APPENDIX A

PERFORMANCE WORK STATEMENT

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Performance Work Statement
Remedial Investigation / Feasibility Study
Former Camp Butner
Butner, Granville County, North Carolina
I04NC000902
14 July 2011
Revision 0

1.0 OBJECTIVE: The objective of this task order is to achieve acceptance of Decision Document(s) in compliance with CERCLA and Department of Defense, Army, and USACE Regulations and Guidance to include Interim Guidance and Data Item Descriptions (DID) at the referenced Munitions Response Sites.

2.0 BACKGROUND

2.1 Work under this Performance Work Statement (PWS) falls within the Military Munitions Response Program (MMRP) for Former Camp Butner, a Formerly Used Defense Site (FUDS). The Contractor shall perform all work in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP), 40 CFR Part 300. All activities involving work in areas potentially containing explosive hazards shall be conducted in full compliance with United States Army Corps of Engineers (USACE), Department of the Army (DA), and Department of Defense (DOD) regulations.

2.2 Available Site Specific information will be provided with the request for proposal for contractor review and use via either a designated Internet site or delivery of recorded data on CD/DVD. This information may include but is not limited to general site history, previous investigations and other documentation.

3.0 General Requirements:

3.0.1 Contractor Methods: This is a performance based task order. The performance objectives and standards included herein are the basis of the task order requirements. The technical approach and level of effort expended to achieve task order objectives and standards are solely up to the contractor to select and adjust as necessary through the life of the task order. Government recognizes the contractor's right to change the technical approach and level of effort from that proposed with the understanding that the contractor shall still meet all project objectives and gain government Quality Assurance acceptance in order to receive payment. Given the short time available during the pre-award phase to evaluate the site it is possible that after award and refinement of the conceptual site model and data needs that the contractor will wish to adjust the investigation strategy. If after the TPP but before the field work begins an adjustment in the quantities or types field investigations are required to achieve the performance standard or the Government determines that the performance standard must be adjusted, the Government at its discretion may choose to modify the contract with the price adjustment based upon the prorated unit prices proposed in the accepted offer. Once these adjustments are complete, the contractor shall be obligated to deliver the required performance standard making adjustments in the field strategy as may be necessary to achieve the standard without a change in price.

3.0.2 Quality monitoring and measurement: The contractor will be evaluated periodically during performance of this task order to ensure compliance with the proposed and accepted performance goals, regulations, guidance and DIDs, and to document that acceptance criteria (AC), delivery schedule, and the overall completion date are being met. This evaluation will be performed according to a Quality Assurance Surveillance Plan (QASP). A programmatic QASP will be provided by the government as a starting point for the contractor prepared Draft QASP per Task 2. The government will finalize the contractor's Draft QASP. This final QASP will be supplied to the contractor and used by the government to evaluate the contractor's performance. Failure to adequately complete any service or submittal at the stated minimum acceptance criteria (quality) will result in repeat of the work at the contractor's expense until the minimum AC is met. Tasks that cannot be repeated such as public meetings may result in a poor performance evaluation.

3.0.3 Performance Requirements. Performance requirements are addressed in each task and summarized in the Performance Requirements Summary (PRS) provided in Attachment A. Performance metrics are provided in Attachment B. If discrepancies or ambiguity exists between the documents, the order of precedence is 1) the Task; 2) Performance Requirements Summary; 3) Performance Metrics

3.0.4 Task pricing: A pricing schedule is provided in Attachment D which will be used as a basis for negotiation of price increase or decrease due to government changes in the specified performance objectives.

3.1 Task 1, Technical Project Planning (TPP): This is a Firm Fixed Price/Unit Price task.
Objective: Implement the four-phase TPP process in accordance with EM 200-1-2, EM 1110-1-4009 and applicable Interim Guidance Documents.

Performance Standard: Achieve the objectives of each TPP phase as listed in EM 200-1-2, EM 1110-1-4009 and applicable Interim Guidance Documents. Facilitate meetings in a professional and organized manner.

AC: Acceptance of TPP documents (meeting presentations, agenda, handouts, CSM and memorandums) with up to one (1) revision. Meetings held are organized; accomplish requirements of the TPP process; and professional in nature. Zero letters of reprimand, grievances, or formal complaints

Measurement / Monitoring: TPP checklist for each phase as provided in the guidance will be used to measure and document successful progress; guidance cited will be used to evaluate content of documents for acceptance / non-acceptance. Government will attend and evaluate organization and facilitation of the meetings, and professional nature of the meetings.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: The contractor shall utilize the TPP process to obtain consensus on specific Data Quality Objectives that the contractor intends to achieve in pursuit of the established RI performance requirement that were proposed and accepted as the basis for the RI task. The Contractor shall plan for meetings to occur as follows: first meeting, pre-Work Plan with resulting DQOs and conceptual site model (CSM), and TPP Memorandum; second meeting, to finalize Work Plan with resulting TPP addendum; third meeting, verify all data gaps have been filled and finalize Remedial Investigation Report with resulting TPP addendum. The contractor shall organize and coordinate all meetings; identify and involve all stakeholders, upon approval by the Government; and be responsible for the logistics of these meetings to include, but not limited to, providing a facilitator, obtaining meeting location, and sending invitation letters (pending government review and acceptance). The Contractor shall prepare, submit for review and gain acceptance of a TPP memorandum or addendum for each meeting. If a site visit is planned prior to acceptance of a Work Plan, the Contractor shall prepare and submit for acceptance an Abbreviated Accident Prevention Plan (AAPP). The Contractor shall utilize statistical methods to support the decision making processes used to characterize both UXO/DMM (such as Visual Sample Plan (VSP) software) and MC. The Contractor shall prepare a preliminary Munitions Response Prioritization Protocol for each Munitions Response Site covered under this task order.

3.2 Task 2, RIFS Work Plan (WP), Uniform Federal Policy for Quality Assurance Project Plan (UFP-QAPP) and QASP: This is a Firm Fixed Price task.
Objective: Prepare, submit and gain acceptance of a WP, munitions constituent (MC) UFP-QAPP and QASP that are detailed and comprehensive plans covering all aspects of site characterization, risk assessment and methodology, and project execution. UFP-QAPP applies only to environmental sampling.

Performance Standard: Prepare the WP in accordance with DID WERS-001 and EM 1110-1-4009, EM 385-1-1, EM 385-1-97. Prepare the sampling and analysis plan, field sampling, and UFP-QAPP in accordance with EM 1110-1-4009, DID WERS-009.01, and UFP-QAPP, as appropriate. Prepare a risk assessment work plan incorporating implementation of the risk assessment and methodologies per EPA Risk Assessment Guidance (RAGS) and USACE EM 200-1-4, Volumes I and II, as appropriate. UFP-QAPP content shall also meet the requirements of DoD Quality Systems Manual for Environmental Laboratories (current version). Draft QASP includes requirements in regulations, guidance, DIDs and the Quality Control Plan in the WP.

AC: Acceptance of WP and UFP-QAPP with two revisions. Draft QASP reflects requirements and QCP with one revision required.

Measurement / Monitoring: Review of WP, UFP-QAPP and QASP per guidance to verify that the minimum acceptable content has been provided.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: Incorporate all decisions pursuant to the TPP process. The sampling and analysis plan (SAP) shall include the Contractor's phased approach and address contaminants of interest and sample media (soil/groundwater/sediment/surface water).

3.2.1 Optional, Task 2a, Explosive Siting Plan: This is a Firm Fixed Price task. If this optional task is not awarded, an Explosive Siting Plan will be provided by the government for inclusion in the WP.

Objective: Prepare, submit and gain acceptance of an Explosives Siting Plan.

Performance Standard: Prepare required submission in accordance with DoD 6055.09-m, EM 385-1-97, Errata Sheet #3, and DID WERS-003 as a stand alone document for inclusion after acceptance into the WP.

AC: Acceptance of submission with two revisions.

Measurement / Monitoring: Review by Government using guidance cited to determine acceptability.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: Allow eight (8) weeks in the schedule for DDESB approval after submission of final document to the CEHNC-CX.

3.3 Task 3, GeoSpatial Data: This is a Firm Fixed Price/Unit Price task.
Objective: Utilize GIS in the development of the Conceptual Site Model (CSM) and maintain and manage all project and geospatial data.

Performance Standard: Manage and maintain project data, and develop CSM in GIS IAW DID WERS-007.01, EM 200-1-2, EM 1110-1-4009 and applicable Interim Guidance Documents.

AC: Acceptance of CSM and GeoSpatial Data submissions meets quality and formatting requirements.

Measurement / Monitoring: Review by Government using guidance cited to determine acceptability.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: The GeoSpatial Data shall include:
- A comprehensive CSM
- A pre and post-project response action geospatial data analysis will be performed using a GIS.
- All available existing data that is applicable to the project will be consolidated into the GeoDatabase and analyzed to relay pertinent information to the PDT. If an existing GIS database is available, it will be provide by the government.
- The analysis of data from the GIS shall support all conclusions of the CSM.
- The information attained through the pre-RI analysis will be documented in the work plan.
- The information attained in the post-RI and FS analysis will be documented in the RI and FS reports.
- The pre-RI analysis will encompass social, environmental and/or economic entities that will be or may be impacted by response-action activities.
- The post-RI and FS analysis will detail entities impacted by RI/FS activities and impacts of future response action activities (if applicable).
- The pre and post-RI and FS analysis may detail the fieldwork strategies, areas of concern, survey requirements, environmental concerns, milestones and/or other factors that affect product delivery and future action planning.
- Entities that may be affected by response actions include but are not limited to: landowners, homeowners, rental tenants, schools, utilities, roads, businesses, recreational areas, air traffic, water bodies and/or industries.
- The GeoDatabase shall be a living repository that is refined throughout the life of the project.
- Incorporate layers that overlay on maps of the site that identify physical features, and MPPEH/MD and Range-Related Debris found during the investigation. Examples include: streets, anomalies, MEC positively identified, identifiable MD, sampling location, cultural resources, environmental, biological, and socio-economic variables.
- Archeological site location(s) will not be released to the public without written permission from USACE.

- Perform civil surveys IAW EM 1110-1-4009 and DID WERS-007.01
- Property owner privacy will be preserved. Property owner names shall not be disseminated in any documents.
- Maintain and update property GIS data for all landowners with in the project boundaries.
- Track and assist the District in obtaining property Right -of -Entry as needed.

3.4 Task 4, RI/FS Field Activities: This is a Firm Fixed Price/Unit Price task.
Objective: Conduct a remedial investigation in accordance with CERCLA, characterizing the nature and extent of MEC contamination at the required munitions response sites (MRS) meeting the project DQOs as defined during the TPP process. This task shall include all field activities necessary to execute this task except MC sampling. MC sampling requirements are covered under Task 12, Environmental Sampling & Analysis.

All subtasks **exclude** Army National Guard property with the exception of optional Task 4a.

3.4.1 Optional Task 4a, Army National Guard Property. Refer to historical project documentation of site location, historical information, and boundaries.

3.4.2 Optional Task 4b, Flame Thrower Range, FUDS Project No. I04NC00902-R02. Refer to historical project documentation of site location, historical information, and boundaries. Based on data collected during the March 2006 Removal Action (USAE), it is not expected that additional field work would be required for this MRS.

3.4.3 Optional Task 4c, Hand Grenade Range, FUDS Project No. I04NC00902-R03. Refer to historical project documentation of site location, historical information, and boundaries. Based on data collected during the Engineering Evaluation/ Cost Analysis, completed on R03 in March 2006, with no finds of MEC or MD, it is not expected that additional field work would be required for this MRS.

3.4.4 Task 4d, Range Complex 1, FUDS Project No. I04NC00902-R04. Refer to historical project documentation of site location, historical information, and boundaries.

3.4.5 Optional Task 4e, Range Complex 2, FUDS Project No. I04NC00902-R05. Refer to historical project documentation of site location, historical information, and boundaries.

3.4.6 The following applies to all MRSs:

Performance Standard: Field work, data quantity and quality, and analysis of said data (does not include area where Rights-of-entry were not obtained) provide the following results in the RI report:
- Demonstrate that the work was performed in accordance with the applicable laws, regulations, and guidance documents;
- Demonstrate that all areas with elevated anomaly density or with potential to contain MEC will have been traversed at the completion of fieldwork and that there is a 90% chance of detecting these areas;
- Demonstrate with at least 90% confidence that areas classified as MEC-contaminated have greater than or equal to .1 when significant intrusive activities occur, .5 when use is moderate and 1 when little or no intrusive activities occur UXO per acre.
- Demonstrate that the boundaries of all identified MEC contaminated areas have been delineated to an accuracy of at least +/- half the transect spacing, maximum 250 feet, and demonstrate that a 90% confidence has been achieved for bounding the potential depth of MEC.
- Demonstrate that a 90% confidence in the nature (type and density) of MEC and MEC related debris, for each relatively homogeneous MEC contaminated area, has been achieved.
- Demonstrate that data inputs from the RI into the FS will enable remediation cost estimates with an accuracy of +50%/-30%. The work and reporting shall address the surface and sub-surface metallic anomaly density distribution (anomaly/acre) across identified MEC contaminated areas and other remediation cost drivers such as vegetation type and density, terrain conditions, soil type, exclusion zone evacuation costs, etc each to a level of accuracy within the range specified herein.

Additionally:
- Perform the RI field activities in accordance with the accepted Work Plan and UFP-QAPP.
- Proper processing and disposition of UXO, DMM and MC encountered in accordance with approved plan(s).
- All Material Potentially Presenting an Explosive Hazard (MPPEH) and munitions debris processed in accordance with Chapter 14, EM 1110-1-4009 and Errata Sheet No. 2.
- Meet the project DQOs as defined by the TPP process.
- All geophysics shall be IAW geophysics DID.

For this task order 1 acre of transects equals 14,520 lf (2.75 miles) of transects 3 feet wide. One acre's worth of grids equals seventeen (17) 2500 sf grids or four (4) 10,000 sf grids.

AC: Conduct the RI in accordance with the accepted/approved WP, UFP-QAPP, and ESP. QC data submitted meets requirement described in DID WERS-004.01.
- No more than 3 CARs/948s for non-critical violations and/or 1 CAR/948 for critical violation. No unresolved Corrective action requests. - All final data and QC tests/documentation submitted. Government QA acceptance of QC tests/documentation gained.
- No Class "A" Safety accidents, contractor at fault; <1 non-explosive Class C accidents; and <2 non-explosive related Class D accidents, IAW AR 385-40.
- Major safety violations, no more than 1 non-explosive related safety violation.
- Minor safety violations, no more than 2 safety violations.
- Zero letters of reprimand, grievances, or formal complaints.

Measurement / Monitoring: Period inspection/review of field work. Verify compliance with accepted WP, UFP-QAPP. Quality control tests/documentation submitted per the QASP for government review. Additionally, statistical confidence will be calculated using the Visual Sampling Plan software, UXO Estimator or other approved statistical method. Boundary precision will be determined by evaluation of the sampling footprint as it relates to the reported contaminated/uncontaminated areas in question. Anomaly density profile and other remediation cost driver precision will be verified by QA of methods used.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements:
- Restore all areas to their original condition; all access/excavation/detonation holes shall be backfilled.
- Maintain a detailed accounting of all UXO, DMM, MD and range-related debris encountered per DID WERS-004.01. This accounting shall include: amounts of UXO, DMM and MD; nomenclature; location and depth of UXO/DMM; location of MD; and final disposition. The accounting system shall also account for all demolition materials utilized on site. Digital photographs of UXO and DMM and examples of MD found during the investigation are to be taken.
- All UXO, DMM and MC encountered during this munitions response shall be processed in accordance with the approved work and safety plans.
- To the maximum extent practicable, the permanent record shall include sensor data that is digitally-recorded and geo-referenced. Exceptions to the collection of sensor data that is digitally-recorded and geo-referenced should be limited primarily to cases where impracticable.
- The contractor is responsible for evacuations.

3.4.8 Task 4f, Evacuations: This is a Cost Plus Fixed Fee task.
Objective: Provide support for evacuation of residences displaced due to intrusive investigation exclusion zones.

Performance Standard: Support evacuation of residences in an efficient and timely manner so as not to cause delays in schedule and complaints from the residences.

AC: Necessary voluntary evacuations accomplished in a courteous and professional manner with no contract a fault delay to project schedule.

Measurement / Monitoring: Government monitoring of evacuations, receipt of complaints from the public, unsolicited commendations.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating.

Specific Task requirements: The Contractor shall provide printing services and distribution of door hangers for evacuation reminders. The Contractor shall provide logistics for Hospitality Area (HosA), transportation to the HosA and support evacuation requirements; food and drink. The Contractor shall arrange for kenneling as necessary. The Contractor shall provide additional services for evacuation, as required, by the District. The following shall be used for price of evacuation:
- Sleeping Rooms $77 at Government Per Diem

- Hospitality Suite	$175 plus taxes and gratuity per day of evacuations
- Food	$15 per person per day
- Transportation	$50 round trip per car load once per week of fieldwork
- Pet Boarding	$40 per pet per day

3.5 Task 5, Remedial Investigation (RI) Report:
Objective: Prepare, submit and gain acceptance of a RI report in accordance with EM CX Interim Guidance 06-04 and EPA Guidance.

Performance Standard: The RI report shall document the result of the RI and be in accordance with EP 1110-1-18, EM CX Interim Guidance 06-04 and EPA guidance.

AC: Acceptance of RI with two revisions.

Measurement / Monitoring: Review of RI against guidance to verify that the minimum acceptable content has been provided.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements:
- Prepare, submit and gain acceptance of a RI report in accordance with EP 1110-1-18 EM-CX Interim Guidance 06-04, and EPA guidance.
- Use EPA MEC Hazard Assessment, not Ordnance and Explosives Risk Impact Assessment.
- Incorporate all RI data and data from previous investigations, historical documents, PA/SI into this RI, to include areas where no actual field work was performed.
- Recommend changes in realignment of MRS dependent on RI findings.
- Prepare, as an appendix to this report, a new or update Munitions Response Site Prioritization Protocol (MRSPP) for each MRS dependent upon RI findings using the MRSPP worksheets, http://www.lab-data.com/MRSPP/ .

3.6 Task 6, Feasibility Study (FS) and Report: This task is a Firm Fixed Price task.

Objective: Conduct a feasibility study and prepare, submit and gain acceptance of a FS report in accordance with EM CX Interim Guidance 06-04.

Performance Standard: The FS report shall document the result of the feasibility study and be in accordance with EP 1110-1-18, EM CX Interim Guidance 06-04 and EPA guidance.

AC: Acceptance of FS with two revisions.

Measurement / Monitoring: Review of FS against guidance to verify that the minimum acceptable content has been provided.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: None.

3.7 Task 7, Proposed Plan: This task is a Firm Fixed Price task.

Objective: Prepare, submit and gain acceptance of a Proposed Plan (PP).

Performance Standard: Prepare the PP in accordance with CERCLA, ER 200-3-1, EP 1110-1-18, EM-CX Interim Guidance 06-04, and EPA 540-R-98-031.

AC: Acceptance of PP with two revisions.

Measurement / Monitoring: Review of PP against guidance to verify that the minimum acceptable content has been provided.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: After government & regulator review, the revised draft-final version of the Proposed Plan will be subject to a minimum 30-day public review. A public meeting shall be held to present the Proposed Plan to the public. This public meeting falls under Task 9, Community Relations Support.

3.8 Task 8, Decision Document: This task is a Firm Fixed Price task.

Objective: Prepare, submit and gain acceptance of a Decision Document (DD) for each MRS identified.

Performance Standard: Prepare the DDs in accordance with CERCLA, ER 200-3-1, EP 11101-1-18, Appendix C, and EPA 540-R-98-031.

AQL: Acceptance of DDs with two revisions.

Measurement / Monitoring: Review of DD against guidance to verify that the minimum acceptable content has been provided.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: PWS Appendix C provides new formatting requirements for the Decision Document. For formatting of Decision Documents, Attachment C supersedes MM CX Interim Guidance 06-04.

3.9 Task 9, Community Relations Support: This task is a Firm Fixed Price/Unit Price, task.
Objective: Successfully complete public meetings and support the Wilmington District with community relations.

Performance Standard: Contractor attends and participates in meetings. Meeting transcripts PP meeting are accurate. Meeting materials are accepted by the government as required.

AC: Acceptance of meeting materials with two revisions. Acceptance of PP meeting transcripts in one revision. Meetings held are organized; and professional in nature. Personnel are thoroughly familiar with the project. Zero letters of reprimand, grievances, or formal complaints

Measurement / Monitoring: Review of required materials for meetings. Government will attend and evaluate contractor's attendance, participation and professional demeanor.

Incentives/Disincentives: Satisfactory or greater CPARS rating/poor CPARS rating.

Specific Task Requirements: The Contractor shall attend and participate in Two (2) public meetings. These meetings are different and in addition to TPP meetings. These meetings will be held at a location in the vicinity of Camp Butner. The support shall include, but is not limited to: preparation and delivery of briefings, graphics, maps, posters, and support of question and answer sessions. The Contractor shall also obtain the meeting site, perform public notification and prepare any correspondence necessary to meeting the objectives of this task. The government shall approve all correspondence, public notices and all other materials prior to being presented/distributed to the public. These actions are independent of the field activities that involve interaction with the community. The meeting for the Proposed Plan shall be covered under this task. Transcripts of the public meeting for the Proposed Plan shall be prepared and submitted with the Final Proposed Plan.

3.10 Task 10, Public Involvement Plan (PIP): This task is a Firm Fixed Price task.
Objective: Update, submit and gain acceptance of a PIP in accordance with EP 1110-3-8, ER 200-3-1, EM-CX Interim Guidance 06-04, guidance provided in the FUDS Public Involvement Toolkit and DENIX website.

Performance Standard: Prepare the PIP in accordance with EP 1110-3-8, ER 200-3-1, EM-CX Interim Guidance 06-04, guidance provided in the FUDS Public Involvement Toolkit and DENIX website.

AQL: Acceptance of PIP with two revisions.

Measurement / Monitoring: Review of PIP against guidance to verify that the minimum acceptable content has been provided.

Incentive/Disincentive: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: This effort shall include, but is not limited to: preparation and delivery of stakeholder surveys, review and presentation of survey findings, completion of stakeholder interviews. The government shall approve all correspondence, survey content, and all other materials prior to being presented/distributed to the public. These actions are independent of the field activities that involve interaction with the community.

3.11 Task 11, Administrative Record: This task is a Firm Fixed Price task.
Objective: Establish and maintain the Administrative Record for each MRS throughout the period of performance of this Task Order.

Performance Standard**:** Prepare in accordance with the guidance in EP 1110-3-8, Chapter 4 (Establishing and Maintaining Administrative Records) and Standard Operating Procedure for Formerly Used Defense Sites (FUDS) Records Management, Revision 5, dated January 2008 (or most recent version).

AC: Administrative record will be evaluated against guidance for compliance with requirements, accuracy and completeness of the record, with up to one uncorrected deficiencies remaining during the period of performance.

Measurement / Monitoring: The government will visit, at least once, the administrative record's location and check for completeness and compliance with referenced EP; electronic submissions will be evaluated randomly upon receipt as data is entered into the record.

Incentive/Disincentive: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Specific Task Requirements: Secure a location such as a public library for a place to house the Administrative Record in the local city or community of each MRS. This task requires close coordination with the Wilmington District (CESAW) and USAESCH to secure all required documents to support the Administrative Record. Provide copies of all final documents posted to the Administrative Record on CD/DVD to USAESCH and CESAW, 2 copies each. These files shall be in pdf format suitable for placement on the PIRS web site.

3.12 Task 12, Environmental Sampling & Analysis: This task is a Firm Fixed Price/Unit Price task
Objective: Collect sufficient data that meets the project DQOs as defined during the TPP process, of known quality and quantity to determine the nature and extent of munitions constituents (MC) to support and perform a human health and ecological baseline risk assessment.

All subtasks **exclude** Army National Guard property with the exception of optional Task 12a.

3.12.1 Optional Task 12a, Army National Guard Property. Refer to historical project documentation of site location, historical information, and boundaries.

3.12.2 Optional Task 12b, Flame Thrower Range, FUDS Project No. I04NC00902-R02. Refer to historical project documentation of site location, historical information, and boundaries

3.12.3 Optional Task 12c, Hand Grenade Range, FUDS Project No. I04NC00902-R03. Refer to historical project documentation of site location, historical information, and boundaries. Based on data collected during the Engineering Evaluation/ Cost Analysis completed on R03 in March 2006 with no finds of MEC or MD, it is not expected that additional field work would be required for this MRS.

3.12.4 Task 12d, Range Complex 1, FUDS Project No. I04NC00902-R04. Refer to historical project documentation of site location, historical information, and boundaries.

3.12.5 Optional Task 12e, Range Complex 2, FUDS Project No. I04NC00902-R05. Refer to historical project documentation of site location, historical information, and boundaries.

Performance Standard: Perform field activities in accordance with the Work Plan and UFP-QAPP. MC analyses shall be performed in accordance with the requirements of the Department of Defense (DoD) Quality Assurance Manual (QAM), WERS-009.01 Munitions Constituents Chemical Data Quality Deliverables, and the approved project specific UFP-QAPP. The ecological and human health risk assessment shall be performed in accordance with the EPA Risk Assessment Guidance (RAGS) and USACE EM 200-1-4, Volumes I and II.

AC: Sampling field work and data meets established criteria within the accepted Uniform Federal UFP-QAPP, SAP, and Work Plan.

Measurement / Monitoring: Periodic inspection/review of field work, and data. Verify compliance with accepted WP, UFP-QAPP and ESP. Quality control tests/documentation submitted per the QASP for government review.

Incentive/Disincentive: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

Task Specific Requirements: The contractor shall propose on the sampling rationale, and methods that will be utilized to ensure that data generated are of an acceptable quality for its intended use, propose a **phased approach and address contaminants of interest and all sample media (soil/groundwater/sediment/surface water).**. The contractor shall also propose on the quantity, quality and the methods used to verify adherence to the PARCCS parameters for sample collection, handling, laboratory analysis, verification and validation. Any deviations from the accepted SAP shall be documented in the Daily Quality Control Reports (DQCR) and conveyed to USAESCH personnel immediately. The contractor will provide and price an independent laboratory to analyze QA samples separate from the contractor's primary laboratory.

4.0 Submittals.

Even though draft and draft final submittals are requested, the term "draft" shall not reflect upon the quality of the submittal being provided by the Contractor. Submittals shall include all supporting materials including supporting data whether electronic or hardcopy. Submittals not meeting the requirements of referenced guidance or Data Item Descriptions or missing supporting data may be rejected and revised by the contractor at the contractor's own expense.

4.1 The Contractor shall deliver the specified number of copies shown in Table 4.2 of each report listed in Table 4-1 to the following addressees (addresses to be verified by Contractor):

US Army Engineering & Support Center, Huntsville
Attn: CEHNC-CT-E (Lydia Tadesse)
PO Box 1600
Huntsville, AL 35807-4301
4820 University Square
Huntsville, AL 35816-1822

US Army Engineering & Support Center, Huntsville
Attn: CEHNC-OE-COR (Chris Cochrane)
PO Box 1600
Huntsville, AL 35807-4301
4820 University Square
Huntsville, AL 35816-1822

US Army Engineering & Support Center, Huntsville
Attn: CEHNC-OE-DC (Chris Cochrane)

PO Box 1600
Huntsville, AL 35807-4301
4820 University Square
Huntsville, AL 35816-1822

Commander
U.S. Army of Corps of Engineers, Wilmington District
Attn: CESAW-TS-EG (Ray Livermore)
69 Darlington Avenue
Wilmington, NC 28402-1890
Contractor to obtain and/or verify addresses.

4.2 Submittals and Due Dates.
The Contractor shall submit 1 copy of the entire submittal on a CD with each hard copy of a submittal (Reports, Plans, etc) in accordance with DID WERS-007.01. Hardcopies shall be printed on both sides of the paper whenever possible.

Table 4-1 List of Submittals

Submittal	**Due Date (Calendar Days)**
Meeting minutes for Kickoff phone conference	7 days after Kickoff phone conference
Proposed Schedule	7 days after kickoff conference call
Pre-TPP Meeting Materials	14 Days prior to TPP meetings
Conceptual Site Model (CSM)	With Pre-TPP materials
AAPP	7 days prior to site visit
Final TPP Memorandum	7 days after acceptance of comment responses
Draft TPP Memorandum Addendum	7 days after second TPP meeting
Final TPP Memorandum Addendum	7 days after acceptance of comment responses
Draft TPP Memorandum Addendum	7 days after third TPP meeting
Final TPP Memorandum Addendum	7 days after acceptance of comment responses
Draft Public Involvement Plan	TBD
Draft-Final Public Involvement Plan	14 days after acceptance of comment responses
Final Public Involvement Plan	7 days after acceptance of comment responses
Pre-Public Meeting Materials	14 Days prior to public meetings
Final Public Meeting Materials	no later than day of Meeting
Draft Work Plan/CSP and Draft QASP	21 days after acceptance of TPP memorandum
Draft Final Work Plan/CSP	14 days after acceptance of comment responses
Final Work Plan/CSP	14 days after receipt of comments and TPP meeting
Quality Control Documents	**As required by Regulation, guidance, DIDs, QCP, QASP, or agreed to in project schedule, to include the following**:
Daily QC Report for Environmental Sampling	Daily during Sampling Activities
Analytical Data Submittal for QA Evaluation	30-45 days after completion of fieldwork
Electronic Laboratory Data Submittal	45-60 days after completion of fieldwork
Draft RI Report	60-81 days after completion of field work
Draft Final RI Report	21 days after acceptance of comment responses
Final RI Report	14 days after acceptance of comment responses and TPP meeting
Draft FS Report	21 days after of acceptance of the RI Report
Draft Final FS Report	14 days after acceptance of comment responses
Final FS Report	14 days after on board Review
Draft Proposed Plan	14 days after of acceptance of the FS Report
Draft Final Proposed Plan	14 days after acceptance of comment responses
Final Proposed Plan	14 days after PP public meeting
PP Meeting Transcripts	with final Proposed Plan
Responsiveness Summary	with Decision Document Submittals
Draft Decision Document	14 days after acceptance of Proposed Plan
Draft Final Decision Document	7 days after acceptance of comment responses
Final Decision Document	7 days after acceptance of comment responses
Final Administrative Record (On CD/DVD)	upon completion of the Record

Final GIS Files on CD — End of Project

4.3 Submittal Quantities
Provide the number of submittals shown in Table 4-2 to the addressees given in Section 4.2. No draft documents shall be released to the regulatory community until reviewed by the government.

Table 4-2 Submittal Guidance

	Draft Documents	Draft Final/Final Documents
KO/COR	1 each	1 each
USAESCH	3	3
CESAW	2	3

4.4 Period of Performance: The Completion Date for this Task Order is 30 March 2014

5.0 Milestone Payments for firm fixed price tasks: Milestones will be considered met or completed when the required QC documentation has been submitted, QA completed and the submittal and/or product is accepted. Any payment vouchers submitted that do not coincide with the final accepted milestones or do not have the appropriate QC documentation will be rejected. All payments will be made utilizing an agreed upon Payment Milestone Schedule. The Contractor shall provide suggested milestones for payment. Milestones for payment shall be shown on the project schedule.

5.1 The following is a list of potential milestones for payment:
- Final Submittals: upon government acceptance, for example: Final WP
- Field Work: for defined units and activities completed and QA review and acceptance, for example: Final QC density data package.
- Meetings: after completion of meetings with government acceptance of meeting minutes, for example: Final PP meeting minutes.

6.0 REFERENCES:

6.1 Refer to "Base Contract."

6.2 Data Items Descriptions at the following website:
http://www.hnd.usace.army.mil/engr/WERS.aspx .

7.0 GENERAL CONDITIONS: See the Base Contract Section C, Section 10 General Conditions and the following addendums:

7.1 This is a performance based task order. The inclusion of unit prices in the proposal shall in no way be construed to mean that the Government is procuring a specified number of units of any given service.

7.2 Government acceptance of the proposed technical approach and/or price does not relieve the Contractor from full responsibility for the viability, productivity, and efficiency of the approach used to meet the performance requirements of the PWS at the price proposed. The task order is for the provision of services that ultimately meet the performance requirements of this task. If the contractor must adjust its technical approach or perform more field work than anticipated in order to achieve the proposed performance goal then the contractor will do so with no change in task order price.

7.3 If the Government at its sole discretion chooses to modify the performance standard the parties to this task order will assess the impact on the estimated amount of field work required to achieve the new performance standards and will negotiate a price adjustment based upon the unit prices providing as price proposal supporting documentation (See Attachment D).

7.4 The Contractor attests that it applied due diligence in the research and development of its proposal has priced reasonable estimates of the site conditions and the associated risks into the price. The Contractor accepts full and sole responsibility for identifying and considering all factors that may affect the cost to execute the work. The act of signing this task order signifies that the Contractor has been given ample opportunity to assess the conditions under which the work will be performed and the Contractor either fully understands those conditions or has factored the risk into the price.

7.5 The Government provided the Contractor with historical documents and documents from previous site activities. The Contractor attests it interpreted the data utilizing an experienced understanding of how the data of this type is collected, analyzed, interpreted, and presented.

8.0 ARMY CONTRACTOR MANPOWER REPORTING

8.1 Implementation.

8.1.1 The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains a secure Army data collection site where the contractor will report contractor manpower information (including subcontractor manpower information) required for performance of this contract. The contractor shall submit all the information required in the format specified at the following web address: **https://cmra.army.mil/default.aspx**

8.1.2 The Contractors shall fill in the required information on the website, fields are shown below:

- Contract Number
- Delivery Order Number (if applicable)
- Task Order Number (if applicable)
- Requiring Activity Unit Identification Code (UIC)
- Command
- Contractor Contact Information
- Federal Service Code (FSC)
- Direct Labor Hours
- Direct Labor Dollars
- Location Information (where contractor and subcontractors (if applicable) performed the services

8.1.3 Reporting period will be the period of performance not to exceed 12 months ending September 30 of each government fiscal year and must be reported by 15 October of each calendar year.

8.1.4 If your particular contract crosses fiscal years, 2 entries must be made to capture the data for the contract period; for example if the contract start date is 1 January 2007 and ends 31 December 2007, the data for the period from 1 January 2007 through 30 September 2007 shall be entered not later than 15 October 2007 and the period 1 October 2007 through 31 December 2007 shall be entered not later than 15 January 2008.

Attachment A

Performance Requirements Summary:

A.1 The Contractor shall meet the following performance requirements. Performance requirements are addressed in each task and summarized in the following Performance Requirements Summary. If discrepancies or ambiguity exists between the documents, the order of precedence is 1) the Task; 2) Performance Requirements Summary; 3) Performance Metrics

Table A-1 Performance Requirements Summary

Task Application	Objective	Performance Standard	Minimum Acceptable Criteria	Measurement / Monitoring	Incentive/ Disincentive
1	Implement the four-phase TPP process in accordance with EM 200-1-2, EM 1110-1-4009 and applicable Interim Guidance Documents.	Achieve the objectives of each TPP phase as listed in EM 200-1-2, EM 1110-1-4009 and applicable Interim Guidance Documents. Facilitate meetings in a professional and organized manner.	Acceptance of TPP documents (meeting presentations, agenda, handouts, CSM and memorandums) with up to one (1) revision. Meetings held are organized; accomplish requirements of the TPP process; and professional in nature. Zero letters of reprimand, grievances, or formal complaints.	TPP checklist for each phase as provided in the guidance will be used to measure and document successful progress; guidance cited will be used to evaluate content of documents for acceptance / non-acceptance. Government will attend and evaluate organization and facilitation of the meetings, and professional nature of the meetings.	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.
2	Prepare, submit and gain acceptance of a WP, munitions constituent (MC) UFP-QAPP and QASP that are detailed and comprehensive plans covering all aspects of site characterization, risk assessment and methodology, and project execution. UFP-QAPP applies only to environmental	Prepare the WP in accordance with DID WERS-001 and EM 1110-1-4009, EM 385-1-1, EM 385-1-97. Prepare the sampling and analysis plan, field sampling, and UFP-QAPP in accordance with EM 1110-1-4009, DID WERS-009.01, and UFP-QAPP, as appropriate. Prepare a risk assessment work plan incorporating implementation of the risk assessment and methodologies per EPA Risk	Acceptance of WP and UFP-QAPP with two revisions. Draft QASP reflects requirements and QCP with one revision required.	Review of WP, UFP-QAPP and QASP per guidance to verify that the minimum acceptable content has been provided.	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

	sampling.	Assessment Guidance (RAGS) and USACE EM 200-1-4, Volumes I and II, as appropriate. UFP-QAPP content shall also meet the requirements of DoD Quality Systems Manual for Environmental Laboratories (current version). Draft QASP includes requirements in regulations, guidance, DIDs and the Quality Control Plan in the WP.			
3	Utilize GIS in the development of the Conceptual Site Model (CSM) and maintain and manage all project and geospatial data.	Manage and maintain project data, and develop CSM in GIS IAW DID WERS-007.01, EM 200-1-2, EM 1110-1-4009 and applicable Interim Guidance Documents.	Acceptance of CSM and GeoSpatial Data submissions meets quality and formatting requirements.	Review by Government using guidance cited to determine acceptability.	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.
4 (a-e)	Conduct a remedial investigation in accordance with CERCLA, characterizing the nature and extent of MEC contamination at the required munitions response sites (MRS) meeting the project DQOs as defined during the TPP process. This task shall include all field activities necessary to execute this task except MC sampling. MC sampling requirements are covered	Field work, data quantity and quality, and analysis of said data (does not include area where Rights-of-entry were not obtained) provides the following results in the RI report: - Demonstrate that the work was performed in accordance with the applicable laws, regulations, and guidance documents; - Demonstrate that all areas with elevated anomaly density or with potential to contain MEC will have been traversed at the completion of fieldwork and that there is a 90% chance of detecting these areas;	Conduct the RI in accordance with the accepted/approved WP, UFP-QAPP, and ESP. QC data submitted meets requirement described in DID WERS-004.01. - No more than 3 CARs/948s for non-critical violations and/or 1 CAR/948 for critical violation. No unresolved Corrective action requests. - All final data and QC tests/documentation submitted. Government QA acceptance of QC tests/documentation gained. - No Class "A" Safety accidents, contractor at fault; <1 non-explosive Class	Period inspection/review of field work. Verify compliance with accepted WP, UFP-QAPP. Quality control tests/documentation submitted per the QASP for government review. Additionally, statistical confidence will be calculated using the Visual Sampling Plan software, UXO Estimator or other approved statistical method. Boundary precision will be determined by evaluation of the sampling footprint as it relates to the	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

	under Task 12, Environmental Sampling & Analysis.	- Demonstrate with at least 90% confidence that areas classified as MEC-contaminated have greater than or equal to .1 when significant intrusive activities occur, .5 when use is moderate and 1 when little or no intrusive activities occur UXO per acre. - Demonstrate that the boundaries of all identified MEC contaminated areas have been delineated to an accuracy of at least +/- half the transect spacing, maximum 250 feet, and demonstrate that a 90% confidence has been achieved for bounding the potential depth of MEC. - Demonstrate that a 90% confidence in the nature (type and density) of MEC and MEC related debris, for each relatively homogeneous MEC contaminated area, has been achieved. - Demonstrate that data inputs from the RI into the FS will enable remediation cost estimates with an accuracy of +50%/-30%. The work and reporting shall address the surface and sub-surface metallic anomaly density distribution (anomaly/acre) across identified MEC contaminated areas and other remediation cost drivers such as vegetation type and density, terrain	C accidents; and <2 non-explosive related Class D accidents, IAW AR 385-40. - Major safety violations, no more than 1 non-explosive related safety violation. - Minor safety violations, no more than 2 safety violations. - Zero letters of reprimand, grievances, or formal complaints.	reported contaminated/uncontaminated areas in question. Anomaly density profile and other remediation cost driver precision will be verified by QA of methods used.	

		conditions, soil type, exclusion zone evacuation costs, etc each to a level of accuracy within the range specified herein. Additionally: - Perform the RI field activities in accordance with the accepted Work Plan and UFP-QAPP. - Proper processing and disposition of UXO, DMM and MC encountered in accordance with approved plan(s). - All Material Potentially Presenting an Explosive Hazard (MPPEH) and munitions debris processed in accordance with Chapter 14, EM 1110-1-4009 and Errata Sheet No. 2. - Meet the project DQOs as defined by the TPP process. - All geophysics shall be IAW geophysics DID. For this task order 1 acre of transects equals 14,520 lf (2.75 miles) of transects 3 feet wide. One acre's worth of grids equals seventeen (17) 2500 sf grids or four (4) 10,000 sf grids.			
4f	Provide support for evacuation of residences displaced due to intrusive investigation exclusion zones.	Support evacuation of residences in an efficient and timely manner so as not to cause delays in schedule and complaints from the residences.	Necessary voluntary evacuations accomplished in a courteous and professional manner with no contract a fault delay to project schedule.	Government monitoring of evacuations, receipt of complaints from the public, unsolicited commendations.	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.
5	Prepare, submit and gain	The RI report shall document the result	Acceptance of RI with two revisions.	Review of RI against guidance	Satisfactory or greater CPARS

	acceptance of a RI report in accordance with EM CX Interim Guidance 06-04 and EPA Guidance.	of the RI and be in accordance with EP 1110-1-18, EM CX Interim Guidance 06-04 and EPA guidance.		to verify that the minimum acceptable content has been provided.	rating/poor CPARS rating and/or re-performance of work at contractor's expense
6	Conduct a feasibility study and prepare, submit and gain acceptance of a FS report in accordance with EM CX Interim Guidance 06-04.	The FS report shall document the result of the feasibility study and be in accordance with EP 1110-1-18, EM CX Interim Guidance 06-04 and EPA guidance.	Acceptance of FS with two revisions.	Review of FS against guidance to verify that the minimum acceptable content has been provided.	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.
7	Prepare, submit and gain acceptance of a Proposed Plan (PP).	Prepare the PP in accordance with CERCLA, ER 200-3-1, EP 1110-1-18, EM-CX Interim Guidance 06-04, and EPA 540-R-98-031.	Acceptance of PP with two revisions.	Review of PP against guidance to verify that the minimum acceptable content has been provided.	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.
8	Prepare, submit and gain acceptance of a Decision Document (DD) for each MRS identified.	Prepare the DDs in accordance with CERCLA, ER 200-3-1, EP 11101-1-18, Appendix C, and EPA 540-R-98-031.	Acceptance of DDs with two revisions.	Review of DD against guidance to verify that the minimum acceptable content has been provided.	Satisfactory or greater CPARS rating/poor CPARS rating.
9	Successfully complete public meetings and support the Wilmington District with community relations.	Contractor attends and participates in meetings. Meeting transcripts PP meeting are accurate. Meeting materials are accepted by the government as required.	Acceptance of meeting materials with two revisions. Acceptance of PP meeting transcripts in one revision. Meetings held are organized; and professional in nature. Personnel are thoroughly familiar with the project. Zero letters of reprimand, grievances, or formal complaints	Review of required materials for meetings. Government will attend and evaluate contractor's attendance, participation and professional demeanor.	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.
10	Update, submit and gain acceptance of a	Prepare the PIP in accordance with EP 1110-3-8, ER 200-3-	Acceptance of PIP with two revisions.	Review of PIP against guidance to verify that the	Task specific Incentives/Disincentives: Satisfactory

	PIP in accordance with EP 1110-3-8, ER 200-3-1, EM-CX Interim Guidance 06-04, guidance provided in the FUDS Public Involvement Toolkit and DENIX website.	1, EM-CX Interim Guidance 06-04, guidance provided in the FUDS Public Involvement Toolkit and DENIX website.		minimum acceptable content has been provided.	or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.
11	Establish and maintain the Administrative Record for each MRS throughout the period of performance of this Task Order.	Prepare in accordance with the guidance in EP 1110-3-8, Chapter 4 (Establishing and Maintaining Administrative Records) and Standard Operating Procedure for Formerly Used Defense Sites (FUDS) Records Management, Revision 5, dated January 2008 (or most recent version).	Administrative record will be evaluated against guidance for compliance with requirements, accuracy and completeness of the record, with up to one uncorrected deficiencies remaining during the period of performance.	The government will visit, at least once, the administrative record's location and check for completeness and compliance with referenced EP; electronic submissions will be evaluated randomly upon receipt as data is entered into the record.	Incentive/Disincentive: Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.
12	Collect sufficient data that meets the project DQOs as defined during the TPP process, of known quality and quantity to determine the nature and extent of munitions constituents (MC) to support and perform a human health and ecological baseline risk assessment.	Perform field activities in accordance with the Work Plan and UFP-QAPP. MC analyses shall be performed in accordance with the requirements of the Department of Defense (DoD) Quality Assurance Manual (QAM), WERS-009.01 Munitions Constituents Chemical Data Quality Deliverables, and the approved project specific UFP-QAPP. The ecological and human health risk assessment shall be performed in accordance with the	Sampling field work and data meets established criteria within the accepted Uniform Federal UFP-QAPP, SAP, and Work Plan.	Periodic inspection/review of field work, and data. Verify compliance with accepted WP, UFP-QAPP and ESP. Quality control tests/documentation submitted per the QASP for government review.	Satisfactory or greater CPARS rating/poor CPARS rating and/or re-performance of work at contractor's expense.

		EPA Risk Assessment Guidance (RAGS) and USACE EM 200-1-4, Volumes I and II.			

Attachment B
PERFORMANCE METRICS

B.1 Performance Metrics for Performance Assessment Record (PAR)

	Exceptional	Very Good	Satisfactory	Marginal	Unsatisfactory
PAR Category: Quality of Product or Service					
Performance indicator: Document reviews					
Draft Plans, Reports, and documents [Plans, documents and reports are considered draft until accepted as final by the Government]	All contract-milestone documents accepted as submitted	No substantive comments (i.e. limited to grammar, spelling, terminology) to any of the documents, but a few exceptions were noted and corrected	Contractor met Acceptance Criteria	One or more documents required revisions to be resubmitted for approval prior to proceeding. Two backchecks were required on one or more documents before original comments were resolved satisfactorily.	One or more documents did not comply with contract requirements, or one or more documents required more than two backchecks before original comments were resolved satisfactorily, or more than one document was rejected.
Performance indicator: Project Execution					
Process Compliance	Zero Corrective Action Requests (CAR) or 948s	1-2 CARs/948s for non-critical violations to WP requirements	Contractor met Acceptance Criteria	5-6 CARs/948s for non-critical violations and/or 2 CARs/948 for critical violations	>6 CARS for non-critical violations and/or {>2} CARs/948s for critical violations, or any unresolved CARs
Project Execution	Zero letters of reprimand, grievances, or formal complaints AND one or more unsolicited letters of commendation		Contractor met Acceptance Criteria	One letter of reprimand, grievance or formal complaint that was resolved through negotiation	More than one letter of reprimand, grievance or formal complaint that were resolved through negotiation
Task Completion			Contractor met Acceptance Criteria		Final data and QC documentation submitted but not accepted
PAR Category: Schedule					
Performance indicator: Timely completion of tasks					
Final Plans and Reports, project milestones, T.O. invoices	All document submittals and task order milestones and invoices	Project closed out/final invoice accepted ahead of schedule	Project closed out/final invoice accepted on T.O. date	Project closed out/final invoice accepted within 30 calendar days after T.O. date.	Project closed out/final invoice accepted more than 30

	Exceptional	Very Good	Satisfactory	Marginal	Unsatisfactory
	complete and accepted by T.O date, project closed out/final invoice approved ahead of schedule				calendar days after T.O. date.
Project status reports accurate			Yes		No
Performance indicator: Impacts to schedule					
Impacts caused by Contractor or other causes identified, in writing to HNC CO/ PM, in a timely manner to apply acceptable corrective actions.			Yes		No
PAR Category: Cost Control (Not Applicable for Firm Fixed Price)					
Performance indicator: No unauthorized cost overruns					
Unauthorized cost overruns			No		Yes
Total Project Costs	Total contract invoices less than 98% of T.O. authorized amount	Total contract invoices greater than 98% but less than 99.99%of T.O. authorized amount	Total contract invoices between 99.99% and 100% of T.O. authorized amount	Total contract invoices greater than 100% but less than 105% of T.O. authorized amount	Total contract invoices greater than or equal to 105% of T.O. authorized amount
Performance indicator: Monthly cost report					
Monthly cost reports accurate			Yes		No
Performance indicator: Impacts to cost					
Impacts caused by Contractor or other causes identified, in writing to HNC CO/PM, in a timely manner to apply acceptable corrective actions.			Yes		No
PAR Category: Business Relations					
Performance indicator: Met contractual obligations					
Corrective Actions taken were timely and effective (Refer to CARs issued to Contractor)			Yes		No
Performance indicator: Professional and Ethical Conduct					
Meetings and correspondences	Zero letters of reprimand,		Contractor met Acceptance	One letter of reprimand,	More than one letter of

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	Exceptional	**Very Good**	**Satisfactory**	**Marginal**	**Unsatisfactory**
with Public, project delivery team and other stakeholders	grievances, or formal complaints AND one or more unsolicited letters of commendation		Criteria	grievance or formal complaint that was resolved through negotiation	reprimand, grievance or formal complaint that were resolved through negotiation OR removal of one or more project personnel as a results of a letter of reprimand, grievance or formal complaint.
Performance indicator: Customer has overall satisfaction with work performed					
Customer survey results for rating period	4.0-5.0	3.0-3.9	2.0-2.9	1.0-1.9	<1.0
Performance indicator: Personnel responsive and cooperative					
Key personnel responsive, and cooperative	Always		Most Times		Almost Never
PAR Category: Management of Key Personnel and Resources					
Performance indicator: Personnel knowledgeable and effective in their areas of responsibility					
Personnel assigned to tasks	All personnel proposed by Contractor were assigned to project, some personnel were substituted by higher qualified individuals.		All personnel proposed by Contractor were assigned to project, some personnel were substituted by equally qualified individuals.	All personnel proposed by Contractor were assigned to project, some personnel were substituted by equally qualified individuals, Letter of reprimand received for personnel conduct from HNC.	All personnel proposed by Contractor were assigned to project, some personnel were substituted by lesser qualified individuals or HNC requested, in writing, removal of assigned personnel for poor performance.
Performance indicator: Personnel able to manage resources efficiently					
Instances when resource management had negative impact on project execution	0	1-2	3-4	5-6	>6
PAR Category: Safety					
Performance indicator: Accidents and Violations					
*No Class A Accidents, Contractor at fault	0 No class A accidents IAW AR 385-10	No class A accidents IAW AR 385-10	Contractor met Acceptance Criteria	<2 non-explosive related Class C accidents, or 1 non-explosive Class B accident,	1 Any Class A accident IAW AR-385-10, or Any explosive

	Exceptional	Very Good	Satisfactory	Marginal	Unsatisfactory
				IAW AR 385-10	related accident.
*Major safety violations	0 accidents/injuries No safety violations	0 accidents/injuries No safety violations		2 non-explosive safety violations.	>1 any violation of procedures for handling, storage, transportation, or use of explosives IAW the WP, and all Federal, State and local laws/ordinances.
*Minor safety violations	No safety violations	1 safety violation		3 safety violations	>3 safety violations

Classes of Accidents:

- **Class A:** Fatality or permanent total disability (Government Civilian, Military Personnel, and/or Contractor), or >$2,000,000 property damage.

- **Class B:** Permanent partial disability or impatient hospitalization of 3 or more persons (Government Civilian, Military Personnel, and/or Contractor), $500,000< $2,000,000 property damage.

- **Class C:** Lost Workday (Contractor) or Lost Time (Government Civilians), $50,000< $500,000 property damage.

- **Class D:** $2000 < $50,000 property damage.

* From Section C of Solicitation Number W912DY-08-R-0016, Amendment 0007 (may be included but are not limited to these).

The following guidelines are provided for issuing ratings that are subjective in nature, these ratings will be supported by the weight of evidence documented during the government's surveillance efforts:

<u>Exceptional:</u> Performance *meets* contractual requirements and *exceeds many* to the Government's benefit. The contractual performance of the element or sub-element being assessed was accomplished with *few minor problems* for which corrective actions taken by the Contractor were *highly effective.*

<u>Very Good:</u> Performance *meets* contractual requirements and *exceeds some* to the Government's benefit. The contractual performance of the element or sub-element being assessed was accomplished with *some minor problems* for which corrective actions taken by the Contractor were *effective.*

<u>Satisfactory:</u> Performance *meets* contractual requirements. The contractual performance of the element or sub-element contains *some minor problems* for which corrective actions taken by the Contractor *appear or were satisfactory.*

<u>Marginal:</u> Performance *does not meet all* contractual requirements. The contractual performance of the element or sub-element being assessed reflects a *serious problem* for which the Contractor has *not yet identified corrective actions.* The Contractor's proposed actions appear only *marginally effective or were not fully implemented.*

Unsatisfactory: Performance *does not meet most* contractual requirements and *recovery is not likely* in a timely manner. The contractual performance of the element or sub-element contains *serious problems* for which the Contractor's corrective actions *appear or were ineffective*

Attachment C

1. REQUIREMENTS AND PROCEDURES:

a. This interim guidance provides specific requirements for MMRP Decision Documents.

b. Format and content of ALL MMRP decision documents and action memoranda, regardless of signature authority shall be in accordance with Section 2. Each document will contain:

(1) A title page,

(2) A table of contents,

(3) List of acronyms,

(4) Page numbers on each page indicating page number and total number of pages in the document, e.g., "1 of 25".

(5) Header in the upper right-hand corner of each page including; document type ("Decision Document", "Time Critical Removal Actions (TCRA) Action Memorandum", or "Non-time Critical Removal Action (TCRA) Action Memorandum"), project name ("Sitka Naval Operating Base"), project location ("Sitka, Alaska"), and project number to include MRS number.

c. All decision documents or action memoranda, regardless of level of signature authority, will be accompanied by an Executive Summary that for Headquarters (HQ). USACE will forward to ACSIM-ISE and DASA (ESOH). The Executive Summary shall be kept to a single page, whenever possible, and will include:

(1) Title, including project name and project number, date DD (or AM) was signed and by whom,

(2) Brief description of the Munitions Response Sites (MRS), covered by the decision,

(3) Brief description of selected response action and its relationship to other cleanup actions,

(4) Degree of risk reduction,

(5) Present worth cost of selected response action, and the contribution to the cost-to-complete of all remedies for the FUDS Property,

(6) Amounts and fiscal year(s) that funds are required for remedial/removal action design and construction,

(7) Duration of any remedial action-operation (RA-O), removal action construction (RmA-C) and/or Long Term Monitoring (LTM) actions,

(8) Land use controls (LUC) required and means of maintaining them,

(9) Other potential response actions considered, and

(10) Expected result of the action.

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2.0 CONTENT

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Remedial Action Decision Document Outline

PART 1: THE DECLARATION

The Declaration functions as the abstract and formal authorizing signature page for the DD.

1. PROJECT NAME AND LOCATION.
2. STATEMENT OF BASIS AND PURPOSE.
   Certify the factual and legal basis for the Selected Remedy.
3. ASSESSMENT OF PROJECT MRS.
   Certify that the MRS poses a threat to public health, welfare, or the environment.
4. DESCRIPTION OF SELECTED REMEDY.
   a. Describe the major components of the Selected Remedy in a bullet fashion.

   b. Describe the scope and role of this MRS.

   c. Describe how this remedial action addresses principal threats and other contamination at the MRS (i.e., what is being treated, what is being contained, and what is the rationale for each).
5. STATUTORY DETERMINATIONS.
   a. Describe how the Selected Remedy satisfies the statutory requirements of CERCLA §121 and discuss the applicability of the 5-year review requirements.
6. DATA CERTIFICATION CHECKLIST.
   The Declaration should certify that the following information is included in the DD (or provide a brief explanation for why this information is not included):

   a. Munitions and Explosives of Concern (MEC) and munitions constituents (MC) and their respective concentrations.

   b. Baseline risk represented by the MEC/MCs.

   c. Cleanup levels established for MEC/MCs and the basis for these levels.

   d. How MEC and MC will be addressed.

   e. Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and DD.

   f. Potential land and groundwater use that will be available at the MRS as a result of the Selected Remedy.

   g. Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected.

   h. Key factor(s) that led to selecting the remedy (i.e., describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision).
7. AUTHORIZING SIGNATURE.
   The following general paragraph and signature block. (*Note: Signature block may not appear alone on a page – it must be on the same page with the preceding paragraph*):

   "This Decision Document presents the selected response action at [place]. The U.S. Army Corps of Engineers is the lead agency under the Defense Environmental Restoration Program (DERP) at the [FUDS property name] Formerly Used Defense Site, and has developed this Decision Document consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and the National Oil and

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Hazardous Substances Pollution Contingency Plan (NCP). This decision document will be incorporated into the larger Administrative Record file for [FUDS property name], which is available for public view at [address]. This document, presenting a selected remedy with a present worth cost estimate of [$$], is approved by the undersigned, pursuant to Memorandum, DAIM-ZA, September 9, 2003, subject: Policies for Staffing and Approving Decision Documents (DDs), and to Engineer Regulation 200-3-1, Formerly Used Defense Sites (FUDS) Program Policy."

