	5	
Aluminum	200	20	
Antimony	5	1	
Arsenic	10	0.5	0.10 / 5.0
Barium	200	20	10 / 100
Beryllium	4	0.5	
Cadmium	5	0.4	0.05 / 1.0
Calcium	1000	500	
Chromium	10	1	0.10 / 5.0
Cobalt	50	5	
Copper	25	2.5	
Iron	300	10	
Lead	5	1	0.5 / 5.0
Magnesium	5000	500	
Manganese	15	1.5	
Nickel	40	4.0	
Potassium	5000	500	
Selenium	10	1	0.5 / 1.0
Silver	10	1	0.10 / 5.0
Sodium	5000	500	

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Thallium	10	1
Vanadium	50	5
Zinc	20	2
Molybdenum	50	2.5
Strontium	10	0.5
Titanium	10	0.5

TABLE 2. THERMO 6500 ANALYSIS LINES

Element	Wavelength
Al	396.1
As	189.042
Ca	317.933
Fe	259.9
Mg	279.078
Mn	257.610
Pb	220.353
Se	196.026
Tl	190.864
V	292.402
Ag	328.068
Ba	455.4
Be	313.042
Cd	226.502
Co	228.616
Cr	267.716
Cu	324.753
K	766.491
Na	589.5
Ni	231.604

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Sb	206.838
Zn	206.2
Mo	202.030
Sn	189.900
Sr	407.7
Ti	334.9

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TABLE 3: LOW, MID AND HIGH STANDARD LEVELS

Element	Low	Mid	High
	ug/l	ug/l	ug/l
Al	10000	40000	80000
As	500	2000	4000
Ca	10000	40000	80000
Fe	10000	40000	80000
Mg	10000	40000	80000
Mn	500	2000	4000
Pb	500	2000	4000
Se	500	2000	4000
Tl	500	2000	4000
V	500	2000	4000
Ag	62.5	250	500
Ba	500	2000	4000
Be	500	2000	4000
Cd	500	2000	4000
Co	500	2000	4000
Cr	500	2000	4000
Cu	500	2000	4000
K	10000	40000	80000
Na	10000	40000	80000
Ni	500	2000	4000
Sb	500	2000	4000
Zn	500	2000	4000
Mo	500	2000	4000
Sn	500	2000	4000
Sr	500	2000	4000
Ti	500	2000	4000

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TABLE 4: ICV STANDARD LEVELS

Element	Concentration
	ug/l
Al	40000
As	2000
Ca	40000
Fe	40000
Mg	40000
Mn	2000
Pb	2000
Se	2000
Tl	2000
V	2000
Ag	250
Ba	2000
Be	2000
Cd	2000
Co	2000
Cr	2000
Cu	2000
K	40000
Na	40000
Ni	2000
Sb	2000
Zn	2000
Mo	2000
Sn	2000
Sr	2000
Ti	2000

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TABLE 5: CCV STANDARD LEVELS

Element	Concentration
	ug/l
Al	40000
As	2000
Ca	40000
Fe	40000
Mg	40000
Mn	2000
Pb	2000
Se	2000
Tl	2000
V	2000
Ag	250
Ba	2000
Be	2000
Cd	2000
Co	2000
Cr	2000
Cu	2000
K	40000
Na	40000
Ni	2000
Sb	2000
Zn	2000
Mo	2000
Sn	2000
Sr	2000
Ti	2000

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TABLE 6: CRIA STANDARD LEVELS

Element	CRIA
	ug/l
Al	200
As	10
Ca	1000
Fe	300
Mg	5000
Mn	15
Pb	5
Se	5
Tl	10
V	50
Ag	10
Ba	200
Be	5
Cd	5
Co	50
Cr	10
Cu	25
K	5000
Na	5000
Ni	40
Sb	5
Zn	20
Mo	50
Sn	50
Sr	10
Ti	10

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TABLE 7: BLANK SPIKE, MATRIX SPIKE AND MATRIX SPIKE DUPLICATE LEVELS

Element	Concentration
	ug/l
Al	27000
As	2000
Ca	25000
Fe	26000
Mg	25000
Mn	500
Pb	500
Se	2000
Tl	2000
V	500
Ag	50
Ba	2000
Be	50
Cd	50
Co	500
Cr	200
Cu	250
K	25000
Na	25000
Ni	500
Sb	500
Zn	500
Mo	500
Sn	500
Sr	500
Ti	500

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TABLE 8: TYPICAL RUN SEQUENCE

BLANK
MID
HIGH
HIGH STD
ICV
ICB
CRIA
ICSA
ICSAB
CCV
CCB
MB
SB
SAMPLE1
DUPLICATE
SERIAL DILUTION
MATRIX SPIKE
MATRIX SPIKE DUPLICATE
POST DIGESTION SPIKE
SAMPLE2
SAMPLE3
CCV
CCB
SAMPLE4
SAMPLE5
SAMPLE6
SAMPLE7
SAMPLE8
SAMPLE9
SAMPLE10
SAMPLE11
SAMPLE12
SAMPLE13
CRIA
ICSA
ICSAB
CCV
CCB
ETC.

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TABLE 9: ICSA SOLUTION LEVELS

Element	Concentration
	mg/l
Al	500
As	0
Ca	500
Fe	200
Mg	500
Mn	0
Pb	0
Se	0
Tl	0
V	0
Ag	0
Ba	0
Be	0
Cd	0
Co	0
Cr	0
Cu	0
K	0
Na	0
Ni	0
Sb	0
Zn	0
Mo	0
Sn	0
Sr	0
Ti	0

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TABLE 10: ICSAB SOLUTION LEVELS

Element	Concentration
	mg/l
Al	500
As	1.0
Ca	500
Fe	200
Mg	500
Mn	0.5
Pb	1.0
Se	1.0
Tl	1.0
V	0.5
Ag	1.0
Ba	0.5
Be	0.5
Cd	1.0
Co	0.5
Cr	0.5
Cu	0.5
K	0
Na	0
Ni	1.0
Sb	1.0
Zn	1.0
Mo	1.0
Sn	1.0
Sr	1.0
Ti	1.0

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TABLE 11: SINGLE ELEMENT INTERFERENCE CHECK SOLUTION (SIC) LEVELS

Element	Concentration
	mg/l
Al	500
As	0
Ca	500
Fe	200
Mg	500
Mn	0
Pb	0
Se	0
Tl	0
V	0
Ag	0
Ba	0
Be	0
Cd	0
Co	0
Cr	0
Cu	0
K	0
Na	0
Ni	0
Sb	0
Zn	0
Mo	0
Sn	0
Si	50
Sr	0
Ti	0

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DIGESTION OF SOILS FOR ICP ANALYSIS

Prepared by: Dave Metzgar Date: 09/04/2013

Reviewed by: Svetlana Izosimova Date: 09/13/2013

Annual Review

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Reviewed by: _____ Date: _____

Document Control

Issued to: QA Department Date: 09/13/2013

Issued to: Metals Department Date: * 09/13/2013

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Issued to: _____ Date: _____

Effective 7 days after "*" date

TEST NAME: DIGESTION OF SOILS FOR ICP ANALYSIS

METHOD REFERENCE: 3050B

DEPARTMENT: METALS

REPORTING LIMIT: Not applicable

REVISIONS: Section 6.4: Changed CPI to Environmental Express
Section 7.10: updated detail
Appendix A: page 12, Minimum sample size changed to 50 grams.

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 This method is applicable for the digestion of sediments, soils, sludges and solid wastes. After digestion, the samples can be analyzed by ICP. This digestion method is based upon SW846 method 3050B.

1.2 An aliquot of a homogenized soil is digested with repeated additions of nitric acid and hydrogen peroxide. The volume is reduced to 5 ml and then hydrochloric acid is added and the sample is refluxed for 15 minutes. The sample is cooled to room temperature and diluted to 50 ml. If particulate matter is present, the sample is filtered.

2.0 PRESERVATION

All soils must be refrigerated at $\leq$ 6 ^{o}C. All bottleware used by Accutest Southeast is tested for cleanliness prior to shipping to clients. Analysis results must be < ½ RL to be acceptable. Please refer to SOP SAM104, current revision for further instruction.

3.0 HOLDING TIME

All samples should be digested and analyzed within 6 months of the time of collection.

4.0 INTEREFRENCES

Sludge and soil samples can contain diverse matrix types, which may contain a variety of interference. Spiked samples can be used to determine if this interference is adequately treated in the digestion process. For discussion of other interference, refer to specific analytical methods.

5.0 APPARATUS

The apparatus needed for this digestion procedure are listed below.

5.1 Automatic repipettor (s)

5.2 Fisher Brand 0.45 micron (um) filter or equivalent. Filter lots are checked for cleanliness through the Method Blank process. All Method Blank analytical results must be < ½ RL to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated filters must be re-filtered through acceptable filters.

5.3 Top loader balance- capable of accurately weighing 0.01g. Refer to SOP QA005, current revision for balance calibration information.

5.4 Thermometer- capable of measuring to at least 125^0C and checked against NIST traceable thermometers. Refer to SOP QA002, current revision for further information.

5.5 Environmental Express Hot Block or equivalent capable of maintaining a temperature of 90-95°C.

5.6 Environmental Express digestion vessels or equivalent, 50ml capacity. Each Lot of digestion tubes comes with a Certificate of Analysis which demonstrates cleanliness as well as volume accuracy. Please refer to Digestion Tube Certificate Logbook for further information. Tube Lots are also checked through the Method Blank process. All Method Blank analytical results must be < ½ RL to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Re-digestion is required for all samples prepared with the contaminated tube lot.

5.7 Fisher Brand disposable 10 ml syringes or equivalent. Syringe lots are checked for cleanliness through the Method Blank process. All Method Blank results must be < ½ RL to be acceptable, if not, the contaminated lot must be identified and removed from laboratory use. Samples filtered through the contaminated syringes must be re-filtered through acceptable syringes.

5.8 Fisher Brand wooden spatulas or equivalent.

5.9 Eppendorf Pipette (s) - Pipette (s) are checked weekly for accuracy and to ensure they are in good working condition. Volumes are checked at 100% of maximum volume, the 50% (mid-range) and between 10% and 25% at the low range, whichever constitutes most frequently used volume for a particular pipette. Pipettes are checked within the metals department approximately once per week and stored electronically in the “Eppendorf Calibration Log”. Refer to SOP QA006, current revision for further information regarding pipette calibration.

5.10 Class A volumetric flask (s)

5.11 Class A volumetric pipette (s)

5.13 Teflon Chips

5.14 Solid Standard Reference Material (SRM) as required per project/client specific requirements.

6.0 REAGENTS

All chemicals listed below are trace metal grade unless otherwise specified. Refer to Acid Certificate of Analysis logbook for Certificate of Analysis and compliance with specifications of the grade listed. De-ionized (DI) water should be used whenever water is required. Accutest Laboratories produces DI water to the specifications for the ASTM Type II standard designation based on the system manufacturer's performance specifications. The DI water is used exclusively for laboratory purposes. Refer to SOP QA037, current revision for more information regarding testing and monitoring.

6.1 Hydrochloric acid, Fisher Trace metal grade or equivalent

6.2 Nitric acid, Fisher Trace metal grade or equivalent

6.3 Hydrogen peroxide, reagent grade ,30%

6.4 Metals spiking solutions commercially purchased:

Environmental Express Multielement spiking solution or equivalent made with 5% HNO3 and a trace of HF.

Inorganic Ventures 5000 mg/l Mineral solution.

Prepared Metals Standards:

100ppm Molybdenum, 100ppm Tin, 100ppm Strontium, and 100ppm Titanium spiking solution prepared as follows: Using a 10ml class A volumetric pipette, add 10mls of 1000ppm stock Molybdenum, 10mls of 1000ppm stock Tin, 10mls of 1000ppm Strontium, and 10mls of 1000ppm Titanium to a 100ml class A volumetric flask containing approximately 50mls of DI water and 3mls of concentrated Nitric acid and 5mls of concentrated HCL. Dilute to volume with DI water and mix well. This standard must be prepared every 6 months or before stock standard expiration date, whichever comes first. Refer to Metals Standard Prep Logbook for further information. Some of the information included in the logbook is as follows: standard name, elements in mix, manufacturer, lot number, parent expiration date, acid matrix, stock concentration, volume of standard added, total volume, final prepared concentration, prep date, initials, MET number, and prepared standard expiration date.

7.0 PROCEDURE

7.1 Decant any free liquid from the solid sample. Remove any foreign objects such as twigs or rocks. The sample container must have enough room to move the matrix around with the wooden spatula. Mix the sample thoroughly using the wooden spatula. Make certain the entire sample is mixed well. The wooden spatula must reach the bottom of the original container and be able to be moved through the entire sample to ensure proper mixing. If the sample is packed tightly or matrix is dense and can not be efficiently moved around in the original jar, a secondary container such as a porcelain dish must be used. Remove the sample from the original container and place in the clean secondary container. While in the secondary container thoroughly mix sample around until appearing uniform in consistency. Upon completion the sample is re-packed into the original container. Refer to SOP QA034, current revision for more information on sample homogenization. Using a wooden spatula weigh out approximately 1.0 gram of a homogeneous sample on a top loading balance and place in the digestion vessel.

7.2 The sample identification must be accurately recorded on the digestion vessel and sample digestion log. In addition to the samples, a serial dilution (performed at the analytical bench), a post digestion spike (performed at the analytical bench), a matrix spike (MS), matrix spike duplicate (MSD), blank spike, duplicate (DUP) and a method blank should be set up with each batch of 20 samples. Refer to Table 1 for the spiking solution levels to use for each matrix spike, matrix spike duplicate, and blank spike. For the method blank and blank spike, 1.0 g of Teflon chips should be used. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

7.3 Add 2.5 ml of concentrated nitric acid to all quality control and samples.

7.4 Pre heat the Hot Block to 90 to 95°C. Place the labeled digestion vessels into the heating apparatus. Heat the samples at a gentle reflux for 10-15 minutes at 90 to 95°C. Allow the samples to cool.

7.5 Add an additional 2.5 ml of concentrated nitric acid to all quality control and samples. Heat the samples at a gentle reflux for an additional 30 minutes. Allow samples to cool.

7.5.1 If brown fumes are generated, which indicates oxidation of sample by HNO3, then repeat step 7.5 until no brown fumes are present.

7.5.2 Allow sample to evaporate to 5 ml without boiling or heat at 90 to 95°C without boiling for 2 hours. Do not allow sample to go to dryness.

7.6 Allow samples to cool. Add 2 ml of DI water and 3 ml of 30% hydrogen peroxide to each sample and reflux until effervescence subsides.

7.7 Continue to add 30% hydrogen peroxide in 1ml aliquots with warming until the effervescence is minimal or until the general sample appearance is unchanged. Do not add more than a total of 10 mls of 30% hydrogen peroxide.

7.8 Allow sample to evaporate to 5 ml or heat at 90 to 95°C for 2 hours. Do not allow sample to go to dryness.

7.9 Allow samples to cool. Add 5 ml of concentrated HCl and reflux for an additional 15 minutes.

7.10 Allow the sample to cool. Dilute to final volume of 50 mls using DI water, cap and shake vessel. If particulate matter is present, uncap the vessel and filter using Fisher Brand disposable syringe and 0.45 micron (um) filter or equivalent. The method blank and blank spike for the filtered sample's prep group must be filtered as well. All samples are filtered at the analytical bench.

7.11 The sample is now ready for analysis by ICAP.

8.0 QC REQUIREMENTS:

For each digestion batch of 20 samples, a serial dilution (performed at the analytical bench), a post digestion spike (performed at the analytical bench), a matrix spike (MS), a matrix spike duplicate (MSD), a duplicate (DUP), a blank spike (LCS), and a method blank should be prepared. Re-digestion is suggested for QC that does not meet the Accutest QC limits. The appropriate lab supervisor or lab manager will notify the analyst of samples that need re-digestion. Please refer to TABLE 1 in this SOP for spiking volumes and concentrations. Refer to scheduling sheets and/or project specific QAPP for further information regarding client specific QC requirements.

9.0 GLASSWARE CLEANING:

All glassware should be washed with soap and tap water and then soaked in a 5% nitric acid bath. It should then be rinsed at least 3 times with de-ionized water. Refer to SOP GN196, current revision for further information regarding glassware cleaning.

10.0 DOCUMENTATION REQUIREMENTS:

All digestion information should be completed in the Metals Digestion Log. The information required includes: the sample identification (including bottle number), the initial sample weight, the final sample volume, the acids (including the lot number and manufacturer), the spiking solutions used, the observed temperature, the corrected temperature, the thermometer ID, the digestion vessel lot number, the filter lot number, the Teflon chips lot number, analysts signature, and the digestion date. The analyst should write additional information such as unusual sample characteristics in the comment section.

11.0 SAFETY:

The analyst should follow normal safety procedures as outlined in the Accutest Laboratory Safety Manual which includes the uses of safety glasses and lab coats. In

addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact supervisor.

12.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

12.1 Pollution Prevention

Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids must be followed. All method users must be familiar with the waste management practices described in Section 12.2.

12.2 Waste Management

Individuals performing this method must follow established waste management procedures as described in the Sample and Laboratory Waste Disposal SOP SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

13.0 GENERIC DEFINITIONS

13.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples or 24 hours which ever comes first.

13.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

13.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. A CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

13.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

13.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

13.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

13.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

13.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the precision and bias of a method in a given sample matrix.

13.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

13.10 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

13.11 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

14.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Statistical control limits are stored in the LIMS for QA purposes only. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

15.0 Hotblock Maintenance

Clean surface area of hotblock periodically to prevent sample and reagent build up on the surface of the block. If the hotblock can not maintain a temperature between 90-95 degree C or the user experiences any other type of mechanical or electronic error a service representative will need to be contacted. Any hotblock that is not functioning properly must be tagged as “Out of Service”.

TABLE 1: ICP METALS SPIKING LEVELS

ELEMENT	INITIAL CONC (ppm)	VOLUME USED (ml)	FINAL CONC (mg/l)	FINAL VOL. (ml)
Ba	200	0.50	2.0	50
Be	5	0.50	.05	50
Cd	5	0.50	.05	50
Cr	20	0.50	.20	50
Cu	25	0.50	.25	50
Co	50	0.50	0.50	50
Mn	50	0.50	0.50	50
V	50	0.50	0.50	50
Zn	50	0.50	0.50	50
As	200	0.50	2.0	50
Se	200	0.50	2.0	50
Pb	50	0.50	0.50	50
Tl	200	0.50	2.0	50
Sb	50	0.50	0.50	50
Mo	100	0.25	0.50	50
Sn	100	0.25	0.50	50
Al	200/5000	0.5/0.25	27	50
Fe	200/5000	0.5/0.25	26	50
Mg	5000	0.25	25	50
Ca	5000	0.25	25	50
K	5000	0.25	25	50
Na	5000	0.25	25	50
Ag	5	0.50	0.05	50
Ni	50	0.50	0.50	50
Sr	100	0.25	0.50	50
Ti	100	0.25	0.50	50

APPENDIX A

1.0 Application

Appendix A designed to supplement SOPs MET104.xx and MET105.xx for the preparation of soil samples for compliance with DoD and certain state-specific projects

2.0 Background

A theory of particulate sampling was developed by geologist Pierre Gy to improve the quality of data gathered in support of mineral exploration and mining. The MIS approach described herein is based upon Gy's theories and is applicable to environmental sampling at contaminated sites.

A large portion of sampling error is a result of compositional and distributional heterogeneity.

Compositional heterogeneity describes the variability of contaminant concentrations between the particles that make up the population in the sample. This type of heterogeneity results in fundamental error (FE).

Distributional heterogeneity occurs when particles are not randomly distributed across the population due to slight spatial variations. Spatial variability will be missed if all samples are collected from one place. This type of heterogeneity results in grouping and segregation error (GSE).

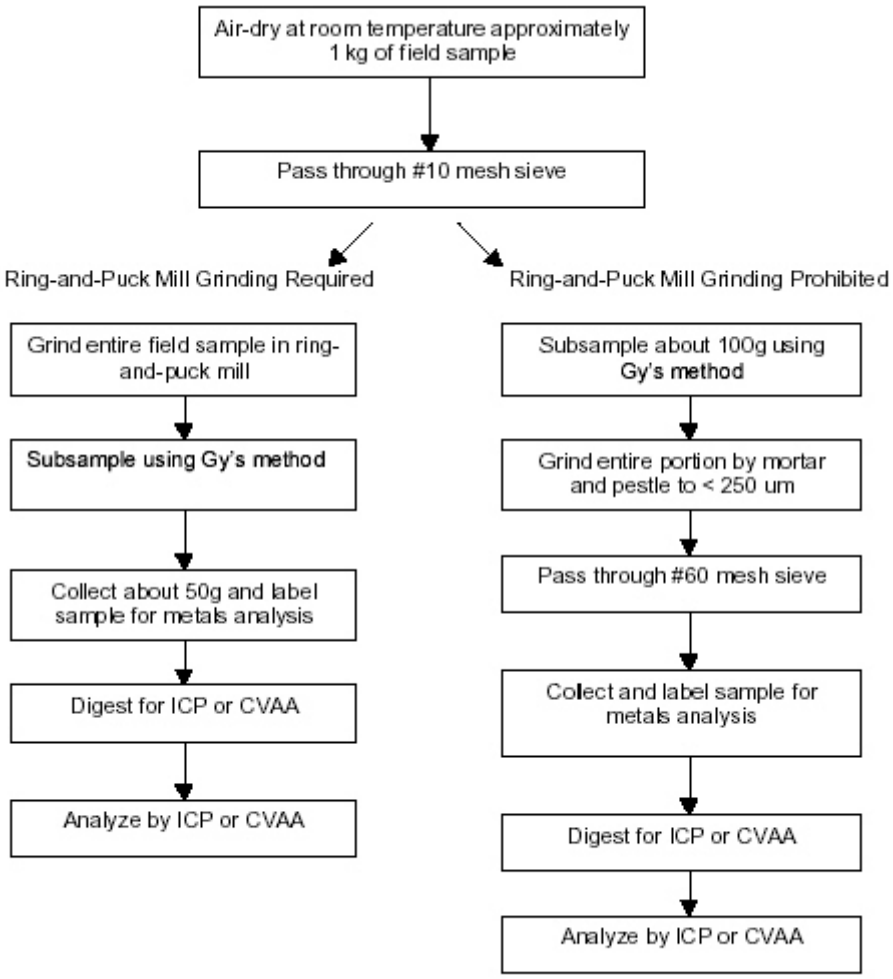
Gy found that fundamental error is directly proportionate to maximum particle size and inversely proportionate to sample size, therefore it is beneficial to collect and analyze a sample of sufficient size that consists of particulate matter where majority of contamination is present. In order to manage FE under 15%, particulate matter size must be under 2 mm and minimum sample mass above 30g.

To minimize GSE, it is imperative to collect sample increments randomly and in enough locations to capture the spatial variability, even within sample that already has been collected from the field.

3.0 Subsampling for Metals

Some projects require that metals analysis be performed on the multi-incremental sample that was collected for 8330B. The technique used should be listed in the project QAPP or SOW. Consult the client if this information is not available.

See flow chart below for various subsampling techniques:



If Ring and Puck Mill grinding is required, then proceed with the grinding procedure listed in SOP OP046 for explosives. The metallic components from the Ring and Puck Mill may introduce chromium and iron into the sample.

After grinding, place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick. Using a rectangular scoop, collect multiple top-to-bottom cuts across the sample (see figure below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Transfer the samples to the metals department for analysis.

If Ring and Puck Mill grinding is not required then follow the procedure listed below.

Transfer the sample to a large ziplock bag after it has been air dried and sieved. Sample should be transferred over the downdraft tables to minimize dust contamination. Seal the bag and thoroughly mix the sample.

Place a baking tray on the downdraft table. Transfer the entire sample to the tray. Shape the sample into an elongated pile with flattened top surface that it is approximately 1 cm thick. Using a rectangular scoop, collect multiple top-to-bottom cuts across the sample (see figure below). A minimum of 4 cuts should be made through each sample. Combine the cuts in an appropriately labeled container. Minimum sample size should be 50 grams. Close the jar and repeat this procedure for each sample including the MB.

Return the remaining sample to the ziplock bag or mixing bowl.

Grind each sample and MB to a particle size less than 250 um with a non-metallic mortar and pestle.

Place a baking tray on the downdraft table. Sieve each sample through a #60 sieve onto a tray.

Collect and label the samples. Transfer the samples to the metals department for analysis.

For digestion withdraw approximately 5 g of sieved material. If mortar-and-pestle grinding was specified per QAPjP, 1 g is sufficient. Follow digestion procedure outlined in the body of this SOP.

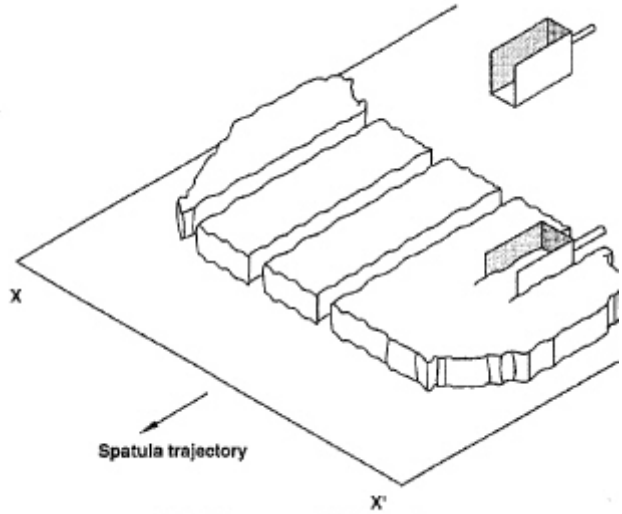


FIG. 1 Transversal Subsampling

ANALYSIS OF PERCHLORATE BY LC/MS/MS

Prepared by:	Norm Farmer	Date:	08/31/13
Reviewed by:	Mike Eger	Date:	09/06/13

Annual Review

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Issued to:		Date:	
Issued to:		Date:	

Effective 7 days after "*" date

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TEST NAME: ANALYSIS OF PERCHLORATE BY LC/MS/MS

METHOD REFERENCE: SW846 6850

DEPT: HPLC

Revised Sections: 6.10, 7.1, 7.1.3, 7.4.1.3, 7.4.2.4, 7.6-7.6.4, 8.0 and 11.1

1.0 SCOPE AND APPLICATION, SUMMARY

1.1 Scope and Application

1.1.1 This method is used to determine the concentrations of Perchlorate in water and solid matrices utilizing an HPLC equipped with a tandem mass spectrometer (MS/MS).

1.1.2 The following compound can be reported by this method:

Perchlorate ClO_4^- CAS # 14797-73-0

1.1.3 The reporting limits (RL) are based on the extraction procedure and the lowest calibration standard. Reporting limits may vary depending on matrix complications and volumes. Reporting limits for this method are 0.2ug/l for aqueous samples and 2ug/kg for solid samples.

1.1.4 The Method Detection Limit (MDL) for each analyte is evaluated on an annual basis for each matrix and instrument. MDLs are pooled for each matrix, and the final pooled MDLs are verified. The verified MDLs are stored in the LIMS and should be at least 2 to 3 times lower than the RL. Exceptions may be made on a case by case basis; however, at no point shall the MDL be higher than the reported RL.

1.1.5 Compounds detected at concentrations between the RL and MDL are quantitated and qualified as estimated values and reported with either a “J” or “I” qualifier. Some program or project specifications may require that no values below the RL be reported.

1.2 Summary

1.2.1 This method is adapted from SW846 6850.

1.2.2 Samples are received, stored, and extracted within the appropriate holding times.

1.2.3 Water samples are filtered and analyzed directly by HPLC/MS/MS. Soils are extracted with reagent water, filtered and then analyzed by HPLC/MS/MS. Sample preparation is discussed within this SOP.

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1.2.4 Perchlorate is separated, detected and quantitated using an HPLC/MS/MS. After HPLC separation and ionization, the perchlorate is isolated in the first mass spectrometer and transferred to a collision cell for fragmentation. The resulting fragments *m/z* 83 (ClO_3^-), 85 ($^{37}ClO_3^-$), and 89 ($Cl^{18}O_3^-$) are introduced into the second mass spectrometer where they are detected and quantified.

1.2.5 Manual integrations are performed in accordance with SOP QA029.

2.0 PRESERVATION AND HOLDING TIME

2.1 Preservation

2.1.1 Samples shall be collected in 125mL polyethylene bottles. A 4oz jar is recommended for solid samples. Containers should only be filled 2/3s of the way. This will reduce potential anaerobic biodegradation.

2.1.2 The samples must be refrigerated at ≤ 6°C from the time of collection until extraction. The extracts must be stored at ≤ 6°C until analysis.

2.2 Holding Time

2.2.1 Aqueous samples must be analyzed within 28 days of collection.

2.2.2 Solid and waste samples must be extracted and analyzed within 28 days of collection.

3.0 INTERFERENCES

3.1 Data from all blanks, samples, and spikes must be evaluated for interferences. Method interferences may be caused by contaminants in solvents, reagents, or glassware. All of these materials must be demonstrated to be free from interferences.

3.2 All reagent solutions and samples (including QC samples) should be filtered through 0.45um nominal pore size or smaller (0.2um) membrane syringe filter to remove particulates and prevent damage to the instrument, columns and flow systems. Filters specifically designed for HPLC applications should be used.

3.3 Hydrogen sulfate ion ($H^{34}SO_4^-$), *m/z* 99, formed from a minor sulfur isotope, is commonly present in samples. $H^{34}SO_4^-$ elutes before perchlorate but at high concentrations can tail into the retention time of the perchlorate peak and elevate its baseline at *m/z* 99. Quantitation of perchlorate based on *m/z* 83, 85 and 89 avoids this potential interference from $H^{34}SO_4^-$.

3.4 Retention time shifts may occur as competing anions in the sample take up active sites on the column stationary phase. In such samples, perchlorate will elute earlier than in the calibration standards. The $Cl^{18}O_4^-$ peak from the IRCS will

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also shift, and therefore is used to confirm the identification of the native perchlorate peak.

3.5 Potential problems may arise when analyzing samples containing high levels of total dissolved solids (TDS) (i.e. salts of chloride, sulfate, carbonate/bicarbonate, etc.). Ionization suppression can occur when high levels of dissolved salts are introduced into the mass spectrometer, resulting in a reduction in the perchlorate analyte peak. The degree of ionization suppression will depend on the type and concentration of interfering ions present, and whether or not they overlap with perchlorate when eluted. The $Cl^{18}O_4^-$ peak from the IRCS will similarly be affected and the internal standard calibration will correct for this effect. However, significant ionization suppression can result in failure to meet the ± 50% IRCS response verification acceptance criterion. Additionally, ionization suppression can result in the complete loss of the analyte signal, particularly when the perchlorate levels of the sample are at or near the reporting limit. Sample dilution, the use of a smaller injection volume or sample cleanup can be used to help minimize this effect.

A conductivity limit study (Section 7.3) should be performed in order to determine the approximate level of TDS that can be tolerated by a particular system before it impacts the chromatographic performance and quantitation.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to a maximum of 20 samples.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. For all GC and HPLC methods, a CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Conductivity Limit (CL): The threshold of common ionic suppressors that can be present in the system without significantly affecting the quantitation of perchlorate.

4.5 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still considered valid.

4.6 Interference Check Sample (ICS): A dissolved salt solution prepared at the maximum conductivity limit and fortified with perchlorate at the reporting limit.

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4.7 Internal Standards (ISTD): A compound which is similar to the target analyte(s) in chemical composition and behavior, but which is not normally found in environmental samples. This may also be referred to as an Internal Recovery and Calibration Standard (IRCS).

4.8 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

4.9 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.10 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.11 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.12 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.13 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.14 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 REAGENTS

5.1 Water – HPLC grade or equivalent

5.2 Acetonitrile – HPLC grade or equivalent

5.3 Acetic Acid, Glacial – ACS Grade or equivalent.

5.4 Sodium Chloride, NaCl

5.5 Sodium Sulfate, Na_2SO_4

5.6 Sodium Carbonate, Na_2CO_3

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5.7 Interference Check Solution (ICS) – 5000mg/l each of chloride, sulfate, and carbonate by dissolving 2.06g NaCl + 2.77g Na_2SO_4 + 2.21g Na_2CO_3 into 250ml of DI.

5.8 Perchlorate stock standards – Traceable to Certificate of Analysis.

5.9 $Cl^{18}O_4^-$ – Internal Standard

6.0 APPARATUS

6.1 HPLC – Agilent Technologies 1260

Suitable HPLC equipped with an autosampler, pump, and column compartment.

6.2 MS/MS – Agilent Technologies 6460A

Suitable tandem MS capable of fractionating and monitoring the appropriate ions.

6.3 Data System – Agilent Technologies MassHunter B.04.00 and B.04.01

6.3.1 A computer system interfaced to the HPLC/MS/MS that allows for the continuous acquisition and storage of all data obtained throughout the duration of the chromatographic program.

6.3.2 The software should allow for the viewing of the specific MS/MS Spectra acquired over the analytical run. Comparisons can then be made between spectra from standards and samples.

6.3.3 Data is archived to a backup server for long term storage.

6.4 Column (RP) – K'(Prime) Technologies 5um 4mm X 250mm or equivalent.

6.5 Vortexer

6.6 Ultrasonic Bath

6.7 Centrifuge – Adequate for clarifying soils extracts prior to filtration.

6.8 15ml Centrifuge tubes

6.9 Disposable Syringes

6.10 Syringe or Vial Filters 0.45um or 0.2um

6.11 Glass screw cap and autosampler vials

6.12 Volumetric Pipettors and class "A" volumetric glassware for dilutions of standards and extracts.

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7.0 PROCEDURE

7.1 Standards Preparation

Standards are prepared from commercially available certified neat or reference standards. All standards must be logged in the HPLC Standards Logbook. All standards shall be traceable to their original source. The standards should be stored at ≤ 6°C, or as recommended by the manufacturer. Calibration levels, spike and surrogate concentrations, and vendor part numbers can be found in the MS STD Summary in the Active SOP directory.

7.1.1 Stock Standard Solutions

Stock standards are available from some commercial vendors. All vendors must supply a "Certificate of Analysis" with the standard. The certificate will be retained by the lab. Hold time for unopened stock standards is until the vendor's expiration date. Once opened, the hold time is reduced to one year or the vendor's expiration date (whichever is shorter).

7.1.2 Intermediate Standard Solutions

Intermediate standards are prepared by quantitative dilution of the stock standard with HPLC water. The hold time for intermediate standards is six months or the vendor's expiration date (whichever is shorter). Intermediate standards may need to be remade if comparisons to other standards indicate analyte degradation or concentration changes.

7.1.3 Calibration Standards

Calibration standards for Perchlorate are prepared at a minimum of six concentration levels through quantitative dilutions of the intermediate standard. Calibration standards are prepared in HPLC water. The low standard is at a concentration at or below the RL and the remaining standards defines the working range of the detector.

Calibration Conc. (ug/l)	Volume (ul) of 100ug/l Perchlorate Intermediate Std	ISTD Conc. (ug/l)	Volume (ul) of 1000ug/l ISTD Intermediate Std	Final Volume (ml)
0.2	20	5	50	10
0.5	50	5	50	10
1	100	5	50	10
2	200	5	50	10
5	500	5	50	10
10	1000	5	50	10
25	2500	5	50	10
50	5000	5	50	10

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Calibration standard concentrations are verified by the analysis of an initial calibration verification (ICV) standard.

7.2 HPLC/MS/MS Conditions

7.2.1 HPLC Conditions

25ul autosampler injection

Mobile phase – Isocratic 50% A and 50% B

Eluent A: 95% Water, 5% Acetonitrile, and 0.1% acetic acid
Eluent B: 95% Acetonitrile, 5% Water, and 0.1% acetic acid

Column temperature – 30.0 °C Flow – 0.5 ml/min

7.2.2 MS/MS Conditions

Ionization Mode – ESI w/ Jet Stream

Fragmentation Voltage – 70 to120 V

Collision Energy – 20 to 30 V

Dwell Time 100 msec

Fragmentation Table:

$Cl^{18}O_4^-$ (ISTD) *m/z* 107 to 99
Perchlorate *m/z* 99 to 83
Perchlorate *m/z* 101 to 85

HPLC/MS/MS conditions are optimized for each instrument. Actual conditions may vary slightly from those listed above.

7.3 Conductivity Limit Study

Before any samples can be run, a conductivity limit study must be performed for each individual HPLC/MS/MS system in order to determine the approximate sample conductivity that can be tolerated before the loss of column capacity brings about a significant reduction in analyte signal. The specific conductivity of each aqueous sample or extract may be measured and recorded and compared to the conductivity limit (CL) in order to determine the approximate amount of sample dilution that may be necessary to produce acceptable perchlorate recovery.

7.3.1 Prepare a 5000mg/l Dissolved Salt Solution (DSS) each of chloride, sulfate, and carbonate by dissolving 2.06g NaCl + 2.77g Na_2SO_4 + 2.21g Na_2CO_3 into 250ml of DI.

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7.3.2 Using the above stock, prepare various concentrations of DSS ranging from 500mg/l to 2000mg/l. Fortify each concentration with 0.5 ug/l perchlorate and 5.0 ug/l ISTD.

7.3.3 Analyze the various Dissolved Salt Solutions. The perchlorate recovery should be within 85-115% of the theoretical value and the ISTD recovery within ± 50% of that of the ICV or CCV. If the recovery meets these criteria, then perchlorate may be accurately analyzed in samples having that high a TDS.

7.3.4 Determine the conductivity of the highest acceptable DSS. That will be considered the Conductivity Limit (CL) for the system. For most systems this limit is about 10,000 umhos/cm.

7.3.5 The conductivity of each sample is determined by the General Chemistry Department prior to the analysis of any samples. Samples that exceed the Conductivity Limit may need to be diluted prior to analysis.

7.3.6 For DoD projects, an Interference Check Solution (ICS) must be prepared and analyzed with each batch. The ICS is a DDS prepared at the Conductivity Limit (CL) and fortified with perchlorate at the Reporting Limit.

7.4 Sample Preparation

7.4.1 Aqueous Samples

7.4.1.1 Remove samples to be analyzed from the storage cooler and allow them to warm to ambient temperature. Transfer 10ml of sample to a 16ml screw top vial.

7.4.1.2 Use 10ml of reagent water for the method blank (MB) and blank spike (BS). Use additional 10ml aliquots for the matrix spike (MS) and matrix spike duplicate (MSD).

7.4.1.3 Add 20ul of spike mix to the BS, MS, and MSD.

7.4.1.4 Add 50 ul of ISTD solution, cap and invert several times.

7.4.1.5 Store until ready for analysis.

7.4.2 Solid Samples

7.4.2.1 Remove samples to be analyzed from the storage cooler. Transfer 1.0g of sample to a clean 16ml vial or 15ml centrifuge tube. Record the weight to 0.01g on the prep sheet.

7.4.2.2 Add 10ml HPLC grade water to the vial. Cap and shake for about 1 minute.

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7.4.2.3 Use 1.0g of blank sand for the method blank (MB) and blank spike (BS). Use additional 1.0g aliquots for the matrix spike (MS) and matrix spike duplicate (MSD).