APPROVED:

(insert individual's signature block here) Date________________________

For present worth cost estimate of $2M or less:
District Commander" Signature Block

For present worth cost estimate of more than $2M and less than or equal to $10M:
HQUSACE signature block for:
Chief, Department of Defense
Support Team
Directorate of Military Programs

For present worth cost estimate of more than $10M:
Signature block for ACSIM or DASA(ESOH) or both

PART 2: THE DECISION SUMMARY

The Decision Summary identifies the Selected Remedy, explains how the remedy fulfills statutory and regulatory requirements, and provides a substantive summary of the Administrative Record file that supports the remedy selection decision.

1. PROJECT NAME, LOCATION, AND BRIEF DESCRIPTION.
   a. Name and location.

   b. FUDS Project Number.

   c. Lead and support agencies (e.g., DoD, State, Tribes).

   d. Source of cleanup monies (e.g., ER-FUDS, ER-Army, ER-BRAC).

   e. Brief MRS description.

2. PROJECT HISTORY AND ENFORCEMENT ACTIVITIES.
   a. History of MRS activities that led to the current problems.

   b. History of federal, state, and local MRS investigations and removal and remedial actions conducted under CERCLA or other authorities.

   c. History of CERCLA enforcement activities at the MRS (e.g., results of PRP searches, issuances of special notices to PRPs).

3. COMMUNITY PARTICIPATION.
   a. Describe how the public participation requirements in CERCLA and the NCP were met in the remedy selection process (e.g., community relations plans, fact sheets, public notices, public meetings, public Restoration Advisory Board).

   b. Describe other community outreach and involvement efforts.

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c. Describe efforts to solicit views on the reasonably anticipated future land uses and potential future land uses.

4. SCOPE AND ROLE OF RESPONSE ACTION.
   a. The planned sequence of actions.

   b. The scope of problems those actions will address.

   c. The authorities under which each action will be/has been implemented (e.g., removal, remedial).

5. PROJECT MRS CHARACTERISTICS: (Include maps, a site plan, or other graphical presentations, as appropriate.)

   a. Describe the conceptual site model (CSM) on which the risk assessment and response action are based.

   b. Provide an overview of the MRS, including the following:

      (1) Size of MRS (e.g., acres).

      (2) Geographical and topographical information (e.g., surface waters, flood plains, wetlands).

      (3) Surface and subsurface features (e.g., number and volume of tanks, lagoons, structures, and drums on-site).

      (4) Areas of archaeological or historical importance.

   c. Describe the sampling strategy (e.g., which media were investigated, what sampling approach was used, over what area, when was the sampling performed).

   d. Describe known or suspected sources of contamination.

   e. Describe types of contamination and the affected media, including the following:

      (1) Types and characteristics of MEC/MCs (e.g., toxic, mobile, carcinogenic, non-carcinogenic).

      (2) Quantity/volume of MEC/MC that needs to be addressed.

      (3) Concentrations of MEC/MCs in each medium.

      (4) RCRA hazardous wastes and affected media.

   f. Describe location of contamination and known or potential routes of migration, including the following:

      (1) Lateral and vertical extent of contamination.

      (2) Current and potential future surface and subsurface routes of human or environmental exposure.

      (3) Likelihood for migration of MEC/MCs from current location or to other media.

      (4) Human and ecological populations that could be affected.

   g. For MRSs with groundwater contamination, describe the following:

      (1) Aquifer(s) affected or threatened by site contamination, types of geologic materials, approximate depths, whether aquifer is confined or unconfined.

      (2) Groundwater flow directions within each aquifer and between aquifers and groundwater discharge locations (e.g., surface waters, wetlands, other aquifers).

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(3) Interconnection between surface contamination (e.g., soils, sediments/surface water) and groundwater contamination.

(4) Confirmed or suspected presence and location of non-aqueous phase liquids.

(5) If groundwater models were used to define the fate and transport of MEC/MC, identify the model used and major model assumptions.

h. Note other site-specific factors that may affect response actions at the MRS.

6. CURRENT AND POTENTIAL FUTURE LAND AND WATER USES.

a. Land Uses.

(1) Current on-site land uses.

(2) Current adjacent/surrounding land uses.

(3) Reasonably Anticipated Future Land Uses and Basis for Future Use Assumptions (e.g., zoning maps, nearby development, 20-year development plans, dialogue with local land use planning officials and citizens, reuse assessment).

b. Groundwater and Surface Water Uses.

(1) Current groundwater and surface water uses.

(2) Potential beneficial groundwater and surface water uses (e.g. potential drinking water, irrigation) and basis for future use assumptions (e.g., Comprehensive State Groundwater Protection Plan, promulgated state classification guidelines).

(3) If beneficial use is potential drinking water source, identify the approximate time frame of projected future drinking water use (e.g., groundwater aquifer not currently used as a drinking water source but expected to be utilized in 30 to 50 years).

(4) Location of anticipated use in relation to location and anticipated migration of contamination.

7. SUMMARY OF PROJECT MRS RISKS.

a. Human Health Risks.

(1) Identify the concentrations of MEC/MC in each medium.

(2) Summarize the results of the exposure assessment.

(3) Summarize the results of the toxicity assessment for the MEC/MC.

(4) Summarize the risk characterization for both current and potential future land use scenarios and identify major assumptions and sources of uncertainty.

b. Ecological Risks.

(1) Identify the concentrations of MEC/MC in each medium.

(2) Summarize the results of the exposure assessment.

(3) Summarize the results of the ecological effects assessment.

(4) Summarize the results of the ecological risk characterization and identify major assumptions and sources of uncertainty.

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c. Basis for Response Action.

(1) Clearly Present the Basis for Taking the Response Action at the Conclusion of this Section.

8. REMEDIAL ACTION OBJECTIVES.

a. Present a clear statement of the specific RAOs for the MRS (e.g., treatment of contaminated soils above health-based action levels, restoration of groundwater plume to drinking water levels, and containment of DNAPL source areas) and reference a list or table of the individual performance standards.

b. Discuss the basis and rationale for RAOs (e.g., current and reasonably anticipated future land use and potential beneficial groundwater use).

c. Explain how the RAOs address risks identified in the risk assessment (e.g., how will the risks driving the need for action be addressed by the response action?).

9. DESCRIPTION OF ALTERNATIVES: The objective of this section is to provide a brief understanding of the remedial alternatives developed for the MRS.

a. Remedy Components. Provide a bulleted list of the major components of each alternative, including but not limited to:

(1) Treatment technologies and the materials they will be used to address (e.g., principal threats).
(2) Containment components of remedy (e.g., engineering controls, cap, hydraulic barriers) and the materials they will be used to address (e.g., low concentration source materials, treatment residuals).

(3) Land use controls (and entity responsible for implementing and maintaining them).

(4) Operations and maintenance (O&M) activities required to maintain the integrity of the remedy (e.g., cap maintenance).

(5) Monitoring requirements.

b. Common Elements and Distinguishing Features of Each Alternative. Describe common elements and distinguishing features unique to each response option. Examples of these elements include:

(1) Key ARARs (or ARAR waivers) associated with each alternative (e.g., action- and/or location-specific groundwater treatment units, manifesting of hazardous waste, and regulating solid waste landfills).

(2) Long-term reliability of remedy (potential for remedy failure/replacement costs).

(3) Quantity of untreated MEC/MC to be disposed off-site or managed on-site in a containment system and degree of residual contamination remaining in such waste.

(4) Estimated time required for design and construction (i.e., implementation time frame).

(5) Estimated time to reach cleanup levels (i.e., time of operation, period of performance).

(6) Estimated capital, annual O&M, and total present worth costs, discount rate, and the number of years over which the remedy cost estimate is projected.

(7) Describe uses of presumptive remedies and/or innovative technologies.

c. Expected Outcomes of Each Alternative.

(1) Available land uses upon achieving performance standards. Note time frame to achieve performance standards (e.g., commercial or light industrial use available in 3 years when cleanup levels are achieved).

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(2) Available groundwater uses upon achieving performance standards. Note time frame to achieve performance standards (e.g., restricted use for industrial purposes in technical impracticability [TI] waiver zone, drinking water use in non-TI zone upon achieving cleanup levels in 50 to 70 years).

(3) Other impacts or benefits associated with each alternative.

10. COMPARATIVE ANALYSIS OF ALTERNATIVES. Compare the relative performance of each alternative against the others with respect to the nine evaluation criteria (summarize in a table if appropriate).

11. PRINICIPAL MEC/MC ISSUES. Identify the MEC/MC issues at the MRS and discuss how the alternatives will address them.

Note: The *Statutory Determinations* section of the DD should explain whether or not the Selected Remedy satisfies the statutory preference for remedies employing treatment that reduces toxicity, mobility, or volume as a principal element. By indicating whether the principal threats will be addressed by the alternatives, this section of the *Decision Summary* should provide the basis for that statutory determination.

12. SELECTED REMEDY.

a. Summary of the Rationale for the Selected Remedy.

(1) Provide a concise discussion of the key factors for remedy selection.

b. Detailed Description of the Selected Remedy.

(1) Expand on the Description of the Selected Remedy from that which was provided in the Description of Alternatives section and provide a brief overview of the RAOs and performance standards.

c. Cost Estimate for the Selected Remedy.

(1) Present a detailed, activity-based breakdown of the estimated costs associated with implementing and maintaining the remedy (include estimated capital, annual O&M, and total present worth costs discount rate and the number of years over which the remedy cost estimate is projected).

d. Estimated Outcomes of Selected Remedy.

(1) Available land use(s) upon achieving cleanup levels. Note time frame to achieve available use (e.g., commercial or light industrial use available in 3 years when cleanup levels are achieved).

(2) Available groundwater use(s) upon achieving cleanup levels. Note time frame to achieve available use (e.g., restricted use for industrial purposes in TI waiver zone, drinking water use in non-TI zone upon achieving cleanup levels in 50 to 70 years).

(3) Final cleanup levels for each medium (i.e., contaminant-specific cleanup levels), basis for cleanup levels, and risk at cleanup levels (if appropriate).

(4) Anticipated socioeconomic and community revitalization impacts (e.g., increased property values, reduced water supply costs, jobs created, increased tax revenues due to redevelopment, environmental justice concerns addressed, enhanced human uses of ecological resources).

(5) Anticipated environmental and ecological benefits (e.g., restoration of sensitive ecosystems, protection of endangered species, protection of wildlife populations, wetlands restoration).

13. STATUTORY DETERMINATIONS.

a. Explain how the remedy satisfies the requirements of §121 of CERCLA to:

(1) Protect human health and the environment.

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(2) Comply with ARARs, or justify a waiver.

(3) Be cost-effective.

(4) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable (i.e., explain why the Selected Remedy represents the best option).

(5) Satisfy the preference for treatment as a principal element, or justify the selection of an alternative remedy.

b. Explain 5-year review requirements for the Selected Remedy.

14. DOCUMENTATION OF SIGNIFICANT CHANGES FROM PREFERRED ALTERNATIVE OF PROPOSED PLAN. If there are significant changes in the Selected Remedy from the Preferred Alternative:

a. Discuss the Preferred Alternative originally presented in the Proposed Plan.

b. Describe the significant changes in the Selected Remedy.

c. Explain the rationale for the changes and how they could have been reasonably anticipated based on information presented in the Proposed Plan or the Administrative Record file.

PART 3: THE RESPONSIVENESS SUMMARY

The Responsiveness Summary serves the dual purposes of: (1) presenting stakeholder concerns about the MRS and preferences regarding the remedial alternatives; and (2) explaining how those concerns were addressed and the preferences were factored into the remedy selection process. This discussion should cross-reference sections of the Decision Summary that demonstrate how issues raised by the community have been addressed.

1. STAKEHOLDER ISSUES AND LEAD AGENCY RESPONSES: Summarize and respond concisely to issues raised by stakeholders.

2. TECHNICAL AND LEGAL ISSUES: Expand on technical and legal issues, if necessary

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Attachment D

Price Spreadsheet

Firm Fixed Price Lump Sum Prices offered and accepted are the sole basis of this contract. Unit Prices included herein have no bearing on the task order price and are proposed only to provide a basis for determining a fair and reasonable price if the Government in its sole discretion chooses to modify the performance requirements of this task order. This is a performance based task order and the inclusion of unit prices in the proposal shall in no way be construed as the Government procuring a specified number of units of any given service. The contract is for the provision of services that ultimately meet the performance requirements of each task.

Camp Butner RI/FS				
Task, Title, Type	Qty	Unit	Price	Total
1, Technical Project Planning, FFP/UP	1.0	LS		
1a, Additional meeting, FUP	1.0	Ea		
2, RI/FS Work Plan, FFP	1.0	LS		
2a, Optional, Explosive Siting Plan, FFP	1.0	LS		
3, GIS, FFP/UP	1.0	LS		
3a, Additional GIS per month, FUP	1.0	EA		
4, RI/FS Field Activities, FFP/FUP				
4a, Optional Army National Guard Property*, FFP	1.0	LS		
4b, Optional Flame Thrower Range*, FFP	1.0	LS		
4c, Optional Hand Grenade Range*, FFP	1.0	LS		
4d, Range Complex 1*, FFP	1.0	LS		
4e, Optional Range Complex 2*, FFP	1.0	LS		
4f, Evacuations, CPFF	1.0	LS		
Civil Survey, per acre, FUP	1.0	Ea		
Light Vegetation Removal, per acre, FUP	1.0	Ea		
Medium Vegetation Removal, per acre, FUP	1.0	Ea		
Heavy Vegetation Removal, per acre, FUP	1.0	Ea		
Density Transects per acre - Light Brush, FUP	1.0	Ea		
Density Transects per acre - Medium Brush, FUP	1.0	Ea		
Density Transects per acre - Heavy Brush, FUP	1.0	Ea		
DGM Transect geophysics per acre, FUP	1.0	Ea		
Analog Transect geophysics per acre, FUP	1.0	Ea		
DGM Grids geophysics per acre, FUP	1.0	Ea		
Analog Grids geophysics per acre, FUP	1.0	Ea		
Mob/Demob Density Transect Team, FUP	1.0	Ea		
Mob/Demob, DGM Team, FUP	1.0	Ea		
Mob/Demob, MEC Investigation Team, FUP	1.0	Ea		
Each Demolition Shot, FUP	1.0	Ea		
Intrusive Investigation – Land, per day, FUP	1.0	Ea		
Intrusive Investigation - Land, per week, FUP	1.0	Ea		
Program/Project Management, per week, in office, FUP	1.0	Ea		
Program/Project Management, per week, in field, FUP	1.0	Ea		
Site Management (SUXOS, UXOQC, UXOSO), per week, FUP	1.0	Ea		
Contractor can add relevant fixed unit pricing for review and acceptance by the Government.				

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Camp Butner RI/FS				
Task, Title, Type	Qty	Unit	Price	Total
5, Remedial Investigation Report Initial, FFP	1.0	LS		
6, Feasibility Study Report Initial MRS, FFP	1.0	LS		
7, Proposed Plan Initial MRS, FFP	1.0	LS		
8, Decision Document Initial MRS, FFP	1.0	LS		
9, Community Relations Support, FFP	1.0	LS		
10, Public Involvement Plan, FFP	1.0	LS		
11, Administrative Record, FFP	1.0	LS		
12, Environmental Sampling & Analysis, FFP/FUP				
4a, Optional Army National Guard Property*, FFP	1.0	LS		
4b, Optional Flame Thrower Range*, FFP	1.0	LS		
4c, Optional Hand Grenade Range*, FFP	1.0	LS		
4d, Range Complex 1*, FFP	1.0	LS		
4e, Optional Range Complex 2*, FFP	1.0	LS		
Sampling and analysis, Soil, ten plus QC/QA, MS/MSD, FUP	1.0	Ea		
Sampling and analysis, Water, ten plus QC/QA, MS/MSD, FUP	1.0	Ea		
Sampling and analysis, Sediment, ten plus QC/QA, MS/MSD, FUP	1.0	Ea		
Sampling and analysis, Groundwater sample, FUP	1.0	Ea		
Sampling and analysis, Groundwater, plus QC/QA, MS/MSD, FUP	1.0	Ea		
Sampling and analysis, Groundwater sample using Push Probe, FUP	1.0	Ea		
Incremental Sampling Unit(DU) (100'x100'), FUP	1.0	Ea		
Pre & Post Detonation per set, FUP	1.0	Ea		
Installation of monitoring well, base price per well, FUP	1.0	Ea		
Installation of monitoring well, price per additional foot, FUP	1.0	Ea		
Subsurface Sampling, per 2' - 4' boring, FUP	1.0	Ea		
Contractor can add relevant fixed unit pricing for review and acceptance by the Government.	1.0	Ea		
			Total	

- Note: Use RSMeans, most recent version, for applicable unit pricing using applicable location factors.
- * Mob/Demob costs shall be included in each of the subtasks for Tasks 4 (a-e) and 12(a-e).

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APPENDIX B

SITE MAPS

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LIST OF FIGURES

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Figure 1.1 Site Location

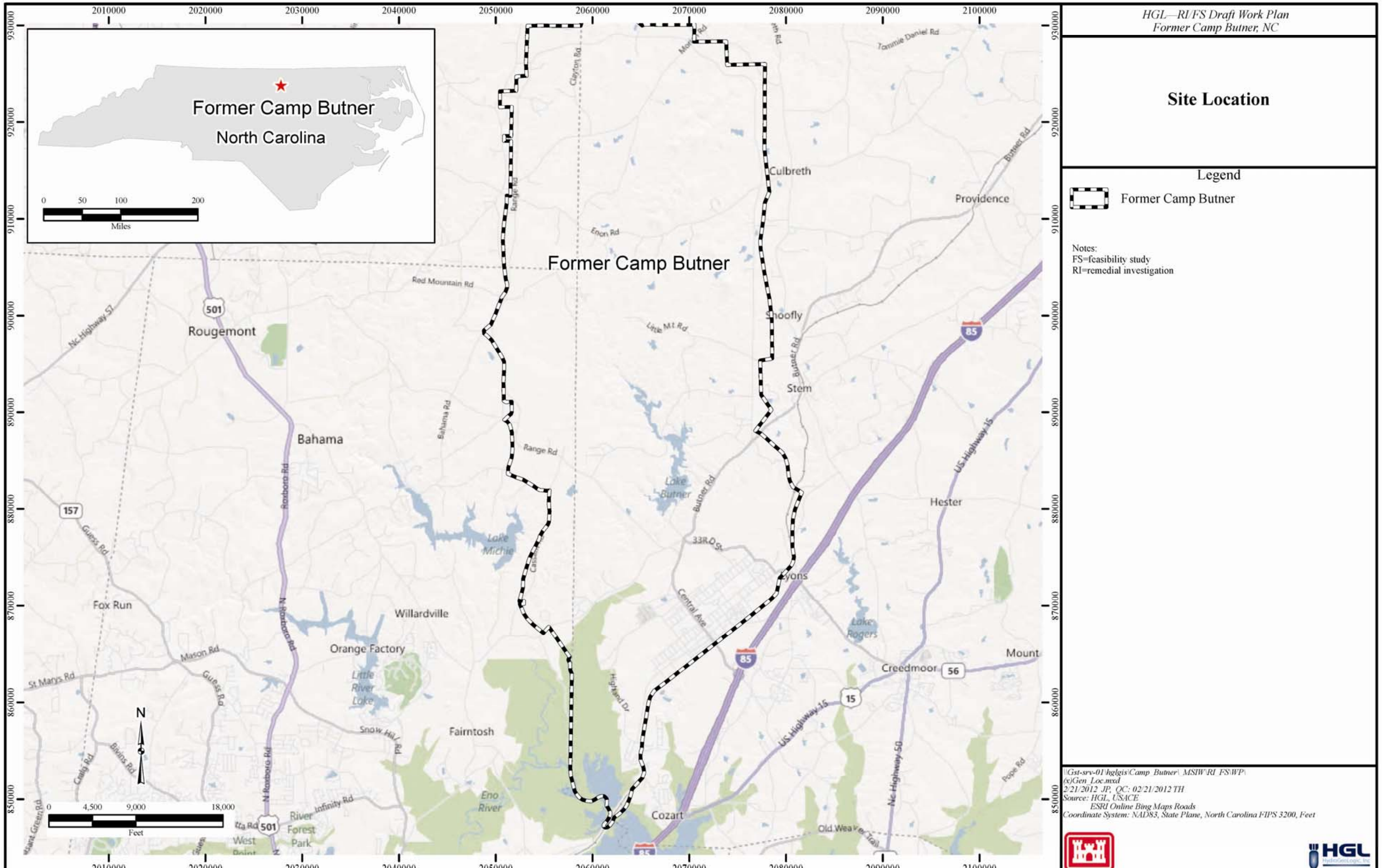


Figure 1.2 MRS Location Map

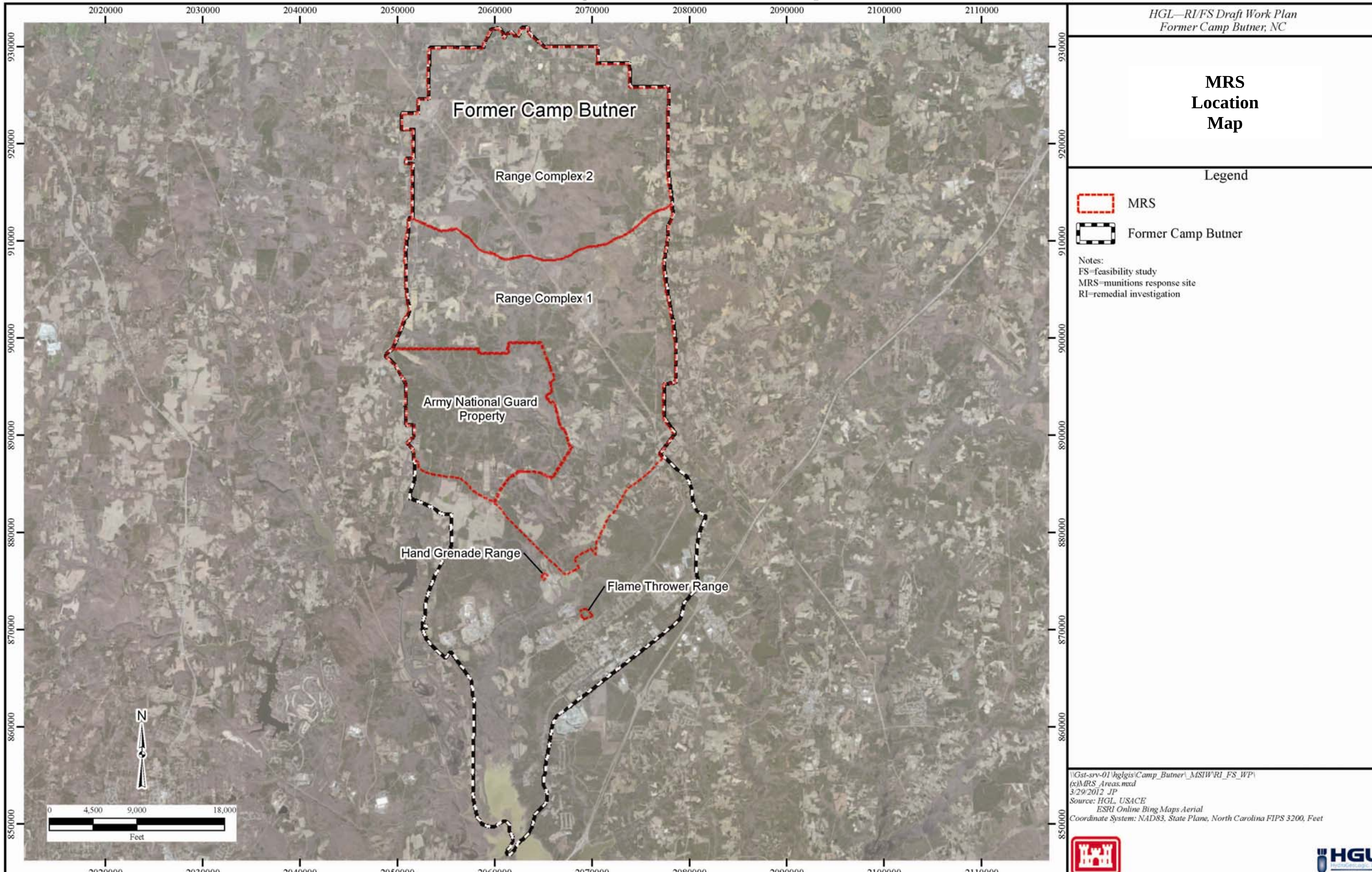


Figure 1.3 RI/FS Process

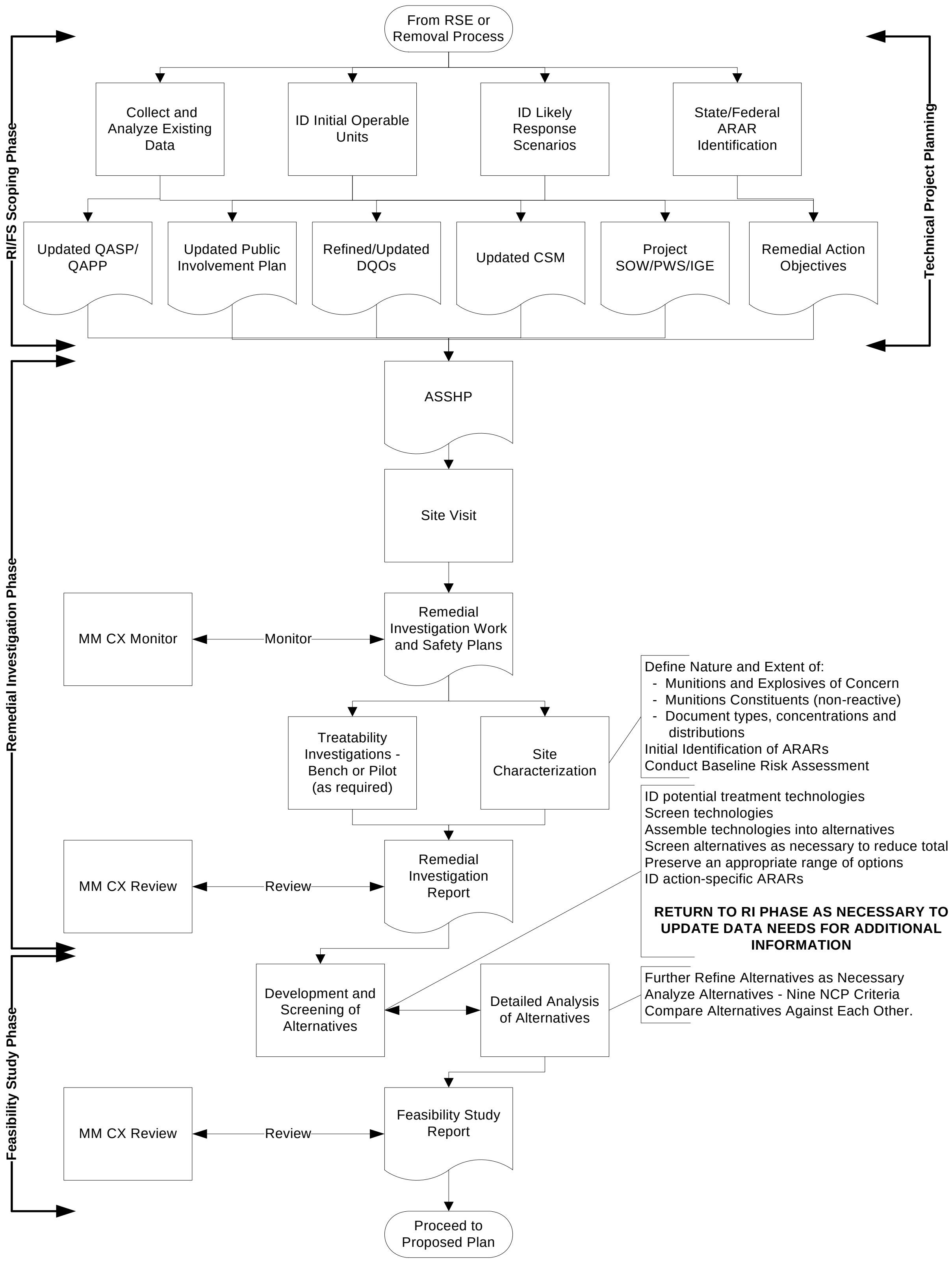


Figure 1.4 Historical Use Munitions Feature

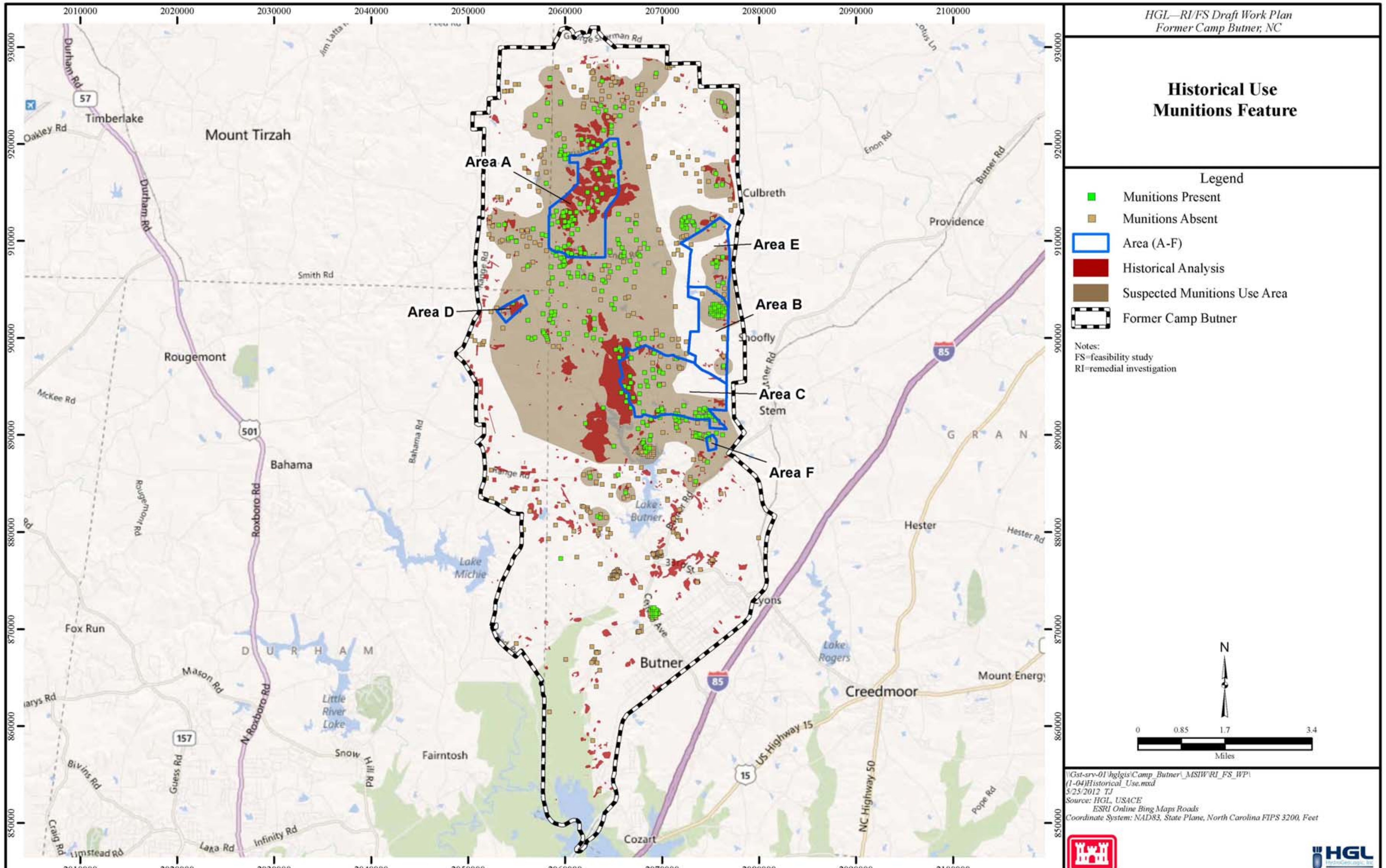


Figure 1.5 Munitions Use Areas

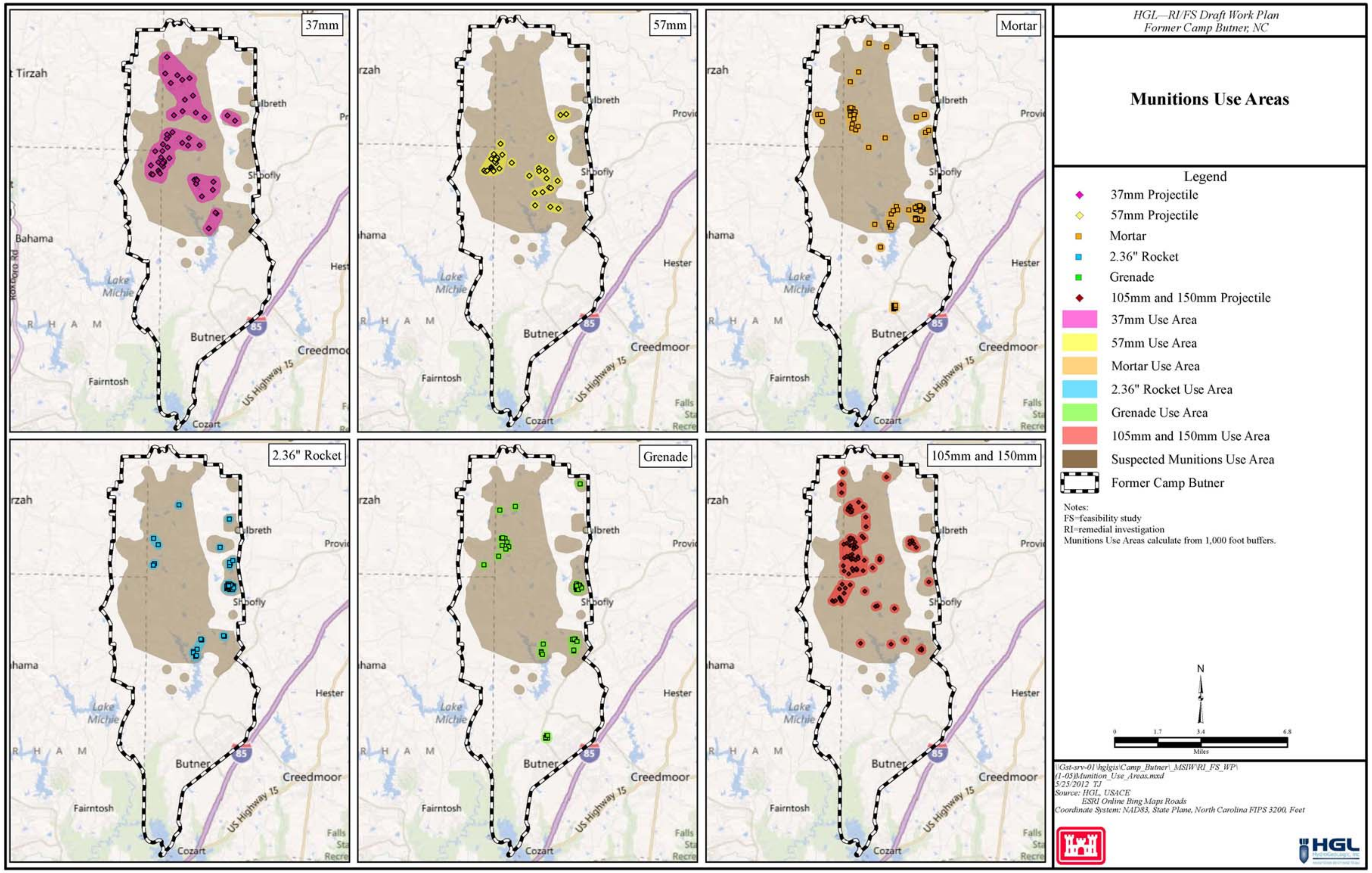
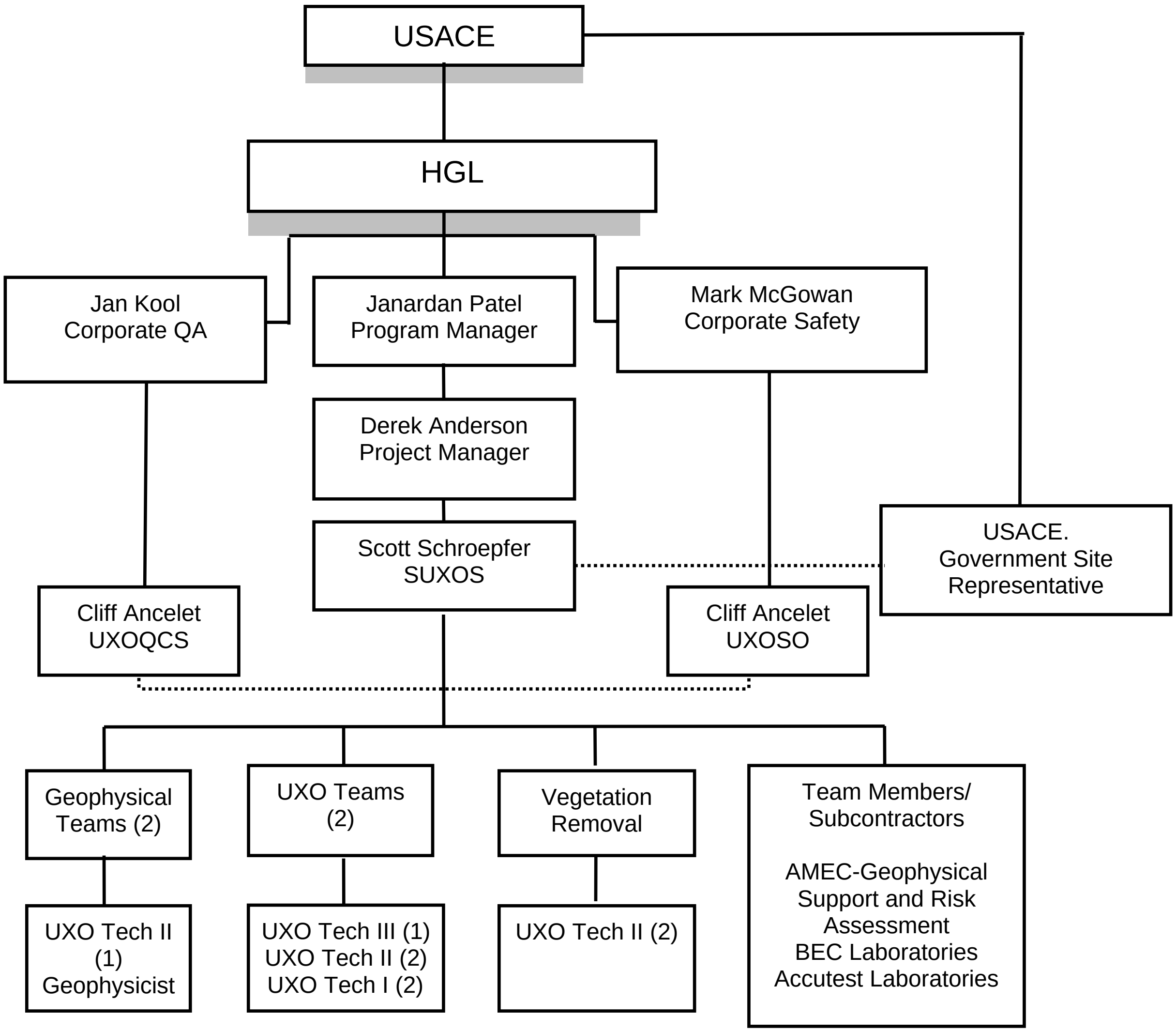


Figure 2.1 Organizational Chart



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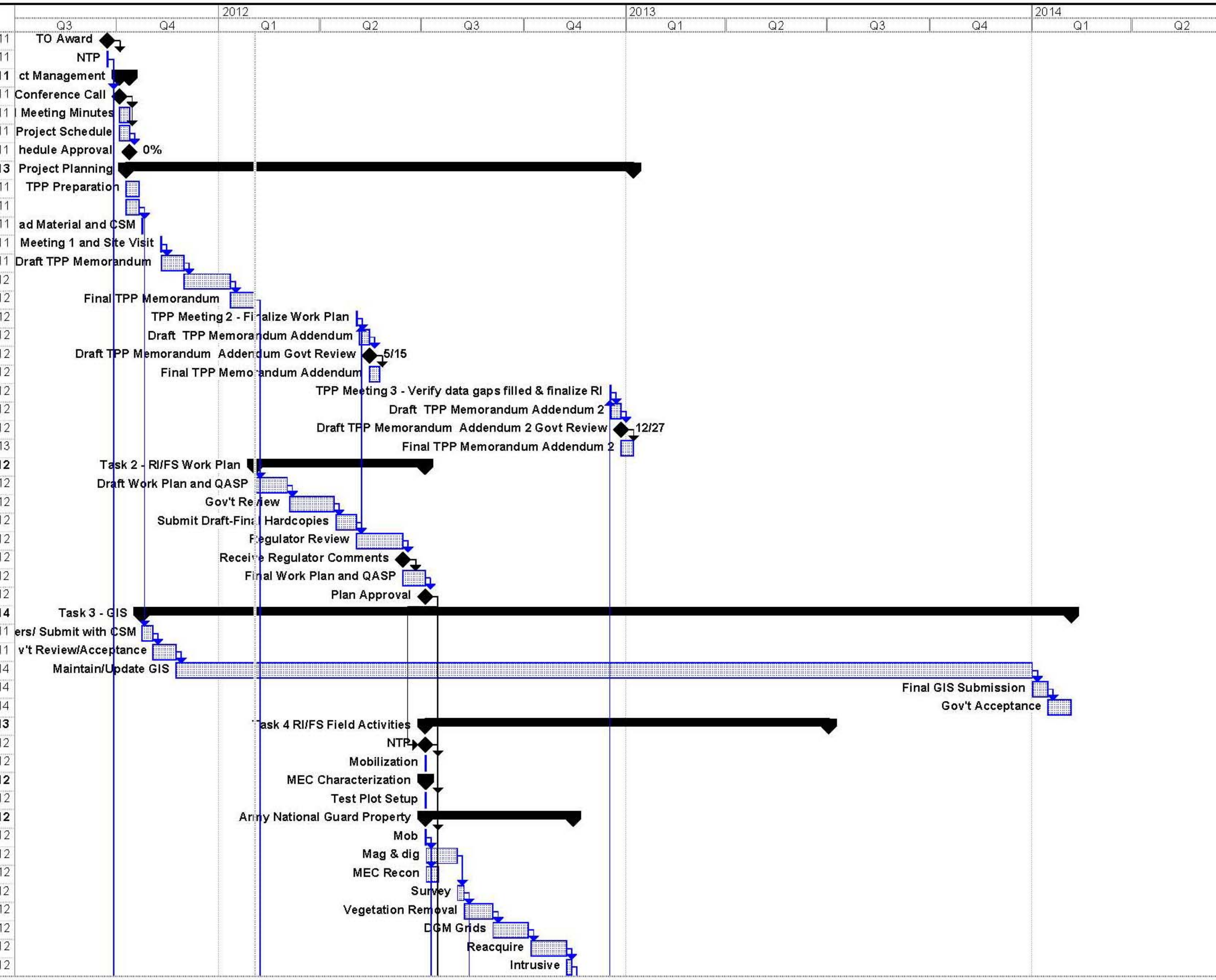
__________ Reporting

-------------- Lines of Communication

Figure 2.2 Project Schedule

Schilling AFB TPP Memorandum

ID	Task Name	Duration	Start	Finish
1	TO Award	0 days	Fri 9/23/11	Fri 9/23/11
2	NTP	1 day	Fri 9/23/11	Fri 9/23/11
3	**Project Management**	**7 days**	**Tue 10/4/11**	**Wed 10/12/11**
4	Kick-Off Conference Call	0 days	Tue 10/4/11	Tue 10/4/11
5	Kick-Off Conference Call Meeting Minutes	7 days	Tue 10/4/11	Wed 10/12/11
6	Project Schedule	7 days	Tue 10/4/11	Wed 10/12/11
7	Schedule Approval	0 days	Wed 10/12/11	Wed 10/12/11
8	**Task 1 - Technical Project Planning**	**326 days**	**Mon 10/10/11**	**Mon 1/7/13**
9	TPP Preparation	10 days	Mon 10/10/11	Fri 10/21/11
10	CSM Preparation	10 days	Mon 10/10/11	Fri 10/21/11
11	Submit Read Ahead Material and CSM	1 day	Mon 10/24/11	Mon 10/24/11
12	TPP Meeting 1 and Site Visit	1 day	Thu 11/10/11	Thu 11/10/11
13	Draft TPP Memorandum	14 days	Fri 11/11/11	Wed 11/30/11
14	Draft TPP Memorandum Govt Review	30 days	Thu 12/1/11	Wed 1/11/12
15	Final TPP Memorandum	16 days	Thu 1/12/12	Thu 2/2/12
16	TPP Meeting 2 - Finalize Work Plan	1 day	Fri 5/4/12	Fri 5/4/12
17	Draft TPP Memorandum Addendum	7 days	Mon 5/7/12	Tue 5/15/12
18	Draft TPP Memorandum Addendum Govt Review	0 days	Tue 5/15/12	Tue 5/15/12
19	Final TPP Memorandum Addendum	7 days	Wed 5/16/12	Thu 5/24/12
20	TPP Meeting 3 - Verify data gaps filled & finalize RI	1 day	Tue 12/18/12	Tue 12/18/12
21	Draft TPP Memorandum Addendum 2	7 days	Wed 12/19/12	Thu 12/27/12
22	Draft TPP Memorandum Addendum 2 Govt Review	0 days	Thu 12/27/12	Thu 12/27/12
23	Final TPP Memorandum Addendum 2	7 days	Fri 12/28/12	Mon 1/7/13
24	**Task 2 - RI/FS Work Plan**	**109 days**	**Fri 2/3/12**	**Wed 7/4/12**
25	Draft Work Plan and QASP	21 days	Fri 2/3/12	Fri 3/2/12
26	Gov't Review	30 days	Mon 3/5/12	Fri 4/13/12
27	Submit Draft-Final Hardcopies	14 days	Mon 4/16/12	Thu 5/3/12
28	Regulator Review	30 days	Fri 5/4/12	Thu 6/14/12
29	Receive Regulator Comments	0 days	Thu 6/14/12	Thu 6/14/12
30	Final Work Plan and QASP	14 days	Fri 6/15/12	Wed 7/4/12
31	Plan Approval	0 days	Wed 7/4/12	Wed 7/4/12
32	**Task 3 - GIS**	**598 days**	**Mon 10/24/11**	**Wed 2/5/14**
33	Establish Baseline GIS Layers/ Submit with CSM	8 days	Mon 10/24/11	Wed 11/2/11
34	Gov't Review/Acceptance	15 days	Thu 11/3/11	Wed 11/23/11
35	Maintain/Update GIS	550 days	Thu 11/24/11	Wed 1/1/14
36	Final GIS Submission	10 days	Thu 1/2/14	Wed 1/15/14
37	Gov't Acceptance	15 days	Thu 1/16/14	Wed 2/5/14
38	**Task 4 RI/FS Field Activities**	**259 days**	**Wed 7/4/12**	**Tue 7/2/13**
39	NTP	0 days	Wed 7/4/12	Wed 7/4/12
40	Mobilization	1 day	Thu 7/5/12	Thu 7/5/12
41	**MEC Characterization**	**1 day**	**Thu 7/5/12**	**Thu 7/5/12**
42	Test Plot Setup	1 day	Thu 7/5/12	Thu 7/5/12
43	**Army National Guard Property**	**95 days**	**Thu 7/5/12**	**Wed 11/14/12**
44	Mob	1 day	Thu 7/5/12	Thu 7/5/12
45	Mag & dig	20 days	Fri 7/6/12	Thu 8/2/12
46	MEC Recon	7 days	Fri 7/6/12	Mon 7/16/12
47	Survey	4 days	Fri 8/3/12	Wed 8/8/12
48	Vegetation Removal	18 days	Thu 8/9/12	Mon 9/3/12
49	DGM Grids	24 days	Tue 9/4/12	Fri 10/5/12
50	Reacquire	24 days	Mon 10/8/12	Thu 11/8/12
51	Intrusive	3 days	Fri 11/9/12	Tue 11/13/12



RI/FS at Camp Butner
09/06/2011
HydroGeoLogic, Inc

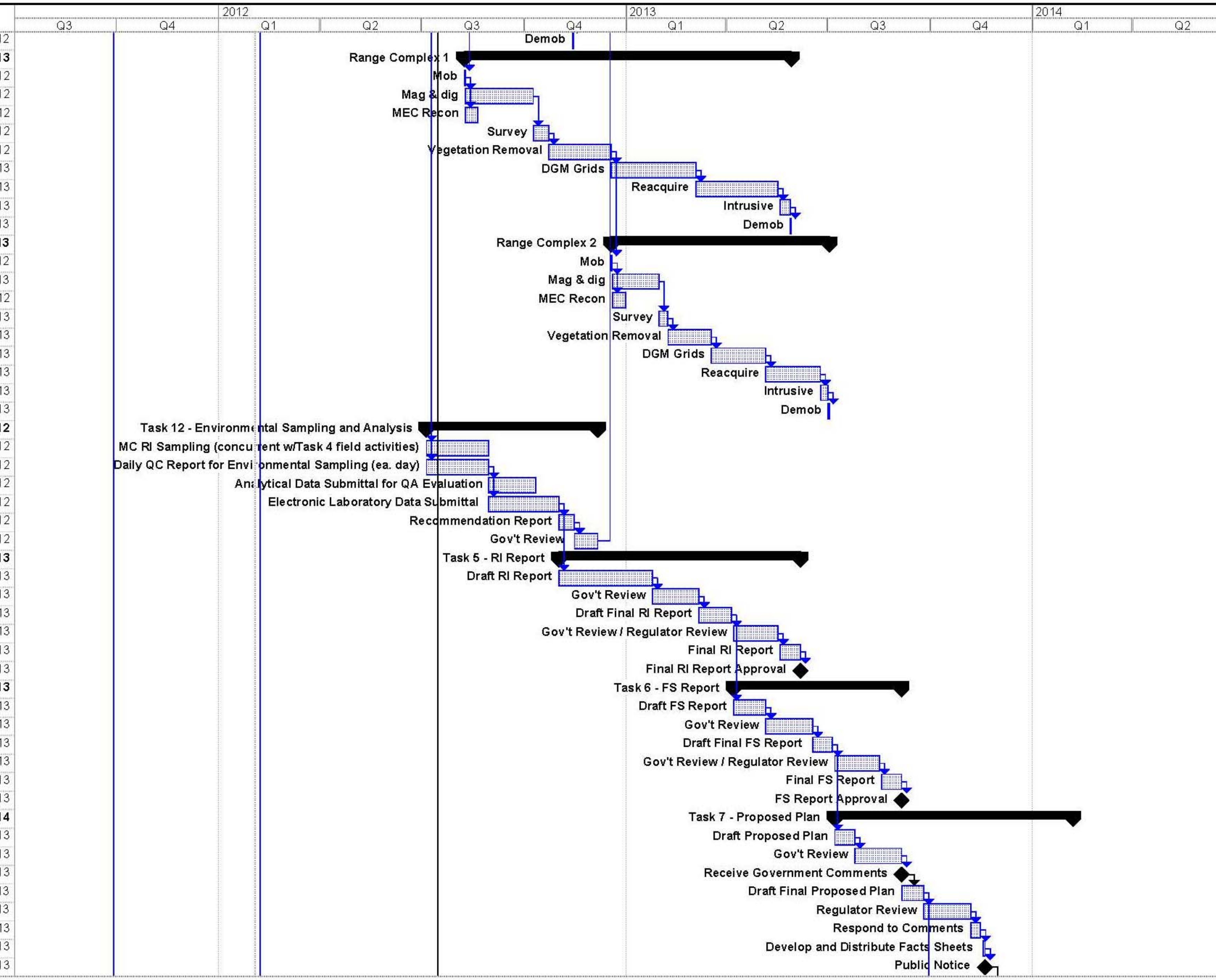
Task	Milestone	Project Summary	External Milestone	Progress	
Split	Summary	External Tasks	Inactive Task	Deadline	

W912DY-10-D-0023 Page 1 February 2012

Figure 2.2 Project Schedule (continued)

Schilling AFB TPP Memorandum

ID	Task Name	Duration	Start	Finish
52	Demob	1 day	Wed 11/14/12	Wed 11/14/12
53	**Range Complex 1**	**210 days**	**Thu 8/9/12**	**Wed 5/29/13**
54	Mob	1 day	Thu 8/9/12	Thu 8/9/12
55	Mag & dig	43 days	Fri 8/10/12	Tue 10/9/12
56	MEC Recon	7 days	Fri 8/10/12	Mon 8/20/12
57	Survey	10 days	Wed 10/10/12	Tue 10/23/12
58	Vegetation Removal	40 days	Wed 10/24/12	Tue 12/18/12
59	DGM Grids	54 days	Wed 12/19/12	Mon 3/4/13
60	Reacquire	54 days	Tue 3/5/13	Fri 5/17/13
61	Intrusive	7 days	Mon 5/20/13	Tue 5/28/13
62	Demob	1 day	Wed 5/29/13	Wed 5/29/13
63	**Range Complex 2**	**140 days**	**Wed 12/19/12**	**Tue 7/2/13**
64	Mob	1 day	Wed 12/19/12	Wed 12/19/12
65	Mag & dig	30 days	Thu 12/20/12	Wed 1/30/13
66	MEC Recon	8 days	Thu 12/20/12	Mon 12/31/12
67	Survey	6 days	Thu 1/31/13	Thu 2/7/13
68	Vegetation Removal	27 days	Fri 2/8/13	Mon 3/18/13
69	DGM Grids	35 days	Tue 3/19/13	Mon 5/6/13
70	Reacquire	35 days	Tue 5/7/13	Mon 6/24/13
71	Intrusive	5 days	Tue 6/25/13	Mon 7/1/13
72	Demob	1 day	Tue 7/2/13	Tue 7/2/13
73	**Task 12 - Environmental Sampling and Analysis**	**110 days**	**Fri 7/6/12**	**Thu 12/6/12**
74	MC RI Sampling (concurrent w/Task 4 field activities)	40 days	Fri 7/6/12	Thu 8/30/12
75	Daily QC Report for Environmental Sampling (ea. day)	40 days	Fri 7/6/12	Thu 8/30/12
76	Analytical Data Submittal for QA Evaluation	30 days	Fri 8/31/12	Thu 10/11/12
77	Electronic Laboratory Data Submittal	45 days	Fri 8/31/12	Thu 11/1/12
78	Recommendation Report	10 days	Fri 11/2/12	Thu 11/15/12
79	Gov't Review	15 days	Fri 11/16/12	Thu 12/6/12
80	**Task 5 - RI Report**	**155 days**	**Fri 11/2/12**	**Thu 6/6/13**
81	Draft RI Report	60 days	Fri 11/2/12	Thu 1/24/13
82	Gov't Review	30 days	Fri 1/25/13	Thu 3/7/13
83	Draft Final RI Report	21 days	Fri 3/8/13	Fri 4/5/13
84	Gov't Review / Regulator Review	30 days	Mon 4/8/13	Fri 5/17/13
85	Final RI Report	14 days	Mon 5/20/13	Thu 6/6/13
86	Final RI Report Approval	0 days	Thu 6/6/13	Thu 6/6/13
87	**Task 6 - FS Report**	**109 days**	**Mon 4/8/13**	**Thu 9/5/13**
88	Draft FS Report	21 days	Mon 4/8/13	Mon 5/6/13
89	Gov't Review	30 days	Tue 5/7/13	Mon 6/17/13
90	Draft Final FS Report	14 days	Tue 6/18/13	Fri 7/5/13
91	Gov't Review / Regulator Review	30 days	Mon 7/8/13	Fri 8/16/13
92	Final FS Report	14 days	Mon 8/19/13	Thu 9/5/13
93	FS Report Approval	0 days	Thu 9/5/13	Thu 9/5/13
94	**Task 7 - Proposed Plan**	**154 days**	**Mon 7/8/13**	**Thu 2/6/14**
95	Draft Proposed Plan	14 days	Mon 7/8/13	Thu 7/25/13
96	Gov't Review	30 days	Fri 7/26/13	Thu 9/5/13
97	Receive Government Comments	0 days	Thu 9/5/13	Thu 9/5/13
98	Draft Final Proposed Plan	14 days	Fri 9/6/13	Wed 9/25/13
99	Regulator Review	30 days	Thu 9/26/13	Wed 11/6/13
100	Respond to Comments	7 days	Thu 11/7/13	Fri 11/15/13
101	Develop and Distribute Facts Sheets	2 days	Mon 11/18/13	Tue 11/19/13
102	Public Notice	0 days	Tue 11/19/13	Tue 11/19/13