7.4.2.4 Add 20uL of spike mix to the BS, MS, and MSD. Invert each vial several times to mix.

7.4.2.5 Add 50 ul of ISTD solution, cap and invert several times.

7.4.2.6 Vortex the mixture, then place the vials in an ultrasonic bath for at least 10 minutes.

7.4.2.7 Remove the vials from the bath and allow the contents to settle.

7.4.2.8 If necessary, centrifuge the samples for 5 minutes to separate the solids from the extract solution.

7.4.2.9 Filter the extract through a .45um or 0.2um Teflon syringe filter to remove any particulate.

7.4.2.10 Transfer 2ml of sample to a labeled 2ml screw top vial.

7.4.2.11 Store until ready for analysis.

7.5 HPLC/MS/MS Analysis

Instrument calibration consists of three major sections:

Mass Tuning and Calibration
Initial Calibration Procedures
Continuing Calibration Verification

7.5.1 Mass Tuning and Calibration

Before samples can be run, the LC/MS/MS system must be mass tuned and calibrated.

The instrument should be hardware tuned per manufacturer's instructions after any maintenance is performed and prior to analyzing a new calibration curve.

The instrument must have a valid mass calibration prior to any sample analysis. The mass calibration should be updated as needed. (i.e. QC failures, ion masses showing large deviations from know masses, or major instrument maintenance is performed).

Verify the instrument tune and mass calibration by analyzing a Perchlorate stock standard. The Perchlorate ions should be within ± 0.3 *m/z* of mass 83, 85, and 89.

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The theoretical ratio of *m/z* 83/85 should be 3.06, but must fall between 2.3 and 3.8.

7.5.2 Initial Calibration Procedures

Before samples can be run, the HPLC/MS/MS system must be calibrated.

7.5.2.1 Internal Standard Calibration

A minimum 6-point calibration curve is created for Perchlorate.

Response factors (RF) for each analyte are determined as follows:

$$RF = (A_{anayte} \mathbf{X} C_{istd})/(A_{istd} \mathbf{X} C_{analyte})$$

A_{anayte} = area of the analyte
A_{istd} = area of the internal standard
$C_{analyte}$ = concentration of the analyte
C_{istd} = concentration of the internal standard.

The mean RF and standard deviation of the RF are determined for each analyte. The percent relative standard deviation (%RSD) of the response factors is calculated for each analyte as follows:

%RSD = (Standard Deviation of RF X 100) / Mean RF

If the %RSD $\leq$ 20%, linearity through the origin can be assumed and the mean RF can be used to quantitate target analytes in the samples. Alternatively if the %RSD > 20% a calibration curve of response vs. amount can be plotted. If the correlation coefficient (r) is $\geq$0.995 ($r^2 \geq$0.990) then the curve can be used to quantitate target analytes in the samples.

7.5.2.2 Initial Calibration Verification (ICV)

The validity of the initial calibration curve must be verified through the analysis of an initial calibration verification (ICV) standard. The ICV should be prepared from a second source at a mid-range concentration.

The %D for the compound of interest should be $\leq$ 15%. If the ICV does not meet these criteria, a second standard should be prepared. If the ICV still does not meet criteria, analyze an ICV prepared from a third source. If this ICV meets criteria, proceed with sample analysis. If the ICV still does not meet criteria, determine which two standards agree. Make fresh

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calibration standards and an ICV from the two sources that agree. Recalibrate the instrument.

7.5.2.3 Retention Time Windows

A retention time window study is not necessary for this method. However, it is beneficial to monitor analyte and ISTD retention times and peak area counts in all samples and QC standards.

Retention time shifts may occur as competing anions (high TDS) in the sample take up active sites on the column stationary phase. In such samples, perchlorate will elute earlier than in the calibration standards. The $Cl^{18}O_4^-$ peak (ISTD) will also shift, and therefore is used to confirm the identification of the native perchlorate peak.

The RRT of the perchlorate ion in a sample is the retention time of the perchlorate ion divided by the retention time of the internal standard. The RRT must be 1.0 ± 2% (0.98 – 1.02).

Retention time windows in the software should be set wide enough so not to miss any potential peaks.

7.5.3 Continuing Calibration Verification (CCV)

Continuing calibration verification standards for perchlorate are prepared at two concentrations; one CCV level should be near the mid-point and the other CCV level should be at the low-point of the calibration curve.

The mid-point CCV must be analyzed at the beginning and end of each run to verify that the initial calibration is still valid. Additionally the mid-point CCV must be analyzed after every 10 samples.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 15% for the analyte in the mid-point CCV.

Additionally the low-point CCV must be analyzed at the beginning and end of each run to verify instrument sensitivity. Additional low-point CCVs may be analyzed after every 10 samples in order to reduce the reanalysis rate.

The percent difference (%D) for each analyte of interest will be monitored. The |%D| should be ≤ 50% (30% for DoD projects) for the analyte in the low-point CCV.

If the first continuing calibration verification does not meet criteria, a second standard may be injected. If the second standard does not meet criteria, the system must be recalibrated.

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If the |%D| is outside the control limits, then documented corrective action is necessary. This may include recalibrating the instrument and reanalyzing the samples, performing instrument maintenance to correct the problem and reanalyzing the samples, or qualifying the data. Under certain circumstances, the data may be reported, i.e. The CCV failed high, the associated QC passed, and the samples were ND.

NOTE: Any target analytes that are detected in the samples must be bracketed by an acceptable initial calibration curve and acceptable CCV standards; otherwise, the samples must be reanalyzed or the data must be qualified.

7.5.4 Sample Extract Analysis

7.5.4.1 Samples are analyzed in a set referred to as an analysis sequence or batch. A batch consists of the following:

Initial Calibration Standards (or Initial CCV)
QC Extracts
Sample Extracts
CCV Standards
ICS (DoD Projects Only)

7.5.4.2 Internal standard solution was added to sample and QC sample during the sample preparation steps. If the samples or extracts need to be diluted, additional aliquots of ISTD should be added to bring the final concentration to 5.0 ug/l.

7.5.4.3 Twenty-five microliters (same amount as standards) of extract is injected into the HPLC by the autosampler. The data system then records the resultant peak responses and retention times.

7.5.4.4 Tentative identification of an analyte occurs when the peak from the sample extract fall within the retention time window of the target compound.

The RRT of the perchlorate ion in a sample is the retention time of the perchlorate ion divided by the retention time of the internal standard. The RRT must be 1.0 ± 2% (0.98 – 1.02).

Check the ratio of *m/z* 83 to *m/z* 85. The theoretical ratio of *m/z* 83/85 should be 3.06; however, the ratio of *m/z* 83 to *m/z* 85 must be between 2.3 and 3.8.

If the RRT and *m/z* 83/85 both meet the above criteria, then the hit is considered to be confirmed.

7.5.4.5 If the compound identification does not confirm, then the result should be reported as ND or “U”.

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7.5.4.6 If the analyte response exceeds the linear range of the system, the extract must be diluted and reanalyzed. It is recommended that extracts be diluted so that the response falls into the middle of the calibration curve.

7.5.4.7 If peak identification is prevented by the presence of interferences, further cleanup may be required or the extract must be diluted so that the interference does not mask any analytes.

7.6 Maintenance and Trouble Shooting

7.6.1 Refer to SOP GC001 for routine instrument maintenance and trouble shooting.

7.6.2 All instrument maintenance must be documented in the appropriate "Instrument Repair and Maintenance" log. The log will include such items as problem, action taken, correction verification, date, and analyst.

7.6.3 Repairs performed by outside vendors must also be documented in the log. The analyst or Department Supervisor responsible for the instrument must complete the log if the repair technician does not.

7.6.4 PC and software changes must be documented in the "Instrument Repair and Maintenance" log. Software changes may require additional validation.

8.0 METHOD PERFORMANCE

Method performance is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

Blank spike, blank spike duplicate, matrix spike, and matrix spike duplicate samples are compared to **method defined** control limits. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

9.0 QUALITY ASSURANCE / QUALITY CONTROL

Accuracy and matrix bias are monitored by the use of surrogates and by the analysis of a QC set that is prepared with each batch (maximum of 20 samples) of samples. The QC set consists of a method blank (MB), blank spike (BS), matrix spike (MS), and matrix spike duplicate (MSD). All control limits are updated annually and are listed in the LIMS.

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9.1 Internal Standards

9.1.1 $Cl^{18}O_4^-$ is used as internal standards for this method. The response of the internal standard in all subsequent runs should be ±50% of the internal standard response in the opening CCV for each sequence. On days that an initial calibration is performed, the internal standard responses should be compared to the internal standard responses for the mid-point standard.

9.1.2 If the internal standard responses are not within limits, the following are required.

9.1.2.1 Check to be sure that there are no errors in calculations, integrations, or internal standards solutions. If errors are found, recalculate the data accordingly.

9.1.2.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample. If the recovery is high due to interfering peaks, it may be possible to get a more accurate recovery by analyzing the sample on a different column type.

9.1.2.3 If no problem is found, prepare a second aliquot of extract and reanalyze the sample.

9.1.2.4 If upon reanalysis, the responses are still not within limits, the problem is considered matrix interference.

9.1.2.5 Verify the conductivity of the sample. If the conductivity is greater than 7500 umhos/cm, then the TDS may be suppressing the response. Reanalyze the sample at increasing dilutions until the acceptance criteria have been met.

9.1.2.6 The sample may need to be reported from the dilution or the results qualified.

9.2 Method Blank

9.2.1 The method blank is either HPLC water or cleaned sand (depending upon sample matrix). The method blank is then taken through all procedures along with the other samples to determine any contamination from reagents, glassware, or high level samples. The method blank must be free of any analytes of interest or interferences at ½ the required reporting level to be acceptable. If the method blank is not acceptable, corrective action must be taken to determine the source of the contamination. Samples associated with a contaminated method blank shall be evaluated as to the best corrective action for each particular sample. This may include reanalyzing the samples, re-extracting and reanalyzing the samples or qualifying the results with a “B” or “V” qualifier.

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9.2.2 If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification.

9.2.3 If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. This must be approved by the department supervisor.

9.2.4 If the MB is contaminated but the samples results are < 10 times the contamination level, the source of the contamination should be investigated and documented. The samples should be re-extracted and reanalyzed for confirmation. If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.3 Blank Spike

9.3.1 The blank spike is either HPLC water or cleaned sand (depending upon sample matrix) to which the spike standard has been added. The blank spike is then taken through all procedures along with the other samples to monitor the efficiency of the extraction procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = (Blank Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest must fall within 80-120% of true value for the results to be acceptable.

9.3.2 If the blank spike recovery is not within the established control limits, the following are required.

9.3.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.3.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.3.2.3 If the recovery of an analyte in the BS is high and the associated sample is non-detect, the data may be reportable.

9.3.2.4 If no problem is found, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the

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samples, re-extracting and reanalyzing the samples, or qualifying the results as estimated.

9.3.2.5 If there is insufficient sample to re-extract, or if the sample is re-extracted beyond hold time, the appropriate footnote and qualifiers should be added to the results. This must be approved by the department supervisor.

9.4 Matrix Spike and Matrix Spike Duplicate

9.4.1 Matrix spike and spike duplicates are replicate sample aliquots to which the spike standard has been added. The matrix spike and spike duplicate are then taken through all procedures along with the other samples to monitor the precision and accuracy of the procedure. The percent recovery for each analyte is calculated as follows:

% Recovery = [(Spike Amount – Sample Amount) / Amount Spiked] X 100

The percent recovery for each analyte of interest must fall within 80-120% of true value for the results to be acceptable.

9.4.2 If the matrix spike recoveries are not within the established control limits, the following are required.

9.4.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.4.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.4.2.3 If no problem is found, compare the recoveries to those of the blank spike. If the blank spike recoveries indicate that the problem is sample related, document this on the run narrative. Matrix spike recovery failures are not grounds for re-extract but are indications of the sample matrix effects.

9.4.3 Precision

Matrix spike and spike duplicate recoveries for each analyte are used to calculate the relative percent difference (RPD) for each compound.

RPD = [| MS Result – MSD Result | / Average Result] X 100

The RPD for Perchlorate should be less than 15%. If the RPDs fall outside of the established control limits, the MS and MSD should be reanalyzed to ensure that there was no injection problem. If upon

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reanalysis the RPDs are still outside of the control limits, the department supervisor shall review the data and determine if any further action is necessary. RPD failures are generally not grounds for re-extraction.

9.5 Interference Check Solution (ICS) (for DoD projects only)

9.5.1 The ICS is a dissolved salt solution that has been prepared at the instruments maximum conductivity limit as determined in Section 7.3. The solution was spiked with perchlorate at the reporting limit and ISTD at 5.0ug/l.

% Recovery = (ICS Spike Amount / Amount Spiked) X 100

The percent recovery for each analyte of interest must fall within 70-130% of true value for the results to be acceptable.

9.5.2 If the ICS spike recovery is not within the established control limits, the following are required.

9.5.2.1 Check to be sure that there are no errors in calculations, dilutions, integrations, or spike solutions. If errors are found, recalculate the data accordingly. If errors are suspected, re-vial and re-inject the extract to verify.

9.5.2.2 Check instrument performance. It may be necessary to re-vial and re-inject the extract in order to verify performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample.

9.5.2.3 Prepare and analyze a second ICS at ½ the maximum conductivity limit. If this ICS meets criteria it may be an indication that the column is degraded and either needs to be replaced or that the CL needs to be lowered.

9.5.2.4 If the CL is to be lowered, confirm that the conductivity of each sample was lower than the new CL. If the conductivity of any sample was higher than the new CL, dilute and reanalyze the sample.

9.5.2.5 Under no circumstances should samples or extracts with a conductivity greater than the CL be reported without being properly diluted.

10.0 CALCULATIONS

The concentration of Perchlorate in the original sample is calculated as follows:

Water (ug/l) = $(CONC_{inst}) \times (V_F / V_I) \times DF$

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Soil (ug/kg) = $[(CONC_{inst}) \times (V_F / W_I) \times DF] / \%solids$

$CONC_{inst}$	=	Instrument concentration calculated from the initial Calibration using mean CF, linear curve, or Quadratic curve
DF	=	Dilution Factor
V_F	=	Volume of final extract (ml)
V_I	=	Volume of sample extracted (ml)
W_I	=	Weight of sample extracted (g)
%solids	=	Dry weight determination in decimal form

11.0 SAFETY AND POLLUTION PREVENTION

11.1 Safety

The analyst should follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which includes the use of safety glasses, gloves, and lab coats.

The toxicity of each reagent and target analyte has not been precisely defined; however, each reagent and sample should be treated as a potential health hazard. Material Safety Data Sheets (MSDS) or Safety Data Sheets (SDS) are available for all reagents and many of the target analytes. Exposure must be reduced to the lowest possible level. Personal protective equipment should be used by all analysts.

11.2 Pollution Prevention

Wastewater, methanol, and acetonitrile from the instrument are collected in waste storage bottles and are eventually transferred to the non-chlorinated waste drum.

Sample Extracts are archived and stored for 30 days after analysis. Old extracts and standards are disposed of in the waste vial drum.

12.0 REFERENCES

SW846 Method 8000C Revision 3, March 2003

SW846 Method 6850 Revision 0, January 2007

DOD Perchlorate Handbook Revision 1, Change 1, August 2007

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STANDARD OPERATING PROCEDURE FOR THE DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY

Prepared by:	Rick Watkins	Date:	10/01/2012
Reviewed by:	Angel Rivera	Date:	10/06/2012

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TITLE: DETERMINATION OF INORGANIC ANIONS BY ION CHROMATOGRAPHY

METHOD REFERENCES: EPA 300.0, Revision 2.1, 1993; SW846 9056A; 40CFR, part 136, Ap. B – MDL procedure.

***Revised Sections*: fluoride reporting limit – sec. 3.0, Preservation procedures amended in sec. 6.0; addition of ICS-2100 – sec. 7.1, Class 1 weights added – sec. 7.3; Balance calibration procedures added – sec. 7.2; calibration curves – 8.2.1 and 8.2.2, soil spike procedure – 10.1.2., sample filtering – 10.2, pump priming – 11.4, low check criteria – 11.9.3; MS and MSD are discussed in Method Performance sec. 13.0; DoD version and NELAC/TNI revisions corrected in sec. 17**

1.0 SCOPE AND APPLICATION

1.1 This method is for the measurement of anions such as bromide, chloride, fluoride, nitrate, nitrite and sulfate by ion chromatography. The method is applicable to potable and non-potable water, solids after extractions, and neutral leachates.

2.0 SUMMARY OF METHOD

2.1 A small volume of sample is introduced into an ion chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, and analytical column, a suppressor column, and a conductivity detector.

2.2 Detection limits vary with the instrument conditions and calibration levels used.

3.0 REPORTING LIMIT AND METHOD DETECTION LIMIT

3.1 Reporting Limit. The normal reporting limit for this method is normally established at or above the lowest non-zero concentration standard in the calibration curve. Detected concentrations below this concentration are not reported unless MDL reporting is being done. Reporting limits were set as follows:

ANALYTE	REPORTING LIMIT
Bromide	0.50 mg/l
Chloride	2.00 mg/l
Fluoride	0.20 mg/l
Nitrate	0.10 mg/l
Nitrite	0.10 mg/l
Sulfate	2.00 mg/l

3.2 Method Detection Limit. Experimentally determine MDLs using the procedure specified in 40 CFR, Part 136, Appendix B. This value represents the lowest reportable concentration of an individual compound that meets the method qualitative identification criteria.

3.2.1 Experimental MDLs must be determined semiannually for this method, as outlined in EPA 300.0. Refer to SOP QA020, current revision, for further details.

4.0 DEFINITIONS

4.1 Batch: A group of samples which are similar with respect to matrix and the testing procedures being employed and which are processed as a unit. A sample batch is limited to

a maximum of 20 samples or samples loaded on an instrument within the same 12-hour shift, which ever comes first.

4.2 Blank Spike (BS): An analyte-free matrix spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. Blank Spike Recoveries are used to document laboratory performance for a given method. This may also be called a Laboratory Control Sample (LCS).

4.3 Continuing Calibration Verification (CCV): A check standard used to verify instrument calibration throughout an analytical run. CCV must be analyzed at the beginning of the analytical run, after every 10 samples, and at the end of the run.

4.4 Holding Time: The maximum times that samples may be held prior to preparation and/or analysis and still be considered valid.

4.5 Initial Calibration (ICAL): A series of standards used to establish the working range of a particular instrument and detector. The low point should be at a level equal to or below the reporting level.

4.6 Initial Calibration Verification (ICV): A standard from a source different than that used for the initial calibration. A different vendor should be used whenever possible. The ICV is used to verify the validity of an Initial Calibration. This may also be called a QC check standard.

4.7 Matrix Spike (MS): A sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike recoveries are used to document the bias of a method in a given sample matrix.

4.8 Matrix Spike Duplicate (MSD): A replicate sample aliquot spiked with a known amount of analyte(s), processed simultaneously with the samples through all the steps of the analytical procedure. The matrix spike duplicate recoveries are used to document the precision and bias of a method in a given sample matrix.

4.9 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is processed simultaneously with the samples through all the steps of the analytical procedure. The method blank is used to document contamination resulting from the analytical process.

4.10 Method Detection Limits (MDLs) MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. This definition is qualitative in nature and does not evaluate an acceptable quantitative limit for method performance. MDLs should be determined semiannually for every matrix in this method. Refer to SOP QA020, current revision.

4.11 Reagent Blank: The reagent blank is a blank that has the same matrix as the samples, i.e., all added reagents, but did not go through sample preparation procedures. The reagent blank is an indicator for contamination introduced during the analytical procedure. For methods requiring no preparation step, the reagent blank is equivalent to the method blank.

4.12 Reagent Grade: Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents, which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

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4.13 Reagent Water: Water that has been generated by any method, which would achieve the performance specifications for ASTM Type II water.

4.14 Reference Material: A material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.

4.15 Sample Duplicate (DUP): A replicate sample which is used to document the precision of a method in a given sample matrix.

4.16 Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical integrity of the sample.

5.0 HEALTH & SAFETY

5.1 The analyst should follow normal safety procedures as outlined in the Accutest Laboratory Safety Manual which includes the use of safety glasses and lab coats. In addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.

5.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets should be made available to all personnel involved in these analyses.

6.0 COLLECTION, PRESERVATION, AND HOLDING TIME

6.1 Samples must be cooled to <6°C at the time of collection.

6.2 Bromide, chloride, fluoride, and sulfate must all be analyzed within 28 days. Nitrite and nitrate must be analyzed within 48 hours.

7.0 APPARATUS AND MATERIALS

7.1 Ion Chromatograph with a guard column, an analytical column, a suppressor column, and a conductivity detector. This SOP is written for the use with the Dionex ICS-2000 or ICS-2100 instrument. The ICS-2000 is run using the external water mode with the suppressor and using internally generated eluent. No manual eluent preparation is required for the ICS-2000 or ICS-2100 instrument. The columns used are listed below. Alternate columns may be used if all method requirements can be met.

Maintenance and troubleshooting procedures are described in detail in operation manual. Most basic procedures include checking connections for leaks, cleaning and/or replacing tubing, monitoring and recording the pressure.

7.1.1 Suppressor column, ASRS Ultra 4 mm. Dionex part number 061561

7.1.2 Guard Column, IONPAC AG18 4 mm. Dionex part number 060551

7.1.3 Analytical Column, IONPAC AS18. Dionex part number 060549

7.2 Top loading balance, capable of weighing to 0.01 g. Calibrated and serviced annually by

outside vendor and verified daily with Class 1 weights.

7.3 Class 1 weights

7.4 Volumetric glassware, class A.

7.5 Volumetric pipettes, class A or autopipetters. Note: If autopipetters are used, make sure that the calibration is checked before use as specified in the autopipetter SOP QA006, current revision.

7.6 Helium tank and regulator. On the ICS-2000 and ICS-2100 instruments, helium is used only for head pressure on the water reservoirs. The pressure should be set at approximately 6 psi.

7.7 Magnetic stirrers and stirring bars (for solid samples)

7.8 Nylon 0.45 um membrane filters or equivalent, that can be attached to the end of the syringe.

7.9 Disposable syringes, for sample filtering.

7.10 Field conductivity meter to pre-determine dilutions for possible interferences.

8.0 REAGENTS

All chemicals listed below are reagent grade unless otherwise specified. Deionized water must be used whenever water is required.

8.1 Stock Standard Solution, 1000 mg/L: The stock standard solution for all the anions can be purchased commercially from various manufacturers.

Bromide: Absolute Standards #54107, 1000ppm, or equivalent
Chloride: LabChem #LC13000-7, 1000ppm, or equivalent
Fluoride: Acculon #IC-F-10X-1, 1000ppm, or equivalent
Nitrate: Acculon #IC-NO3-N-10X-1, 1000ppm, or equivalent
Nitrite: Acculon #IC-NO2-N-10X-1, 1000ppm, or equivalent
Sulfate: I-CAL #IC5041-5, 1000ppm, or equivalent

8.2 Calibration standard solutions: Solutions containing bromide, chloride, fluoride, nitrate, and sulfate must be made fresh weekly. Solutions containing nitrite should be made fresh daily. Note: Levels shown below are suggested levels and may be changed to meet different reporting limit requirements.

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8.2.1 The final concentrations of suggested standards are shown in the table below. All units are in mg/l.

Anion	STDA	STDB	STDC	STDD	STDE	STDF	STDG
F	.1	.5	1	2.5	3	4	5
CHL	2	10	30	50	65	80	100
NO2	.1	.5	1	2.5	3	4	5
BRO	.5	1	7.5	12.5	15	20	25
NO32	0.1	.5	1	2.5	3	4	5
SO4	2	10	30	50	65	80	100

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8.2.2 The volume of 1000 mg/L stock added to 100 ml volumetric flask are shown in the table below. All volume units are in ml.

Anion	STDA	STDB	STDC	STDD	STDE	STDF	STDG
F	.01	.05	.1	.25	.3	.4	.5
CHL	.2	1	3	5	6.5	8	10
NO2	.01	.05	.1	.25	.3	.4	.5
BRO	.05	.1	.75	1.25	1.5	2.0	2.5
NO32	.01	.05	.1	.25	.3	.4	.5
SO4	.2	1	3	5	6.5	8	10

8.7 CCV. Same concentration as standard D.

8.8 ICV (External Check Solution.) The ICV can be made in the same manner as the standard D from a separate source than the standards. It must be within the range of the curve. Alternatively, it can be purchased from a outside supplier.

8.9 0.2N H_2SO_4 for suppressor regeneration: Pipet 1.0 ml of concentrated H_2SO_4 into 100 ml DI and dilute to final volume of 200ml with DI.

8.10 0.1M Oxalic Acid for metals column clean-up: Dissolve 6.3 g of oxalic acid into approx. 300 mL of DI water. Bring to final volume of 500 mL with DI water.

8.11 10X eluent concentrate (300mM KOH) for hydrophilic ionic contamination clean-up.

8.12 Acetonitrile, reagent grade

8.13 1M HCl: Add 8.3 ml of concentrated hydrochloric acid to approximately 70 ml of deionized water. Dilute to a final volume of 100 ml and mix well.

9.0 INTERFERENCES

9.1 Interferences can be caused by substances with retention times that are similar to and overlap those of the anion of interest. This interference is especially important at low concentrations.

9.2 The acetate anion elutes early during the chromatographic run and can cause elution times of other anions to vary when large amounts of acetate are present. High levels of acetate also can cause interference with the fluoride peak. Therefore, this method is not recommended for leachates containing acetic acid.

9.3 Large amounts of an anion can interfere with the peak resolution of an adjacent anion. High concentrations of an anion can also cause the peak to be misidentified on the chromatograph due to the large width of the peak. Sample dilution and fortification can be used to correct most interference problems connected with peak resolution.

9.4 Samples that contain particles greater than 0.45 μm and reagents with particles larger than 0.2 μm must be filtered to prevent damage to instrument columns and flow systems.

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10.0 SAMPLE PREPARATION PROCEDURE

10.1 For soil samples, follow the preparation outlined below.

10.1.1 Mix the sample well and remove any artifacts as discussed in SOP QA034, current revision. Weigh approximately 10 g of sample and add 100 ml of DI water. Mix the resulting slurry for 10 minutes using a magnetic stirring device. Filter the resulting slurry through a 0.45 um membrane filter before analysis. Record the weight to the nearest 0.01 g on preparation log.

10.1.2 For matrix spikes, make sure to spike the aliquot of the sample directly and then add the volume of DI water needed to make the volume of liquid being added to the soil sample equal to 100 ml including the volume of the spike solutions. In most cases this will be 97 mls of DI. If Bromide is not being analyzed, the make-up volume will be 98.75 mls of DI.

10.1.3 Prepare blank QC (Method Blank and Blank Spike) using clean sand, using approximately 10 g aliquot and 100 ml of DI water. Record the weight to nearest 0.01 g.

10.1.4 Check with the lab supervisor if there is insufficient sample to use a 10 g aliquot. Smaller aliquots may be used if a homogeneous portion of the sample can be obtained. The sample must always be extracted with 10 times the sample weight of DI water.

10.2 For soil samples, pre-filter all samples through 0.45 um filters before analysis. Matrix spikes must be spiked before filtration. It is not necessary to pre-filter all water samples using a 0.45 um syringe filter. Pre-filter water samples only if they contain sediment or appear cloudy. Pre-filter method blanks and blank spikes to act as QC check of the filters. Record the lot number of the filters in the run log.

11.0 ION CHROMATOGRAPHY ANALYSIS PROCEDURE

11.1 Check to make sure that the helium tank pressure is > 100 PSI and the pressure gauge by the eluent bottles is set at 6 PSI.

11.2 Fill the eluent generation bottle(s) that are to be used with deionized water (resistance of 18.2 megaohms or greater), making sure that they are pressurized with helium. On the instrument panel (or in the software) set the water volume at the level in the bottles and adjust the flow rate up to 1.0 ml/min. Check the KOH is set at the proper molarity. Normally it should be set at 30 mM. Also fill the external water bottle(s) for the suppressor with deionized water.

11.3 Check the lines coming out of the suppressor for air bubbles. Bubbles should be present. If not, then check to make sure the current is on and the suppressor is working properly.

11.4 Check the pump waste line and see if bubbles are present. If they are present, then prime the pump using the procedure described below.

11.4.1 Verify that the priming valve on the primary pump head (right side) is closed. Hit the prime button on the front panel.

11.4.2 Follow the screen prompts. When prompted, open the waste valve by turning the knob ¼ to ½ turn counter-clockwise.

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11.4.3 Check for air bubbles on the pump waste line. Continue priming until no air bubbles are exiting the waste line. Turn the pump off and then close the waste valve.

11.4.4 Allow the instrument conditions to settle and then check the pressure and check for air bubbles. If there is still a problem, the priming procedure may be repeated.

11.5 In the software, go to the browser and go to the correct instrument panel (1 or 2). Then connect the instrument. Monitor the baseline until it is stable.

11.6 Go to the template sequences and edit a sequence for the samples in the run. If a calibration is being using from an earlier run, make sure to copy the calibration into the front of the sequence. After the sequence is generated, then save it using the file name (instrument, date, run). Refer to the instrument manuals or help screens in the program for help in using the software. A summary of the instrument conditions required for the analysis of anions is shown below. Note: the retention time for each anion must not exceed ± 10% of that anions retention time from the calibration. Refer to section 14.7 for more discussion of the proper application of retention time.

Column: IonPac AG18, AS18
Eluent: 30 mM KOH
Suppressor setting: approximately 38 mAmps. This setting will be autogenerated.
Flow Rate: 1.0 ml/min
Inj. Volume: 12.5 µl
Pump pressure – should be around 2000 psi
Detection: Suppressed conductivity, SRS Ultra II, external water mode

11.7 Check sample conductivity with a field conductivity meter to determine if dilutions are needed. Refer to spreadsheet of possible dilutions stored on LAN in GenChem directory.

11.8 Load the autosampler and turn it on. The autosampler should then move to the first sample. A print-out of the autosampler table should be generated showing the order that the samples are loaded into the autosampler.

11.9 Start the run. Monitor the results as the run is going to make sure that problems are identified quickly. Note: the initial demonstration of capability, including instrument MDL's and linear calibration ranges, must be completed before samples can be run.

11.9.1 Data files should be saved using the naming scheme of instrument, year (last 2 digits), month, day, run number followed by the extension of .ic. For example, the first IC run on instrument 2 on May 20, 2005 would be named 205052001. This name should always be used in the workgroup description in the LIMS system.

11.9.2 It is recommended that a new calibration be run a minimum of once per month. (It is required that a calibration be run once per quarter.) Calibrations standards may be varied from the one stated in this SOP depending on the levels of each anion that are to be reported. A minimum of 5 standards and a blank are required and a low standard must be at or below the reporting limit for each anion. A correlation coefficient of 0.995 is required. If this correlation coefficient is not met, than the instrument must be recalibrated.

11.9.3 After the calibration, a low check at the reporting limit must be run. This low check must have the levels in standard A or at the reporting limit for the calibration outlined in this SOP and recoveries must be in the range of 50 –150%. On a daily basis, it is

recommended that an external check is analyzed and recoveries must be within a range of 90 - 110 %. (This check must be analyzed at a minimum with each new calibration.) Continuing calibration checks and continuing calibration blanks must be run every 10 samples. The continuing calibration checks must have recoveries in the range of 90 -110 %. Refer to the quality control section of this SOP for more detail on these quality control samples.

11.10 After the run is completed, review all of the chromatograms and check for overlapping peaks, dilutions, etc.

11.10.1 If the retention time of any anion in the ICV or CCV check standards has shifted more than 10% from the original calibration curve retention time, then no results can be reported for that anion. The column should be reconditioned, if necessary, and the instrument recalibrated before any more samples are reported for that anion. Affected samples are reanalyzed after the problem has been corrected.

11.10.2 If a sample peak has shifted significantly from the original retention time (and the ICV and CCV check standards are within the 10% retention time window), then verify the reported result using post-digest spike on that sample. Do not report results from peaks where the retention time has shifted more than 10 percent unless the peak can be verified using a post-digest spike.

11.10.3 For large or overlapping peaks, make dilutions. If at all possible, make dilutions and reruns on the same run as the original sample.

11.10.4 Refer to section 14.7 for information on how to determine the appropriate retention time window.

11.11 Review all data and update the appropriate tests in the LIMS system. A write-up including a run log, a calibration summary, batch quality control summary, and copies of all chromatograms should be turned into the area supervisor for each batch.

11.11.1 If edits are needed in the calibration after the data has been calculated, the run can be reprocessed using the batch function in the software. Refer to the instrument manuals or on-screen help for addition information.

12.0 INSTRUMENT MAINTENANCE

12.1 Whenever a new suppressor is put in place or when the baseline is unstable or very high, the suppressor should be regenerated. The procedure below is for the Ultra 4 mm suppressor.

12.1.1 Using a disposable plastic syringe, push approximately 3 mL if 0.2(200mN) H_2SO_4 through the ELUENT OUT port and 5 mL of 0.2N H_2SO_4 through the REGIN IN port respectively.

12.1.2 Allow the suppressor to sit for approximately 20 minutes to fully hydrate the suppressor screens and membranes.

12.1.3 Re-connect the suppressor to the system in the recycle mode.

12.2 Periodically, due to the matrix of samples, both guard and analytical columns become degraded and cleaning them becomes necessary. This is evidenced in changing retention times, round-shaped peaks, tailing peaks and overall poor integration. The metals cleanup

should be done a minimum of once per month, while the others should be done a minimum of once per quarter.

12.2.1 There are 3 recommended cleanup solutions for the AS18A and AG18 columns.

12.2.2 Metal contamination column clean-up: Use 500 ml of 0.1M oxalic acid solution.

12.2.3 Low valency hydrophilic ionic contamination column clean-up. Use 500 ml of 10X eluent concentrate (300 mM KOH).

12.2.4 High valency hydrophobic ion 200mM HCl in 80% acetonitrile: The acetonitrile solution is stored in a separate eluent bottle because acetonitrile slowly breaks down in acidic aqueous solutions. Prepare 2 bottles (E1 and E2) with the following 500-mL solutions: E1: 100% Acetonitrile and E2: 1M HCl using DI water.

12.3 Column Clean-up Procedure.

12.3.1 Prepare 500 mL solution of the appropriate cleanup solution from 12.2.1

12.3.2 Disconnect the ASRS-ULTRA from the IonPac AS18A Analytical column. **Make sure to reverse the order of the guard and analytical column in the eluent flow path.** Contaminants that have accumulated on the guard column can be eluted onto the analytical column and irreversibly damage it. Cleaning each column separately is recommended. Double check that the eluent flows in the direction designated on each of the column labels.

12.3.3 Set the pump flow rate to 1.0 mL/min for an AS18A 4-mm analytical or guard column.

12.3.4 Rinse the column for 15 minutes with DI water before pumping the chosen cleanup solution over the columns.

12.3.5 Pump the cleanup solution through the column for at least 60 minutes.

12.3.6 Rinse the column for 15 minutes with DI water before pumping eluent over the column.

12.3.7 Equilibrate the columns with eluent before resuming normal operation for at least 30 minutes.

12.3.8 Reconnect the ASRS-ULTRA and place the guard column in line between the injection valve and the analytical column.

13.0 METHOD PERFORMANCE

Method performance (accuracy and precision) is monitored through the routine analysis of negative and positive control samples. These control samples include method blanks (MB), blank spikes (BS), matrix spikes (MS), and matrix spike duplicates (MSD). The MB and BS are used to monitor overall method performance, while the MS and MSD are used to evaluate the method performance in a specific sample matrix.

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Blank spike, matrix spike, and matrix spike duplicate samples are compared to method defined control limits. Control limits are stored in the LIMS. Additionally, blank spike accuracy is regularly evaluated for statistical trends that may be indicative of systematic analytical errors.

14.0 QC REQUIREMENTS

14.1 A method detection limit study must be done semiannually or whenever there is a significant change in the background or instrument response. The MDL study is done following the procedure outlined in the Accutest laboratory SOP QA020, current revision. A minimum of seven replicates spiked at 3 to 5 times the MDL must be taken through the procedure for each anion. If instrument conditions (columns, etc.) are modified, then a new MDL must be done.

14.2 Although national standards define batch as a maximum of 20 samples in one day, IC batch size is reduced to 10 samples in order to satisfy method QC frequency and various program requirement (state-specific as well as private clients). A method blank and a spike blank are required to be run with every batch. Additionally a matrix spike and a matrix duplicate are required for every 10 samples. In some cases a matrix spike duplicate may be required in place of a duplicate.

14.2.1 The method blank must contain <½ RL of each anion that is reported and this sample must be run with each set of samples in a batch. If the blank contains more than the reporting level, then all samples must be reanalyzed. If no sample volume remains to be reanalyzed, then the data must be flagged. (The exception is if the sample results are less than the reporting limit.)

14.2.1.1 Although the method states that values greater than the MDL should be suspect, this is not appropriate for the concentration levels being applied for this analysis. MDL's are generally up to 10 times lower than reporting limits for all analytes and values over the MDL do not impact data usability.

14.2.2 The recovery of the spike blank must be within the limits of 90 to 110% recovery for each anion that is reported and this sample must be run with each set of samples in a batch. If the recoveries are outside of this range, then all associated samples must be reanalyzed. If no sample volume remains to be reanalyzed, then the data must be flagged.

14.2.3 The matrix spike is spiked with all anions of interest. Method limits of 90 -110 % recovery must be applied. Control limits must be generated from laboratory data to support method limits. If the recoveries are outside of this range, and all other method quality control is within limits, then matrix interference should be suspected.

14.2.4 For matrix duplicates control limits of 10% RPD must be applied for all sample values within the calibration range (up to 10 times the reporting limit). If the RPD values are outside of this range, and all other method quality control is within limits, then sample non-homogeneity should be suspected.

14.3 An external source standard (ICV) must be analyzed after every new calibration and its recovery must be within 10% of the true value. Continuing calibration checks and blanks are run every 10 samples (recoveries must be in the 90 to 110% range) and the blanks must not have anion concentrations higher than one half the reporting limit. If the CCV is not within ± 10%, a second CCV should be analyzed. If the CCV is still outside of the limits, sample analysis must be discontinued and the cause determined, and the instrument recalibrated. All samples after the last acceptable CCV must be reanalyzed.

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14.4 It is recommended that a new calibration be run a minimum of once per month. (It is required that a calibration be run once per quarter.) Calibrations standards may be varied from the one stated in this SOP depending on the levels of each anion that are to be reported. A minimum of 5 standards and a blank are required and a low standard must be at or below the reporting limit for each anion. A correlation coefficient of 0.995 is required.

14.4.1 A new calibration is required when standard retention times shift by more than 10% from the original calibration.

14.5 A low check at the reporting limit (CCV2) for each anion must be run after each calibration. Acceptance criteria is 50 – 150%.

14.6 Continuing Calibration Verification (CCV) Checks at or near the mid-level of the curve must be run at the beginning and the end of the run and after every 10 samples throughout the run. Every CCV must be followed by a continuing calibration blank (CCB). The CCV must have results within 90-110 % of the true value. If the results are outside of that range for a CCV, then all bracketed samples must be reanalyzed. The results for the CCB must be <1/2 RL for an analyte. If they are not, then all bracketed samples for that analyte must be reanalyzed.

14.7 Retention time windows must be established whenever a new column/guard column is installed in an instrument or whenever a major change has been made to an instrument. Retention time shift is checked weekly with a CCV to ensure it does not exceed 10%, and the data is stored on LAN in GenChem directory.

Retention time windows are established by injecting standard mix three times over the course of 24 hours and calculating the standard deviation of the retention times of each analyte. Plus or minus three times the standard deviation of the retention times is defined as the retention time window of that compound.

Peak identification is based on the retention time of an analyte in the standard (initial or continuing) being used as the mid-point of the retention time window. The retention time windows should be used as a guide for identifying compounds; however, the experience of the analyst should weigh heavily in the interpretation of the chromatograms. The analyst should monitor the retention times of known standard peaks throughout an instrument run as an indication of instrument performance.

Because calculated retention time windows are generally very tight (less than ± 0.10 minutes), the retention time windows for the data processing method are generally set wider than the calculated window. This is done to ensure that the software does not miss any potential “hits”. The analyst will then review these “hits” and determine if the retention times are close enough to the retention time of the target analyte to positively identify the peak or to require confirmation.

14.8 The Linear Calibration Range (LCR) is the concentration range the instrument response is linear and must be initially determined and verified every 6 months or whenever a significant change in the instrument is observed or expected. Initially, enough standards must be used to insure the curve is linear. The linearity verification must use at a minimum, a blank and 3 standards. The verification data must be within ± 10% of the initial values. If the data falls outside of this range, then the linearity of the instrument must be reestablished. If any portion of the curve is nonlinear, then sufficient standards must be used to clearly delineate the nonlinear portion of the curve.

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14.9 ***Contingencies for handling out-of-control QC***. Upon certain circumstances data can be reported from batches with QC non-conformances. Such samples are to be qualified accordingly. Examples include:

- If the MB is contaminated but the samples are non-detect, then the source of contamination should be investigated and documented. The sample results can be reported without qualification. If the MB is contaminated but the samples results are > 10 times the contamination level, the source of the contamination should be investigated and documented. The samples results may be reported with the appropriate "B" or "V" qualifier. *This must be approved by the department supervisor.* Samples with hits <10 times contamination are reprepped and reanalyzed. If there is insufficient sample to reanalyze, or if the sample is re-analyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. *This must be approved by the department supervisor*
- Similarly, if the recovery of LCS or CCV is high and the associated sample is non-detect, the data may be reportable. If the recovery of LCS or CCV is below lower acceptance limit, the department supervisor shall review the data and determine what further corrective action is best for each particular sample. That may include reanalyzing the samples, reprepping and/or reanalyzing the samples, or qualifying the results as estimated. *This must be approved by the department supervisor.* If there is insufficient sample to reanalyze, or if the sample is re-analyzed beyond hold time, the appropriate footnote and qualifiers should be added to the results. *This must be approved by the department supervisor.*

  If the matrix spike recoveries are not within the established control limits, compare the recoveries to those of the LCS to assess method performance in clean QC matrix. Matrix spike recovery failures are not grounds for reanalysis but are an indication of the sample matrix effects

15.0 DOCUMENTATION REQUIREMENTS

15.1 All reagents must be recorded in a reagent logbook with manufacturers, lot numbers, and expiration dates. All reagent information must be cross referenced on the sample worksheet.

15.2 All instrument data must be exported to the LIMS system and a copy of the run log must be included in the logbook by the instrument.

15.3 A data package consisting of a manual run log, a LIMS run log, a calibration summary, batch quality control summary, and copies of all chromatograms must be turned into the area supervisor for each batch. The analyst should also complete the preliminary review in the LIMS system.

15.4 Refer to SOP QA029, current revision, for procedures and documentation that must be followed when peaks are manually integrated.

16.0 POLLUTION PREVENTION & WASTE MANAGEMENT

16.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 16.2.

16.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, SAM108, current revision. This document describes the proper disposal of all waste materials generated during the testing of samples.

17.0 ADDITIONAL REFERENCES

17.1 Dionex Instrument and column manuals

17.2 QA029 Manual Integration SOP, current revision.

17.3 NELAC 2003 and TNI 2009 standards.

17.4 DoD QSM, Rev. 4.2, 2010

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Table 1 QC Criteria

Quality Control	Acceptance Criteria	Corrective Action
Initial Calibration: r = coefficient of correlation	≥0.995	Rerun calibration standards, and/or prepare new calibration standards and recalibrate the instrument, or document why the data are acceptable.
Initial Calibration Verification standard (ICV)	90 - 110% of the standard's true value	Rerun standard, and/or prepare new standard, and/or recalibrate instrument, or document why the data are acceptable.
Continuing Calibration Verification standard (CCV)	90 - 110% of the standard's true value	Rerun standard, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable.
Low-level Standard	50 - 150% of the standard's true value	Rerun standards, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable.
Method blank (MB) and Calibration Blank (CB)	< ½ RL	Reanalyze, and/or stop the run and determine the source of contamination, or document why the data are acceptable.
Retention time	90 - 110% of the standard's true value	Rerun standard, and/or recalibrate instrument and reanalyze all samples run since the last acceptable CCV, or document why the data are acceptable.
Blank Spike (BS or LSC)	90-110%	Determine and correct the problem, reanalyze samples, if necessary, or document why data are acceptable.
MS/MSD	90-110%	Determine and correct the problem, reanalyze samples and MS/MSD, or document why data are acceptable
Sample Duplicate	≤10%	Determine and correct cause of the poor reproducibility

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Certificate of Accreditation

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621 Mainstream Drive, Suite 270
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has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: November 30, 2015

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 30th of January 2013

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

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Scope of Accreditation
For
Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228
Marcia K. McGinnity
877-345-1113

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Empirical Laboratories, LLC to perform the following tests:

Accreditation granted through: November 30, 2015

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B; EPA 624	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B; EPA 624	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	EPA 8260B; EPA 624	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B; EPA 624	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B; EPA 624	1,1,2-Trichloroethane
GC/MS	EPA 8260B; EPA 624	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B; EPA 624	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B; EPA 624	1,1-Dichloropropene
GC/MS	EPA 8260B; EPA 624	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,2,3-Trichloropropane
GC/MS	EPA 8260B; EPA 624	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B; EPA 624	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B; EPA 624	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B; EPA 624	1,2-Dichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B; EPA 624	1,2-Dichloropropane
GC/MS	EPA 8260B; EPA 624	1,3,5-Trimethylbenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B; EPA 624	1,3-Dichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,3-Dichloropropane
GC/MS	EPA 8260B; EPA 624	1,4-Dichlorobenzene
GC/MS	EPA 8260B; EPA 624	1,4-Dioxane
GC/MS	EPA 8260B; EPA 624	1-Chlorohexane
GC/MS	EPA 8260B; EPA 624	2,2-Dichloropropane
GC/MS	EPA 8260B; EPA 624	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B; EPA 624	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B; EPA 624	2-Chlorotoluene
GC/MS	EPA 8260B; EPA 624	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B; EPA 624	4-Chlorotoluene
GC/MS	EPA 8260B; EPA 624	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B; EPA 624	Acetone
GC/MS	EPA 8260B; EPA 624	Acetonitrile
GC/MS	EPA 8260B; EPA 624	Acrolein
GC/MS	EPA 8260B; EPA 624	Acrylonitrile
GC/MS	EPA 8260B; EPA 624	Allyl chloride
GC/MS	EPA 8260B; EPA 624	Benzene
GC/MS	EPA 8260B; EPA 624	Bromobenzene
GC/MS	EPA 8260B; EPA 624	Bromochloromethane
GC/MS	EPA 8260B; EPA 624	Bromodichloromethane
GC/MS	EPA 8260B; EPA 624	Bromoform
GC/MS	EPA 8260B; EPA 624	Bromomethane
GC/MS	EPA 8260B; EPA 624	Carbon Disulfide
GC/MS	EPA 8260B; EPA 624	Carbon Tetrachloride
GC/MS	EPA 8260B; EPA 624	Chlorobenzene
GC/MS	EPA 8260B; EPA 624	Chloroethane
GC/MS	EPA 8260B; EPA 624	Chloroform
GC/MS	EPA 8260B; EPA 624	Chloromethane
GC/MS	EPA 8260B; EPA 624	Chloroprene
GC/MS	EPA 8260B; EPA 624	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B; EPA 624	cis-1,3-Dichloropropene
GC/MS	EPA 8260B; EPA 624	cis-1,4-Dichloro-2-butene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B; EPA 624	Cyclohexane
GC/MS	EPA 8260B; EPA 624	Dibromochloromethane
GC/MS	EPA 8260B; EPA 624	Dibromomethane
GC/MS	EPA 8260B; EPA 624	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B; EPA 624	Di-isopropyl ether
GC/MS	EPA 8260B; EPA 624	ETBE
GC/MS	EPA 8260B; EPA 624	Ethyl methacrylate
GC/MS	EPA 8260B; EPA 624	Ethylbenzene
GC/MS	EPA 8260B; EPA 624	Hexachlorobutadiene
GC/MS	EPA 8260B; EPA 624	Hexane
GC/MS	EPA 8260B; EPA 624	Iodomethane
GC/MS	EPA 8260B; EPA 624	Isobutyl alcohol
GC/MS	EPA 8260B; EPA 624	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B; EPA 624	Methacrylonitrile
GC/MS	EPA 8260B; EPA 624	Methyl Acetate
GC/MS	EPA 8260B; EPA 624	Methyl methacrylate
GC/MS	EPA 8260B; EPA 624	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B; EPA 624	Methylcyclohexane
GC/MS	EPA 8260B; EPA 624	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B; EPA 624	Naphthalene
GC/MS	EPA 8260B; EPA 624	n-Butylbenzene
GC/MS	EPA 8260B; EPA 624	n-Propylbenzene
GC/MS	EPA 8260B; EPA 624	p-Isopropyltoluene
GC/MS	EPA 8260B; EPA 624	Propionitrile
GC/MS	EPA 8260B; EPA 624	sec-Butylbenzene
GC/MS	EPA 8260B; EPA 624	Styrene
GC/MS	EPA 8260B; EPA 624	t-Butyl alcohol
GC/MS	EPA 8260B; EPA 624	tert-Amyl methyl ether
GC/MS	EPA 8260B; EPA 624	tert-Butylbenzene
GC/MS	EPA 8260B; EPA 624	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B; EPA 624	Tetrahydrofuran
GC/MS	EPA 8260B; EPA 624	Toluene
GC/MS	EPA 8260B; EPA 624	trans-1,2-Dichloroethene (trans-1,2-DCE)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B; EPA 624	trans-1,3-Dichloropropene
GC/MS	EPA 8260B; EPA 624	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B; EPA 624	Trichloroethene (TCE)
GC/MS	EPA 8260B; EPA 624	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B; EPA 624	Vinyl acetate
GC/MS	EPA 8260B; EPA 624	Vinyl Chloride (VC)
GC/MS	EPA 8260B; EPA 624	m,p-Xylenes
GC/MS	EPA 8260B; EPA 624	o-Xylene
GC/MS	EPA 8260B; EPA 624	Xylenes (Total)
GC/MS	EPA 8270C/D; EPA 625	1,1'-Biphenyl
GC/MS	EPA 8270C/D; EPA 625	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D; EPA 625	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,4-Dioxane
GC/MS	EPA 8270C/D; EPA 625	1-Methylnaphthalene
GC/MS	EPA 8270C/D; EPA 625	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D; EPA 625	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D; EPA 625	2,4-Dimethylphenol
GC/MS	EPA 8270C/D; EPA 625	2,4-Dinitrophenol
GC/MS	EPA 8270C/D; EPA 625	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D; EPA 625	2,6-Dichlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D; EPA 625	2-Chloronaphthalene
GC/MS	EPA 8270C/D; EPA 625	2-Chlorophenol
GC/MS	EPA 8270C/D; EPA 625	2-Methylnaphthalene
GC/MS	EPA 8270C/D; EPA 625	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D; EPA 625	2-Nitroaniline
GC/MS	EPA 8270C/D; EPA 625	2-Nitrophenol (ONP)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D; EPA 625	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D; EPA 625	3-Methylphenol/4-Methylphenol
GC/MS	EPA 8270C/D; EPA 625	3-Nitroaniline
GC/MS	EPA 8270C/D; EPA 625	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D; EPA 625	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D; EPA 625	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D; EPA 625	4-Chloroaniline
GC/MS	EPA 8270C/D; EPA 625	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D; EPA 625	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D; EPA 625	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D; EPA 625	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D; EPA 625	Acenaphthene
GC/MS	EPA 8270C/D; EPA 625	Acenaphthylene
GC/MS	EPA 8270C/D; EPA 625	Acetophenone
GC/MS	EPA 8270C/D; EPA 625	Aniline
GC/MS	EPA 8270C/D; EPA 625	Anthracene
GC/MS	EPA 8270C/D; EPA 625	Atrazine
GC/MS	EPA 8270C/D; EPA 625	Benzaldehyde
GC/MS	EPA 8270C/D; EPA 625	Benzidine
GC/MS	EPA 8270C/D; EPA 625	Benzo(a)anthracene
GC/MS	EPA 8270C/D; EPA 625	Benzo(a)pyrene
GC/MS	EPA 8270C/D; EPA 625	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D; EPA 625	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Benzoic Acid
GC/MS	EPA 8270C/D; EPA 625	Benzyl alcohol
GC/MS	EPA 8270C/D; EPA 625	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D; EPA 625	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D; EPA 625	bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D; EPA 625	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D; EPA 625	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D; EPA 625	Caprolactam
GC/MS	EPA 8270C/D; EPA 625	Carbazole

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D; EPA 625	Chrysene
GC/MS	EPA 8270C/D; EPA 625	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D; EPA 625	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D; EPA 625	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D; EPA 625	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D; EPA 625	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D; EPA 625	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D; EPA 625	Fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Fluorene
GC/MS	EPA 8270C/D; EPA 625	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D; EPA 625	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D; EPA 625	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D; EPA 625	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D; EPA 625	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D; EPA 625	Isophorone
GC/MS	EPA 8270C/D; EPA 625	Naphthalene
GC/MS	EPA 8270C/D; EPA 625	Nitrobenzene
GC/MS	EPA 8270C/D; EPA 625	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D; EPA 625	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D; EPA 625	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D; EPA 625	Pentachlorophenol
GC/MS	EPA 8270C/D; EPA 625	Phenanthrene
GC/MS	EPA 8270C/D; EPA 625	Phenol
GC/MS	EPA 8270C/D; EPA 625	Pyrene
GC/MS	EPA 8270C/D; EPA 625	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Chlordane (n.o.s.)
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC/UV	EPA 8330A/B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A/B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A/B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A/B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A/B	Nitrobenzene
HPLC/UV	EPA 8330A/B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Nitroguanidine
HPLC/UV	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B/C	TPH DRO
GC/FID	EPA 8015B/C	TPH ORO
GC/FID	EPA 8015B/C	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C; EPA 200.7	Aluminum
ICP	EPA 6010B/C; EPA 200.7	Antimony
ICP	EPA 6010B/C; EPA 200.7	Arsenic
ICP	EPA 6010B/C; EPA 200.7	Barium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010B/C; EPA 200.7	Beryllium
ICP	EPA 6010B/C; EPA 200.7	Boron
ICP	EPA 6010B/C; EPA 200.7	Cadmium
ICP	EPA 6010B/C; EPA 200.7	Calcium
ICP	EPA 6010B/C; EPA 200.7	Chromium, total
ICP	EPA 6010B/C; EPA 200.7	Cobalt
ICP	EPA 6010B/C; EPA 200.7	Copper
ICP	EPA 6010B/C; EPA 200.7	Iron
ICP	EPA 6010B/C; EPA 200.7	Lead
ICP	EPA 6010B/C; EPA 200.7	Magnesium
ICP	EPA 6010B/C; EPA 200.7	Manganese
CVAA	EPA 7470A; EPA 245.1	Mercury
ICP	EPA 6010B/C; EPA 200.7	Molybdenum
ICP	EPA 6010B/C; EPA 200.7	Nickel
ICP	EPA 6010B/C; EPA 200.7	Potassium
ICP	EPA 6010B/C; EPA 200.7	Selenium
ICP	EPA 6010B/C; EPA 200.7	Silver
ICP	EPA 6010B/C; EPA 200.7	Sodium
ICP	EPA 6010B/C; EPA 200.7	Strontium
ICP	EPA 6010B/C; EPA 200.7	Thallium
ICP	EPA 6010B/C; EPA 200.7	Tin
ICP	EPA 6010B/C; EPA 200.7	Titanium
ICP	EPA 6010B/C; EPA 200.7	Vanadium
ICP	EPA 6010B/C; EPA 200.7	Zinc
IC	EPA 300.0	Bromide
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Sulfate
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride

Non-Potable Water		
Technology	**Method**	**Analyte**
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
Colorimetric	SM 4500-NO2 B-2011	Nitrite as N
Titration	SM 2320 B-2011	Alkalinity
Colorimetric	SM 4500-NH3 G-2011	Ammonia
Probe	SM 5210 B-2011	BOD
Probe	SM 5210 B-2011	CBOD
Colorimetric	EPA 410.4	COD
UV/Vis	EPA 7196A SM 3500-Cr B-2011	Hexavalent Chromium
Colorimetric	EPA 353.2 MOD	Nitrocellulose
Colorimetric	EPA 353.2	Nitrate/Nitrite
Gravimetric	EPA 1664A	Oil and Grease
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	SM 4500-S2 F-2011	Sulfide
UV/Vis	SM 4500-P B5-2011	Total Phosphorus (as P)
UV/Vis	SM 4500-P E-2011	Ortho-Phosphate (as P)
TOC	EPA 9060A; SM 5310 C-2011	Total Organic Carbon
Gravimetric	SM 2540 C-2011	TDS
Gravimetric	SM 2540 D-2011	TSS
Colorimetric	EPA 9012A/B SM 4500-CN G-2011	Cyanide
Physical	EPA 1010A	Ignitability / Flashpoint
Physical	EPA 9095B	Paint Filter
Probe	EPA 9040B/C SM 4500-H+ B-2011	pH(Corrosivity)
Preparation	**Method**	**Type**
Preparation	EPA 1311	TCLP
Preparation	EPA 3005A	Metals digestion
Preparation	EPA 3010A	Metals digestion
Preparation	EPA 3510C	Organics Liquid Extraction
Preparation	EPA 5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	1-Chlorohexane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon Disulfide
GC/MS	EPA 8260B	Carbon Tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B	Di-isopropyl ether
GC/MS	EPA 8260B	ETBE
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Hexane
GC/MS	EPA 8260B	Iodomethane
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene (Cumene)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	m,p-Xylenes
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	o-Xylene
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	tert-Amyl methyl ether
GC/MS	EPA 8260B	tert-Butyl alcohol
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene (TCE)
GC/MS	EPA 8260B	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl Chloride (VC)
GC/MS	EPA 8260B	Xylenes (Total)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
GC/MS	EPA 8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1,2,4-Trichlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol/4-Methylphenol
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetophenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D	bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)
GC/ECD	EPA 8081A/B	Chlordane (n.o.s.)
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A	Nitroguanidine
HPLC/UV	EPA 8330A	PETN

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC/UV	EPA 8330B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330B	3-Nitrotoluene
HPLC/UV	EPA 8330B	3,5-Dinitroaniline
HPLC/UV	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330B	Nitrobenzene
HPLC/UV	EPA 8330B	Nitroguanidine
HPLC/UV	EPA 8330B	PETN
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	EPA 8015B/C	TPH DRO
GC/FID	EPA 8015B/C	TPH ORO
GC/FID	EPA 8015B/C	TPH GRO
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
CVAA	EPA 7471A/B	Mercury
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
UV/Vis	EPA 7196A	Hexavalent Chromium
TOC	Lloyd Kahn	Total Organic Carbon
Colorimetric	EPA 353.2 MOD	Nitrocellulose

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Colorimetric	EPA 9012A/B	Cyanide
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Physical	EPA 1010A	Ignitability/Flashpoint
Titration	EPA 9034	Sulfide
Probe	EPA 9045C/D	pH (Corrosivity)
Preparation	**Method**	**Type**
Preparation	EPA 1311	TCLP
Preparation	EPA 1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	EPA 3050B	Metals Digestion
Preparation	EPA 3546	Organics Microwave Extraction
Preparation	EPA 3550B/C	Organics Sonication
Preparation	SM 2540 B-1997	Percent Solids (Percent Moisture)
Preparation	EPA 5035 /A	Purge and Trap Solid

Notes:

1) This laboratory offers commercial testing service.

Approved By:_____ Date: January 30, 2013

R. Douglas Leonard
Chief Technical Officer

Re-issued: 1/30/13

EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURE

ORGANICS: SOP 179 REVISION #: 10 EFFECTIVE DATE: 20131011

NITRATE/NITRITE, NITRITE
IN SURFACE WATER, WASTEWATER
0.02 to 2.0 mg N/L and NO_3^- or NO_2^-
BY EPA METHOD 353.2

APPROVALS:

Lab Director: _____ Date: 10/11/2013

Data Quality Manager: _____ Date: 10/11/2013

Section Supervisor: _____ Date: 10/11/2013

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Changes Summary:

Revision 10 20131011

- Added reference to Omnion 3.0 software.

Revision 09 20130806

- BS/MS/MSD limits updated from 80%-120% to 90%-110%.
- MS/MSD preparation updated for amount of spike and amount of sample. Also updated to reflect diluted sample, same as original sample analysis.
- Added data checklist as Table 1 and table of contents.

Revision 08 20120608

- Item 12.5 has been updated to reflect NH4OH instead of NaOH.
- QS SOP references have been added.

Review Date: 05/13/2011

- The SOP has been reviewed for accuracy and completeness. No changes have been made.

Review Date: 03/25/2010

- The SOP has been reviewed for accuracy and completeness. No changes have been made.

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NITRATE/NITRITE, NITRITE
IN SURFACE WATER, WASTEWATER
0.02 to 2.0 mg N/L and NO_3^- or NO_2^-
BY EPA METHOD 353.2

1.0 SCOPE AND APPLICATION

1.1 The purpose of this method is to determine nitrate/nitrite in surface waters, and industrial wastewaters.

1.2 The applicable range is 0.05 to 2.0 mg N/L as NO_3^- or NO_2^-. The statistically determined method detection limit or limit of detection as determined in water is 0.01 mg N/L. The reporting limit is 0.050 mg/L. All samples are diluted five times before analysis. The method throughput is 55 injections per hour.

1.3 Each laboratory that uses this method must demonstrate the ability to generate acceptable results using the procedure from the method section 11.

2.0 SUMMARY OF METHOD

Nitrate is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrchloride. The resulting water soluble dye has a magenta color which is read at 520 nm. Nitrite alone also can be determined by running without the cadmium column.

3.0 PRINCIPLE

Nitrate is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl)ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is read at 520 nm. Nitrite alone also can be determined by removing the cadmium column.

4.0 INTERFERENCES

4.1 Residual chlorine can interfere by oxidizing the cadmium column.

4.2 Low results would be obtained for samples that contain high concentrations of iron, copper or other metals. In this method, EDTA is added to the buffer to reduce this interference.

4.3 Samples that contain large concentrations of oil and grease will coat the surface of the cadmium. This interference is eliminated by pre-extracting the sample with an organic solvent.

4.4 Sample turbidity may interfere. Remove turbidity first by filtration with 0.45 µm pore diameter membrane filter prior to analysis.

4.5 Sample pH effects column efficiency. Ensure that all samples have been properly preserved with H_2SO_4 at a concentration proportional to 2 mLs of H_2SO_4 per liter of sample.

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5.0 DEFINITIONS

Laboratory Quality System SOP QS08 "Technical / Operational Definitions, Minimum Essential Quality Control Elements, and Laboratory Calibration Procedures" provides information on the commonly used definitions.

5.1 ANALYTICAL BATCH-The set of samples extracted /distilled/ or digested at the same time to a maximum of 20 samples.

5.2 CALIBRATION BLANK (CB)- A volume of reagent water in the same matrix as the calibration standards, but without the analyte.

5.3 CALIBRATION STANDARD (CAL)- A solution prepared from the primary dilution standard solution or stock standard solutions. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

5.4 FIELD BLANK (FMB)- An aliquot of reagent water or equivalent neutral reference material treated as a sample in all aspects, including exposure to a sample bottle holding time, preservatives, and all preanalysis treatments. The purpose is to determine if the field or sample transporting procedures and environments have contaminated the sample.

5.5 FIELD DUPLICATE (FD)- Two samples taken at the same time and place under identical circumstances which are treated identically throughout field and laboratory procedures. Analysis of field duplicates indicates the precision associated with sample collection, preservation, and storage, as well as with laboratory procedures.

5.6 LABORATORY BLANK (BLK)- An aliquot of reagent water or equivalent neutral reference material treated as a sample in all aspects, except that it is not taken to the sampling site. The purpose is to determine if the analytes or interferences are present in the laboratory environment, the reagents, or the apparatus.

5.7 LABORATORY CONTROL SAMPLE (BS)- A solution prepared in the laboratory by dissolving a known amount of one or more pure compounds in a known amount of reagent water. Its purpose is to assure that the results produced by the laboratory remain within the acceptable limits for precision and accuracy. (This should not be confused with a calibrating standard, it must be prepared from a source other than the same source as the calibration standards).

5.8 LABORATORY DUPLICATE (DUP)- Two aliquots of the same environmental sample treated identically throughout a laboratory analytical procedure. Analysis of laboratory duplicates indicates precision associated with laboratory procedures but not with sample collection, preservation, or storage procedures.

5.9 QUALITY CONTROL CHECK SAMPLE (QCS)- A sample containing analytes of interest at known concentrations (true value) of analytes. The QCS is obtained from a source external to the laboratory or is prepared from standards obtained from a different source than the calibration standards. The purpose is to check laboratory performance using test materials that have been prepared independently from the normal preparation process.

5.10 METHOD DETECTION LIMIT (MDL)- The lowest level at which an analyte can be detected with 99 percent confidence that the analyte concentration is greater than zero.

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6.0 EQUIPMENT AND SUPPLIES

6.1 Lachat QuikChem Series 8000 with Omnion 3.0 software.

6.2 520 nm interference filter.

6.3 Cadmium-Copper Reduction Column (Lachat Part #50237). Purchased pre-packed from Lachat.

6.3.1 CADMIUM COLUMN INSERTION PROCEDURE

6.3.1.1 Before inserting the column, pump all reagents into manifold.
6.3.1.2 Turn the pump off.
6.3.1.3 On the column, disconnect the center tubing from one of the union connectors and immediately connect to the outlet tubing of the buffer mixing coil.
6.3.1.4 Connect the open tubing on the column to the tee fitting where the color reagent is added. **DO NOT LET AIR ENTER THE COLUMN.**
6.3.1.5 Return the pump to normal speed.
6.3.1.6 The direction of reagent flow through the column is not relevant.

6.3.2 CADMIUM COLUMN MAINTENANCE

6.3.2.1 To store the column and maximize its life span and efficiency:
Note: At no time allow air to enter the column.

6.3.2.2 Close the column by-pass valve.
6.3.2.3 Place all reagent lines into clean DI H_2O.
6.3.2.4 When all air is out of system, open the column by-pass valve and rinse manifold for 2 to 3 minutes.
6.3.2.5 Close the column by-pass valve.
6.3.2.6 Place all reagent lines in NH_4Cl Buffer solution.
6.3.2.7 When all air bubbles are out of the system, open the column by-pass valve and allow the buffer to fill the column. This takes about 2 to 3 minutes.
6.3.2.8 Close the column by-pass valve.
6.3.2.9 Rinse the manifold with clean DI H_2O for 2 to 3 minutes.
6.3.2.10 Remove all tubing from the DI H_2O and run the pump until the manifold is dry.

7.0 SAMPLE HANDLING AND PRESERVATION

Quality Systems SOP QS10 related to Sample Receipt, Handling, & Processing provides details for collection, preservation, shipment, and storage.

7.1 Samples should be collected in hard or soft plastic or glass bottles. All bottles must be thoroughly cleaned and rinsed with reagent water. Volume collected should be sufficient to ensure a representative sample, allow for replicate analysis (if required), and minimize waste disposal.

7.2 Nitrite will be oxidized by air O_2 to nitrate in a few days. If analysis can be made within 24 hours, the sample should be preserved by refrigeration at 4°C. When samples must be stored for more than 24 hours, they must be preserved with sulfuric acid (2 mL conc. H_2SO_4 per liter) and refrigerated. The holding time is 28 days.

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7.3 Caution: Samples must **not** be preserved with mercuric chloride or thiosulfate because this will degrade the cadmium column.

7.4 If build-up of suspended matter in the reduction column restricts sample flow, the samples may be pre-filtered.

8.0 PREPARATION OF REAGENTS

The laboratory's LIMS system allows for complete documentation and for the traceability of reagents and standards used within the laboratory. The following information relates to the specific reagents and standards used for the performance of the method. **All reagents shall be made from ACS reagent grade chemicals. All reagents used for distillation and analysis are entered into Element. These reagents are added to the batch sheet when the samples are batched to ensure traceability of the reagents used to the samples they were used with.**

8.1 Use deionized water (10 megohm) for all solutions.

8.2 **Reagent 1. Acidified Deinonized Water**

Volumetrically, add 4.0 mL of conc H_2SO_4 to 1500 mL DI H_2O in a 2L volumetric flask. Dilute to mark and mix.

In order to maintain a matrix match between the pH of the standards used to create the calibration curve, the quality control standards, and the client samples, acidified deionized water is utilized as the diluent and blank matrix. When new acidified DI H_2O or NH_4Cl buffer is used, the pH matrix balance maybe shifted. This may cause the initial quality control samples to fail. If this occurs it may be necessary to adjust the pH of the system to match that of the calibration run. This is accomplished by varying the amount of acid in the carrier solution. A more acidic solution will lower the values read, and raising the pH of the acidified DI H_20 will raise the concentration values.

NOTE: Changing the acidity of the carrier solution should be done only after all other possible sources of trouble have been eliminated (check for leaks and clogs in the tubing, QC standard preparation, proper tension on pump tubing, etc.)

Store in plastic bottles at room temperature.

8.3 **Reagent 2. Ammonium Chloride Buffer, pH 8.5**

By Volume: In a hood, to a 1 L volumetric flask add 500 mL water, 105 mL concentrated hydrochloric acid (HCl), 95 mL ammonium hydroxide (NH_4OH), and 1.0 g disodium EDTA. Dissolve and dilute to the mark. Invert to mix. Adjust pH to 8.5 with HCl or NH_4OH**. The pH should be checked each time the reagent is used and adjusted back to 8.5.**

NOTE: Reagents 1 and 2 determine the pH of the final product and need to be prepared as consistently as possible from batch to batch to ensure accurate results.

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8.4 **Reagent 3. Sulfanilamide Color Reagent**

By Volume: To a 1 L volumetric flask add about 600 mL water. Then add 100 mL of 85 percent phosphoric acid (H_3PO_4), 40.0 g sulfanilamide, and 1.0 g N-(1-naphthyl)ethylenediamine dihydrochloride (NED). Shake to wet, and stir to dissolve for 30 minutes. Dilute to the mark, and invert to mix. Store in a dark bottle. This solution is stable for two months.

9.0 PREPARATION OF STANDARDS

9.1 Following are standards preparations for one channel system determining $NO_2^- + NO_3^-$ or NO_2^-. The use of NO_3^- standards is recommended when running a one channel method for $NO_2^- + NO_3^-$.

9.2 **Standard 1. Stock Nitrate Standard 1,000 mg N/L as NO_3^-**

Purchased commercially from Fisher at a concentration of 1000 mg/L. Give an Element # on receipt and labeled with that Element #.

9.3 **Standard 2. Working Nitrate Standard, 20.00 mg N/L as NO_3^-**

By Volume: In a 100 mL volumetric flask, add 2.0 mL Stock Standard 1 (commercially prepared at 1000 mg/L). Dilute to the mark with acidified water (reagent 1) and invert to mix. Give an Element # and label standard with that Element #.

9.4 **Set of Eight Working NO_3^- Standards:**

2.0 mg N/L: Dilute 10.0 mL of 20mg N/L to 100 mL acidified water
1.6 mg N/L: Dilute 8.0 mL of 20mg N/L to 100 mL acidified water
1.2 mg N/L: Dilute 6.0 mL of 20mg N/L to 100 mL acidified water
0.80 mg N/L: Dilute 4.0 mL of 20mg N/L to 100 mL acidified water
0.40 mg N/L: Dilute 2.0 mL of 20mg N/L to 100 mL acidified water
0.20 mg N/L: Dilute 10.0 mL of 2.0mg N/L to 100 mL acidified water
0.10 mg N/L: Dilute 5.0 mL of 2.0mg N/L to 100 mL acidified water
0.00 mg N/L: Blank acidified de-ionized water

Dilute each to the mark with acidified DI H_2O and invert to mix. The nitrate standards have been successfully preserved and reused. Standards are good for 5 months. More volume of the 1.2 mg/L standard is needed because the 1.2 standard is the preferred check standard for the Lachat calibration. Each standard is given an Element # and the standard is labeled with that Element # and expiration date.

9.6 **Blank Spike (Laboratory Control Sample)**
Performance evaluation samples that we have analyzed and received the true values for are used for second source verification of the curve. These standards are documented as to source, concentration and expiration date and given a unique identifier in Element.

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10.0 CALIBRATION AND STANDARDIZATION:

Quality Systems SOP QS08 "Technical / Operational Definitions, Minimum Essential Quality Control Elements, and Laboratory Calibration Procedures" related to Calibration Procedures provides laboratory wide protocols for calibration and standardization.

10.1 Prepare reagents and standards as described in sections 8 and 9 above.

10.2 Set up manifold as shown in section 17 of the Lachat method.

10.3 Input data system parameters as shown in section 17 of the Lachat method.

10.4 Pump DI water through all reagent lines and check for leaks and smooth flow. Switch to reagents and allow the system to equilibrate until a stable baseline is achieved.

10.5 Place standards in the sampler. Input the information required by the data system. **Remember to change standard descriptions to the correct element #'s within the software.**

10.6 Calibrate the instrument by injecting the standards. The data system will then associate the concentrations with the peak area for each standard to determine the calibration curve.

10.7 Verify the calibration using a second source standard ICV. This standard must have a recovery of 90 to 110%. Also the curve is verified using a BS analyzed every 20 samples or per batch with a recovery of 90% to 110%.

10.7 Verify continuing calibration standard using a midrange calibration standard (1.2 mg/L) (CCV) every ten samples. Compute the percent recovery using the following equation: %R=D/K x100 where R = recovery, D =Determined concentration of analyte in the calibration standard, K = Actual concentration of the analyte in the calibration standard.

10.8 If recovery exceeds ±10%, the analytical system is judged to be out of control, and the problem must be immediately identified and corrected and the samples analyzed must be reanalyzed back to the first acceptable CCV.

A new curve must be prepared at the beginning of each analysis run using the standards as described in section 9.4 correlation coefficient of at least 0.995 must be obtained from the curve, and an ICV (second source) must be read with each curve to ensure the curve is correct, the ICV (second source) should be well within the acceptable range (90%-110%). If not, the analysis must stop and the problem found and corrected before analysis begins.

11.0 COLUMN EFFICIENCY PROCEDURE

11.1. Visually inspect the column. Check for air bubbles in the column or lines, gaps in the column or any change in the cadmium surface characteristics, (cadmium granules should be dark gray).

11.2 If air bubbles are present in column, connect the column into the manifold, turn the pump on maximum and tap firmly with a screwdriver handle, being careful not to break the column, working up the column until all air is removed. If air cannot be removed, the column should be repacked. Cadmium columns should be stored filled with buffer. If air enters the column, efficiency will decrease.

11.3 Check the flow efficiency by disconnecting the cadmium column from the manifold and reconnecting to a green pump tube. Pump buffer through the packed column and collect in a graduated cylinder. The flow rate with the column connected should be greater than 4.0 mL/min.

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11.4 Determine the column efficiency at the beginning of each analysis run by using the **concentration ratio method**:

1. Calibrate with the mid-range NO_2-N or NO_3-N standards
2. Run a known concentration NO_2-N standard
3. Run a matching concentration NO_3-N standard
4. The column efficiency is determined by the equation:

$$\frac{C_{NO_3\text{-}N}}{C_{NO_2\text{-}N}} \times 100 = E$$

$C_{NO_3\text{-}N}$ = concentration of NO_3 standard
$C_{NO_2\text{-}N}$ = concentration of NO_2 standard
E = % efficiency

5. If the efficiency is <90 percent, the column should be repacked

12.0 PROCEDURE

12.1 Prepare reagents and standards as described in sections 8 and 9 above.
12.2 Set up manifold as shown in section 17 of the Lachat method.
12.3 Input data system parameters:

12.3.1 DATA SYSTEM PARAMETERS

12.3.1.1 Timing
Sample throughput: 20 samples/h; 40 s/sample
Pump speed: 35
Cycle period: 40 s

12.3.1.2**Nitrate + Nitrite:**
Inject to start of peak period: 28 s
Inject to end of peak period: 60 s

12.3.1.3Parameter, Data Window:
Top Scale Response: approximately 0.50 abs
Bottom Scale Response: 0.00 abs

12.3.1.4**GAIN** = 140 x 1
12.3.1.5**Carrier and diluent** is acidified deionized water.
12.3.1.62" is 135 cm of tubing on a 2 inch coil support
12.3.1.7Apparatus: Standard valve, flow cell, and detector head modules are used.
12.3.1.8 All manifold tubing is 0.8 mm (0.032 inches) i.d. This is 5.2 uL/cm.
Notes: This is a two state switching valve used to place the cadmium column in-line with the manifold.

12.4 Pump DI water through all reagent lines and check for leaks and smooth flow. Switch to reagents and allow the system to equilibrate until a stable baseline is achieved.
12.5 Adjust sample to pH between 5 and 9 before analysis with either concentrated HCl or NH4OH (Concentrated Ammonium Hydroxide) for preserved samples. Record on Lachat analysis sheet that this has been done.

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12.6 Place samples in the autosampler. Input the sample identification required by the data system.

13.0 SYSTEM NOTES

13.1 The manifold used in this procedure is **10-107-04-1-A.** It is designed to read NO2-NO3 over a range of 0.05 mg N/L to 2.0 mg N/L.

13.2 QuikChem AE: The NO_3^- concentration can be determined in an RDF using the equation ([NO_2^- + NO_3^-]/column efficiency.

13.3 SERIES 4000/SYSTES IV: The NO_3^- concentration can be determined in a pseudo-channel using the equation ([NO_2^- + NO_3^-] - [NO_2^-]/column efficiency.

13.4 SEGMENT BOUNDARIES:
A - 2.0
C - 0.80
H - 0.00

14.0 QUALITY CONTROL

14.1 Each laboratory using this method is required to operate a formal quality control (QC) program. The minimum requirements of this program consist of an initial demonstration of laboratory capability, and the periodic analysis of laboratory reagent blanks, fortified blanks (BS), and other laboratory solutions as a continuing check on performance. The laboratory is required to maintain performance records that define the quality of the data that are generated.