RI/FS at Camp Butner 09/06/2011 HydroGeoLogic, Inc	Task		Milestone	◆	Project Summary		External Milestone	◆	Progress		
	Split		Summary		External Tasks		Inactive Task		Deadline	⇩	

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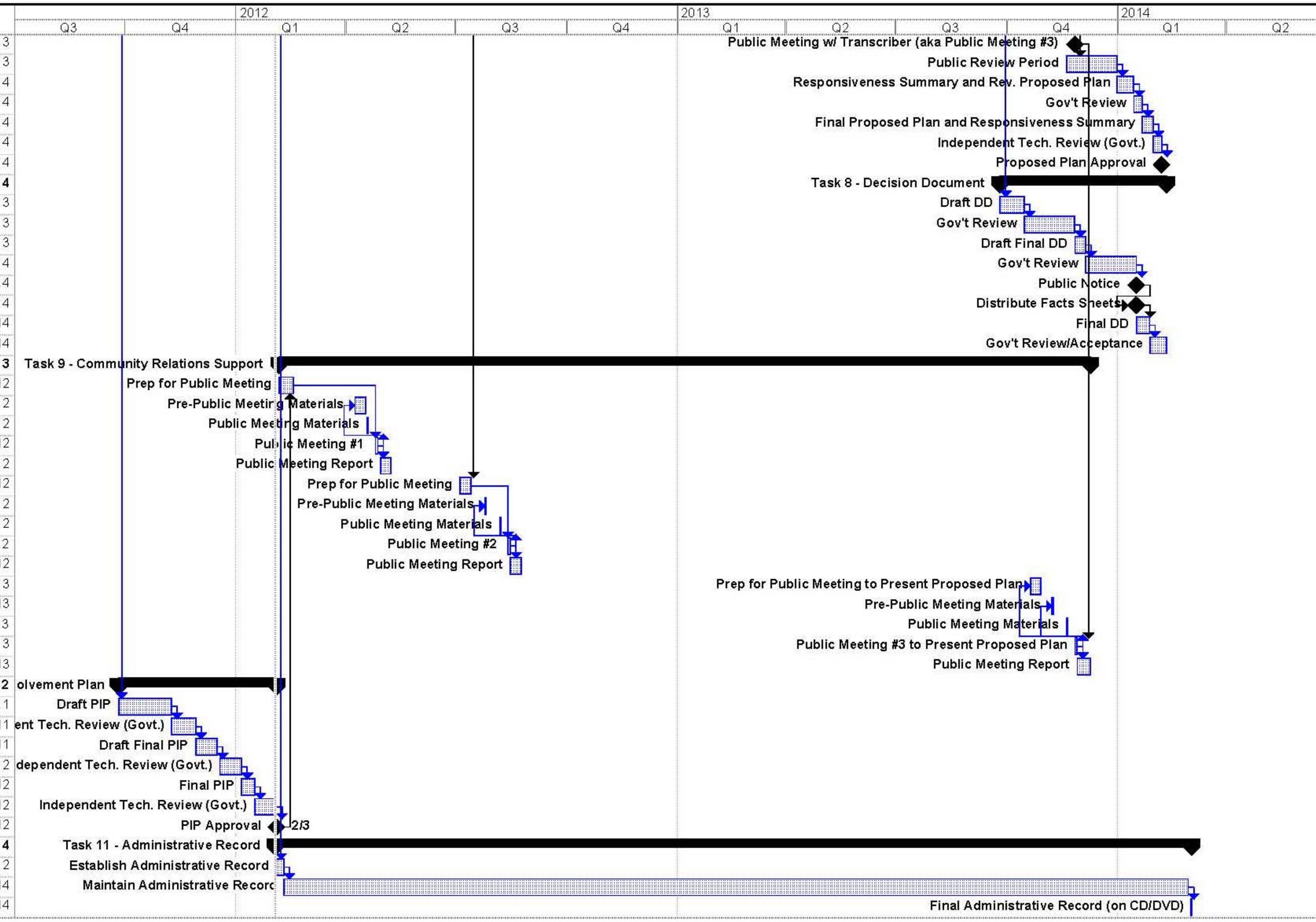
Figure 2.2 Project Schedule (continued)

Schilling AFB TPP Memorandum

ID	Task Name	Duration	Start	Finish
103	Public Meeting w/ Transcriber (aka Public Meeting #3)	0 days	Tue 11/26/13	Tue 11/26/13
104	Public Review Period	30 days	Wed 11/20/13	Tue 12/31/13
105	Responsiveness Summary and Rev. Proposed Plan	10 days	Wed 1/1/14	Tue 1/14/14
106	Gov't Review	5 days	Wed 1/15/14	Tue 1/21/14
107	Final Proposed Plan and Responsiveness Summary	7 days	Wed 1/22/14	Thu 1/30/14
108	Independent Tech. Review (Govt.)	5 days	Fri 1/31/14	Thu 2/6/14
109	Proposed Plan Approval	0 days	Thu 2/6/14	Thu 2/6/14
110	**Task 8 - Decision Document**	**98 days**	**Thu 9/26/13**	**Mon 2/10/14**
111	Draft DD	14 days	Thu 9/26/13	Tue 10/15/13
112	Gov't Review	30 days	Wed 10/16/13	Tue 11/26/13
113	Draft Final DD	7 days	Wed 11/27/13	Thu 12/5/13
114	Gov't Review	30 days	Fri 12/6/13	Thu 1/16/14
115	Public Notice	0 days	Thu 1/16/14	Thu 1/16/14
116	Distribute Facts Sheets	0 days	Thu 1/16/14	Thu 1/16/14
117	Final DD	7 days	Fri 1/17/14	Mon 1/27/14
118	Gov't Review/Acceptance	10 days	Tue 1/28/14	Mon 2/10/14
119	**Task 9 - Community Relations Support**	**481 days**	**Mon 2/6/12**	**Mon 12/9/13**
120	Prep for Public Meeting	10 days	Mon 2/6/12	Fri 2/17/12
121	Pre-Public Meeting Materials	7 days	Mon 4/9/12	Tue 4/17/12
122	Public Meeting Materials	1 day	Thu 4/19/12	Thu 4/19/12
123	Public Meeting #1	2 days	Thu 4/26/12	Fri 4/27/12
124	Public Meeting Report	7 days	Mon 4/30/12	Tue 5/8/12
125	Prep for Public Meeting	7 days	Thu 7/5/12	Fri 7/13/12
126	Pre-Public Meeting Materials	1 day	Thu 7/26/12	Thu 7/26/12
127	Public Meeting Materials	1 day	Tue 8/7/12	Tue 8/7/12
128	Public Meeting #2	2 days	Tue 8/14/12	Wed 8/15/12
129	Public Meeting Report	7 days	Thu 8/16/12	Fri 8/24/12
130	Prep for Public Meeting to Present Proposed Plan	7 days	Mon 10/21/13	Tue 10/29/13
131	Pre-Public Meeting Materials	1 day	Fri 11/8/13	Fri 11/8/13
132	Public Meeting Materials	1 day	Wed 11/20/13	Wed 11/20/13
133	Public Meeting #3 to Present Proposed Plan	2 days	Wed 11/27/13	Thu 11/28/13
134	Public Meeting Report	7 days	Fri 11/29/13	Mon 12/9/13
135	**Task 10 - Public Involvement Plan**	**95 days**	**Mon 9/26/11**	**Fri 2/3/12**
136	Draft PIP	32 days	Mon 9/26/11	Tue 11/8/11
137	Independent Tech. Review (Govt.)	14 days	Wed 11/9/11	Mon 11/28/11
138	Draft Final PIP	14 days	Tue 11/29/11	Fri 12/16/11
139	Independent Tech. Review (Govt.)	14 days	Mon 12/19/11	Thu 1/5/12
140	Final PIP	7 days	Fri 1/6/12	Mon 1/16/12
141	Independent Tech. Review (Govt.)	14 days	Tue 1/17/12	Fri 2/3/12
142	PIP Approval	0 days	Fri 2/3/12	Fri 2/3/12
143	**Task 11 - Administrative Record**	**542 days**	**Fri 2/3/12**	**Mon 3/3/14**
144	Establish Administrative Record	5 days	Fri 2/3/12	Thu 2/9/12
145	Maintain Administrative Record	536 days	Fri 2/10/12	Fri 2/28/14
146	Final Administrative Record (on CD/DVD)	1 day	Mon 3/3/14	Mon 3/3/14



RI/FS at Camp Butner 09/06/2011 HydroGeoLogic, Inc	Task		Milestone		Project Summary		External Milestone		Progress
	Split		Summary		External Tasks		Inactive Task		Deadline

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Figure 3.1 Range Complex 1 – Transect Map

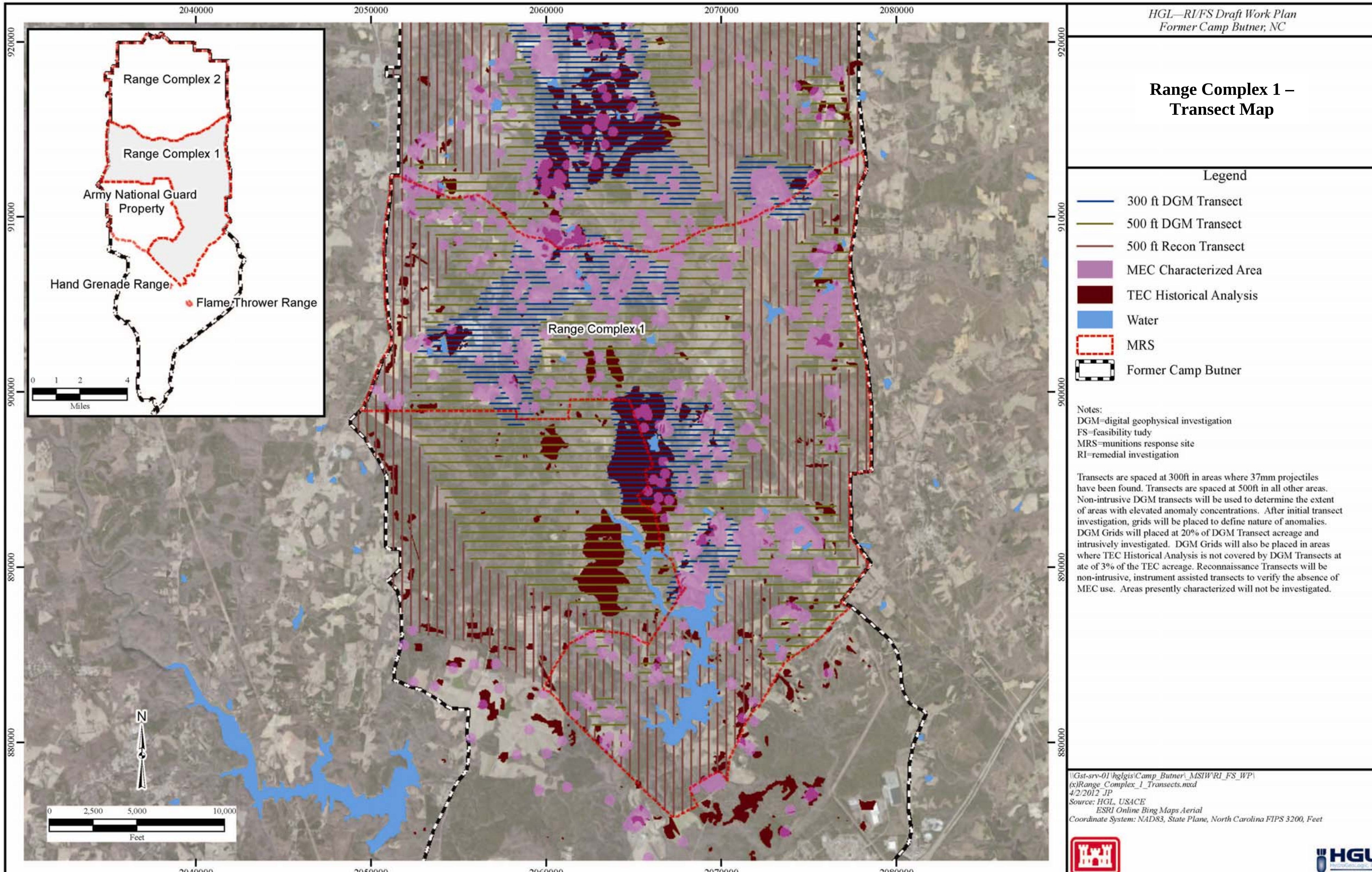


Figure 3.2 Range Complex 2 – Transect Map

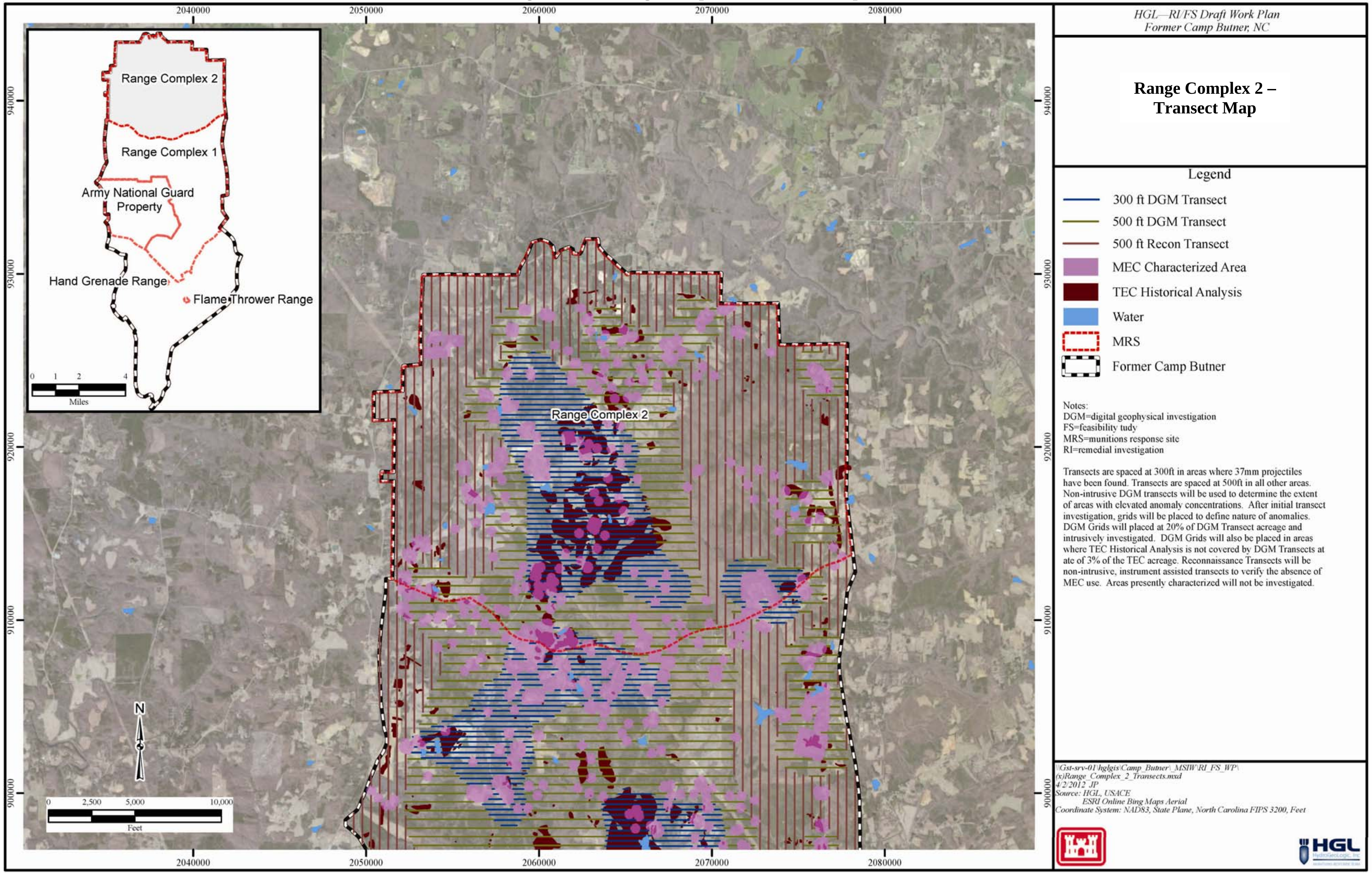


Figure 3.3 Army National Guard Property – Transect Map

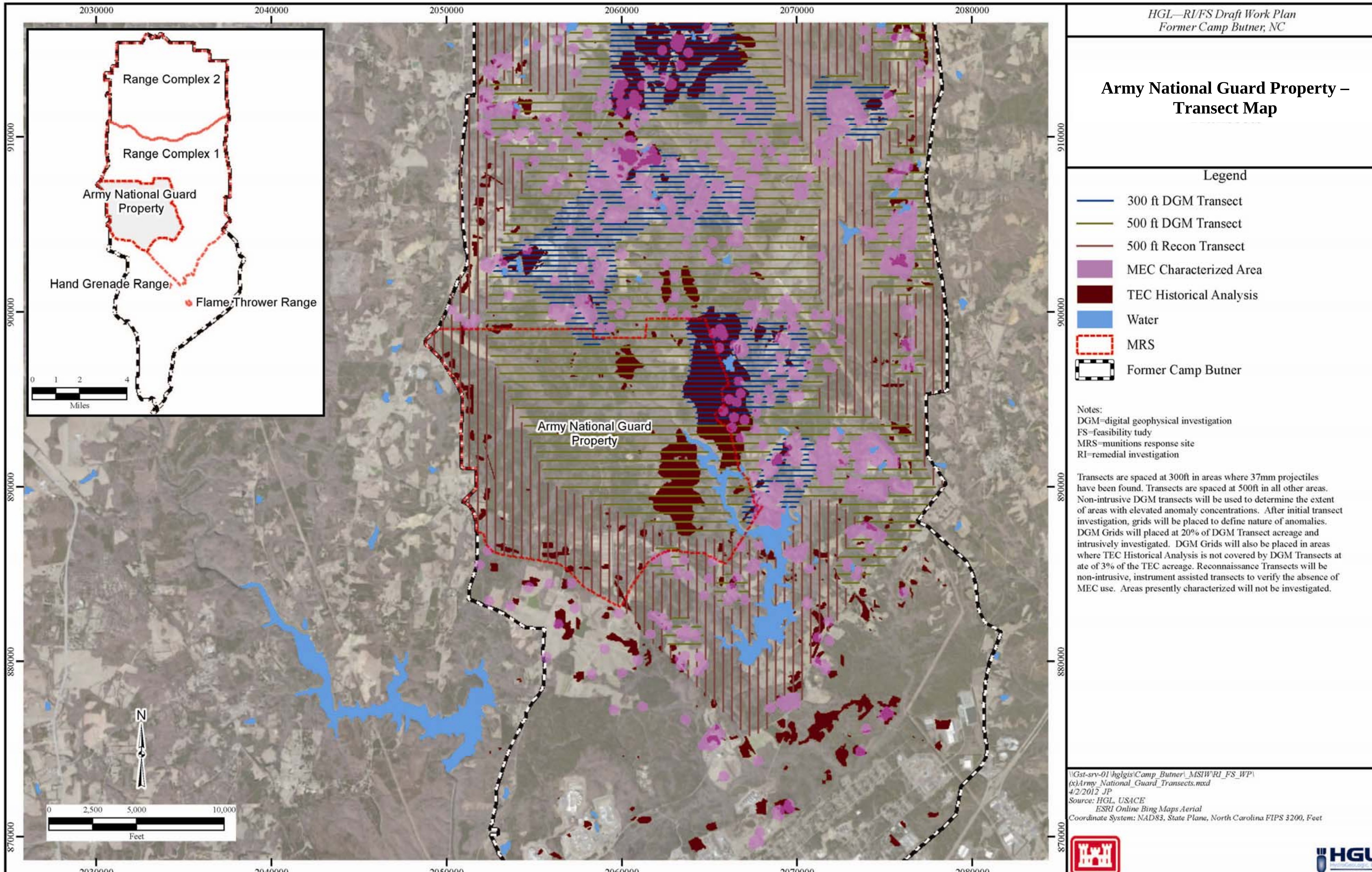


Figure 3.4 Preliminary MEC – Conceptual Site Model

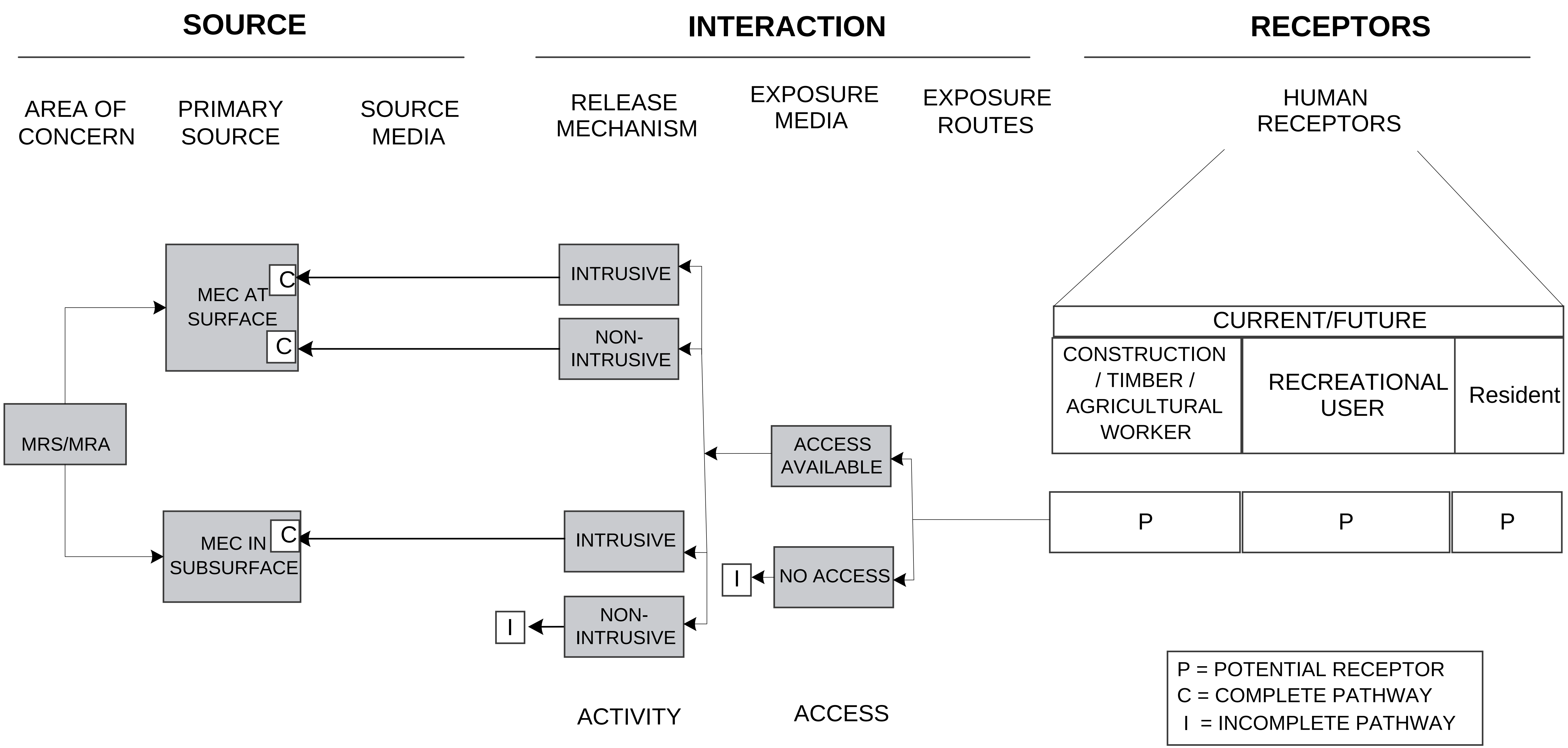
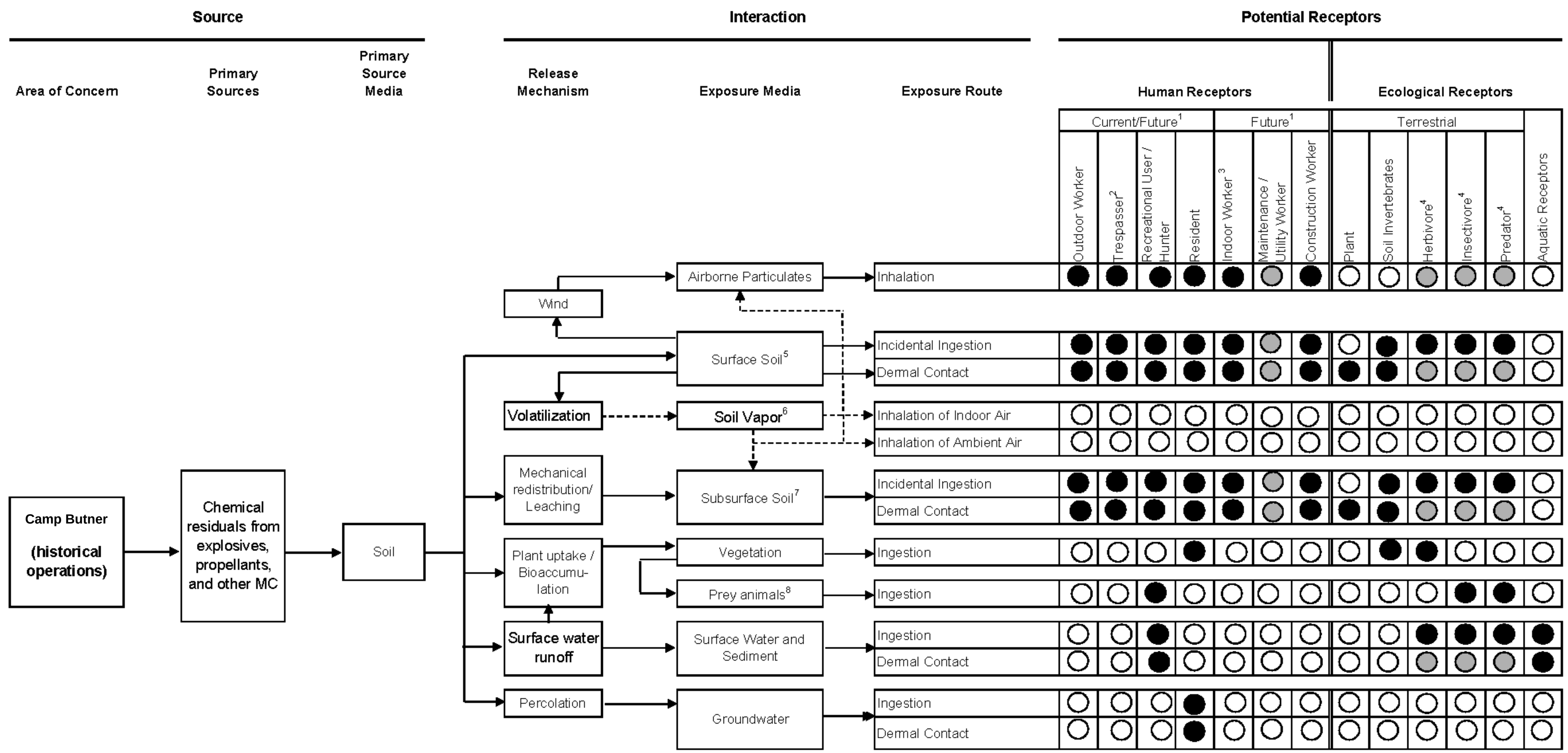


Figure 3.5 Munitions Constituents – Conceptual Site Model



Complete or Potentially Complete Pathway (to be evaluated)
Complete but Minor Pathway (not evaluated)
Incomplete Pathway (not evaluated)

Notes:

1. Current receptors evaluated for exposure to surface soils; future receptors evaluated for exposure to surface and subsurface soil.
2. Includes adolescent child (10-17) and an adult
3. Indoor worker conservatively evaluated for ingestion, dermal contact and inhalation with soils
4. Will include a mammal and a bird as representative species of the trophic level.
5. Surface soil is represented by soil samples collected from 0 - <1 feet below ground surface (ft bgs)
6. Pathway is incomplete; no volatile compounds were identified in soil
7. Subsurface soil will be represented by soil samples collected below 1 ft bgs (to a maximum of 2 ft bgs for ecological receptors). Under future use scenarios for human receptors, it is assumed development activities will result in mixing surface and subsurface soil up to a maximum depth of 10 ft bgs.
8. Prey animals will include invertebrates for the insectivores and herbivorous mammals for the predators.

Note: The CSM will be updated with the results of the RI investigation. If constituents of interest for a historical munitions site are nondetect in all samples collected from a medium (e.g., groundwater), then there will be no potentially complete exposure pathways for that medium.

Figure 5.1 HGL ATF License

DEPARTMENT OF THE TREASURY - BUREAU OF ALCOHOL, TOBACCO AND FIREARMS

LICENSE/PERMIT (18 U.S.C. CHAPTER 40, EXPLOSIVES)

In accordance with the provisions of Title XI, Organized Crime Control Act of 1970, and the regulations issued thereunder (27 CFR Part 555)you may engage in the activity specified in this license/permit within the limitations of Chapter 40, Title 18, United States Code and the regulations issued thereunder, until the expiration date shown. See "WARNING" and "NOTICES" on back.

DIRECT ATF CORRESPONDENCE TO
Christopher R. Reeves
Chief, Federal Explosives Licensing Center (FELC)
Bureau of Alcohol, Tobacco, Firearms and Explosives
244 Needy Road
Martinsburg, West Virginia 25405
Telephone: 1-877-283-3352 Fax: 1-304-616-4401

LICENSE/PERMIT NUMBER: **5-NM-001-20-4F-00302**

EXPIRATION DATE: **June 1, 2014**

NAME
HYDROGEOLOGIC, INC MUNITIONS RESPONSE TEAM

Premises Address CHANGES? You must notify the FELC at least 10 days before the mov
8202 LOUISIANA BLVD, NE
ALBUQUERQUE, NM 87113-

TYPE OF LICENSE OR PERMIT
20-MANUFACTURER OF HIGH EXPLOSIVES

CHIEF, FEDERAL EXPLOSIVES LICENSING CENTER (FELC)
Christopher R. Reeves
Christopher R. Reeves

PURCHASING CERTIFICATION
I certify that this is a true copy of a license/permit issued to me to engage in the activity specified.

(SIGNATURE OF LICENSEE/PERMITTEE)

Mailing Address CHANGES? You must notify the FELC at least 10 days before the change
HYDROGEOLOGIC, INC
HYDROGEOLOGIC, INC MUNITIONS RESPONSE TEAM
8202 LOUISIANA BLVD, NE
ALBUQUERQUE, NM 87113-

The licensee/permittee named herein shall use a reproduction of this license/permit to assist a transferor of explosives to verify the identity and status of the licensee/permittee as provided in 27 CFR Part 555. The signature on each reproduction must be an ORIGINAL signature.

HGL MRT - Ø5 - ØØØ

ATF F 5400.14/5400.15, Part 1 (8/89)

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APPENDIX C

POINTS OF CONTACT

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Name	Organization and Role	Telephone Number	Mailing Address	Email Address
Janice Jamar	USACECH Contracting Officer	256-895-1343 (o)	U.S. Army Engineering & Support Center, Huntsville Attn: CEHNC-CT-E PO Box 1600 Huntsville, AL 35807-4301	janice.a. jamar@usace.army.mil
Chris Cochrane	USACECH/ PM and COR	256-895-1696 (o) 256-990-0888 (cell)	U.S. Army Engineering & Support Center, Huntsville Attn: CEHNC-OE-DC (Chris Cochrane) P.O. Box 1600 Huntsville, AL 35807-4301 Overnight Mailing Address: USAESCH ATTN: OE (Cochrane) 4820 University Square Huntsville, AL 35816-1822	chris.cochrane@usace.army.mil
Ray Livermore	USACE-SAW, PM	910-251-4702 (o)	U.S. Army of Corps of Engineers, Wilmington District Attn: CESAW-TS-EG (Ray Livermore) 69 Darlington Avenue Wilmington, NC 28402-1890	raymond.r.livermore@usace.army.mil
Tom Bohannon	USACE-Savannah, OESS	256-895-1290	U.S. Army of Corps of Engineers, Savannah District Attn: Tim Bohannon P.O. Box 889 Savannah, GA 31402-0889 Overnight Mailing Address: USAESCH – Savannah District 100 W. Oglethorpe Ave. Savannah GA 31401 Attn: Tim Bohannon	timothy.p.bohannon@usace.army.mil
Cecil “Bud” Morgan	USACECH/ Environmetnal Manager	256-895-1491 (o) 256-509-0854 (cell)	U.S. Army Engineering & Support Center, Huntsville Attn: OE (Morgan) P.O. Box 1600 Huntsville, AL 35807-4301 Overnight Mailing Address: USAESCH ATTN: OE (Morgan) 4820 University Square Huntsville, AL 35816-1822	cecil.w.morgan@usace.army.mil

Name	Organization and Role	Telephone Number	Mailing Address	Email Address
Elise M. Goggin	USACECH/ Geophysicist	256-895-1635 (o) 256-679-0419 (cell)	U.S. Army Engineering & Support Center, Huntsville Attn: OE P.O. Box 1600 Huntsville, AL 35807-4301	elise.m.goggin@usace.army.mil
Marti Morgan	NCDENR	919-707-8342 (o)	DENR Office Building 217 West Jones Street Raleigh, NC 27603-6100	martha.morgan@ncdenr.gov
Julie Hiscox	USACE SAD/ FUDS PM	912-652-5363 (o) 912-656-1183 (cell)	USACE - Savannah District P.O. Box 889 Savannah, GA 31402-0889 Attn: Julie Hiscox	julie.a.hiscox@usace.army.mil
Derek Anderson	HGL/ PM	706-372-5138 (cell)	HGL 325 Heritage Forest Drive Blythewood, SC 29016	danderson@hgl.com
Scott Schroepfer	HGL/ SUXOS	913-378-2307 (o) 707-330-6411 (cell)	HGL 6340 Glenwood, Suite 200, Building #7 Overland Park, Kansas 66202	sschroepfer@hgl.com
Janardan Patel	HGL/ Program Manager	703-736-4509 (o) 703-471-4180 (fax)	HGL 11107 Sunset Hills Road Suite 400 Reston, VA 20190	jpatel@hgl.com
Mark McGowan	HGL/ CHSM	703-736-4561 (o) 703-888-6441 (cell) 703-471-4180 (fax)	HGL 11107 Sunset Hills Road Suite 400 Reston, VA 20190	mmcgowan@hgl.com
Larry Hudgins	AMEC/ Technical Manager	704-655-1352 (o) 612-325-3275 (cell)	AMEC Environmental & Infrastructure, Inc 10300 Mull Court Huntersville, NC 28078	larry.hudgins@amec.com
Raye Lahti	AMEC/ Geophysicist	970-569-3361 (o) 651-767-2335 (cell)	AMEC Environment & Infrastructure, Inc. 800 Marquette Ave Suite 1200 Minneapolis, MN 55402	raye.lahti@amec.com

APPENDIX D

ACCIDENT PREVENTION PLAN

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EMERGENCY INFORMATION

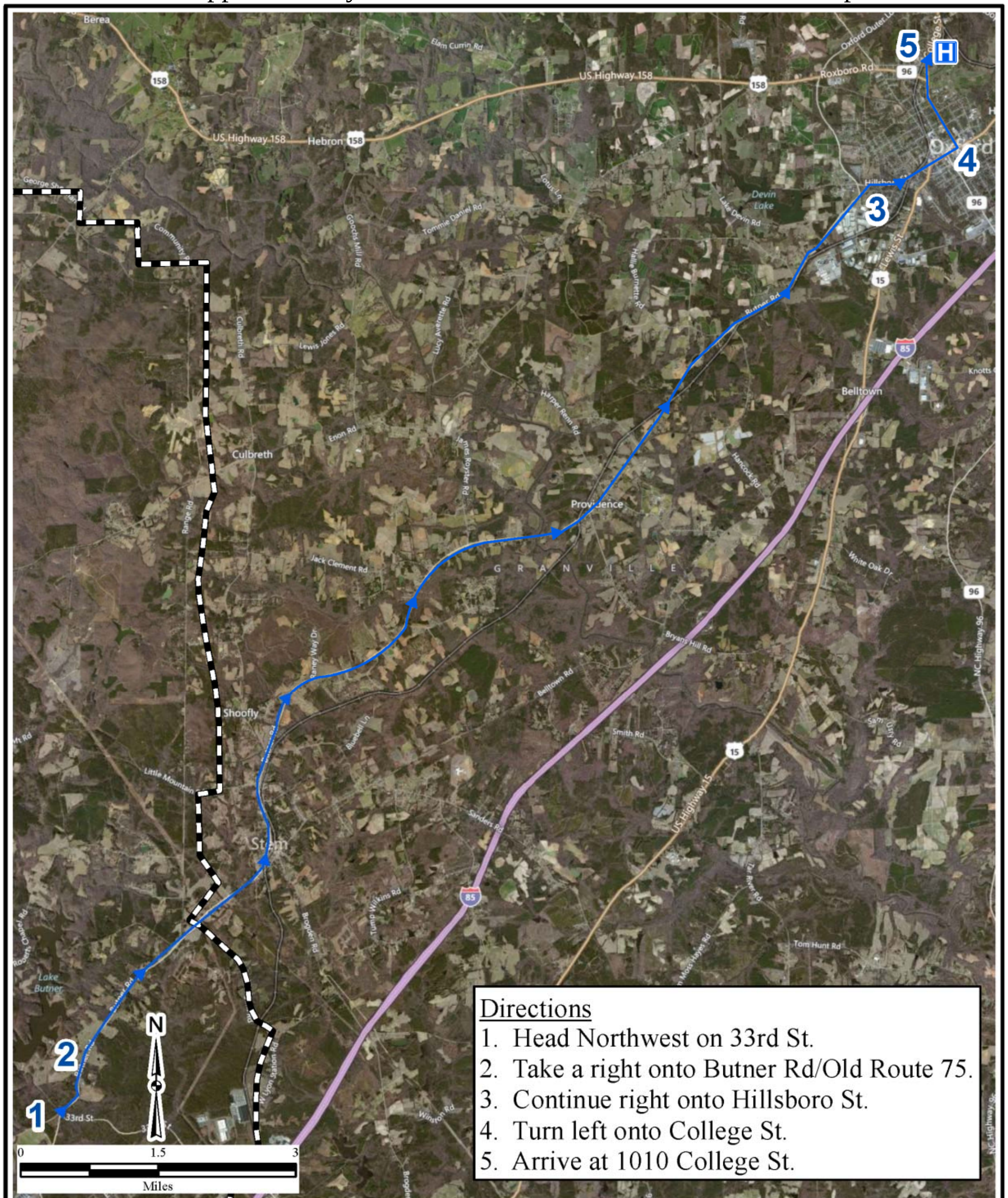
To facilitate quick retrieval of information in the event of an emergency, this summary has been placed in the front of this Accident Prevention Plan. In the event of any situation or unplanned occurrence requiring assistance, the appropriate contact(s) should be made from the list below. In most emergency situations, telephone contact should first be made with the site point of contact, who will then notify the appropriate response teams. In the event of alife-threatening emergency, emergency personnel should be contacted before the site point of contact.

EMERGENCY TELEPHONE NUMBERS AND PROJECT CONTACTS

Fire, Police, Emergency Medical Services	911	
Emergency Medical Care Granville County EMS Station 406 Grey Street Creedmoor, North Carolina 27522	(919) 528-3700	
Granville Medical Center (Hospital) 1010 College Street Oxford, North Carolina 27565	(919) 690-3000	
National Poison Control	(800) 222-1222	
National Response Center Environmental Emergencies	(800) 424-8802	
Client		
U.S. Army Engineer Support Center-Huntsville, Project Manager	Chris Cochrane	(256) 895-1696
U.S. Army Corps of Engineers, Wilmington District, Project Manager	Ray Livermore	(910) 251-4702
HydroGeoLogic, Inc.		
Health and Safety Emergency Number	(800) 341-3647	
Project Manager	Derek Anderson	(706) 372-5138
Site Manager/Senior Unexploded Ordnance Supervisor	Scott Schroepfer	(707) 330-6411
Site Safety Health Officer/Unexploded Ordnance Safety Officer	Cliff Ancelet	(505) 382-3938
Unexploded Ordnance Safety Manager	Ronald D. Mendenhall, Jr.	Office: (505) 341-3362 Cell: (505) 280-2036
Corporate Health and Safety Director	Mark McGowan, CIH, CSP	Direct: (703) 736-4561 Cell: (703) 888-6441
Project Health and Safety Manager	Edie Scala-Hampson, CIH, CHMM	Cell: (847) 409-6384
HGL Corporate Occupational Physician *WorkCare 24-Hour Hotline Nurse	Peter Greaney, MD	(714) 978-7488, ext. 114 *(888) 449-7787

ROUTE MAP AND DIRECTIONS TO
GRANVILLE MEDICAL CENTER
(HOSPITAL)

It takes approximately 30 minutes of travel time to reach the hospital.



\\gst-srv-01\HGLGIS\Camp_Butner\RIFS_WP\Hospital_Route.mxd
Map Source: HGL

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Legend

Camp Butner Boundary

Granville Medical Center
1010 College St
Oxford, NC 27565

Hospital Route
(Approximately 30 minutes)

Hospital Route
Former Camp Butner
North Carolina

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ACCIDENT PREVENTION PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
MILITARY MUNITIONS RESPONSE SITES
FORMER CAMP BUTNER
GRANVILLE COUNTY, NORTH CAROLINA

SIGNATURE SHEET

CLIENT:	U.S. Army Engineering and Support Center, Huntsville
CONTRACT NO.:	W912DY-10-D-0023
TASK ORDER NO.:	0009
PROJECT NO.:	I04NC000902
PROJECT MANAGER:	Derek Anderson
PREPARED BY:	Scott Schroepfer
PREPARATION DATE:	April 17, 2012
REVISION NO.:	0

APPROVED BY:

________________________	9/13/2012
Derek R. Anderson, P.E.	Date
HGL Project Manager	
(706) 372-5138	

________________________	5/22/2012
Ronald D. Mendenhall, Jr.	Date
HGL UXO Safety Manager	
(505) 348-3362	

M. McGowan CSP, CIH

________________________	September 13, 2012
Mark A. McGowan, CIH, CSP	Date
HGL Corporate Health & Safety Director	
(703) 736-4561	

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ATTACHMENTS

LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

AHA	activity hazard analysis
AMEC	AMEC Earth and Environmental, Inc.
APP	Accident Prevention Plan
ARNG	Army National Guard
CFR	Code of Federal Regulations
CHSD	Corporate Health and Safety Director
CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
CSP	Certified Safety Professional
DA	Department of the Army
DART	days away, restricted, or transferred
DDESB	Department of Defense Explosives Safety Board
DoD	U.S. Department of Defense
DOT	Department of Transportation
EM	Engineering Manual
EMR	experience modification rate
ERP	emergency response plan
EZ	exclusion zone
FS	Feasibility Study
FTR	Flame Thrower Range
FUDS	Formerly Used Defense Site
H&S	health and safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HGL	HydroGeoLogic, Inc.
HGR	Hand Grenade Range
HSP	Health and Safety Program
IAW	in accordance with
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
MMRP	Military Munitions Response Program
mph	miles per hour
MPPEH	material potentially presenting an explosive hazard
MRS	munitions response site
MSDS	material safety data sheet

NAICS	North American Industry Classification System
NOAA	National Oceanic and Atmospheric Administration
OSHA	Occupational Safety and Health Administration
OSIC	On-Scene Incident Commander
PHSM	project health and safety manger
PM	Project Manager
PPE	personal protective equipment
PWS	performance work statement
RC1	Range Complex 1
RC2	Range Complex 2
RI	Remedial Investigation
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SUXOS	Senior UXO Supervisor
TP	Technical Paper
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineer Support Center-Huntsville
UXO	unexploded ordnance
UXOSO	UXO Safety Officer

ACCIDENT PREVENTION PLAN ACKNOWLEDGMENT

I have read, understand, and agree to abide by the provisions as detailed in this Accident Prevention Plan and Site Safety and Health Plan prepared by HydroGeoLogic, Inc. Failure to comply with these provisions may lead to disciplinary action that may include dismissal from the work site, termination of employment, or, for subcontractors, termination of the work contract.

Printed Name	Company	Signature	Date

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1.0 BACKGROUND INFORMATION

This Accident Prevention Plan (APP) and accompanying Site Safety and Health Plan (SSHP) (Attachment 1) describe the safety program that will be implemented by HydroGeoLogic, Inc. (HGL) during work under Contract No. W912DY-10-D-0023, Task Order No. 0009, at the former Camp Butner in Granville County, North Carolina. The project involves geophysical detection and investigation of anomalies, associated brush clearance activities, disposal of munitions and explosives of concern (MEC) and munitions debris (MD), and environmental sampling.

All activities involving work in areas potentially containing unexploded ordnance (UXO) hazards will be conducted in full compliance with the safety standards of the U.S. Army Corps of Engineers (USACE), the Department of the Army (DA), and the U.S. Department of Defense (DoD), and with state and local safety requirements regarding personnel, equipment, and procedures.

The following job-specific background information is provided on the contract and contractor.

1.1 CONTRACTOR

HGL (Corporate Office)
11107 Sunset Hills Road
Suite 400
Reston, Virginia 20190
(703) 478-5186

1.2 CONTRACT NUMBER

W912DY-10-D-0023 (Task Order No. 0009)

1.3 PROJECT NAME

Remedial Investigation (RI)/Feasibility Study (FS), Former Camp Butner, Granville County, North Carolina.

1.4 PROJECT DESCRIPTION

HGL will perform a RI/FS at Camp Butner, North Carolina, a Formerly Used Defense Site (FUDS), in accordance with (IAW) the U.S. Army Engineer Support Center-Huntsville (USAESCH) performance work statement (PWS), Revision 1, dated August 25, 2011. Figures showing the scoped munitions response sites (MRSs) listed below are presented in Appendix B of the Work Plan:

- Army National Guard (ARNG) Property
- Range Complex 1 (RC1)
- Range Complex 2 (RC2)

- Hand Grenade Range (HGR)
- Flame Thrower Range (FTR)

1.5 CONTRACTOR ACCIDENT EXPERIENCE

Table 1.1 provides HGL's 5-year accident and incident history as well as its experience modification rates (EMRs) for the policy periods in question. HGL's days away, restricted, or transferred (DART) and total recordable incident rates are much lower than the average rates for other companies operating under the same North American Industry Classification System (NAICS) code. HGL's EMR is consistently less than 1.0 and was 0.82 for the 2011/2012 policy year.

Table 1.1
Health and Safety Performance Indicators

Year	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**
EMR	0.81	0.81	0.83	0.84	0.82
Year	**2006**	**2007**	**2008**	**2009**	**2010**
Fatalities	0	0	0	0	0
DART Cases	2	1	0	1	2
DART Case Incident Rate	1.07	0.47	0.00	0.37	0.74
U.S. Bureau of Labor Statistics DART Incident Rate (NAICS Code 562910)	2.60	2.60	1.90	1.5	-
Total Recordable Cases	5	2	2	1	5
Total Recordable Incident Rate	2.68	0.93	0.81	0.37	1.85
U.S. Bureau of Labor Statistics Total Incident Rate (NAICS Code 562910)	4.40	4.80	3.10	3.30	-
Average Number of Employees	221	245	268	310	345
Hours Worked	373,347	429,384	491,857	534,.080	541,685

1.6 PHASES OF WORK AND HAZARDOUS ACTIVITIES REQUIRING ACTIVITY HAZARD ANALYSIS

Work will consist of the following phases, each of which is discussed in detail in Attachments 1 and 3:

- Mobilization and site preparation,
- Brush clearing,
- Geophysical system ground reconnaissance,
- Intrusive investigation of anomalies (i.e., anomaly reacquisition and excavation or mag and dig),
- Disposal of MEC and MD,
- Environmental sampling, and
- Demobilization.

2.0 STATEMENT OF HEALTH AND SAFETY POLICY

The purpose of this safety and health policy statement is to establish HGL's commitment to employee health and safety (H&S) as an integral part of business conduct. It is the policy of HGL to provide a safe and healthy work environment for all employees and subcontractors.

HGL considers no phase of operation or administration to be of greater importance than injury or illness prevention. Safety takes precedence over expediency or shortcuts, and every reasonable step will be taken to reduce the possibility of injury, illness, or accident.

This APP describes the procedures that must be followed during RI fieldwork at the Camp Butner MRSs. Operational changes that could affect the health or safety of personnel, the community, or the environment will not be made without the prior approval of HGL's Project Manager (PM) and Corporate Health and Safety Director (CHSD).

HGL subcontractors must complete their work IAW HGL's APP. Subcontractors will provide all personal protective equipment (PPE) used by their employees and furnish documentation of all required training. A current copy of the APP will be kept on the project site at all times. This document will be made available to the USAESCH PM and HGL's project health and safety manager (PHSM) for review prior to the commencement of or during work activities.

HGL will require all visitors to the work site to abide by the requirements of this APP. The HGL PM, with the consent of the PHSM, will provide written addenda to this APP when changes warrant. No changes to the plan will be implemented without prior approval of the HGL PHSM.

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3.0 RESPONSIBILITIES AND LINES OF AUTHORITY

A detailed organization chart for project management is found in Figure 2.1 in the accompanying Work Plan.

3.1 HGL PERSONNEL

The following identifies key HGL personnel responsible for the safe execution of this project:

- **PM:** Derek Anderson
- **CHSD:** Mark McGowan, Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP)
- **PHSM:** Edie Scala-Hampson, CIH and Certified Hazardous Materials Manager (CHMM)
- **Site Safety and Health Officer (SSHO)/UXO Safety Officer(UXOSO):** Cliff Ancelet
- **Site Manager/(Senior UXO Supervisor (SUXOS):** Scott Schroepfer

In matters related to workplace H&S, the SSHO, referred to hereinafter as the UXOSO, will report directly to the CHSD, who reports to corporate management at the most senior level. Routine contact between the UXOSO and the CHSD is anticipated during the course of the project.

3.2 LINE OF AUTHORITY

The following shows the project personnel, the organizations that they represent, and their roles in the project.

Table 3.1
Project Personnel

U.S. Government	
Chris Cochrane	USAESCH, PM
Ray Livermore	USACE Wilmington District, PM
HGL	
Derek Anderson	PM
Mark McGowan	CHSD
Edie Scala-Hampson	PHSM
Scott Schroepfer	Site Manager/SUXOS
Clifton Ancelet	SSHO/UXOSO

3.2.1 All Personnel

Each person is responsible for his/her own H&S, completing tasks in a safe manner, and reporting any unsafe acts or conditions to the SUXOS and UXOSO. All persons on site are responsible for continuous adherence to APP procedures during the performance of any project work. In no situation may work be performed in a manner that conflicts with the intent of or the inherent safety precautions expressed in this APP.

All HGL and subcontractor personnel are required to read and acknowledge their understanding of this APP by signing the APP acknowledgement form located in the front of this document and by cooperating with project management to ensure a safe work site.

3.2.2 Project Manager

The responsibilities of Derek Anderson, the PM, include the following:

- Ensuring conformance with HGL corporate and USACE H&S policies and procedures,
- Coordinating the project with USACE H&S personnel,
- Ensuring that the project has the necessary resources to operate safely,
- Ensuring that the project personnel satisfy HGL and USACE H&S requirements and,
- Ensuring that project personnel implement the project APP/SSHP and have the appropriate regard for safe job performance,
- Ensuring that all fieldwork is properly documented, and
- Maintaining open H&S lines of communications between the client and all contractors.

3.2.3 Corporate Health and Safety Director

The responsibilities of Mark McGowan, CIH and CSP, the CHSD, include the following:

- Overseeing the development and coordination of the APP/SSHP as required,
- Recommending changes to the APP/SSHP if warranted by changed conditions,
- Administering HGL's corporate Health and Safety Program (HSP),
- Determining the level of PPE required,
- Developing site-specific employee emergency response plans based on expected hazards,
- Confirming each HGL team member's suitability for work based on physician recommendations,
- Conducting field H&S audits to ensure APP/SSHP conformance and HGL policy compliance,
- Certifying that all workers have proper training per 29 Code of Federal Regulations (CFR) 1910.120(e),
- Updating equipment or procedures based on information obtained during site operations,
- Investigating significant accidents and illnesses, and implementing corrective action plans,
- Establishing air monitoring parameters based on expected contaminants,

- Establishing employee exposure monitoring notification programs,
- Stopping any operation that threatens the H&S of the team or surrounding population, and
- Upgrading or downgrading levels of protection based on site observations or monitoring results.

3.2.4 Responsibilities at Project Level

All personnel involved in field activities are responsible for adherence to this APP during the performance of their work. The following subsections describe the responsibilities of on-site personnel.

3.2.5 Senior Unexploded Ordnance Supervisor

The HGL SUXOS has direct responsibility for all MEC related activities. The SUXOS will be responsible for the following:

- Providing initial MEC hazard awareness and recognition training to the field team personnel before field activities in a suspected MEC contaminated area commence,
- Coordinating with the UXOSO in establishing planned ingress, egress, and routine vehicle and footpath routes within the project area to avoid MEC hazards,
- Ensuring that surface MEC hazards are identified and visibly marked using pin-flags, and that verbal warnings and instructions are given to the field team,
- Providing MEC anomaly avoidance by ensuring that a qualified UXO technician is in front of any non-UXO field personnel when entering an area suspected of MEC contamination hazards;
- Ensuring that MEC items found are documented, properly inspected, and contained, and
- Coordinating explosive operations and final disposition of MEC hazards.

3.2.6 Unexploded Ordnance Safety Officer

The UXOSO reports to the CHSD and is responsible for field enforcement of the APP. All site MEC and munitions constituents (MC) activities will be conducted under the supervision of the HGL UXOSO on an "as needed" basis. The UXOSO will act as safety oversight for normal and emergency work, and will perform any necessary emergency notification as the On-Scene Incident Commander (OSIC). He is also responsible for the following:

- Authorizing stop work as related to H&S issues,
- Implementing the APP/SSHP,
- Enforcing all provisions of the APP/SSHP,
- Determining evacuation routes,

- Enforcing the use of the "buddy" system,
- Establishing work zones and exclusion zones (EZs),
- Investigating accidents, incidents, and near misses,
- Presenting daily safety meetings,
- Presenting training requirements to site personnel and visitors,
- Maintaining safety logs and records in the field,
- Implementing changes to the APP/SSHP as directed by the CHSD or PSHM,
- Administering and enforcing the HSP,
- Enforcing the level of PPE required,
- Investigating work-related accidents and illnesses, and implementing corrective action plans,
- Establishing air-monitoring parameters based on expected contaminants,
- Establishing employee exposure monitoring notification programs,
- Stopping any operation that threatens the health or safety of the team or surrounding population, and
- Upgrading levels of protection based on site observations or monitoring results.