14.2 INITIAL DEMONSTRATION OF PERFORMANCE

14.2.1 The initial demonstration of performance is used to characterize instrument performance (determination of Linear calibration range and analysis of quality control samples) and laboratory performance (determination of MDLs) prior to performing analyses by this method.

14.2.2 Linear Calibration Range (LCR)—The LCR must be determined initially and verified every 6 months or whenever a significant change in instrument response is observed or expected. The initial demonstration of linearity must use sufficient standards to insure that the resulting curve is linear. The verification of linearity must use a minimum of a blank and three standards.

14.2.3 Quality Control Sample (QCS)—When beginning the use of this method, verify the calibration standards and acceptable instrument performance with the preparation and analysis of a QCS. The performance evaluation samples we run on a daily basis are an example of a QCS. The concentrations should match stated values within ±20%. If not in this range the source of the problem should be identified and corrected before continuing with on-going analysis.

14.2.4 Method Detection Limit (MDL)—MDLs must be established for all analytes, using reagent water (blank) fortified at a concentration of two to three times the estimated instrument detection limit. To determine MDL values, take seven replicate aliquots of the fortified reagent water and process through the entire analytical method. Perform all calculations defined in the method and report the concentration values in the appropriate units. Calculate the MDL as follows: MDL = t x S where t=Student's value for a 99% confidence level and a standard deviation estimate with n-1

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degrees of freedom [t = 3.14 for seven replicates, t= 2.528 for twenty one replicates]. S= standard deviation of the replicate analyses.
MDLs should be determined annually, when a new operator begins work, or whenever there is a significant change in the background or instrument response.

15.0 ASSESSING LABORATORY PERFORMANCE AND ANALYTE RECOVERY AND DATA QUALITY

15.1 A initial calibration verification (second source standard) must be analyzed immediately following calibration and be in the range of 90 to 110%. If the ICV (second source) is out of the range of 90 to 110% the calibration curve must be reanalyzed or remade and reanalyzed before processing any samples. A continuing calibration verification (CCV) (Standard 1.2 mg/L) must be run every tenth sample and at the end of the run. Criteria ±10%. If the CCV is not within 10% reanalyze the CCV solution. If the second analysis confirms calibration to be outside the limits, all data analyzed back to the last acceptable CCV must be reanalyzed after the source of the problem is found and resolved.

15.2 The CCV must be followed by a continuing calibration blank (CCB). Criteria <MDL.
Values that exceed the MDL indicate laboratory or reagent contamination should be suspected and corrective actions must be taken before continuing analysis.

15.3 A preparation blank (BLK) must be analyzed every twenty samples. Criteria < ½ RL.

15.4 A blank Spike (BS) –(laboratory control sample) must be analyzed every twenty samples. Criteria ±20%

15.5 A matrix spike and matrix spike duplicate must be analyzed with every ten samples. Criteria ±10% Spikes are set up on a sample after you know the concentration of that sample. It should be low enough or diluted to be low enough so that 1.0 mg/L NO_3^-N can be added to the sample and not be over 2.0 mg/L NO_3^-N. The spike is usually 0.5 mls of 20.0 mg/L spiking solution + 19.5 mLs of sample (5x dilution of sample like all sample analyses). The true value of the spike is 1.0 mg/L. This is calculated by:

$$\% \text{ Recovery} = \frac{(\text{Spiked Sample Concentration}) - (19.5/20 \text{ Sample Concentration})}{0.5/20 \text{ Spike Concentration Used}}$$

19.0 CORRECTIVE ACTION

Quality Control SOP QS05, "Data Deviations / Interpretations / Exceptions: Laboratory Non-Conformance / Corrective Action Procedures, Decision Making Guidelines for Evaluating Laboratory Analytical Sample and Quality Control Results", provides details on handling out of control data.

16.1 INSTRUMENT RELATED

16.1.1. ICV not within ± 10%
- 16.1.1.1. If the problem is with the solution.
  - 16.1.1.1.1 Re-prepare, obtain new stock if necessary.
- 16.1.1.2 If the problem is with the calibration.
  - 16.1.1.2.1 Recalibrate thru analysis of appropriate standards and recheck ICV.

16.1.2 CCV not within ± 10%
- 16.1.2.1 If the problem is with the solution.
  - 16.1.2.1.1 Re-prepare, obtain new stock if necessary.
- 16.1.2.2 If the problem is with the calibration.

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16.1.2.2.1 Recalibrate thru analysis of appropriate standards and re-prepare/reanalyze the previous ten sample according the following guidelines.

16.1.3 If the CCV was biased high, any of the previous ten samples which were below the MDL do not require reanalysis.

16.1.4 If the CCV was biased low, the previous ten samples must be re-analyzed.

16.1.5 BLK/CCB not <± MDL (USACE)(**For DOD QSM Ver. 3 no analyte detected >2xMDL, frequency- beginning and ending a run and every 10 samples**)or ± RL.

16.1.5.1 If the BLK/CCB is biased high.

16.1.5.1.1 Any samples below the MDL or greater than 10X the CCB bias need not be reanalyzed.

16.1.5.1.2 Any samples above the detection limit but less than 10X the BLK/CCB level must be reanalyzed after the problem is corrected.

16.1.5.2 If the BLK/CCB is biased low.

16.1.5.2.1 Any samples greater than 10X the absolute BLK/CCB bias need not be reanalyzed.

16.1.5.2.2 All other samples must be reanalyzed after the problem is corrected.

16.1.6 BS not within our in-house generated control limits (or ±10%).

16.1.6.1 If the problem is with the instrument.

16.1.6.1.1 Reanalyze when instrument is in control.

16.1.6.1.2 If biased high, the impact upon the data user must be evaluated. The samples will be re-extracted or the data will be qualified on the final report.

16.2 SAMPLE MATRIX RELATED

16.2.1 Replicate analysis RPD not within ±20%

16.2.1.1 The associated sample data must be qualified on the final report.

16.2.2 Spike analysis recovery not within ±10%

16.2.2.1 If the analyte level in the sample is greater than 4X the spiking level, the %recovery can not be evaluated and no action is taken.

16.2.2.2 If the analyte level in the sample is not greater than 4X the spiking level, the associated sample data must be qualified on the final report.

20.0 DATA ANALYSIS AND CALCULATIONS

Quality Systems SOP QS09 "General and Commonly used Laboratory Calculations" provides details on general calculations used throughout the laboratory.

17.1 Calibration is done by injecting standards. The data system will then prepare a calibration curve by plotting peak area versus standard concentration. Sample concentrations calculated from the regression equation.

17.2 Report only those values that fall between the lowest and the highest calibration standards. Samples exceeding the highest standard must be diluted and reanalyzed.

17.3 Report sample results for nitrate/nitrite in mg N/L as NO_3^- + NO_2^- to two significant figures for samples above the MDL. Report results below the MDL as less than the detection limit.

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21.0 HEALTH AND SAFETY

18.1 Laboratory SOP QS13 "Safety Program & Chemical Hygiene Plan" discusses the safety program that is to be followed labwide.

18.2 Care should be used in handling all samples. Safety glasses must be worn in the lab at all times. The use of latex gloves and lab coats is highly recommended.

18.3 Research into expected sample content and concentration should be done in order to be prepared for additional safety considerations. Generally, any samples that need special consideration have applicable notes on the sample logs.

18.4 MSDS sheets are available for all reagents and standards that have been purchased. These are located on the bookshelves in the Quality Assurance Officer's office.

19.0 POLLUTION PREVENTION

19.1. Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

19.2. Quantity of chemicals purchased should be based on expected usage during its shelf-life and the disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

19.3 For information about pollution prevention that may be applicable to laboratories and research institutions, consult "Less is Better: Laboratory Chemical Management for Waste Reduction," available from the American Chemical Society's Department of Government Regulations and Science Policy, 1155 16th Street N.W., Washington D.C. 20036, (202) 872-4477.

20.0 WASTE MANAGEMENT

Laboratory SOP QS14 on Waste Handling discusses general guidelines for the appropriate handling of wastes and the laboratory program on waste management.

21.1 METHOD PERFORMANCE

21.2 The method support data are presented in section 17 of the Lachat method 10-107-04-1-A. This data was generated according to a Lachat Work Instruction during development of the method.

21.3 Although Lachat Instrument publishes method performance data, including MDL, precision, accuracy and carryover studies, we cannot guarantee that each laboratory will be capable of meeting such performance. Individual laboratory and instrument conditions, as well as laboratory technique, play a major role in determining method performance. The support data serves as a guide of the potential method performance. Some labs may not be able to reach this level of performance for various reasons, while other labs may exceed it.

23.0 REFERENCES

1. U.S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised August 1993, Method 353.2

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2. Lachat Instruments, QuikChem Method 10-107-04-1-C, "Determination of Nitrate/Nitrite in Surface and Wastewaters by Flow Injection Analysis", Revised August 2000.

3. Methods for Determination of Inorganic Substances in Water and Fluvial Sediments. Book 5. Chapter A1. U.S. Department of the Interior, U.S. Geological Survey.

23.0 TABLES

Table 1 Data Review Checklist

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Table 1, Nitrate Data 2nd check

- ❑ Analyst authorization
- ❑ All general information complete
- ❑ Base MDL
- ❑ Correct Units
- ❑ Corrections crossed out & initialed with explanation (where required)
- ❑ Run chart, calibration curve, results & run log included
- ❑ Curve correlation (on chord 3) & date good
- ❑ BLK/BS per day & per 20 samples & in control
- ❑ TV's & sources indicated
- ❑ Samples noted when <DL
- ❑ MS/MSD per 20 & in control
- ❑ MS prep included
- ❑ CCV/CCB done where required & in control
- ❑ Samples greater than LR rerun
- ❑ NO_2 std analyzed & column efficiency in control (>90%)
- ❑ BS, MS/MSD prep. indicated &/or calculation shown
- ❑ Holding time met
- ❑ Problems discussed with manager
- ❑ Necessary NCR's attached
- ❑ Additional information needed for reports:

1st checked by/date:

2nd checked by/date:

Table 1, Nitrate Data 2nd check

- ❑ Analyst authorization
- ❑ All general information complete
- ❑ Base MDL
- ❑ Correct Units
- ❑ Corrections crossed out & initialed with explanation (where required)
- ❑ Run chart, calibration curve, results & run log included
- ❑ Curve correlation (on chord 3) & date good
- ❑ BLK/BS per day & per 20 samples & in control
- ❑ TV's & sources indicated
- ❑ Samples noted when <DL
- ❑ MS/MSD per 20 & in control
- ❑ MS prep included
- ❑ CCV/CCB done where required & in control
- ❑ Samples greater than LR rerun
- ❑ NO_2 std analyzed & column efficiency in control (>90%)
- ❑ BS, MS/MSD prep. indicated &/or calculation shown
- ❑ Holding time met
- ❑ Problems discussed with manager
- ❑ Necessary NCR's attached
- ❑ Additional information needed for reports:

1st checked by/date:

2nd checked by/date:

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SOP was reviewed by E. Jared, Laboratory Scientist, on 20120913 and no revisions were required. Betty Quillen

Reviewed by Emily Jared 20130801. No changes required. Marcia

EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURE

INORGANICS: SOP 234 REVISION #: 03 EFFECTIVE DATE: 090210

ANALYSIS OF NITROCELLULOSE IN AQUEOUS AND NON-AQUEOUS SAMPLES BY BASIC HYDROLYSIS AND MEASUREMENT OF NITRATE AND NITRITE (MODIFIED 353.2)

APPROVALS:

Lab Director: _____ Date: 9/8/10

Data Quality Manager: Marcia _____ Date: 9/8/10

Section Supervisor: Betty DeVille _____ Date: 9/8/10

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Changes Summary
Revision Date: 09/2/10

- This is an update to revision 02 dated 03/15/10.
- Updates were needed for the aqueous procedure due to discontinued production of necessary filters. These updates were implemented 07/08/10.

Revision Date: 03/15/10

- The SOP is formatted to include all 22-elements required per the NELAC standards.
- The laboratory's revision of all technical SOPs now includes a Table of Contents that provides the map of the technical information contained within the SOP.
- Additional requirements, based upon the DoD QSM 4.1, have been integrated into the routine sample flow; however, if the requirement is different from routine sample flow, then the requirement is outlined and documented as such to be followed only when DoD samples are analyzed.
- Numerous improvements/modifications were made to this SOP. Details/specifications were added that require evaluation start to finish.

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1.0 Identification of the Test Method

Nitrocellulose in aqueous and non-aqueous samples by basic hydrolysis and measurement of nitrate/nitrite by method 353.2 modified to include extraction of nitrocellulose from the sample matrix.

This SOP is compliant with methods –EPA method 353.2 modified to include a simple hydrolysis steps.

2.0 Applicable Matrix or Matrices

This SOP is applicable to water or soil matrix using the applicable method of sample preparation and analysis.

3.0 Detection Limit

1.0 ug/g for soils and 400 ug/L for waters.

4.0 Scope of Application

Each parameter that is analyzed and reported under the scope of this SOP is listed in Table 1 of this SOP. This table also lists the associated Reporting Limit (also defined as the Limit of Quantitation) and the lowest Calibration level for each analyte. When applicable, surrogate and Internal Standard Analytes are listed and indicated as such within this table.

5.0 Summary of the Test Method

5.1 An air-dried and "ground" soil sample is extracted with water and methanol to remove inorganic nitrate and nitrite and methanol soluble explosives.
5.2 The remaining solids are extracted with acetone.
5.3 Basic hydrolysis is used to liberate nitrate + nitrite as nitrogen from the nitrocellulose. The solution is neutralized.
5.4 The Lachat flow injection analyzer or equivalent technology measures the nitrate and nitrite. Theoretical nitrocellulose is found by calculation.

6.0 Definitions

Laboratory Quality System SOP QS08 **"**Technical / Operational Definitions, Minimum Essential Quality Control Elements, and Laboratory Calibration Procedures" provides information on the commonly used definitions.

7.0 Interferences

7.1 Since the method is not specific for NC, other sources of nitrate and nitrite ions can cause interferences. This method was optimized to minimize potential sources of interference.

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Free nitrate and nitrite in the water sample pass freely through the filter, and do not cause interference. Other nitrate esters, such as nitroglycerine and PETN also liberate nitrate and nitrite upon hydrolysis. Nitroglycerine does not interfere since it is not retained on the membrane. Passing methanol through the membrane prior to extracting with acetone eliminates interference from PETN. High-grade sodium hydroxide (99.99%) dissolved in 18 Mega-ohm-cm reagent grade water is used for hydrolysis.

7.2 All acetone should be evaporated before hydrolysis to avoid excessive pressure in the hydrolysis tube.

7.3 Nitrocellulose is not stable in acetone. Minimize the time that the extracts are in acetone.

8.0 Safety

Laboratory SOP QS13 "Safety Program & Chemical Hygiene Plan" discusses the safety program that is to be followed lab-wide.

8.1 The acetone used as the extraction solvent is flammable. It should not be used near sparks or an open flame.

8.2 The hydrolysis is performed at high temperature in a sealed glass container. No acetone should remain in the tube before hydrolysis. The hydrolysis must be carried out in a hood behind a shield.

9.0 Equipment & Supplies

9.1 Beakers – 100-mL
9.2 Erlenmeyer flasks – 250 mL
9.3 40-mL glass vials with Teflon-lined caps
9.4 Volumetric flasks – 100 mL
9.5 Class A 50 mL graduated cylinder
9.6 Water bath for use at 100 °C.
9.7 Pipettes - 1 mL, 2 mL, 4 mL and 10mL volumetric, Class A, glass.
9.8 Flow injection analyzer that uses the cadmium reduction method to measure Nitrate + Nitrite as Nitrogen.
9.9 Balance - measurable to 0.01g
9.10 Centrifuge- International Centrifuge Model 2K or equivalent.
9.11 Dessicator
9.12 Tube Rotator- Scientific Instrument Products CO Model 60448 or equivalent.
9.13 Pasteur Pipettes.
9.14 Mortar and pestle
9.15 Sieve – 30 mesh.
9.16 Disposable centrifuge tube – 50 mL with a screw cap (may use 40 mL VOA vials)
9.17 Disposable culture tube – 50 mL glass with a Teflon lined screw cap (may use 40 mL VOA vials)

10.0 Reagents and Standards

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The laboratory's LIMS system allows for complete documentation and for the traceability of reagents and standards used within the laboratory. The following information relates to the specific reagents and standards used for the performance of the method:

10.1 HPLC grade chemicals shall be used in all tests. It is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without affecting the accuracy of the determination.

10.2 Nitrocellulose – Standard Analytical Reference Material.

10.3 Reagent water – Use Modulab system.

10.4 Sulfuric Acid – Reagent grade.

10.5 Methanol – Reagent grade.

10.6 Acetone – Reagent grade.

10.7 Sodium Hydroxide (1 N)

10.8 Nitrogen – Industrial grade or equivalent

10.9 Stock Standard Solutions.

10.9.1. Dry the Nitrocellulose standard to constant weight in a desiccator in the dark. Place about 100 mg (weighed to the nearest 0.1 mg) into a 100 mL volumetric flask and dilute to volume with acetonitrile. Allow at least 48 hours for dissolution to occur. Store in a refrigerator at 4°C in the dark. Calculate the concentration of the stock solution from the actual weight used (nominal concentration = 1,000 mg/L). Stock solution may be used for up to one year.

10.9.2. Nitrite Standard – Weigh 0.1500 g Sodium Nitrite and dilute to 100 mL in water. Prepare fresh yearly. Or alternately order from a commercial manufacturer.

10.9.3. Nitrate Standard- Weigh 0.1630 g Potassium Nitrate and dilute to 100 mL in water. Prepare fresh yearly. Or alternately order from a commercial manufacturer.

10.10 Working Standards:

10.10.1. Nitrocellulose working standard A- Add 10 mLs of stock Nitrocellulose standard to a 100 mL volumetric flask and fill to the mark with acetonitrile. The true value is 100 mg/L. This standard must be kept out of the light and cool so that no evaporation occurs. Prepare fresh every six months.

10.10.2. Nitrocellulose working standard B- Add 1.0 mL of stock Nitrocellulose standard to a 100 mL volumetric flask and fill to the mark with acetonitrile. The true value is 10 mg/L. This standard must be kept out of the light and cool so that no evaporation occurs. Prepare fresh every six months.

10.10.3. Nitrite/Nitrate Intermediate Standard – Combine 1.00 mL Sodium Nitrite stock solution with 1.00 mL Potassium Nitrate stock solution and dilute to 100 mL in water. (10 mg/L). Prepare fresh every six months.

10.10.4. Refer to SOP-179 for Nitrate & Nitrite by Lachat method for instructions on how to make working standards to generate the calibration curve.

11.0 Sample Collection, Preservation, Shipment, and Storage

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11.1 Quality Systems SOP QS10 related to Sample Receipt, Handling, & Processing provides details for collection, preservation, shipment, and storage.
11.2 Grab samples must be collected and stored in glass containers. Follow conventional sampling procedures.
11.3 Samples must be kept at or below 4°C and in the dark from the time of collection through analysis.
11.4 Soil samples should be air-dried to constant weight at room temperature. The nitrocellulose content of dried and "ground" soil samples is stable.
11.5 The holding time for this procedure is 28 days.

12.0 Quality Control

12.1 Quality Systems SOP QS08 "Technical / Operational Definitions, Minimum Essential Quality Control Elements, and Laboratory Calibration Procedures" outlines details related to laboratory wide protocols on quality control. The laboratory must, on an ongoing basis, analyze a method blank, a laboratory control sample (blank spike), matrix spike, and a matrix spike duplicate for each analytical batch (up to a maximum of 20 samples/batch) to assess precision and accuracy. For laboratories analyzing one to ten samples per month, at least one spiked sample per month is required.
Note: Sample duplicates are deemed to be not useful when sample data concentrations are expected to be non-detects.

13.0 Calibration and Standardization

Quality Systems **SOP QS08** "Technical / Operational Definitions, Minimum Essential Quality Control Elements, and Laboratory Calibration Procedures" related to Calibration Procedures provides laboratory wide protocols for calibration and standardization.

13.1 Refer to SOP-179 for Nitrate & Nitrite by Lachat method for instructions on how to make working standards to generate the calibration curve.

14.0 Procedure

14.1 Aqueous
14.1.1 Rinse 250 mL Erlenmeyer flasks with methanol.
14.1.2 Label 250 mL Erlenmeyer flasks as to what samples are being digested (BS, BLK, MS, MSD, Sample ID). Pour up 25 mLs of sample using Class A graduated cylinder and add to rinsed 250 mL Erlenmeyer flasks.
14.1.2.1. Matrix spikes (MS/MSD) and Blank Spikes (BS) are prepared by adding 2 mLs of working nitrocellulose standard A to 25 mLs of DI water for the BS and to 25 mLs of sample for the matrix spikes.
14.1.3. Boil gently in water bath until a final volume of about 3-5 mLs is reached (Do not allow to go to dryness).
14.1.4. HYDROLYSIS: Add 5 mL of 1 N aqueous NaOH to 250 mL Erlenmeyer flask, swirl, and pour into 40 mL VOA vials. Cap the vials tightly and heat them

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in a boiling water bath for 30 minutes. During heating, shake the tubes every 10 minutes.
14.1.5. Cool the tubes for 30 minutes. Bring to final volume of 25 mLs with DI water.
14.1.6. Adjust the pH manually with 1 N H_2SO_4 to neutralize. (Record Element ID of the 1 N H2SO4 on Bench sheet and the pH before and after adjustment).
14.1.7. Use routine set-up parameters when quantifying NO_3-NO_2 with a flow injection analyzer (FIA). Refer to SOP-179 using method 353.2 (cadmium reduction).
14.1.8. Also analyzed an un-digested aliquot of sample for use in determining a NO2/NO3 correction.

14.2 Non-Aqueous

14.2.1. Place about 50 grams of wet sample into a 9 cm evaporating dish. Dry overnight in a fume hood at ambient temperature.
14.2.2. Grind the sample with a mortar and pestle so it passes through a 30-mesh screen.
14.2.3. Weigh and record on bench sheet to the nearest 0.4 grams, 10.0 ±0.4 grams of sample into a 50 mL centrifuge tube. Weigh out duplicate and spike sets for each set of more than 20 samples. Add 30 mLs of water into the tubes.
14.2.4. Rotate the tubes on the test-tube rotator for 5 minutes.
14.2.5. Centrifuge the tubes at maximum rpm in the centrifuge for 5 minutes.
14.2.6. Decant the supernatant water and dispose of it.
14.2.7. Add 20 mL of methanol into the tubes. Cap and shake the tubes to break up the pill of sample in the tube's bottom. Record the lot # of the methanol on the bench sheet.
14.2.8. Rotate the tubes on the test-tube rotator for 5 minutes.
14.2.9. Centrifuge the tubes at maximum rpm in the centrifuge for 5 minutes.
14.2.10. Decant the supernatant methanol and dispose of it.
14.2.11. Add 20 mL of acetone into the tubes. Cap and shake the tubes to break up the pill of sample in the tube's bottom. Record the lot # of the acetone on the bench sheet.
14.2.12. Rotate the tubes on the clinical rotator for 5 minutes.
14.2.13. Centrifuge the tubes at maximum rpm in the centrifuge for 5 minutes.
14.2.14. Decant the supernatant acetone into a 50 mL screw top culture tube or 40 mL VOA vial. Rinse with 3 mL of acetone and add it to the VOA vial.
14.2.15. Add spiking solutions for quality control samples at this point – MS/MSD/BS. The spike for non-aqueous samples is prepared by adding 2 mLs of working standard A to 20 mLs of acetone for the BS and to the supernatant acetone from the sample for the matrix spikes.
14.2.16. Evaporate the acetone to dryness in a warm water bath while blowing down with nitrogen.
14.2.17. Add 5 mL of 1 N aqueous NaOH. Cap the tubes tightly and heat them in a boiling water (100°C) bath for 30 minutes. During heating, shake the tubes every 10 minutes.

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14.2.18. Cool the tubes for 30 minutes. Add 20.0 mL of water into the tubes. Final volume is 25 mL.
14.2.19. Adjust the pH manually with 1 N H_2SO_4 to neutralize record the element # for the 1N H2SO4 and the pH before and after adjustment on the bench sheet.
14.2.20. Use routine set-up parameters when quantifying NO_3-NO_2 with a flow injection analyzer (FIA). Refer to SOP-179 using method 353.2 (cadmium reduction).

15.0 Data Analysis and Calculations

Quality Systems SOP QS09 "General and Commonly used Laboratory Calculations" provides details on general calculations used throughout the laboratory.

15.1 The concentration of nitrocellulose, [NC], is found by first calculating the mass of nitrogen, N, found in the samples by analysis of Nitrate+Nitrite on the FIA.

15.1.1 AQUEOUS

$$[NC] \text{ in ug/L} = \frac{[\text{concentration of Nitrate + Nitrite as N (ug/L)}] \times [\text{Final (L)}]}{[\text{Initial (L)}] \times \text{Conversion}}$$

Where:

Initial is equal to the initial sample volume in liters.
Final is equal to the final sample volume in liters.
Conversion is equal to 0.126 as munitions grade nitrocellulose is about 12.6% nitrogen by weight (Barkley and Rosenblatt 1978, Helton 1976). The mass of nitrocellulose in the sample is calculated by summing the total mass of N found as nitrate + nitrite and dividing by 0.126.

15.1.2. NON-AQUEOUS

$$[NC] \text{ in ug/g} = \frac{[\text{concentration of Nitrate + Nitrite as N (ug/L)}] \times [\text{Final (L)}]}{[\text{Initial (g)}] \times \text{Conversion}}$$

Where:

Initial is equal to the initial sample weight in grams.
Final and Conversion = see aqueous definitions.

16.0 Method Performance

Demonstration of Capability (DOC): Each analyst must perform a DOC prior to reporting data. The analyst must prepare (for prep technicians) and analyze (analysts reviewing and reporting data) 4-BS samples. The data is calculated for accuracy and precision requirements. The DOC form, as listed within section 2.5 of the Quality is

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completed by each analyst and then provided to the supervisor for further processing and approval.

DOC BS Preparation: Add 4.0 mLs of the working Nitrocellulose standard B to 40 mLs of acetone for the aqueous DOC and add the 4.0 mLs of the working Nitrocellulose standard B to 20 mLs of acetone for the non-aqueous DOC. Follow SOP procedure for preparation and analysis steps.

DOC Accuracy and Precision Criteria: The four blank spike's analyzed for the DOC need to be in the range of 50 to 100% recovery. Duplicates should be below 25% relative percent difference.

17.0 Pollution Prevention

Quantity of chemicals purchased should be based on expected usage during its shelf-life and the disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

18.0 Data Assessment and Acceptance Criteria for Quality Control Measures

Quality Control SOP QS05, "Data Deviations / Interpretations / Exceptions: Laboratory Non-Conformance / Corrective Action Procedures, Decision Making Guidelines for Evaluating Laboratory Analytical Sample and Quality Control Results", provides details on data assessment and acceptance criteria for Quality Control Measures. Table 2 of this SOP provides information on QC samples, frequency, and the associated criteria specific to the performance of this method.

Reports will include a minimum of a blank, blank spike (BS), matrix spike and matrix spike duplicate. Relative percent difference (RPD) should be below 25%. The accuracy control limits will default to historical control limits of 50 to 100% with marginal limits up to 120% for aqueous and non-aqueous samples.

19.0 Contingencies for Handling out-of-control or unacceptable data

Quality Control SOP QS05, "Data Deviations / Interpretations / Exceptions: Laboratory Non-Conformance / Corrective Action Procedures, Decision Making Guidelines for Evaluating Laboratory Analytical Sample and Quality Control Results", provides details on handling out of control data. Table 2 within this SOP also lists corrective actions associated with the failure of the various QC samples employed for the performance of this method.

19.1 Nitrocellulose is a very technique oriented method. Care must be taken with each step of the preparation method to make sure that the samples are handled correctly. Light destroys nitrocellulose so samples cannot be left out for breaks or for attending other tests while prepping and analyzing these samples. If QC failures occur samples

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must be re-prepped and reanalyzed at least once to make sure that the QC failure was not caused by analyst error.

20.0 Waste Management

Laboratory SOP QS14 on Waste Handling discusses general guidelines for the appropriate handling of wastes and the laboratory program on waste management.

20.1 Extracted soil samples will be drummed in their centrifuge tubes and processed for disposal with respect to state and/or federal regulations.

20.2 Methanol and acetone will be drummed and processed for disposal with respect to state and/or federal regulations.

21.0 References

21.1 USEPA Methods for Chemical Analysis of Water and Wastes Method 353.2.

21.2 Barkley, J.J. and D.H. Rosenblatt (1978) Automated nitrocellulose analysis. U.S. Army Medical Bioengineering Research and Development Laboratory, Technical Report 7807, ADA067081.

21.3 Helton, D.O. (1976) Chemical and physical characterization of nitrocellulose fines. U.S. Army Medical Research and Development Command, ADA036151.

22.0 Tables, Diagrams, Flowcharts and Validation Data

TABLE 1 – Analytes DL/LOD/LOQ

Parameter	DL	LOD	LOQ
Nitrocellulose in water (ug/L)	400	800	1200
Nitrocellulose in soil (ug/g)	1.0	2.0	4.0

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Table 2 - Method Quality Control Requirements Summary			
QC Check	**Minimum Frequency / Requirements**	**Acceptance Criteria**	**Corrective Action for Failures / Data Useability**
Calibration Curve	• Prior to analyzing any samples • A minimum of 5-points for linear fits • Low standard at the RL/LOQ level	• For Linear calibration fits a correlation coefficient of 0.995 • Must follow curve processing requirements from SOP QS08	• Re-evaluate curve mix and makeup • Re-run curve • Check instrument for maintenance needs • Re-prep the curve standards Samples cannot be analyzed until there is a passing calibration
ICB	At the beginning of every sequence	Must meet the MB criteria	Re-run
ICV	Alternate source standard to be analyzed after every calibration curve	Must be ±10%	• Re-analyze an ICV from a different source • Re-prep and re-analyze the ICV • Re-calibrate and verify standard preps and sources
CCV	• At the beginning of every sequence • For every 10-client samples	Must be ±10%	Run last ten samples over back to the last passing CCV.
Closing CCV	• At the end of every sequence	Must be ±10%	Run last ten samples over back to the last passing CCV.
MB	One per prep batch	• Must be less than the LOD	• Re-analysis to confirm the positive value • Ascertain if there are any samples within the batch that meet the MB criteria and provide the information for the decision makers • If results are between the LOD and LOQ, then assess the data and notify the PM for further action • Re-prep of samples associated with the MB • NCR will be required for data reported • Final Report data flagging will be required

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Table 2 - Method Quality Control Requirements Summary			
QC Check	**Minimum Frequency / Requirements**	**Acceptance Criteria**	**Corrective Action for Failures / Data Useability**
LCS	One per prep batch	50 to 100% Will accept up to 120%.	• Follow guidelines from SOP QS05
MS	One per prep batch	50 to 100% Will accept up to 120%	Flag data with an "N" on the final report.
MSD	One per prep batch	50 to 100% Will accept up to 120%	Flag data with an "N" on the final report.
DOC Study	• Initially per analyst prior to reporting data • Annually • Follow specific guidelines from section 16 for the preparation and analysis of DOC samples	• Must meet the criteria of the LCS for average accuracy • Precision criteria is 25%	• Re-prep and / or • Re-analysis
MDL Study	Once per year as required for state certification.		
LOD Verification	Every quarter	See QS08	
LOQ Verification	Every quarter	See QS08	

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Table 3, Technical Completeness / Accuracy Checklist

1. Were all the QC check elements analyzed – refer to Table 2 of the SOP
2. Were the QC criteria met
3. In cases of failures, was there an NCR written
4. Were dilution factors applied correctly
5. Was the data uploaded into LIMS via direct upload – if yes, then was a cross check subset of the uploaded values performed
6. If the data was entered into LIMS manually, was a check of all entered values performed
7. Was the red marked data in LIMS checked for accuracy and the corresponding hard copy data documented appropriately
8. Were proper data qualifiers applied to the data in LIMS
9. Was the hard copy package checked for completeness to include all data for the sequence such that the data reviewer could reconstruct sample analyses and validate / approve the data

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Table 4, ANALYST DATA REVIEW CHECKLIST

Sample Number(s):	
Batch Number(s):	
Method:	**Nitrocellulose using modified method 353.2 (Nitrate + Nitrite)**

QA/QC Item	Yes	No	NA	Second Level Review
1. Were samples analyzed within holding times?				
2. Was initial calibration curve QC criteria met?				
3. Was all continuing calibration criteria in control?				
4. Did any sample exceed the highest calibration standard? (If yes, were appropriate dilutions made to generate samples concentration within calibration range?)				
5. Did LCS or blank spike meet control limits?				
6. Did MS/MSD meet control limits?				
7. Was the preparation (Method) Blank below the project required detection limits?				
8. Were samples returned back to cold storage immediately after use?				
9. Sample preparation information is correct/complete in LIMS.				
10. Analytical results are correct and complete.				
11. The appropriate SOP's have been used and followed.				
12. "Raw data" have been correctly interpreted/appropriately documented.				
13. "Special" sample preparation and analytical requirements have been met.				
14. Example calculation has been included per batch of samples.				

Comments on any "No" response:

_____

_____

_____

Analyst: _____ Date: _____

Second-Level Review: _____ Date: _____

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EMPIRICAL LABS, LLC.
TRAINING ATTENDANCE RECORD

TRAINING TOPIC: SOP234 Rev03 - Analysis of Nitrocellulose in Aqueous and Non-aqueous Samples By Basic Hydrolysis and Measurement of Nitrate and Nitrite(Modified 353.2)

Group: Betty Deville

ATTENDEES:

	NAMES (print)	SIGNATURE	REMARK	DATE	TIME	INSTRUCTOR
1	Veronica Mullen	Veronica Mullen		9-15-10	11:54	BLD
2	Kendra Gentry	Kendra Gentry		9-15-10	12:00	BLD
3						
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EMPIRICAL LABORATORIES, LLC
STANDARD OPERATING PROCEDURE

INORGANICS: SOP 234 REVISION #: 03 EFFECTIVE DATE: 090210

ANALYSIS OF NITROCELLULOSE IN AQUEOUS AND NON-AQUEOUS SAMPLES BY BASIC HYDROLYSIS AND MEASUREMENT OF NITRATE AND NITRITE (MODIFIED 352.2)

APPROVALS:

Lab Director: _____ Date: 9/8/10

Data Quality Manager: _____ Date: 9/8/10

Section Supervisor: _____ Date: 9/8/10

No changes
KBG 9/14/11

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Appendix E
Contractor Forms

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Contractor Forms Index

Hazard Communications and Safety Training Acknowledgment Form
Daily Health & Safety Report
Daily Site Report
Daily Quality Control Report (DQCR)
Weekly Quality Control Report
Site Safety Tailgate Meeting Form
Field Activity Daily Log
MEC Discovery Form
Explosives Accountability Log
Daily Health and Safety Compliance Inspection Form
Nonconformance and Corrective Action Report Form
Visitors Sign-In Log
Daily EM61 Geophysical QC Form
EM61 Geophysical Target Reacquisition Form
EM61 Geophysical Target Dig Selection and Intrusive Results Table
On-Site QA Checklist
Three Phase Control- Preparatory Phase Inspection Report
Three Phase Control- Initial Phase Report
Three Phase Control- Follow-Up Phase Report
Photo Log

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FPM Remediations, Inc.

HAZARD COMMUNICATIONS AND SAFETY TRAINING ACKNOWLEDGMENT

PROJECT/OFFICE TITLE: _____

LOCATION: _____ CONTRACT#: _____

The following personnel acknowledge by their signature that they have received a copy of the FPM Corporate Safety & Health Plan and have reviewed and agree to comply with all of the provisions of applicable site specific Health and Safety Plans and Work Plans for this FPM location. The signed personnel understand that violating any of the health and safety requirements specified in the plan could prohibit the offender from working at this FPM location. In addition, personnel acknowledge that they have been trained on all elements of Hazard Communications as required by CFR 1910.1200 including the checked topics listed below:

- ☐ Emergency Response Plan – Emergency Response Numbers and Route to Hospital
- ☐ Chemical Hazards, Physical Hazards, and Job-specific Hazards
- ☐ Air Monitoring Procedures and Action Levels (if applicable)
- ☐ Site Control Measures and Personal Protective Equipment (PPE) Requirements
- ☐ Location of MSDS's/SDS's
- ☐ Confined Space Entry Procedures & Permits (if applicable)
- ☐ Location and Use of Emergency Equipment/Fire Extinguishers
- ☐ Use, Maintenance, and Storage of PPE
- ☐ Spill Containment and Response
- ☐ Incident Reporting Procedures (Accidents, Near Misses, Injuries, Illness)
- ☐ Decontamination Procedures (if applicable)
- ☐ Blood Borne Pathogens and FPM's Exposure Control Plan (1st Responders)
- ☐ FPM Standard Operating Procedures

NAME (Print)	SIGNATURE	DATE

FPM Remediations, Inc.

HAZARD COMMUNICATIONS AND SAFETY TRAINING ACKNOWLEDGMENT

NAME (Print)	SIGNATURE	DATE

FPM Remediations, Inc.

DAILY HEALTH & SAFETY REPORT

Date: _____

Report Number: _____
Project Title: _____
Location: _____
Contract Number: _____

WEATHER	CLEAR	PT CLOUDY	OVERCAST	RAIN	SNOW	FOG
TEMP	< 32 F	32 – 50 F	50 – 70 F	70-85 F	85-100 F	>100 F
WIND	< 10 mph	10 – 20 mph	20 – 30 mph	30 – 40 mph	> 40 mph	
HUMIDITY	DRY	MODERATE	HUMID			

Personnel On-Site

No.	Name/Company	Affiliation	Location/Description of Work
1.			
2.			
3.			
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Field Changes: YES_____ NO_____

If yes, filed Nonconformance and Corrective Action Report number (NCR No.):_____

FPM Remediations, Inc.

DAILY HEALTH & SAFETY REPORT

Date: _____

Health & Safety (Briefings held, PPE, injuries, near misses, etc.)
Daily Brief (SUXO/UXOSO): **Site Safety Tailgate Briefs (teams):** **H & S Compliance Inspection:** **Incidents/Accidents:** **Illnesses:** **Discrepancies/Action Items:** **Visitors:**

Contractor Verification: On behalf of the contractor, FPM Remediations, Inc., I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ _____

Signature Date

FPM Remediations, Inc.

DAILY SITE REPORT

Date: _____

Report Number: _____
Project Title: _____
Location: _____
Contract Number: _____

WEATHER	CLEAR	PT CLOUDY	OVERCAST	RAIN	SNOW	FOG
TEMP	< 32 F	32 – 50 F	50 – 70 F	70-85 F	85-100	>100 F
WIND	< 10 mph	10 – 20 mph	20 – 30 mph	30 – 40 mph	> 40 mph	
HUMIDITY	DRY	MODERATE	HUMID			

Personnel On-Site

No.	Name	Hrs.	Affiliation	Location/Description of Work
1.				
2.				
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30.				