3.3 SUBCONTRACTORS

The following teaming partner and subcontractors have been identified:

- AMEC Earth and Environmental, Inc. (AMEC) will supplement HGL by providing on site personnel and resources during execution of the RI/FS. AMEC has extensive Military Munitions Response Program (MMRP) human health/ecological risk assessment experience with DoD at MEC sites throughout the country.
- MicroBac Laboratories will perform off site laboratory analytical services for MC.
- Accutest Laboratories will also provide off site laboratory analytical services.

When working in an EZ, employees of subcontractors will be escorted by HGL UXO-qualified personnel at all times to ensure that they avoid MEC hazards.

The UXOSO will require that employees of subcontractors adhere to applicable site safety requirements. This will involve consideration of the nature, location, and duration of their work tasks. At a minimum, employees of subcontractors will receive a daily briefing on anticipated risks and safety rules designed to mitigate those risks. The UXOSO will consult with the PHSM and/or CHSD, if questions arise. Subcontractors performing work at the site will attend a safety meeting as required by and held by the UXOSO each day prior to the start of work. The UXOSO will monitor subcontractor operations to ensure compliance with site safety requirements.

4.0 TRAINING

All HGL employees, subcontractors employees, and site visitors must be trained IAW this APP. In every case, appropriate training will include briefings by the UXOSO on site hazards and work rules. In addition, the UXOSO will require evidence of prior completion of mandatory courses in some situations. The UXOSO will maintain a file of training certificates or other documentation verifying that these requirements have been met.

4.1 MANDATORY TRAINING FOR PERSONNEL EXPOSED TO SIGNIFICANT SITE HAZARDS

The UXOSO will verify that the following training courses have been completed by on-site personnel:

- **UXO training**. Evidence of certification is required for site workers handling material potentially presenting an explosive hazard (MPPEH) items IAW DoD Explosives Safety Board (DDESB) Technical Paper (TP) 18.
- **Forty-hour course on H&S in hazardous waste operations.** Evidence of training as a site worker IAW 29 CFR 1926.65 is required for site workers and visitors potentially exposed to chemical, radiological, or ordnance hazards. Evidence of a recent annual refresher course also is required.
- **Eight-hour course on supervision of hazardous waste operations**. Evidence of training as a supervisor IAW 29 CFR 1926.65 is required for at least one HGL supervisor or manager present on the site.
- **Heavy equipment operation.** Evidence of training in the safe operation of heavy equipment will be required for operators of bulldozers, forklifts, backhoes, and similar machines.
- **First aid/cardiopulmonary resuscitation (CPR)**. Evidence of current certification in first aid/CPR will be required for a sufficient number of HGL employees to permit scheduling of at least two with this training on the project site at all times. Procedures to manage bloodborne pathogens should be a component of this training.
- **Respirator training**. The need for training in the use of respirators is **not** anticipated. However, if the PHSM and/or the CHSD deems that it is necessary, the UXOSO will require that anyone who uses a respirator provide evidence of appropriate training.
- **Occupational Safety and Health Administration (OSHA)-approved 30-hour course on construction safety.** The UXOSO will keep on the site a certificate confirming that he received training in construction safety within the previous 3 years, IAW Paragraph 01.A.17 of Engineering Manual (EM) 385-1-1.

In addition, the UXOSO will make inquiries to determine whether new employees have previous experience on a hazardous waste site or MRS. He will arrange for close supervision of inexperienced workers by an experienced supervisor for at least the first 3 days of their work on the site.

4.2 SITE-SPECIFIC TRAINING

A detailed presentation on site risks and the workplace H&S program will be conducted by the UXOSO before work commences on the site, and at other times when new site workers arrive. Topics will include the following:

- Requirements and responsibilities for maintaining a safe and healthful work environment,
- General H&S policies and procedures,
- Safe work practices,
- Phases and sequence of work,
- Employee and supervisor responsibilities for reporting accidents,
- Emergency response plans and notification procedures for obtaining medical treatment,
- Work site communication,
- Access, egress, and evacuation routes,
- Route to the hospital,
- Procedures for reporting and correcting unsafe conditions or practices,
- Specific job hazards and the means to mitigate the risks,
- Names of and contact information for those responsible for safety program administration,
- Site hazards, hazard recognition, hazard control, and symptoms of excessive exposure to site hazards,
- MEC suspected on site,
- MPPEH and precautions,
- Reporting requirements for MEC/UXO,
- Site control and work zone boundary locations and posting of hazards warning signs,
- Proper use of required PPE, and
- Safe use of engineering controls and equipment on the project site.

In addition, the UXOSO will provided detailed safety training in the following areas to workers exposed to the hazard described:

- **Chemical hazard communication**. If chemicals are brought onto the job site, employees potentially exposed to their hazards will receive appropriate safety training. This will include the details of the chemical hazard communication program described in Attachment 1, the SSHP.
- **Fire prevention and response**. The UXOSO will conduct training sessions on measures to prevent fires and procedures for suppressing fires. Employees will receive

training in the use of fire extinguishers to fight incipient fires.

- **Control of hazardous energy (lockout/tagout)**. If site work involves the potential for injury from the release of stored energy, then employees will be trained in appropriate lockout/tagout procedures described in the SSHP.

The UXOSO will confer with the PHSM and/or CHSD to determine an appropriate schedule for retraining employees in site-specific safety topics. Annual or more frequent refresher sessions will be required.

Daily safety briefings will be conducted by the UXOSO for site personnel prior to the start of each day’s activities. Such sessions will be used to discuss anticipated risks and safe practices to mitigate hazards.

The UXOSO also will conduct appropriate safety briefings for visitors and vendor representatives who will be on the site for short periods. The topics covered will be determined by the nature of the potential hazards to which they will be exposed.

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5.0 SAFETY AND HEALTH INSPECTIONS

Informal daily inspections will be conducted by the UXOSO to verify that site operations and personnel are complying with this APP and the SSHP. The results of these inspections will be recorded in the safety log and reported to the SUXOS.

The UXOSO will direct that any safety violation be corrected immediately, and he will halt work if a condition places employees at unacceptable risk. He will confer with the PHSM and/or CHSD if unsafe conditions cannot be corrected promptly, or if violations occur repeatedly.

The UXOSO will investigate every accident, injury, or near-miss event, and prepare a formal report of the incident for review by the PHSM and/or CHSD.

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6.0 HEALTH AND SAFETY EXPECTATIONS AND COMPLIANCE

6.1 HGL'S CORPORATE HEALTH AND SAFETY PROGRAM

HGL's HSP is designed to provide the safety training and tools required to enable HGL management to provide a safe work environment for its employees, project personnel, subcontractors, and the general public in and around project sites.

6.2 HGL'S HEALTH AND SAFETY PROGRAM NONCOMPLIANCE POLICIES AND PROCEDURES

HGL's HSP provides steps for addressing safety infractions as early as possible and returning to a safe and compliant work environment. Because noncompliance with H&S policies, site-specific H&S plans, and other safe work practices could potentially lead to serious injuries to individuals on a job site, this disciplinary policy is more stringent than the general HGL progressive disciplinary policy.

6.3 HGL'S WRITTEN PROCEDURES FOR HOLDING MANAGERS AND SUPERVISORS ACCOUNTABLE FOR HEALTH AND SAFETY

Written H&S goals are developed annually for members of the management team. The goals are designed to advance development of the HSP at HGL, involve all levels of employees, proactively address H&S issues, and force accountability of H&S for the management team. Management personnel are held accountable for completion of these goals, and compensation is tied to the success of an individual's performance in meeting the goals.

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7.0 ACCIDENT REPORTING

In the event that a reportable accident occurs at the job site, the UXOSO will provide an immediate verbal notification to the HGL PHSM and/or CHSD and to the USAESCH PM. Accidents will be investigated to identify causes and control measures. USAESCH Form 3394 (Attachment 2) will be completed by the UXOSO and forwarded within 2 working days to the HGL PHSM and/or CHSD and to the USAESCH PM.

Reports to USAESCH will be completed for accidents that result in one or more of the following outcomes**:**

- Fatal injury,
- Injury of employees,
- Lost work days, or
- Property damage exceeding $2,000.

If required, an OSHA Form 300 will be complete by the PHSM and/or CHSD, in consultation with the UXOSO.

In the event of a significant near-miss event or other incident for which USAESCH reporting is not required, the UXOSO will investigate the incident and report the results of the investigation using an appropriate HGL form. This form will be sent to the PHSM and/or CHSD and to the HGL PM for review.

Daily records of first aid treatments will be maintained by the UXOSO on prescribed forms.

Exposure data (man-hours worked) will be provided to the PM by the SUXOS at regular intervals, and the PM will prepare the monthly reports for the USAESCH PM.

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8.0 MEDICAL SUPPORT

8.1 EMERGENCY INFORMATION

To facilitate the quick retrieval of information in the event of an emergency, a table listing points of contact and associated contact information has been placed near the front of this APP. In the event of any situation or unplanned occurrence that requires immediate or emergency assistance, the appropriate contacts should be notified. In most emergency situations, telephone contact should first be made with the site point of contact, who will then notify the appropriate response teams. In the event of a life-threatening emergency, emergency personnel should be contacted before the site point of contact.

8.2 DIRECTIONS TO HOSPITAL

To facilitate the quick retrieval of information in the event of an emergency, directions to the Granville County EMS Station, located at 406 Grey Street, Creedmoor, North Carolina, and the Granville Medical Center, located at 1010 College Street, Oxford, North Carolina, and maps depicting the routes, have been placed in the front matter of this APP.

8.3 EMERGENCY TREATMENT

At least two site workers qualified in first aid and CPR will be present on the site at all times. It is anticipated that workers with this training will assist others who sustain minor injuries at the site.

If injuries are more serious, the UXOSO will assess the situation and determine a course of action consistent with the written emergency procedures, which are found in the accompanying SSHP. The UXOSO will determine whether the injured person should be transported using a site vehicle, or if an ambulance will be required to transport the injured person to a medical treatment facility.

Emergency medical services will be contacted by calling 911. The designated caller will remain on the line with the 911 operator unless the caller needs to assist the injured person.

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9.0 PERSONAL PROTECTIVE EQUIPMENT

Basic “level D” PPE for site work will consist of a basic work outfit offering some protection against abrasion and sunlight, heavy work gloves, sturdy work boots, and safety glasses with side shields or comparable side protection. The following additions to this basic ensemble will be required under the circumstances indicated:

- A hard hat will be required when employees are exposed to the danger of head impacts with hard objects, such as backhoe buckets. Hard hats generally will be required for work around heavy equipment.
- Nonmetallic safety-toe work boots, or boots offering comparable protection to the toes, will be required when employees are exposed to the danger of crushing injuries to the foot.
- Earplugs or ear muffs will be required when employees work around loud machinery. The UXOSO will require the use of hearing protection by employees using chainsaws or performing other noisy tasks.
- Chaps or similar protection of the legs will be required if deemed necessary by the UXOSO for protection against contact with machinery, abrasive vegetation or underbrush.
- Waders or similar protection of the lower body will be required if deemed necessary by the UXOSO for protection against contact with water and submerged vegetation.
- Personnel conducting environmental sampling for MC will wear disposable nitrile gloves that will be changed between sampling locations and/or every 15 minutes during collection activities. The UXOSO will require other measures to avoid skin contact with contaminants or to limit inhalation exposures, if necessary.
- Full-face shields, fire resistant welder’s gloves, and welder’s aprons will be worn by staff handling leaking white phosphorous, plasticized white phosphorous, and red phosphorous munitions or items contaminated with white phosphorous residue.

The UXOSO will assess the adequacy of PPE during the course of the project and consult with the PHSM and/or CHSD if modifications appear desirable. He will notify the PHSM and/or CHSD immediately if unexpected site conditions (such as soil contaminated with chemicals) are encountered to discuss needed changes in PPE, work practices, or both.

Site workers will be responsible for cleaning their protective equipment and maintaining its effectiveness. HGL will provide cleansing wipes, wash sprays and cloths, or equivalent cleaning supplies for this purpose. Site personnel will be responsible for daily inspections of their protective equipment. They will be instructed to inform the UXOSO if protective equipment is in need of replacement.

10.0 PLANS, PROGRAMS, AND PROCEDURES

The following plans have been identified as applicable to this project.

10.1 LAYOUT PLANS

Project site layout plans will be provided in the site-specific briefing and will include: temporary site facilities, portable toilets, equipment storage, planned parking areas, fencing, explosives storage, public traffic routes, access and egress to the work site, and rally points. See USACE EM 385-1-1, Section 04.A.01.

10.2 EMERGENCY RESPONSE PLAN

Prior to the start of this project, all personnel will review the APP/SSHP. The plan will be tested for effectiveness during the course of the project. The emergency response plan (ERP) will include escape routes, critical operations, rescue/medical duties, emergency reporting, and emergency contacts. Emergency alert systems will be developed, tested, and used to alert persons during emergency situations. Emergency phone numbers will be posted in conspicuous spots. If employees are working alone in remote locations, a means of contact must be provided. See USACE EM 385-1-1, Section 01.E.01 to .06.

10.2.1 Procedures and Test

During the project the ERP may be tested with an emergency drill or a walk through of emergency response procedures. If necessary, additional training to review procedures may be conducted. See USACE EM 385-1-1, Section 01.E.01.

10.2.2 Spill Plans

HGL will conduct cleanup operations in the event of a spill of hazardous material (i.e., fuel or oil from UXO field operations). The UXOSO will manage the collection of the spilled material with absorbent pads and containerize the pads or materials within Department of Transportation (DOT)-approved drums for disposal as potential contaminated hazardous waste. A complete spill kit will be maintained on site when spills are a potential hazard.

10.2.3 Firefighting Plan

In the event of a fire or explosion, the UXOSO will notify the police, fire department, and ambulance service; contact the USACE Wilmington District and HGL PMs; and escort the response personnel to the location of the fire or explosion. The UXOSO will determine the extent of the fire, coordinate and manage fire suppression efforts until the fire department arrives, use available on-site fire extinguishers (Type 10 lb 4A:60BC) on incipient stage fires only, and provide emergency first aid as needed. Site personnel will not fight fires containing explosives. The responding fire department personnel will be informed of the nature of the fire and whether explosives are present. See USACE EM 385-1-1, Section 09.A.01.

10.2.4 Emergency Telephone Numbers

Emergency response telephone numbers are provided with the front matter of this APP and will be maintained in each project vehicle.

10.2.5 Wild Land Fire Prevention Plan

Wild land fires will be responded to as indicated in Section 10.27, Fire Prevention, and Section 10.2.3, Firefighting Plan. Additional fire prevention measures will be taken (e.g. brush removal, wetting area down) during planned UXO disposal activities. See USACE EM 385-1-1, Section 09.K.01.

10.2.6 Man Overboard/Abandon Ship

Not applicable. Waterborne activities are not within the PWS for this project.

10.3 HAZARD COMMUNICATION PROGRAM

A Hazard Communication Program will be implemented to provide information about manufactured hazardous substances, including chemical hazards and the control of those hazards. The written Hazard Communication Program includes information on container labeling, the use of material safety data sheets (MSDS), and personnel training. Hazardous waste substances are excluded from this program. The following policies and regulations will be followed: the HGL H&S Program Mannual, Section 5.1, Hazard Communication; USACE EM 385-1-1, Section 06.B.01, Hazard Communication; and 29 CFR 1910.1200 and 1926.59.

The UXOSO must ensure that project personnel can immediately obtain the required information about chemicals of concern during an emergency.

10.4 RESPIRATORY PROTECTION PLAN

Not applicable. Respiratory hazards are not anticipated for this project.

10.5 HEALTH HAZARD CONTROL PLAN

Not applicable. Hazardous or toxic agents are not anticipated for this project.

10.6 LEAD ABATEMENT PLAN

Not applicable. Lead hazards are not anticipated for this project.

10.7 ASBESTOS ABATEMENT PLAN

Not applicable. Asbestos hazards are not anticipated for this project.

10.8 ABRASIVE BLASTING PLAN

Not applicable. Abrasive hazards are not anticipated for this project.

10.9 CONFINED SPACE

Not applicable. Confined space hazards are not anticipated for this project. However, excavations greater than 4 feet in depth will be considered confined spaces. Where there is the potential for buildup of vapors, permit-required confined space entry procedures will be followed. See USACE EM 385-1-1, Section 34.A.

10.10 HAZARDOUS ENERGY CONTROL PLAN

Not applicable. Hazardous energy locations are not anticipated for this project.

10.11 CRITICAL LIFT PROCEDURES

Not applicable. Critical lifts are not anticipated for this project.

10.12 CONTINGENCY PLAN FOR SEVERE WEATHER

Routinely monitoring weather conditions and reports may help reduce the impact of severe weather and natural disasters. Weather conditions will be a part of the daily briefing. It may be necessary to halt certain hazardous operations or stop work altogether to allow the situation to pass. The UXOSO must decide what operations, if any, are safe to perform based on existing and anticipated conditions.

Explosive and UXO operations must cease during thunderstorms and if there is any indication that lightning is approaching within 5 miles of the project location. See USACE EM 385-1-97, Section I.2.J.02.02.

The best protection against most severe weather episodes and natural disasters is to avoid them. This means seeking shelter before a storm hits. See USACE EM-385-1-1, Section 06.I.

10.12.1 Safe Locations During Severe Weather and Locations to Avoid

No place is absolutely safe from severe weather; however, some places are safer than others.

Large enclosed structures (substantially constructed buildings) tend to be much safer than smaller or open structures.

- The risk for lightning injury depends on whether the structure incorporates lightning protection, the construction materials used, and the size of the structure.
- In general, fully enclosed metal vehicles such as cars, trucks, buses, and vans, with the windows rolled up, provide good shelter from many weather conditions.

AVOID being in or near

- High places and open fields, isolated trees, rain or picnic shelters, communications towers, electrical equipment, pipes, flagpoles, light poles, bleachers (metal or wood), metal fences, or water (lakes, streams, rivers, etc.).

When inside a building AVOID

- Using a telephone, washing hands, or any contact with conductive surfaces with exposure to the outside (such as a metal doors or window frames, electrical wiring, telephone wiring, cable TV wiring, plumbing, etc.) if lightning is a factor.

10.12.2 Safety Guidelines for Individuals

Generally speaking, personnel should identify and seek shelter that is appropriate for the type of severe weather being encountered. Proper shelter always includes a sound structure and removal from the elements.

When available, attention is to be paid to warnings from sources such as the National Weather Service or National Oceanic and Atmospheric Administration (NOAA) and other credible weather detection systems. However, this information should not override good common sense.

10.13 ACCESS AND HAUL ROAD PLAN

Not applicable. Access and haul roads are not within the PWS for this project.

10.14 DEMOLITION PLAN

Not applicable. Demolitions are not within the PWS for this project.

10.15 EMERGENCY RESCUE PLAN

An Emergency Rescue Plan is not required for this project. Local emergency rescue capabilities will be utilized through the 911 system.

10.16 UNDERGROUND CONSTRUCTION FIRE PREVENTION AND PROTECTION PLAN

Not applicable. Underground activities are not within the PWS for this project.

10.17 COMPRESSED AIR PLAN

Not applicable. Compressed air activities are not within the PWS for this project.

10.18 FORM AND SHORING ERECTION AND REMOVAL PLAN

Not applicable. Form and shoring activities are not within the PWS for this project.

10.19 JACKING PLAN, SLAB PLAN

Not applicable. Jacking and slab activities are not within the PWS for this project.

10.20 BLASTING PLAN

The transportation, handling, storage, and use of demolition explosives, blasting agents, and blasting equipment are addressed in Section 3.5 of the Work Plan and HGL's standard operating procedures (SOPs). Applicable state and federal regulations, as well as explosive blasting procedures required in EM 385-1-1, Section 29, apply.

10.21 DIVING PLAN

Not applicable. Diving activities are not within the PWS for this project.

10.22 PLAN FOR PREVENTION OF ALCOHOL AND DRUG ABUSE

All project personnel will be asked to read and abide by the HGL Substance Abuse Policy and Procedures located on the HGL SharePoint website. This policy will be posted at the job site and in the project office.

HGL Portal Home > Document Center > HGL Policies

HGL SharePoint link:
https://sharepoint.hgl.com/docs/HGL%20Policies/Substance%20Abuse%20Policy.pdf

10.23 FALL PROTECTION PLAN

Not applicable. Field activities at heights greater than four feet above ground surface are not within the PWS for this project.

10.24 STEEL ERECTION PLAN

Not applicable. Steel erection activities are not within the PWS for this project.

10.25 NIGHT OPERATIONS LIGHTING PLAN

Not applicable. Night operations are not within the PWS for this project. Activities will be performed during daylight hours only.

10.26 SITE SANITATION PLAN

The following sanitation provisions will be established and maintained for the duration of this project. See USACE EM 385-1-1, Section 02.

- Drinking water
  - An adequate supply of cool water will be supplied and kept in water coolers in the on-site support zone. The water cooler will be kept closed.
- Toilet Facilities

  - HGL will provide a portable sanitary facility on the site; hand-washing stations will be made available.

- Waste Disposal
  - A trash receptacle will be provided in the support zone for the disposal of rubbish and other nonhazardous waste materials.

10.27 FIRE PREVENTION PLAN

A copy of the site-specific Fire Prevention Plan will be posted on site and implemented. See USACE EM 385-1-1, Section 09.A.01.

- Major work place fire hazards include the following:
  - Brush and range fires,
  - Flammable and combustible liquids,
  - Electrical fires, and
  - Waste materials and combustible waste.

- Potential ignition sources include the following:
  - Matches, lighters, sparks, and open flames,
  - Heat or sparks from vehicle engines or exhaust,
  - Electrical overloads or malfunctions,
  - Lightning and inclement weather,
  - Smoking,
  - Static discharge, and
  - Internal combustion.

- Types of fire suppression equipment include the following:
  - Water, and
  - Fire extinguishers.

- Housekeeping responsibilities include the following:
  - All site workers are responsible for fire prevention.
  - A good housekeeping program must be implemented.
  - Waste material must be removed daily.

In the event of a fire in the HGL field office, personnel will only attempt to extinguish the fire if it is identified as containable and one other person is present to act as a safety observer. All additional occupants will evacuate immediately following the posted emergency evacuation routes and go to the designated rally point. Muster will be taken by the senior person present to account for all personnel.

11.0 CONTRACTOR INFORMATION

This section provides information on how HGL will meet the requirements of the applicable sections of this APP.

11.1 EXCAVATIONS

Excavation activities will be limited to anomaly investigation and soil sampling activities with hand tools to identify subsurface targets. Earthmoving machinery may be required if the overburden of the excavation requires it.

Excavations will only be conducted by UXO-qualified personnel. Entry into excavations deeper than 4 feet is prohibited unless an HGL authorized Excavation Competent Person (ECP) is present who has evaluated the soil type by mechanical and visual means and who has perscribed the required sloping or benching necessary to secure the excavation from collapse. Excavations 4 feet or deeper may only be entered and exited via a step ladder. Excavations in or near chemically contaminated areas will require air monitoring prior to entry for parameters likely to impact entrants inside the excavation. The ECP should consult with the CHSD priot to authorizing entry into the excavation for verification that propoer safety procedures are being followed.

11.2 MEDICAL AND FIRST AID REQUIREMENTS

Before beginning site work, arrangements will be made with medical facilities and personnel to provide prompt attention to medical emergencies and occupational safety and health matters.

The emergency communications plan, transportation options, directions, and maps to the nearest medical facilities will be posted in the site trailers and in each site vehicle.

At a minimum, at least two on-site employees will be qualified to administer first aid and CPR.

The UXOSO vehicle will be designated as the primary emergency support vehicle. All site vehicles will carry first aid kits, and first aid equipment will be available at the site trailers.

11.3 SANITATION

HGL shall establish and maintain basic sanitation provisions for employees at all places of employment as specified below:

- An adequate supply of cool drinking water,
- Approved portable toilet systems,
- Washing facilities, located next to toilet facilities, and
- Waste disposal receptacles.

HGL employees will keep the work and support areas neat and orderly and free of trash and debris. An area will be established where personnel can take a break. The area will be clearly marked or identified.

All refuse will be deposited into designated containers while on site. It is the responsibility of all project personnel with the UXOSO providing oversight to ensure that the project site is kept clean.

11.4 PERSONAL PROTECTIVE EQUIPMENT

Based on hazard evaluations, HGL has selected Level D PPE for use at the site. The minimum attire for fieldwork will be short-sleeve shirts, long pants, and leather or protective work shoes suitable for current weather conditions.

Additional PPE will be required as indicated below:

- Gloves – required when working with hand tools or when the threat of a hand injury exists,
- Composite-toed or safety boots,
- Eye protection or safety glasses – required when potential eye injury exists,
- Hearing protection – required whenever sound-pressure levels exceed 85 decibels, and
- Head protection or hard-hat – required when head injury or overhead hazards exist.

11.5 FIRE PREVENTION

A written fire prevention plan will be provided and posted at the project site. It will include emergency contact information, a list of major workplace fire hazards, potential ignition sources, types of fire suppression equipment available to control a fire, and responsibilities and good housekeeping procedures and considerations.

Fire prevention training and awareness will provided during the site-specific brief and during daily tailgate safety briefings.

11.6 PUBLIC SAFETY REQUIREMENTS

The public will be notified through the public meeting and news media prior to the initiation of field work. Site access will be limited and EZs will be maintained. Danger, caution, and warning signs will be posted as required, and hazardous work activities will cease if necessary to ensure public safety.

12.0 SITE-SPECIFIC HAZARDS AND CONTROLS

HGL has analyzed the PWS and historical information to determine work risk hazards associated with fieldwork tasks to be performed at the site. The hazards likely to be encountered during fieldwork include classic safety, explosive ordnance, physical safety, and biological hazards. Chemical and ionizing radiation hazards are not likely to be encountered while performing fieldwork.

The following task hazard analysis includes both Hazardous Waste Operations and Emergency Response (HAZWOPER) and non-HAZWOPER related tasks, which may or may not occur during the initial phase of the project, but may occur during the removal of MEC or during the continuation of fieldwork. Table 12.1 presents the task hazard analysis for all planned work activities. The activity hazard analysis (AHA) sheets developed specifically for the hazardous tasks associated with this project site are located in Appendix F of the APP. Each AHA sheet provides job-specific steps, associated hazards, and those actions necessary to eliminate or minimize the potential hazards.

Table 12.1
Task Hazard Analysis

Potential Hazards	Tasks					
	MEC Intrusive Ops	Geophysical Investigation Surveying	MEC Excavation	MPPEH Processing	MC Soil Sampling	Off-road Vehicle Operations
Flying debris/objects			X	X		X
Noise > 85dBA		X	X	X		X
Electrical	X	X	X	X		X
Suspended loads		X	X	X		
Buried utilities, drums, tanks	X	X	X	X		
Slip, trip, fall	X	X	X	X	X	X
Back injury	X	X	X	X	X	X
Confined space entry			X			
Trenches/excavations			X		X	
Visible lightning	X	X	X	X	X	X
Vehicle traffic	X	X	X			X
Fires		X	X			X
Heavy equipment			X			
Explosive ordnance	X	X	X	X	X	
Biological	X	X	X	X	X	X
Heat/cold stress	X	X	X	X	X	X

Table 12.2 presents the principal steps, potential hazards, and recommended controls for the MEC/UXO tasks.

Table 12.2
Hazard Analysis Steps, Hazards, and Recommended Controls for MEC Tasks

Principal Steps	Potential Hazards	Recommended Controls
Transportation of explosive materials	Accidental detonation of explosives	Explosives will be transported IAW 49 CFR, Parts 100-199.
		Explosives will be transported in closed vehicles whenever possible.
		When using an open vehicle, explosives will be covered.
		Motor vehicles will be shut off when loading/unloading explosives.
		Beds of vehicles will have a nonconductive bed liner, dunnage, or sand bags to protect the explosives from contact with the metal bed and fittings.
		Initiating explosives, such as blasting caps, will remain separated at all times.
		Each vehicle used for the transport of MEC/UXO will be outfitted with a fire extinguisher and first aid kit.
	Accidental detonation of explosives	Trucks will not be refueled when loaded with MEC/UXO.
	Motor vehicle driver	Motor vehicle drivers operating within or outside the boundaries of any federal installation will be licensed in accordance with federal, state, and local regulations.
	Vehicle operations	Drivers will observe all posted speed limits while operating a motor vehicle on a public roadway.
		Vehicles transporting explosives off road will not exceed 20 miles per hour (mph).
		Chock wheels when loading or unloading MEC/UXO-related materials.
		All drivers will be licensed IAW state, local, and station regulations.
		The maximum vehicle speed while transporting explosives off paved roads will be 20 mph.
Storage of explosive materials	Environmental hazards Biological hazards Physical hazards Electrical hazards Suspended loads Fire hazards	PPE, delay of work effort PPE, repellants, avoidance PPE, proper lifting techniques, engineering controls PPE, grounding, equipment maintenance PPE, hardhats Non-sparking tools, grounding Fire extinguishers, prevention of smoking
	Accidental detonation of explosives	Materials will be stored in accordance with federal, state, and local regulations.
		Refer to the UXO subcontractor's SOPs for the storage of explosive materials.

Table 12.2 (continued)
Hazard Analysis Steps, Hazards, and Recommended Controls for MEC Tasks

Principal Steps	Potential Hazards	Recommended Controls
Surveying and establishing boundaries and grids	Accidental detonation of explosives	Personnel involved will attend a site-specific MEC/UXO recognition class prior to the commencement of any site activities.
		UXO personnel will escort non-UXO personnel at all times.
		Mark and avoid UXO. Only UXO personnel will handle MEC/UXO waste.
		Check location with magnetometer prior to driving stakes.
	Wildlife, slips, trips, falls, insects, poisonous plants, use of hand tools.	Refer to the AHA.
MEC avoidance	Accidental detonation of explosives	Personnel involved will attend a site-specific MEC/UXO recognition class prior to the commencement of any site activities.
		Personnel must remainalert and mark all MEC located.
		A UXO Technicain II or above will escort non-UXO personnel at all times. Intrusive operations will cease when nonessential personnel are within the EZ.
		Visual surface sweeps will be conducted with magnetometers or other suitable geophysical instrumentation to identify potential MEC/UXO.
MEC avoidance	Environmental hazards Biological hazards Physical hazards Fire hazards	PPE, delay of work effort PPE, repellants, avoidance PPE, proper lifting, engineering controls Prevention of smoking Fire extinguishers Drivers will not stop or park in grass areas that may catch fire from vehicle exhaust or heat.
Transportation of MEC	Accidental detonation of explosives	No personnel allowed in cargo compartment of vehicle.
	Accidental detonation of explosives	No MEC/UXO will be allowed in the passenger compartment of the vehicle.
		MEC/UXO will be blocked, braced, and secured.
		No smoking will be permitted in vehicles used for transport of MEC/UXO.
	Vehicle operations	Vehicles will be placarded IAW DOT regulations.
		Vehicles transporting explosives off road will not exceed 20 mph.
		Drivers will observe all posted speed limits while operating a motor vehicle on a public roadway.
UXO disposal operations	Accidental detonation of explosives	Procedures for safe demolition and explosives use will be observed.

Table 12.2 (continued)
Hazard Analysis Steps, Hazards, and Recommended Controls for MEC Tasks

Principal Steps	Potential Hazards	Recommended Controls
MEC-related scrap demilitarization	Accidental detonation of explosives	Only Explosive Ordnance Disposal/UXO technicians will perform explosive demilitarization of MEC-related scrap.
Inspection/certification of MPPEH	Accidental detonation of explosives	Only UXO technicians will inspect MPPEH and range-related scrap.
		Personnel in the immediate vicinity of MPPEH inspections will be kept to the minimum necessary for safe operations, but no fewer than two UXO technicians, consisting of at least one UXO Technician II and one UXO Technician III.
		Observe requirements of DoD 4160.21-M-1.
UXO disposal operations MEC-related scrap demilitarization Inspection/certification of MPPEH MEC intrusive activities	Noise hazards Environmental hazards Biological hazards Physical hazards Electrical hazards Suspended loads Fire hazards	Hearing protection, engineering controls PPE, delay of work effort PPE, repellants, avoidance PPE, proper lifting techniques, engineering controls PPE, grounding, equipment maintenance PPE, hardhats Non-sparking tools and grounding Fire extinguishers Prevention of smoking
MEC intrusive activities	Accidental detonation	The UXO team will follow MEC anomaly avoidance procedures during excavation activities.
		Personnel in the immediate vicinity of MEC operations will be kept to the minimum necessary for safe operations, but no less than two UXO technicians comprising of at least one UXO Technician II and one UXO Technician III.
		Do not subject MEC/UXO to heat, shock, or friction.
		Only hand excavation permitted when within 1 foot of known MEC/UXO.
		Hand-operated magnetometers will be used frequently to pinpoint the location of suspect MEC/UXO.
	Non-UXO personnel	Establish EZ; post warning signs, maintain site control.
		Stop all MEC/UXO operations when non-UXO personnel are within the EZ.

ATTACHMENT 1

SITE SAFETY AND HEALTH PLAN

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LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
ARNG	Army National Guard
BATF	Bureau of Alcohol, Tobacco, and Firearms
CDC	Center for Disease Control
CESAW	USACE, Wilmington District
CFR	Code of Federal Regulations
CHSD	Corporate Health and Safety Director
CHSM	Corporate Health and Safety Manager
CPR	cardiopulmonary resuscitation
DDESB	Department of Defense Explosives Safety Board
DGM	digital geophysical mapping
DoD	U.S. Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
EM	Engineering Manual
EOD	explosive ordnance disposal
ERP	emergency response plan
ESP	Explosives Site Plan
EZ	exclusion zone
FTR	Flame Thrower Range
GPS	Global Positioning System
H&S	Health and Safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HGL	HydroGeoLogic, Inc.
HGR	Hand Grenade Range
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mph	miles per hour
MPPEH	material potentially presenting an explosive hazard
MRS	munitions response site
MSDS	material safety data sheets
OE	ordnance and explosives
OJT	on-the-job-training

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

OSHA	Occupational Safety and Health Administration
PM	Project Manager
POC	point of contact
PPE	personal protective equipment
PWP	plasticized WP
PWS	Performance Work Statement
RC1	Range Complex 1
RC2	Range Complex 2
RP	red phosphorous
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SUXOS	Senior UXO Supervisor
TP-18	Technical Paper 18
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineer Support Center-Huntsville
UXO	unexploded ordnance
UXOSO	UXO Safety Officer
WNV	West Nile Virus
WP	white phosphorus
WP	work plan

EMERGENCY INFORMATION

To facilitate the quick retrieval of information in the event of an emergency, this summary has been placed in the front of this Accident Prevention Plan (APP). In the event of any situation or unplanned occurrence requiring assistance, the appropriate contact(s) should be made from the list below. For emergency situations, telephone contact should be made with the site point of contact who will then contact the appropriate response teams. In the event of a serious, life threatening emergency, emergency personnel should be contacted prior to contacting the site point of contact.

EMERGENCY TELEPHONE NUMBERS AND PROJECT CONTACTS

Fire, Police, Emergency Medical Services:	911	
Emergency Medical Care: Granville County EMS Station 406 Grey Street Creedmoor, North Carolina 27522 Granville Medical Center (Hospital) 1010 College Street Oxford, North Carolina 27565	(919) 528-3700 (919) 690-3000	
National Poison Control	(800) 222-1222	
National Response Center Environmental Emergencies	(800) 424-8802	
Client		
U.S. Army Engineer Support Center-Huntsville (USAESCH), Project Manager (PM) U.S. Army Corps of Engineers (USACE), Wilmington District (CESAW), PM	Chris Cochrane Ray Livermore	(256) 895-1696 (910) 251-4702
HydroGeoLogic, Inc.		
Health & Safety (H&S) Emergency Number	(800) 341-3647	
PM	Derek Anderson	(706) 372-5138
Site Manager/Senior Unexploded Ordnance (UXO) Supervisor (SUXOS)	Scott Schroepfer	(707) 330-6411
Site Safety Health Officer (SSHO)/UXO Safety Officer (UXOSO)	Cliff Ancelet	(505) 382-3938
UXO Safety Manager	Ronald D. Mendenhall, Jr.	Office: (505) 341-3362 Cell: (505) 280-2036
Corporate Health and Safety Director (CHSD)	Mark McGowan, CIH, CSP	Direct: (703) 736-4561 Cell: (703) 888-6441
Project Health and Safety Manager (PHSM)	Edie Scala-Hampson, CIH, CHMM	Cell: (847) 409-6384
HGL Corporate Occupational Physician *WorkCare 24-hour hotline Nurse	Dr. Peter Greaney. MD	714-978-7488 ext. 114 * 888-449-7787

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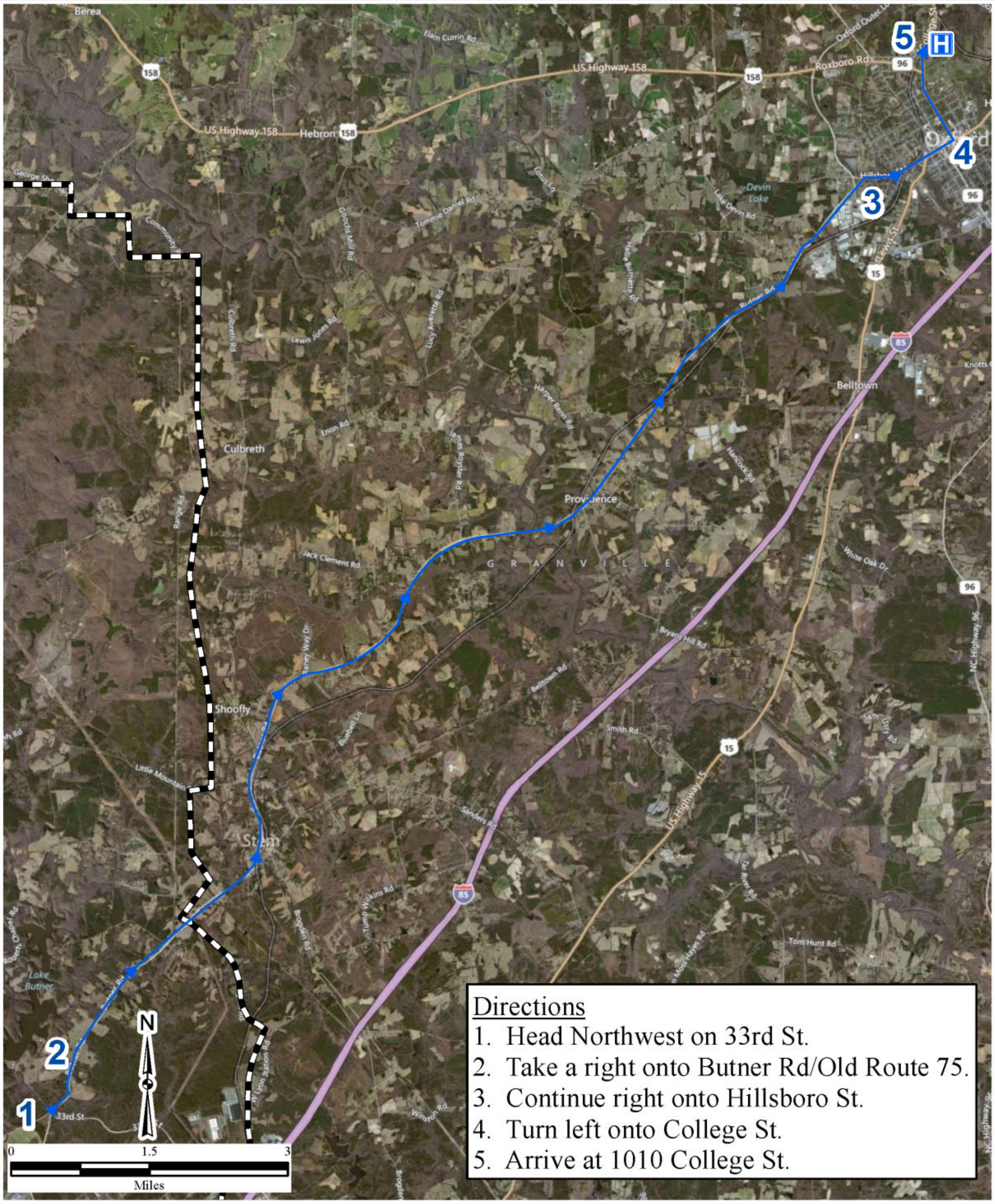
ROUTE MAP AND DIRECTIONS TO GRANVILLE MEDICAL CENTER

It takes approximately 30 minutes of travel time to reach the hospital.



\\gst-srv-01\HGLGIS\Camp_Butner\RIFS_WP\Hospital_Route.mxd
Map Source: HGL

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Legend

Camp Butner Boundary

Granville Medical Center
1010 College St
Oxford, NC 27565

Hospital Route
(Approximately 30 minutes)

Hospital Route
Former Camp Butner
North Carolina

1.0 INTRODUCTION

The objective of this Site Safety and Health Plan (SSHP) is to ensure that safe working conditions exist during this project. These health and safety procedures have been established based on preliminary analysis of potential hazards present at the Former Camp Butner Munitions Response Sites (MRSs). HydroGeoLogic, Inc. (HGL) has developed this SSHP to address occupational safety and health hazards associated with the completion of remedial investigation (RI) field activities at the project MRSs and specified in the Accident Prevention Plan (APP). The SSHP address the requirements of 29 Code of Federal Regulations (CFR) 1910.120(b)(4)(ii), 29 CFR 1926.65(b)(4)(ii), U.S. Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-1 and other Federal, state, and local safety and health requirements. The SSHP addresses those elements of safety, which are specific to the RI at Former Camp Butner, and have the potential for negative effects on the health and safety of workers. Therefore, the level of detail provided in the SSHP has been tailored to address the type of work, complexity of operations to be accomplished, and the hazards anticipated for the Former Camp Butner RI.

HGL has presented this SSHP as an attachment to the APP based on U.S. Army Engineering and Support Center (USAESCH) guidance (Data Item Description [DID] Worldwide Environmental Remediation Services [WERS]-005.01). Some of the required SSHP elements have been adequately addressed elsewhere in the work plan (WP) or APP. In an effort to eliminate redundancy, if a specific element has been previously addressed, the element of the SSHP is listed and the location in the WP/APP where the element is addressed has been identified.

The personal health and safety of individuals directly or indirectly involved in HGL projects is of particular concern to HGL. Therefore, prudent and reasonable measures will be taken to establish and maintain safe and healthy working conditions.

This plan applies primarily to HGL personnel and activities. Subcontractors are more familiar with the health and safety issues associated with the specific expertise for which they are hired; therefore each subcontractor is responsible for developing their own SSHP that addresses those hazards.

This plan provides minimum guidelines for all site activities. It identifies the minimum controls, use of personal protective equipment (PPE), emergency procedures, training, etc. that will be implemented during this project. If necessitated by conditions encountered in the field, additional site-specific information will be added to this plan. No significant changes to this plan will be made without prior approval of the HGL Project Manager (PM) and the Corporate Health and Safety Director (CHSD).

RI field activities will include the following:

- Munitions and explosives of concern (MEC), material potentially presenting an explosive hazard (MPPEH), and munitions debris (MD) identification, mapping, anomaly avoidance, removal, inspection and handling, and disposal

  - HGL UXO technicians will conduct analog magnetometer surveys, MEC identification and mapping, anomaly avoidance and MEC/MPPEH/MD removal, inspection, handling and disposal.
- Vegetation Clearance
  - Limited vegetation clearance will be conducted by HGL unexploded ordnance (UXO) technicians to provide access for geophysical evaluation and soil sampling activities.
- Geophysical Survey (digital geophysical mapping [DGM] and analog geophysical mapping [AGM])
  - HGL will provide oversight and escort of teaming partner AMEC during DGM geophysical survey activities at the MRS.
  - HGL will conduct AGM of MRS locations, as specified in the WP.
- Surface and Subsurface Soil Sampling
  - HGL will collect surface and subsurface soil, sediment, and groundwater samples for laboratory analysis of explosives, metals, and perchlorate (groundwater only).
- Topographic Survey
  - HGL will provide escort and oversight if subcontractor topographic surveyors will be on-site.
- Investigation-Derived Waste (IDW) Management
  - HGL will provide oversight, and sampling (soil and water) for waste characterization and disposal, if needed.
  - Subcontractor: IDW management firm will pickup, remove, and transport IDW (drums or liquids) from the site, if storage of site related waste is needed

It is estimated that the majority of the on-site work for this project will be completed between August and October of 2012.

1.1 SITE DESCRIPTION, INSTALLATION HISTORY AND ENVIRONMENTAL SETTING

A summary of the Former Camp Butner location, history, and environmental setting is provided in Sections 1.5, 1.6, and 1.7 of the work plan.

1.2 SITE HISTORY, LAND USE, AND CONTAMINATION CHARACTERIZATION

The MRS site history, land use, and contamination characterization is presented in Sections 1.6 through 1.9 of the work plan.

2.0 HAZARD AND RISK ANALYSIS

HGL has analyzed the Performance Work Statement (PWS) and historical information to determine work risk hazards associated with field work tasks to be performed at the Former Camp Butner MRSs. The hazards likely to be encountered during fieldwork include: classic safety, explosive ordnance, physical safety, and biological. Chemical and ionizing radiation hazards are not likely to be encountered while performing the fieldwork. The tasks and hazard/risk analyses detailed in this section shall be modified and approved throughout the project as needed to address changing work conditions.

The following task hazard analysis includes both Hazardous Waste Operations and Emergency Response (HAZWOPER) and non-HAZWOPER related tasks, which may or may not occur during the initial phase of the project, but may occur during the removal action of MEC or during the continuation of fieldwork. Table 2.1 presents the task hazard analysis for all planned work activities. The Activity Hazard Analysis (AHA) Sheets developed specifically for the hazardous tasks associated with this project site are located in Attachment 3 of the APP. Each AHA Sheet provides job specific steps, associated hazards, and those actions necessary to eliminate or minimize the potential hazards.

Table 2.1
Task Hazard Analysis

Potential Hazards	Tasks					
	MEC Intrusive Ops	**Geophysical Investigation Surveying**	**MEC Excavation**	**MPPEH Processing**	**MC Soil Sampling**	**Off-road Vehicle Operations**
Flying debris/objects			X	X		X
Noise > 85dBA		X	X	X		X
Electrical	X	X	X	X		X
Suspended loads		X	X	X		
Buried utilities, drums, tanks	X	X	X	X		
Slip, trip, fall	X	X	X	X	X	X
Back injury	X	X	X	X	X	X
Confined space entry			X			
Trenches/excavations			X		X	
Visible lightning	X	X	X	X	X	X
Vehicle traffic	X	X	X			X
Fires		X	X			X
Heavy equipment			X			
Explosive Ordnance	X	X	X	X	X	
Biological	X	X	X	X	X	X
Heat/Cold Stress	X	X	X	X	X	X

MPPEH = material potentially presenting an explosive hazard

Table 2.2 presents the principal steps, potential hazards, and recommended controls specifically for the MEC/UXO tasks.

Table 2.2
MEC Activity, Potential Hazards, and Recommended Controls

MEC Activity	Potential Hazards	Recommended Controls
Transportation of explosive materials	Accidental detonation of explosives	Explosives will be transported in accordance with 49 Code of Federal Regulations (CFR), Parts 100-199.
		Explosives will be transported in closed vehicles whenever possible.
		When using an open vehicle, explosives will be covered.
		Motor vehicles will be shut off when loading/unloading explosives.
		Beds of vehicles will have a nonconductive bed liner, dunnage, or sand bags to protect the explosives from contact with the metal bed and fittings.
		Initiating explosives, such as blasting caps, will remain separated at all times.
		Each vehicle used for the transport of MEC/UXO will be outfitted with a fire extinguisher and first-aid kit.
		Do not fuel trucks when loaded with MEC/UXO.
	Motor vehicle driver and vehicle operations	Motor vehicle drivers operating within or outside the boundaries of any federal installation will be licensed in accordance with federal, state, and local regulations.
		Drivers will observe all posted speed limits while operating a motor vehicle on a public roadway.
		Vehicles transporting explosives off pave roads will not exceed 20 miles per hour (mph).
		Chock wheels when loading or unloading MEC/UXO-related materials.
Storage of explosive materials	Noise hazards Environmental hazards Biological hazards Physical hazards Electrical hazards Suspended loads Fire hazards	Hearing Protection, Engineering controls Personal Protective Equipment (PPE), Delay work effort PPE, Repellants, Avoidance PPE, Proper lifting, Engineering controls PPE, Grounding, Equipment maintenance PPE, Hardhats Non Sparking tools, Grounding, Always have available Fire extinguisher No Smoking
	Accidental detonation of explosives	Materials will be stored in accordance with federal, state and local regulations. Refer to the UXO Subcontractors Standard Operating Procedures (SOPs) for the Storage of Explosive Materials.

Table 2.2 (continued)
MEC Activity, Potential Hazards, and Recommended Controls

MEC Activity	Potential Hazards	Recommended Controls
Surveying and establishing boundaries and grids	Accidental detonation of explosives	Personnel involved will attend a site-specific MEC/UXO recognition class prior to the commencement of any site activities.
		UXO personnel will escort non-UXO personnel at all times.
		Mark and avoid UXO. Only UXO personnel will handle MEC/UXO waste.
		Check location with magnetometer prior to driving stakes.
	Wildlife, slips, trips, falls, insects, poisonous plants, use of hand tools.	Refer to the AHA.
MEC Avoidance	Accidental detonation of explosives	Personnel involved will attend a site-specific MEC/UXO recognition class prior to the commencement of any site activities.
		Be alert and mark all MEC located.
		An UXO Technician II or above will escort non-UXO personnel at all times. Intrusive operations will cease when nonessential personnel within exclusion zone (EZ).
		Visual surface sweeps will be conducted with magnetometers or other suitable geophysical instrumentation to identify potential MEC/UXO.
	Environmental hazards Biological hazards Physical hazards Fire hazards	PPE, Delay work effort PPE, Repellants, Avoidance PPE, Proper lifting, Engineering controls No Smoking Always have available fire extinguisher Drivers will not stop or park on or in grass areas that may catch fire from vehicle exhaust
Transportation of MEC	Accidental detonation of explosives	No personnel allowed in cargo compartment of vehicle.
	Accidental detonation of explosives	No MEC/UXO allowed in passenger compartment of vehicle.
		Block, brace, secure MEC/UXO.
		No smoking in vehicles used for transport of MEC/UXO.
	Vehicle operations	Placard vehicle in accordance with U.S. Department of Transportation regulations.
		Vehicles transporting explosives off road will not exceed 20 mph.
		Drivers will observe all posted speed limits while operating a motor vehicle on a public roadway.
UXO disposal operations	Accidental detonation of explosives	Observe procedures for safe demolition and explosives use

Table 2.2 (continued)
MEC Activity, Potential Hazards, and Recommended Controls

MEC Activity	Potential Hazards	Recommended Controls
MEC-Related Scrap Demilitarization	Accidental detonation of explosives	Only Explosive Ordnance Disposal (EOD)/UXO technicians will perform explosive demilitarization of MEC-related scrap.
Inspection/Certification of MPPEH	Accidental detonation of explosives	Only UXO technicians will inspect MPPEH and range-related scrap.
		Personnel in the immediate vicinity of MPPEH inspections will be kept to the minimum necessary for safe operations but no less than two UXO Technicians, comprising of at least one UXO Technician II and one UXO Technician III.
		Observe requirements of U.S. Department of Defense (DoD) 4160.21-M-1.
UXO disposal operations MEC-Related Scrap Demilitarization Inspection/Certification of MPPEH MEC Intrusive Activities	Noise hazards Environmental hazards Biological hazards Physical hazards Electrical hazards Suspended loads Fire hazards	Hearing Protection, Engineering controls PPE, Delay work effort PPE, Repellants, Avoidance PPE, Proper lifting, Engineering controls PPE, Grounding, Equipment maintenance PPE, Hardhats Non Sparking tools, Grounding, Always have available fire extinguisher No Smoking
MEC Intrusive Activities	Accidental detonation	The UXO team will follow MEC anomaly avoidance procedures during excavation activities
		Personnel in the immediate vicinity of MEC operations will be kept to the minimum necessary for safe operations, but no less than two UXO technicians comprising of at least one UXO Technician II and one UXO Technician III.
		Do not subject MEC/UXO to heat, shock, or friction.
		Only hand excavation permitted when within 1 foot of known MEC/UXO.
		Hand-operated magnetometers will be used frequently to pinpoint the location of suspect MEC/UXO.
	Non-UXO personnel	Establish EZ; post warning signs, maintain site control.
		Stop all MEC UXO operations when non-UXO personnel are within the EZ.

Table 2.3 lists the equipment to be used and inspection and training requirements for the project.

Table 2.3
Project Equipment and Training Requirements

Equipment to be Used	Inspection/ Test Requirements	Training Requirements
Vehicles	Daily – preventive maintenance and operational checks	Valid driver's license
Ordnance detection locators	Prior to operation	40-hour HAZWOPER (CFR 1910.120); 8-hour HAZWOPER Refresher (CFR 1910.120) 24-hour supervise field experience; Graduate of a formal military EOD or DoD certified training course
Demolition/explosive materials		Must have all the above certifications and a valid Bureau of Alcohol, Tobacco, and Firearms (BATF) Employee Possessor Questionnaire (ATF E-Form 5400.28) on file
Explosive vehicle	Explosive Vehicle Inspection (DD Form 626)	Must have all the above certifications and a valid driver's license
Blocking, bracing, and cushioning materials	Prior to operation	UXO Technician III certified or above
Fire extinguishers	Monthly	Site specific
First-aid kits	Weekly – inventory and inspection	Cardiopulmonary Resuscitation (CPR) and First Aid Certified
Manual hand tools	Prior to operation	On-the-job-training
Mechanized equipment	Prior to operation	Operator's certificate
Heavy Equipment	Prior to operation	Operator's certificate
Geophysical instrumentation	Prior to operation	On-the-job-training (OJT)
Global Positioning System (GPS) instrumentation	Prior to operation	OJT
PPE	Prior to use	Site specific
Communications equipment	Prior to operation	Site specific
Battery charging station	Prior to operation – visual Monthly – entire system	Site specific
Eye wash station	Weekly – visual Monthly – operational 90-day – solution replacement	Site specific
Weather monitoring equipment	Prior to operation	UXO Technician III or above

The principal anticipated hazard to site workers is unexploded ordnance. This hazard will be managed through procedures stated in detail in the WP. There is no evidence that chemical or radiological hazards are present on the site. However, if evidence of these is discovered, the site safety officer will notify the PM and UXOSO as soon as possible. Appropriate addenda to this plan will be prepared.

In the unlikely event that a chemical weapon (or chemical weapons material) is encountered during operations, work will halt immediately, and personnel will withdraw upwind from the area. The USAESCH safety specialist will be notified. Site personnel will stand by and wait for instructions from the USAESCH contracting officer.

Biological hazards anticipated for this project site include bees, wasps, hornets, spiders, ticks, ants, mosquitoes, poisonous snakes, and blood-borne pathogens. Biological hazards are discussed in detail in Section 2.7 of this document.

The potential for exposure to munitions constituents could exist during collection of soil and water samples, and possibly during other times. Management of this hazard is discussed in Section 9.15 of this document.

If site conditions or activities occur that are not discussed in this document or in the accident prevention plan, then the UXOSO will notify the CHSD immediately and new procedures will be developed.

2.1 CLASSIC SAFETY

The following distinct phases of project work or distinct potentially hazardous operations have been identified:

- Mobilization and site preparation,
- Brush clearing,
- Geophysical transect and grid survey reconnaissance,
- Intrusive investigation of anomalies (i.e., anomaly reacquisition and excavation),
- Disposal of MEC and munitions debris,
- Environmental sampling, and
- Demobilization.