Field Changes: YES_____ NO_____

If yes, filed Nonconformance and Corrective Action Report number (NCR No.):_____

Work Performed (include location)	
Equipment Used:	
Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	

FPM Remediations, Inc.

DAILY SITE REPORT

Date: _____

Ordnance or Ordnance Related Material Encountered, Condition and Location:	
Disposition of Ordnance Items Encountered, Include Dates:	
Verbal Instructions Received or Given:	
Changed Conditions/Delays/Conflicts Encountered:	
Other Comments or Additional Information:	

Contractor Verification: On behalf of the contractor, FPM Remediations, Inc., I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ _____

Signature Date

FPM Remediations, Inc.

DAILY QUALITY CONTROL REPORT

Date: _____

Report Number: _____
Project Title: _____
Location: _____
Contract Number: _____

WEATHER	CLEAR	PT CLOUDY	OVERCAST	RAIN	SNOW	FOG
TEMP	< 32 F	32 – 50 F	50 – 70 F	70-85 F	85-100	>100 F
WIND	< 10 mph	10 – 20 mph	20 – 30 mph	30 – 40 mph	> 40 mph	
HUMIDITY	DRY	MODERATE	HUMID			

Personnel On-Site

No.	Name	Affiliation	Location/Description of Work
1.			
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Instrumentation:

Type	Serial Number	Initial Time	Initial Reading	End Use Time	End Use Reading
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA- 52 B		N/A	N/A	N/A	N/A
Magnetometer, DML 2000		N/A	N/A	N/A	N/A
Magnetometer, DML 2000		N/A	N/A	N/A	N/A

FPM Remediations, Inc.

DAILY QUALITY CONTROL REPORT

Date: _____

Field Changes: YES_____ NO_____

If yes, filed Nonconformance and Corrective Action Report number (NCR No.):_____

Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	
Work Performed	
Definable Feature of Work & Phase (Preparatory, Initial, Follow On)	
QA/QC Samples Collected	
Problems Encountered/Resolved	
Visitors	
Notes	
Tomorrow's Expectations	

Contractor Verification: On behalf of the contractor, FPM Remediations, Inc., I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ _____

Signature Date

FPM Remediations, Inc.

WEEKLY QUALITY CONTROL REPORT

Date: _____

Report Number: _____
Project Title: _____
Location: _____
Contract Number: _____

WEATHER	CLEAR	PT CLOUDY	OVERCAST	RAIN	SNOW	FOG
TEMP	< 32 F	32 – 50 F	50 – 70 F	70-85 F	85-100	>100 F
WIND	< 10 mph	10 – 20 mph	20 – 30 mph	30 – 40 mph	> 40 mph	
HUMIDITY	DRY	MODERATE	HUMID			

Personnel On-Site

No.	Name	Affiliation	Location/Description of Work
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

Instrumentation:

Type	Serial Number	Initial Time	Initial Reading	End Use Time	End Use Reading
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
White, DFX 300mm		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA - 52 CX		N/A	N/A	N/A	N/A
Schonstedt, GA- 52 B		N/A	N/A	N/A	N/A
Magnetometer, DML 2000		N/A	N/A	N/A	N/A
Magnetometer, DML 2000		N/A	N/A	N/A	N/A

FPM Remediations, Inc.

WEEKLY QUALITY CONTROL REPORT

Date: _____

Field Changes: YES_____ NO_____

If yes, filed Nonconformance and Corrective Action Report number (NCR No.):_____

WEEKLY SYNOPSIS	
Health & Safety (Briefing held, PPE, injuries, near misses, etc.)	
Work Performed	
Definable Feature of Work & Phase (Preparatory, Initial, Follow On)	
QA/QC Samples Collected	
Problems Encountered/Resolved	
Visitors	
Notes	

Contractor Verification: On behalf of the contractor, FPM Remediations, Inc., I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as may be noted above.

_____ _____

Signature Date

FPM Remediations, Inc.

SITE SAFETY TAILGATE MEETING

Date: _____

PROJECT NAME/CLIENT:		REPORT NUMBER:	
PROJECT NUMBER:		PROJECT MANAGER:	

TEAM:

LOCATION:

TASK TO BE PERFORMED:

I. Purpose for meeting: (check all that apply)

	DAILY SAFETY BRIEFING
	Begin New Task. Task: Initial Site Visit/ Team assignment
	Periodic Safety Meeting
	New Site Procedures
	New Site Conditions / Information
	New Site Workers

MEETING ATTENDEES:

NAME (Print)	SIGNATURE	COMPANY

FPM Remediations, Inc.

SITE SAFETY TAILGATE MEETING

Date: _____

NAME (Print)	SIGNATURE	COMPANY

FPM Remediations, Inc.

SITE SAFETY TAILGATE MEETING

Date: _____

ON-SITE SAFETY MEETING RECORD *Page 2 of 2*

II. Topic (check all that apply)

	Site Safety Personnel		Decontamination
	Work Area Description		Emergency Response
	Site Characterization		Hazard Communication
	Equipment Hazard(s)		On-site Emergency
	Biological Hazard(s)		On-site Injuries
	Chemical Hazard(s)		Evacuation Procedures
	Physical Hazard(s)		Rally Point
	Heat Stress		Emergency Communications
	Cold Stress		Directions to Hospital
	Site Control		Emergency Equipment
	Work and Support Zones		Drug and Alcohol Policies
	PPE		Medical Monitoring
	Air Monitoring		Task Training
	Safe Work Practices		Unexploded Ordnance (UXO)

III. Remarks –

IV. Verification I certify that the personnel listed on this roster received the briefing described above. Site personnel not attending this meeting will be briefed before beginning their assigned duties.

_____

UXO Site Safety Officer

_____

Senior UXO Supervisor

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DAILY LOG	DATE			
	NO.			
	SHEET		OF	

FPM Remediations, Inc.

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	**PROJECT NO.**
PROJECT NAME:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
VISITORS ON SITE:	**CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:**
WEATHER CONDITIONS:	**IMPORTANT TELEPHONE CALLS:**
FPM PERSONNEL ON SITE:	
SIGNATURE:	**DATE:**

DAILY LOG	DATE			
	NO.			
	SHEET		OF	

FPM Remediations, Inc.

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	**PROJECT NO.**
PROJECT NAME:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	

FPM Remediations, Inc.

MEC/MULTIPLE ANOMALY DISCOVERY FORM

UXO Supervisor:_____ **Date:**_____

Anomaly ID No. (i.e. FAR A-001)						
Anomaly Longitude (X) / Latitude (Y)	X:			Y:		
Object Length				Inches		
Object Diameter/Thickness				Inches		
Object Weight (Estimated)				Pounds		
Slope of Terrain (Check one box)	□	<10°	□	10° to 30°	□	>30°
Vegetation Cover (Check one box)	□	Cleared	□	Vegetated	□	Wetland
Soil Type (Check one box)	□	Sand	□	Silt	□	Clay
Inclination (Circle one)	0°	45°	90°	135°	180°	
Orientation (Circle one)	N-S	NW-SE	E-W	SW-NE		

Item Description/Justification/Comments

Anomaly Type/Category (Check Appropriate Box)

□ UXO □ DMM □ Munitions Debris □ Practice Ordnance □ Inert Ordnance
□ Metal Waste □ Sub-surface Anomaly □ Other _____

Was photo taken?	□ Yes	□ No	File Name:

Ordnance Positive Identification (If known, record below. Include fuze condition and disposition)

Quantity:	Ordnance Mark/Mod:	Nose Fuze Mark/Mod:	Tail Fuze Mark/Mod:
Ordnance Filler:	□ Explosive □ Propellant	□ Pyrotechnic □ Other	N.E.W.

Ordnance Category:

□ Bombs □ Land Mines □ Rockets	□ Clusters/Dispensers □ Misc. Explosive Devices □ Pyrotechnics and Flares	□ Grenades □ Mortars □ Projectiles	□ Guided Missiles □ Underwater Ordnance □ Small Arms

Fuzing Types

□ Piezo-Electric □ All-ways Acting (PD) □ Mech Long Delay □ Powder Train Time Fuze (PTTF)	□ Proximity (VT) □ Electric □ Point-Initiating, Base-Detonating □ MT Superquick	□ Impact □ Point Detonating □ Mechanical Time	□ Base Detonating □ Influence □ Pressure

Status of MEC/UXO

□ Armed □ Unarmed

Physical Condition of MEC/UXO (Check all that apply)

□ Broken Open	□ Soil Staining	□ Filler Visible	□ Soil Sample Taken

FOR UXOSS USE

Disposition: (Clarify Under Remarks) □ Transport □ Leave In Place □ Other		Date:
Notifications To Installation By:	Signature:	Date:
Transported By:	Signature:	Date:
Transferred To:	Signature:	Date:
Storage Location:		
Destroyed By:	Signature:	Date:

Remarks:

Signature: _____

UXOSS

UXO – Ordnance fuzed, armed or otherwise prepared for action and fired or placed in such a manner that it constitutes a hazard
DMM – Ordnance that was disposed of by abandonment; may have been fuzed or armed, but was not employed
Inert – Same physical features as an ordnance item but does not and never did contain energetic material
Munitions Debris – Ordnance material that contained or was in contact with energetic material, which has been expended (e.g., fragments from projectile)

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FPM Remediations, Inc.

EXPLOSIVES ACCOUNTABILITY LOG

Contract:		Project Name:	
Date:		Work Area & Grid Numbers:	
Team Number:		Team Leader:	
Explosives Issued:		Signature of Team Leader:	
Item	Quantity	Lot Number	Checker's Initials
Explosives Expended:		Signature of Team Leader:	
Item	Quantity	Lot Number	Checker's Initials
Explosives Returned:		Signature of SUXOS:	
Item	Quantity	Lot Number	Checker's Initials

Notes:

The signatures in each section of this document indicated that the items listed in that section were in fact issued, expended, or returned to storage and that the qualities listed were verified through a physical count.

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FPM Remediations, Inc.

DAILY HEALTH AND SAFETY COMPLIANCE INSPECTION

DATE:	TIME:	LOG NO.:
CONTRACT NO.:	TASK ORDER NO.:	
SITE NAME AND LOCATION:		

WEATHER CONDITIONS: _____

I. AREAS INSPECTED: (List by grid number, Team or task) _____

II. INSPECTION RESULTS

Item Description	Pass	Item Description	Pass
1. Personal Protection (PPE) per HASP	Y / N	9. UXO/OE Detection Equipment	Y / N
2. Work Practices Follow HASP/WP	Y / N	10. UXO/OE Detection Equipment Calibration	Y / N
3. Site Control/Decon per HASP	Y / N	11. MSDSs and Container Labeling per HASP	Y / N
4. First Aid Kit(s)/Eyewash Station(s)	Y / N	12. On- and Off-Site Communications	Y / N
5. Fire Extinguisher(s)	Y / N	13. Site House Keeping	Y / N
6. Flammable Storage Areas	Y / N	14. Explosives / Ordnance Storage Areas	Y / N
7. Safety and Health Monitoring Equipment Use	Y / N	15. Other: (list)	Y / N
8. Monitoring Equipment Calibration	Y / N	16. Other: (list)	Y / N

III. SUMMARY OF DEFICIENCIES NOTED: (If Required) _____

IV. CORRECTIVE ACTIONS RECOMMENDED: (If required) _____

V. REINSPECTION RESULTS: (If required) _____

VI. SIGNATURES:

_____ UXO Safety Officer

_____ Sr. UXO Supervisor / Project Manager

Note: Safety Compliance Inspections are to be conducted each work day and documented on this form.

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FPM Remediations, Inc.

Nonconformance and Corrective Action Report

Date: _____

Report Number: _____

Project Title: _____

Location: _____

Contract Number: _____

Description of Nonconformance and Cause:	
Proposed Disposition:	

Submitted by: _____ **Date:** _____

Approved by: _____

Actual Disposition approved by Project Manager:	
Implementation of Disposition assigned to::	

Completed by: _____ **Date:** _____

Verified by: _____ **Date:** _____

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FPM Remediations, Inc.

VISITORS SIGN-IN LOG

PROJECT LOCATION: _____

PROJECT SITE: _____ **PROJECT NO:** _____

DATE	NAME	COMPANY	TASK	IN	OUT

COMMENTS: _____

_____

_____

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FPM Remediations, Inc.

EM61-MK2 QC Form

Project: _____
Location: _____

DATE: _____; OPERATOR:_____; GP data sys: EM61MK2 ; Position data: _____
Coil serial #:_____; Console EM61MK2 serial #:_____; Data logger serial #:_____;
EM61 MK2 Warm Up: (minimum 15 min.) start time: _____ end time: _____

1) Null Instrument: _____; Values Stable? ____Y ____N

2) Personnel Test: **data file name:**_____.r61
Interference by Operator? ____Y ____N If so, at what distance? _____
Interference by Others? ____Y ____N If so, at what distance? _____

3) Cable Shake Test: **data file name**: _____.r61
Data spikes while shaking cables? ____Y ____N Comments: _____

Opening Function Tests

4) Static Background / Static Standard Test: **data file name**: _____.r61
3 min, 1 min, 1 min - All three segments in 1 file as 3 separate lines
Acceptance Criteria-Background response ≤ 2 mV Peak to Peak on Channels 2, 3, and 4 and ≤ 4 mV on Channel 1.

Channel	Background (mV) Line #	Standard (mV) Line #	Recovery (mV) Line #
Ch 1			
Ch2			
Ch3			
Ch4 (top)			

Standard object and location: Small ISO, on board mounted center of coil
Battery Voltage: _____V

5) Opening IVS and Latency Test: **data file name**: _____.r61
Known Position of Object N_____,E_____

6) Opening Background: **data file name:** _____.r61

Closing Function Tests

7) Static Background / Static Standard Test: data file name: _____.r61
3 min, 1 min, 1 min - All three segments in 1 file as 3 separate lines
Acceptance Criteria-Background response ≤ 2 mV Peak to Peak on Channels 2, 3, and 4 and ≤ 4 mV on Channel 1

Channel	Background (mV) Line #	Standard (mV) Line #	Recovery (mV) Line #
Ch 1			
Ch2			
Ch3			
Ch4 (top)			

Standard object and location: Small ISO, on board mounted center of coil
Battery Voltage: _____V

8) PM IVS + Latency Test: data file name: _____.r61
Known Position of Object N_____,E_____

9) Closing Background: **data file name:** _____.r61

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EM61-MK2 Geophysical Target List for Relocation and Reacquisition
Project # _____
Site Name _____

Target Information					Field Result						
Target ID	**Easting (m)**	**Northing (m)**	**Grid Value for Ch2 (mV)**	**Target Size (m)**	**Initial of surveyer**	**False Positive (Y/N)**	**Offset Distance (m)**	**Offset Direction**	**Reloacted EM Peak for Ch2 (mV)**	**Date**	**Comments**

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EM61-MK2 Geophysical Target Dig Selection and Intrusive Results Table

Project # ______________________

Site Name _______________________

Target Information					Dig Reslts									Post Dig QC			
Target ID	**Easting (m)**	**Northing (m)**	**Grid Value for Ch2 (mV)**	**Target Size (m)**	**Offset Distance/ Direction (m/NE)**	**Anomaly Type (UXO, DMM, MD, CD, RRD …)**	**Anomay description and quantity (1 rebar, 5 nails, wire, MK3, Projectile 75mm MK1, Granade M42,NoDig/Utility …)**	**Object depth from center of mass (m)**	**Object Weight (kg)**	**Object Dimensions (Length/Width/ Thicknes) (m)**	**If is MEC, Physical Condition and Inclination and Azimuth (degree 0,45,90../ direction N, NE …)**	**Date**	**Team Lider Initials**	**Hole Cleared (Y/N)**	**EM Respnse at Hole (mV)**	**Date**	**QC Initials**

Projection WGS84, UTM 13N, meters

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APPENDIX G

GENERIC ON-SITE QA CHECKLIST

Project Name/Contract No. _____

Audit Date (Start): _____ **Audit Date (End):** _____

CHECKPOINTS:

1. Review Scope of Work (DO/TO & WP)	**YES**	**NO**	**N/A**	**COMMENTS**
a. Objectives Clearly Identified	☐	☐	☐	
b. Check for Changes to WP & Up To Date	☐	☐	☐	
c. Proper Depth of Clearance Identified	☐	☐	☐	
d. Proper Target Ordnance Identified	☐	☐	☐	
e. Detection & Target Depth(s) Specified	☐	☐	☐	
f. Exclusion Zone Identified in WP	☐	☐	☐	
2. Documentation Requirements	**YES**	**NO**	**N/A**	**COMMENTS**
a. Notice to Proceed from KO	☐	☐	☐	
b. Approval Letter for Work Plan/SSHP	☐	☐	☐	
c. Approval Letter, FAA (If Required)	☐	☐	☐	
d. Certificate of Grounding, Lightning Protection (if required)	☐	☐	☐	
e. Explosive Permits/License (if required)	☐	☐	☐	
f. GFE Transfer Documentation (if required)	☐	☐	☐	

2. Documentation Requirements (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
g. Approval Letter, Public/Personnel Withdraw Distance (e.g., 1 Frag in 600 sq. ft.)	☐	☐	☐	
h. Dig Permits for Utilities (if required)	☐	☐	☐	
i. Current copy of the Work Plan on site. Review the new contract to determine if approval of the work plan is required. If not, then delete the requirement to have an approval letter on site	☐	☐	☐	
3. CEHNC QA Files Established	**YES**	**NO**	**N/A**	**COMMENTS**
a. Quality Assurance Reports	☐	☐	☐	
b. Approval Letter's (NTP, Personnel & WP/SSHP) for Contractor Operations	☐	☐	☐	
c. Weekly Contractor Reports SUXOS/QC	☐	☐	☐	
(if provided)				
4. Site-Specific Safety & Health Plan (SSHP)	**YES**	**NO**	**N/A**	**COMMENTS**
a. Emergency Notification List Posted & Available	☐	☐	☐	
b. Emergency Routes/Maps Available & Issued to Each Team	☐	☐	☐	
c. Work Task Identified in Hazard Analysis, Approved SSHP	☐	☐	☐	
d. MSDS(s) On-Site Approved SSHP	☐	☐	☐	

4. Site-Specific Safety & Health Plan (SSHP) (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
e. Visitors/Safety Briefing Log Current and Updated	☐	☐	☐	
f. All Personnel On-Site in the Proper PPE	☐	☐	☐	
g. Minimum of Two Personnel On-Site First Aid/CPR Trained, EM 385-1-1, Section 3, Page 19, Paragraph 03.A.02	☐	☐	☐	
h. 16-Unit First Aid Kits or Kits Approved by a Licensed Physician in the Ratio of one for every 25 persons or less. EM 385-1-1. Section 3, Page 19, Paragraph 03.A.03	☐	☐	☐	
5. Technical Management	**YES**	**NO**	**N/A**	**COMMENTS**
a. Procedures Established for the Discovery of RCWM	☐	☐	☐	
b. Procedures Developed for Discovery of MEC which cannot be destroyed in place	☐	☐	☐	
c. Project Grid Size, Layout, Lane Width (e.g., 5’ or Less) Established	☐	☐	☐	
d. Established Procedures for Changed Site Conditions	☐	☐	☐	
e. Organizational Chart current and indicates Assignment, Duties, Responsibilities to include Geophysical Teams	☐	☐	☐	
f. Procedures for Reporting and Disposition of MPPEH	☐	☐	☐	
g. Procedures Established for Disposal of MEC in Populated/Sensitive Areas	☐	☐	☐	

5. Technical Management (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
h. Procedures Established for Managing, Reporting, Venting and Disposing of munitions debris and range-related debris.	☐	☐	☐	
i. Additional Task and Procedures being Followed (e.g., PAO, Community Relations, Weekly & Monthly Project Status Reports)	☐	☐	☐	
j. Procedures Established for Recording, Reporting and Implementing Lessons Learned	☐	☐	☐	
k. Limitations Posed and Ability of Detection System(s) Chosen	☐	☐	☐	
l. Proper Use of Geophysical Detections Systems Used	☐	☐	☐	
m. Procedures Established for Disposal of MEC in non-populated/non-sensitive areas	☐	☐	☐	
6. Facilities. Reference EM 385-1-1	**YES**	**NO**	**N/A**	**COMMENTS**
a. Adequate Work Space & Facilities (Restrooms, etc.)	☐	☐	☐	
b. Good Housekeeping (No Fire Hazards, Tripping Hazards, etc.)	☐	☐	☐	
c. Approved and Suitable Containers for Flammable Toxic or Explosive Materials	☐	☐	☐	
d. Approved/Adequate Explosive Storage Facilities	☐	☐	☐	
e. Fire/Emergency Exits Clear & Unbarred	☐	☐	☐	
f. Personnel Limits Maintained	☐	☐	☐	
g. Site Security Adequate	☐	☐	☐	

6. Facilities. Reference EM 385-1-1 (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
h. Toilets. EM 385-1-1, Section 2, Page 14, Paragraph 02.B Toilets	☐	☐	☐	
i. Washing Facilities. EM 385-1-1, Section 2, Page 16, Paragraph 02.C Washing Facilities	☐	☐	☐	
7. Equipment, Reference Approved WP/Manufacture Operators Manual	**YES**	**NO**	**N/A**	**COMMENTS**
a. Tools Appropriate and Serviceable	☐	☐	☐	
b. Proper Personnel Protective Equipment (PPE) Present, Serviceable & Utilized	☐	☐	☐	
c. Equipment Calibrated (Last Call Date _____ Next Call Date _____)	☐	☐	☐	
d. Survey Equipment Inspected & Serviceable	☐	☐	☐	
e. Heavy Equipment Inspected & Serviceable IAW EM 385-1-1, Section 16	☐	☐	☐	
f. Are Equipped with at Least One Dry Chemical or CO2 Fire Extinguisher-Minimum rating of 5-BC – IAW EM 385-1-1, Section 16	☐	☐	☐	
g. Two Separate Means of Communications, Radio(s) Cell Phone, Land Line(s)	☐	☐	☐	
h. Geophysical Equipment On-Hand & Serviceable	☐	☐	☐	

8. Explosive Storage Requirements. Reference EP 1110-1-18	**YES**	**NO**	**N/A**	**COMMENTS**
a. Proper Storage Containers Type 2 Magazines conforming to standards set forth in Section 55.206 of ATFP 5400.7, AFT Explosives Law and Regulations.	☐	☐	☐	
b. Placards. Each magazine will display the placards required by Department of Transportation (DOT) regulations in accordance with DOD 6055.09-STD and Department of the Army Pamphlet (DA Pam) 385-64 for Hazard Division of MEC stored in the magazine.	☐	☐	☐	
c. Explosive Compatibility Groups. Segregated into the appropriate hazard division/storage compatibility group criteria listed in Chapter 3, DOD 6055.09-STD.	☐	☐	☐	
d. Physical Security. Contractor shall conduct and document physical security survey. The survey is to determine if fencing or guards are required.	☐	☐	☐	
e. Locks. Shall meet the standards listed in Section 55.208 (a) (4), ATFP 5400.7.	☐	☐	☐	
f. A key control system will be documented in the Work Plan, EP 1110-1-18.	☐	☐	☐	

8. Explosive Storage Requirements. Reference EP 1110-1-18 (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
g. Lightning Protection. Magazine constructed of metal that has 3/16 inch steel or thicker in accordance with National Fire Protection Association (NFPA) 780.	☐	☐	☐	
h. Lightning Protection. Magazine grounded in accordance with NFPA.	☐	☐	☐	
i. Lightning Protection. Magazine is located at least 6.5 feet from the nearest fence.	☐	☐	☐	
j. Lightning Protection. BRAC, IRP, FUDS and Active Installation will meet the provisions of DOD 6055.09-STD. Army installations will also meet the provisions of DA Pam 385-64.	☐	☐	☐	
k. Fire Protection. Extinguishers of appropriate size (minimum 10 BC) and type will be located in all explosives storage facilities.	☐	☐	☐	
l. Explosive Limits Maintained. .	☐	☐	☐	
m. Waiver. MACOM approval for storage of commercial of explosives on-site (if required).	☐	☐	☐	
9. Explosive Management Plan. Reference Approved WP/49 CFR	**YES**	**NO**	**N/A**	**COMMENTS**
a. Signature Authority On-Hand	☐	☐	☐	
b. Periodic Inventories Conducted On-Schedule	☐	☐	☐	

9. Explosive Management Plan. Reference Approved WP/49 CFR (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
c. Accountability Records Maintained	☐	☐	☐	
d. Lost/Stolen Reporting Procedures in Place	☐	☐	☐	
e. Final Disposition Procedures Documented	☐	☐	☐	
f. Key Control/Security	☐	☐	☐	
10. Transportation of MEC. Reference EP 1110-11-18. Chapter 15/49 CFR	**YES**	**NO**	**N/A**	**COMMENTS**
a. Hazardous Waste Manifest (EPA Form 8700-22) (if required)	☐	☐	☐	
b. Hazard Classification of MEC IAW TB 700-2	☐	☐	☐	
c. Training of Transporting MEC IAW 49 CFR, Part 172 & State Applicable State Requirements	☐	☐	☐	
d. Documented Organizational Responsibilities for Transportation of MEC	☐	☐	☐	
e. Approved Transportation Plan	☐	☐	☐	
f. Pre-operational checks of vehicles being conducted	☐	☐	☐	
g. All operators licensed for vehicle	☐	☐	☐	
h. Fire Fighting & First Aid Equipment on board	☐	☐	☐	
i. Cargo properly segregated/blocked and braced and in proper container	☐	☐	☐	
j. Proper DOT Placards/Fire Fighting Symbols Used	☐	☐	☐	

11. UXO Operational Plan, Reference Approved WP & EP 1110-1-18	**YES**	**NO**	**N/A**	**COMMENTS**
a. Contractor following methodology defined in WP	☐	☐	☐	
(1) SUXOS conducted physical check prior to sweep operations	☐	☐	☐	
(2) Daily Safety Meeting Conducted by SUXOS/SSHO	☐	☐	☐	
b. Geophysical Detection/Magnetometer Used	☐	☐	☐	
(1) Pre-Operational Checks Performed Prior to Sweep Operations	☐	☐	☐	
(2) Operational Condition Annotated in Log Book	☐	☐	☐	
(3) UXO Teams	☐	☐	☐	
(4) Quality Control	☐	☐	☐	
(5) Quality Assurance	☐	☐	☐	
c. Operational Teams Operating IAW WP	☐	☐	☐	
(1) UXO Supervisor Conducted Physical Check Prior to Sweep Operation	☐	☐	☐	
(2) Pre-Sweep Operational/Safety Brief Conducted	☐	☐	☐	
(3) Individual Sweep Lanes/Transects Marked IAW WP	☐	☐	☐	
(4) Contacts Marked & Investigated Properly	☐	☐	☐	
(5) Results of Sweep Operation Recorded	☐	☐	☐	
(6) All MEC, Inert Items & Scrap Examined by at Least Two UXO Personnel	☐	☐	☐	

11. UXO Operational Plan, Reference Approved WP & EP 1110-1-18 (Continued)	**YES**	**NO**	**N/A**	**COMMENTS**
(a) AEDA (Range Residue) IAW PWS/SOW and Properly Addressed in WP	☐	☐	☐	
(7) All UXOs Clearly Marked	☐	☐	☐	
d. QC Operations IAW WP	☐	☐	☐	
e. Non-Munitions Debris Being Collected (as required)	☐	☐	☐	
f. Munitions Debris Inspected/Vented/Segregated	☐	☐	☐	
g. Geophysical Test Grids Appropriate and IAW PWS/SOW	☐	☐	☐	
12. Disposal Operations Planned On-Site IAW the Approved WP	**YES**	**NO**	**N/A**	**COMMENTS**
a. Disposal Method IAW WP	☐	☐	☐	
13. Location Survey & Mapping Plan. Reference Contract DIDs	**YES**	**NO**	**N/A**	**COMMENTS**
a. Professional Land Surveyor	☐	☐	☐	
b. Surveyors Received Safety Briefing	☐	☐	☐	
c. UXO Escort Provided	☐	☐	☐	
d. Grid Stake, Locations Swept with Geophysical Equipment prior to Driving Stakes	☐	☐	☐	
e. Survey Notes Being Recorded	☐	☐	☐	
14. Quality Control Plan. Reference PWS/SOW/DID(s)	**YES**	**NO**	**N/A**	**COMMENTS**
a. QC Operational/Checks Being Conducted IAW WP	☐	☐	☐	

14. Quality Control Plan. Reference PWS/SOW/DID(s) (continued)	**YES**	**NO**	**N/A**	**COMMENTS**
b. QC Grid/Transect Established IAW WP	☐	☐	☐	
c. Results of QC Checks Being Recorded	☐	☐	☐	
d. Pass/Fail Criteria Clearly Defined IAW PWS/SOW	☐	☐	☐	
15. Vegetation Removal Reference WP/SSHP & OSHA Req.	**YES**	**NO**	**N/A**	**COMMENTS**
a. Vegetation Removal & Localized, if required	☐	☐	☐	
b. Equipment Operation to Prevent Impact with Possible Surface UXO	☐	☐	☐	
c. Cutting does not Present Impalement Hazard	☐	☐	☐	
d. UXO Personnel Monitoring Cutting Operation	☐	☐	☐	
e. UXO Discovered Marked/Handled Appropriately	☐	☐	☐	
f. Equipment Being Operated Safely & IAW Equipment Operators Manual/WP	☐	☐	☐	
16. Munition Constituents (MC) Sampling and Analysis Plan, if required	**YES**	**NO**	**N/A**	**COMMENTS**
a. Key Personnel Identified	☐	☐	☐	
b. Quality Assurance Responsibilities Identified	☐	☐	☐	
c. Procedures for Collection of Samples	☐	☐	☐	
d. Local Carrier Location Identified	☐	☐	☐	

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FPM Remediations, Inc.

THREE PHASE CONTROL – PREPARATORY PHASE INSPECTION REPORT

Date: _____

Project Name _____

Project Location _____

Project Number _____

Contract Number _____

Inspection/Surveillance Point Task	Verified By (Signature)	Verification Date
Review and Approval of Project Planning Documents		
ESS		
Work Plan		
Project Schedule		
HSP		
UFP-QAPP		
SOPs		
Project Personnel Qualifications		
Pre-Mobilization Readiness Review		
Overall Readiness		
Site Access		
Permits		
Field Office/Equipment Staging		
Personnel Readiness - UXO		
Personnel Readiness - Geo		
Personnel Readiness - Other		
Equipment Readiness - UXO		
Equipment Readiness - Geo		
Equipment Readiness - Other		

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FPM Remediations, Inc.

THREE PHASE CONTROL – INITIAL PHASE REPORT

Date: _____

Project Name _____

Project Location _____

Project Number _____

Contract Number _____

Inspection/Surveillance Point Task	Verified By (Signature)	Verification Date
Review Preparatory Phase Inspection Report		
Mobilization		
Post-Mobilization – UXO Equipment		
Post-Mobilization – UXO Personnel		
Post-Mobilization – Geo Equipment		
Post-Mobilization – Geo Personnel		
Post-Mobilization – Other Equipment		
Post-Mobilization – Other Personnel		
IVS Establishment		
IVS Area Selection – Analog Assisted Surface Clearance		
IVS Area DGM Survey		
Digging of DGM targets		
DGM Resurvey of IVS Area		
Placement of ISOs		
RTG-GPS Measurement of ISO Locations		
Geophysical Investigation		
Initial QC Tests		
MEC Disposal		
Preparation for MEC Disposal		

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FPM Remediations, Inc.

THREE PHASE CONTROL – FOLLOW-UP PHASE REPORT

Date: _____

Project Name _____

Project Location _____

Project Number _____

Contract Number _____

Report Number _____

Weekly / Monthly / Final (circle one)

Inspection/Surveillance Point Task	Discrepancies / Corrective Action Taken	Corrective Action Completed	Verified By (Signature)	Verification Date
Review Initial Phase Inspection Report				
Detector-Aided Surface Clearance (UXO)				
Geophysical Investigation				
Opening QC				
Opening IVS (Amplitude)				
Closing QC				
Closing IVS (Amplitude)				
Static Positional Accuracy				
Dynamic Positional Accuracy				
Dynamic Background				

FPM Remediations, Inc.

THREE PHASE CONTROL – FOLLOW-UP PHASE REPORT

Date: _____

Inspection/Surveillance Point Task	Discrepancies / Corrective Action Taken	Corrective Action Completed	Verified By (Signature)	Verification Date
Anomaly detection				
Along-Line Measurement Spacing				
Repeat Measurement Amplitude and Positional Accuracy				
DGM Grid Coverage				
Anomaly Reacquisition (Geo)				
Anomaly Reacquisition (Geo)				
Intrusive Investigation				
Target Anomaly Location Resolution (UXO)				
MEC Disposal				
Pre-MEC Disposal Operations				
Post-MEC Disposal Operations				
MPPEH Documentation				

FPM Remediations, Inc.

Construction and Remediation Services

Photo Log

Log Number:

Project Title: ____________________

Location: ____________________

Contract Number: ____________________

WEATHER	BRIGHT SUN	CLEAR	OVERCAST	RAIN	SNOW
TEMPERATURE	< 32	32 - 50	50 - 70	70-85	>85
WIND	STILL	MODERATE	HIGH		
HUMIDITY	DRY	MODERATE	HUMID		

Personnel On-Site

Name	Affiliation	Location/Description of Work

Number	Date	Direction	Description

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Appendix F
Explosives Safety Submission

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XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs

EXPLOSIVES SAFETY SUBMISSION

HOLLOMAN AIR FORCE BASE
NEW MEXICO
RCRA PERMIT NUMBER: NM6572124422-2

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for:

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Avenue, Suite 155
Lackland AFB, Texas 78236-9853

June 2014

Prepared by:

FPM Remediations, Inc.
584 Phoenix Drive
Rome, NY 13441

URS **Group, Inc.**
7720 N 16th Street, Suite 100
Phoenix, AZ 85020-4493

XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs

EXPLOSIVES SAFETY SUBMISSION

HOLLOMAN AIR FORCE BASE
NEW MEXICO
RCRA PERMIT NUMBER: NM6572124422-2

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Approved by:

Ron Vanderford — Date
UXO Safety and Quality Assurance
FPM Remediations, Inc.

Ivana Raicevic, PhD — Date
MMRP Installation Manager
FPM Remediations, Inc.

Maureen Whalen, CG, CPG, PMP — Date
Project Manager
FPM Remediations, Inc.

FPM Remediations, Inc. (FPM) prepared this Explosives Safety Submission (ESS) under the direction of the Air Force Civil Engineer Center (AFCEC). Details contained in this ESS are based, in part, on information provided in other documents and is subject to limitations and qualifications presented in the referenced documents. This document should be used only with the approval of the AFCEC.

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFMAN	USAF Manual
BATFE	Bureau of Alcohol, Tobacco, Firearms and Explosives
BEEF	Base Engineering Emergency Force
bgs	below ground surface
BIP	Blow-In-Place
BSP	Blind Seed Program
CARA	CBRNE Analytical and Remediation Activity
CBRNE	Chemical, Biological, Radiological, Nuclear and Explosives
CEHNC	Corps of Engineers–Huntsville Center
CSE	Comprehensive Site Evaluation
CSA	Courtesy Storage Agreement
DA	Department of the Army
DDESB	Department of Defense Explosives Safety Board
DFX 300	White's DFX 300 electromagnetic metal detector
DGM	Digital Geophysical Mapping
DoD	Department of Defense
DoDI	Department of Defense Instruction
EC	Engineering Controls
EED	Electro Explosive Device
EM	Engineer Manual
EM61	Geonics EM61-MK2
EMM	Earth-Moving Machinery
EOD	Explosive Ordnance Disposal
EP	Engineering Pamphlet
ESQD	Explosives Safety Quantity Distance
ESS	Explosives Safety Submission
FPM	FPM Remediations, Inc.
G-858	Geometrics G-858 Cesium Vapor Magnetometer
GA-52CX	Schonstedt GA-52CX magnetic locator
GIS	Geographic Information System
GPS	Global Positioning System
GSV	Geophysical System Verification
HFD	Hazardous Fragmentation Distance
HTRW	Hazardous, Toxic and Radioactive Waste
HSTT	High Speed Test Track
IAW	in accordance with
ISO	Industry Standard Object
ITRC	Interstate Technology Regulatory Council
IVS	Instrument Verification Strip
LGRDC	Logistics Readiness Cargo
LRS	Logistics Readiness Squadron
m	meter
mm	millimeter
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
MFD	Maximum Fragmentation Distance
MFD-H	Maximum Fragmentation Distance - Horizontal
MGFD	Munition with the Greatest Fragmentation Distance
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
MSA	Munitions Storage Area
MSD	Minimum Separation Distance
MXS	Holloman Munitions Storage Area designation
NFA	No Further Action
NEW	Net Explosive Weight
NTCRA	Non-Time-Critical Removal Action
OE	Ordnance and Explosives
OSHA	Occupational Safety and Health Administration
PM	Project Manager
QA	Quality Assurance
QC	Quality Control
RCWM	Recovered Chemical Warfare Material
RI	Remedial Investigation
SDA	Safe Disposal Area
Shaw	Shaw Environmental, Inc.
SUXOS	Senior UXO Supervisor
TP	Technical Paper
TSD	Team Separation Distance
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force

UXO	Unexploded Ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
WESCO	Western Explosives Systems Company
WSMR	White Sands Missile Range

1.0 BACKGROUND

1.1 INTRODUCTION

This Conventional Explosives Safety Submission (ESS) has been prepared in support of the Holloman Air Force Base (AFB) Military Munitions Response Program (MMRP) to ensure that all applicable Department of Defense (DoD), United States Air Force (USAF), and Department of Army (DA) explosives safety standards are applied correctly during surface removal and intrusive removal actions at the following Munitions Response Sites (MRSs):

- XU853 (Missile Test Stands)
- XU854 (Able 51 Area)
- FI857a (Former Bunker)
- SR864 (Poorman Range)
- ML865 (Ballistics Rain Field)
- RR869a (Debris Field)

FPM Remediations, Inc. (FPM) has prepared this ESS under Contract FA8903-13-C-0008 with the Air Force Civil Engineer Center (AFCEC).

1.2 PURPOSE OF THE ESS

The intent of this ESS is to provide the explosives safety criteria and methodology to be employed during implementation of Munitions and Explosives of Concern (MEC) response actions and to protect Installation personnel and property from explosive hazards. MEC response actions at the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs will entail conducting a Remedial Investigation (RI) and/or Non-Time-Critical Removal Action (NTCRA), which has been deemed necessary to achieve site closeout for those sites.

This ESS has been prepared in accordance with (IAW) the most current versions of DoD Manual No. 6055.09-M, *Ammunition and Explosives Safety Standards* (DoD, 2008), U.S. Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-97, *Safety & Health Requirements Manual*, (USACE, 2010b), and USAF Manual (AFMAN) 91-201 *Air Force Explosives Safety Standards* (USAF, 2011).