Hazards and potential for injury associated with these activities include the following:

1. Lifting hazards, such as back strain, pulled muscles and tendons, pinched or crushed fingers and toes, and lacerations from sharp surfaces on objects lifted;
2. Hazards associated with the operation of hand and power tools (e.g., chain saws), including lacerations and flying objects;
3. Slip, trip, and fall hazards associated with ground cover, exposed tree/brush stumps, uneven terrain, rocks, and vegetation growth;
4. Inclement weather events, such as heavy rain, and lightning;
5. Sharp objects, including nails, broken glass, cultural debris, and exposed tree/brush stumps;
6. Noise from heavy equipment;

7. Vehicle accidents;
8. Electrical shock from equipment and;
9. Conditions that could cause heat-related illness.

An activity hazard analysis for each of these phases is found in Attachment 3.

2.2 EXPLOSIVE ORDNANCE

2.2.1 MPPEH Hazards

During the project MPPEH will be encountered by the field UXO teams. Every precaution will be taken to ensure all MEC operations are conducted safest possible manner.

2.2.2 MEC Hazard Safety

When MEC is encountered during any phase of work the SUXOS and the UXOSO will be immediately notified. In general, the following MEC safety precautions and protocols will be followed:

- Positively identify all MEC.
- Always remain alert at all times for MEC, UXO and related scrap or MPPEH hazards.
- The cardinal principle to be observed involving ordnance, explosives, ammunition, severe fire hazards, or toxic materials is to limit the exposure to a minimum number of personnel, for the minimum amount of time, to a minimum amount of hazardous material consistent with a safe and efficient operation.
- Always assume MEC hazards contain a live charge until determined otherwise.
- The age or condition of a MEC hazard does not decrease the effectiveness. MEC that has been exposed to the elements for an extended period of time becomes more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded.
- Consider MEC that has been exposed to fire as extremely hazardous. Chemical and physical changes to the contents may have occurred that render it more sensitive than it was in its original state.
- DO NOT approach a leaking white phosphorus (WP) munitions unless absolutely necessary as burning WP may detonate.
- DO NOT dismantle, strip, or handle any MEC unnecessarily.
- Submerge smoking (leaking) plasticized WP (PWP)/red phosphorous (RP)/WP munitions in water or cover with mud, wet sand, or earth as quickly and gently as possible if necessary to handle or transport.
- PWP/RP/WP will ignite and burn on contact with air. Handle crusted over PWP/RP/WP with special care, breaking the crust can cause the round to begin burning again.

- DO NOT touch crusted white phosphorus**.** WP munitions are prone to leak causing smoke in hot weather.
- Additional protective clothing should be worn while removing residue or attempting to move a smoking PWP/RP/WP round into a water bath.
- DO NOT touch, move or jar any ordnance items regardless of the markings or apparent condition. Under no circumstances will any MEC be handled during avoidance activities or moved in an attempt to make a positive identification.
- DO NOT touch, pickup up, kick or move anything that is unfamiliar or unknown.
- DO NOT roll the item over or scrape the item to identify markings.
- DO NOT approach or enter a munitions site if an electrical storm is occurring or approaching. If a storm approaches during site operations, leave the site immediately and seek shelter.
- DO NOT transmit radios or cellular phones in the vicinity of suspect MEC hazards.
- DO NOT walk across an area that the ground surface cannot be seen that has not been cleared of MEC hazards by the UXO Technician.
- DO NOT rely on color codes for positive identification of ordnance items or their contents.
- DO NOT drive vehicles into a suspected MEC area; use clearly marked lanes.
- DO NOT carry matches, cigarettes, lighters or other flame-producing devices into a MEC site.
- DO NOT be misled by markings on the MEC item stating “practice bomb,” “dummy,” or “inert.” Practice ordnance can have explosive charges that are used to mark and/or spot the point of impact; or the item could be marked incorrectly.
- Avoid the forward portions of munitions employing proximity fuzing.
- Assume unknown fuzes contain cocked strikers or anti-disturbance features.
- The location of any ordnance item found anomaly avoidance activities will be clearly marked so it can be easily located and avoided.
- Follow the procedures of the WP and Site Safety and Health Plan (SSHP); and upon locating any MEC hazards immediately notify the UXO Technician so appropriate measures can be taken.

The following warning shall be posted on site.

— WARNING —

REMOVING OR TAKING ANY MUNITIONS, EXPLOSIVE OR UNEXPLODED ORNANCE OR MUNITIONS RELATED DEBRIS FROM THE SITE BY ANY EMPLOYEE IS STRICTLY PROHIBITED

Supplemental "MEC Hazard Safety" information for munitions items potentially used at the Former Camp Butner MRSs includes the following:

Projectiles

- Determine if the projectile has been fired and if so consider it armed;
- Check for the presence of unburned tracers;
- Avoid the rear and front of rocket assisted projectiles;
- Handle projectile components such as powder increments, cartridges, and primers with caution; and
- Seal the open ends of projectiles or sheared projectile components with tape or other suitable material before transporting.

Grenades

- Do not attempt to re-install safety pins on a dud fired grenade;
- Do not attempt to withdraw impinged firing pins from the fuze of a dud fired grenade; and
- Do not dispose of grenades by functioning them as designed.

Rockets

- Approach and work on rockets from the side;
- Do not dismantle or strip dud fired rockets or rocket motors;
- Do not expose electrically fired munitions to radio transmissions within 25 feet;
- Do not transport an unfired rocket motor until having shielded the motor igniter from EMR; and
- Dispose of unfired rocket motors, with or without warheads, in such a manner as to prevent them from becoming propulsive.

Additional MEC safety precautions will be provided during daily safety meetings, presented as General Safety Precautions in HGL SOP 15.01 (Attachment 5), and are addressed in EP 385-1-97, *Explosives Safety and Health Requirements Manual.*

2.2.3 Explosive Demolition Operations

Explosive demolition operations will only be conducted by UXO-qualified personnel who meet the qualifications requirements of DoD Explosives Safety Board (DDESB) Technical Paper 18 (TP-18) and HGL SOP 15.00. Approved engineering controls will be used, as required, to mitigate explosive hazards associated with demolition operations. Demolition explosives and procedures are addressed in the WP Section 3.8 and HGL SOP 15.01 Explosive Demolition Operation. Each task has been analyzed to assess the potential safety hazards that may be encountered by site personnel and prescribe the proper engineering and/or administrative controls and/or PPE. These controls will ensure that the risks to health and safety are reduced or eliminated during project performance.

2.3 CHEMICAL

Chemical hazards are not likely to be encountered while performing the fieldwork, with the exception of hazardous substances brought on site for the execution of site activities. These chemical substances will be discussed in APP Section 12.3 Hazard Communication Program, and with associated material safety data sheet (MSDS). Post-detonation soil sampling will be collected and analyzed for explosives MC (TNT and RDX).

2.4 PHYSICAL

The following physical hazards may be encountered during this project:

- Open trenches or pits and vegetation;
- Cuts and scrapes from visible or buried debris;
- Barbed wire fencing;
- Stress endured from excessive heat or cold; and
- Physical hazards are addressed in more detail in the AHA and the hazard control plan.

2.5 IONIZING RADIATION

Ionizing radiation hazards are not likely to be encountered while performing the fieldwork.

2.6 BIOLOGICAL

Biological hazards, which may be found on-site, include insects, arachnids (such as spiders and scorpions), snakes, and plants. Employee awareness and the safe work practices outlined in the following paragraphs should reduce the risk associated with these hazards to acceptable levels. Images of biological hazards associated with the project site are shown in Attachment 7.

2.6.1 Biting and Stinging Insects

Many types of biting and stinging insects such as mosquitoes, bees, wasps, spiders, and centipedes may be encountered on-site. The SUXOS or UXOSO (as applicable) will encourage the use of insect repellents, if deemed necessary. The biting insects of greatest concern are spiders, especially the black widow and the brown recluse spider. These spiders are of special concern due to the significant adverse health effects that can be caused by their bite.

2.6.2 Mosquitoes

The Center for Disease Control (CDC) has noted the increase of West Nile Virus (WNV) that is transmitted by bites from an infected mosquito. Mosquitoes live in nearly all environments, including urban, wooded, grassy, brushy, arid, or other areas that contain standing pools of water (seeps, drainage, watering holes, etc.).

Standard field gear (work boots, hats, socks, trousers, and work shirts) provide good protection against mosquito bites. Exposed skin is particularly susceptible to bites. However, even when wearing field gear, the following precautions shall be taken when working in areas that might be infested with mosquitoes:

- Spray outer clothing, BUT NOT YOUR SKIN, with an insect repellant that contains permethrin or permanone;
- Apply an insect repellant containing 33 percent DEET, Picardin, or Oil of Lemon eucalyptus to exposed skin (don't spray on cuts or wounds) and avoid areas of standing water as much as possible;
- Reduce time outdoors in evening; and
- Look for the symptoms of the onset of WNV, which occur within 3 to 15 days after being bitten by an infected mosquito.

2.6.3 Bees, Hornets and Wasps

Contact with stinging insects like bees, hornets, and wasps may present a hazard to site personnel. Extreme caution must be exercised whenever site and weather conditions increase the risk of encountering stinging insects.

With these things in mind and with the high probability of contact with stinging insects, all site personnel will comply with the following safe work practices:

- If a worker knows that he is hypersensitive to bee, wasp or hornet stings, he must inform the SUXOS or UXOSO (as applicable) prior to participation in site activities;
- All site personnel will be watchful for the presence of stinging insects and their nests, and will advise the SUXOS or UXOSO (as applicable) if observed;
- Any nests located on-site will be flagged and site personnel will be notified of its presence; and,
- If stung, site personnel will immediately report the incident to the SUXOS or UXOSO to obtain treatment and to allow the SUXOS or UXOSO (as applicable) to observe them for signs of allergic reaction.

2.6.4 Black Widow Spider

The Black Widow spider is not aggressive unless agitated when guarding her egg sac. They live in a variety of natural and domestic habitats such as under rocks and wooden boards, and in dense plant growth. The female spider is glossy black approximately 1-inch long, and marked with a characteristic red hourglass on the underside of the abdomen. The male, which is rarely seen, is smaller and has four pairs of red marks along the sides of the abdomen. Young black widow spiders are tan-to-gray in color and have orange and white "racing stripes" on their abdomens.

Black widow spider venom affects the nervous system. The venom causes pain in the lymph nodes. Other symptoms of a severe bite include nausea, elevated blood pressure, sweating, tremors and increased white blood cell counts. The wound may appear as a bluish red spot, surrounded by a whitish area. Victims of a black widow bite may exhibit the following signs or symptoms:

- Sensation of pinprick or minor burning at the time of the bite; and
- Appearance of small punctures (sometimes none are visible).

After 15 to 60 minutes, intense pain is felt at the site of the bite. The pain quickly spreads and is followed by profuse sweating, rigid abdominal muscles, muscle spasms, breathing difficulty, slurred speech, and poor coordination, dilated pupils, and generalized swelling of the face and extremities.

2.6.5 Brown Recluse Spider

Adult Brown Recluse spiders are soft bodied, yellowish tan to dark brown, about ¼- to ½-inch long, and have long, delicate grayish to dark brown legs covered with short, dark hairs. The leg span is about the size of a half-dollar.

The spider's most distinguishing characteristic is the existence of three pairs of eyes arranged in a semicircle on the forepart of the head and a dark, violin-shaped, marking immediately behind the semicircle of eyes. Normally, all spiders have 4 pairs of eyes; 8 altogether. The neck of the violin points toward the abdomen.

The spider may be found in sheltered corners among debris, in woodpiles, under loose bark and stones. Hands, underarms, lower abdomen, and the ankles are the areas of the body most likely to be bitten. A bite may go unnoticed for six to eight hours before a reddening, swelling, and blistering area around the wound starts to appear. A severe bite can produce an area of dead skin tissue that may require surgery. Victims of a brown recluse bite may exhibit the following signs or symptoms:

- Blistering at the site of the bite, followed by a local burning at the site 30 to 60 minutes after the bite;
- Formation of a large, red, swollen, pustule lesion with a bull's-eye appearance;
- Systemic affects may include a generalized rash, joint pain, chills, fever, nausea and vomiting; and
- Pain may become severe after eight hours, with the onset of tissue necrosis.

There is no effective first aid treatment for Black Widow or Brown Recluse bites. Except for very young, very old or weak victims, spider bites are not considered to be life threatening.

Medical treatment must be sought, however, to reduce the extent of damage caused by the injected toxins. If the spider can be retrieved, it should be taken with the patient to medical treatment. If venomous spiders are suspected or known to be on-site, the SUXOS or UXOSO (as applicable) will brief the site personnel as to their identification and avoidance. As with stinging insects, site personnel should report to the SUXOS or UXOSO (as applicable) if they locate these spiders on-site or notice any type of bite while involved in site activities.

2.6.6 Plants Causing Skin Reactions

A variety of hazardous plants may be encountered onsite. The ailments associated with these plants range from mild hay fever to contact dermatitis to carcinogenic affects. The plants that present the greatest degree of risk to site personnel (i.e., potential for contact vs. affect produced) are those that produce skin reactions and skin and tissue injury.

The hazardous plants of greatest concern are those varieties found in the project area having the ability to cause redness, blisters, swelling, and intense burning and itching due to punctures, scrapes, or lacerations. Improper treatment of an injury can cause secondary infections to occur. Preventive measures that can prove effective for most site personnel are:

- Avoid contact with any hazardous plants on site;
- Remove gloves prior to touching face, neck, or other exposed areas of the body;
- Wash hands, face, or other exposed areas at the beginning of each break period and at the end of each workday; and
- Keep the skin covered as much as possible (i.e., long pants and long sleeved shirts) in areas where these plants are known to exist.

2.6.7 Domestic Dogs

There is a potential for domestic dogs to run free throughout the site. These dogs may become aggressive if threatened or cornered, or for no apparent reason.

If you are approached by a dog that may attack you:

- Never scream and run;
- Remain motionless, hands at your sides, and avoid eye contact with the dog;
- Once the dog loses interest in you, slowly back away until he is out of sight;
- If the dog does attack, “feed” him your jacket, magnetometer, or anything that you can put between yourself and the dog; and
- If you fall or are knocked to the ground, curl into a ball with your hands over your ears and remain motionless. Try not to scream or roll around.

If bitten, immediately wash the wound with soap and water and get medical help. Notify the local animal care and control agency. Give them as much information as possible about the dog's size and color, and in which direction the dog left the area.

Never approach a strange dog. Do not pet a dog without letting him see and sniff you first. Never turn your back to a dog and run away. A dog's first instinct will be to chase and catch you. Always assume that a dog that does not know you may see you as an intruder or a threat.

2.6.8 Venomous Snakes

North Carolina has a variety of snakes; however, the Copperhead, Cottonmouth, Prairie Rattlesnake, and Timber Rattlesnakes are the venomous varieties native to the state. Prairie Rattlesnakes are members of the Pit Viper family, and are recognizable by their large, triangular or diamond-shaped head, and vertically elliptical pupils.

2.6.8.1 <u>Copperhead</u>

The Copperhead is the most common venomous snake in North Carolina. However, Copperheads are usually not aggressive and their bite is very rarely lethal. Like most members of the pit viper family, the Copperhead is a heavy-bodied snake. These snakes range between 24 and 36 in. (61-91) in length and they are covered in hour-glass shaped crossbands which vary in coloration among different populations. The crossbands may be copper, pinkish, reddish brown, or orange. Copperheads are found state-wide in forests and sometimes in fields. The tips of young Copperheads' tails are yellow and they flick them back and forth in a manner that attracts prey.

2.6.8.2 <u>Cottonmouth Snake</u>

Cottonmouths are relatively large heavy-bodied snakes that reach lengths between 30 and 48 in. Their coloration ranges from olive to brown to black and the young have wide, dark crossbands. The adult's coloration is dark so the banding pattern is usually not apparent. Cottonmouths occupy marshes, swamps, and most other aquatic environments in the Coastal Plain and eastern Piedmont. They closely resemble many of the water snakes but they behave differently when confronted. Like other members of the pit viper family, they may shake their tail when aggravated. They are likely to stand their ground while opening their mouth and exposing the light lining of their mouth.

2.6.8.3 <u>Timber Rattlesnakes</u>

Timber Rattlesnakes are not aggressive and they are sometimes reluctant to bite. This attribute makes them the preferred species of venomous snake used during snake handling religious services. However, if you encounter this snake you should leave it alone. Its venom is highly toxic and people have died from its bites. Timber Rattlesnakes range in size between 3 and 5 ft. The coloration of this species is blackish, yellowish, pinkish, or grayish with dark, bent, cross bands aligned along the dorsal length of its body. A reddish dorsal stripe runs between the crossbands and it has a black tail. Timber Rattlesnakes typically inhabit forest, nearby fields, and swampy areas and may be found throughout the various regions of North Carolina.

2.6.8.4 Snake Bite First Aid Treatment

If bitten, a person's physical reaction to the venom is aggravated by acute fear, anxiety, the amount of venom injected, and the speed of absorption of venom into the victim's circulation; the size of the victim; protection provided by clothing (including shoes and gloves); how quickly the victim receives antivenin therapy, and the location of the bite.

It should be noted that the American Red Cross does not advocate the use of snakebite kits for snakebite injuries; rather, experience has shown that the victim has a better chance of recovery without permanent damage when the site of the wound is immobilized and the victim rushed to the closest emergency medical facility (preferably within 30 minutes).

- **What to Do if Bitten by a Venomous Snake –** According to the American Red Cross, these steps should be taken:
  1. Wash the bite with soap and water.
  2. Immobilize the bitten area and keep it lower than the heart.
  3. Get medical help.

- **If a Victim is Unable to reach Medical Care within 30 Minutes.**
  1. Allow bite to bleed freely for 15-30 seconds.
  2. Cleanse and rapidly disinfect area.
  3. Wrap leg/arm rapidly with 3" to 6" Ace bandage past the knee or elbow joint. Leave fang marks open. Apply suction cup extractor (if available) immediately. Wrap bandage no tighter than one would for a sprain.
  4. Apply Extractor until there is no more drainage from fang marks. Extractor can be left in place 30 minutes or more if necessary. It also aids in keeping the venom from spreading by applying a negative pressure against the tissue where the venom was initially deposited.
  5. If an extractor is not available: Apply direct pressure over bite using a 4H4-gauze pad folded in half twice. Tape in place with adhesive tape.
  6. Soak gauze pad in Betadine™ solution if available.
  7. Strap gauze pad tightly in place with adhesive tape.
  8. Overwrap dressing above and below bite area with ACE or crepe bandage.
  9. Wrap ACE bandage as tight as one would for a sprain. Not too tight.
  10. Check for pulse above and below elastic wrap; if too tight. Unpin and loosen.
  11. Immobilize bitten extremity, use splinting if available.
  12. Go to nearest hospital or medical facility as soon as possible.
  13. Try and identify, kill and bring (ONLY if safe to do so) offending snake.

- **What Not to Do if Bitten by a Venomous Snake**
  1. DO NOT permit removal of pressure dressings or ACE bandage until you are at a facility ready and able to administer antivenin. As soon as the dressings are released the venom will spread. The hospital at this time must be prepared to administer the antidote (antivenin).
  2. Do not eat or drink anything unless approved by medical sources.
  3. Do not engage in strenuous physical activity.
  4. Do not apply oral (mouth) suction to bite.
  5. Do not cut into or incise bite marks with a blade.
  6. Do not drink any alcohol or use any medication.
  7. Do not apply either hot or cold packs.
  8. Do not apply a narrow, constrictive tourniquet such as a belt, necktie or cord.

2.6.8.5 Protective Measures for Snakes

- Learn to identify poisonous snakes – this shall be reviewed during site-specific safety training;
- Watch where you sit, where you place your hands and feet, and where your step when exiting a vehicle;
- Avoid rock piles, crevices, and brushy areas. If movement of materials (such as rocks or brush) is necessary, use a remote means to initially relocate the material. Prior to entering an area, look and listen carefully;
- Do not place hands into holes, crevices, debris, or anyplace that may hide a snake;
- Never handle "dead" snakes; they may not be completely dead; and,
- Do not attempt to capture or kill ANY snakes.

2.7 BIOLOGICAL HAZARDS

Biological hazards include, insects, ticks, centipedes, bees/wasps/hornets, and spiders. Poisonous snakes, domestic dogs, and hazardous plants also may be encountered on the project site. Employee awareness and the safe work practices listed below will minimize hazards. The UXOSO will make inquiries about likely biological hazards at the work site, and tailor training material accordingly. Images of potentially dangerous animals and plants that likely are present on the project site are found in Attachment 7.

Mosquitoes, flies, and fleas are likely site pests. The UXOSO will maintain a supply of insect repellant on the site and encourage its frequent use when the potential for insect bites exists.
The following practices should be followed to avoid risks from poisonous plants:

- Avoid contact with any poisonous or unidentified plants. If poisonous plants are identified, warn others and notify the UXOSO;
- Wash hands, face or other exposed areas at the beginning of each break period and at the end of each work day;
- Avoid contact with contaminated tools, equipment and clothing; and wash these regularly; and
- Consider the use of barrier creams, detoxification/wash solutions and orally administered desensitization products.

All snakes should be considered venomous, and all should be avoided. Employees should be extremely cautious when they remove brush, lift rocks and debris, or enter wooded or grassy areas. Heavy gloves, high-top boots, chaps and other protective equipment should be used when needed to prevent contact with snakes.

The following precautions should be followed to avoid the risks of tick bites:

- Standard field gear (work boots, socks, and work uniform) provides good protection against tick bites, particularly if the openings are taped;
- Avoid direct skin contact with ticks by wearing long sleeves, long pants, socks, etc. Consider taping openings in clothing, if this can be done safely;
- When in the field, check yourself often for ticks, particularly on your lower legs and areas covered with hair;
- Spray outer clothing, particularly your pant legs and socks – but not your skin – with an insect repellent that is effective against ticks;
- To the extent feasible, avoid contact with bushes, tall grass, or brush;
- If you find a tick, remove it by pulling on it gently with tweezers (Do not use matches, a lit cigarette, nail polish or any other type of chemical to “coax” the tick out);
- Be sure to remove all parts of the tick’s body, and disinfect the area with alcohol or a similar antiseptic after removal;
- For several days to several weeks after removal of the tick, look for the signs of the onset of Lyme disease, such as a rash that looks like a bulls-eye or an expanding red circle surrounding a light area, frequently seen with a small welt in the center;
- Also look for the signs of the onset of Rocky Mountain spotted fever, such as inflammation in the form of a rash comprising many red spots under the skin. Inflammation may occur three to 10 days after the tick bite; and
- Report symptoms such as flu-like chills, fever, headache, dizziness, fatigue, stiff neck, and bone pain to the UXOSO promptly. These could be the result of tick-borne disease.

Contact with centipedes and stinging insects like bees, hornets and wasps should be avoided to the extent feasible. The UXOSO will modify work rules as necessary to minimize contact, and implement the following procedures:

- If a worker knows that he is hypersensitive to bee, wasp or hornet stings, he must inform the UXOSO of this condition prior to participation in site activities;
- All site personnel will be watchful for the presence of stinging insects and their nests, and will advise the UXOSO if a nest or swarm is present in or near a work area;
- Any nests located will be treated with insecticide from a distance or marked for avoidance;
- Any employee who receives a sting will notify the UXOSO immediately, so that he can observe the affected employee for signs of allergic reaction; and
- Site personnel with a known hypersensitivity to stinging insects will keep required emergency medication on or near their person at all times.

Spiders should be avoided through the same practices discussed above for avoidance of reptiles, ticks, centipedes, and insects. Site personnel will report any suspected spider bite to the UXOSO immediately. Also, they should report the location of possibly venomous spiders observed during the work.

Project personnel will avoid contact with domestic or feral dogs – or any potentially dangerous large animals. They should do nothing to encourage dogs or other large animals to approach the work area, and practice strict avoidance if any should come near. Any bite or close contact with such animals should be reported to the UXOSO immediately.

2.8 MATERIAL HANDLING AND LIFTING PROCEDURES

Site personnel will exercise care in lifting and handling heavy or bulky items. No site worker will attempt to lift any item in excess of **50** pounds without assistance or use of a mechanical device. Materials being lifted either mechanically or manually will not be moved, or suspended, over personnel unless precautions have been made to protect the personnel from falling objects. Whenever heavy or bulky material is to be moved manually, the size, shape, and weight of the object and the distance and path of movement must be considered to prevent joint and back injuries. The following hierarchy will be followed in selecting a means for material handling:

1. Movement of the material by mechanical device (i.e., lift truck, crane, etc.);
2. Movement by manual means using mechanical aid (i.e., dolly or cart); and
3. Movement manually in a planned manner with an adequate number of personnel.

The UXOSO will train employees in proper lifting techniques and require that they lift objects properly. The following procedures shall be followed:

1. A firm grip on the object is essential. Therefore the hands and object will be free of oil, grease, or water, any of which might prevent a firm grip.
2. The hands, and especially the fingers, will be kept away from any points where pinching or crushing could occur, especially when setting the object down.
3. The item will be inspected for metal slivers, jagged edges, burrs, rough or slippery surfaces and pinch points, and gloves will be used, if necessary, to protect the hands.
4. The feet will be placed far enough apart for good balance and stability.
5. Personnel will ensure that solid footing is available prior to lifting the object.
6. When lifting, personnel will remain as close to the load as possible, bend their legs at the knees, keep their back as straight as possible, and lift the object with the legs, as they are straightening from their bending position.
7. Never carry a load that cannot be seen over or around.
8. When placing an object down, the stance and position are identical to that for lifting, with the back kept straight and the legs bent at the knees, while the object is lowered.
9. When two or more people are required to handle an object, care should be taken to ensure the load is lifted and distributed uniformly between the individuals carrying the load. Each person, if possible, will face the direction in which the object is being carried.

2.9 ACTION LEVELS

Action levels and methods to mitigate the hazards noted above vary depending on the hazard. Controls, preventative measures, and treatments are discussed with listed hazardous conditions. Additional action levels and required actions are presented below:

- Implementation of engineering controls and safe work practices shall be discussed prior to starting of work or a new task;
- Upgrades/downgrades in levels of PPE shall be considered if hazards exist or if hazards are mitigated;
- Work stoppage or emergency evacuation of on-site personnel will be carried out if a hazardous condition warrants such action; and
- Public exposures to hazards created by site activities will be prevented or minimized.

3.0 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

This information is found in Section 3.0 of the APP.

4.0 TRAINING

HGL and subcontracted UXO personnel working at this site have completed Naval EOD or other DoD certified UXO training program that details procedures for evaluation and disposal of MEC. All employees at this job site will have completed a training program prior to beginning work on-site, that complies with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120(e)(9). All HGL employees who work at hazardous sites receive 40 hours of off-site training, and three days of actual field experience under the direct supervision of a trained, experienced, supervisor. Each employee also receives eight hours of OSHA refresher training annually.

In addition to the training described above, management and supervisors receive an additional eight hours of training on program supervision. At minimum, two field personnel will have received CPR/First Aid training. In the absence of an infirmary, clinic, or hospital in near proximity to workplaces, personnel should be adequately trained to render first aid and CPR. HGL does not require or designate employees to render first aid/CPR. Trained employees may provide first aid/CPR of their own free will as “Good Samaritans.” Bloodborne pathogen awareness is provided during the CPR/First Aid training. Universal precautions require one to assume that all blood and bodily fluids contain pathogens and require the use of protective barriers to prevent exposure. Latex gloves and CPR barriers will be available in the first aid supplies and must be used. Additionally, washing any body part or surface that has been contaminated with blood is an important part of the universal precautions. The UXOSO should be notified of any potential contact with blood or body fluids resulting from first aid or CPR administered on the job. Additional training will be conducted when circumstances dictate.

Copies of training and qualifications for all staff will be on file during the field activities at the HGL field trailer.

4.1 SITE-SPECIFIC TRAINING

The UXOSO will give site-specific training to all personnel prior to initial site entry. The training will include:

- Project scope to include organization and responsibilities, site orientation, facilities, access, egress, evacuation and emergency routes, and other general information; and
- All elements of the SSHP, including general safety, safe work practices, physical hazards, PPE, on/off-site emergencies, evacuation routes, emergency agencies/numbers, emergency equipment, medical emergencies, drug and alcohol, bloodborne pathogens, and other pertinent safety information.

4.2 TAILGATE MEETINGS

In addition to the above training, daily safety training will be provided each morning on site at a tailgate safety meeting. The safety and health considerations for the day’s activities will be reviewed. A tailgate safety meeting form will be signed upon completion of the tailgate safety meetings. The daily tailgate safety meeting will address that day’s activities, safety issues, specific hazards, and emergency procedures, to include:

- Notification procedures and phone numbers;
- Rally points and safe areas;
- Hospital and evacuation routes; and
- Emergency equipment.

5.0 PERSONAL PROTECTIVE EQUIPMENT

See Section 9.0 Personal Protective Equipment of the APP.

PPE required at the site will be at a level necessary to protect personnel. Normal work clothing will be Level D. A hard hat is not required unless a possible head injury could result from the use of heavy equipment or overhead hazards. Ball caps or hats are recommended for sun protection. Steel toe footwear will not be worn while operating magnetometers or geophysical instruments. The minimum level of protection required of all personnel at all sweep areas is Level D. The following is Level D protection:

- Short or long sleeve cotton coverall or work clothing (e.g., long pants, jeans, short or long sleeve shirt);
- Leather boots/shoes, composite toe;
- Safety glasses with side shields or goggles when an eye hazard exists;
- Hard hat, when an overhead hazard exists;
- Hearing protection, when working around heavy equipment or powered hand tools; and
- Reflective vests when working with traffic control.

The level of protection is based on what is known about the site. The levels of protection may change as site conditions change. The UXOSO will monitor site conditions and provide information to the PM as necessary. The UXOSO may increase the levels of protection when necessary, but will not downgrade them without approval from the HGL Corporate Health and Safety Manager (CHSM). General decontamination and hand washing should be considered after exposure to soil, water, or potential contamination.

Upgrades in PPE will be determined by:

- Request from individual performing tasks;
- Change in work tasks that will increase contact or potential contact with hazardous materials;
- Occurrence or likely occurrence of gas or vapor emission; and
- Known or suspected presence of dermal hazards.

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6.0 MEDICAL SURVEILLANCE

Workers exposed significantly site hazards, including all employees of HGL will participate in a program of medical surveillance of the type specified in 29 CFR 1926.65, the OSHA standard on "Workplace Health and Safety in Hazardous Waste Operations and Emergency Response." Such workers must present a physician's statement that they are medically qualified for (1) work in hazardous waste operations and (2) the use of respirators. The UXOSO will evaluate all physicians' letters and refer any questions to the corporate manager of health and safety. Annual medical certification is required; a physician's statement must be no older than one year.

The UXOSO will take note of any restrictions stated on a physician's statement, and make arrangements to avoid any prohibited activity or condition. In addition, the UXOSO will monitor all employees to detect early signs of exhaustion, heat stress, or other conditions that might suggest a lack of fitness for a particular task.

Medical treatment received incident to a workplace injury or illness will be managed in accordance with the OSHA standard referenced above. The UXOSO will notify the CHSM immediately if such an event occurs.

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7.0 EXPOSURE MONITORING AND AIR SAMPLING

No routine exposure monitoring or air sampling is anticipated. The UXOSO and the PHSM or CHSD will confer to assess the need for such testing, and they will implement a monitoring or sampling program if this is warranted by site activities or conditions.

The UXOSO will monitor employees' noise exposure with a calibrated sound level meter whenever noisy operations are in progress, and require the use of hearing protection whenever the sound level measured in a work area is 85 dBA or greater.

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8.0 HEAT STRESS AND COLD STRESS

Hot, humid work environments could present the risk of heat-related illness. It is also possible that cold, windy conditions could present the risk of hypothermia or frostbite. The UXOSO will remain alert to site conditions that could cause heat-related or cold-related illness. The UXOSO will implement procedures found in Attachments 4 or 5, if necessary.

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9.0 SAFETY PROCEDURES, CONTROLS, AND PRACTICES

This section outlines the general hazards and safe work practices that will be followed by all site personnel to eliminate or reduce the risk of exposure to the anticipated site hazards. These controls are presented as a guide for site personnel and do not cover all compliance issues. The SUXOS and UXOSO will ensure full compliance with applicable regulatory requirements.

9.1 RULES

General safe work practices for every job site include the following:

- Administrative hazard control will be practiced for all site areas by restricting entrance to EZs to essential, qualified personnel.
- The buddy system will be used at all times by all field personnel. No one is to perform field work alone; visual, vocal, or radio communication will be maintained at all times.
- Direct contact with contaminated (or potentially contaminated) surfaces should be avoided. Walk around (not through) puddles, discolored surfaces, and contaminated ground. Do not kneel on the ground or set equipment on the ground. Stay away from any waste drums unless necessary. Bag equipment to protect it from contamination.
- Wearing open-toed, high-heeled, canvas, or cloth-top shoes will be prohibited in all areas other than office or general public areas. Slippers or other flimsy types of footwear will be strictly prohibited.
- Anyone reporting to work under the influence of alcohol and/or illegal drugs will be subject to disciplinary action. Any employee under a physician's care and/or taking prescribed medication must notify the Program Manager.
- Smoking will not be permitted in any area where hazardous chemicals or materials are in use or stored.
- Changes in work practices or work rules will be implemented only after a written safety plan amendment has been prepared and authorized. Changes will be communicated to all site personnel.
- Employees will generally be responsible for cleaning and maintaining PPE issued to them. Any noted defects in protective equipment will be reported immediately to the UXOSO.
- Personnel must report all injuries and/or illnesses to their supervisor. This includes minor injuries and near misses.
- Posted danger and warning signs indicating special hazards are to be obeyed at all times.
- All safety guards furnished by the manufacturer are to be used, including safety belts in vehicles.
- Horseplay, scuffling, running, and practical jokes will be prohibited.

- Loose or torn clothing, ties, scarves, wristwatches, bracelets, or rings shall not be worn when they may pose a safety hazard.
- Free access shall be maintained to fire extinguishers, power panels, emergency exits, exit doors, first-aid kits, safety showers, and eyewash stations.
- Supervisors will instruct and monitor employees in proper lifting techniques.
- The lifting capacity of mechanical equipment shall not be exceeded.
- Personnel shall be aware of prevailing weather conditions. When there is a threat of lightning, all work involving heavy equipment will cease.
- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness requires enough illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Specific areas will be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris, and shall be removed at regular intervals.
- All spills shall be cleaned up quickly. Oil and grease shall be cleaned from walking and working surfaces.

9.2 HAZARD COMMUNICATIONS

The UXOSO is to perform the following:

- Complete an inventory of chemicals brought on site by HGL.
- Confirm that an inventory of chemicals brought on site by HGL subcontractors is available.
- Request or confirm locations of MSDS from the client, contractors, and subcontractors for chemicals to which HGL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific Hazardous Communication training.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

9.3 WORK PERMIT REQUIREMENTS

There are no work permit requirements associated with this project.

9.4 MATERIAL HANDLING PROCEDURES

There are no known materials handling procedures associated with this project. Planned explosive MC soil sampling activities will be addressed in the WP.

9.5 DRUM CONTAINER/TANK HANDLING

There are no planned drums or tank handling activities associated with this project.

9.6 COMPREHENSIVE ACTIVITY HAZARD ANALYSIS OF TREATMENT TECHNOLIGIES

There are no planned treatment technologies associated with this project.

9.7 MACHINE GUARDING

In order to protect site personnel from unguarded moving machinery and equipment surfaces, the requirements found in Subpart O of 29 CFR 1910, Section 16B of USAESCH EM 385-1-1 and the general provisions listed below will be followed:

- All reciprocating, rotating, or moving parts of machinery or equipment will be guarded in accordance with manufacturer's specifications, if they create a hazard through contact with personnel.
- No guard, safety appliance, or device will be removed from machinery or equipment or made ineffective except when making immediate repairs, lubrication, or adjustments, and then only after the power has been shut off.
- All guards or safety appliances removed for repair, lubrication, or adjustments will be replaced immediately upon completion of said activity and before the power is restored.

9.8 HAZARDOUS ENERGY CONTROL

All site personnel involved in the use of lock-out/ tag-out for the control of hazardous energy will receive on-site training. All training will comply with Section 12 of EM 385-1-1. In the event that tag-out procedures are used on site, authorized personnel will be trained in the following limitations of tags:

- Tags are essentially warning devices affixed to energy-isolating devices and do not provide the physical restraint on those devices that is provided by a lock;
- When a tag is attached to an energy-isolating means, it is not to be removed without authorization of the authorized person responsible for it, and it is never to be bypassed, ignored or otherwise defeated;

- Tags must be legible and understandable by all authorized and affected personnel whose work operations are, or may be, in the area; and
- Tags must be securely attached to energy-isolating devices so that they cannot be inadvertently or accidentally detached during use.

9.9 ILLUMINATION

Potentially hazardous operations will be performed only during the time period from 30 minutes after sunrise to 30 minutes before sunset.

9.10 LIGHTNING AND SEVERE STORMS

The safety officer will remain aware of weather forecasts and plan for inclement weather during project work. If inclement weather appears imminent, the safety officer will direct site workers to halt work and to take refuge in vehicles or nearby buildings. **A lightning detector will be present on the** site and will be monitored by the UXOSO when threatening weather is noted or when storms are forecast. If the UXOSO deems that lightning is a potential threat, he will order employees to take shelter in an enclosed building or in a vehicle.

9.11 SANITATION AND DRINKING WATER

An adequate supply of potable (drinkable) water will be provided on site at all times and will be supplied in accordance with the following provisions:

- Containers will be clearly marked, capable of being tightly closed, equipped with a tap, maintained in a sanitary manner, and cleaned at least weekly.
- Where single-service cups are provided, separate sanitary containers will be provided for the storage of the unused cups and for the disposal of the used cups.
- Water or other supplied beverages will not be dipped from the container by any means, and use of a common cup will not be allowed. Use of non-potable water is not anticipated; however, if containers of such water are used, they will be conspicuously labeled “Caution: water unfit for drinking, washing, or cooking.”

Toilet and washing facilities will be available at the project site. The UXOSO will require proper hygienic practices to remove contaminants that might be present on the hands, clothing, or PPE, especially when personnel conduct environmental sampling for MC.

9.12 POWER AND HAND TOOL OPERATION

To control the hazards associated with power tool operation, the requirements outlined in Engineering Manual (EM) 385-1-1, Chapter 13; and the safe work practices listed below will be observed when using power tools:

- Operation of power tools will be conducted by personnel trained in the use of the tool, its operation, and safety precautions.

- Power tools will be inspected prior to use, and defective equipment will be removed from service until repaired.
- Power tools with guards for moving parts will have such guards in place prior to and during use, and loose fitting clothing or long hair will be secured away from moving parts.
- Hands, feet, etc., will be kept away from all moving parts.
- Maintenance and/or adjustments to equipment will not be conducted while it is in operation or connected to a power source, and maintenance on gasoline-powered tools will be conducted only after the spark plug has been removed and secured.

Use of improper or defective hand tools can contribute significantly to the occurrence of accidents on site. Therefore, the requirements outlined in EM 385-1-1, Chapter 13 and the safe work practices listed below will be observed when using hand tools:

- Hand tools will be inspected for defects prior to each use.
- Defective hand tools will be removed from service and repaired or properly discarded.
- Tools will be selected and used in the manner for which they were designed.
- Be sure of footing and grip before using any tool.
- Do not use tools that have split handles, mushroom heads, worn jaws, or other defects.
- Leather work gloves will be worn to increase gripping ability and to protect the hand if a cut, laceration, or puncture hazard exists during the use of the tool.
- Safety glasses or a face shield will be used if use of tools presents an eye/face hazard.
- Do not use makeshift tools or other improper tools.

9.13 CHEMICAL HAZARD COMMUNICATION

The UXOSO will control the entry of chemical products into the work environment, and limit the number of such products to the minimum necessary for project execution. He will obtain a copy of a material safety data sheet for all such chemical products (unless an exception applies) and maintain these on the site. In addition, the UXOSO will review the hazards inherent in the storage and anticipated use of the chemicals, and provide training to workers exposed to these hazards. Such training will be provided upon initial assignment to the site and before use of the product. Supplemental training will be scheduled and presented whenever a new hazardous substance is introduced into the work area or whenever an employee changes job locations where different products are encountered.

The UXOSO will maintain on the site the following documents and records, and inform site workers of their place of storage: (1) The OSHA standard on chemical hazard communication (29 CFR 1910.1200) and (2) A list of chemical products on the site, with associated material safety data sheets (Attachment 6).

Subcontractors will comply with the requirements presented above and will supply the UXOSO with copies of material safety data sheets for any chemical products that they bring onto the site.

9.14 SPILL CONTROL

A portable spill-response kit containing oil/solvent absorbent pillows/pads, PPE and disposal supplies will be maintained in a readily accessible location where fuels, oils, solvents and other environmentally harmful materials are stored on site. The UXOSO will train workers in the proper use of such equipment.

9.15 CONTACT WITH CONTAMINATED SOIL OR WATER

Significant exposure to chemical contaminants in soil and water is unlikely. Limited potential for exposure to munitions constituents will exist when employees collect samples of soil, sediment or groundwater, or otherwise come into contact with soil or water. The UXOSO will inform site workers of the risks discussed below, and implement the precautions described.

Inhalation of chemical vapors and contaminated dust could occur during excavation operations. Chemical vapors could be present above freshly exposed earth long after excavation tasks are complete. Personnel will attempt to remain upwind of excavation operations, fresh excavations, and piles of freshly exposed earth.

The UXOSO will implement procedures to minimize skin contact with potentially contaminated soil and water. Personnel collecting environmental samples will wear disposable nitrile gloves during collection activities.

Ingestion of contaminants could occur through hand-to-mouth contact that is easily avoided. The UXOSO will require proper hygienic practices to prevent ingestion of contaminants that might be present on the hands, clothing, or PPE.

The UXOSO will halt work immediately and confer with the HGL manager of health and safety if evidence of grossly contaminated soil, sediment, or water is noted. Such evidence could include unusual odors, unusually discolored soil, sediment, or water, or the unexpected presence of chemical containers.

9.16 WORK AROUND HEAVY EQUIPMENT

The UXOSO will verify that operators have been trained in the safe operation of the heavy equipment that they are required to use. Personnel near operations involving heavy equipment will wear brightly colored safety vest, maintain a distance that is greater than the reach of the equipment, and maintain eye contact with the operator. Hard hats will be worn around excavating equipment. The backhoe will be lowered to the ground and equipment will be turned off when material is collected from the bucket or when workers approach for any other reason.

9.17 WORK AROUND DEEP WATER

The UXOSO will evaluate planned tasks carefully to determine the likelihood of slips or falls into deep water. If the hazard will be present, then the UXOSO will confer with the HGL manager of health and safety before the task begins to determine appropriate safety precautions.

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10.0 SITE CONTROL

10.1 WORK ZONE ACCESS CONTROL AND SECURITY

The UXOSO and other site mangers will control access to the site during operations, and enforce upon site visitors the restrictions found elsewhere in this document. If difficulties related to access control and site security arise, the UXOSO will confer with military authorities to identify corrective action.

10.2 WORK ZONES

The EZ around a potentially hazardous operation will be determined in each case by the UXOSO. When ordnance could be disturbed, the fragmentation distances established in the WP and Explosives Site Plan (ESP) will define the EZ. In other cases, the EZ will be dictated by the distance necessary to avoid work hazards, such as the steep edge of an excavation or heavy downwind dust concentrations. If heavy equipment is used, then the "reach" of the bucket, plus a few extra feet, will determine the radius of the EZ.

The support zone will include the office trailer, access roads, and adjacent areas so designated by the UXOSO. The UXOSO will implement procedures to prevent the transport of gross contamination from the EZ into the support zone on boots, clothing, tools and heavy equipment. The need for rigorous decontamination procedures is not anticipated.

The UXOSO will designate contamination-reduction zones where employees will remove gross contamination before entry into the support zone, or before movement of tools and equipment into the support zone, if necessary.

10.3 SITE COMMUNICATIONS

Effective on-site and off-site communication will be established prior to initiation of site activities. On-site communication will be used to coordinate site operations, to maintain site control, to convey safety information, and to alert site personnel to emergency situations. Off-site communication will be available to ensure effective coordination with off-site management personnel, the USACE, and emergency response services.

All site personnel will be familiar with the different methods of both on-site and off-site communication. The methods that will be used for on- and off-site communication will include:

1. On-site communications will consist of hand-held radios, cell phones or other supplied communication systems. Air horns, bullhorns, sirens, or hand signals can also be used, as needed, for communications.
2. Off-site communications will be accomplished by cell phones or other supplied communication systems. The UXOSO will verify that the 911 service is available, and make appropriate alternative arrangements if it is not available.

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11.0 PERSONNEL HYGENE AND DECONTAMINATION

Personal hygiene, sanitary and washing facilities, personnel and Level D decontamination, and waste control plans are discussed below.

11.1 SANITARY FACILITIES

HGL will provide and maintain portable sanitary facilities with at least one unit for each 15 workers, in accordance with EM 385-1-1, Section 2. The sanitary facilities will be maintained and serviced at regular intervals. They will be located adjacent to or near the current work activities.

11.2 WASHING FACILITIES

HGL will provide hand-washing facilities, convenient to the work area, including potable washing water and soap. All hand-washing facilities will be supplied with soap, paper towels, and trash receptacles. All washing facilities or areas will be kept clean and free of trash.

All field personnel will wash their hands and face before eating, drinking, and before leaving the site for the day.

11.3 PERSONNEL DECONTAMINATION

Effective decontamination is not simply removing contamination, it begins with preventing contamination. PPE prevents the wearer from becoming contaminated, and good work practices reduce contamination of protective clothing and equipment.

11.4 LEVEL D DECONTAMINATION

No Level D personnel decontamination is anticipated for this project.

11.5 WASTE CONTROL AND DISPOSAL

Solid trash, paper towels, and other items used in the work areas will be classified as solid waste and containerized and disposed of as such.

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12.0 EQUIPMENT DECONTAMINATION

Procedures for the decontamination of field equipment are presented in Section 3 of the Work Plan.

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13.0 EMERGENCY EQUIPMENT AND FIRST AID

The emergency equipment listed in Table 13.1 will be on site, stored in the location indicated and available for use during the operation specified. Emergency equipment assigned to an area or team will be maintained in proper working order by the team, as directed by the team leader. The UXOSO will conduct an inspection of all emergency equipment at least weekly to ensure completeness and proper working order.

Table 13.1
Emergency Equipment Requirements

Emergency Equipment	No. Per Location	Area Where Item(s) Will Be Stored	Operation Requiring Specified Equipment
CPR Mask	1 ea.	Support Zone	All operations
Portable Eye Wash Kit*	2 ea.	Each vehicle	All operations
15-Minute Eye Wash*	1 ea.	Support Zone	All operations
Biohazard Kit	1 ea.	Support Zone	All operations
First Aid Kit	1 ea.	Each vehicle	All operations
Fire Extinguisher	1 ea.	Support vehicles, and Support Zone	All operations
Cellular Phone/ Site Communication	1 ea.	SUXOS/UXOSO and Support Zone	All operations

*If employees exposed to corrosives, strong irritants, or toxic chemicals

The size and number of first aid kits will be sufficient to accommodate the maximum number of people (including government personnel and visitors) on site at any given time.

When required, portable eyewash bottles will be available for immediate use while the injured person is transported to the area where the 15-minute eye flushing station will be available. After flushing, the eyes will be bandaged lightly, and the person will be transported to the appropriate medical facility for further evaluation and treatment, if needed.

Personnel administering first aid and/or CPR will comply with the following:

- Personnel will wear disposable latex gloves if there is any visible body fluid;
- The CPR Pocket Mask will be used when performing CPR and disposed of after;
- Personnel will immediately change clothing that becomes contaminated with body fluids as a result of performing first aid, or as soon as feasible; and
- Personnel will wash their hands immediately after performing first aid procedures.

14.0 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

The Emergency Response Plan (ERP) addresses the following emergency response and contingency procedures: pre-emergency contingency planning, contacting off-site agencies, documentation, personnel, medical facility routes, and MSDS. Each is summarized below in this section.

14.1 PRE-EMERGENCY CONTINGENCY PLANNING

A pre-emergency contingency plan is a written document that sets forth policies and procedures, and outlines authority for responding to site emergencies. The contingency plan will be part of the SSHP, will anticipate the potential emergencies at the site; and will integrate actions by the local agencies, fire department, and medical facilities.

The contingency plan assigns the role of authority to the UXOSO and SUXOS. These two individuals are responsible for directing emergency response operations, notifying on-site and off-site personnel, requesting aid from outside sources, and documenting the event.

14.2 CONTACTING OFF-SITE AGENCIES

The pre-emergency contingency plan will include arrangements with the local medical provider, police, and fire department for support in the event of an emergency. A list of telephone numbers and directions to these agencies will be posted at the HGL field trailer. All personnel will be informed of this list and the communication system at the morning tailgate safety meeting. A map is included in the front of the document showing the location of the closest medical provider in relationship to the site. If the client has emergency response capability or a site contingency plan, the site contingency plan will show the integration with the client's established program.

14.3 DOCUMENTATION

The UXOSO and CHSD will initiate an investigation and documentation of any incidents. This is important in all cases, but especially so when the incident has resulted in personal injury, on-site property damage, or damage to the surrounding environment. Documentation may be used to help avert recurrences, as evidence in future legal action, for assessment of liability by insurance companies, and for review by government agencies. Documentation may include a written transcript taken from tape recordings made during the emergency, or a bound field book with notes. The document must be accurate and authentic. Documentation steps will include:

- An objective recording of all information.
- A chain-of-custody procedure.
- Signed and dated document entries.
- A minimum number of documents to avoid confusion and because they may have to give testimony at hearings or in court.

- If details change or revisions are needed, the person making the notation should mark a horizontal line through the old material and initial the change. Nothing should be erased.
- At a minimum, the following should be included:
  - Chronological history of the accident;
  - Facts about the incident and when they became available;
  - Title and names of personnel involved; composition of team;
  - Actions – decisions made and by whom; orders given to whom, by whom, and when; actions taken – who did what, when, where, and how;
  - Types of samples and test results; air monitoring results;
  - Possible exposure of site personnel; and
  - History of all injuries or illnesses during, or as a result of, the emergency.

14.4 PERSONNEL ROLES, AUTHORITY, AND COMMUNICATION

The UXOSO has full responsibility and commensurate authority for responding to any emergency that may occur at the MEC work site, until HGL is relieved by the proper authorities. With multiple teams working on site, emergency alerts will be broadcasted on mobile and/or hand portable field radios. The UXOSO will inform the SUXOS and PM of emergencies and response actions by telephone or fax as soon as reasonably practicable, followed by a written report providing full detail. HGL will provide the UXOSO with a cellular telephone and radio communication for use in the field, along with telephone numbers and frequencies that may be used to communicate with emergency services providers and other authorities. See Table 14.1 below of the list of emergency services and contacts.

Table 14.1
Emergency Telephone Numbers

Fire, Police, Emergency Medical Services:	911	
Emergency Medical Care:		
Granville County EMS Station 406 Grey Street Creedmoor, North Carolina 27522	(919) 528-3700	
Granville Medical Center (Hospital) 1010 College Street Oxford, North Carolina 27565	(919) 690-3000	
National Poison Control	(800) 222-1222	
National Response Center Environmental Emergencies	(800) 424-8802	
Client		
U.S. Army Engineer Support Center-Huntsville (USAESCH), Project Manager (PM)	Chris Cochrane	(256) 895-1696
U.S. Army Corps of Engineers (USACE), Wilmington District (CESAW), PM	Ray Livermore	(910) 251-4702
HydroGeoLogic, Inc.		
Health & Safety (H&S) Emergency Number	(800) 341-3647	
PM	Derek Anderson	(706) 372-5138
Site Manager/Senior Unexploded Ordnance (UXO) Supervisor (SUXOS)	Scott Schroepfer	(707) 330-6411
Site Safety Health Officer/UXO Safety Officer (UXOSO)	Cliff Ancelet	(505) 382-3938
UXO Safety Manager	Ronald D. Mendenhall, Jr.	Office: (505) 341-3362 Cell: (505) 280-2036
Corporate Health and Safety Director (CHSD)	Mark McGowan, CIH, CSP	Direct: (703) 736-4561 Cell: (703) 888-6441
Project Health and Safety Manager (PHSM)	Edie Scala-Hampson, CIH, CHMM	Cell: (847) 409-6384
HGL Corporate Occupational Physician *WorkCare 24-hour hotline Nurse	Dr. Peter Greaney. MD	714-978-7488 ext. 114 * 888-449-7787

14.4.1 Emergency Recognition and Prevention

Emergency situations might arise due to fire, injury/accident, accidental initiation of explosives or ordnance, serious illness, or weather (e.g., lightning). It will be the responsibility of all personnel to be observant regarding the work environment, to personally practice safe work habits, and to insist that other personnel work safely. However, it is the duty of the UXOSO to ensure that the potential for emergencies is minimized at the work site by closely observing personnel work habits and ensuring that the physical layout of the work site is established and maintained in such a way that there is minimal potential for accident.

14.5 ROUTE MAPS TO THE CLOSEST MEDICAL FACILITY

Maps containing routes and written directions to the supporting medical facility are provided in the front of the APP and this document. This information will be given to all personnel at morning tailgate safety meetings, and a copy will be kept on site.

14.6 MATERIAL SAFETY DATA SHEETS

When available, MSDS can provide valuable information when handling a chemical substance. Since the establishment of the Hazard Communication Standard (29 CFR 1910.1200), chemical manufacturers and distributors are required to provide MSDSs and warning labels on their products. Obtaining an MSDS on a chemical substance may provide valuable information on the chemical and physical hazards the material presents.

The sections on an MSDS and the information they can provide are:

- Chemical identity and manufacture information;
- Hazardous ingredients and exposure limits;
- Physical and chemical characteristics;
- Fire and explosion hazard data;
- Reactivity and stability data;
- Health hazard and medical treatment information;
- Precautions and protection for safe handling and use; and
- Control measures to avoid overexposure.

MSDSs are intended to provide comprehensive hazard information; however, many published MSDSs are incomplete and lack enough accurate information to assess a chemical hazard. Therefore, MSDSs should be used as a guide along with more in-depth information from other sources. Applicable MSDSs brought onsite by HGL and its sub-contractors will be filed in a binder, maintained onsite at the HGL field office trailer, and will be available for project personnel at all times.

15.0 EMERGENCY RESPONSE PLAN

The emergency response plan is provided below.

15.1 OPERATIONS

The frequency and severity of emergency situations can be dramatically reduced through proper implementation of the APP. However, if an emergency does occur, quick, decisive action is required. Delays in minutes can create or escalate life-threatening situations. In an emergency situation, site personnel involved in emergency response and rescue must be prepared to respond immediately. All required equipment must be on hand, in proper working order, and ready to use. To ensure rapid, effective response to a site emergency, the procedures and contingency plans outlined in this section must be implemented prior to and during any site activities involving exposure to safety and health hazards.

15.2 PRE-EMERGENCY PLANNING WITH LOCAL EMERGENCY RESPONDERS

Prior to conducting site operations, HGL site representatives contacted and/or met with the appropriate local authorities. The purpose of the meetings was to inform local authorities of the nature of the site activities to be performed under this SSHP, and the potential hazards that the conduct of these activities pose to site personnel, the environment, and the general public.

15.2.1 Identification of Local Emergency Services

During the meeting with local authorities, HGL personnel will be informed as to the type of emergency services available through the local authorities and were given the contact phone numbers for these services. In the event that evacuation of the general public is required due to either normal site operations or an emergency event, the Safety point of contact (POC), USACE Ordnance and Explosives Safety Specialist (OESS), and HGL UXOSO are responsible for contacting the appropriate local officials who execute and coordinate an evacuation. The phone numbers for pre-notified local emergency services are listed in Table 15.1.

Table 15.1
Local Emergency Services

Emergency Contact	Telephone Number
Fire/Emergency/Police	911
Granville County EMS Station	(919) 528-3700
Granville Medical Center	(919) 690-3000

15.3 PERSONNEL ROLES AND LINES OF AUTHORITY, AND COMMUNICATION

Key personnel roles, lines of authority, and communications plan are described below.

15.3.1 Personnel On-Scene Incident Commander

In the event of an emergency, the UXOSO assumes the responsibility of the site. The alternate person to assume this role, in the event that the UXOSO is unavailable or incapacitated, is the SUXOS. The UXOSO has responsibility for directing all on-site and off-site response personnel and, as soon as possible, advises the USACE OE Safety Specialist of the emergency situation.

15.3.2 On-Site Emergency Response Services

HGL personnel are trained to provide first aid treatment for minor injuries. At least two people onsite will be first aid-and CPR-trained. The UXOSO will determine whether any injury requires treatment in addition to first aid. If there is any doubt as to whether or not additional treatment is necessary, the UXOSO will call 911 for follow-on advanced care and transport to Granville Medical Center (Hospital).

15.3.3 Off-Site Emergency Response Services

Off-site emergency response services that may be needed in the event of a site emergency include medical and law enforcement personnel. All requests for emergency services are accessible via the 911 telephone system.

15.4 EMERGENCY RECOGNITION AND PREVENTION

During the development of this SSHP, great attention has been given to identifying potential safety and health hazards associated with conducting site activities. Once identified, these hazards were assessed to determine if they could result in an emergency situation. Contingency plans for responding to these potential emergency situations have been developed and are included in this section. The potential emergencies that may result during site activities are as follows:

- Injury or illness
- Fire/explosion
- Inclement weather

In the event that additional site or task hazard information becomes available during the project, the CHSD will assess this information to determine whether the contingency plans in this section need to be updated.

15.5 SAFE DISTANCES AND PLACES OF REFUGE

Safe distances and places of refuge will be addressed at the daily tailgate site safety meetings, depending on field activities. Work and EZs will vary from day to day. EZs will be established to protect the public during UXO intrusive activities and safe working distances will be established to protect site workers.

During an emergency situation all work will stop and field crews will return to the site trailer for further direction on the best place of refuge.

15.6 SITE SECURITY AND CONTROL

In an emergency, it is imperative that site control and security be maintained. The UXOSO will utilize the Personnel Site Entry/Exit Log to ensure all are present or accounted for at the pre-arranged emergency assembly points. Depending upon site size and configuration, weather and wind conditions, and the nature of the emergency, the following will, as applicable, be used to maintain site security:

- Close, but do not lock, gates as evacuation occurs;
- Erect flagging or barrier tape to prevent accidental entry; and
- Use vehicles to block access routes to the site, but ensure they can be moved rapidly if emergency vehicles must use the access route.

15.7 EVACUATION ROUTES AND PROCEDURES

Evacuation routes and procedures are discussed below.

15.7.1 Evacuation Route

The established evacuation route will be checked by the UXOSO and then traveled by all site personnel prior to the start of site activities to establish familiarity with the route. Emergency meeting points will vary from day to day depending on work location. The planned evacuation route will be discussed with the field crew at the daily tailgate safety briefing.

Emergency evacuation routes will be posted in the HGL field office at each room’s exit point. All exit routes will be unobstructed and kept free of debris.

15.7.2 Medical Facilities

A map showing the location of the Granville Count Medical Center (Hospital) will be kept readily available in each project vehicle. The emergency number is 911; the switchboard number is (919) 690-3000.

15.7.3 Directions to Hospital

A map to the hospital will be in each vehicle and posted in the field. Directions and maps can also be found in the front of this document and the APP.

15.7.4 Medical Evacuation

Medical evacuation requirements will be determined by the emergency first responder. Personnel requiring additional treatment will be evacuated to the hospital. Any further treatment or evacuation will be arranged by the hospital site personnel who will receive specialized training that will be given by the UXOSO and conducted prior to initiating site activities involving safety and health hazards. Training will be documented using the site training log and will include the subjects listed below:

- Emergency chain-of-command;
- Communication methods and signals;
- Emergency equipment and PPE;
- Removing injured personnel from the site; and
- Emergency contacts, telephone numbers, and hospital route.

15.8 DECONTAMINATION

Leaking hazardous substances are not expected to be encountered in the MRSs. Field crews are to avoid drums or leaking substances, and to report them when discovered. The CESAW PM will be notified and will make decisions on further actions if required.

15.9 EMERGENCY MEDICAL TREATMENT AND FIRST AID

In the event of an emergency, field crews will have first aid kits and at least two staff qualified to administer first aid. The objective will be to stabilize the victim and call for medical assistance. All work will stop during emergency situations and the UXOSO and SUXOS will be notified.

15.9.1 Assessing the Emergency

Available information related to the emergency and the on-site response capabilities should be evaluated and the information listed below obtained to the extent possible:

- What happened:
  - Type of incident.
- Casualties involved:
  - Victims (number, location, and condition),
  - Treatment required, and
  - Missing personnel.
- Cause of incident
- Extent of damage to structures, equipment, and terrain
- What can be done to mitigate the situation; consider:
  - Equipment and personnel needed for rescue and hazard mitigation;
  - Number of uninjured personnel available for response;
  - Resources available on site;
  - Resources available from off-site response groups and agencies;
  - Time needed for off-site response resources to reach the site; and

- Hazards involved in rescue and response.

15.9.2 Rescue and Response Actions

Based on the information collected during the emergency assessment, the general actions listed below are taken, with some actions being conducted concurrently. No one is to attempt emergency response or rescue until the situation has been assessed and the appropriate response outlined by the UXOSO.

- Enforce the Buddy System:
  - Allow no one to enter a hazardous area without a partner, and
  - Personnel in the EZ should be in line-of-sight of or in communication with the UXOSO or their designee.
- Survey Casualties:
  - Locate all victims and assess their condition, and
  - Determine resources needed for stabilization and transport.
- Assess existing and potential hazards and determine:
  - Whether and how to respond,
  - The need for evacuation of site personnel and off-site population, and
  - The resources needed for evacuation and response.
- Request Aid:
  - Contact the required off-site/on-site personnel or facilities, such as ambulance, fire department and police, etc.
- Allocate Resources:
  - Allocate on-site personnel and equipment to rescue and initiate incident response operations.
- Control:
  - Assist in bringing the hazardous situation under complete or temporary control, and use measures to prevent the spread of the emergency (control fire, secure site, etc.).
- Extricate:
  - Remove or assist victims from the area.
- Stabilize:
  - Administer any medical procedures that are necessary before the victims can be moved,
  - Stabilize or permanently fix the hazardous condition, and

  - Attend to what caused the emergency and anything damaged or endangered by the emergency (e.g., drums, tanks).
- Transport:
  - Transport using either on-site or off-site assets.
- Casualty Logging:
  - Record the name of the victim, time of injury, destination, and condition upon transport.
- Evacuate:
  - Move site personnel to the rally point, a safe distance upwind of the incident, and
  - Monitor the incident for significant changes; the hazards may diminish, permitting personnel to re-enter the site, or hazards may increase and require public evacuation.
- Casualty Tracking:
  - Record disposition, condition, and location.

15.10 EMERGENCY ALERTING AND RESPONSE PROCEDURES

Emergency response procedures include all steps to be taken for notifying, evaluating, reacting to, documenting, and following up on a given emergency situation. To ensure all necessary elements are covered, the procedural steps outlined in this paragraph are implemented for each emergency, regardless of its nature.

15.10.1 Notification

Once the UXOSO has been informed of the emergency, the UXOSO will alert site personnel to the emergency using radio communication. This is done to:

- Notify personnel and get their attention;
- Stop work activity as required;
- Lower noise levels in order to speed and simplify communication; and
- Begin emergency or evacuation procedures.

If on-site HGL personnel or off-site emergency personnel are to enter the site in response to the emergency, the UXOSO, to the extent possible, will notify response personnel about the nature of the emergency, to include:

- What happened and when it happened;
- Where onsite the emergency situation occurred;
- Who is involved and, if possible, the cause of the emergency;
- The extent of damage and what hazards may be involved; and
- What actions should be taken?

15.11 CRITIQUE OF RESPONSE AND FOLLOW-UP

Before normal site activities can resume, the site and personnel must be prepared and reequipped to handle another emergency. It is also imperative that all federal, state, and local regulatory agencies be notified of the emergency. Therefore, the following activities must be conducted prior to re-starting of site activities:

- Notify all appropriate governmental agencies as required (i.e., OSHA must be notified if there have been any fatalities or three or more personnel hospitalized);
- Restock and clean all equipment and supplies utilized or damaged in the emergency;
- Conduct an accident investigation to determine the cause of the emergency and what preventative measures could be taken to ensure the emergency does not occur again;
- Complete the HGL Incident form; and
- Review and revise, as needed, the site operational procedures and, if necessary, update the SSHP to reflect the new procedures;

15.12 DOCUMENTATION

Information related to an emergency shall be recorded completely and accurately. Documentation will be performed as soon as possible after the emergency to ensure it is recorded while the events are vivid in the minds of the personnel involved. Information to be recorded will include:

- A chronological record of events;
- A listing of the personnel involved, including personnel on site, site personnel who responded, personnel in charge, and off-site groups or agencies that responded;
- A listing of the actions taken to minimize the effects of, or to mitigate, the emergency;
- An assessment of the potential exposures received by site personnel and the surrounding public; and
- A recording of the injuries or illnesses that occurred as a result of the emergency.

15.13 PPE AND EMERGENCY EQUIPMENT

Planned project PPE is Level D. Upgrades of Level D may be required if the situation dictates. Additional PPE such as safety glasses, hardhats, and gloves may be available from the UXOSO. HGL subcontractors will provide their own PPE for their field crews.

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16.0 EMERGENCY RESPONSE TEAM

Not applicable, local fire and rescue personnel will be contacted in case of emergency.

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17.0 LOGS, REPORTS, AND RECORD KEEPING

17.1 SAFETY, TRAINING, AND VISITOR

The UXOSO will maintain a safety log to record all significant information related to workplace health and safety each day. The safety log should include: a record of safety briefings; details of any accidents, injuries, illnesses, or near misses; details related to the conduct and outcome of internal and external audits; the reason for and duration of safety-related “stop work” orders; and any other issues pertaining to site or personnel safety or health.

The UXOSO will document all safety-related training sessions in a training log or on appropriate forms collected in a file or notebook and maintained on the site. This log will include the initial site-specific training conducted prior to the start of site activities, the safety briefings, hazard-specific training, etc.

The UXOSO will maintain a visitor log, which will be used to record the entry and exit of all visitors. No visitors will be allowed to enter the project site without providing the information required.

17.2 INJURY/ILLNESS/ACCIDENT REPORTS

Accident reporting is discussed in Section 7.0 of the APP.

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ATTACHMENT 2

HEALTH AND SAFETY FORMS

SITE SAFETY OFFICER (SS0)
WET BULB GLOBE THERMOMETER (WBGT) LOG

DATE	**TIME**	**DRY BULB TEMP**	**WBGT TEMP**	**RECOMMENDED WORK/REST REGIMEN (PER HOUR)** WORK REST
				/
				/
				/
				/
				/
				/
				/
				/
				/
				/

Permissible WBGT Heat Exposure Threshold Limit Values are given in EC and EF

Table 2 lists values from the 2011 edition of the *American Conference of Governmental Industrial Hygienists* (ACGIH) publication *Threshold Limit Values (TLV®) and Biological Exposure Indices*. This table is intended as an initial screening tool to evaluate whether a heat stress situation may exist. Professional judgment is also of particular importance in assessing the level of heat stress and physiological heat strain of workers. The values in the table below are more protective and they are not intended to prescribe work and recovery periods, but suggest work in a cycle of work and recovery.

Table 2
Screening Criteria for TLV and Action Limit for Heat Stress Exposure

Allocation of Work in a Cycle of Work and Recovery	TLV WBGT values in °C (EF)				Action Limit WBGT Values in °C (EF)			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75 - 100% work	31(87.8)	28(82.4)	-	-	28 (82.4)	25 (77)	-	-
50 - 75% work	31 (87.8)	29(84.2)	27.5 (81.5)	-	28.5 (83.3)	26 (78)	24 (75.2)	-
25 - 50% work	32 (89.6)	30(86)	29(84.2)	28 (82.4)	29.5 (85.1)	27 (80.6)	25.5 (77.9)	24.5 (76.1)
0 - 25% work	32.5(90.5)	31.5(88.7)	30.5 (86.9)	30 (86)	30 (86)	29 (84.2)	28 (82.4)	27 (80.6)

WBGT means the wet bulb globe temperature measured with a black globe thermometer (GT), wet bulb thermometer (WB), and a dry bulb (air) thermometer (DB), and measured according to the following equations:

For indoor or outdoor environments without direct exposure to sunlight,

$$\text{WBGT}°\text{C} = 0.7\text{WB} + 0.3\text{GT}$$

For outdoor environments with direct exposure to sunlight,

$$\text{WBGT}°\text{C} = 0.7\text{WB} + 0.2\text{GT} + 0.1\text{DB}$$

USACE Accident Investigation Report

(For Safety Staff only) REPORT NO. | EROC CODE

UNITED STATES ARMY CORPS OF ENGINEERS
ACCIDENT INVESTIGATION REPORT
(For Use of this Form See Help Menu and USACE Suppl to AR 385-40)

REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)

1. **ACCIDENT CLASSIFICATION**

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE	MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER		☐	

2. **PERSONAL DATA**

a. Name *(Last, First, MI)* | b. AGE | c. SEX ☐ MALE ☐ FEMALE | d. SOCIAL SECURITY NUMBER | e. GRADE

f. JOB SERIES/TITLE

g. DUTY STATUS AT TIME OF ACCIDENT: ☐ ON DUTY ☐ TDY ☐ OFF DUTY

h. EMPLOYMENT STATUS AT TIME OF ACCIDENT: ☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER ☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL ☐ TEMPORARY ☐ STUDENT ☐ OTHER *(Specify)* ____

3. **GENERAL INFORMATION**

a. DATE OF ACCIDENT *(month/day/year)* | b. TIME OF ACCIDENT *(Military time)* hrs | c. EXACT LOCATION OF ACCIDENT | d. CONTRACTOR'S NAME (1) PRIME: (2) SUBCONTRACTOR:

e. CONTRACT NUMBER ____ ☐ CIVIL WORKS ☐ MILITARY ☐ OTHER *(Specify)* ____

f. TYPE OF CONTRACT: ☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER *(Specify)* ____

g. HAZARDOUS/TOXIC WASTE ACTIVITY: ☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER *(Specify)* ____

4. **CONSTRUCTION ACTIVITIES ONLY** *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY ____ (CODE) #

b. TYPE OF CONSTRUCTION EQUIPMENT ____ (CODE) #

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY ____ (CODE) # | b. ESTIMATED DAYS LOST | c. ESTIMATED DAYS HOSPITALIZED | d. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED
PRIMARY ____ (CODE) #
SECONDARY ____ (CODE) #

f. NATURE OF ILLNESS/INJURY ____ (CODE) #

g. TYPE AND SOURCE OF INJURY/ILLNESS
TYPE ____ (CODE) #
SOURCE ____ (CODE) #

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT ____ (CODE) #

b. PERSONAL FLOATATION DEVICE USED? ☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE: ☐ PICKUP/VAN ☐ AUTOMOBILE ☐ TRUCK ☐ OTHER *(Specify)* ____

b. TYPE OF COLLISION: ☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END ☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER *(Specify)* ____

c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
(1) FRONT SEAT			
(2) REAR SEAT			

8. PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	b. OWNERSHIP	c. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*

a. TYPE OF VESSEL/FLOATING PLANT ____ (CODE) #

b. TYPE OF COLLISION/MISHAP ____ (CODE) #

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

ENG FORM 3394, MAR 99 Version 2 EDITION OF SEP 89 IS OBSOLETE. Page 1 of 4 pages (Proponent: CESO)

11. CAUSAL FACTOR(S) *(Read Instruction Before Completing)*

a. (Explain YES answers in item 13)	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐

a. *(CONTINUED)*	YES	NO
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident	☐	☐

b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES *(If yes, attach a copy.)* ☐ NO

12. TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	(Month) (Day) (Year)

13. FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE

b. INDIRECT CAUSE(S)

14. ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).

DESCRIBE FULLY:

15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING (Month/Day/Year)	b. ANTICIPATED COMPLETION (Month/Day/Year)

c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect)*	f. OFFICE SYMBOL
CORPS ______ CONTRACTOR ______			

16. MANAGEMENT REVIEW *(1st)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19. COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE	DATE

Page 2 of 4 pages

*U.S. GOVERNMENT PRINTING OFFICE: 1993-0-791-757

HGL HydroGeoLogic, Inc. MUNITIONS RESPONSE TEAM

Health and Safety Site Visitor Log

Project Name:		**Project Number:**		**Delivery/Task Order:**	
Site Name:		**Location:**			

This form shall be used to track entry into and departure from the ***EXCLUSION ZONE, CONTAMINATION REDUCTION ZONES, OR OTHER WORK ZONES*** on all HydroGeoLogic, Inc. sites. All Personnel shall sign in and out on the form by printing their name, initializing the form and noting the time in/out.

Date	**Name**	**Representing**	**Purpose of visit**	**Escort Required**		**Equipment/ PPE Level**	**Time**	
				Yes	**No**		**In**	**Out**

HGL MR Form 15.21 (Sep 2008)

Page ______ of ______.

HGL Vehicle Inspection Checklist

HGL HydroGeoLogic, Inc. MUNITIONS RESPONSE TEAM

Vehicle Safety Inspection Checklist

Inspection date:	**Site name/location:**
Site Supervisor:	**Vehicle** (make and license plate number):
Mileage:	**Owner** (contractor/HGL/rental):

1. DOCUMENTATION:	**Pass**	**Fail**	**5. BRAKES:**	**Pass**	**Fail**
Registration and License Plate			Hand/Emergency		
Insurance			Service		
Emergency Route Map & Phone #s					
2. TIRES:	**Pass**	**Fail**	**6. BELTS:**	**Pass**	**Fail**
Pressure			Proper tension		
Condition			Condition		
3. EQUIPMENT:	**Pass**	**Fail**	**7. GENERAL:**	**Pass**	**Fail**
Fire extinguishers			Windshield		
First Aid/CPR/Burn Kits			Windshield Wipers		
Emergency Route Directions/Map			Windows (Condition/Operation)		
Vehicle Registration/Rental Contract			Seat Belts		
HGL Insurance Coverage Card			Steering		
Eyewash Kits			Horn		
Spare Tire			Gas Cap		
Tire Changing Equipment			Mirrors		
Tie downs ✱☐			Door/Window Handles/Latches		
Chocks ✱☐			Cleanliness		
Placards ✱☐			Exhaust System ✱☐		
4. FLUID LEVELS:	**Pass**	**Fail**	**8. LIGHTS:**	**Pass**	**Fail**
Oil			Headlights (high & low)		
Coolant			Brake Lights		
Brake			Parking		
Steering			Back-up		
Transmission			Turn Signals		
Windshield Wiper			Emergency Flashers		
Fluid Leaks			Interior Lights		
Last Oil Change (mileage):					

Notes:

1. To be used weekly for all vehicles EXCEPT explosive carriers that must be inspected prior to each explosives transport.
2. Items marked with an ✱ are required for explosive carriers and must be inspected prior to each use per HGL MRT SOP 15-0.
3. All forms with failures must note the deficiencies and forward a copy of this form within two working days to the Safety Officer.

Description of deficiencies:		
Corrective Actions to be taken:		
Inspection conducted by: (Printed name/signature)		
Deficiencies corrected by: (Printed name/signature)		

HGL MR Form 15.23 (Sep 2005)

HGL Safety Inspection Log

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Site Safety Inspection Report

Dates (period covered):	Contract Number:	Delivery Order/Task Number:
Installation or Site Name:	Site Location (city and state):	
Location of Inspection (Grid number or GPS coordinates,):	Activity:	

Weather Conditions:	☐ Sunny	☐ Partly Cloudy	☐ Cloudy	☐ High temperatures	☐ Cold temperatures
Type of Inspection:	☐ Daily:	☐ Weekly	☐ Monthly	☐ Special	☐ Re-inspection

I. ACTVITY INSPECTED (indicate results by an "X")	SATISFACTORY	UNSATISFACTORY	NOT APPLICABLE
a. Site Mobilization/Demobilization			
b. Surface Sweep Operations			
c. Subsurface Operations			
d. Geophysical Operations			
e. Survey/Vegetation Removal Operations			
f. Heavy Equipment/Earth Moving Machinery			
g. Personal Protection Equipment			
h. Safe Work Practices			
i. Site Controls			
j. First Aid/Medical Equipment			
k. Fire Extinguisher/Fire Fighting Equipment			
l. Demolition Operations			
m. Explosive Storage			
n. Explosive Transportation Procedures			
o. Emergency Procedures			
II. OVERALL INSPECTION RESULTS			

III. COMMENTS:

IV. ACTIONS	YES	NO	COMMENTS
Work stopped due to safety violations:			
Safety violation noted:			
Personnel involved:			
Corrective measures:			
Re-inspection required:			
Demolitions Operations Conducted:			

V. SITE VISITORS	NAME	ORGINIZATION	PURPOSE

VI. SIGNATURES. *I acknowledge that I have been briefed on the results of this inspection and will take corrective actions as necessary.*

RECEPIENT (print name/signature)	SITE/UXO SAFETY OFFICER (print name/signature)	PROJECT MANAGER (print name/signature)

HGL MEC Form 15.20 (Sep 2008)

HGL Safety Meeting Attendance Log

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Safety Meeting/Training Attendance Log

Date:		**Time:**		**Conducted by:**	
Site Name/Location:					
Contract Number:				**Delivery/Task Order Number:**	
Project Manager:				**Site Manager** (when applicable):	
(Senior) UXO Supervisor:				**Site Safety Officer/Unexploded Ordnance Safety Health Officer:**	

Training Provided: ☐ Initial Site Hazard ☐ Weekly Safety Training ☐ Daily Safety Meeting ☐ Task/Hazard Specific ☐ Other:

Weather Conditions: ☐ Fair ☐ Poor **Temperature (Low/High):** to °F **Wind speed:** mph **Direction:** **Precipitation:** % **Humidity:** %

I. TRAINING TOPICS COVERED

☐ Planned Site Activities	☐ Heat or Cold Stress	☐ Respirator Use
☐ Demolition Operations	☐ Biological Hazards	☐ Decontamination Procedures
☐ Site Controls	☐ Chemical Hazards	☐ Emergency Procedures/Route
☐ Exclusion Zone/Personnel Limits	☐ Routes of Chemical Exposure	☐ First Aid Procedures
☐ Site Communications	☐ Chemical Exposure Symptoms	☐ Buddy Team Procedures
☐ Physical Hazards	☐ Level/Type of PPE	☐ Other (describe topic(s) below)

Explain: ______________________________

Hospital/Clinic:	**Address:**	**Phone:**

II. SITE PERSONNEL / TRAINING ATTENDEES (Continued on 2nd page)

	Name	Signature	Company
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

III. SAFETYBRIEF / TRAINING VERIFICATION

I certify that the personnel listed on this roster have received the safety and health training described above.

______________________________ Site Manager or Senior UXO Supervisor

______________________________ Site Safety and Health Officer or UXO Safety Officer

HGL MR Form 15.18 (Oct 2010)

Page ______ of ______.

HGL Safety Meeting Attendance Log (continued)

HGL HydroGeoLogic, Inc.

Safety Meeting and Training Attendance Log

II. SITE PERSONNEL / TRAINING ATTENDEES (continued from 1st page)			
	Name	Signature	Company
11.			
12.			
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HGL MEC Form 15.18 (Oct 2010)

Page ______ of ______.

Vehicle Accident Report

Vehicle

Driver ________________________ Accident Date _______________ Driver's License/State _______________

Address ____

City ____________________ State ___________ Zip _____________ Phone ____________________________

Vehicle # _____________________ Year _______ Make ___________ Model _________ Plate # ____________

State ____________ Vehicle Owner: ( ) GSA ( ) Leased/Rent ( ) Private Vehicle

Vehicle Damage ____ Est. Repair Cost $_________________

Other Vehicles

Driver ________________________ Driver's License __________________________ State ________________

Address ____

City _______________________________ State __________________ Zip __________________

Phone ______________________________ SSN ___________________

Owner's Name (Check if same as driver { }) ____

Address ____________________________ City ________________________ State ______ Zip _____________

Insurance Company ____________________________________ Policy # _______________________________

Vehicle: Year ___________ Make _____________ Model _____________ Plate # _____________ State ______

Vehicle Damage ____

Passenger(s) ( ) Yes ( ) No (List on back) Injuries ( ) Yes ( ) No (List names and address on back)

Accident Description

Date ________________ Time _____________

Location ____

Description ____

____

____

____

____

Witness ___________________________ Address ____

Phone # ___________________________

Police Officer's Name ____ Dept. ____________________________

Employee ________________________________ ___________________________ ____________
(Print Name) (Signature) (Date)

SUXOS ________________________________ ___________________________ ____________
(Print Name) (Signature) (Date)

General Liability, Property Damage, and Loss Report

Project Location ________________________ Task Order #________________ Date _________________

How did the damage or loss occur: ____

____

Description of damage or loss: ____

____

Identification of damaged or lost property: ____

____

Location of damaged or lost property (before loss): ____

____

Date and time of damaged or lost property: ____

Owner of damaged or lost property:

Name ____ Phone # _________________________________

Address ____ City/State ______________________________

Employer name & address ____

Injured Parties (Also complete a Supervisor Employee Injury Report)

1. Name ____ Phone # ____________________________

Address ____ City/State __________________________

Employer name & address ____

2. Name ____ Phone # ____________________________

Address ____ City/State __________________________

Employer name & address ____

Witnesses:

1. Name ____ Phone # ____________________________

Address ____ City/State __________________________

Employer name & address ____

2. Name ____ Phone # ____________________________

Address ____ City/State __________________________

Employer name & address ____

Were pictures taken? ( ) Yes ( ) No

Were police notified? ( ) Yes ( ) No Dept. ____

Employee _________________________ _____________________________ _______________
(Print Name) (Signature) (Date)

SUXOS ____________________________ _____________________________ _______________
(Print Name) (Signature) (Date)

HGL Supervisor's Employee Injury Report

HGL
HydroGeoLogic, Inc.

SUPERVISOR'S Incident Investigation Report

(To be completed by the employee's supervisor or other responsible administrative official)

Location where accident occurred	Employer's Premises: Yes No Job site: Yes No	Date of accident or illness
Who was injured?	Employee Non-Employee	Time of accident a.m. p.m.
Length of time with firm	Job title or occupation	
What property/equipment was damaged?	Property/equipment owned by:	
What was employee doing when injury/illness occurred? (Add additional sheets if needed)		
How did injury/illness occur? List all objects and substances involved.		
Part of body affected/injured?		
Nature and extent of injury/illness and property damaged (be specific)		

PLEASE INDICATE ALL OF THE FOLLOWING WHICH CONTRIBUTED TO THE INJURY OR ILLNESS

____ Failure to lockout	____ Improper maintenance	____ Poor housekeeping
____ Failure to secure	____ Improper protective equipment	____ Unrealistic schedule/budget
____ Horseplay	____ Inoperative safety device	____ Unsafe arrangement or process
____ Fatigue	____ Lack of training or skill	____ Unsafe equipment
____ Improper guarding	____ Operating without authority	____ Unsafe position
____ Improper instruction	____ Physical or mental impairment	____ Other ________________

____

____

____

Supervisor's corrective action to ensure this type of accident does not recur:

Was employee trained in the appropriate use of Personal Protective Equipment/Proper safety procedures? ..... Yes ___ No ____
Was employee cautioned for failure to use Personal Protective Equipment/Proper safety procedures? .... Yes ___ No ____
Did employee promptly report the injury/illness? .... Yes ___ No ____
Is there modified duty available? .... Yes ___ No ____
If so, Please describe: ____

Supervisor's name	Supervisor's signature	Phone#	Date
____________________	____________________	__________	_____

https://sharepoint.hgl.com/docs/munitions response/uxo personnel/01 - forms/safety/supervisor incident investigation report.doc July 2010 V0.0

HGL Incident Report

HGL INCIDENT REPORT

Section 1 – General Information

Date of Occurrence	Date Reported	Reported to whom?	Time of Occurrence
Employee Name	Work Address	City, State, Zip Code	Work Phone Number
Date of Birth	Home Address	City, State, Zip Code	Home Phone Number
Occupation (Title)		Full time _____ Part time _____ Temporary _____	
Location of Occurrence	Address	City, State, Zip Code	
Description of Incident (include what employee was doing, work process, cause, injury and body part)			
Witness(es)	Address	City, State, Zip Code	Work Phone Number
Was First Aid given on-site? Yes _____ No _____ By whom?			
Was employee taken to hospital? Yes _____ No _____ Ambulance Yes _____ No _____ If so, provide name, address, and phone number of hospital and name of attending physician below:			
Name of Hospital:	Address:	City, State, Zip Code:	Phone Number:
Attending Physician:			
Did employee seek medical attention other than an emergency room? Yes _____ No _____ If so, provide practice name, address, phone number and name of attending physician below:			
Practice Name:	Address:	City, State, Zip Code:	Phone Number:
Attending Physician:			
Did employee lose time on the job? Yes _____ No _____ If so, how many days after the initial injury date? _____			
Was employee assigned light duty? Yes _____ No _____ If so, how many days after the initial injury date? _____			
Supervisor (print):	Signature:	Date:	
Employee (print):	Signature:	Date:	
Witness (print):	Signature:	Date:	
Witness (print):	Signature:	Date:	
Director, Health & Safety:	Signature:	Date:	

Incident Report Form 1 HGL 12/1/2009

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ATTACHMENT 3

ACTIVITY HAZARD ANALYSES FOR PHASES OF WORK

ACTIVITY HAZARD ANALYSIS

Overall Risk Assessment Code (RAC): **M**

Date Prepared: July 2011
Project Name: RI/FS Former Camp Butner
Activity/Work Task: Mobilization/Demobilization
Activity Location(s): Camp Bunter MRSs
Prepared By: Edie Scala-Hampson, CIH, CHMM
Reviewed By: Ron Mendenhall, UXO Safety Manager

Risk Assessment Code Matrix						
E=Extremely High Risk H=High Risk M=Moderate Risk L=Low Risk		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
1. Readiness Review-Health and Safety	Inadequate preparation which can lead to the pain and suffering of an accident	Conduct readiness review. Answer the following questions: • Have all site hazards been recognized? • Do you have all the necessary equipment to evaluate site hazards? • Are engineering, administrative and PPE controls ready to be implemented as needed? • Are back up emergency safety supplies and first aid supplies available and complete?	M
2. Mobilize Equipment, Tools and Safety Gear	Strains, sprains, awkward bending/lifts and ergonomic hazards	• Use proper lifting techniques. • Maintain good personal fitness • Ensure walking pathway is clear • Do not lift greater than 50 lbs. • Use mechanical assistance or 2 man lift whenever possible • Limit repetitive awkward motions	M
3. Travel to site	Traffic (road and site traffic)	• Assure vehicle is adjusted per your personal specifications and is in good working order and all cargo is secured and distractions are minimized. Familiarize yourself with the route and directions.	M
4. On-site Mobilization • Determine location for set up/staging equipment • Develop HGL's capability at the site, to include installation of office/equipment storage trailers, etc. • Set up office/storage trailers and other support services	Traffic-Struck by hazards	• Select location away from traffic • Place barricades for work site protection, if necessary • Wear high visibility vest • Stay clear of traffic and equipment. Have all necessary PPE (hardhat, safety glasses, hearing protection, vest, etc).	M
	Driving over soft ground Uneven and rough terrain	Choose location with level and firm soils	M
	Site access control-unwanted entry	Maintain a constant watch for intrusion of unauthorized personnel	L
	Electric shock	Require that all electrical power hook up, installations and disconnections be made or certified by a qualified electrician who will provide written certification of installation and grounding.	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Slip, trip and fall hazards	• Wear slip resistant footwear • Keep work area picked up and as clean as feasible and free of tripping and fall hazards.	M
	Flying debris	• Wear safety glasses when there is a potential for flying debris • Ensure eyewash is available	L
	Strains, sprains, awkward bending/lifts and ergonomic hazards-Tow trailer activities	• Use proper lifting techniques. • Maintain good personal fitness • Ensure walking pathway is clear • Do not lift greater than 50 lbs. • Use mechanical assistance or 2 man lift whenever possible • Limit repetitive awkward motions • Do not overexert or overstrain muscles/joints	M
	Noise-Hearing loss	Wear hearing protection if noise levels from neighboring equipment exceeds 85 dBA (if you cannot be heard speaking in a normal voice at arms distances)	M
	Spills and leaks	Maintain a portable spill response kit (if spills are possible) containing absorbent materials, non-sparking shovel, PPE and disposable supplies in a readily accessible location	L
	Hand tools-cut hazards, jamming, pinch points, struck-by	Assure that they are in good repair and used correctly. The right tool for the right job.	M
	Contact with equipment-Struck by	Conduct daily task specific briefings regarding the hazards associated with the tasks. All personnel will wear a minimum of Level D protection. All HGL subcontractors will be required to attend the site specific hazards health and safety training .Maintain eye contact with equipment operators if is necessary to enter active work zones	L
5. Removal and transport of equipment and supplies from the site	Take home toxics	• Note a source of Decon water on site. Do not bring contaminated PPE or boots into truck. • Use liners to prevent contamination of truck	M
	Same hazards as in step 4 above	See action to eliminate or minimize hazards in step 4	M

Equipment	Inspection	Training
1. All equipment and tools required for sit setup	Daily inspection	40-hr. HAZWOPER 8-hr. HAZWOPER HAZ COM

ACTIVITY HAZARD ANALYSIS

Overall Risk Assessment Code (RAC): M

Date Prepared: July 2011
Project Name: RI/FS Former Camp Butner
Activity/Work Task: Munitions Response Area/Site Brush Clearing and Grubbing
Activity Location(s): Former Camp Butner MRSs
Prepared By: Edie Scala-Hampson, CIH, CHMM
Reviewed By: Ron Mendenhall, UXO Safety Manager

Risk Assessment Code Matrix						
E=Extremely High Risk H=High Risk M=Moderate Risk L=Low Risk		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
1. Site access control	Unauthorized entry	• Implement positive site access control prior to site operations • Maintain a constant watch or surveillance for intrusion of unauthorized personnel. Positive site access control will be established prior to on-site operations using barricades, signs or other methods to ensure unauthorized access during tasks that could cause exposure to MEC or other safety and health hazards.	L
	MEC hazard/explosion, fire and overpressure	• Deliver daily task specific briefings regarding the hazards associated with the task and the procedures used to control/mitigate the hazards • Use required PPE as indicated in the SSHP, by all personnel inside the EZ • Require attendance, of all HGL subcontractors ,at the site specific hazards and health and safety training given by the HGL UXOSO • Implement MEC anomaly avoidance procedures. All non-UXO personnel will be escorted by a UXO Technician II or above. • Instruct non-UXO personnel to not touch or disturb any potential MEC items. Non-UXO personnel will adhere to the instructions of the UXO Technician II • In dense brush/vegetation areas use handheld detector/ locators to identify and mark MEC hazards • Have a fire extinguisher readily available • Turn off all motorized equipment during fueling.	M
2. Conduct surface Inspection of MEC hazard area/grid prior to brush/vegetation clearing	MEC hazard/explosion, fire and overpressure	• See Step 1 above	M
	Traffic-Struck by hazards	• Note all moving equipment in work areas • Wear Hi visibility vest • Make eye contact with equipment operators to let them know you are there • Use a spotter when visibility is poor (backing)	L
	Slip, trip and fall hazards -Walking over soft ground, uneven terrain	• Determine best access route before transporting equipment or walking in order to avoid tripping hazards • Wear slip resistant footwear with ankle support • Be aware of rocks, brush, animal boroughs and other hazards. Choose firm ground for walking, if possible	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Cuts, lacerations, flying debris from brush/vegetation (eye hazards)	• Wear thick clothing fabrics and appropriate PPE such as leather gloves when there is a potential for cuts and lacerations. • Wear safety glasses if there is a potential for dust and flying debris. • Ensure eye wash is available • Maintain adequate First Aid supplies	M
	Remote location	• Determine accessibility to associates, communication needs, first aid and rescue equipment and procedure. Institute buddy system.	L
	Environmental hazards Biologicals- Plants, insects, wildlife Adverse Weather Temperature Stresses UV Hazards	See General Site hazards actions	M
	Injury from physical exertion, sprains, sprains, awkward bending/lifts and ergonomic hazards	• Use proper lifting techniques • Assure solid footing • Maintain good personal level of fitness. Be alert to signs and symptoms of overexertion • Do not lift greater than 50 lbs. • Use mechanical assistance or 2 man lift whenever possible • Limit repetitive awkward motions • Have water available and first aid supplies • Take adequate rest/recovery periods	M
	Dust inhalation	Provide dust suppression if operation is generating too much dust.	L
	Environmental hazards Biologicals- Plants, insects, wildlife Adverse Weather Temperature Stresses UV Hazards	See General Site hazards actions See General Site hazards actions See General Site hazards actions See General Site hazards actions See General Site hazards actions	M
3. Install flag locators	Injury from unintentional contact-MEC/explosion, fire and overpressure (as indicated above)	• Visually screen the location prior to placing flag locators • Clear location with geophysical instrument prior to placing stake or monument (any soil penetrating activity). Any MEC items located will be marked with cross red pin flags or encircling the hazard with red flagging tape. The location will be reported to the SUXOS or UXOS • See Step 1 above for MEC hazards	M
4. Hand brush clearing/grubbing	Flying debris, dust, dirt, rocks, sparks, abrasions	• Select hand tools and power tools that are right for the job. Inspect all tools daily, prior to use. Defective tools must be tagged and removed from service immediately. • Wear safety glasses and other required PPE as indicated in the SSHP • Ensure that eyewash and first aid supplies are readily available • Wear abrasion resistant clothing (thick fabrics) • Watch for people ,plants, rocks, animals and animal burrows during clearing and grubbing	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Injury from unintentional contact-MEC/explosion, fire and overpressure (as indicated above)	• See Step 1 above for MEC	M
	Hand tools-struck by hazards/pinch points, jamming from applied force	• Follow the procedures and safety precautions specified by the manufacturer to ensure safe operation of all hand and power tools. When using machetes, no personnel will be within a 25 foot radius of the machete operator. The machete operator will use an attached wrist lanyard to prevent the machete escape from operator control • Assure tools are in good repair with adequate grips.	M
	Same hazards as Step 2, 3 and 4	• See step 2, 3 and 4	M
5. Use of mechanical brush/vegetation clearing equipment	Same hazards as Step 2, 3 and 4	• Inspect (inspection performed by UXO technician) all areas of the grid ahead of the vegetation removal crews with the aid of handheld magnetometers.	M
	Spills and leaks-Environmental damage	• Maintain a portable spill response kit containing absorbent materials, non-sparking shovel, PPE and disposable supplies in a readily accessible location • Screw caps on tightly and store fuel in designated area	L
	Noise-hearing loss	• Wear hearing protection when noise levels are above 85 dBA (when you cannot be hear speaking in a normal voice at arm's length)	M

Equipment	Inspection	Training
1. Hand tools	Daily inspections to ensure in good repair and not damaged	UXO personnel will be trained IAW DDESB TP 18 40-hr. HAZWOPER
2. Detector/locator equipment	Perform daily instrument function and calibration test	8-hr. HAZWOPER PPE Training
3. Hand/mechanical brush clearing equipment	Perform daily equipment inspection and maintenance IAW manufacturer's specifications	Initial Site Safety /task Hazard Training Qualified operator trained in magnetometer/metal detector instrument operation

ACTIVITY HAZARD ANALYSIS

***Overall Risk Assessment Code (RAC):* M**

Date Prepared: July 2011
Project Name: RI/FS Former Camp Butner
Task: Munitions Response Site – Geophysical Investigations
Activity Location(s): Former Camp Butner MRSs
Prepared By: Edie Scala-Hampson, CIH, CHMM
Reviewed By: Ron Mendenhall, UXO Safety Manager

Risk Assessment Code Matrix						
E=Extremely High Risk H=High Risk M=Moderate Risk L=Low Risk		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
1. Load/Unload Geophysical equipment	Walking over soft ground, uneven terrain/ Slip, trip and fall hazards	• Determine the best access route before transporting equipment. • Wear slip resistant footwear with ankle support. Pay attention to footing and best path of travel to avoid tripping hazards. • Prohibit jumping from truck beds • Be aware of rocks, brush, animal boroughs and other hazards. Choose firm ground for walking, if possible	L
	Heavy lifting : Injury from physical exertion, sprains, sprains, awkward bending/lifts, fatigue, and ergonomic hazards	• Use proper lifting technique to load geophysical equipment into back of truck. Equipment can weigh up to 30 lbs. Assure solid footing • Maintain good personal level of fitness. Be alert to signs and symptoms of overexertion • Do not lift greater than 50 lbs alone • Use mechanical assistance or 2 man lift whenever possible for awkward or heavy objects • Limit repetitive awkward motions • Have water available and first aid supplies • Take adequate work/rest periods	M
	General site hazards-project	• Deliver daily task specific briefings regarding the hazards associated with the task and the procedures used to control/mitigate the hazards • Use required PPE as indicated in the SSHP	M
2. Survey area with geophysical equipment and mark work area boundaries	Slips, trips and falls and steep slopes	• Wear slip resistant footwear with ankle support. Pay attention to footing and best path of travel to avoid tripping hazards. • Note terrain and footing and walk the area to be scanned (if possible) and mark uneven surfaces. Do not use geophysical equipment if slope is too steep to operate safely	M
	Remote location	• Determine accessibility to associates, communication needs, first aid and rescue equipment and procedure. Institute buddy system.	M
	Getting lost	• Sign in before departing for an area and inform office personnel of destination. Do not travel alone; bring a site map, compass and radio. Perform a radio check.	M
	Hand tools used to install stakes	• Select hand tools and power tools that are right for the job. • Inspect all tools daily, prior to use. Defective tools must be tagged and removed from service immediately.	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Sprains, strains	• Avoid twisting and turning when walking with the scanner • Be aware of terrain while traversing the proposed investigation grid	M
	Electrical shock	• Check weather reports before going out to the field and postpone geophysical surveys until weather clears (Note: A serious electrical shock can occur if contact is made with lightning while holding lightning attractive geophysical equipment.	M
	Repetitive motion	• Switch off sides of the body regularly to prevent strain. (Note: some of the equipment leans to one side) • Mark or survey area by bending with legs not the back, particularly if weight is being carried.	M
	Environmental hazards Biologicals- Plants, insects, wildlife Adverse Weather Temperature Stresses UV Hazards	See General Site hazards actions See General Site hazards actions See General Site hazards actions See General Site hazards actions See General Site hazards actions	M
3. Assembly/disassembly/maint. of equipment	Pinch points	• Make sure that fingers/hands do not get caught between cord and plug in.	L
	Cuts	• Wear protective gloves while cutting to prevent injury. (Some equipment or support equipment may need the use of a blade). Use the right tool for the job.	L
	Electrical shock	• All circuits will be properly grounded and protected with fuses or circuit breakers	L
	Hazard communication-chemical exposure	• Label any and all containers as to contents (fuel can, glue, etc.) • Obtain MSDS	L
	Hand and skin injury-hand tools	• Use correct tools. Keep screws and bolts free of corrosion and adequately lubricated. Do not use excessive force.	L
	Traffic-Struck by hazards	• Note all moving equipment in work areas. • Wear High Vis vest. • Stay off roads if possible. • Place cones near vehicles and work areas.	L
4. Install flag locators	Injury from unintentional contact-MEC/explosion, fire and overpressure (as indicated above)	• Visually screen the location prior to placing flag locators • Clear location with geophysical instrument prior to placing stake or monument (any soil penetrating activity).. The location will be reported to the SUXOS or UXOS • See Step 1 above for MEC hazards	M
5. Hand brush clearing/grubbing	Flying debris, dust, dirt, rocks, sparks, abrasions	• Select hand tools and power tools that are right for the job. Inspect all tools daily, prior to use. Defective tools must be tagged and removed from service immediately. • Wear safety glasses and other required PPE as indicated in the SSHP • Ensure that eyewash and first aid supplies are readily available • Wear abrasion resistant clothing (thick fabrics) • Watch for people ,plants, rocks, animals and animal burrows during clearing and grubbing	L
	Injury from unintentional contact-MEC/explosion, fire and overpressure (as indicated above)	• See Step 1 above for MEC	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Hand tools-struck by hazards/pinch points, jamming from applied force	• Follow the procedures and safety precautions specified by the manufacturer to ensure safe operation of all hand and power tools. When using machetes, no personnel will be within a 25 foot radius of the machete operator. The machete operator will use an attached wrist lanyard to prevent the machete escape from operator control • Assure tools are in good repair with adequate grips.	M
	Same hazards as Step 2, 3 and 4	• See step 2, 3 and 4	M
6. Use of mechanical brush/vegetation clearing equipment	Same hazards as Step 2, 3 and 4	• Inspect (inspection performed by UXO technician) all areas of the grid ahead of the geophysical crews with the aid of handheld magnetometers (Step 3).	M
	Spills and leaks-Environmental damage	• Maintain a portable spill response kit containing absorbent materials, non-sparking shovel, PPE and disposable supplies in a readily accessible location • Screw caps on tightly and store fuel in designated area	L
	Noise-hearing loss	• Wear hearing protection when noise levels are above 85 dBA (when you cannot be hear speaking in a normal voice at arm's length)	M

Equipment	Inspection	Training
1. Geophysical equipment 2. Hand tools	Battery integrity/charging, calibrating in the site field office Check for frayed segment and damaged connections Daily inspections to ensure in good repair and not damaged	40-hr. HAZWOPER 8-hr. HAZWOPER PPE Training Initial Site Safety /task Hazard Training Qualified operator trained in geophysical equipment operation

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ACTIVITY HAZARD ANALYSIS

Overall Risk Assessment Code (RAC): **M**

Date Prepared: August 2011
Project Name: RI/FS Former Camp Butner
Activity/Work Task: Inspection/Handling of Material Potentially Presenting an Explosive Hazard: Munitions and Range-Related Debris and Scrap
Activity Location(s): Former Camp Butner MRSs
Prepared By: Edie Scala-Hampson, CIH, CHMM
Reviewed By: Ron Mendenhall, UXO Safety Manager

Risk Assessment Code Matrix						
E=Extremely High Risk H=High Risk M=Moderate Risk L=Low Risk		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
1. Site access control	Unauthorized entry	• Implement positive site access control prior to site operations • Maintain a constant watch or surveillance for intrusion of unauthorized personnel. Positive site access control will be established prior to on-site operations using barricades, signs or other methods to ensure unauthorized access during tasks that could cause exposure to MEC or other safety and health hazards. The MSD /EZ of will be established prior to initiation of MPPEH inspection and handling activities. UXO teams will observe the team separation distance (TSD) in accordance with the DDESB-approved ESS/ESP.	L
2. UXO Technicians will inspect MPPEH, MD, RD and scrap to insure an explosive hazard does not exist	MEC hazard/explosion, fire and overpressure	• Only trained and qualified UXO Technicians will perform MMPEH inspection activities. • Segregate all MPPEHH according to its classification as either Material Documented as an Explosive Hazard (MDEH) or Material Documented as Safe (MDAS). • Stow separately in locked/sealed containers in a secure area until final disposition. • Escort all non-UXO personnel by a UXO Technician • Instruct non-UXO personnel to not touch or disturb any potential MEC items. Non-UXO personnel will adhere to the instructions of the UXO Technician. • Have a fire extinguisher readily available. • Certify and verify documentation is completed using DD Form 1348-1A, *Material Transfer/Release* Form and the HGL Chain of Custody Manifest form before releasing physical control or custody of MPPEH, MD, RD or scrap.	M
	Chemical Hazards from EXPRAY use and MEC • DMSO (Dimethyl sulfoxide) 45% of EXPRAY. If the skin is in contact with any potentially hazardous chemicals (explosives, heavy metals such as lead volatile/semi-volatile compounds) DMSO will act as a vehicle for absorption of the chemical into the body This chemical is absorbed through the intact skin and acts as a carrier, transporting any chemicals in contact with the skin into the body • RDX • Tetryl • TNT	• Use in well-ventilated area. • Spray away from the body. • Do not inhale. • Wear proper personal protective equipment (PPE): Neoprene, butyl, Silver Shield brand, or 4H brand gloves • In case of accidental contact with eyes – flush with water. • Do not use near fire. • Do not puncture aerosol can	H

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Remote location	Determine accessibility to associates, communication needs, first aid and rescue equipment and procedure. Institute buddy system.	L
	Environmental hazards Biologicals- Plants, insects, wildlife Adverse Weather Temperature Stresses UV Hazards	See SSHP General Site hazards actions	M
	Injury from misidentification of MPPEH	Visually inspect all MPPEH by two independent 100 percent inspections by at least one UXO Technician II and one UXO Technician III to determine its status as either Material Documented as Explosive Hazard (MDEH) Or Material Documented as Safe (MDAS). All MPPEH will undergo a quality control inspection by a UXO Quality Control Specialist as specified by the site specific Work Plan and/ or Explosive Safety Submission/Plan.	M
	Contact with moving vehicles	Be aware of vehicle traffic. Stay off of roads	L

Equipment	Inspection	Training
Weigh scales	Perform calibration before each use	• UXO personnel will be trained IAW DDESB TP 18, DOD 4140.62, USACE EM 385-1-97 and EM 1110-1-4009 • Documentation of training will be kept on file at the project site • Initial Site Safety/Task hazard training • PPE training • 40 hr HAZWOPER, • 8 hr. Annual HAZWOPER • Training in survey instruments-magnetometers. • All personnel operating hand tools will be trained in the proper inspection, maintenance and use.

ACTIVITY HAZARD ANALYSIS

Overall Risk Assessment Code (RAC): **M**

Date Prepared: February 2012
Project Name: RI/FS Former Camp Butner
Task: Demolition of MEC
Activity Location(s): Former Camp Butner MRSs
Prepared By: Edie Scala-Hampson, CIH, CHMM
Reviewed By: Ron Mendenhall, UXO Safety Manager

Risk Assessment Code Matrix						
E=Extremely High Risk H=High Risk M=Moderate Risk L=Low Risk		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
1. Site access control	Unauthorized entry	• Implement positive site access controls prior to site operations. • Maintain a constant watch for intrusion of unauthorized personnel. Positive site access controls will include as required: barricades, signs or other methods to control unauthorized access during tasks that could cause exposure to MEC or other environmental/safety hazards. • Establish the MSD/EZ. IAW the DDESB-approved ESP • Employ UXO teams, that conduct simultaneous MEC activities, to observe the MSD for intentional detonations during explosive demolition operations	L
2. Using demolition explosives counter charge on MEC hazards to blow in place (BIP) or to conduct consolidated demolition shots.	MEC hazard/explosion, fire and overpressure	• Read and sign off on the HGL work plan and SSHP. Prior to commencing all explosive operations site personnel will be given task-specific briefings regarding the hazards associated with the task and the procedures used to control/mitigate the hazards. • Deliver daily task specific briefings, prior to commencing all explosive operations, regarding the hazards associated with the task and the procedures used to control/mitigate the hazards. • Use authorized, trained and qualified UXO Technicians to perform MEC explosive demolition and surface clearance activities. • Use required PPE as indicated in the SSHP, by all personnel inside the EZ. Minimum Level D. • Require attendance, of all HGL subcontractors ,at the site specific hazards and health and safety training given by the HGL UXOSO • Escort all non-UXO personnel by a UXO Technician II • Instruct non-UXO personnel to not touch or disturb any potential MEC items. Non-UXO personnel will adhere to the instructions of the UXO Technician II • Have a fire extinguisher readily available for protection of all non-essential personnel, only those personnel essential to the performance of the demolition operations will be permitted to work inside the MSD/EZ while MEC items are being primed for demolition. • Restrict entry: Any occupied building or public roadways in the MSD will be evacuated and/or blocked to prevent non-essential personnel from entering during demolition operations. • Comply with evacuation procedures. Before initiation of demolition explosive charges all HGL and subcontractor personnel will evacuate to a designated safe area outside of the EZ. • Use engineering controls if necessary to reduce the effect of blast and fragmentation. Sandbag or water mitigation will be used IAW with USAESH HNC-ED-CS-S-98-7, HNC-ED-CS-S-00-3, HNC safety advisory dated 7 Nov 11, and DDESB memo dated 29 Nov 10 (Classification regarding use of sandbags for mitigation of fragmentation and blast effects due to intentional detonations).	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Adverse weather and lightning	• Monitor and take appropriate precautions to protect personnel and property when there are warnings or indications of severe weather. Be aware of lightning, use the lightning 30/30 Rule: If it takes less than 30 seconds to hear thunder after seeing the flash, lightning is near enough to pose a threat; after the storm ends, wait 30 minutes before resuming work activities. If a lightning meter is used, MEC operations should cease from first lightning strike within six miles and wait 30 minutes from last strike before field activities resumes. • Suspend MEC operations when an electrical storm approaches to within 5 miles of the project location.	M
	Cuts and lacerations	• Wear thick clothing fabrics and appropriate PPE such as leather gloves when there is a potential for cuts and lacerations. • Wear safety glasses if there is a potential for dust and flying debris. • Maintain adequate First Aid supplies • Use Level D PPE per the APP for all tasks with the potential for cuts or lacerations. Personnel will be trained in the proper use and selection of the equipment and the tools they must use to complete their task and the hazards of exposed metal and other cut hazards.	L
	Eye hazards- Flying debris, dust, dirt, rocks, sparks, abrasions	• Use eye protection which meets ANZI/ASSE Z81 to protect eyes from hazards associated with MEC operations and flying debris • Select hand tools and power tools that are right for the job. Inspect all tools daily, prior to use. Defective tools must be tagged and removed from service immediately • Ensure that eyewash and first aid supplies are readily available • Wear abrasion resistant clothing (thick fabrics)	L
	Lifting	• Restrict lifts to 50 pounds or less. When lifting in excess of 50 pounds, but no more than 100 pounds two or more workers are required. Any item weighing more than 100 pounds will only be lifted using mechanical equipment or devices. Personnel will use safe lifting procedures and lift with their legs and not their backs and will be trained in proper lifting techniques.	L
	Mechanized equipment	• Inspect all mechanized equipment, prior to it being placed in use on site (per a competent person, IAW, the manufacturer's recommendations and requirements of this SSHP). All mechanized equipment will be inspected daily (while in use) to ensure safe operating conditions. Inspections will be conducted by the operator or a designated competent person at the beginning of the day of use. Prior to daily use braking and operating systems will be function checked and all safety devices will be in place. Whenever an unsafe condition or discrepancy is found the equipment will be immediately removed from service and prohibited from use until the unsafe condition is corrected. ONLY qualified operators holding an appropriate certification are permitted to operate mechanized equipment. Equipment operations will be conducted in a manner as to not endanger personnel. Equipment will not be mounted nor dismounted while moving.	L
	Physical injury from mechanized equipment	• Establish a clear safety zone at the maximum radius of the bucket. The safety zone will be clearly marked with orange safety cones or other demarcation. Personnel will remain clear and not enter the safety zone when excavator is in operation. All personnel working near the safety zone will wear PPE consisting of a high-visibility vest and head, foot and eye protection.	L
	Sprains and strains	• Wear sturdy footwear. • Avoid twisting or turning while opening doors and walking with hand-pulled equipment. • Use caution to not over exert or overstrain muscles and joints. • Know your limitations	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Slips, trips and falls	• Wear slip resistant footwear with ankle support • Determine best access route before transporting equipment or walking in order to avoid tripping hazards • Be aware of uneven walking surfaces, rocks, brush, animal boroughs and other hazards. • Avoid walking near cliffs or on inclined/slopes greater than 30 degrees. • Choose firm ground for walking, if possible • Continually inspect work area for hazards and practice good housekeeping procedures and maintain clear work areas to remove trip hazards.	L
	Contact with moving vehicles	• Be aware of vehicle traffic. Stay off of roads.	L
	Overhead hazards	• Wear hard hats in those areas with the potential for head injury. All protective head gear shall meet the current requirements of ANSI Z89.1.	L

Equipment	Inspection	Training
1. Remote firing device or initiators.	• Conduct preoperational inspection • Perform equipment function test.	• UXO Technicians will meet the training/certification requirements of DDESB Technical Paper 18. • Documentation of training will be kept on file at the project site. • Initial Site Safety/Task Hazard Training. • PPE Training. • 40 hr HAZWOPER. • 8 hr Annual HAZWOPER Refresher. • All personnel operating initiating firing devices will in training in the proper inspection, maintenance and use.