1.3 MUNITIONS RESPONSE SITE LOCATIONS

Holloman AFB is located in Otero County, New Mexico, seven miles west of the city of Alamogordo **(Figure 2-1, Appendix A - Maps)**. It is situated in a semi-arid region within the northern portion of the Chihuahuan Desert. Holloman AFB is contiguous with the much larger (2.2 million acres) White Sands Missile Range (WSMR), which is located to the north, west and southwest of Holloman AFB.

Holloman AFB is situated on approximately 50,763 acres of land. The southern portion of the Installation contains the flight line, composed of a series of runways running north-south, east-west, and northeast-southwest. The Apache Mesa Golf Course is located south of the runways. The Main Base is located at the southeast corner of the Installation, where Route 70 borders the site. The West Area and the North Area refer to the improved areas around the original airfield (southeastern triangle formed by the runways). The Main Base contains housing and administrative buildings. The High Speed Test Track (HSTT) runs north-south and is located to the northwest of the airfield. The track is the world's longest of its kind at 9.5 miles, has been used for an array of missile testing for decades, and is still in use today (Shaw Environmental, Inc. [Shaw], 2010). The summary of acreages for Munitions Response Areas (MRAs) and associated MRSs identified following the CSE Phase II that will be **addressed by this ESS** is provided in **Table 1-1**.

Table 1-1
MRA and MRS Designations and Acreage Summary

MRA ID	MRA Acres*	MRS ID	Site Name	Site Acres*
853	205	**XU853**	**Missile Test Stands**	**205**
854	48	**XU854**	**Able 51 Area**	**48**
857	21	FI857	Former Bunker [No Further Action (NFA)]	20
		FI857a	**Former Bunker**	**1**
864	23	**SR864**	**Poorman Range**	**23**
865	18	**ML865**	**Ballistics Rain Field**	**18**
869	4	RR869	Debris Field [NFA]	1
		RR869a	**Debris Field**	**4**

*Acreage rounded to nearest whole number,1 shown for sites less than 1 acre

1.4 OPERATIONAL HISTORY AND CURRENT LAND USE

Holloman AFB was first established in 1942 as Alamogordo Army Air Field flying primarily B-17s, B-24s, and B-29s. In 1947, it became the primary site for the testing and development of un-manned aircraft, guided missiles, and other research programs. In 1968, the 49th Tactical Fighter Wing arrived at Holloman AFB and has since conducted fighter aircraft training and operations. Holloman AFB has also served as the German Air Force's Tactical Training Center since 1996.

Previous MMRP work conducted at MRAs 853, 854, 857, 864, 865, and 869 consisted of a Comprehensive Site Evaluation (CSE) Phase I followed by a CSE Phase II. The CSE Phase II included visual surveys of all MRAs and environmental media sampling of surface and subsurface soils at MRAs 857, 864, and 865 (HDR Environmental, Operations and Construction, Inc.[HDR], 2013).

1.4.1 XU853 – MISSILE TEST STANDS

Operational History

The approximately 205-acre Missile Test Stands MRA 853 is located in the south-central portion of the Base east of the southern end of the HSTT. The area was used primarily in the 1940s and 1950s as a launch area for an array of rocket and missile testing programs. The majority of missile testing at MRA 853 ended in the late 1950s with brief test vehicle programs lasting into the 1960s. Five launch complexes associated with the rocket and missile testing activities are the GAPA, or MX-606; the NATIV, or MX-770; the JB-2 Loon, or MX-544; the Aerobee, or MX-1011; and the Test Stand. The CSE Phase II visual survey found small arms debris (5.56mm, 7.62mm, and .50-caliber) associated with recent training activities and Munitions Debris (MD). Three expended 5-inch rocket motors used to denote a survey marker were observed in the southeastern corner of the MRA. An expended 5-inch rocket motor was observed in the western portion of the MRA. At the conclusion of the CSE Phase II, the entire MRA 853 was identified as MRS XU853 and recommended for further munitions response action.

Current Land Use

Currently, the Missile Test Stands (XU853) MRS is closed; however, many of the facilities and buildings remain. Many of the buildings present at the MRS have been used for warehousing/general storage. Part of the MRS, including buildings 1105, 1106, 1107 and the nearby water tank and water tower, is currently in use by the Holloman AFB water distribution utility shop.

1.4.2 XU854 – ABLE 51 AREA

Operational History

The approximately 48-acre Able 51 Area MRA 854 was used as a launch facility in the late 1950s and early 1960s for testing of Mace and Matador missiles. Also known as the BQM-34A Drone Launch area, this area was also used for research on mobile launch capability of both manned and unmanned aircraft, using rocket boosters, without the need for prepared airfields. Building 1440, completed in 1962, was used as a missile launch facility and as an observation blockhouse for Mace and Matador missiles and drone launches. Since missile testing ended at the Able 51 Area MRA 854 in the early 1970s, Building 1440 either has been used for storage or has been vacant. Building 1442 was constructed in 1959 as a missile launch facility and is currently vacant. Missiles and aircraft were launched from a fixed launcher as well as mobile launchers tethered to concrete pads within the Able 51 Area MRA 854. At the conclusion of the CSE Phase II, the entire MRA 854 was identified as MRS XU854 and recommended for further munitions response action. As shown in the figures **(Appendix A)**, MRS XU854 (Able 51 Area) and its Explosives Safety Quantity Distance (ESQD) arcs lie outside the installation boundary; however, the MRS is located on property owned by Holloman AFB.

Current Land Use

Although the Able 51 Area (XU854) MRS is not currently used for testing activities, recent evidence suggests the site was also used for small arms training activities. Vegetation

surrounding the buildings consists of desert scrubland, and the land surface within the MRS is relatively flat.

1.4.3 FI857A – FORMER BUNKER

Operational History

The Former Bunker MRA 857 was investigated as part of an archaeological survey and was described as having historical munitions activities. The site record lists a bomb tail section, four missile casings, nine bomb casings, drone parts, and a 1942 .30-06-caliber cartridge within the remnants of a collapsed wooden tower. In addition, the survey narrative describes an excavated pit with no associated munitions debris. Small arms debris consisting of .22, .32, .50 caliber, and 7.62mm casings, as well as a 7.62mm link and a .50 caliber link, were observed. MD observed at the MRA included a grenade pin, an M38 practice bomb box fin, and nine M38 practice bomb casings with no spotting charges present. These practice bombs were nearly intact with no damage and grouped together indicating that they were likely disposed of at the location. Holloman AFB Cultural Resources established that the area had also been used as a confidence training obstacle course for Security Forces personnel. The CSE Phase II recommended splitting the MRA into two MRSs: FI857 (19.8 acres) was recommended for NFA and FI857a (0.8 acre) was recommended for future munitions response action.

Current Land Use

The location of the Former Bunker (FI857a) MRS is currently unused. Vegetation at the MRS is consistent with desert scrubland and the area is generally flat lying.

1.4.4 SR864 – POORMAN RANGE

Operational History

The Poorman Range MRA 864 is located in the southwestern portion of the base immediately to the south of the Jeep Target Area Skeet Range MRA 862 and east of the active Jeep Target Area. The MRA is identified by the Laboratory of Anthropology Site Record for the Jeep Target Area as an area to the east with 25 gun placement stations. Each station has seven 8- x 8-foot concrete pads and 2- x 3-foot concrete footings for mounting the gun turret superstructure. The station dimensions are approximately 43 x 43 feet separated by 30 feet. Tow targets were reported among the debris scatter for the area. Based on a review of the CSE Phase II findings, .50 caliber casings and links were observed near the firing stations. In addition, 5.56mm and 7.62mm blanks were also observed on the MRA; however, these are likely from training exercises associated with the adjacent Prime Base Engineering Emergency Force (BEEF) Training Area. Clay target debris was scattered along the northwestern edge of the MRA. MD observed at the MRA consisted of expended M18 Smoke Grenades. These are likely from training activities associated with the Prime BEEF Training Area. MEC items found east and west of MRA boundary were documented consisting of intact M18 smoke grenades and M116A1 hand grenade simulators which are also likely associated with training exercises at the Prime BEEF Training Area. Based on the findings of the CSE Phase II, the MRA boundary was expanded to include the areas where MEC and MD were found resulting in a new MRA acreage

of approximately 23 acres. At the conclusion of the CSE Phase II, the entire MRA 864 (23 acres) was identified as MRS XU864 and recommended for further munitions response action.

Current Land Use

The Poorman Range (SR864) MRS is currently unused. There is evidence that training activities associated with the Prime BEEF Training Area have occurred at this site. The site exhibits relatively flat topography, and vegetation in the vicinity is consistent with desert scrubland.

1.4.5 ML865 – Ballistics Rain Field

Operational History

The Ballistics Rain Field MRA 865 is located in the western portion of the Base west of the HSTT and just north of Hay Draw. The MRA was used to create artificial rain for the purpose of testing the effects on artillery. The direction of fire was from the east to the west, although the firing point was not identified. The period of operation for the Ballistics Rain Field MRA 865 is unknown; however; aerial photography from 1972 shows the earth and timber target butt at the western end of a road perpendicular to the HSTT. Based on the CSE Phase II findings, the MRA boundary was expanded resulting in a new MRA acreage of approximately 18 acres. At the conclusion of the CSE Phase II, the entire MRA 865 (18 acres) was identified as MRS ML865 and recommended for further munitions response action.

Current Land Use

The Ballistics Rain Field (ML865) MRS is open space and relatively flat, and is currently unused. Facilities still present at the location include piping and nozzles for the artificial rain, and the earth and timber target structure with a steel plate at the face of the structure.

1.4.6 RR869a–Debris Field

Operational History

The Debris Field MRA 869 is located in the south-central portion of the Base north of Munitions Storage Buildings 1197 and 1198. Debris consistent with a possible missile drone crash site was observed during the CSE Phase I visual survey on the southern slope of Ritas Draw. MD observed within the MRA included 5-inch rocket motor fragments. The CSE Phase II visual survey identified one .50-caliber projectile and minor amounts of clay target debris. Metal scrap was observed across the MRA, as well as a rocket launcher and possible rocket debris, one expended hand grenade fuze, and expended electric squibs. One MEC item, a squib with a single intact charge, was identified. Based on the results of the CSE Phase II investigation, the Debris Field MRA 869 was recommended to be split into two MRSs. The 0.1-acre Debris Field (RR869) MRS falls under the Installation Restoration Program category and is ineligible under MMRP. The 3.5-acre Debris Field (RR869a) MRS contains surface MEC and MD and potential subsurface MEC and/or MD, and was recommended for further munitions response action.

Current Land Use

The Debris Field (RR869a) MRS is currently unused open space covered by desert scrubland vegetation along the southern bank of Ritas Draw. This MRS exhibits rolling topography with gorges and gullies.

1.5 REASON FOR MUNITIONS RESPONSE

The MRSs included in this ESS had varying missions ranging from missile testing to training at small arms ranges. All of the MRSs included in this ESS were recommended for further munitions response actions due to the presence of range-related debris, MD, or MEC. **Table 1-2** presents a summary of the munitions response actions that FPM will conduct at each site.

Project Scope

Under this contract, the MMRP RI and NTCRA work at the above MRSs will be addressed by separate work plans and will include the following actions:

- Providing MEC avoidance for all field activities.
- Performing 100% surface clearance within some locations.
- Removing Material Potentially Presenting an Explosive Hazard (MPPEH) that could pose a safety hazard to personnel during fieldwork.
- Eliminating sources of Digital Geophysical Mapping (DGM) signal interference (i.e., metal objects) that could obscure subsurface anomalies and thus reduce the effectiveness of the DGM surveys to detect and map subsurface targets.
- Performing intrusive investigation and subsurface removal actions on DGM targets as well as Munitions Constituents sampling at MEC/MPPEH locations and in areas with significant amounts of MD.
- Characterizing and segregating MPPEH into Material Documented as an Explosive Hazard (MDEH) (i.e., MEC/ Unexploded Ordnance [UXO]) or Material Documented as Safe (MDAS).
- Providing final disposition and certification of MEC, MDAS, and metallic scrap generated from surface and subsurface MEC activities.

Table 1-2
Description of Planned Remedial Actions at the MRSs

SITES	ACREAGE	MUNITIONS RESPONSE ACTION
XU853 (Missile Test Stands)	205	Surface clearance of transects and grids, DGM followed by subsurface clearance
XU854 (Able 51 Area)	48	Surface clearance of transects and grids, DGM followed by subsurface clearance
FI857a (Former Bunker)	1	100% Surface clearance, DGM followed by subsurface clearance
SR864 (Poorman Range)	23	100% Surface clearance, DGM followed by subsurface clearance
ML865 (Ballistics Rain Field)	18	100% Surface clearance, DGM followed by subsurface clearance
RR869a (Debris Field)	4	100% Surface clearance, DGM followed by subsurface clearance

2.0 MAPS

The following maps are included in **Appendix A.**

Figure 2-1 Holloman Air Force Base Location Map

Figure 2-2 XU853, XU854, FI857a, SR864, ML865, and RR869a MRS Location Map

Figure 2-3 XU853 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-4 XU854 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-5 FI857a MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-6 SR864 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-7 ML865 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-8 RR869a MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

Figure 2-9 XU853, XU854, FI857a, SR864, ML865, and RR869a Safe Disposal Areas Showing ESQD Arcs

Figure 2-10 Location of Donor Explosives Storage at Munitions Storage Area (MSA)

3.0 START DATE

Fieldwork for the RI will begin August 2014. Fieldwork for the NTCRA will begin January 2016.

4.0 TYPES OF MEC

Table 4-1 shows the types of MEC and MD recovered at the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs during the previous CSE Phase II.

Table 4-1
Types of MEC and Munitions Debris Recovered at the MRSs

AREA	MEC	MUNITIONS DEBRIS & OTHER MATERIAL
XU853 (Missile Test Stands)	None	Small arms, 40 millimeter (mm) flares, smoke grenades, tail boom for 81 mm illumination mortar, M13 Distress signal, 5” rocket motors
XU854 (Able 51 Area)	None	Small arms, 40 mm flares, M74 airburst simulator, slap flares, smoke grenades
FI857a (Former Bunker)	None	Small arms, M38 100 lb. practice bombs
SR864 (Poorman Range)	M18 Smoke Grenade, M116A1 Grenade Simulator	Small arms, smoke grenades
ML865 (Ballistics Rain Field)	105mm Projectile with T-bar fuze (2)	155 mm projectiles, 105 mm projectiles, 75 mm projectiles, projectile fuzes, 5” rocket motors
RR869a (Debris Field)	Electric squib	Small arms, debris from 2.75” rocket launcher and possibly 5” rocket motors, electric squibs

5.0 EXPLOSIVES SAFETY QUANTITY DISTANCE FOR MUNITION WITH THE GREATEST FRAGMENTATION DISTANCE

5.1 SELECTION OF MUNITION WITH THE GREATEST FRAGMENTATION DISTANCE

The MRSs included in this ESS will have the Munition with the Greatest Fragmentation Distance (MGFD) based upon the most likely munition to be encountered in that MRS. As the items discovered during the CSE Phase II are not listed in the Fragmentation Database Review Forms, items that are more hazardous have been substituted to ensure a satisfactory Minimum Separation Distance (MSD).

If MEC with a greater fragmentation distance is encountered, the MSD will be adjusted in accordance with Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 16 *Methodologies for Calculating Primary Fragment Characteristics* (DDESB, 2011), operations will continue, and an amendment to the ESS submitted for approval (a copy of this document will be available on site). ESQD arcs will be adjusted accordingly.

5.2 MINIMUM SEPARATION DISTANCES

The MSD is equivalent to the MGFD of the UXO item that may be present in a particular zone and is based on the data presented in **Table 5-1.** The Fragmentation Data Review Forms for the MSDs are presented in **Appendix B**.

Table 5-1
Minimum Separation Distances

MRS	MEC	MSD (feet)						
		For Unintentional Detonations			For Intentional Detonations			
		Hazardous Fragmentation Distance (HFD)		K40[1] TSD	Without EC: Larger of MFD-H or K328[2]	Using Sandbag Mitigation (Single Item)		Water Mitigation
		Without EC	With EC			Single Layer	Double Layer	
XU854, SR864, FI857	M383 40mm grenade	207	200	22	302	200	12.5	200
XU853, RR869A	MK10 5" Rocket Motor	428	Not permitted	115	1874	Not permitted	Not permitted	Not permitted
ML865	M549A1 155mm projectile	387	220	99	2371	220	Not permitted	275

1. K40 also referred as "team separation distance (TSD)" - The allowable blast overpressure distance for unintentional detonations of non-fragmenting munitions.
2. K328 - The allowable blast overpressure distance or MSD for a planned detonation of non-fragmenting munitions.

For XU854, SR864, and FI857a:

- The MGFD is the M383 40mm grenade (high explosive filler).
- The MSD for the M383 40mm grenade for *Unintentional Detonations* is 200 feet with engineering controls (EC) and 207 feet without EC. For *Intentional Detonations*, the MSD is 302 feet (based on the MFD-H distance without EC).

For XU853 and RR869a:

- The MGFD is the MK10 5" rocket motor.
- The MSD for the MK10 5" rocket motor for *Unintentional Detonations* is not permitted with EC and 428 feet without EC. For *Intentional Detonations*, the MSD is 1,874 feet (based on the MFD-H distance without EC).

For ML865:

- The MGFD is the M549A1 155mm projectile.
- The MSD for the M549A1 155mm projectile for *Unintentional Detonations* is 220 feet with EC and 387 feet without EC. For *Intentional Detonations*, the MSD is 2,371 feet (based on the MFD-H distance without EC).

FPM is responsible for ensuring non-essential personnel remain outside the ESQD arc of an active FPM operation (surface or subsurface clearances and demolition). MSD restrictions from MEC areas to non-project personnel will be applied during surface and subsurface investigations.

Essential Project Personnel are defined as those on-site contractors and DoD personnel required to participate in the MEC removal/sampling, along with those approved and authorized visitors. *Non-Essential Project Personnel* are defined as all other personnel not considered to be required to accomplish the task, such as unauthorized visitors.

For *Essential Project Personnel*, the MSD/TSD is listed in **Table 5-1** under the K40 TSD column. For *Non-Essential Project Personnel*, the MSDs are listed under the HFD – Without EC column.

5.3 EXPLOSIVES SAFETY QUANTITY DISTANCE ARCS

Figures 2-3 through 2-8 illustrate the ESQD arcs around each of the six MRSs. As shown in the figures, MRS XU854 (Able 51 Area) and its ESQD arcs lie outside the installation boundary; however, the MRS is located on property owned by Holloman AFB. In addition to securing all ESQD arcs within the Holloman AFB boundary, FPM will ensure that areas outside of the base boundary are secured during explosive operations by coordinating with WSMR, Holloman AFB, and local law enforcement agencies.

5.4 DEMOLITION REQUIREMENTS

5.4.1 LICENSING AND PERMITS

FPM maintains a Bureau of Alcohol, Tobacco, & Firearms Type 33 Federal Explosives License, No. 6-NY-00986, which allows authorized site UXO personnel to purchase, receive and use donor explosives to dispose of MEC.

5.4.2 PLANNED SAFE DISPOSAL AREAS

A safe disposal area (SDA) will be established within each MRS in the event that multiple, safe-to-move MEC items must be destroyed. **Figure 2-9** depicts the approximate locations for the SDAs and associated ESQD arcs at each of the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs.

5.4.3 BLOW-IN-PLACE

FPM will dispose of all unsafe-to-move MEC items by the Blow-In-Place (BIP) method. The FPM Senior UXO Supervisor (SUXOS) will determine if a BIP is required or the item can be safely moved to a collection point.

5.4.4 COLLECTION POINTS

Collection points may be established within each MRS to facilitate the inventory and disposition of safe-to-move MEC. The collection of multiple MEC items is not anticipated for this project,

but if deemed necessary, the maximum Net Explosive Weight (NEW) at a collection point will be limited such that the K40 overpressure distance for the total NEW does not exceed the hazardous fragmentation distance for the area.

5.4.5 IN-GRID CONSOLIDATED SHOT

If determined acceptable to move by the SUXOS, MEC items may be consolidated prior to demolition and/or disposal. U.S. Army Engineering and Support Center, Huntsville publication "*Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites*," dated March 2000 will be used and a copy of this report will be available on site. The maximum NEW for a consolidated shot will be limited such that the K328 overpressure distance for the total NEW (including donor charges) does not exceed the MSD for the intentional detonation.

Net Explosive Weight for disposal of consolidated shots will not exceed 25 pounds. No MEC will be transported outside an MRS by FPM unless required for the protection of personnel and/or property. Any transportation of MEC outside an MRS will be coordinated with Holloman AFB Explosive Ordnance Disposal (EOD) and Base Security.

5.4.6 EXPLOSIVES STORAGE MAGAZINES

A Courtesy Storage Agreement (CSA) between FPM Remediations and the 49th MXS (designation for Holloman AFB Munitions Storage Area) allows courtesy storage of up to 100 pounds NEW of donor explosives in properly sited DDESB-approved facilities. The CSA is attached to this document as **Appendix C**. **Figure 2-10** depicts the location of the MSA; the 49th MXS will assign specific munitions storage bunkers for FPM's use after mobilization.

5.4.7 DELIVERY AND TRANSPORTATION OF DONOR EXPLOSIVES

MEC items will be disposed of by the use of donor explosives. Western Explosives Systems Company (WESCO) will be FPM's explosives vendor and explosives will be delivered on a pre-arranged schedule based on the 49th MXS operations tempo. All security and access procedures will be arranged by FPM's SUXOS and coordinated with the 49th MXS and Base Security. All incoming explosive shipments to Holloman AFB are inspected and cleared by the 49th LRS (Logistics Readiness Squadron)/LGRDC (Logistics Readiness Cargo) section. USAF security (or contract security as directed by Holloman AFB Security Police) will escort the delivery vehicle to the MSA and provide all directions to the driver. The FPM SUXOS or his/her designated representative will be on site to inspect and sign for all explosives. All personnel handling explosives will be listed on FPM's most current Bureau of Alcohol, Tobacco, Firearms and Explosives (BATFE) Notice of Clearance.

FPM will follow all applicable explosives and safety standards while handling and transporting explosives. Rules commonly found in safety standards for explosive-laden vehicles are:

- Transportation of donor explosives between the MSA and MRSs shall use the safest and most direct route possible.
- Donor explosives will not be left unattended in a vehicle.

- Excess donor explosives will be returned to the MSA after each demolition operation.
- Vehicles used to transport donor explosives will be equipped with a minimum of two serviceable and properly mounted 2A:10BC rated fire extinguishers.
- Vehicles will be equipped with wheel chocks to prevent a parked vehicle without a driver from rolling.
- Explosives shall be properly secured in a vehicle to prevent movement.
- Vehicles will properly display Department of Transportation hazard class explosives placards for the highest hazard class of the explosives being transported.

5.4.8 INVENTORY AND MAINTENANCE OF EXPLOSIVES AND STORAGE FACILITIES

Once donor explosives are stored, the USAF will maintain control of all items. Access to explosives will be coordinated with the 49th MXS and the FPM SUXOS, or in the SUXOS' absence, senior FPM employees named on FPM's BATFE Notice of Clearance. A mandatory monthly inspection of all donor explosives will be conducted as per the CSA with the 49th MXS. Weekly inventories will be conducted by FPM, unless otherwise prevented by MSX operations. Due to the potential constraints on access, FPM personnel will take each access opportunity granted to inventory explosives.

6.0 MEC MIGRATION

The region surrounding Holloman AFB and Alamogordo, New Mexico has a semi-arid climate. Temperatures below the freezing mark may be encountered from the end of November to mid-February. Buried ordnance heaving due to freeze/thaw is not expected in an area with a frost depth of 0-1 inches. The potential for migration of MEC due to frost heave will not be a factor at Holloman AFB.

7.0 DETECTION EQUIPMENT AND RESPONSE TECHNIQUES

7.1 DETECTION EQUIPMENT

The geophysical instruments chosen for this investigation were selected based on their proven ability to detect the ordnance items expected at the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs at the required depths, and based on anticipated future land use of the project sites. The geophysical instruments (digital and analog) that will be used during this investigation are:

- Geonics EM61-MK2 (EM61)
- Geometrics G-858 Cesium Vapor Magnetometer (G-858)
- Geometrics MetalMapper
- Schonstedt GA-52CX
- White's DFX 300

The DGM surveys will be conducted using the EM61 electromagnetic and the G-858 magnetic systems based on their proven ability to detect the targets of primary interest with great accuracy. The digital systems will be used both to initially detect anomalies as well as to perform anomaly reacquisitions. The MetalMapper may be used to further discriminate between detected anomalies and targets of interest.

Hand-held magnetic locators (Schonstedt GA-52CX) and electromagnetic locators (White's DFX 300) will be used during intrusive investigation of the identified anomaly locations to locate potential UXO in the subsurface. Descriptions of the digital and analog detection instruments are provided below.

7.1.1 GEONICS EM61-MK2

The EM61 is a high-resolution time-domain electromagnetic system that can detect electrically conductive objects. The basic elements of an electromagnetic sensor are a transmit coil and a receive coil. A current pulse running through the transmit coil creates the primary electromagnetic field. Changes in this primary field set up eddy currents in the object, under the sensor. The eddy currents produce a secondary or induced electromagnetic field emanating from the object. This induced electromagnetic field is associated with the decay of eddy currents in metal objects near the sensor and is measured by the receiver coil, the output signal being proportional to the rate of change of the electromagnetic flux through the receiver coil. The receiver is timed to measure the signal within four time gates (216, 336, 660, and 1,266 microseconds) after the current pulse in the transmitter loop is completed. The four time gates allow discrimination between different types of targets based on the time-decay rate of the response. A measurable response in milliVolts implies that a metal object is present, and the profile of that response can be used to estimate the object's size. The EM61 can record up to 12 records per second with four time gates per record.

An EM61 system consists of a pair of 0.5- by 1.0-m coils. The lower coil is both a transmitter and receiver and the upper coil is exclusively a receiver coil. The lower coil is located 0.42 m above the ground surface for optimal data collection using the standard wheel mode, and the upper coil is 0.30 m above the lower coil. The EM61 is fully equipped for simultaneous logging of Global Positioning System (GPS) and electromagnetic data. Actual configurations will depend on site conditions and maximum operating efficiency, but larger arrays are normally deployed on either vehicle-towed frameworks mounted on wheels or skids. Smaller, man-portable wheel mounted systems containing a single transmitter and receiver are also available.

Details regarding the use of EM61 magnetic sensors for geophysical data collection and target reacquisitions are included in the RI Work Plan.

7.1.2 GEOMETRICS G-858 CESIUM VAPOR MAGNETOMETER

The G-858 is used for detecting and mapping ferrous metallic objects by measuring the net strength of the total magnetic field simultaneously within two optically pumped cesium vapor sensors. The total magnetic field includes the Earth's geomagnetic field [approximately 48,500 nanoTeslas at the Holloman AFB location] and any anomaly generated from nearby ferromagnetic material. The G-858 is comprised of a belt-mounted display and logging console

connected to two cesium sensors mounted on a hand-held counterbalanced staff. To provide data positioning, the G-858 will be coupled to a GPS. The console contains electronics to acquire magnetic field data with positional data and display them on its screen for review and edit. The G-858 consists of three items: (1) a photon emitter containing a cesium light emitter (lamp); (2) an absorption chamber containing cesium vapor and a "buffer gas" through which the emitted photons pass; and (3) a photon detector, arranged in that order. When the sensor encounters a perturbation (quantum energy) from a local magnetic source (e.g., 60-mm ordnance), this energy may hit one of the cesium atoms and cause it to jump into a new energy state, which may, in turn, absorb a photon from the cesium emitter. If this is the case, it will cause a decrease in the number of photons reaching the detector and this decrease can be easily recorded as a measure of the magnetic anomaly.

A magnetic base station consisting of a single G-858 sensor and microprocessor console will be established in an area away from vehicle or pedestrian traffic, and clear of surface and subsurface cultural interference (e.g., metallic debris, fencing, and utilities). The base station console will be time-synchronized with the mobile field system console daily. The base station data will be later used to correct for diurnal variations in the Earth's magnetic field during the time of the G-858 surveys.

7.1.3 GEOMETRICS METALMAPPER

The MetalMapper is an advanced electromagnetic system configured for the detection and characterization of UXO. This technology represents a significant departure from existing commercially available electromagnetic instruments for UXO detection. This system uses time domain electromagnetic principles to induce electrical currents in buried metallic objects and then measure the effects of those currents in receivers on the surface.

The system can be operated in static and dynamic mode. Static measurements are acquired when the system is stationary over a known target. The other default measurement type is dynamic acquisition. This is intended for use while towing the Metal Mapper over an area.

In static mode, the MetalMapper system is placed on top of previously identified targets and then measures the magnetic field caused by the current in that target. It uses that information to compute the size, shape and the depth of the buried object and then compares the gathered data of an unlabeled target to that of an established "UXO library". In this way, the system allows scrap metal to be distinguished from UXO. A prioritized dig list can be then generated that identifies each target as either one that has a high confidence of being MEC related or one that is non-hazardous.

7.1.4 SCHONSTEDT GA-52CX

The Schonstedt GA-52CX hand-held magnetic locator (GA-52CX) detects changes in the Earth's ambient magnetic field caused by ferrous metal. The technology uses two fluxgate magnetometers, aligned and mounted a fixed distance apart, to detect localized changes in the Earth's field caused by ferrous metal or disturbances in soil conditions. An audio signal is provided to the operator who uses changes in the signal pitch to pinpoint the location of the ferrous metal item. The detection capability of the GA-52CX varies according to the local

conditions, the size of the object, and the skill of the operator. The GA-52CX is a useful, inexpensive, and highly portable magnetometer that has become the standard UXO detection device used by UXO/EOD technicians.

7.1.5 WHITE'S DFX 300

The White's DFX 300 (DFX 300) is a hand-held analog electromagnetic metal detector. The DFX 300 has multi-frequency capability and uses operating frequencies of three and 15 kiloHertz, or both at the same time for enhanced target discrimination. An audio signal is provided to the operator who uses changes in the signal pitch and a Liquid Crystal Display screen to display/pinpoint the location of the metal item. In general, the DFX 300 is capable of detecting both ferrous and non-ferrous metals to a maximum depth of ~1.5 m (~4.5 feet). The actual detection capability of the instrument varies according to the local conditions, the size, orientation, and depth of the object, and the skill of the operator.

7.2 CAPABILITIES AND LIMITATIONS OF THE DETECTION METHOD

The detection capabilities of the Geometrics EM61 and G-858 will be tested by establishing an Instrument Verification Strip (IVS) at Holloman AFB in order to conduct MMRP work.

The maximum MEC depth of detection is estimated by multiplying the MEC principal diameter (in mm) by 11 (Interstate Technology Regulatory Council [ITRC], 2004). **Table 7-1** summarizes the estimated maximum detection depths for the munitions items most likely to be encountered at the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs.

Table 7-1
Estimated Maximum MEC Detection Depths [1]

MEC ITEM	DIAMETER	ESTIMATED MAXIMUM DETECTION DEPTH
M383 40mm grenade	40 mm	0.44 m (1.45 feet)
MK10 5" Rocket Motor	127 mm	1.397 m (4.58 feet)
M549A1 155mm projectile	155 mm	1.705 m (5.59 feet)

Note:
1. ITRC, 2004

7.2.1 MEC REMOVAL DEPTHS

The planned future land use for the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs is unrestricted land use. FPM will investigate anomalies that are above established thresholds to the estimated detection depth of a 155mm projectile (5.59 feet). If an anomaly of interest is more than 5.59 feet bgs, further investigation of the anomaly may continue to a maximum of 10 feet bgs. It is anticipated that ordnance items will not be found beyond their respective Maximum Detection Depths.

7.2.2 IMPOSED LIMITATIONS

The terrain and geology at Holloman AFB does not impose significant limitations on the proposed clearance method. Vegetation removal will be limited to only what is absolutely necessary to accomplish the task.

7.3 GEOPHYSICAL SURVEY MODES

For FI857a, SR864, ML865, and RR869a, 100% coverage surface clearances will be followed by 100% coverage DGM, data processing, and intrusively investigating and removing all anomalies above the established site-specific threshold. For XU853 and XU854, transects and grids will be laid out and then surface clearance, DGM, data processing, and subsurface clearance will be performed in those areas. Visual Sample Plan software will be used to statistically determine the number of intrusive samples required to be dug to achieve a 95% confidence level of MEC potential at the sites.

7.4 ANOMALY REACQUISITION

In preparation for MEC intrusive investigation, anomaly locations will be reacquired using the same type of geophysical and navigational instrumentation as was used to detect and map the anomalies. Anomaly locations identified in the geophysical data will first be relocated with the GPS and marked on the ground with plastic pin flags. Using the geophysical equipment, the reacquisition team, consisting of a geophysicist and a UXO technician, will then re-survey the area around the reacquired coordinate location within a radius of ~1 meter (~3 feet) from the flag.

7.5 SURFACE SWEEP PROCEDURES

Areas to receive surface sweeps will be sectioned into grids. Within each grid, a UXO Sweep Team will begin a survey in a straight-line abreast, but as the sweep commences, each member will stagger their start to minimize any interference between the handheld metal detectors. The staggered start will also ensure ample overlap of survey paths, reducing the potential for missed anomalies. At all times, when a survey line is halted for an item examination by a UXO technician, the rest of the line will stop as well until the item is marked, and a signal to proceed given. The sweep path will be marked along the way so that 100% coverage is assured. This will be achieved by the use of environmentally safe marking paint, nylon ropes, or live GPS tracking.

7.6 MANUAL AND MECHANICAL EXCAVATION

Intrusive investigations are normally conducted manually by using hand tools and using a magnetometer to define location and depth of an anomaly. The anomalies will then be excavated until their sources are encountered and identified. To gain access to a partially buried or subsurface anomaly, excavation will not be conducted directly over the anomaly but shall be initiated to the side of the anomaly to prevent the inadvertent striking of possible UXO.

Earth Moving Machinery (EMM) may be used to remove soil that is too compacted or too deep to efficiently excavate using hand tools. Excavations shall progress in 6-inch lifts and off to the side of the anomaly source. After each lift, the anomaly location and depth will be redefined with a handheld metal detector and the excavation location adjusted as required to ensure the excavation is being conducted to the side of the anomaly source. Excavation with EMM will stop within an estimated 12 inches of the anomaly and UXO Technicians will continue the excavation with hand tools. This process will continue until the source of the anomaly can be located in the sidewall of the excavation with a hand-held metal detector and then removed using hand tools.

To limit noise exposure, the EMM operator will use hearing protection IAW the Health and Safety Plan and Occupational Safety and Health Administration (OSHA) 1910.95. At no time will the EMM operator receive an 8-hour time-weighted noise exposure exceeding 85 decibels.

7.7 QUALITY CONTROL AND QUALITY ASSURANCE

A Geophysical System Verification (GSV) (Nelson, et al., 2009) will be established and used to confirm that the geophysical detection system and ongoing monitoring of production work are performed correctly.

The GSV consists of two main elements: an IVS and a Blind Seed Program (BSP). The objectives of the IVS are to verify that the geophysical detection system is operating as designed, to capture levels of background noise due to site conditions on a daily basis, and to streamline daily Quality Control (QC) checks. DGM Team members will test the functionality of the EM61, MetalMapper and GPS instruments by passing through the IVS that is seeded with Industry Standard Objects (ISO) placed at a variety of detectable depths and orientations.

As part of the Quality Assurance (QA) program, the BSP will be used throughout the DGM transects and grids to provide ongoing systematic confirmation that the targets can be detected and source items recovered.

To ensure high-quality geophysical data and established Data Quality Objectives (DQO) are being met, part of the QA program will also involve the FPM QC Geophysicist monitoring and evaluating the DGM QC data, survey data and data collection procedures, and data processing steps to verify that the field instruments are operating properly and established procedures are being followed; the QC Geophysicist will also oversee 10% reprocessing of DGM data. Details of the GSV elements and QA/QC program are included in the Work Plan.

UXO Team members will perform daily operational QC tests on the GA-52CX and DFX 300 to verify the detection capability of their instruments. The QC tests will be conducted by passing through a hand-held instrument test strip that is seeded with ISOs placed at a variety of detectable depths. The operator must detect each ISO or the instrument will not be used.

The UXO Quality Control Specialist (UXOQCS) will perform a QC inspection of a minimum of 10% of the areas/targets cleared. For QC inspections, the UXOQCS will use both GA-52CX and a DFX 300 instruments. Additionally, the UXOQCS will conduct inspections of recovered MDAS scrap, and any material or item potentially presenting an explosive hazard, to ensure there are no explosive components or hazards. QC failures are summarized as:

- Failure to completely clear DGM target locations.
- Any MEC or associated explosive component that is left uninvestigated.
- Any failure to recover a blind seed.

If a detection failure is identified, the UXOQCS will conduct a Root-Cause-Analysis to determine if the failure is the result of the process, procedures, equipment and/or personnel. The UXOQCS will provide his/her findings to the Project Manager (PM) and SUXOS with suggested corrective actions. Once approved by management, FPM will implement the corrective actions, such as re-collecting DGM grid-based data. The Root-Cause-Analysis and corrective actions will be attached to the weekly report. QC failures will be documented, reported, and corrective actions taken.

A Root-Cause-Analysis may include, but not necessarily be limited to the following actions:

- Careful evaluation, recovery, and destruction of MEC/UXO.
- Certification of the identification and disposition of each anomaly excavated.
- Review of representative dig sheet data.
- Review and evaluation of geophysical data.
- Field evaluation of the site QC operations.

QA procedures will also be applied to gauge performance versus project DQOs. The procedures include the following steps:

- Evaluation of site conditions at the time of dig and comparison to basis for planned approach.
- Excavation only at flagged locations where an anomaly has been relocated.
- Checking excavations to ensure anomaly was fully investigated prior to proceeding.
- Recording of anomaly excavation results and feedback to anomaly assessment.

8.0 DISPOSITION TECHNIQUES

8.1 COMMUNICATIONS PROCEDURES

Personnel will have two forms of communications at all times by the use of hand-held radios and cellular telephones to coordinate activity on the worksite. Daily radio checks will be conducted to ensure proper working order, and the results recorded in the UXO Safety Officer (UXOSO) logbook.

Hand-held radios will not be used closer than 25 feet from exposed EED's (electro explosive devices) i.e. electric blasting caps and no closer than 10 feet for packaged EED's. Use of cellular phones will not be allowed closer than 10 feet to EED's in any configuration.

8.2 EXCAVATION PROCEDURES

Targets will be primarily excavated manually with a hand tools. **Section 7.6** addresses potential EMM operations with equipment such as a backhoe for targets buried >0.7 meters (>2.0 feet).

8.3 SUBSURFACE ANOMALY CLEARANCE METHODOLOGY

Point clearance activities will be conducted where required for the XU853, XU854, FI857a, SR864, ML865, and RR869a MRSs.