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ACTIVITY HAZARD ANALYSIS

***Overall Risk Assessment Code (RAC):* M**

Date Prepared: February 2012
Project Name: RI/FS Former Camp Butner
Task: DGM and DGPS Collection and Recording
Activity Location(s): Former Camp Butner MRSs
Prepared By: Edie Scala-Hampson, CIH, CHMM
Reviewed By: Ron Mendenhall, UXO Safety Manager

Risk Assessment Code Matrix						
E=Extremely High Risk H=High Risk M=Moderate Risk L=Low Risk		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
1. Load/Unload Geophysical equipment	Walking over soft ground, uneven terrain/ Slip, trip and fall hazards	• Determine the best access route before transporting equipment. • Wear slip resistant footwear with ankle support. Pay attention to footing and best path of travel to avoid tripping hazards. • Prohibit jumping from truck beds or raised platforms. • Be aware of rocks, brush, animal boroughs and other hazards. Choose firm ground for walking, if possible	L
2. Setting up and operating: a. Precision Differential Global Positioning Systems (DGPS). b. Hand operated/towed metal detectors, locators and magnetometers. Perform DGM and DGPS survey data collection and recording using the EM61-Mk2 metal detector.	Dehydration, heat stress, sunburn	• Drink a minimum of two liters of water per day. Remain in shade whenever possible. Wear sunscreen with sun protection factor of at least 15.	L
	Heavy lifting: Injury from physical exertion, sprains, strains, awkward bending/lifts, fatigue, and ergonomic hazards	• Use proper lifting technique to load geophysical equipment into back of truck. • Assure solid footing • Maintain good personal level of fitness. Be alert to signs and symptoms of overexertion • Do not lift greater than 50 lbs. • Use mechanical assistance or 2 man lift whenever possible for awkward or heavy objects • Limit repetitive awkward motions • Have water available and first aid supplies	M
	Contact with MEC/UXO	• Deliver daily task specific briefings regarding the hazards associated with the task and procedures used to control/mitigate the hazards • Use required PPE as indicated by the SSHP, by all personnel inside the EZ. • Require attendance of all HGL and subcontractors at the site specific hazards and health and safety training given by the HGL UXOSO. • Escort all non-essential UXO personnel by a UXO Technician II or above. • Instruct non-UXO personnel to not touch or disturb any potential MEC items. Non-UXO personnel will adhere to the instruction of the UXO Technician.	M
	Adverse weather and lightning	• Monitor warnings or indications of severe weather conditions. Take appropriate precautions to protect personnel and property. Be aware of lightning, use the lightning 30/30 Rule: If it takes less than 30 seconds to hear thunder after seeing the flash, lightning is near enough to pose a threat; after	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
		the storm ends, wait 30 minutes before resuming work activities. If a lightning meter is used, MEC operations should cease from first lightning strike within six miles and wait 30 minutes from last strike before field activities resume. • Suspend all work activities when an electrical storm approaches to within 5 miles of the project location.	
	Slips, trips and falls	• Wear slip resistant footwear with ankle support. Pay attention to footing and best path of travel to avoid tripping hazards. • Note terrain and footing and walk the area to be scanned (if possible) and mark uneven surfaces. Do not use geophysical equipment if slope is too steep to operate safely.	M
	Traffic-struck hazards	• Note all moving equipment in work areas. • Wear High Vis vest. • Stay off roads if possible.	L
	General Site Hazards	• Refer to General Site Hazards AHA	
	Getting lost	• Sign in before beginning a hike, do not travel alone (use buddy system), and bring a topographic mapcompass and communication device.	L

Equipment	Inspection	Training
1. DGPS System 2. EM61-M2 metal detector 3. Batteries	• Inspect all electronic connections and system test for proper setup. • Perform data input validation. • Inspect equipment setup • Perform equipment detection validation test. • Secure batteries from movement and damage. • Inspect batteries daily for damage, cracks and leaks and remove from service when these conditions are present.	• Site-specific/task-specific safety training and Hazards Communications • 40 hr HAZWOPER • 8 hr HAZWOPER annual refresher • PPE • All personnel tasked with use of metal detectors, locators and magnetometers will be trained in their use.

ACTIVITY HAZARD ANALYSIS

***Overall Risk Assessment Code (RAC):* M**

Date Prepared: February 2012
Project Name: RI/FS Former Camp Butner
Task: Surface and Subsurface Target Anomaly Investigation and Munitions and Explosive of Concern Clearance
Activity Location(s): Former Camp Butner MRSs
Prepared By: Edie Scala-Hampson, CIH, CHMM
Reviewed By: Ron Mendenhall, UXO Safety Manager

Risk Assessment Code Matrix

E=Extremely High Risk H=High Risk M=Moderate Risk L=Low Risk		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
1. Conduct mechanical and hand tool subsurface target anomaly investigation to clear MEC. 2. Establishment of subsurface grid or clearance area. 3. Conduct point detection magnetometer assisted excavations to investigate subsurface target anomaly.	General	Prior to commencing all explosive operations site personnel will be given task-specific briefings regarding the hazards associated with the task and the procedures used to control/mitigate the hazards. All personnel within the EZ will wear a minimum of Level D PPE. All employees and subcontractors required to read and sign-off on the HGL WP and SSHP.	L
	Unauthorized entry	Site personnel will maintain a constant watch for intrusion of unauthorized personnel. Positive site access control will be established prior to on-site operations using barricades, signs or other methods to ensure that unauthorized access during tasks that could cause exposure to MEC or other environmental/safety hazards. The MSDs/EZ will be established based on the munition with the greatest fragmentation distance (MGFD) identified in the DDESB-approved ESP/ESS prior to initiation of MEC activities.	L
	MEC hazard/explosion, fire and over pressure	• Deliver daily task specific briefings regarding the hazards associated with the task and procedures used to control/mitigate the hazards • Use required PPE as indicated by the SSHP, by all personnel inside the EZ. • Required attendance of all HGL and subcontractors at the site specific hazards and health and safety training given by the HGL UXOSO. • Escort all non-essential UXO personnel by a UXO Technician II or above. • Instruct non-UXO personnel to not touch or disturb any potential MEC items. Non-UXO personnel will adhere to the instruction of the UXO Technician. • Only trained and qualified UXO Technicians will authorize to perform MEC surface and subsurface clearance activities as specified the training requirement section of this AHA. • MEC operations will be suspended when an electrical storm approaches to within 5 miles of the project location.	M
	Adverse weather and lightning	• When there are warnings or indications of severe weather, conditions will be monitored and appropriate precautions taken to protect personnel and property. Be aware of lightning, use the Lightning 30/30 Rule: If it takes less than 30 seconds to hear thunder after seeing the flash, lightning is near enough to pose a threat; after the storm ends, wait 30 minutes before resuming work activities.	L
	Cave-in of excavated soil, open excavation and permits	Excavated soil will be placed two (2) feet away from the edge of the excavation area. A competent person will examine and determine if soil type requires protective measures using sloping or benching methods to protect employees from cave-ins. If anomaly is deeper than four (4) feet stop excavation and notify the UXOSO. When excavation exceeds a depth of 4 feet sufficient egress measures are required. Excavations shall be backfilled upon completion of anomaly clearance. Excavations not immediately backfilled or covered will be cordoned off to prevent personnel, livestock and wildlife from entering or falling into the excavation. When required, an excavation permit will be obtained by the Project Manager from the appropriate authority.	M

Job Steps	Hazards	Actions to Eliminate or Minimize Hazards	RAC
	Contact with moving vehicles	Be aware of vehicle traffic. Stay off of roads.	L
	Cuts and lacerations	Level D PPE with leather gloves will be used per the APP for all tasks with the potential for cuts or lacerations. Personnel will be trained in the proper use and selection of the equipment and tools they must use to complete their task and the hazards of exposed metal and other cut hazards.	L
	Eye hazards	Personnel will use protective eyewear which meets ANZI/ASSE Z81 to protect their eyes from hazards associated with MEC operations.	L
	Lifting	A single worker is restricted to lifting 50 or less. When lifting in excess of 50 pounds, but no more than 100 pounds two or more workers are required. Any item weighing more than 100 pounds will only be lifted using mechanical equipment or devices. Personnel will use safe lifting procedures and lift with their legs and not their backs and will be trained in proper lifting techniques.	L
	Mechanized equipment	Mechanized equipment shall be inspected prior to being placed in use on site by a competent person IAW the manufacturer recommendations and requirements of this SSHP. All mechanized equipment will be inspected daily (while in use) to ensure safe operating conditions. Inspections will be conducted by the operator or a designated competent person at the beginning of the day of use. Prior to daily use braking and operating systems will be function checked and all safety devices will be in place. Whenever an unsafe condition or discrepancy is found the equipment will be immediately removed from service and prohibited from use until the unsafe condition is corrected. ONLY qualified operators holding an appropriate certification are permitted to operate mechanized equipment. Equipment operations will be in a manner as to not endanger personnel and IAW with manufacturer's instructions. Equipment will not be mounted nor dismounted while moving.	M
	Physical injury from mechanized equipment	Establish a clear safety zone at the maximum radius of the bucket. The safety zone will be clearly marked with orange safety cones. Personnel will remain clear and not enter the safety zone when excavator is in operation. All personnel working near the safety zone will were PPE consisting of a high-visibility vest and head, foot and eye protection.	M
	Overhead hazards	Safety hard hats will be required in those areas with the potential for head injury. All protective head gear shall meet the current requirements of ANSI Z89.1	M
	Sprains and strains	Wear sturdy footwear. Avoid twisting or turning while opening doors and walking with hand-pulled equipment. Personnel will be cautioned about physical strain associated with strenuous activities that may be conducted on site. Personnel will use caution to not over exert themselves of overstrain muscles and joints.	L
	Slips, trips and falls	Ensure safe and secure footing, wear sturdy footwear, and continually inspect work area for hazards and practice good housekeeping procedures and maintain clear work areas to remove trip hazards. Personnel will also be aware of uneven walking, animal boroughs, ground surfaces tree roots, small scrubs and the potential for rocks and other trip hazards associated with the work site. Avoid walking near cliffs or on inclined/slopes greater than 30 degrees.	L

Equipment	Inspection	Training
1. Hand tools for excavating	Daily inspection of hand tools.	• UXO Technicians shall meet the training/certification requirements of DDESB Technical Paper 18. • 40 hr HAZWOPER. • 8 hr HAZWOPER annual refresher. • Documentation of training will be kept on file at the project site. • Initial Site Safety/Task Hazard Training. • Current equipment operator certificate • PPE Training.
2. Mechanized equipment	Daily inspections and tests IAW manufacturer's instructions and recommendations.	
3. Handheld magnetometers	Magnetometers will be response tested daily at the test plot to ensure proper operations. All magnetometer tests will be recorded in their respective equipment test log.	

ATTACHMENT 4

HEAT STRESS: ENVIRONMENTAL ASSESSMENT AND MANAGEMENT OF EXPOSURE

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WORKPLACE HEALTH AND SAFETY PROGRAM

HEAT STRESS: ENVIRONMENTAL ASSESSMENT AND MANAGEMENT OF EXPOSURE

TABLE OF CONTENTS

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LIST OF APPENDICES

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1.0 INTRODUCTION

Work in hot, humid environments can cause heat to accumulate in the body faster than it can be dissipated. This accumulation of heat can produce serious illnesses, which range from mild to fatal. The heat-related illnesses, which are described in the appendix, include heat rash, heat cramps, heat exhaustion, and heat stroke. The first three conditions normally do not have extremely serious consequences – unless an exhausted employee falls and suffers injury. Heat stroke, however, can cause death or permanent injury to the brain. For this reason, heat stroke should be treated as a medical emergency, and all heat-related illnesses should be prevented through application of the precautions discussed in this procedure. If situations are encountered that are not addressed in this document, the project manager or site safety officer should contact the corporate Safety Department to discuss appropriate protective measures.

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2.0 ASSESSMENT OF THE POTENTIAL FOR HEAT-RELATED ILLNESS

More than for any other physical agent, the potential health hazards from work in hot environments depend strongly on physiological factors that lead to a range of susceptibilities, depending on the level of acclimatization. Therefore, professional judgment is of particular importance in assessing the level of heat stress and physiological heat strain to provide adequate guidance for protecting nearly all healthy workers with due consideration of individual factors and the type of work.

A heat stress or strain condition exists when a person's body becomes warmer when heat is added faster than it is dissipated. Many factors affect the rate of heat addition and the rate of heat loss. Increased heat accumulation occurs when a person works more strenuously or exposes himself to a source of radiant heat (e.g., the sun or an industrial boiler). Loss of heat from the body is hindered by high humidity, low air movement, and high temperature of air and surrounding objects. Heavy clothing or additional protective equipment, which might be required on a project site, also can reduce the loss of heat and thus increase heat accumulation.

2.1 ENVIRONMENTAL DETERMINANTS

The environmental determinants of the potential for heat stress are the temperature and humidity of the air, the amount of air movement, and radiant heat from the sun or nearby hot objects. These parameters can be measured easily and combined to calculate the "wet bulb globe temperature index" (WBGT), a useful single-number indicator of the environmental contribution to heat stress exposure. (See HS-T-4.)

When workers are exposed to direct sunlight, that index is defined in the following way:

$$WBGT = 0.7\times T_{nwb} + 0.2\times T_g + 0.1\times T_{db}$$

Where: WBGT is the Wet Bulb Globe Temperature Index,
T_g is the globe temperature (influenced by air temperature and radiant heat flux),
T_{db} is the dry bulb temperature (influenced by air temperature), and
T_{nwb} is the natural wet bulb temperature (influenced by air temperature, air humidity, and air movement).

When workers are not exposed to direct sunlight, the index is calculated in the following way:

$$WBGT = 0.7\times T_{nwb} + 0.3\times T_g$$

A higher value of WBGT indicates a greater potential for heat stress. Both higher air temperature and higher radiant heat increase the value of the WBGT index. Higher air movement and lower air humidity decrease the WBGT value by enhancing evaporative cooling and lowering the T_{nwb} measurement. (Of course, higher air movement would not lower T_{nwb} if the relative humidity were 100%.)

An alternative to the WBGT index is "adjusted temperature," which is easier to estimate, but much less informative. It is obtained through the following simple calculation:

Adjusted Temperature = [actual air temperature + (13 H {sunshine fraction})].

The actual air temperature is measured by means of a standard mercury thermometer with the bulb shielded from direct sunlight. "Sunshine fraction" is obtained through an estimate of the percent of the time that the sun is not covered by clouds thick enough to produce a shadow (100% sunshine = no cloud cover and sharp distinct shadows, and 0% sunshine = no shadows). Note that "sunshine fraction" = (percent sunlight)/100. Relative humidity and wind speed are not included in this much cruder determination of the potential for heat related illness.

2.2 THE CONTRIBUTION OF METABOLIC HEAT

Work generates body heat, which must be dissipated into the environment. More strenuous work generates more heat. At a given WBGT value (e.g., 85°F), it could be safe to perform continuous light work for hours – but very dangerous to perform heavy work without frequent breaks and other precautions. Any assessment of the potential for heat-related illness requires consideration of the work load. The following classification system may be used:

Work Load	Examples
Light	Sitting with moderate arm and leg movements. Standing with light work requiring mostly arm movement. Standing with light work at a machine with some walking about.
Moderate	Scrubbing in a standing position. Walking about with moderate lifting or pushing. Walking on level ground at 6 km/hr while carrying a 3 kg load.
Heavy	Shoveling dry sand. Intermittent heavy lifting with pushing or pulling (e.g., pick and shovel work).
Very Heavy	Shoveling wet sand.

Many jobs involve several task elements, some of which are more or less strenuous than others. It is appropriate in such cases to estimate an average work load over a 15 - 60 minute period. For example, the "moderate" category might be appropriate for a job that required walking and light carrying, with occasional digging with a shovel and moving of heavy objects.

2.3 THE CONTRIBUTIONS OF OTHER FACTORS

Work load and environmental factors are not the only determinants of the potential for heat-related illness. Heavy or impermeable protective clothing can increase the risk greatly, even if the work is not strenuous and the temperature is not high. Also, workers who are not acclimatized to hot work environments are much more likely to experience the harmful effects of heat stress. Many other health and "lifestyle" variables are important as well. These are discussed in the sections that follow, and in the appendix.

3.0 THRESHOLDS OF CONCERN

The risk of heat-related illness among healthy workers who are acclimatized to hot work is low if the WBGT value does not exceed the American Conference of Governmental Industrial Hygienists (ACGIH) “screening criteria” shown below:

Table 2 lists values from the 2011 edition of the ACGIH publication *Threshold Limit Values (TLV®) and Biological Exposure Indices*. This table is intended as an initial screening tool to evaluate whether a heat stress situation may exist. Professional judgment is also of particular importance in assessing the level of heat stress and physiological heat strain of workers. The values in the table below are more protective and they are not intended to prescribe work and recovery periods, but suggest work in a cycle of work and recovery.

Table 2
Screening Criteria for TLV and Action Limit for Heat Stress Exposure

Allocation of Work in a Cycle of Work and Recovery	TLV WBGT Values in °C (EF)				Action Limit WBGT Values in °C (EF)			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75 - 100% work	31(87.8)	28(82.4)	-	-	28 (82.4)	25 (77)	-	-
50 - 75% work	31 (87.8)	29(84.2)	27.5 (81.5)	-	28.5 (83.3)	26 (78)	24 (75.2)	-
25 - 50% work	32 (89.6)	30(86)	29(84.2)	28 (82.4)	29.5 (85.1)	27 (80.6)	25.5 (77.9)	24.5 (76.1)
0 - 25% work	32.5(90.5)	31.5(88.7)	30.5 (86.9)	30 (86)	30 (86)	29 (84.2)	28 (82.4)	27 (80.6)

WBGT means the wet bulb globe temperature measured with a black globe thermometer (GT), wet bulb thermometer (WB), and a dry bulb (air) thermometer (DB), and measured according to the following equations:

For indoor or outdoor environments without direct exposure to sunlight,

$$WBGT°C = 0.7WB + 0.3GT$$

For outdoor environments with direct exposure to sunlight,

$$WBGT°C = 0.7WB + 0.2GT + 0.1DB$$

When the air temperature exceeds 75 °F, the SSHO will begin measuring and recording the WBGT index at least once each hour. He or she then will specify an hourly work/rest cycle consistent with the data in the table above (to the extent feasible) for acclimatized workers wearing normal, permeable work clothing. (A more protective regimen will be specified for unacclimatized workers. The corporate Safety Department will specify alternate regimens for workers wearing very heavy or impermeable protective clothing.)

The Site Safety and Health Officer (SSHO) will make feasible adjustments for more or less demanding tasks, as the ACGIH criteria indicate. Additional adjustments will be necessary if heavy protective clothing is worn by workers. (See the applicable site health and safety plan.)

3.1 PROTOCOL FOR USE OF ADJUSTED TEMPERATURE

If the adjusted temperature exceeds 72.5EF, then the SSHO will require that employees take at least a 15-minute break following each work period of maximum duration shown in the table below.

The SSHO will require physiological monitoring as described in Section 4.3 during each rest break, and take appropriate action as required by that section.

The SSHO will be very cautious in the use of adjusted temperature to protect employees, especially when humidity is high and air movement is low. Longer breaks and shorter work periods should be required in such situations. Extreme caution is warranted if work tasks are more than moderately strenuous, if heavy clothing is worn, or if the adjusted temperature greatly exceeds 90EF. The Safety Department should be consulted in such situations.

3.2 PHYSIOLOGICAL MONITORING

Physiological monitoring to detect the symptoms of heat stress is required under the following circumstances:

1. A feasible work/rest cycle is not sufficiently protective to conform to the ACGIH recommendations in Section 4.2.1,
2. The adjusted-temperature protocol described in Section 4.2.2 is used and the adjusted temperature in the workplace exceeds 72.5EF, or
3. Impermeable protective clothing is worn by workers in hot environments.

The SSHO will use one of the methods found in National Institute for Occupational Safety and Health (NIOSH) Publication 85-115 to conduct the physiological monitoring (see references). One of the following measurements shall be used:

1. Heart Rate. Count the radial (wrist) pulse during a 30-second period as early as possible in the rest period.
   a. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same.
   b. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third and keep the rest period the same.
2. Oral Temperature. Use a clinical thermometer (3 minutes under the tongue), or a similar device to measure the oral temperature, at the end of each work period (before drinking).
   a. If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
   b. If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.

Tympanic membrane (ear) temperature may be considered equivalent to oral temperature.

Personal monitoring devices that continuously measure heart rate and/or body temperature may be used with the approval of the Safety Department. The SSHO should become familiar with the operation of the devices and instruct employees on their proper use.

3.3 MAINTENANCE OF RECORDS

The SSHO will maintain a written (or electronic) record of measurements and observations required by this procedure. This information may be recorded as entries in the project safety log or as entries on a data sheet created for this purpose.

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4.0 REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents (American Conference of Governmental Industrial Hygienists, 2011).

NIOSH Publication 85-115, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (National Institute for Occupational Safety and Health, 1985).

Extreme Heat: A Prevention Guide to Promote Your Personal Health and Safety (Office of Public Affairs, Centers for Disease Control and Prevention, 1996).

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APPENDIX

BACKGROUND MATERIAL ON HEAT-RELATED ILLNESSES

Heat Stroke

Heat stroke occurs when the body becomes unable to control its temperature. The body's temperature rises rapidly, the sweating mechanism fails, and the body is unable to cool down. Body temperature may rise to 106°F or higher within 10-15 minutes. **Heat stroke can cause death or permanent disability if emergency treatment is not given.**

Warning signs of heat stroke vary but may include:

- an extremely high body temperature (oral temperature above 103°F)
- red, hot, and dry skin (no sweating)
- rapid, strong pulse
- throbbing headache
- dizziness
- nausea
- confusion
- unconsciousness

If you see any of these signs, you may be dealing with a life threatening emergency. Have someone call for immediate medical assistance while you begin cooling the victim:

- Get the victim to a shady area.
- Cool the victim rapidly using whatever methods you can. For example, immerse the victim in a tub of cool water; place in a cool shower; spray with cool water from a garden hose; sponge with cool water; or if the humidity is low, wrap the victim in a cool, wet sheet and fan him or her vigorously.
- Monitor body temperature and continue cooling efforts until the body temperature drops to 101-102°F.
- If emergency medical personnel are delayed, call the hospital emergency room for further instructions.
- Do not give the victim alcohol to drink.
- Get medical assistance as soon as possible.

Sometimes a victim's muscles will begin to twitch uncontrollably as a result of heat stroke. If this happens, keep the victim from injuring himself, but do not place any object in the mouth and do not give fluids. If there is vomiting, make sure the airway remains open by turning the victim on his or her side.

Heat Exhaustion

Heat exhaustion is the body's response to an excessive loss of the water and salt contained in sweat. Those most at risk are elderly people, people with high blood pressure, and people working or exercising in a hot environment.

Warning signs of heat exhaustion include:

- heavy sweating

- paleness
- muscle cramps
- tiredness
- weakness
- dizziness
- headache
- nausea or vomiting
- fainting

The skin may be cool and moist. The victim's pulse rate will be fast and weak, and breathing will be fast and shallow. If heat exhaustion is untreated it may progress to heat stroke. Seek medical attention immediately if symptoms are severe or the victim has heart problems or high blood pressure. Otherwise, help the victim to cool off, and seek medical attention if symptoms worsen or last longer than one hour.

Cooling measures that may be effective include:

- cool, non-alcoholic beverages, as directed by your physician
- rest
- cool shower, bath, or sponge bath
- an air-conditioned environment
- lightweight clothing

Heat Cramps
Heat cramps usually affect people who sweat a lot during strenuous activity. This sweating depletes the body's salt and moisture. The low salt level in the muscles causes painful cramps. Heat cramps may also be a symptom of heat exhaustion.

Heat cramps are muscle pains or spasms—usually in the abdomen, arms, or legs—that may occur in association with strenuous activity. If you have heart problems or are on a low sodium diet, get medical attention for heat cramps.

If medical attention is not necessary, take these steps:

- Stop all activity, and sit quietly in a cool place.
- Drink clear juice or a sports beverage.
- Do not return to strenuous activity for a few hours after the cramps subside because further exertion may lead to heat exhaustion or heat stroke.
- Seek medical attention for heat cramps if they do not subside in one hour.

Heat Rash
Heat rash is a skin irritation caused by excessive sweating during hot, humid weather. It can occur at any age but is most common in young children.

Heat rash looks like a red cluster of pimples or small blisters. It is more likely to occur on the neck and upper chest, in the groin, under the breasts, and in elbow creases.

The best treatment for heat rash is to provide a cooler, less humid environment. Keep the affected area dry. Dusting powder may be used to increase comfort, but avoid using ointments or creams. They keep the skin warm and moist and may make the condition worse. Treating heat rash is simple and it usually does not require medical assistance. Other heat-related problems can be much more severe.

Sunburn

Sunburn should be avoided because it is damaging to the skin. Although the discomfort is usually minor and healing often occurs in about a week, a more severe sunburn may require medical attention.

Symptoms of sunburn are well known. The skin becomes red, painful, and abnormally warm after sun exposure.

Consult a doctor if these symptoms are present:

- fever
- fluid-filled blisters
- severe pain

Also, remember these tips when treating sunburn:

- Avoid repeated sun exposure.
- Apply cold compresses or immerse the sunburned area in cool water.
- Apply moisturizing lotion to affected areas. Do not use salve, butter, or ointment.
- Do not break blisters.

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ATTACHMENT 5

COLD STRESS: ENVIRONMENTAL ASSESSMENT AND MANAGEMENT OF EXPOSURE

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WORKPLACE HEALTH AND SAFETY PROGRAMS

COLD STRESS: ENVIRONMENTAL ASSESSMENT AND MANAGEMENT OF EXPOSURE

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1.0 INTRODUCTION

Exposure to freezing or cold temperatures can cause serious injuries. Among these is frostbite, the freezing of fluid in body tissue. Trench foot is another injury that can be produced by cold (but not necessarily freezing) temperatures when the feet are damp. Hypothermia, the severe drop in the core temperature of the body, is the most serious cold-related injury. It can occur after prolonged exposure to cold air, or after much briefer period of immersion in cold water. These workplace hazards are discussed in detail in the appendix.

This document describes procedures for assessing the potential for cold-related injury in the workplace and for implementing work rules to protect employees. It is designed to prevent exposure to conditions that could lead to either the freezing of exposed skin (frostbite) or a dangerous decrease in body temperature (hypothermia).

If situations are encountered that are not addressed in this document, the project manager or the site safety officer should contact Corporate Safety to discuss appropriate protective measures. Project managers and safety officers should consult Corporate Safety before any major modifications to this procedure are implemented.

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2.0 ASSESSMENT OF THE POTENTIAL FOR COLD STRESS

The potential for cold stress is determined primarily by two variables: the temperature of the air and the speed of the wind. At a given temperature, calm air is less dangerous. The “cooling power” of moving air on exposed flesh can be expressed as an equivalent chill temperature (ECT), which combines temperature and air speed. The following table shows values of ECT for various temperature and speed combinations.

The conditions represented by Zones B and C are extremely dangerous to exposed skin. Continuous exposure of exposed skin should not be permitted if the equivalent chill temperature is -25°F or less. Work under conditions represented by Zone A is much less dangerous to exposed skin. However, workers can suffer frostbite injury in the less severe environment if they develop a false sense of security and fail to take precautions.

The potential for hypothermia also is dependent upon air temperature and air speed. At low ECT values, precautions against this hazard are necessary, even if workers are dressed in well insulating clothing. The danger of hypothermia is especially severe if immersion in water is possible during the work.

EQUIVALENT CHILL TEMPERATURE (°F)
AT VARIOUS AIR TEMPERATURES AND WIND SPEEDS*

Estimated Wind Speed (mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	Zero	- 10	- 20	- 30	- 40	- 50	- 60
calm	50	40	30	20	10	0	- 10	- 20	- 30	- 40	- 50	- 60
5	48	37	27	16	6	- 5	- 15	- 26	- 36	- 47	- 57	- 68
10	40	28	16	- 9	- 24	- 24	- 33	- 46	- 58	- 70	- 83	- 95
15	36	22	9	- 5	- 18	- 32	- 45	- 58	- 72	- 85	- 99	
20	32	18	4	- 10	- 25	- 39	- 53	- 67	- 82	- 96		
25		Zone A		- 15	- 29	- 44	- 59	- 74	- 88			
30		Little Danger		- 18	- 33	Zone	- 63	- 79		Zone C		
35		(in < 1hour, if skin is dry)		- 20	- 35	B**	- 67	- 82		Great Danger (Flesh may freeze		
40	26	10	- 6	- 21	- 37	- 53	- 69	- 85		within 30 seconds.)		

*Zone B: Increasing Danger (Danger from freezing of exposed flesh within one minute.

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3.0 PREVENTION OF COLD-RELATED ILLNESS

The project or site safety and health officer (SSHO) will make an assessment of the potential for cold stress before field work begins. Work rules related to the prevention of cold-related injury will be required if conditions of the type represented in Zones A, B, or C in the table on page 2 are anticipated. Under such conditions, the SSHO will measure temperature and wind speed when work commences each day and at routine intervals (at least every four hours) thereafter, unless he or she believes that some other means of hazard assessment is adequate. The safety department must approve any alternative means of hazard assessment.

When work is conducted under conditions represented in Zones A, B, or C, the SSHO will implement work rules described below to manage the potential hazard.

3.1 GENERALLY APPLICABLE PRECAUTIONS

The SSHO will implement the following work rules, as appropriate, when conditions of the type represented in Zones A, B, or C in the table on page 2 occur in the work environment:

- Employees will receive training on the dangers and symptoms of cold-related injury and the work rules adopted to prevent it.
- Site workers will be warned that older individuals and people with circulatory problems might be at increased risk for clod-related injury, and that added precautions might be necessary to protect them.
- Each employee will be under protective observation by someone else during work; (i.e., use of the "buddy system" will be required, as it is on all Zapata Engineering projects).
- Employees who experience pain in the extremities or evident shivering will be removed from exposure to the cold work environment.
- Work must be halted if frostbite cannot be prevented. Continuous skin exposure will not be permitted when the ECT is –25°F or less (Zones B and C on page 2.
- Tasks should be scheduled to avoid long periods during which workers must sit or stand still.
- Work expectations for new employees should be adjusted downward for the first few days, to permit acclimatization to the cold conditions.
- Dehydration, which decreases blood flow to the extremities, should be avoided. Employees will be encouraged to replenish water lost to perspiration and respiration. The SSHO will provide soups and warm sweet drinks as appropriate.
- The SSHO will develop procedures that reduce the likelihood of immersion in water or soaking of the clothing by other means during project work. Such precautions should apply to any work with liquids like gasoline, alcohols, solvents, or cleaning fluids.

- The SSHO will plan for any likely scenarios that would lead to wet clothing (through immersion in water, soaking by mist, etc.), and provide for quick changing into dry clothing and treatment for hypothermia.
- Emergency plans will give special attention to the prevention of cold-related injury (hypothermia and freezing of damaged tissues).

3.2 SELECTION OF PROTECTIVE CLOTHING

The rules implemented by the SSHO will require that employees wear adequately insulating dry clothing if conditions of the type represented in Zones A, B, or C in the table on page 2 are anticipated. Workers should wear cold-protective clothing appropriate for the environmental conditions and the level of physical activity. The following considerations should guide the selection and use of protective clothing:

- Layered clothing should be used to preserve body heat. An easily removable outer windbreak garment should be worn in windy conditions.
- Inner garments and underwear should be made of fabrics that dry quickly and wick moisture away from the body.
- Outer garments should be made with provisions for easily ventilation to prevent the wetting of inner layers by sweat.
- An employee should not enter or remain in a cold work environment if his or her clothing is wet as a consequence of sweating. If clothing is wet, then the employee should change into dry clothing before returning to the cold environment.
- Gloves and/or mittens should be used as necessary to protect the hands, and employees should be warned not to touch very cold objects and surfaces with bare skin.
- Workers should routinely change socks and removable felt insoles to reduce moisture around the feet.
- Eye protection suitable to the type of hazard should be used. Special precautions against ultraviolet light and glare might be necessary in snow-covered terrain.
- Hardhat liners should be used if necessary. If work must be done on slippery surfaces, then shoe attachments that enhance traction should be used.

3.3 WORK/WARMING REGIMENS

If continuous work must be performed at an ECT below 19.4°F, then the SSHO or project manager will provide a heated shelter (tent, cabin, or similar space) for warming after exposure to the cold environment. Employees should be encouraged to use the shelter at frequent intervals, and upon (1) onset of heavy shivering, (2) occurrence of minor frostbite, or (3) onset of feelings of excessive fatigue, drowsiness, irritability, or euphoria.

The SSHO will monitor environmental conditions and implement a mandatory work/warming regimen that is at least as protective as the one recommended in the following table for those conditions.

WORK/WARMING SCHEDULE FOR A 4-HOUR SHIFT					
Air Temp. (°F)	Air Speed (mph) Calm	5	10	15	20
- 15 to -19	Normal Breaks (1)	Normal Breaks (1)	75 min. max. work period with 2 breaks	55 min. max. work period with 3 breaks	40 min. max. work period with 4 breaks
- 20 to - 24	Normal Breaks (1)	75 min. max. work period with 2 breaks	55 min. max. work period with 3 breaks	40 min. max. work period with 4 breaks	30min. max. work period with 5 breaks
- 25 to - 29	75 min. max. work period with 2 breaks	55 min. max. work period with 3 breaks	40 min. max. work period with 4 breaks	30 min. max. work period with 5 breaks	
- 30 to - 34	55 min. max. work period with 3 breaks	40 min. max. work period with 4 breaks	30 min. max. work period with 5 breaks		
- 35 to - 39	40 min. max. work period with 4 breaks	30 min. max. work period with 5 breaks			
- 40 to - 44	30 min. max. work period with 5 breaks		Non-emergency work should cease.		
- 45 and below					

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4.0 REFERENCE MATERIAL ON MEDICAL CONDITIONS

4.1 FROSTBITE

What Happens to the Body: (1) Freezing in the deep layers of skin and tissue; (2) Pale, waxy-white skin color; (3) Skin becomes hard and numb; (4) Fingers, hands, toes, feet, ears, and nose normally are affected fires.

4.1.1 What Should Be Done? (land temperatures)

- Move the person to a warm dry area. Don't leave the person alone.
- Remove any wet or tight clothing that may cut off blood flow to the affected area.
- DO NOT rub the affected area, because rubbing causes damage to the skin and tissue.
- Gently place the affected area in a warm (105°F) water bath and monitor the water temperature to slowly warm the tissue. Don't pour warm water directly on the affected area because it will warm the tissue too fast causing tissue damage. Warming takes about 25-40 minutes.
- After the affected area has been warmed, it may become puffy and blister. The affected area may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area should be dried and wrapped to keep it warm. NOTE: If there is a chance the affected area may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage.
- Seek medical attention as soon as possible.

4.2 HYPOTHERMIA - (MEDICAL EMERGENCY)

4.2.1 What Happens to the Body?

Normal body temperature (98.6°F/37°C) drops to or below 95°F (350EC); fatigue or drowsiness; uncontrolled shivering; cool bluish skin; slurred speech; clumsy movements; irritable, irrational or confused behavior.

4.2.2 What Should Be Done: (land temperatures)

- Call for emergency help (i.e., Ambulance or Call 911).
- Move the person to a warm, dry area. Don't leave the person alone. Remove any wet clothing and replace with warm, dry clothing or wrap the person in blankets.
- Have the person drink warm, sweet drinks (sugar water or sports-type drinks) if they are alert. Avoid drinks with caffeine (coffee, tea, or hot chocolate) or alcohol.
- Have the person move their arms and legs to create muscle heat. If they are unable to do this, place warm bottles or hot packs in the arm pits, groin, neck, and head areas. DO

NOT rub the person's body or place them in warm water bath. This may stop their heart.

4.2.3 What Should Be Done? (water temperatures)

- Call for emergency help (Ambulance or Call 911). Body heat is lost up to 25 times faster in water.
- DO NOT remove any clothing. Button, buckle, zip, and tighten any collars, cuffs, shoes, and hoods because the layer of trapped water closest to the body provides a layer of insulation that slows the loss of heat. Keep the head out of the water and put on a hat or hood.
- Get out of the water as quickly as possible or climb on anything floating. DO NOT attempt to swim unless a floating object or another person can be reached because swimming or other physical activity uses the body's heat and reduces survival time by about 50 percent.
- If getting out of the water is not possible, wait quietly and conserve body heat by folding arms across the chest, keeping thighs together, bending knees, and crossing ankles. If another person is in the water, huddle together with chests held closely.

4.2.4 How to Protect Workers?

- Recognize the environmental and workplace conditions that lead to potential cold-induced illnesses and injuries.
- Learn the signs and symptoms of cold-induced illnesses/injuries and what to do to help the worker.
- Train the workforce about cold-induced illnesses and injuries.
- Select proper clothing for cold, wet, and windy conditions. Layer clothing to adjust to changing environmental temperatures. Wear a hat and gloves, in addition to underwear that will keep water away from the skin (polypropylene).
- Take frequent short breaks in warm dry shelters to allow the body to warm up.
- Perform work during the warmest part of the day.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Use the buddy system (work in pairs).
- Drink warm, sweet beverages (sugar water, sports-type drinks). Avoid drinks with caffeine (coffee, tea, or hot chocolate) or alcohol.
- Eat warm, high-calorie foods like hot pasta dishes.

4.2.5 Workers Are at Increased Risk When?

- They have predisposing health conditions such as cardiovascular disease, diabetes, and hypertension.
- They take certain medication (check with your doctor, nurse, or pharmacy and ask if any medicines you are taking affect you while working in cold environments).
- They are in poor physical condition, have a poor diet, or are older.

ATTACHMENT 6

LIST OF CHEMICAL PRODUCTS WITH ASSOCIATED MATERIAL SAFETY DATA SHEETS

(For Use on the Project Site)

ATTACHMENT 7

IMAGES OF DANGEROUS ANIMALS AND PLANTS AT THE PROJECT SITE

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Feral Dog

Cottonmouth

Prairie Rattlesnake

Broadbanded Copperhead

Timber Rattlesnake

Ticks of various species

Widow Spiders of various species

Recluse Spiders

Various Bees, Wasps, Ants (including Fire Ants), Mosquitoes, and Centipedes

Poison Ivy

APPENDIX E

SAMPLING AND ANALYSIS PLAN

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SAMPLING AND ANALYSIS PLAN
PART 1: FIELD SAMPLING PLAN

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LIST OF ACRONYMS AND ABBREVIATIONS

ARNG	Army National Guard Property
CA	cost analysis
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
DERP	Defense Environmental Restoration Program
DID	Data Item Description
DoD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DQO	data quality objective
EE	engineering evaluation
EPA	U.S. Environmental Protection Agency
ESTCP	Environmental Security Technology Certification Program
FS	Feasibility Study
FSP	Field Sampling Plan
FTR	Flame Thrower Range
HGL	HydroGeoLogic, Inc.
HGR	Hand Grenade Range
IDW	investigation-derived waste
ISM	incremental sampling methodology
MC	munitions constituent
MEC	munitions and explosives of concern
MRS	munitions response site
PDT	project delivery team
PETN	pentaerythritol tetranitrate
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RA	removal action
RC1	Range Complex 1
RC2	Range Complex 2
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SERDP	Strategic Environmental Research and Development Program
SOP	standard operating procedure
TO	task order
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAESCH	U.S. Army Engineer Support Center, Huntsville
WP	Work Plan

1.0 PROJECT BACKGROUND

This Sampling and Analysis Plan (SAP), includes a Field Sampling Plan (FSP) and a Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP). This document has been developed as Appendix E to the work plan (WP) prepared by HydroGeoLogic, Inc. (HGL) for the U.S. Army Engineering Support Center, Huntsville (USAESCH) under Contract No. W912DY-10-D-0023, Task Order (TO) No. 0009, for munitions response sites (MRSs) at the former Camp Butner, Granville County, North Carolina.

Appendix E provides details for the completion of sampling and analysis activities planned for completion of TO component activities during the Remedial Investigation (RI)/Feasibility Study (FS) for the designated MRSs. The five MRSs included in the RI\FS are as follows:

- Range Complex 1 (RC1);
- Range Complex 2 (RC2);
- Army National Guard Property (ARNG);
- Hand Grenade Range (HGR); and
- Flame Thrower Range (FTR).

Figures 1.1 and 1.2 (all WP figures are presented in Appendix B) show the locations of Former Camp Butner and the five former Camp Butner RI\FS MRSs, respectively.

1.1 SITE HISTORY AND CONTAMINANTS

A summary of MRS history is presented in Section 1.7 of the WP. Previous investigation activities are summarized in Section 1.9 and in Table 1.1 of the WP.

1.2 SUMMARY OF EXISTING SITE DATA

HGL has examined the Historical Photographic Analysis (2001), Engineering Evaluation/Cost Analysis (EE/CA) (2004), Groundwater Monitoring (2004), Soil and Sediment Sampling (2006) and Removal Action (RA) Reports (2006 and 2010) that document previous investigations at Camp Butner. Based on a review of these historical reports, it was determined that munitions constituents (MCs) have not been fully assessed during previous activities; therefore, this RI provides a supplemental MC sampling plan to satisfy Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements.

1.3 SITE-SPECIFIC DEFINITION OF PROBLEMS

Based on the potential munitions and explosives of concern (MEC) items used at Camp Butner, explosives constituents may be present at locations within the project site. Constituents of concern for each medium are identified below:

- Soils, Surface Water and Sediment — explosives (including pentaerythritol tetranitrate [PETN] and nitroglycerine) and selected metals (antimony, copper, lead and zinc)
- Groundwater — Perchlorate and lead

Explosives constituents typically degrade when exposed to the environment for considerable lengths of time. We do not anticipate these constituents will be measured at concentrations that exceed selected screening levels. However, soil samples will be collected using incremental and discrete soil sampling procedures and analysis, as required, to be determined within each MRS (based on MEC investigation results). The only exception is FTR and HGR; investigation activities at these two MRSs are sufficient and, based on USAESCH direction, no additional characterization is required at this time.

Table 3.5 of the WP identifies the estimated number of samples to be collected and analytical requirements during the RI using the sampling methods specified.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The Technical Management Plan (Section 2.0 of the WP) details the organization, structure, roles, and function of the project management team, and the approach, methods, and procedures that will be used for management of the RI/FS at Camp Butner.

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3.0 PROJECT SCOPE AND OBJECTIVES

The scope and objectives of the Camp Butner RI/FS are presented in Sections 1.2 and 1.3 of the Work Plan, respectively. The UFP-QAPP provides additional information concerning project data quality objectives (DQOs).

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4.0 FIELD ACTIVITIES

4.1 OVERVIEW

The field investigation plan and applicable rationale are presented in Section 3.0 of the WP. The MC investigation approach uses various sampling strategies and techniques and is summarized in Section 3.3 and Table 3.1 of the WP. MC sampling and quality assurance (QA) procedures and requirements are presented in Sections 3.11 and 3.12, respectively.

During completion of the RI field activities, RI sample locations will be selected using MEC and geophysical characterization results. A phased approach, based on RI analytical results, will be used to determine if supplemental surface water, sediment, and groundwater sample collection is required. If RI groundwater sampling is required, all samples will be collected from existing wells. No groundwater monitoring well installation activities are currently planned for the RI. The estimated number of samples to be collected from each media matrix, applicable QA/quality control (QC) sampling, and analytical procedures are summarized in Table 3.5 of the WP.

4.1.1 ISM Soil Sampling

Soil samples will be collected using incremental sampling methodology (ISM) procedures and techniques at locations to be determined within each of the three MRSs (based on MEC investigation results) and at 10 background locations.

4.1.2 Discrete Soil Sampling

If the project delivery team (PDT) determines that supplemental soil sampling is required based on results of the RI ISM sampling, HGL will collect additional ISM samples for surface soil and discrete subsurface soil samples at locations specified by the PDT using either ISM or discrete soil sampling techniques, as defined in Appendix I (2.13).

4.1.3 Surface Water/Sediment and Groundwater Sampling

If the PDT determines that surface water, sediment, and/or groundwater sampling is required based on results of the RI soil sampling, HGL will collect surface water, sediment, and/or groundwater samples at locations specified by the PDT using sampling techniques, as defined in Appendix I.

4.1.4 Quality Assurance and Quality Control

QA (QA split) and QC (QC duplicate and triplicate) samples are analyzed for the purpose of assessing the quality of the sampling effort and of the analytical data. These samples include QA split samples, QC duplicates/triplicate of field samples, QC equipment rinsate blanks, and ambient samples. Split or duplicate samples are collected as a single sample, homogenized, divided into two or more equal parts, and placed in separate containers. The number of duplicate/triplicate samples is generally 10 percent of the field samples. The ISM samples; however, will not be homogenized or split to generate duplicate samples. The replicate sample for the ISM method will include three independent ISM samples collected from the same SU, collected to assess field sampling precision.

4.1.4.1 Quality Control Duplicate Samples

The sampling team will collect QC samples for analysis by the contract laboratory. Triplicate samples will be collected during completion of the ISM sampling activities (MRS and background soil sampling). QC duplicate samples will be generated from field duplicates collected from the standard discrete soil, sediment/surface water, and groundwater samples. The identity of QC samples will not be provided to the analysts or laboratory personnel. This procedure ensures that the laboratory will not know which QC sample matches the field sample. A table will be provided in the report that designates the QC sample to the duplicate field sample. The purpose of the QC samples is to provide site-specific, field-originated checks of the quality of the data generated by the laboratory.

4.1.4.2 Quality Assurance Split Samples

QA samples will be sent by overnight delivery to Accutest Laboratories to evaluate the performance of the primary laboratory. These samples will be generated from field splits. The ISM QA samples; however, will not be generated from a field split sample. The ISM QA sample will be an independently collected replicate from an SU.

4.1.4.3 QC Equipment Rinsate Blanks

Rinsate blanks (or equipment blanks) are samples consisting of analyte-free water collected from a final rinse of sampling equipment after the decontamination procedure have been performed. The purpose of rinsate blanks is to measure the effectiveness of the decontamination process and materials storage/handling protocols. By analyzing rinsate blanks, the potential for cross contamination of samples by the sampling equipment may be evaluated.

4.1.4.4 Temperature Blanks

Temperature blanks are containers of organic-free reagent water that are kept with the field sample containers from the time they leave the laboratory until they are returned to the laboratory. The purpose of temperature blanks is to evaluate the temperature of the cooler during transit and upon arrival at the laboratory.

4.1.5 Decontamination

Decontamination of the pertinent sampling equipment will be performed between each sampling event. Decontamination will be performed in an area of the site considered to be free from contamination. Sampling and monitoring equipment will be decontaminated prior to sampling as specified in Section 3.12 of the WP.

5.0 FIELD OPERATIONS DOCUMENTATION

Field activities will be documented using field logbooks and applicable field forms as specified in standard operating procedure (SOP) 4.04 (Field Logbook Use and Maintenance), the WP, and associated UFP-QAPP.

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6.0 SAMPLE PACKAGING AND REQUIREMENTS

Sample QA procedures associated with sample identification, chain-of-custody, sample handling, storage, and shipping are presented in Section 3.12 of the WP.

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7.0 INVESTIGATION-DERIVED WASTES

Investigation derived waste (IDW) will be consolidated in a central location in a way that allows easy vehicular access. Drums will be stored on pallets; no more than three drums per pallet. Each drum will be marked with (1) Source of material (2) date of collection, and (3) drum contents using a paint pen and vinyl waste label indicating the container is on hold pending analysis. The drums will be numbered sequentially; the sequence will be recorded in the field book along with the drum contents and date.

8.0 LABORATORY PROCEDURES

Laboratory procedures including, but not limited to, data reduction, deliverables, and operations are described in the UFP-QAPP.

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9.0 REFERENCES

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APPENDIX E

QUALITY ASSURANCE PROJECT PLAN

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LIST OF ATTACHMENTS

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LIST OF ACRONYMS AND ABBREVIATIONS

Accutest	Accutest Laboratories
ADR	automated data review
AMEC	AMEC Environmental & Infrastructure, Inc.
amu	atomic mass unit
ANG	Army National Guard
AR	Army Regulation
ASR	Archives Search Report
bgs	below ground surface
°C	degrees Celsius
CA	corrective action
CAS	Chemical Abstracts Service
CCB	continuing calibration blank
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CoC	chain of custody
COD	chemical oxygen demand
COR	contracting officer’s representative
CQC	Chemical Quality Control
CRREL	Cold Regions Research and Engineering Laboratory
CSM	conceptual site model
%D	percent difference
DDESB TP-18	Department of Defense Explosives Safety Board Technical Paper 18
DGM	digital geophysical mapping
DL	detection limit
DoD	Department of Defense
DOT	U.S. Department of Transportation
DQCR	daily quality control report
DQI	data quality indicator
DQO	data quality objective
EB	equipment blank
EDD	electronic database deliverable
EE/CA	engineering evaluation/cost analysis
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ES	electrospray ionization
ESL	ecological screening level
ESS	Environmental Sampling Supply
FS	feasibility study

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

FTL	Field Team Leader
FTR	Flame Thrower Range
g	grams
GC	gas chromatography
GPS	global positioning system
H&S	health and safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HGL	HydroGeoLogic, Inc.
HGR	Hand Grenade Range
HHRA	human health risk assessment
HNO_3	nitric acid
HPLC	high performance liquid chromatography
IAW	in accordance with
ICB	initial calibration blank
ICP	inductively coupled plasma
ICS	interference check solution
ICV	initial calibration verification
ID	identification
IDW	investigation derived waste
IS	internal standard
ISM	incremental sampling methodology
kg	kilogram
L	liter
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
LQAP	Laboratory Quality Assurance Plan
MB	method blank
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
Microbac	Microbac Laboratories, Inc.
MIS	multi-incremental sampling

mL	milliliter
MMRP	Military Munitions Response Program
MRS	munitions response site
MS	mass spectrometry
MS	matrix spike
MSD	matrix spike duplicate
m/z	mass-to-charge ratio
NA	not applicable
NCDENR	North Carolina Department of Environment and Natural Resources
NELAP	National Environmental Laboratory Accreditation Program
OE	ordnance and explosives
.pdf	portable document format
PE	pollyethylene
PM	project manager
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
QCSR	Quality Control Summary Report
QSM	Department of Defense Quality Systems Manual for Environmental Laboratories
%R	percent recovery
r	correlation coefficient
r^2	correlation
RA	remedial action
RC1	Range Complex 1
RC2	Range Complex 2
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RPD	relative percent difference
%RSD	percent relative standard deviation
RSL	Regional Screening Level
SDG	sample delivery group
SEDD	Staged Electronic Data Deliverable
SL	screening level
SLERA	screening level ecological risk assessment
SO	Safety Officer

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

SOP	standard operating procedure
SUXOS	Senior Unexploded Ordnance Supervisor
TBD	to be determined
TCLP	toxicity characteristic leaching procedure
TCRA	Time Critical Removal Action
TM	technical manual
TPP	technical project planning
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
UXO	unexploded ordnance
UXOSO	Unexploded Ordnance Safety Officer
WERS	Worldwide Environmental Services Contract
WP	work plan
WWII	World War II

QUALITY ASSURANCE PROJECT PLAN

INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared by HydroGeoLogic, Inc. (HGL) to support the remedial investigation (RI) and feasibility study (FS) that will be performed at five munitions response sites (MRSs) at former Camp Butner, Granville County, North Carolina. This work is being conducted for the U.S. Army Engineering Support Center, Huntsville (USAESCH) under Contract No. W912DY-10-D-0023, Task Order No. 0009. The five MRSs to be addressed by this project include:

- Army National Guard (ANG) Property
- Flame Thrower Range (FTR)
- Hand Grenade Range (HGR)
- Range Complex 1 (RC1)
- Range Complex 2 (RC2)

The QAPP provides information on five areas: (1) Project Management and Objectives, (2) Measurement and Data Acquisition, (3) Field Sampling Rationale, (4) Assessment and Oversight, and (5) Data Review. This document meets the requirements and elements set forth in the *Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (QSM)*, Version 4.2 (DoD, 2010), and the U.S. Environmental Protection Agency (EPA) guidance document entitled *Uniform Federal Policy (UFP) for Quality Assurance Project Plans* (EPA, 2005). This QAPP provides a process for obtaining data of sufficient quality and quantity to satisfy project needs. It describes the functional activities, data quality objectives (DQOs), and measures necessary to obtain adequate data for a given purpose. Data acquisition, reporting, and evaluation will be completed in accordance with (IAW) this QAPP. As any new procedures are required, addenda to this document will be issued.

AMEC Environmental & Infrastructure, Inc. (AMEC) is HGL's teaming partner for this project. AMEC will be tasked with performing data validation, data quality evaluation (including authoring the project Quality Control Summary Report [QCSR]), and risk assessment.

All staff participating in project/field efforts are required to read this plan and become familiar with the analytical procedures and the implementation of these procedures to ensure that analytical/sample goals are met consistently. In addition, key personnel are responsible for mentoring assigned staff in aspects of this QAPP that would have a potential impact on the work assigned to them.

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QAPP Worksheet #1
Title and Approval Page

Site Name/Project Name: Camp Butner RI/FS
Site Location: Granville County, North Carolina

Title: Camp Butner RI/FS QAPP
Revision Number: 1
Revision Date: 9/13/2012

Appendix E: Draft RI/FS QAPP, Former Camp Butner, North Carolina
Document Title

USAESCH
Lead Organization

Kenneth F. Rapuano, CHMM, HGL
Preparer's Name and Organizational Affiliation

11107 Sunset Hills Road, Suite 400, Reston, Virginia, 21090; (703) 736-4546; kfr@hgl.com
Preparer's Address, Telephone Number, and Email Address

September 2012
Preparation Date

Investigative Organization's Senior Chemist: ______________________
Signature
Kenneth F. Rapuano, CHMM, HGL
Printed Name/Organization/Date

Investigative Organization's Project Manager (PM): ______________________
Signature
Derek Anderson, HGL
Printed Name/Organization/Date

Investigative Organization's Project Quality Assurance (QA)/Quality Control (QC) Manager: ______________________
Signature
Jan Kool, Ph.D., P.G., HGL
Printed Name/Organization/Date

QAPP Worksheet #1
Title and Approval Page (continued)

Site Name/Project Name: Camp Butner RI/FS
Site Location: Granville County, North Carolina

Title: Camp Butner RI/FS QAPP
Revision Number: 1
Revision Date: 3/28/2012
Page 2 of 2

Approval Signatures:

Lead Organization's PM: ______________________________
Signature

Chris Cochrane, USAESCH
Printed Name/Organization/Date

Regulatory Organization: ______________________________
Signature

____
Printed Name/Title/Organization/Date

____
Approval Authority

Other Approval Signatures: ______________________________
Signature

____
Printed Name/Title/Organization/Date

____
Approval Authority

QAPP Worksheet #2
QAPP Identifying Information

Site Name/Project Name: Camp Butner RI/FS
Site Location: Granville County, North Carolina
Operable Units: Five MRSs
Contractor Name: HGL
Contract Number: W912DY-10-D-0023
Contract Title: Huntsville Center - Worldwide Environmental Services Contract (WERS)
Task Order Number: 0009

Title: Camp Butner RI/FS QAPP
Revision Number: 0
Revision Date: 9/12/2012

1. Identify guidance used to prepare the QAPP: UFP-QAPP; DoD QSM Version 4.2

2. Identify regulatory program: EPA Region 4 – Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act of 1986; North Carolina Department of Environment and Natural Resources (NCDENR)

3. Identify approval entities: U.S. Army Corps of Engineers (USACE); EPA Region 4; and NCDENR

4. The QAPP is: generic or $\boxed{\text{project-specific}}$ (circle one)

5. List dates of scoping sessions that were held: November 10, 2011 (Technical Project Planning [TPP] Session)

6. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date
None	NA

7. List organizational partners (stakeholders): USACE; EPA Region 4; and NCDENR

8. List data users: HGL; AMEC; USACE; EPA Region 4; and NCDENR

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below.