Targeted anomaly locations identified during the geophysical mapping will be intrusively investigated until a source representing the geophysical anomaly is recovered and/or the anomaly cannot be replicated/reacquired (e.g., a sufficient metal source is removed or mineralized soil concentration/nodules have been removed such that they no longer produce a coherent geophysical response). Data describing the anomaly sources discovered during the intrusive investigation process will be recorded and input into the site GIS database. Recorded anomaly data will, at a minimum, include size, estimated weight, orientation, depth bgs, and a description of the item excavated. All MPPEH/MEC items identified will be reported to the SUXOS. The SUXOS will then determine the appropriate Removal Actions (e.g., BIP). After the source item(s) have been excavated and disposed of, the area within a 1-meter (3-foot) radius of the position of the discovered source will be checked by the UXO Team Leader using the GA-52CX and DFX 300 hand-held instruments. The UXOQCS will also use the GA-52CX and DFX 300 hand-held instruments to perform 10% QC checks to verify the metallic source items have been removed from the holes.

8.3.1 OPERATIONS IN POPULATED AREAS

MEC remediation activities conducted under this ESS will not be performed in close proximity to populated areas.

8.3.2 ADMINISTRATIVE CONTROLS

Administrative controls will be coordinated with Base Security. These will consist of prior notification to Base Security and FPM's AFCEC representative of upcoming MEC disposal. If needed, a traffic control and flow plan will be established and coordinated with local authorities in the event installation roadways are required to be closed during the intended operations.

8.3.3 ENGINEERING CONTROLS

Engineering Controls for demolition of MEC will be used where required IAW Corps of Engineer–Huntsville Center (CEHNC) document HNC-ED-CS-S 98-7, *Use of Sand Bags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions* (CEHNC, 1999) and Buried Explosive Module procedures. These controls will be applied as necessary to mitigate fragmentation and blast hazards created during open detonation demolition operations. The UXOSO and SUXOS will coordinate and determine the appropriate EC that will be needed during demolition operations.

8.4 DEMOLITION OPERATIONS

UXO personnel will dispose of MEC on a daily basis using appropriate EC. If demolition operations cannot be conducted at the time the item is located, it will be secured in place with sand bags and security will be provided 24 hours a day until disposal of the item can be achieved.

Demolition activities are inherently hazardous and require strict adherence to approved safety and operational procedures. At a minimum, the demolition operations team will consist of three UXO-qualified personnel, including the UXOSO, a UXO Demolition Supervisor, and a UXO Technician. These operations will be performed under the direction and supervision of the SUXOS. All on-site personnel have the authority to stop work in the event they observe unsafe conditions. The UXOSO will monitor compliance with the safety measures contained in USACE EM 385-1-1 *Safety and Health Requirements Manual* (USACE, 2011).

To control/mitigate hazards associated with blast and fragmentation, all demolition operations will be conducted by detonating MEC items IAW DA Technical Manual 60A-1-1-31 *General Information on Explosive Ordnance Disposal (EOD) Procedures* (DA, 2009), USACE EM 385-1-97, *Safety & Health Requirements Manual*, (USACE, 2013 Change 1)*;* and CEHNC-approved EC, as specified in HNC-ED-CS-S-98-7, (CEHNC, 1999).

FPM will use the Holloman AFB EOD notification matrix to inform and coordinate with those listed (e.g., AFCEC, Wing Command Post or Operations Center, EOD, Range Control, Base Security, Air Control Tower, local law enforcement and the local fire department) before demolition operations are conducted. Authority to initiate the demolition operation setup and the actual detonation of MEC will rest solely with the SUXOS. Prior to authorizing the detonation of explosive charges, the SUXOS is responsible for ensuring that all personnel have been evacuated from the demolition area and all personnel have been accounted for. The SUXOS will also ensure that all pertinent parties have been notified of an intentional detonation and that the area is secure.

Upon completion of demolition operations, the demolition team will visually inspect each demolition shot to confirm that no residual hazards are present. At that point, the SUXOS will authorize the resumption of site operations. The team will also use the GA-52CX and DFX 300 instruments to ensure all MPPEH is removed from the detonation crater.

8.5 SCRAP AND MPPEH PROCEDURES

8.5.1 INSPECTION AND CERTIFICATION

During performance of field operations, the UXO Team will recover, inspect and dispose of MPPEH. Inspection and classification of MPPEH is a critical aspect of MEC operations and only qualified personnel, such as a UXO Technician II or above will perform these inspections and at least two techs will verify the MPPEH is free of explosive hazards prior to removal from the grid as MDAS. Containers, such as lockable 55-gallon drums or roll-offs, will be used for storage of MDAS depending on the volume accumulated. Each container will be kept closed and sealed, except when materials are being loaded into the container or the contents of the container are being inspected. Each container will be closed in a manner requiring the container seal be

broken to gain access to the interior of the container. FPM will have all MDAS delivered to an approved local metals processing facility for recycling/smelting at the end of the project or periodically as required.

8.5.2 DD FORM 1348-1

All MPPEH procedures will be conducted in accordance with DoD Instruction (DoDI) 4140.62 *Material Potentially Presenting an Explosive Hazard* (2014), EM 1110-1-4009 (USACE, 2010a), and EM 385-1-97 (USACE, 2013 Change 1).

MPPEH will be documented by authorized and technically qualified personnel as MDAS after a 100% inspection and an independent 100% re-inspection to determine that it is safe from an explosives safety perspective. MDAS may be released to the public, but MDEH material may be released only to an entity or individual that has the required knowledge, training, permits and licenses to treat MDEH. The following statement will be printed on the accompanying documentation where only MDAS is processed:

> *"This certifies and verifies that the material listed has been 100% inspected and, to the best of our knowledge and belief, is inert and/or free of explosive hazards or related materials."*

Where Range Debris is being processed along with MDAS, the following statement will be entered on each DD Form 1348-1:

> *"This certifies and verifies that the material listed has been 100% inspected and, to the best of our knowledge and belief, is free of explosive hazards, engine fluids, illuminating dials and other visible liquid Hazardous Toxic and Radioactive Waste (HTRW) materials."*

9.0 ENVIRONMENTAL, ECOLOGICAL, CULTURAL, AND OTHER CONSIDERATIONS

The northwestern portion of the XU853 MRS is within the wetland buffer and protected habitat zone for the White Sands Desert Pupfish (Cyprinodon tularosa). FPM will coordinate all operations within XU853 with the Holloman AFB Natural Resources office and IAW the Holloman AFB Integrated Natural Resource Management Plan. FPM will also coordinate all brush clearing activities with the Holloman AFB Natural Resources office, and vegetation removal will be limited to only what is absolutely necessary to accomplish the task. Two areas within the scope of this ESS contain structures that are considered eligible for inclusion in the National Register of Historic Places. In XU853, Buildings 1116, 1127, 1139; the JB-2 ramp; and a Test Stand are associated with important historical events. In XU854, Buildings 1440 and 1442 also are considered to have historical significance.

10.0 TECHNICAL SUPPORT

10.1 TECHNICAL ESCORT UNIT

Previous investigations have not identified the presence of Recovered Chemical Warfare Material (RCWM) in these MRSs. However, if suspected RCWM is encountered during any phase of work, FPM will immediately cease all operations, withdraw upwind from the work area, and establish an exclusion zone IAW Engineering Pamphlet (EP) 75-1-3 *Recovered Chemical Warfare Materiel (RCWM) Response Procedures* (USACE, 2007). FPM will maintain a security watch over the suspect item until relieved by competent authority, maintaining the "two-man rule" at all times.

The SUXOS will immediately request Holloman AFB EOD support from the Wing Command Post for official identification of the suspect item. If Holloman AFB EOD determines the item to be RCWM, they will notify the 20th Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Command or a subordinate unit such as the CBRNE Analytical and Remediation Activity (CARA) through the official DoD process.

10.2 CONTRACT UXO PERSONNEL

FPM has a full-time staff of UXO personnel. Additional UXO field personnel will be contracted on an as-needed basis when the projected work tempo increases. All UXO personnel will meet the requirements in DDESB TP 18 *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel* (DDESB, 2004)**.**

11.0 RESIDUAL RISK MANAGEMENT

11.1 LAND USE CONTROLS

Land Use Controls are not anticipated at any of the sites addressed in this ESS since all six sites will be closed.

11.2 LONG-TERM MANAGEMENT

Long-term management (e.g. five-year reviews) will not be applicable since all six sites will be closed.

12.0 UXO SAFETY EDUCATION PROGRAM

There is no public education program planned for this project as all work is taking place on Holloman AFB. No base housing will be impacted during this project and it is not anticipated that work areas from other entities will be impacted. FPM will coordinate efforts with other entities that may require access into Holloman AFB MRSs and ensure they are aware of possible UXO hazards. Any issues requiring potential public notification or education will be conducted through the AFCEC/Holloman AFB Public Affairs Office.

13.0 STAKEHOLDER MANAGEMENT

Transparent and proactive communication between FPM, AFCEC, the Installation, State and Federal regulators (New Mexico Environment Department and U.S. Environmental Protection Agency, Region 6), and local stakeholders is critical for the success of this project. Agreement between Base officials and regulators/stakeholders on the path forward is documented in the approved work plans. Communication and the exchange of monthly reports, deliverable documents, meeting information/minutes, photos, and milestone status among the project team and between the project team and stakeholders will be facilitated through the use of a web-based SharePoint site (Project Website) developed for this project.

This website will be available to the project team, AFCEC and Holloman AFB, and other stakeholders via a username and password. FPM's PM and Deputy PM will coordinate with AFCEC, Holloman AFB, and the team with shared calendars, alerts, and notifications.

14.0 CONTINGENCIES

None has been identified at this time.

15.0 REFERENCES

The following references were used in the preparation of this ESS. FPM will comply with applicable Federal, State, and local requirements in the course of completing this project.

15.1 USACE PUBLICATIONS

- CEHNC, 1999, U.S. Army Engineering and Support Center, Huntsville (CEHNC) document *Use of Sand Bags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions* HNC-ED-CS-S 98-7 and approved by the DDESB on 23 February.
- CEHNC, 2000, U.S. Army Engineering and Support Center, Huntsville publication titled "*Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites*," March.
- CEHNC, 1998, U.S. Army Engineering and Support Center, Huntsville document *Buried Explosion Module (BEM): A Method for Determining the Effects of Detonation of a Buried Munition* HNC-ED-CS-S-97-7-Revision 1, January.
- USACE, 2007, U.S. Army Corps of Engineers, EP 75-1-3, *Recovered Chemical Warfare Materiel (RCWM) Response Procedures*, 30 November 2004 (Errata #1, dated December 2007).
- USACE, 2010a, U.S. Army Corps of Engineers EM 1110-1-4009, Engineer Manual, *Military Munitions Response Actions*, 15 June 2007 (Errata #1 through 3, dated June, November, December 2007; Errata #4, dated February 2010).

- USACE, 2013, U.S. Army Corps of Engineers, EM 385-1-97, *Safety & Health Requirements Manual*, 17 May (Change 1).
- USACE, 2011, U.S. Army Corps of Engineers EM 385-1-1, *Safety and Health Requirements Manual*, September 2008 (Changes #1 through 3, dated April, October and June 2010; Changes #4 through 6, dated March, April and July 2011).

15.2 US AIR FORCE PUBLICATIONS

- USAF, 2011, AFMAN 91-201 *Explosives Safety Standards*, 12 January.

15.3 DEPARTMENT OF THE ARMY PUBLICATIONS

- DA, 2009, Department of the Army (DA) Technical Manual 60A-1-1-31 *General Information on Explosive Ordnance Disposal (EOD) Procedures*, September.

15.4 DEPARTMENT OF DEFENSE PUBLICATIONS

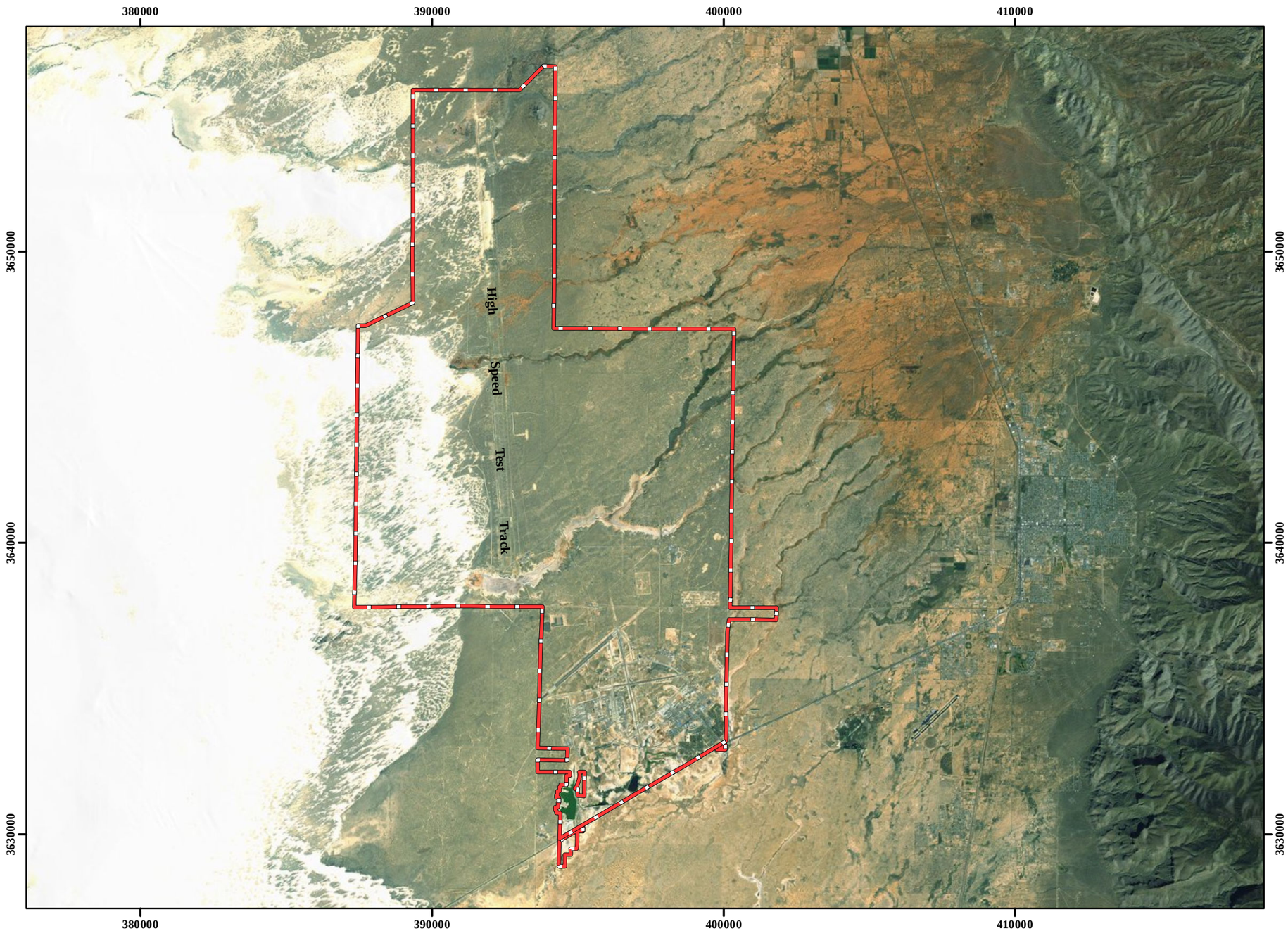
- DDESB, 2004, DDESB TP 18 *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel*, 20 December**.**
- DDESB, 2013, Technical Paper 16, *Methodologies for Calculating Primary Fragment Characteristics*, 16 April.
- DoDI, 2008, DoDI 4140.62 *Material Potentially Presenting an Explosive Hazard (MPPEH)*, 25 November 2008 with Change 1, 19 February 2014.
- DoD, 2008, DoD 6055.09-M, *Ammunition and Explosives Safety Standards*, date varies by Volume.

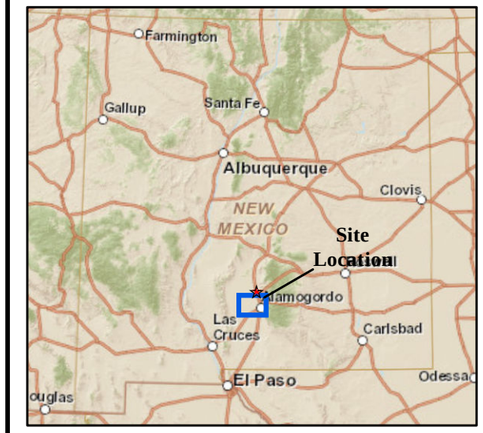
15.5 OTHER DOCUMENTATION

- HDR, 2013, *Final Report of the Comprehensive Site Evaluation Phase II Report*, September.
- Nelson, et al., 2009, *Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response*. Environmental Security Technology Certification Program (ESTCP), July.

APPENDIX A

Maps





Legend

Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-1

Holloman AFB Location

FPM Remediations, Inc.

2014

NOTES:

Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 12,000 feet

0 1,850 3,700 Meters

0 6,000 12,000 Feet

N W E S

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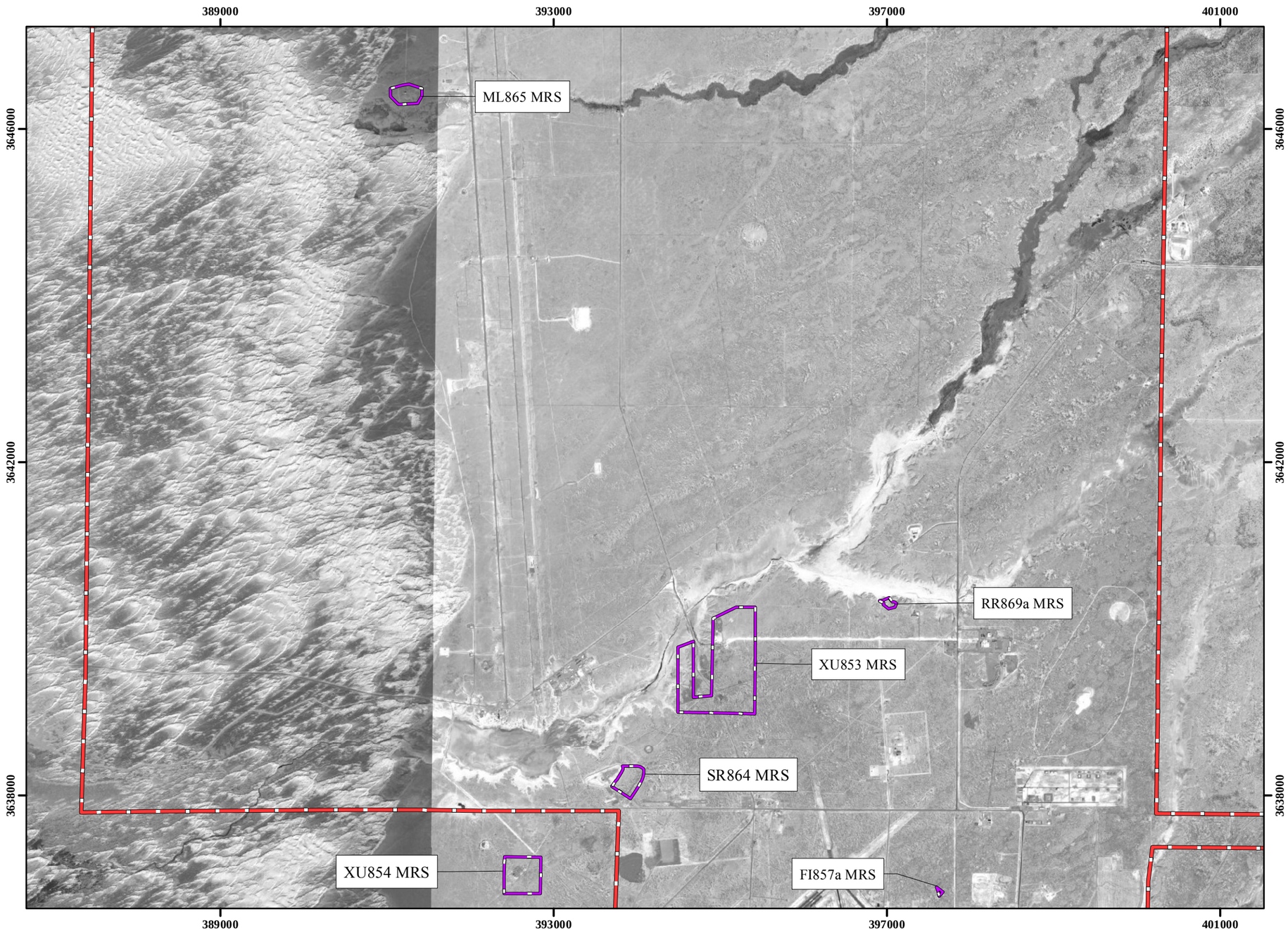

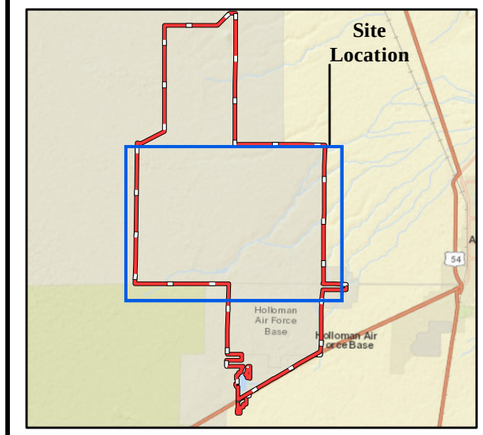

Legend

- MRS Boundaries
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

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FIGURE 2-2

XU853, XU854, FI857a, SR864, ML865, and RR869a MRS Location Map

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2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
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Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 4,200 feet

0 650 1,300 Meters

0 2,100 4,200 Feet

N W E S

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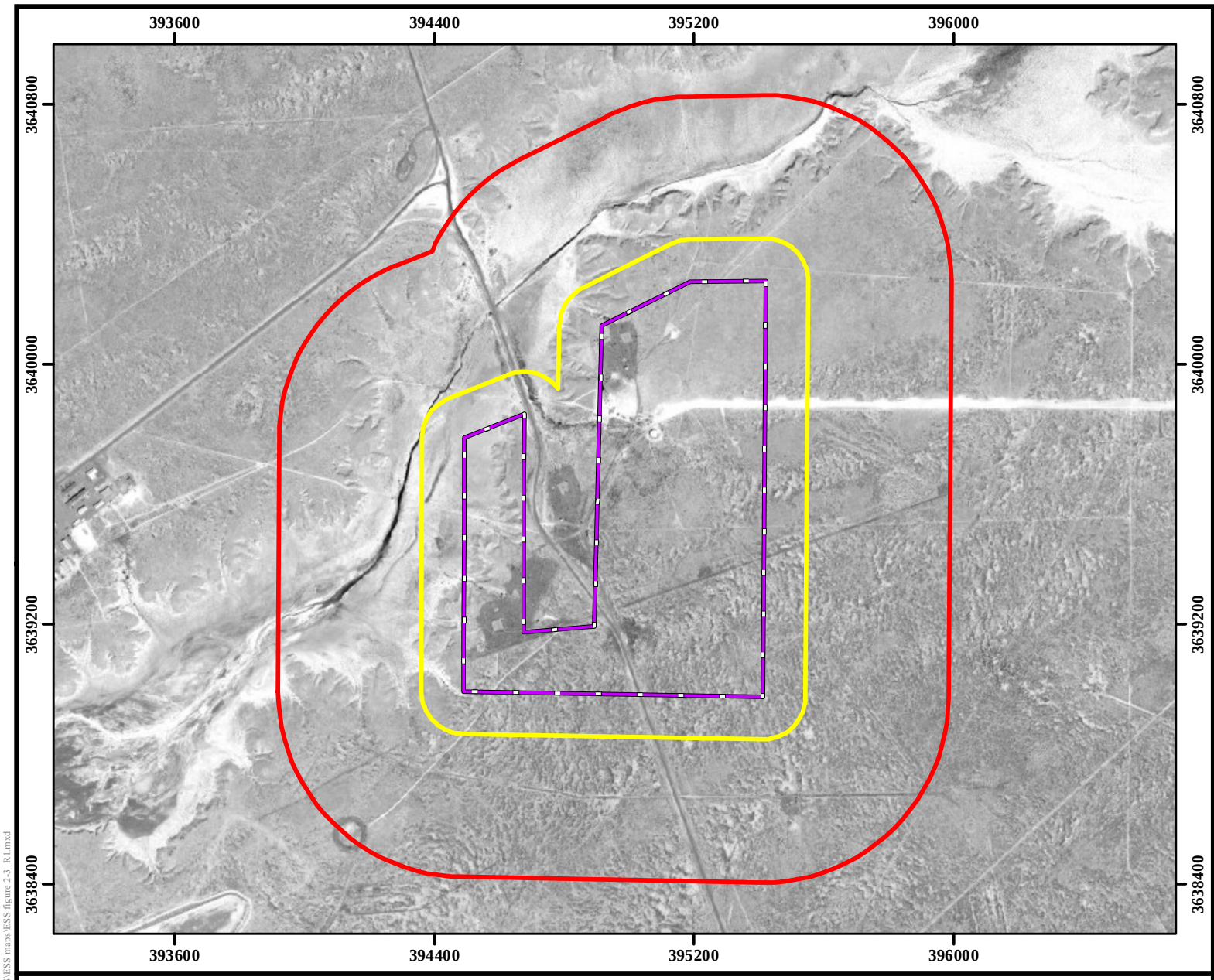

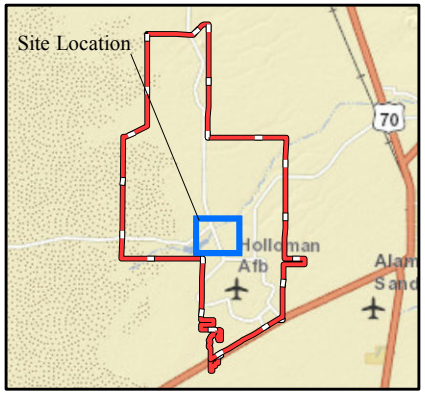

Legend

- ESQD Arc for HFD Unintentional Detonations (428 feet)
- ESQD Arc for MFD-H Intentional Detonations (1874 feet)
- XU853 MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
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Alamogordo, NM

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FIGURE 2-3

XU853 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

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2014

NOTES:
Revision Date: 5/27/2014

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Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 1,500 feet

0 230 460 Meters

0 750 1,500 Feet

N W E S

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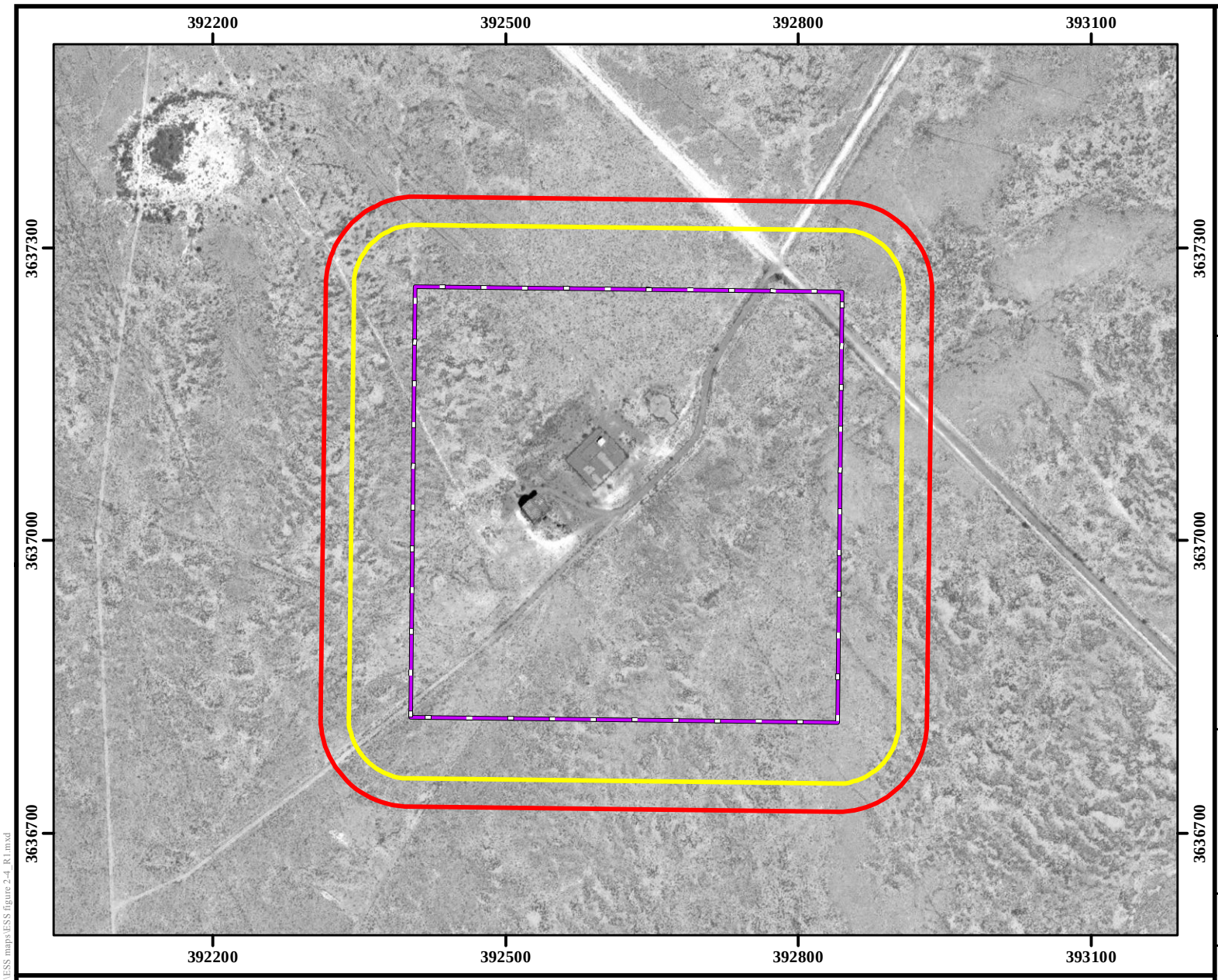

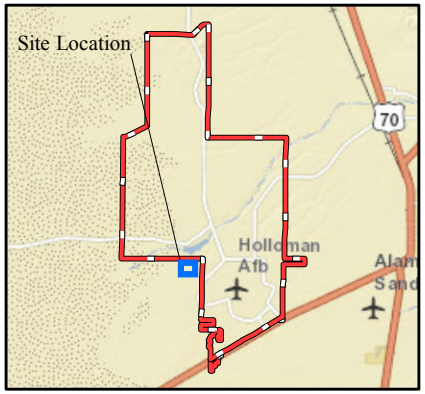

Legend

- ESQD Arc for HFD Unintentional Detonations (207 feet)
- ESQD Arc for MFD-H Intentional Detonations (302 feet)
- XU854 MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
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FIGURE 2-4

XU854 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

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1 inch = 500 feet

0 75 150 Meters

0 250 500 Feet

N W E S

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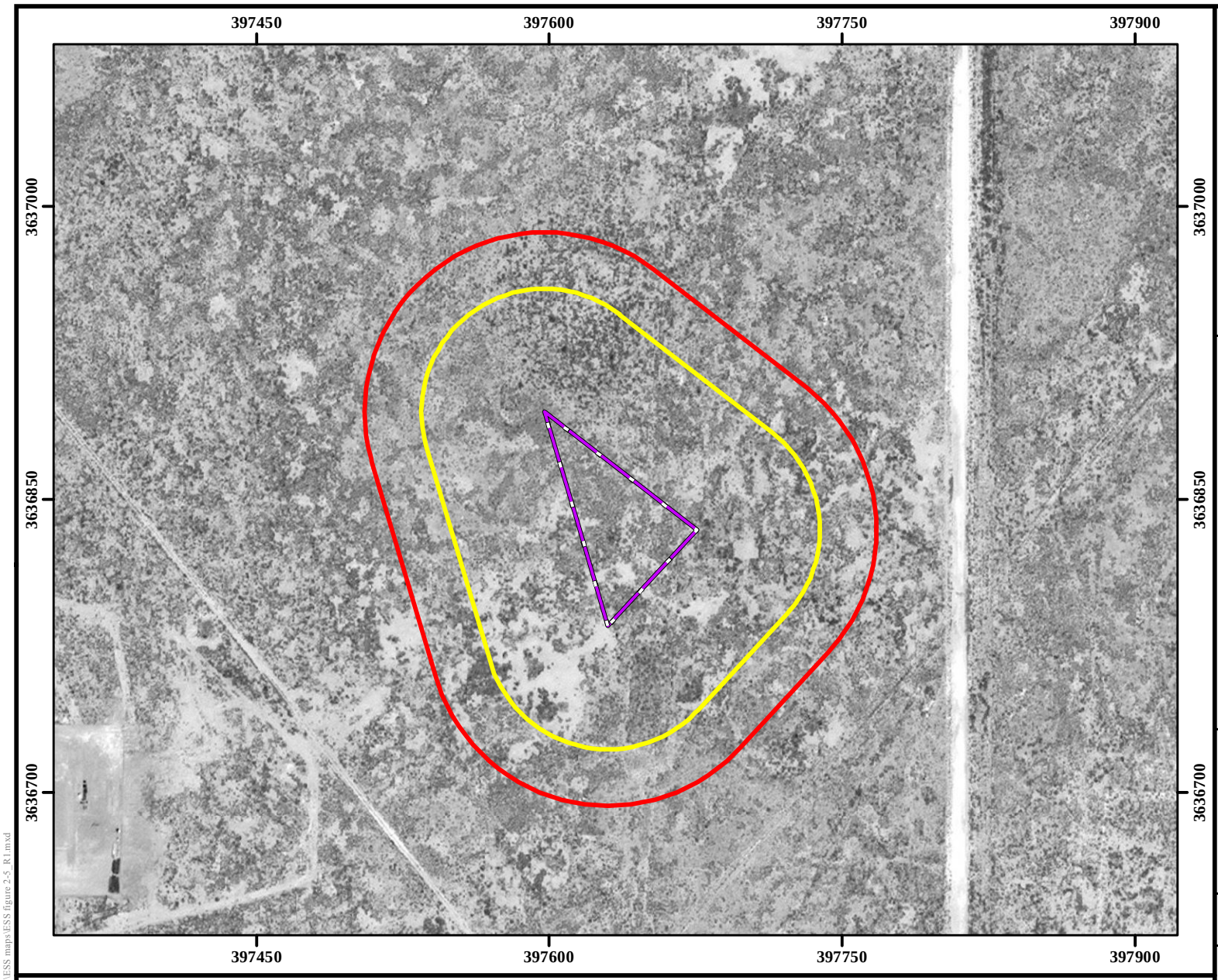

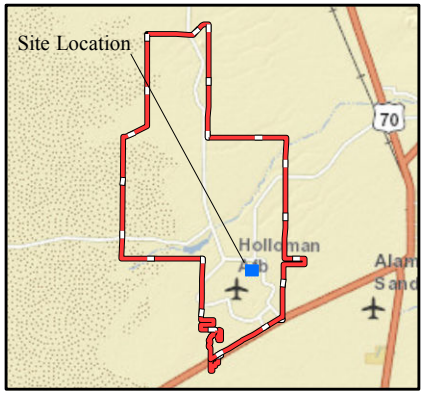

Legend

- ESQD Arc for HFD Unintentional Detonations (207 feet)
- ESQD Arc for MFD-H Intentional Detonations (302 feet)
- FI857a MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
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Alamogordo, NM

AFCEC

FIGURE 2-5

FI857a MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

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Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 250 feet

0 40 80 Meters

0 125 250 Feet

N W E S

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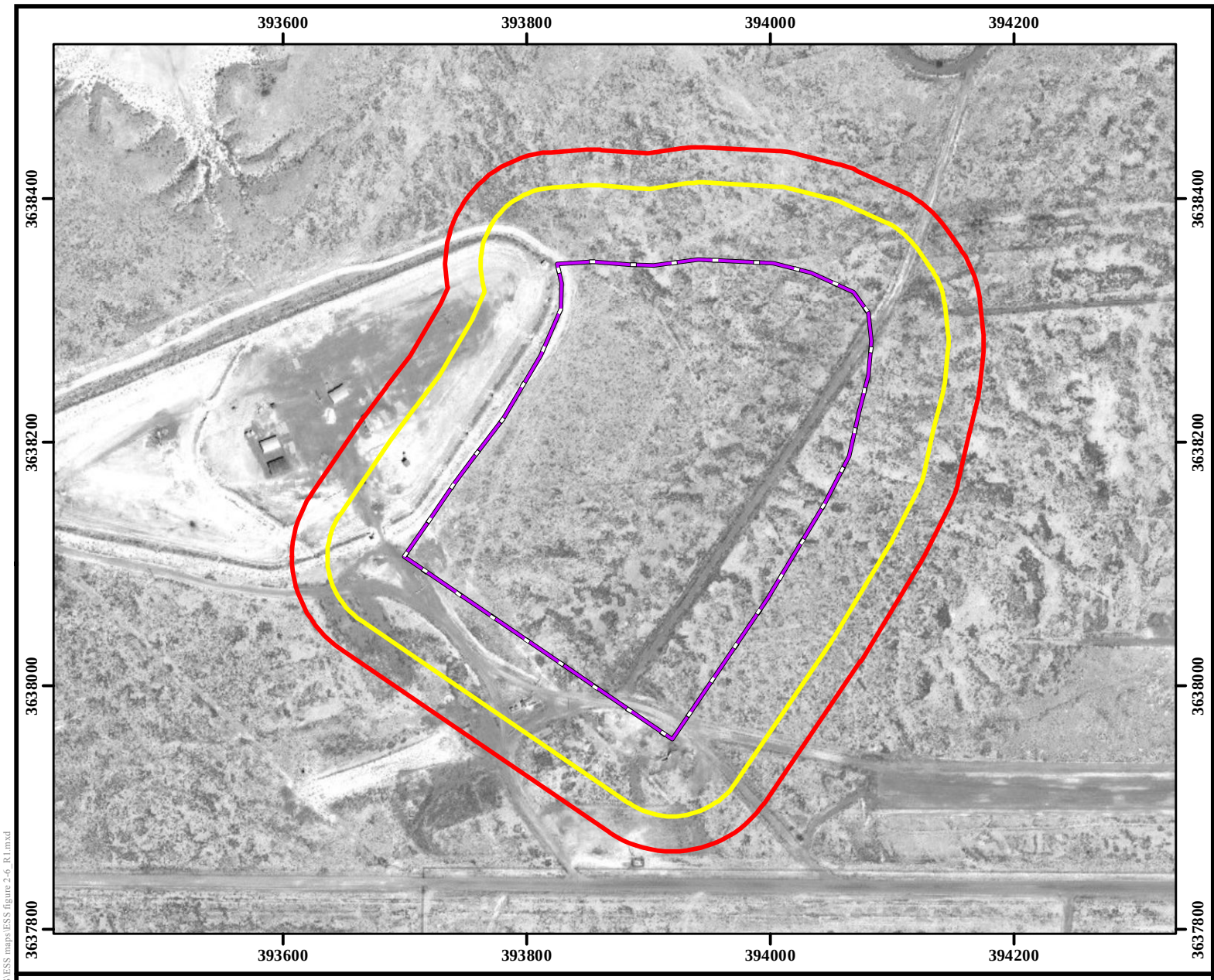

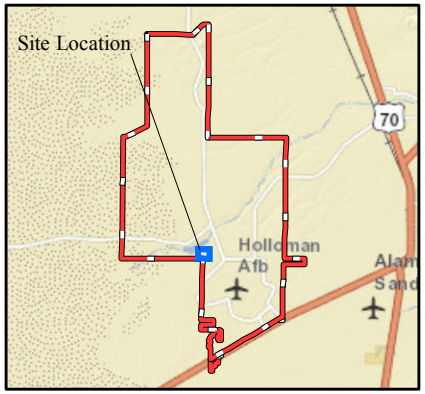

Legend

- ESQD Arc for HFD Unintentional Detonations (207 feet)
- ESQD Arc for MFD-H Intentional Detonations (302 feet)
- SR864 MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
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Alamogordo, NM

AFCEC

FIGURE 2-6

SR864 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
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Central Meridian: -105.0000
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1 inch = 400 feet

0 60 120 Meters

0 200 400 Feet

N W E S

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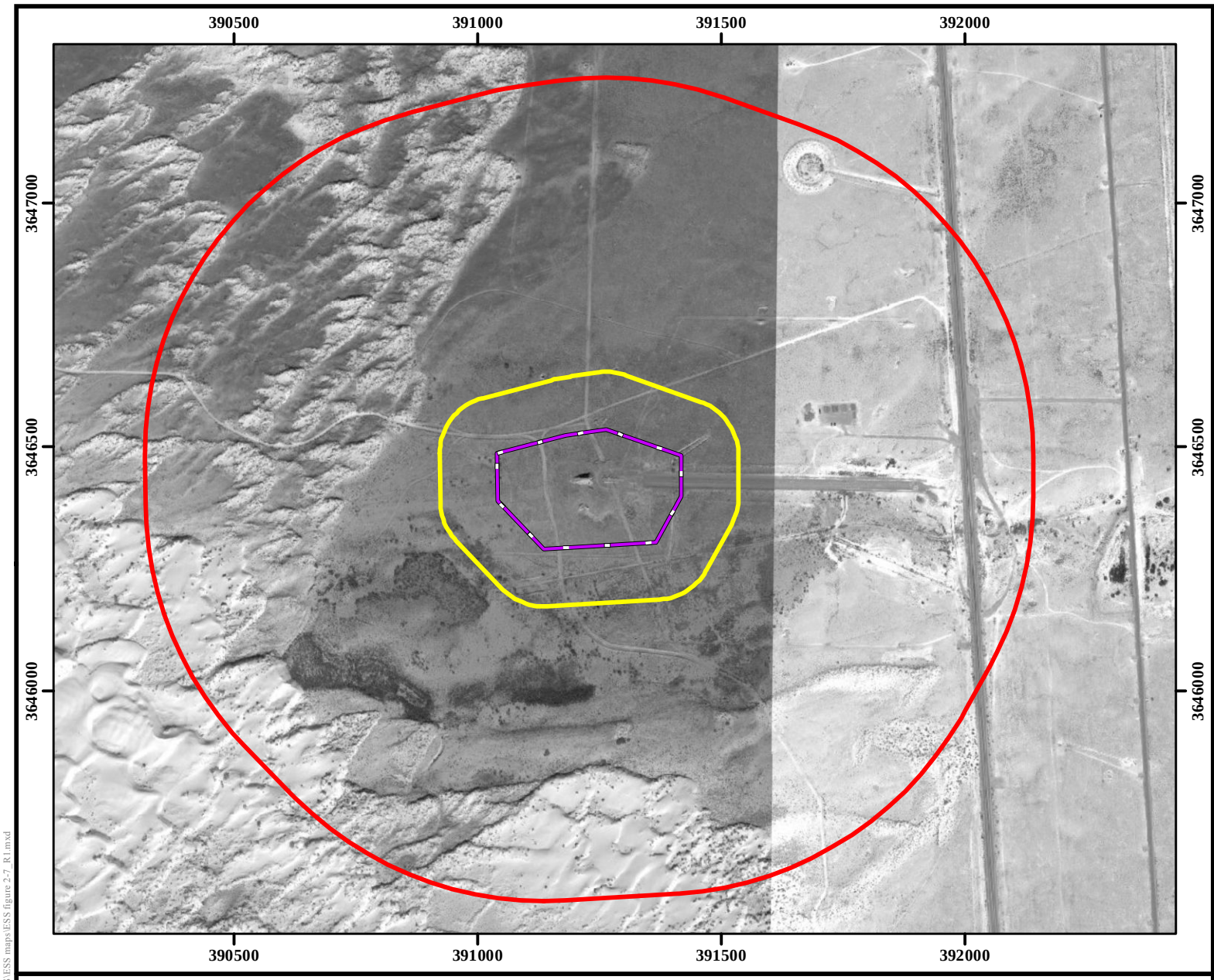

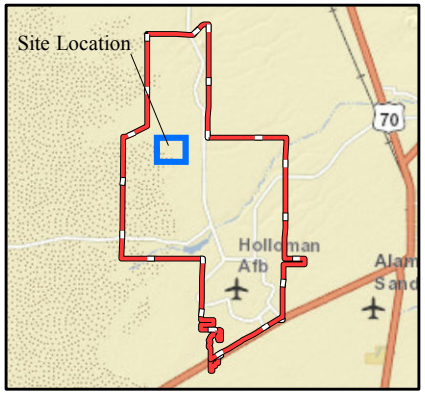

Legend

- ESQD Arc for HFD Unintentional Detonations (387 feet)
- ESQD Arc for MFD-H Intentional Detonations (2371 feet)
- ML865 MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
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Alamogordo, NM

AFCEC

FIGURE 2-7

ML865 MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 1,000 feet

0 150 300 Meters

0 500 1,000 Feet

N W E S

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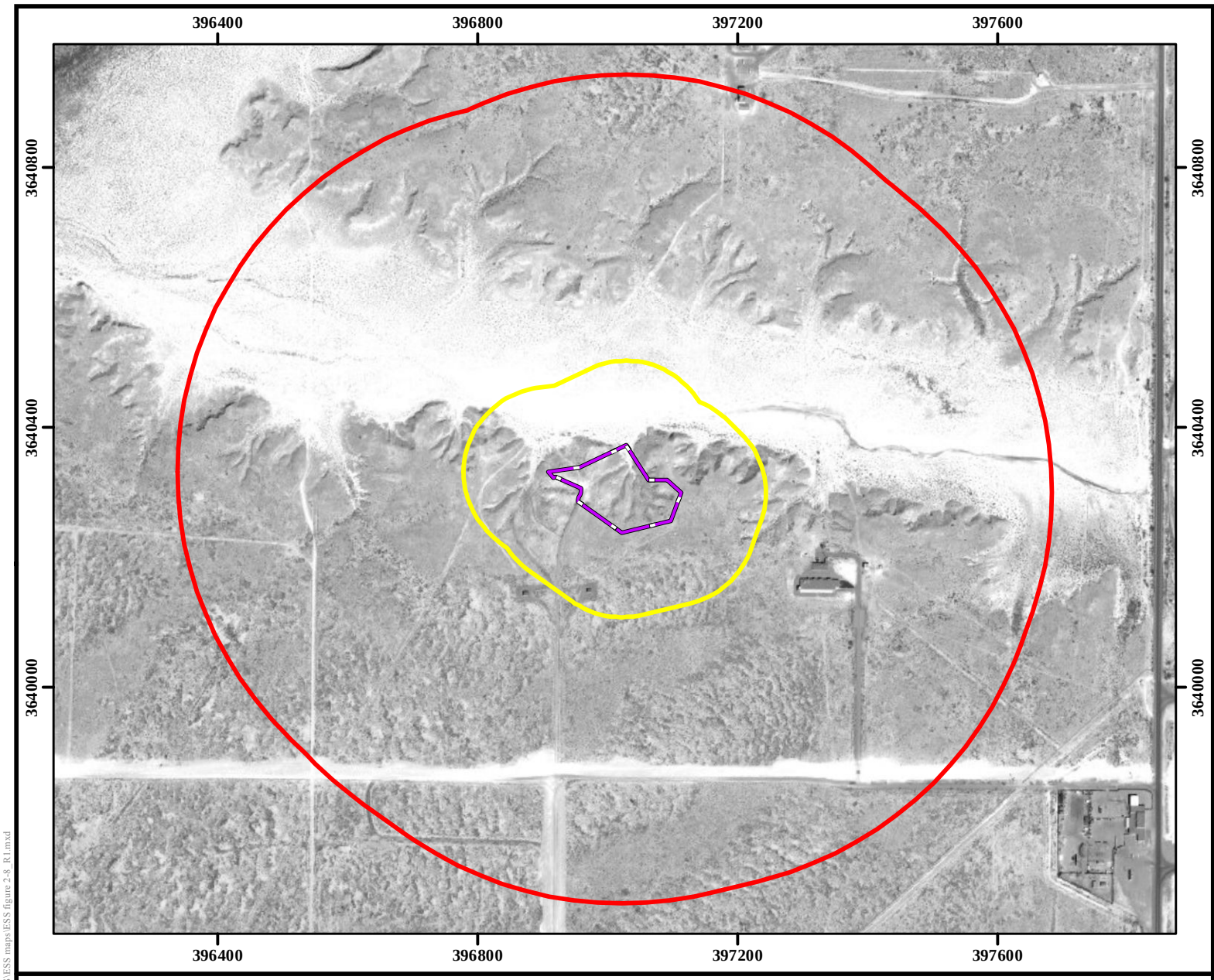
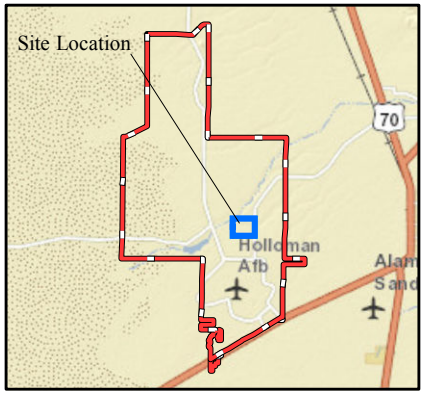




Legend

- ESQD Arc for HFD Unintentional Detonations (428 feet)
- ESQD Arc for MFD-H Intentional Detonations (1874 feet)
- RR869a MRS Boundary
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-8

RR869a MRS Showing ESQD Arcs for MFD-H (Intentional) and HFD (Unintentional) Detonations

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

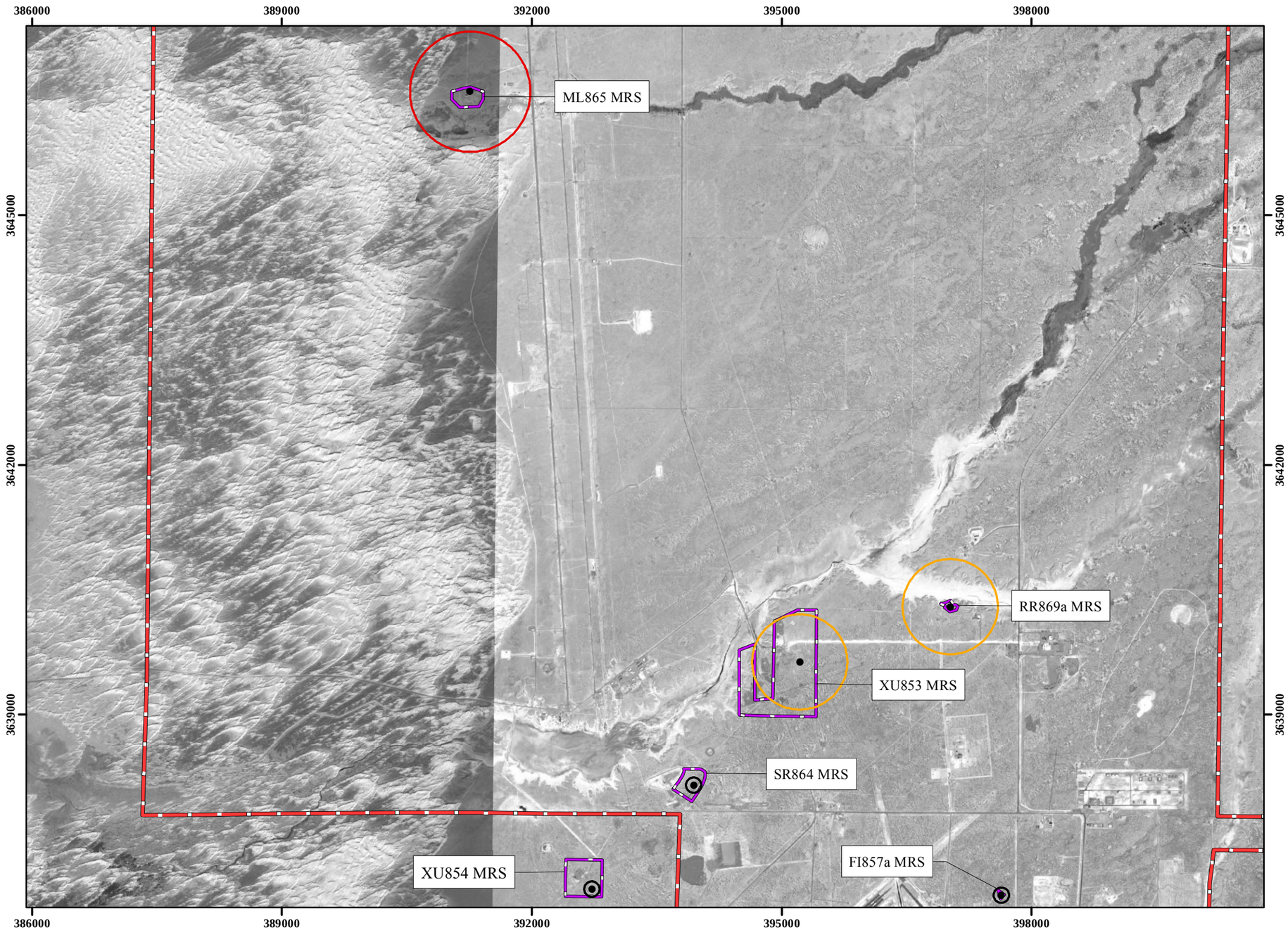
1 inch = 750 feet

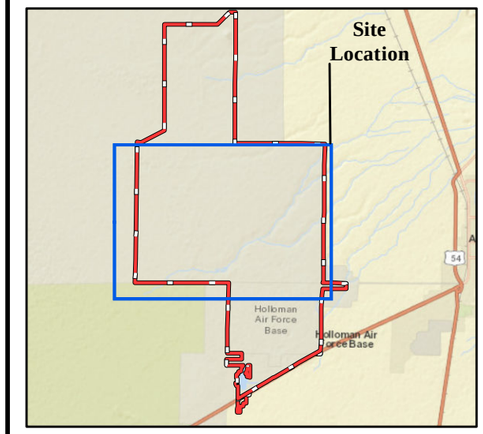
0 115 230 Meters

0 375 750 Feet

N W E S

Path: C:\Projects\New Mexico\GIS\ESS maps\ESS figure 2-8_R1.mxd





Legend

- Safe Disposal Areas
- ESQD Arcs for Intentional Detonation (302 feet)
- ESQD Arc for Intentional Detonation (2371 feet)
- ESQD Arcs for Intentional Detonation (1874 feet)
- MRS Boundaries
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-9

XU853, XU854, FI857a, SR864, ML865, and RR869a Safe Disposal Areas Showing ESQD Arcs

FPM Remediations, Inc.

2014

NOTES:

Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

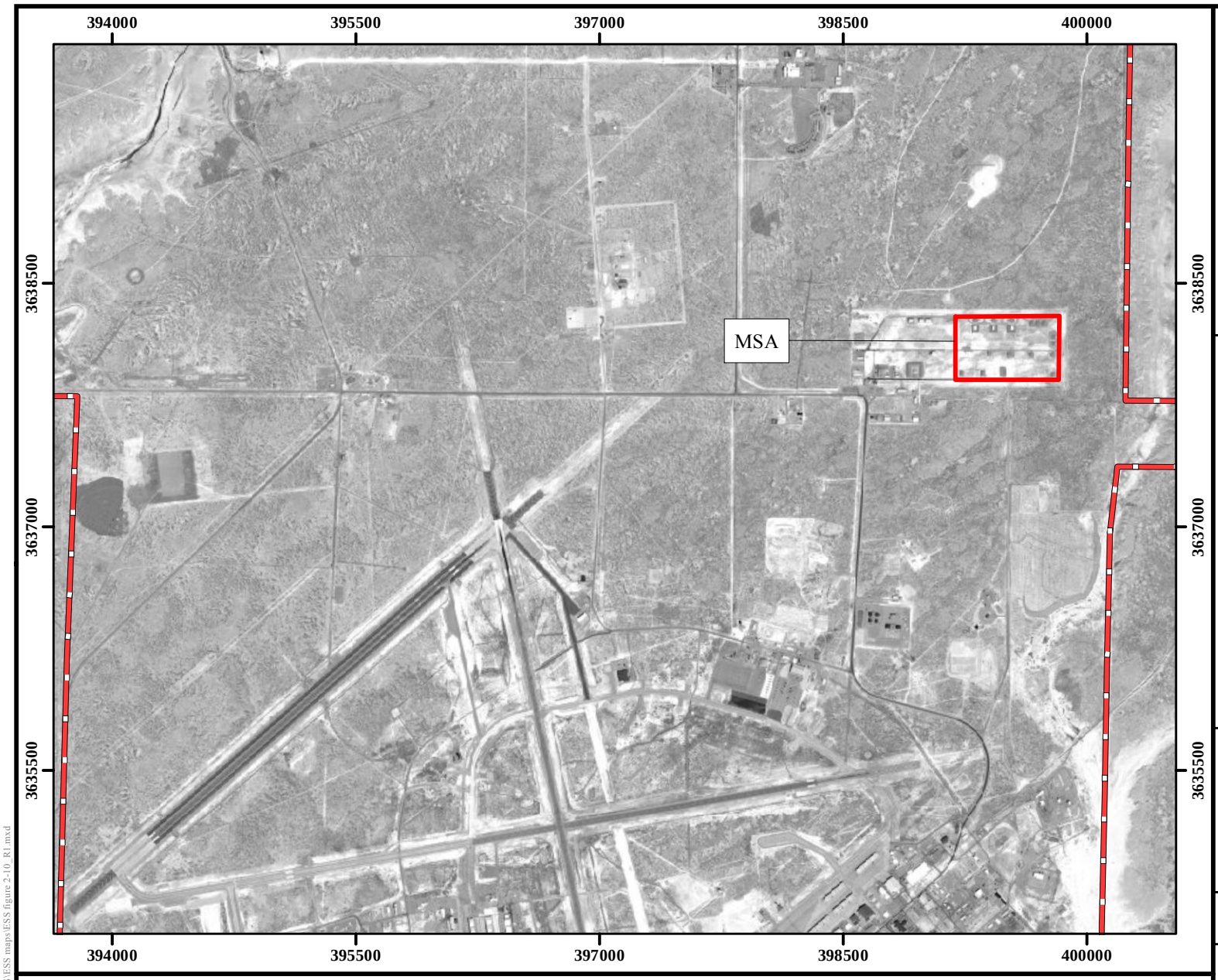
1 inch = 4,200 feet

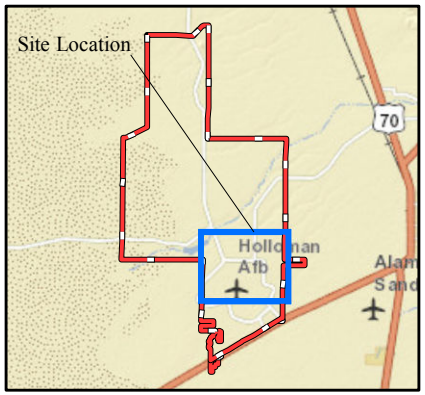
0 650 1,300 Meters

0 2,100 4,200 Feet

N W E S

Path: C:\Projects\New Mexico\GIS\ESS maps\ESS figure 2-9_R1.mxd





Legend

- MSA
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-10

Location of Donor Explosives Storage at Munitions Storage Area

FPM Remediations, Inc.

2014

NOTES:
Revision Date: 5/27/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 3,000 feet

0 450 900 Meters

0 1,500 3,000 Feet

N W E S

Path: C:\Projects\New Mexico\GIS\ESS maps\ESS figure 2-10_R1.mxd

APPENDIX B

Fragmentation Data Review Forms for Minimum Separation Distance (DDESB TP 16)

Fragmentation Data Review Form

Database Revision Date 4/16/2013

Category:	Grenades & Mines
Munition:	40 mm M383 Grenade
Case Material:	Steel, Mild
Fragmentation Method:	Pre-formed Fragmenting
Secondary Database Category:	Shoulder Fired Grenade
Munition Case Classification:	Robust

DODIC:	B571
Date Record Created:	9/21/2004
Record Created By:	MC
Last Date Record Updated:	7/9/2012
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition A-5
Explosive Weight (lb):	0.117
Diameter (in):	1.5600
Cylindrical Case Weight (lb):	0.15906
Maximum Fragment Weight (Intentional) (lb):	0.0003
Design Fragment Weight (95%) (Unintentional) (lb):	0.0003
Critical Fragment Velocity (fps):	6832

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	207
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	302
MFD-V [Maximum Fragment Distance, Vertical] (ft):	246

Overpressure Distances

TNT Equivalent (Pressure):	1.46
TNT Equivalent Weight - Pressure (lbs):	0.171
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	10
Public Traffic Route Distance (2.3 psi); K24 Distance:	13
Inhabited Building Distance (1.2 psi), K40 Distance:	22
Intentional MSD (0.0655 psi), K328 Distance:	182

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1.3
TNT Equivalent Weight - Impulse (lbs):	0.152
Kinetic Energy 10^6 (lb-ft²/s²):	0.0066

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	12
Expected Max. Throw Distance (ft):	25
Minimum Separation Distance (ft):	200

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	24
Expected Max. Throw Distance (ft):	10
Minimum Separation Distance (ft):	12.5

Water Mitigation

Minimum Separation Distance (ft):	200/200
Water Containment System:	5 gal carboys/ inflatable pool

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	1.12	1.12
Mild Steel:	0.30	0.30
Hard Steel:	0.24	0.24
Aluminum:	0.69	0.69
LEXAN:	2.92	2.92
Plexi-glass:	1.51	1.51
Bullet Resist Glass:	1.07	1.07

Item Notes

Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (17 October 2002). Other requests shall be referred to the Chairman, Department of Defense Explosives Safety Board, Room 856C, Hoffman Building I, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600.

Fragmentation Data Review Form

Database Revision Date 4/16/2013

Category:	Rocket Motors
Munition:	5 inch Mk 10 Rocket Motor
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	
Munition Case Classification:	Robust

DODIC:	
Date Record Created:	9/20/2010
Record Created By:	SDH
Last Date Record Updated:	9/14/2011
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Ballistite
Explosive Weight (lb):	23.9
Diameter (in):	5.0000
Cylindrical Case Weight (lb):	39.16382
Maximum Fragment Weight (Intentional) (lb):	0.1452
Design Fragment Weight (95%) (Unintentional) (lb):	0.0148
Critical Fragment Velocity (fps):	5385

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	428
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	1874
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1470

Overpressure Distances

TNT Equivalent (Pressure):	1
TNT Equivalent Weight - Pressure (lbs):	23.900
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	52
Public Traffic Route Distance (2.3 psi); K24 Distance:	69
Inhabited Building Distance (1.2 psi), K40 Distance:	115
Intentional MSD (0.0655 psi), K328 Distance:	945

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1
TNT Equivalent Weight - Impulse (lbs):	23.900
Kinetic Energy 10^6 (lb-ft²/s²):	2.1050

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	Not Permitted
Water Containment System:	Not Permitted

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	10.44	4.11
Mild Steel:	1.95	0.79
Hard Steel:	1.60	0.65
Aluminum:	3.90	1.67
LEXAN:	8.53	4.89
Plexi-glass:	6.98	3.33
Bullet Resist Glass:	6.11	2.69

Item Notes

Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (17 October 2002). Other requests shall be referred to the Chairman, Department of Defense Explosives Safety Board, Room 856C, Hoffman Building I, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600.

Fragmentation Data Review Form

Database Revision Date 4/16/2013

Category:	Surface-Launched HE Rounds
Munition:	155 mm M549A1
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	Projectile
Munition Case Classification:	Robust

DODIC:	D579
Date Record Created:	6/2/2011
Record Created By:	SDH
Last Date Record Updated:	
Individual Last Updated Record:	
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	TNT
Explosive Weight (lb):	15
Diameter (in):	4.5900
Cylindrical Case Weight (lb):	33.29500
Maximum Fragment Weight (Intentional) (lb):	0.3168
Design Fragment Weight (95%) (Unintentional) (lb):	0.0574
Critical Fragment Velocity (fps):	5481

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	387
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	2371
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1857

Overpressure Distances

TNT Equivalent (Pressure):	1
TNT Equivalent Weight - Pressure (lbs):	15.000
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	44
Public Traffic Route Distance (2.3 psi); K24 Distance:	59
Inhabited Building Distance (1.2 psi), K40 Distance:	99
Intentional MSD (0.0655 psi), K328 Distance:	809

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1
TNT Equivalent Weight - Impulse (lbs):	15.000
Kinetic Energy 10^6 (lb-ft²/s²):	4.7585

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	36
Expected Max. Throw Distance (ft):	220
Minimum Separation Distance (ft):	220

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	275
Water Containment System:	1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	14.74	7.31
Mild Steel:	2.71	1.38
Hard Steel:	2.23	1.13
Aluminum:	5.31	2.82
LEXAN:	10.43	6.87
Plexi-glass:	9.11	5.24
Bullet Resist Glass:	8.20	4.43

Item Notes

This item has the same body as the 155 mm M549. The only difference in the rounds is the explosive fill.

Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (17 October 2002). Other requests shall be referred to the Chairman, Department of Defense Explosives Safety Board, Room 856C, Hoffman Building I, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600.

APPENDIX C
Courtesy Storage Agreement

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 49TH WING (ACC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO

21 Feb 2014

MEMORANDUM FOR 49 MXS/MXMW

FROM: FPM-Remediations

SUBJECT: Munitions Courtesy Storage Agreement (CSA), FPM-Remediations

1. Request permission to courtesy store custody account and non-stock listed munitions within the Munitions Storage Area (MSA) IAW AFI 21-201, *Conventional Munitions Maintenance Management*. I understand that the care, preservation and accountability of our assets remain our responsibility. Attached is a list reflecting the maximum quantities of munitions requiring courtesy storage and any unique storage requirements for our organization.

2. <u>FPM-Remediations</u> Account Custodian Responsibilities:

2.1. Responsibility for the munitions remains with the custodians of the owning organization.

2.2. Schedule munitions pick-ups and returns with as much notice as possible. If support is needed for after hours or non-duty days, it can be scheduled, if possible 24 hours, in advance through Munitions Storage Dispatch, at DSN 572-1500/1501.

2.3. Custodians are responsible for providing adequate personnel and equipment to handle and transport munitions assets, and MUST adhere to all *Safety* and *Security* requirements IAW AFMAN 91-201, *Explosive Safety Standards*, AFMAN 24-306, *Manual for the Wheeled Vehicle Driver*, AFI 31-101, *The Air Force Installation Security Program*, AFI 91-203, *Air Force Consolidated Occupational Safety Standard* and TO 11A-1-61-1, *Storage and Outloading Instructions* and applicable MAJCOM/Base directives and supplements.

2.3.1. These movements will include periodic inspections (PIs), return munitions inspections (RMIs), pulls (pick-ups), restores (turn-ins) and the movement stated in paragraph 2.5.

2.4. Ensure individuals withdrawing or returning munitions for courtesy storage are listed on the AF Form 68, *Munitions Authorization Record*. If individuals are not on the AF Form 68, they will only be allowed to receive munitions if they are identified in Attachment 1. All individuals must provide their military ID (CAC) for authentication and sign the AF IMT 4331, *Munitions Transaction Sheet*, provided by the Munitions Storage Element when withdrawing, storing or transporting assets to and from storage facilities IAW FOI 21-204.

2.5. Deliver "Lite" boxes to Munitions Inspection for lot consolidation if picking up or storing partial lots. Only one "Lite box" per lot is allowed in storage unless operational commitments dictate otherwise. Notify Munitions Inspection at DSN 572-1622/1623 before delivering assets. All maintenance on munitions will be accomplished and coordinated with Munitions Inspection.

2.6. Maintain appropriate storage, handling and housekeeping procedures IAW AFMAN 91-201, TO 11A-1-61-1 and applicable MAJCOM/Base directives and supplements for all assets in the courtesy storage area.

2.7. Store munitions in approved, properly marked and securely sealed containers. Stack munitions neatly with "Lite" boxes to the front and top of the stack. Munitions kits needed to support mission requirements may be packaged in nonstandard containers, but will have all required information stenciled on the containers and sealed. Any questions concerning containers should be directed to Munitions Inspection at DSN 572-1622/1623.

2.8. Ensure munitions containers are conspicuously marked with the organization and shop code.

2.9. IAW AFI 21-201 non-DoD owned explosives and other hazardous and toxic materials will not be stored in the MSA. Refer to AFI 21-201 para, 5.2.15.1. and AFMAN 91-201 for guidance.

2.10. Provide technical data to the Munitions Flight for non-DoD materials/munitions (i.e., required for test) prior to storage.

2.11. Email this package to Munitions Storage at 49 MXS/Munitions Storage on the Global address list (49MXSMunitionsStorage@holloman.af.mil) or hand carry to Storage Dispatch upon completion.

2.12. The owning Organization is responsible of accounting and reporting custody account munitions.

2.13. If munitions (which are not on the annual approved allocation letter) need to be stored, the owning Organization will notify Munitions Storage at 572-1500/1501 with the NSN, Nomenclature and quantity of munitions. These assets will only be stored after approval from Munitions Supervision.

2.14. Proper container packaging, marking and lot separation is the owning organization's responsibility. The Storage Element will ensure the owning organization complies with these requirements.

2.15. Renew this agreement annually or when there is a change of Commander.

3. Munitions Flight Responsibilities:

3.1. Munitions Storage will evaluate the CSA to ensure there is enough storage space to honor the request. The CSA will then be forwarded to the Munitions Flight Chief for approval. If approved, Storage Dispatch will forward the completed master copy to the Munitions Operations Element for filing in their electronic records file plan. Storage Dispatch will also file a copy in the Courtesy Storage Agreement book under the appropriate custodian's account number. If disapproved, this letter will be returned to the custodian with reason for disapproval. Any questions should be directed to Munitions Storage Dispatch at DSN 572-1500/1501.

3.2. The Munitions Storage Element will provide escort service and accompany the custodians when withdrawing, storing, inventorying or transporting munitions assets within the MSA.

3.3. The Munitions Flight will provide escort support for contingency operations, ready-response teams, mobility exercises or other valid short-notice requests. Contact Munitions Control at DSN 572-3151 after 1600 on weekdays and Maintenance Operations Center (MOC) at DSN 572-3342 on weekends, if support is required. Those agencies will contact the Munitions Storage stand-by personnel.

3.4. Munitions Storage personnel will ensure that only the individuals listed on the AF Form 68, Munitions Authorization Record, withdraw and return courtesy stored munitions.

3.5. The Munitions Storage Element will notify custodians when assets are scheduled to be re-warehoused for Explosive Site Plan (ESP) or Master Storage Plan (MSP) adjustments. At a minimum, the custodian will be notified by e-mail or telephone. If at all possible, the custodian should be present prior to moving assets.

3.6. IAW AFI 21-201, responsibility for repairing packing discrepancies caused by storage conditions belongs to munitions organizations. Proper container packaging, marking, and lot separation is the owning organization's responsibility. The Storage Element will ensure the owning organization complies with these requirements.

3.7. In the event that seals on a munitions container are discovered damaged or missing, Munitions Inspection will inspect the contents for damaged or missing assets and then re-seal the container.

3.8. Specific conventional munitions authorized for storage IAW AFMAN 91-201 and non-stock listed, will be managed in CAS *Non-accountable Program* (AM101A) and will be updated by Munitions Storage personnel.

4. This letter supersedes all previous letters, same subject.

5. The next annual renewal date is **21 Feb 2015**.

Russell A. Shattles
FPM Remediations, Inc.
MMRP Operations Manager
FPM Remediations Custodian

Attachments:
1. Authorized Individuals not on AF Form 68

1st Ind, FPM-Remediations

MEMORANDUM FOR 49 MXS/MXMW

Concur/~~Nonconcur~~

Russell A. Shattles
FPM Remediations, Inc.
MMRP Operations Manager

2d Ind, 49 MXS/MXMWMC

MEMORANDUM FOR 49 MXS/MXMW

Courtesy storage space is / ~~is not~~ available in the Munitions Storage Area.

SUTTLES.SCOTT.W.1075580491

Digitally signed by SUTTLES.SCOTT.W.1075580491
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=SUTTLES.SCOTT.W.1075580491
Date: 2014.02.25 07:08:59 -07'00'

SCOTT W. SUTTLES, MSgt, USAF
NCOIC, Munitions Storage

3d Ind, 49 MXS/MXMW

MEMORANDUM FOR 49 MXS/MXMW

Approved / ~~Disapproved~~

JEZ.ADAM.J.1084510838

Digitally signed by JEZ.ADAM.J.1084510838
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USAF, cn=JEZ.ADAM.J.1084510838
Date: 2014.03.10 13:14:23 -06'00'

ADAM J. JEZ, SMSgt, USAF
Munitions Flight Chief

Individuals Authorized to Receive Munitions/Material that are not on AF Form 68

Name	Security Clearance	Rank/Duty title	SSAN(Last 6)	Phone

FPM personnel will be listed on this roster once positions are assigned.

Appendix G
Contractor Personnel Qualification Certification Letter

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FPM Remediations, Inc. _____ Environmental Remediations and Construction Services

CORPORATE HEADQUARTERS
584 Phoenix Drive
Rome, NY 13441
315/336-7721
FAX 315/336-7722

September 8, 2014

Mr. Brian Renaghan
AFCEC/CZRX
2261 Hughes Avenue, Suite 155
Joint Base San Antonio – Lackland, TX 78236-9853

Subject: Personnel Qualifications Certification Letter
Military Munitions Response Program (MMRP)
XU853 Missile Test Stand Area and XU854 Able 51 Area MRSs
Holloman Air Force Base
New Mexico

Dear Brian:

Data Item Description MMRP-09-012 requires a certification letter to be provided to identify and verify the qualifications of key unexploded ordnance (UXO) personnel for the MMRP Remedial Action field activities. Mr. George Vaughn of FPM Remediations, Inc. will be the Senior UXO supervisor (SUXOS) for the XU853 Missile Test Stand Area and XU854 Able 51 Area Munitions Response Sites (MRSs) Remedial Action. I certify that the person listed meets or exceeds contact requirements for the functions he will perform. This letter will be updated when additional UXO personnel are identified for the XU853 Missile Test Stand Area and XU854 Able 51 Area MRSs Remedial Action field activities.

Please do not hesitate to contact me if you have any questions about this letter.

Sincerely,

FPM Remediations, Inc.

Maureen Whalen

Maureen Whalen, CG, CPG, PMP
New Mexico-Arizona Group PBR
Contract Project Manager, FPM
315-336-7721 x216

Enclosures (Resume and EOD School Graduation Certificate)

George H. Vaughn Jr.

9021 Hollow Bluff Dr. / Haughton, LA 71037
Home:(318) 949-3149 / Cell:(318) 617-1719

DATE ATTENDED BASIC EOD SCHOOL: Oct 1990 – July 1991
OTHER PERTINENT TRAINING: HAZWOPER 40 HOUR – Nov 2010, Refresher February 2014
HAZWOPER 8 HOUR Supervisor Training – September 2013
USACE #2515
Current DOS approved Senior EOD Tech Bio
Current DOS approved Secret Clearance
Current DoD TS/SCI background investigation

MILITARY EOD ASSIGNMENTS:

July 91 – May 96 Basic EOD , 49th CES/CED (EOD), Holloman AFB, NM
Member of EOD response team, conducted annual range clearances.

May 96 – June 04 Senior EOD, 3rd CES/CED (EOD), Elmendorf AFB, AK
EOD response team leader. Participated in range clearances at Eielson AFB.

June 04 – Jan 05 Senior EOD, 2 CES/CED (EOD), Barksdale AFB, LA
EOD response team leader, NCOIC training

Jan 05 – Jun 05 Senior EOD, Baghdad, Iraq
EOD response team leader

Jun 05 – Jan 07 Senior EOD, 2 CES/CED (EOD), Barksdale AFB, LA
EOD response team leader, NCOIC Logistics

Jan 07 – Jan 08 Senior EOD, 732 ECES Al Taqaddum AB, Iraq
Weapon Intelligence team lead, WIT 7

Jan 08 – Feb 09 Master EOD (MSgt), 2 CES/CED (EOD), Barksdale AFB, LA
EOD response team leader, NCOIC Logistics

Feb 09 – Aug 09 Master EOD (MSgt), 755 ECES Bagram AB, Afghanistan
EOD response team leader, Flight Superintendent, Supervised 18 individuals

Aug 09 – Oct 10 Master EOD (MSgt) 2 CES/CED (EOD), Barksdale AFB, LA
Flight Superintendent, supervised 16 individuals

Oct 10 – Jan 1 2011 Terminal Leave

2 Jan 2011 Retirement

CIVILIAN UXO/EOD EXPERIENCE:
Dec 2010 – Jan 2011 UXO Tech III (Team Lead), USA Environmental, Raritan Job site, New Jersey / Removal Action

Jan 2011 – March 2011 UXO Tech III (Team Lead), USA Environmental, Ft Stewart Job site, Georgia / Removal Action

April 2011 – May 2011 UXO Tech III (Team Lead), Native American Environmental, Alexandria, LA, Removal Action, Louisiana Explosives handler's license

May 2011 – June 2011 UXO Tech III (Team Lead), USA Environmental, Indian Head, MD and Raritan, NJ job sites / Removal Action

July 2011 – Feb 2012 Senior EOD Tech, Triple Canopy, US Embassy Baghdad, Iraq, WPS Contract, EOD Team lead

Mar 2012 – June 2012 UXO Tech III (Team Lead), USA Environmental, FT Polk, LA job site / Removal Action

July 2012 – Sept 2012 UXO Tech III (Team Lead), USA Environmental, Indian Head, MD job site / Removal Action

October 2012 – Present UXO Tech III / SUXOS, FPM Remediations, Barksdale AFB, LA job site / RI/FS, Removal Action and Construction Support

Naval School Explosive Ordnance Disposal

This is to certify that

A1C George H. Vaughn Jr.

has successfully completed the

Basic EOD Course

Class 100S-91

Graduated – 23 July 1991

In witness thereof, this certificate has been signed and given under my hand at Naval School Explosive Ordnance Disposal, Eglin AFB, Florida

This 25th day of August in the Year of Our Lord, Two Thousand Ten

Commanding Officer

NAVSCOLEOD 1500/26
REV (2-00)

Appendix H
Project Schedule

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