All QAPP worksheets are applicable.

QAPP Worksheet #2
QAPP Identifying Information (continued)

Required QAPP Element	QAPP Worksheet	Required Information
Project Management and Objectives		
2.1 Title and Approval Page	1	- Title and Approval Page
2.2 Document Format and Table of Contents 2.2.1 Document Control Format 2.2.2 Document Control Numbering System 2.2.3 Table of Contents 2.2.4 QAPP Identifying Information	2	- Table of Contents - QAPP Identifying Information
2.3 Distribution List and Project Personnel Sign-Off Sheet 2.3.1 Distribution List 2.3.2 Project Personnel Sign-Off Sheet	3 4	- Distribution List - Project Personnel Sign-Off Sheet
2.4 Project Organization 2.4.1 Project Organizational Chart 2.4.2 Communication Pathways 2.4.3 Personnel Responsibilities and Qualifications 2.4.4 Special Training Requirements and Certification	5 6 7 8	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications Table - Special Personnel Training Requirements Table
2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	9 10	- Project Planning Session Documentation (including Data Needs Tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps (historical and present)
2.6 Project Quality Objectives and Measurement Performance Criteria 2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	11 12	- Site-Specific Project Quality Objectives - Measurement Performance Criteria Table
2.7 Secondary Data Evaluation	13	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations Table
2.8 Project Overview and Schedule 2.8.1 Project Overview 2.8.2 Project Schedule	14 15 16	- Summary of Project Tasks - Reference Limits and Evaluation Table - Project Schedule/Timeline Table

QAPP Worksheet #2
QAPP Identifying Information (continued)

Required QAPP Element	QAPP Worksheet	Required Information
Measurement/Data Acquisition		
3.1 Sampling Tasks 3.1.1 Sampling Process Design and Rationale 3.1.2 Sampling Procedures and Requirements 3.1.2.1 Sampling Collection Procedures 3.1.2.2 Sample Containers, Volume, and Preservation 3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures 3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures 3.1.2.5 Supply Inspection and Acceptance Procedures 3.1.2.6 Field Documentation Procedures	17 18 19 20 21 22	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table - Analytical Methods/SOP Requirements Table - Field QC Sample Summary Table - Sampling SOPs - Project Sampling SOP Reference Table - Field Equipment Calibration, Maintenance, Testing, and Inspection Table
3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures	23 24 25	- Analytical SOPs - Analytical SOP References Table - Analytical Instrument Calibration Table - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures 3.3.1 Sample Collection Documentation 3.3.2 Sample Handling and Tracking System 3.3.3 Sample Custody	26 27	- Sample Handling System - Sample Collection, Documentation Handling, Tracking, and Custody SOPs - Sample Custody Requirements Table - Sample Container Identification - Sample Handling Flow Diagram - Example Chain of Custody (CoC) Form and Seal
3.4 QC Samples 3.4.1 Sampling QC Samples 3.4.2 Analytical QC Samples	28	- QC Samples Table - Screening/Confirmatory Analysis Decision Tree
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	29 30	- Project Documents and Records Table - Analytical Services Table - Data Management SOPs

QAPP Worksheet #2
QAPP Identifying Information (continued)

Required QAPP Element	QAPP Worksheet	Required Information
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action (CA) Responses	31 32	- Planned Project Assessments Table - Assessments and Response Actions - Audit Checklists - Assessment Findings and CA Responses Table
4.2 QA Management Reports	33	- QA Management Reports Table
4.3 Final Project Report		- All information obtained during RI fieldwork
Data Review		
5.1 Overview		
5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.2.1 Step IIa Validation Activities 5.2.2.2 Step IIb Validation Activities 5.2.3 Step III: Usability Assessment 5.2.3.1 Data Limitations and Actions from Usability Assessment 5.2.3.2 Activities	34 35 36 37	- Sampling and Analysis Verification (Step I) Process Table - Sampling and Analysis Validation (Steps IIa and IIb) Process Table - Sampling and Analysis Validation (Steps IIa and IIb) Summary Table - Data Usability Assessment

QAPP Worksheet #3
Distribution List

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address
Captain Drew Lequick	Base Operations Supervisor	Camp Butner	NA	drew.lequick@us.army.mil
Chris Cochrane	Technical PM and Contracting Officer's Representative (COR)	USAESCH	(256) 895-1696	chris.cochrane@usace.army.mil
Ray Livermore	District PM	USACE Wilmington	(910) 251-4702	raymond.r.livermore@usace.army.mil
Cecil "Bud" Morgan	Environmental Manager	USAESCH	(256) 895-1491	cecil.w.morgan@usace.army.mil
To be determined (TBD)	TBD	EPA Region 4	TBD	TBD
Marti Morgan	PM	NCDENR	(919) 707-8342	martha.morgan@ncdenr.gov
Derek Anderson	PM	HGL	(706) 372-5138	danderson@hgl.com
John Pendleton	Technical Manager	HGL	(703) 736-4520	jpendleton@hgl.com
Jan Kool	Program QA Manager	HGL	(703) 736-4545	jkool@hgl.com
Ken Rapuano	Project Chemist	HGL	(703) 736-4546	kfr@hgl.com
Jeff Martin	Database Manager	HGL	(703) 736-4533	jmartin@hgl.com
Scott Schroepfer	Senior Unexploded Ordnance (UXO) Supervisor (SUXOS)	HGL	(913) 378-2307 (707) 330-6411	sschroepfer@hgl.com
Cliff Ancelet	UXO Safety Officer (UXOSO)	HGL	(505) 382-3938	cancelet@hgl.com
Larry Hudgins	Munitions and Explosives of Concern (MEC) Technical Manager	AMEC	(704) 655-1352	larry.hudgins@amec.com
Sara B. Mathews	Senior Environmental Scientist	AMEC	(615) 333-0630, ext. 489	sara.mathews@amec.com
Ann Bernhardt	Senior Data Quality Manager	AMEC	(503) 639-3400	ann.bernhardt@amec.com
Stephanie Mossburg	Laboratory PM	Microbac Laboratories, Inc. (Microbac)-Ohio Valley Division	(800) 373-4071	Stephanie.Mossburg@microbac.com
Jean Dent-Smith	Laboratory PM	Accutest Laboratories (Accutest)-Southeast	(407)_425-6700	jeans@accutest.com
Tammy McCloskey	Laboratory PM	Accutest-Mid-Atlantic	(732) 329-0200	tammym@accutest.com

QAPP Worksheet #4
Project Personnel Sign-Off Sheet

Project Personnel	Organization	Title	Signature	Date QAPP Read
Derek Anderson	HGL	PM		
Jan B. Kool, Ph.D.	HGL	Program QA Manager		
Clifton Ancelet	HGL	UXOSO		
Ken Rapuano	HGL	Project Chemist		
Jeff Martin	HGL	Database Manager		
Scott Schroepfer	HGL	SUXOS		
TBD	HGL	Field Personnel		
TBD	HGL	Field Personnel		
Larry Hudgins	AMEC	MEC Technical Manager		
Sara B. Mathews	AMEC	Senior Environmental Scientist		
Ann Bernhardt	AMEC	Senior Data Quality Manager		
Stephanie Mossburg	Microbac	Laboratory PM		
Jean Dent-Smith	Accutest-Southeast	Laboratory PM		
Tammy McCloskey	Accutest-Mid-Atlantic	Laboratory PM		

QAPP Worksheet #5
Project Organizational Chart

See Figure 2.1 of the Work Plan (WP).

QAPP Worksheet #6
Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	**Procedure** (Timing, Pathways, etc.)
Point of Contact with HGL	HGL PM	Derek Anderson	(706) 372-5138	Reporting of project information to the USACE PM through WPs, monthly progress reports, email updates, teleconference calls, and meetings.
QAPP Changes in the Field Daily Field Progress Reports, Field CAs	Technical Manager UXOSO	John Pendleton Cliff Ancelet	(703) 736-4520 (505) 382-3938	Notify HGL PM and Project Chemist of changes to QAPP in the field and rationale for changes. Document changes in field daily progress reports and memoranda to HGL PMs. Review SUXOS daily field progress reports and evaluate need for field CAs (in collaboration with PM); document CA in the daily field progress reports and memoranda to HGL PMs.
Day-to-Day Field Activities, Safety and QA Audits, Milestones	SUXOS	Scott Schroepher	(913) 378-2307 (707) 330-6411	Complete daily field progress reports and forward to HGL FTL. Report completion of milestones.
Reporting Laboratory Data Quality Issues	Microbac PM/ Accutest-Southeast PM/ Accutest-Mid_Atlantic PM	Stephanie Mossburg/ Sue Bell/ Tammy McCloskey	(800) 373-4071/ (813) 741-3338/ (732) 329-0200	All QA/QC issues with project field samples will be reported by the laboratory to the Project Chemist and HGL QA Officer.

QAPP Worksheet #6
Communication Pathways (continued)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Laboratory Analytical CAs	Project Chemist/ Microbac PM/ Accutest-Southeast PM/ Accutest-Mid-Atlantic PM	Ken Rapuano/ Stephanie Mossburg/ Sue Bell/ Tammy McCloskey	(703) 736-4546/ (800) 373-4071/ (813) 741-3338/ (732) 329-0200	Need for laboratory CAs will be determined by the Project Chemist and/or laboratory PM or QA Manager and will be documented in memoranda to HGL PM.
Release of Analytical Data, QAPP Amendments	Project Chemist	Ken Rapuano	(703) 736-4546	Review of AMEC data validation reports to ensure technical and contractual compliance. Amendments to the QAPP will be implemented as required by technical issues. Changes to the QAPP will be approved by the HGL and USACE PMs.
Data Tracking and Management	Data Manager	TBD	TBD	Track data from sample collection through log-in at laboratory to delivery by technical report/sample delivery group and electronic data delivery into database. Assign data reports to validators and track the validation process. Alerts project chemist when data validation reports are available for review.

QAPP Worksheet #7
Personnel Responsibilities Table

Name	Title	Organizational Affiliation	Responsibilities
Derek Anderson	PM	HGL	Provides overall management of the task order including cost, schedule, and technical quality. Manages project staffing, day-to-day project operations and activities, deliverable completion, field investigations, QC, and health and safety (H&S). Acts as the single point of contact for the contract. Maintains communication and coordination with USACE for the duration of the project, including progress and detailed cost reporting. Oversees the management and coordination between contractor staff, subcontractors, and USACE.
John Pendleton Clifton Ancelet	Technical Manager UXOSO	HGL HGL	Responsible for assisting PM and providing senior technical support on Military Munitions Response Program (MMRP)/CERCLA process documents, sampling program design and implementation, and project team coordination. Initiates field CA if deemed necessary.
Jan Kool, Ph.D, P.G.	Program QA Manager	HGL	Responsible for program quality management, including training and programmatic quality processes and controls. Provides senior technical support on CERCLA process documents and sampling program design and implementation.
Ken Rapuano, CHMM	Project Chemist	HGL	Manages analytical and data validation subcontractors. Negotiates project specifications and coordinates the sample collection activity with laboratory capacity. Tracks all samples from collection through analysis, data validation, and report generation. Serves as the primary chemist for all analytical issues. Initiates CAs as deemed appropriate. Supervises the electronic loading for all analytical data to ensure compliance with contract requirements.
David Vandenberg Rick Watkins Paul Ioannides	Laboratory Director	Microbac Accutest-Southeast Accutest-Mid Atlantic	Supervises all laboratory personnel and provides guidance and direction as needed. Responsible for ensuring compliance and integration of facility operation with corporate and regulatory policies and procedures.

QAPP Worksheet #7
Personnel Responsibilities Table (continued)

Name	Title	Organizational Affiliation	Responsibilities
David Baumgartner Svetlana Izosimova Gregory Tomkovich	Laboratory QA Manager	Microbac/ Accutest-Southeast/ Accutest-Mid-Atlantic	Overall responsibility for the development, implementation, and maintenance of the laboratory's quality system and QC activities. Performs internal system and technical audits. Creates CA plans and recommends projects for process improvement. Troubleshoots and resolves problems and provides technical and administrative guidance to laboratory staff. Obtains and maintains laboratory license and permits and oversees laboratory accreditation and certification programs. Serves as the liaison between the laboratory and regulatory offices.
Stephanie Mossburg/ Jean Dent-Smith/ Tammy McCloskey	Laboratory PM	Microbac/ Accutest-Southeast/ Accutest-Mid-Atlantic	Serves as the laboratory's primary contact for the project. Utilizes a variety of project management tools for forecasting and production status tracking. Ensures laboratory compliance with project needs in both QC and project deliverables.
Ann Bernhardt	Data Validator	AMEC	Responsible for operations management and technical support. Performs data validation for sample analysis results.
Mark McGowan	Corporate H&S Officer	HGL	Provides overall supervision of the HGL H&S program.

QAPP Worksheet #8
Special Personnel Training Requirements Table

Project Function	Specialized Training – Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Field Sampling Team, Field Technicians, Geologists, Environmental Scientists, Engineers	40-Hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response (HAZWOPER) Training; 8-Hour HAZWOPER Refresher Training; First Aid/ Cardiopulmonary Resuscitation	Varies(1)	Varies(1)	All personnel performing on-site work	HGL	Certificates available upon request and maintained at project office.
FTLs	Same as above, plus 8-hour HAZWOPER Site Supervisor Training	Varies(1)	Varies(1)	FTLs	HGL	Certificates available upon request and maintained at project office.
UXO team	Same as above for field sampling team, plus UXO training IAW DoD Explosives Safety Board Technical Paper 18 (DDESB TP-18)	Varies(1)	Varies(1)	All UXO Technicians	HGL	Certificates available upon request and maintained at project office.
SUXOS, UXO Safety Officer (SO)	Same as above for Field Sampling Team and FTLs, plus UXO training IAW DDESB TP-18	Varies(1)	Varies(1)	SUXOS, UXO SO/QC	HGL	Certificates available upon request and maintained at project office.

(1) Training provider and date of training will vary from person to person due to individual scheduling of training.

QAPP Worksheet #9
Project Scoping Session Participants Sheet

Project Name Camp Butner RI/FS, Five MRSs

Projected Date(s) of Sampling July 2012-July 2013

Project Manager Chris Cochrane, USACE PM and COR

Site Name: Former Camp Butner

Site Location Granville County, NC

Date of Session: November 10, 2011

Scoping Session Purpose: Develop approach for project planning and execution

Name	Affiliation	Phone #	E-mail Address
See Appendix H			

QAPP Worksheet #10
Problem Definition

The problem to be addressed by the project: The subject sites of this investigation are five MRSs at former Camp Butner. These sites are potentially affected by contamination from MEC and munitions constituents (MC). Two of these MRSs, the FTR and the HGR, are considered sufficiently characterized. No additional field work is planned at these two MRSs and those sites will be carried through the RI/FS process using existing site data. Two of the remaining three MRSs, RC1 and RC2, have been partially investigated. While these investigations have resulted in MEC characterization significant portions of these two MRSs, existing information on the nature and extent of potential MEC and MC contamination is insufficient to evaluate and recommend remedial alternatives. No characterization activities have been performed to date at the ANG Property. The field efforts described in the WP and this QAPP will focus on the remaining portions of RC1 and RC2 along with the ANG Property.
The environmental questions being asked: The following question is applicable to each of the subject MRSs: What is the nature and extent of MEC and MC contamination in site soils, groundwater, and sediment?
Observations from any site reconnaissance reports: See Worksheet #13.
A synopsis of secondary data or information from site reports: HGL performed an in depth review of available site-related documents and summarized site information from the five MRSs in a preliminary conceptual site model (CSM). The CSM describes the area size, suspected past DoD activities, potential MEC/munitions debris (MD), previous investigation/removal activities (if any), and current and future land use. The CSM was used to identify data needs and direct HGL's field investigation approach.
The possible classes of contaminants and the affected matrices: The contaminants of concern at each of the subject MRSs are selected metals, explosives, perchlorate, and white phosphorus. The affected matrices are the surface and near subsurface soil, groundwater, and sediment. The matrix-specific methods and analyte lists are presented in Table 3.5 of the WP. The methods and analyte lists for this project are presented in Worksheets #15.1 through #15.8. These tables also contain a comparison to the EPA Regional Screening Levels (RSLs), which have been selected as the screening criteria for evaluating whether site contamination poses a potential risk to human health. These worksheets also present the ecological screening levels (ESLs) that will be used to determine if site contamination poses a threat to wildlife receptors.
The rationale for inclusion of chemical and non-chemical analyses: The site activities that may have caused contamination at each of the MRSs are well documented. The analyses selected are based on previous site investigations and knowledge about the potential contaminants associated with the activities that occurred at each MRS as described in Section 1.9 and in Tables 1.1 and 1.2 of the WP. Although white phosphorus is not a current contaminant of concern, if munitions items that potentially contain white phosphorus are identified during field investigation activities, samples will be collected to determine the potential presence of this chemical.
Information concerning various environmental indicators: Each MRS will be subject to transect investigation that will incorporate both DGM and AGM investigation. Surface and subsurface anomalies identified in the transect and grid investigations will be used to direct judgmentally located sampling locations (see Sections 3.3 and Table 3.1 of the WP).
Project decision conditions ("If…, then…" statements): Generally, if an analyte is detected above the applicable RSL or ESL, then this analyte will be retained as a contaminant of potential concern for further evaluation. In some decision populations, if analytes are detected above the RSL, then this will be the driver for additional site investigation. If analytes are detected above the ESLs, a decision will be made whether additional site investigation is warranted. If no target analytes are detected above the RSL or ESL at a site, then the need for any additional sampling or other action at that site will be evaluated. Each contaminant detected above the associated benchmark concentrations will be retained as a contaminant of potential ecological concern.

QAPP Worksheet #11
Project Quality Objectives/Systematic Planning Process Statements

Who will use the data? The primary data user will be USAESCH; secondary users will include EPA Region 4, NCDENR, HGL, and AMEC.
What will the data be used for? The data will be used by HGL to prepare the site RI reports; AMEC will use the data to generate the QCSR, the human health risk assessment (HHRA), and screening level ecological risk assessment (SLERA). USACE will use the data and the conclusions of the RI report to answer the environmental questions and support the project decision conditions (see Worksheet #10).
What types of data are needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques) Site-specific field screening and sampling requirements are described in Section 3.3 and Tables 3.1 and 3.5 of the WP. Site-specific analytical requirements are discussed in Section 3.3 and Table 3.5 of the WP. Target analyte lists are presented in QAPP Worksheets #15.1 through 15.8.
How "good" do the data need to be in order to support the environmental decision? The data must be of sufficient quality to support evaluation of results to support decisions about site risk and remedial options (including closure). Laboratory analytical data will be required to be definitive.
How much data are needed? (number of samples for each analytical group, matrix, and concentration) See WP Section 3.7.
Where, when, and how should the data be collected/generated? Following DGM data collection and analysis and intrusive investigation activities, sampling locations will be selected using the decision logic presented in Worksheet #18.
Who will collect and generate the data? HGL field teams under the supervision of the Site Supervisor identified in Worksheet #3. Analytical data will be generated by the Ohio Valley Division of Microbac in Marietta, Ohio; Accutest-Southeast in Orlando, Florida; and Accutest-Mid-Atlantic in Dayton, New Jersey. All project laboratories are certified under the DoD Environmental Laboratory Accreditation Program (ELAP) for the analyses to be performed. These laboratories are also accredited by NCDENR for all analyses to be performed where those analyses are included in NCDENR's fields of accreditation.
How will the data be reported? Laboratory data will be reported in analytical packages (produced in portable document format [.pdf] format) that will at a minimum contain all necessary information to allow for review of the data quality elements listed in Attachment A. Electronic database deliverables (EDDs) will meet the requirements of a Staged Electronic Data Deliverable (SEDD), with a minimum requirement of a Stage 2a deliverable. Field data will be recorded in bound logbooks.
How will the data be archived? Complete project file records will be maintained in HGL's Reston, Virginia, office and will be updated by a project administrator under the PM's direction. Project records will be maintained during the period of performance for this project, plus 10 years.

QAPP Worksheet #12.1
Measurement Performance Criteria Table – Explosives by SW-846 Method 8330B

Matrix	Soil			
Sampling Procedure[1]	Soil: S-2, S-3, and S-4			
Analytical Group	Explosives			
Concentration Level	Low			
Analytical Method/SOP[2]	L-1			
Data Quality Indicator (DQI)	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Frequency of QC Check**	**QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)**
Accuracy/Bias	Analyte-specific (see Worksheets 15.1 and 15.2)	Laboratory control sample (LCS) recoveries	1 per preparation batch (maximum of 20 samples)	A
		Matrix spike (MS)/Matrix spike duplicate (MSD) recoveries	1 per 20 field samples (selected by field team)	S&A
	Method-specific (see Worksheets 15.1 and 15.2)	Surrogate spikes	Every sample, blank, and standard	A
Precision	Relative percent difference (RPD) ≤30%	MS/MSD RPD	1 per 20 field samples (selected by field team)	S&A
		LCS/LCS duplicate (LCSD)[3] RPD	1 per preparation batch (maximum of 20 samples)	A
	RPD ≤50% (soil) RPD ≤30% (water)	Field duplicate analyses (grab samples)	1 per 10 field samples (selected by field team)	S&A
	Percent relative standard deviation (%RSD) ≤20%	Field replicate analyses (incremental sampling methodology [ISM] samples)	1 per 10 field samples (selected by field team)	S&A
	%RSD ≤20%	Laboratory replicate analyses (ISM samples)	1 per preparation batch (maximum of 20 samples)	A
Accuracy/Precision	%RSD ≤20% or correlation (r^2) ≥0.990 for each analyte	Five-point calibration for all analytes (minimum of six points required if using r^2 to evaluate)	Prior to sample analysis and recalibration as required	A

QAPP Worksheet #12.1
Measurement Performance Criteria Table – Explosives by SW-846 Method 8330B (continued)

Matrix	Soil			
Sampling Procedure[1]	Soil: S-2, S-3, and S-4			
Analytical Group	Explosives			
Concentration Level	Low			
Analytical Method/SOP[2]	L-1			
DQI	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Frequency of QC Check**	**QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)**
Accuracy/Precision	Percent difference (%D) ≤20% for each analyte	Second source calibration verification	1 per initial calibration	A
Accuracy/Precision	%D ≤20% for each analyte	Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence	A
Accuracy/Bias and Representativeness	No analytes detected ≥½ limit of quantitation (LOQ) and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	Method blank (MB)	1 per preparation batch (maximum of 20 samples)	A
		Grinding blank (ISM samples only)	Between each sample	A
Accuracy/Bias and Representativeness	No target compound concentrations ≥ ½LOQ	Equipment blank (EB)	1 per 20 field samples	S&A
Sensitivity	Detection limit (DL) ≤½ LOQ	DL study	Preliminary determination, confirmed quarterly	A
	Limit of detection (LOD)	LOD study	Preliminary determination, confirmed quarterly	A
	RSL	LOD below associated RSL, preferable by a factor of ≥3	Preliminary determination, confirmed quarterly	A
	LOQ for each analyte	At or below low concentration of calibration curve	Each initial calibration	A

QAPP Worksheet #12.1
Measurement Performance Criteria Table – Explosives by SW-846 Method 8330B (continued)

Matrix	Soil			
Sampling Procedure[1]	Soil: S-2, S-3, and S-4			
Analytical Group	Explosives			
Concentration Level	Low			
Analytical Method/SOP[2]	L-1			
DQI	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Frequency of QC Check**	**QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)**
Analyte Identification	Position shall be set using the midpoint standard of the calibration curve; on days when initial calibration is not performed, the initial CCV is used	Retention time window position establishment for each analyte and surrogate	Once per initial calibration and at the beginning of the analytical shift	A
	Results between primary and second column RPD ≤40%	Confirmation column	All positive results must be confirmed	A
Completeness	≥95%	Data completeness check	After sampling and analysis complete	S&A

[1] Reference number from QAPP Worksheet #21.
[2] Reference number from QAPP Worksheet #23.
[3] LCSD analysis is not a method requirement; however, if this information is provided, it will be evaluated.
[4] For low-level results (detected value ≤5x LOQ) or when one result is a non-detection, the control limit is absolute difference ≤LOQ (water) or ≤2x LOQ (soil). Non-detected values will be assigned the nominal value of the LOD for making this comparison.

QAPP Worksheet #12.2
Measurement Performance Criteria Table – Metals by SW-846 Method 6020A

Matrix	Water, Soil, and QC Blanks
Sampling Procedure1	Water: S-5; Soil: S-2, S-3, and S-4; QC Blanks: S-1
Analytical Group	Metals
Concentration Level	Low
Analytical Method/SOP2	L-2

DQI	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	Frequency of QC Check	QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)
Accuracy/Bias	Analyte-specific (see Worksheets 15.3 through 15.6)	LCS recoveries	1 per preparation batch (maximum of 20 samples)	A
		MS/MSD recoveries	1 per 20 field samples (selected by field team)	S&A
	%D ≤10% for each analyte present ≥100H DL	Serial dilution (5x) analysis	1 per preparation batch (maximum of 20 samples)	A
	Percent recovery (%R) of 75-125% for each analyte	Post-digestion spike analysis	1 per preparation batch (maximum of 20 samples); required if target analyte not present ≥50x DL in parent sample selected for serial dilution or if serial dilution fails for an analyte meeting the DL criterion	A
Precision	RPD #20%	MS/MSD RPD[3]	1 per 20 field samples (selected by field team)	S&A
		LCS/LCSD[4] RPD	1 per preparation batch (maximum of 20 samples)	A
	RPD ≤30% (soil) RPD ≤20% (water)	Field duplicate analyses[5]	1 per 10 field samples (selected by field team)	S&A
	%RSD ≤20%	Field replicate analyses (ISM samples)	1 per 10 field samples (selected by field team)	S&A
	%RSD ≤20%	Laboratory replicate analyses (ISM samples)[6]	1 per preparation batch (maximum of 20 samples)	A
Accuracy/Precision	Not applicable (NA) for two-point calibration. If multi-point calibration performed, correlation coefficient (r) ≥0.995	Calibration for all analytes (minimum of one point and a blank)	Daily, prior to sample analysis	A

QAPP Worksheet #12.2
Measurement Performance Criteria Table – Metals by SW-846 Method 6020A (continued)

Matrix	Water, Soil, and QC Blanks
Sampling Procedure1	Water: S-5; Soil: S-2, S-3, and S-4; QC Blanks: S-1
Analytical Group	Metals
Concentration Level	Low
Analytical Method/SOP2	L-2

DQI	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	Frequency of QC Check	QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)
Accuracy/Precision	%D ≤10% for each analyte	Initial (second source) calibration verification (ICV)	Daily, prior to sample analysis	A
		CCV	After every 10 field samples, and at the end of the analysis sequence	A
Accuracy/Bias and Representativeness	No analytes detected ≥½ LOQ and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	MB	1 per preparation batch (maximum of 20 samples)	A
		Initial calibration blank (ICB)	Immediately after ICV	A
		Continuing calibration blank (CCB)	Immediately after CCV	A
Accuracy/Bias and Representativeness	No target compound concentrations ≥½ LOQ	EB	1 per 20 field samples	S&A
Sensitivity	Analyte DL ≤½ LOQ	DL study	Preliminary determination, confirmed quarterly	A
	LOD	LOD study	Preliminary determination, confirmed quarterly	A
	RSL	LOD below associated RSL, preferable by a factor of ≥3	Preliminary determination, confirmed quarterly	A
	%R of 80-120% for each analyte	Low-level calibration check at LOQ	Prior to sample analysis	A

QAPP Worksheet #12.2
Measurement Performance Criteria Table – Metals by SW-846 Method 6020A (continued)

Matrix	Water, Soil, and QC Blanks			
Sampling Procedure1	Water: S-5; Soil: S-2, S-3, and S-4; QC Blanks: S-1			
Analytical Group	Metals			
Concentration Level	Low			
Analytical Method/SOP2	L-2			
DQI	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Frequency of QC Check**	**QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)**
Sensitivity (cont.)	LOQ for each analyte	At or below low concentration of calibration curve (if multi-point calibration performed)	Each initial calibration	A
	Intensity within 30-120%	Intensity of the internal standards (ISs) in the sample relative to the corresponding IS intensities in the initial calibration	Every sample, blank, and standard	A
Accuracy/Bias and Representativeness	Absolute value of concentration for all non-spiked analytes <LOD (unless they are a verified trace impurity from one of the spiked analytes)	Interference check solution (ICS) A	Prior to sample analysis	A
	Spiked analyte %R of 80-120%	ICS A and ICS AB	Prior to sample analysis	A

QAPP Worksheet #12.2
Measurement Performance Criteria Table – Metals by SW-846 Method 6020A (continued)

Matrix	Water, Soil, and QC Blanks			
Sampling Procedure1	Water: S-5; Soil: S-2, S-3, and S-4; QC Blanks: S-1			
Analytical Group	Metals			
Concentration Level	Low			
Analytical Method/SOP2	L-2			
DQI	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Frequency of QC Check**	**QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)**
Analyte Identification	Mass calibration ≤0.1 atomic mass units (amu) from the true value; resolution <0.9 amu full width at 10% peak height. %RSD ≤5% for at least four replicate analyses	Mass spectrometer tuning	Prior to sample analysis	A
Completeness	≥95%	Data completeness check	After sampling and analysis complete	S&A

[1] Reference number from QAPP Worksheet #21.
[2] Reference number from QAPP Worksheet #23.
[3] Performing a laboratory duplicate (using the acceptance criteria listed for field duplicates) will be an acceptable alternative to performing an MSD to evaluate laboratory precision for grab sample analyses. MSD analysis is not required for ISM samples.
[4] LCSD analysis is not a method requirement; however, if this information is provided, it will be evaluated.
[5] For low-level results (detected value ≤5H LOQ) or when one result is a non-detection, the control limit is absolute difference ≤LOQ (water) or ≤2H LOQ (soil). Non-detected values will be assigned the nominal value of the LOD for making this comparison.
[6] This is a required QC element and replaces MSD analysis for ISM preparation batches.

QAPP Worksheet #12.3
Measurement Performance Criteria Table – Perchlorate by SW-846 Method 6850

Matrix	Water, Soil, and QC Blanks			
Sampling Procedure[1]	Water: S-5; Soil: S-2, S-3, and S-4; QC Blanks: S-1			
Analytical Group	Inorganics			
Concentration Level	Low			
Analytical Method/SOP[2]	L-3			
DQI	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Frequency of QC Check**	**QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)**
Accuracy/Bias	%R of 80-120%	LCS recoveries	1 per preparation batch (maximum of 20 samples)	A
		MS/MSD recoveries	1 per 20 field samples (selected by field team)	S&A
Precision	RPD ≤15%	MS/MSD RPD[3]	1 per 20 field samples (selected by field team)	S&A
		LCS/LCSD[4] RPD	1 per preparation batch (maximum of 20 samples)	A
	RPD ≤15% (water)	Field duplicate analyses[5]	1 per 10 field samples (selected by field team)	S&A
Accuracy/Precision	r ≥0.995 *or* COD ≥0.995	Calibration (minimum of five standards for linear or six standards for quadratic)	Prior to sample analysis, at the beginning of each 12-hour analytical shift	A
Accuracy/Precision	%D ≤15%	ICV	Daily, prior to sample analysis	A
		CCV	At the beginning of the analysis sequence, after every 10 samples, and at the end of the sequence	A

QAPP Worksheet #12.3
Measurement Performance Criteria Table – Perchlorate by SW-846 Method 6850 (continued)

Matrix	Water, Soil, and QC Blanks			
Sampling Procedure[1]	Water: S-5; Soil: S-2, S-3, and S-4; QC Blanks: S-1			
Analytical Group	Inorganics			
Concentration Level	Low			
Analytical Method/SOP[2]	L-3			
DQI	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Frequency of QC Check**	**QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)**
Accuracy/Bias and Representativeness	No analytes detected ≥½ LOQ and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	MB	1 per preparation batch (maximum of 20 samples)	A
		CCB	Immediately after each LOD verification standard	A
	≤30% drift	ICS	1 per preparation batch (maximum of 20 samples)	A
Accuracy/Bias and Representativeness	No target compound concentrations ≥½LOQ	EB	1 per 20 field samples	S&A
Analyte Identification	Ion mass-to-charge ratio (m/z) should be within ± 0.3 amu of masses 83, 85, and 89	Mass spectrometer mass calibration	Prior to sample analysis	A
	Value of 2.3 to 3.8	m/z 83 to 85 peak area ratio	Positive results in sample, blank, and standard	A
	Value 0.98 to 1.02	IS retention time relative to mean retention time in initial calibration	Every sample, blank, and standard	A

QAPP Worksheet #12.3
Measurement Performance Criteria Table – Perchlorate by SW-846 Method 6850 (continued)

Matrix	Water, Soil, and QC Blanks			
Sampling Procedure[1]	Water: S-5; Soil: S-2, S-3, and S-4; QC Blanks: S-1			
Analytical Group	Inorganics			
Concentration Level	Low			
Analytical Method/SOP[2]	L-3			
DQI	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**Frequency of QC Check**	**QC Sample Assesses Errors for Sampling (S), Analytical (A), or Both (S&A)**
Sensitivity	Analyte DL ≤½LOQ	DL study	Preliminary determination, confirmed quarterly	A
	LOD	LOD study	Preliminary determination, confirmed quarterly	A
	LOQ for each analyte	At or below low concentration of calibration curve	Each initial calibration	A
	%D ≤30%	LOD verification standard	After each ICV and CCV	A
	Intensity within 50-150%	Intensity of the IS in the sample relative to the mean IS intensity in the initial calibration	Every sample, blank, and standard	A
Completeness	≥95%	Data completeness check	After sampling and analysis complete	S&A

[1] Reference number from QAPP Worksheet #21.
[2] Reference number from QAPP Worksheet #23.
[3] Performing a laboratory duplicate (using the acceptance criteria listed for field duplicates) will be an acceptable alternative to performing an MSD to evaluate laboratory precision.
[4] LCSDs are not method requirements; however, if this information is provided, it will be evaluated.
[5] For low-level results (detected value ≤5H LOQ) or when one result is a non-detection, the control limit is absolute difference ≤LOQ (water) or ≤2H LOQ (soil). Non-detected values will be assigned the nominal value of the LOD for making this comparison.

QAPP Worksheet #13.1
Secondary Data Criteria and Limitations Table, ANG Property

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
Archives Search Report (ASR) and ASR Supplement (2004)	USACE-Rock Island Division, ASR Findings for the Former Camp Butner, Butner, North Carolina, 1993 USACE-Rock Island Division, ASR Supplement for the Former Camp Butner, Butner, North Carolina, 2004	Munitions types expected and/or identified included small arms; 2.36-inch rockets; rifle grenades; 37mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars. No known clearances.	Development of RI approach; guide MC sampling approach; guide to MEC clearance approach; revision of CSM, if needed	No site activities have occurred and the MRS is not characterized.
Drinking water sampling for MEC	USACE-Wilmington Division, Final Sampling Report, Drinking Well Sampling Event, Former Camp Butner, NC, 2005	Perchlorate concentrations were detected at relatively shallow depths (15 and 78 feet) in 12 of 23 drinking water wells including detected concentrations at one off-site well location; detected concentrations exceeded project screening criteria at two well locations. Potential sources may include munitions, flares, and application of fertilizers or defoliant. One homeowner confirmed the use of Bulldog Soda fertilizer at his residence. Bulldog Soda contains naturally occurring perchlorate concentrations. Lead concentrations were detected at nine well locations; detected concentrations exceeded the project screening criteria at one unfiltered sample location and at one filtered sample location. Lead typically adsorbs to sediment and these detected concentrations may be a result of elevated turbidity present in the samples. Other potential sources of lead at Camp Burner may include munitions, water supply piping, gasoline, vehicle exhaust, and lead based paint.	It was determined that perchlorate and lead concentrations detected in the groundwater warrant supplemental investigation.	Groundwater analytical results did not identify evidence to indicate that former DoD activities at Camp Butner have impacted the groundwater quality.

QAPP Worksheet #13.2
Secondary Data Criteria and Limitations Table, FTR

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
ASR	USACE-Rock Island Division, ASR Findings for the Former Camp Butner, Butner, North Carolina, 1993 USACE-Rock Island Division, ASR Supplement for the Former Camp Butner, Butner, North Carolina, 2004	This range was used to conduct flame thrower training during World War II (WWII). The layout of the range is unknown. It existed just north of the former cantonment area. The standard range fan for a flame thrower range as given in Technical Manual (TM) 9-855 (August 1944) was used for the range fan. The range fan does not extend beyond site boundaries or overlap other range fans.	The findings of the ASR were used to direct the remedial action (RA) field activities.	No on-site observations or analytical data were obtained.
RA Report	USA Environmental, Inc., Final Report, Removal Action at Former Camp Butner, Butner, North Carolina, 2006	The 2006 RA conducted at the FTR cleared approximately 20 acres to depth of detection using analog techniques. The RA activities identified and disposed of two MEC items and 530 lbs of MD.	The TPP group determined that the current site data set is sufficient to complete RI/FS activities at the HGR.	Based on results of the RA, the nature and extent of MEC at the FTR is considered to have been adequately characterized.

QAPP Worksheet #13.3
Secondary Data Criteria and Limitations Table, HGR

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
ASR and ASR Supplement	USACE-Rock Island Division, ASR Findings for the Former Camp Butner, Butner, North Carolina, 1993 USACE-Rock Island Division, ASR Supplement for the Former Camp Butner, Butner, North Carolina, 2004	The HGR is believed to have been used during WWII for live hand grenade training. Therefore, the standard range fan for a live hand grenade range as given in AR 750-10 (January 1944) was used. The range fan does not extend beyond site boundaries or overlap with other range fans. There have been no reported incidents of ordnance and explosives (OE) on the range.	The findings of the ASR were used to direct subsequent field activities.	No on-site observations or analytical data were obtained.
Engineering Evaluation/Cost Analysis (EE/CA)	Parsons, Final EE/CA, Former Camp Butner, Butner, North Carolina, 2004	Geophysical mapping and intrusive investigation were performed over approximately 8.5 acres. No MEC or MD was identified at the HGR during the EE/CA.	The TPP group determined that the current site data set is sufficient to complete RI/FS activities at the HGR.	Based on EE/CA results, the nature and extent of MEC is considered to have been adequately characterized.

QAPP Worksheet #13.4
Secondary Data Criteria and Limitations Table, RC1

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
1958-69 Annual Surface Inspections	Annual Surface Inspection reports	Area B: 2.36-inch rockets and 81mm mortars Area C: 2.36-inch rockets; 81mm mortars; 37mm, 105mm, 155mm; and 240mm projectiles Area D: 2.36-inch rocket, 37mm and 40mm projectiles Area E: 2.36-inch rocket Area F: No findings reported Other “Unrestricted” Areas: Hand grenades; 37mm, 40mm, 60mm, 81mm, 105mm, and 155mm projectiles; and 2.36-inch rockets	The findings were used to direct the EE/CA.	No subsurface observations or analytical data were obtained.
ASR and ASR Supplement	USACE-Rock Island Division, ASR Findings for the Former Camp Butner, Butner, North Carolina, 1993 USACE-Rock Island Division, ASR Supplement for the Former Camp Butner, Butner, North Carolina, 2004	RC1 (excluding ANG property) existed near the center of the site and contained an artillery impact area, two mortar ranges, and several small arms ranges. The range fan for the artillery impact area was taken from historical maps, while the remainder of the range fans used were standard range fans for the individual type of range. All range fans remain within site boundaries and some range fans overlap with others within the complex.	The findings were used to direct the EE/CA.	No subsurface observations or analytical data were obtained.

QAPP Worksheet #13.4 (continued)
Secondary Data Criteria and Limitations Table, RC1

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
2003 Time Critical Removal Action (TCRA)	Parsons, Final TCRA Report, Lakeview Subdivision, Former Camp Butner, Butner, North Carolina, 2003 USA Environmental, Inc., Final Report, Time Critical OE Removal Action at the Blalock and Riley Properties, Former Camp Butner, Butner, North Carolina, 2004	A TCRA was conducted at the Lakeview Residential Housing Subdivision within RC1 in 2003. Approximately 26 acres were intrusively investigated using analog techniques to a depth of 6 inches. MEC and MD were subsequently recovered. Digital geophysical mapping (DGM) was then conducted over areas previously investigated to a depth of 6 inches and identified additional anomalies. DGM was also conducted over additional subdivision areas (Blalock and Riley properties). A continuation of the TCRA was conducted in 2004 that included the investigation of anomalies identified at the Blalock and Riley properties. MEC-like DGM anomalies were cleared to depth of detection.	Areas addressed by the TCRA are considered to be sufficiently characterized and will not require additional investigation.	Subsurface survey areas do not cover entire MRS MC removal area limited
EE/CA	Parsons, Final EE/CA, Former Camp Butner, Butner, North Carolina, 2004	The EE/CA evaluated 77 acres primarily utilizing DGM to investigate ¼ acre grids (approximately total of 330 grids). Grids were distributed throughout suspected former munition use areas within both RC1 and RC2. Intrusive results provided an indication of actual impact/munitions use areas. A total of 11 MEC and 1485 MD items were recovered during the EE/CA. Munitions types identified at these two MRSs included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades.	Development of RI approach; guide MC sampling approach; guide to MEC clearance approach; revision of CSM, if needed	Data gaps exist MEC surveys limited MC sampling data limited

QAPP Worksheet #13.4 (continued)
Secondary Data Criteria and Limitations Table, RC1

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
Drinking water sampling for MEC	USACE-Wilmington Division, Final Sampling Report, Drinking Well Sampling Event, Former Camp Butner, NC, 2005	Perchlorate concentrations were detected at relatively shallow depths (15 and 78 feet) in 12 of 23 drinking water wells including detected concentrations at one off-site well location; detected concentrations exceeded project screening criteria at two well locations. Potential sources may include munitions, flares, and application of fertilizers or defoliant. One homeowner confirmed the use of Bulldog Soda fertilizer at his residence. Bulldog Soda contains naturally occurring perchlorate concentrations. Lead concentrations were detected at nine well locations; detected concentrations exceeded the project screening criteria at one unfiltered sample location and at one filtered sample location. Lead typically adsorbs to sediment and these detected concentrations may be a result of elevated turbidity present in the samples. Other potential sources of lead at Camp Burner may include munitions, water supply piping, gasoline, vehicle exhaust, and lead based paint.	It was determined that perchlorate and lead concentrations detected in the groundwater warrant supplemental investigation.	Groundwater analytical results did not identify evidence to indicate that former DoD activities at Camp Butner have impacted the groundwater quality.
2008, 2009, 2010 Non-TCRAs	Removal Actions at Lakeview Subdivision and Resdential Parcels Distributed throughout RC1 and RC2 (2008, 2009, and 2010)	Portions of the Lakeview Subdivision that were previously only cleared to a depth of 6-inches were cleared to depth of detection. In addition, RA activities were completed at more than 250 parcels (average parcel was approximately 1.75 acres). Land parcel grids investigated were distributed throughout RC1 and RC2. RA activities were generally focused around existing residential dwellings. Intrusive results indicate the presence of former impact and munitions-use areas. Munitions recovered included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades.	Areas addressed by the TCRA are considered to be sufficiently characterized and will not require additional investigation.	Subsurface survey areas do not cover entire MRS MC removal area limited

QAPP Worksheet #13.5
Secondary Data Criteria and Limitations Table, RC2

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
1958-69 Annual Surface Inspections	Annual Surface Inspection Reports	Area B: 2.36-inch rockets and 81mm mortars Area C: 2.36-inch rockets; 81mm mortars; 37mm, 105mm, 155mm; and 240mm projectiles Area D: 2.36-inch rocket, 37mm and 40mm projectiles Area E: 2.36-inch rocket Area F: No findings reported Other "Unrestricted" Areas: Hand grenades; 37mm, 40mm, 60mm, 81mm, 105mm, and 155mm projectiles; and 2.36-inch rockets	The findings were used to direct the EE/CA.	No subsurface observations or analytical data were obtained.
ASR and ASR Supplement	USACE-Rock Island Division, ASR Findings for the Former Camp Butner, Butner, North Carolina, 1993 USACE-Rock Island Division, ASR Supplement for the Former Camp Butner, Butner, North Carolina, 2004	Range Complex 2 existed on the north side of the site and contained an artillery impact area, a mock German village, and two machine gun ranges. The range fan for the artillery impact area was taken from historical maps, while the remainder of the range fans used were standard range fans for the individual type of range. All range fans remain within site boundaries and some range fans overlap with others within the complex. The entire complex is currently under private ownership.	The findings were used to direct the EE/CA.	No subsurface observations or analytical data were obtained.

QAPP Worksheet #13.5 (continued)
Secondary Data Criteria and Limitations Table, RC2

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
2003 TCRA	Parsons, Final TCRA Report, Lakeview Subdivision, Former Camp Butner, Butner, North Carolina, 2003 USA Environmental, Inc., Final Report, Time Critical OE Removal Action at the Blalock and Riley Properties, Former Camp Butner, Butner, North Carolina, 2004	A TCRA was conducted at the Lakeview Residential Housing Subdivision within RC1 in 2003. Approximately 26 acres were intrusively investigated using analog techniques to a depth of 6 inches. MEC and MD were subsequently recovered. DGM was then conducted over areas previously investigated to a depth of 6 inches and identified additional anomalies. DGM was also conducted over additional subdivision areas (Blalock and Riley properties). A continuation of the TCRA was conducted in 2004 that included the investigation of anomalies identified at the Blalock and Riley properties. MEC-like DGM anomalies were cleared to depth of detection.	Areas addressed by the TCRA are considered to be sufficiently characterized and will not require additional investigation.	Subsurface survey areas do not cover entire MRS MC removal area limited
EE/CA	Parsons, Final EE/CA, Former Camp Butner, Butner, North Carolina, 2004	The EE/CA evaluated 77 acres primarily utilizing DGM to investigate ¼ acre grids (approximately total of 330 grids). Grids were distributed throughout suspected former munitions use areas within both RC1 and RC2. Intrusive results provided an indication of actual impact/munitions use areas. A total of 11 MEC and 1485 MD items were recovered during the EE/CA. Munitions types identified at these two MRSs included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades.	Development of RI approach; guide MC sampling approach; guide to MEC clearance approach; revision of CSM, if needed	Data gaps exist MEC surveys limited MC sampling data limited

QAPP Worksheet #13.5 (continued)
Secondary Data Criteria and Limitations Table, RC2

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
Drinking water sampling for MEC	USACE-Wilmington Division, Final Sampling Report, Drinking Well Sampling Event, Former Camp Butner, NC, 2005	Perchlorate concentrations were detected at relatively shallow depths (15 and 78 feet) in 12 of 23 drinking water wells including detected concentrations at one off-site well location; detected concentrations exceeded project screening criteria at two well locations. Potential sources may include munitions, flares, and application of fertilizers or defoliant. One homeowner confirmed the use of Bulldog Soda fertilizer at his residence. Bulldog Soda contains naturally occurring perchlorate concentrations. Lead concentrations were detected at nine well locations; detected concentrations exceeded the project screening criteria at one unfiltered sample location and at one filtered sample location. Lead typically adsorbs to sediment and these detected concentrations may be a result of elevated turbidity present in the samples. Other potential sources of lead at Camp Burner may include munitions, water supply piping, gasoline, vehicle exhaust, and lead based paint.	It was determined that perchlorate and lead concentrations detected in the groundwater warrant supplemental investigation.	Groundwater analytical results did not identify evidence to indicate that former DoD activities at Camp Butner have impacted the groundwater quality.

QAPP Worksheet #13.5 (continued)
Secondary Data Criteria and Limitations Table, RC2

Secondary Data	Data Source	Data	How Data Will Be Used	Limitations on Data Use
2008, 2009, 2010 Non-TCRAs	Removal Actions at Lakeview Subdivision and Resdential Parcels Distributed throughout RC1 and RC2 (2008, 2009, and 2010)	Portions of the Lakeview Subdivision that were previously only cleared to a depth of 6-inches were cleared to depth of detection. In addition, RA activities were completed at more than 250 parcels (average parcel was approximately 1.75 acres). Land parcel grids investigated were distributed throughout RC1 and RC2. RA activities were generally focused around existing residential dwellings. Intrusive results indicate the presence of former impact and munitions-use areas. Munitions recovered included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades.	Areas addressed by the TCRA are considered to be sufficiently characterized and will not require additional investigation.	Subsurface survey areas do not cover entire MRS MC removal area limited

QAPP Worksheet #14
Summary of Project Tasks

Sampling Tasks: WP Sections 3.3 and Tables 3.1 and 3.5.
Analysis Tasks: WP Section 3.3 and Tables 3.1 and 3.5.
QC Tasks: All matrices will have the following field QC samples collected and analyzed: duplicates (discrete samples), replicates (ISM samples), MS/MSDs, and EBs. All analytical methods will be controlled by initial and continuing calibration standards, tuning, surrogate spike results, LCSs, laboratory duplicates (discrete samples), laboratory replicates (ISM samples), and all other QC procedures defined in the project analytical methods and required to produce definitive data.
Secondary Data: See Worksheet #13.
Data Management Tasks: Analytical data will be delivered by Microbac in a database that meets the requirements of SEDD. The database manager will generate project data tables to allow for any qualifiers required by the validation process to be applied directly to the database.
Documentation and Records: All field observations and sampling records will be entered into bound logbooks. CoC forms, air bills, field instrument calibration logs, and investigation-derived waste records will be prepared and retained.
Analytical Data Reports: Analytical data packages will be required to contain all data required to perform data review in accordance with the data validation protocols detailed in Attachment A. Sufficient documentation must be provided to allow for calibration, QC, blank, and other relevant information to be related to all associated sample analyses.
Assessment/Audit Tasks: Laboratory compliance with QSM and certification status reviewed prior to award of contract; laboratory precision, accuracy, and sensitivity performance compared to project requirements.
Data Review Tasks: The project laboratory will verify that all data are complete and correct for all samples received. Data will be validated by AMEC IAW the data review protocols detailed in Attachment A. Data validation will review those items that are defined as Stage 2B data validation elements by the EPA in its *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009). All data validation and review reports will be approved by the HGL project chemist before use. Data qualifiers will be applied to the database and will receive a 100 percent QC check on data entry. Following validation, data usability will be assessed using the procedures summarized in Worksheet #37 and presented in detail in Attachment B. CA will be initiated as required. Any data gaps and the impact on the overall data set will be evaluated on a site-specific basis.

QAPP Worksheet #15
Reference Limits and Evaluation Tables

The project-specific analytical method reference limits and evaluation tables are presented in Worksheets #15.1 through #15.8. These worksheets include the project analyte lists, the sensitivity limits achievable by the project laboratories, the associated screening levels, the control limits for accuracy (LCS/LCSD, MS/MSD, and surrogate recoveries), and the upper and lower limits that constitute a marginal exceedance of the control limit range. The analyses and target analytes specific to each matrix are listed in Table 3.5 of the WP. The laboratory SOPs for the preparation and analytical methods associated with the limits presented in Worksheets #15.1 through #15.8 are listed in Worksheet #23 and are presented in Appendix C.

The human health screening levels presented in Worksheets #15.1 through #15.8 are the RSLs for tap water and residential soil published in the RSL tables jointly developed by EPA Regions 3, 6, and 9, and updated in May 2012. The RSLs for non-carcinogens are concentrations that correspond to an analyte-specific hazard index of 1; the RSLs for carcinogens are concentrations that correspond to an analyte-specific cancer risk of 1H10^{-6}. NCDENR has established groundwater protection standards in North Carolina Administrative Code Title 15A, Subchapter 2L (“Groundwater Classification and Protection Standards”). In cases where the NCDENR groundwater protection standard is lower than the corresponding tap water RSL, the NCDENR value is presented.

The ESLs in Worksheets #15.1 through #15.8 are derived from multiple sources. The aqueous ESLs are surface water screening levels, selected from the lowest listed value in the following sources: EPA Region 3 freshwater screening benchmarks; EPA Region 5 ESLs; EPA Region 6 ESLs; Los Alamos National Laboratory ECORISK Database Release 3.0 (2011); Savannah River National Laboratory ESLs; and Talmage, et al, 1999. The soil ESLs are soil and sediment screening levels, selected from the lowest listed value in the following sources: EPA ecological site screening levels; EPA Region 5 ESLs; EPA Region 6 ESLs; Los Alamos National Laboratory ECORISK Database Release 3.0 (2011); and Savannah River National Laboratory ESLs.

QAPP Worksheet #15.1
Reference Limits and Evaluation Table – Explosives in Soil by Method 8330B, Microbac

Analyte	CAS Number	Sensitivity Limits (µg/kg)		RSL (µg/kg)	Soil ESL (µg/kg)	Sediment ESL (µg/kg)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		LOD	LOQ					Upper Limit	Lower Limit
1,3,5-Trinitrobenzene	99-35-4	100	250	2,200,000	376	1,300,000	75 - 125	65	135
1,3-Dinitrobenzene	99-65-0	100	250	6100	655	8.61	80 - 125	70	135
2,4,6-Trinitrotoluene	118-96-7	100	250	19,000	6400	420,000	55 - 140	45	155
2,4-Dinitrotoluene	121-14-2	100	250	720	1280	14.4	80 - 125	75	130
2,6-Dinitrotoluene	606-20-2	100	250	720	32.8	39.8	80 - 120	70	130
2-Amino-4,6-dinitrotoluene	35572-78-2	100	250	150,000	10,000	34,000	80 - 125	75	130
2-Nitrotoluene	88-72-2	100	250	2900	9900	28,000	80 - 125	70	130
3-Nitrotoluene	99-08-1	100	250	6100	12,000	24,000	75 - 120	70	130
4-Amino-2,6-dinitrotoluene	19406-51-0	100	250	150,000	3600	9500	80 - 125	75	130
4-Nitrotoluene	99-99-0	100	250	30,000	22,000	52,000	75 - 125	70	135
HMX	2691-41-0	100	250	3,800,000	27,000	27,000,000	75 - 125	65	135
Nitrobenzene	98-95-3	100	250	4800	2260	14.5	75 - 125	70	130
Nitroglycerin	55-63-0	100	250	6100	71,000	1,700,000	50 - 150	35	165
PETN	78-11-5	100	250	120,000	100,000	1,400,000	30 - 140	15	155
RDX	121-82-4	100	250	5600	7500	45,000	70 - 135	65	145
Tetryl	479-45-8	100	250	240,000	990	100,000	10 - 150	0	172
Surrogate									
1,2-Dinitrobenzene	528-29-0	NA	NA	NA	NA	NA	50 - 150	NA	NA

Shading indicates an RSL or ecological benchmark that is lower than the associated LOD.

CAS = Chemical Abstracts Service
ESL = ecological screening level
LOQ = limit of quantitation
µg/kg = micrograms per kilogram
NA = not applicable
RSL = Regional Screening Level
SL = screening level

QAPP Worksheet #15.2
Reference Limits and Evaluation Table – Explosives in Soil by Method 8330B, Accutest-Southeast

Analyte	CAS Number	Sensitivity Limits (µg/kg)		RSL (µg/kg)	Soil ESL (µg/kg)	Sediment ESL (µg/kg)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		LOD	LOQ					Upper Limit	Lower Limit
1,3,5-Trinitrobenzene	99-35-4	50	100	2,200,000	376	1,300,000	75 - 125	65	135
1,3-Dinitrobenzene	99-65-0	50	100	6100	655	8.61	80 - 125	70	135
2,4,6-Trinitrotoluene	118-96-7	50	100	19,000	6400	420,000	55 - 140	45	155
2,4-Dinitrotoluene	121-14-2	50	100	720	1280	14.4	80 - 125	75	130
2,6-Dinitrotoluene	606-20-2	75	100	720	32.8	39.8	80 - 120	70	130
2-Amino-4,6-dinitrotoluene	35572-78-2	50	100	150,000	10,000	34,000	80 - 125	75	130
2-Nitrotoluene	88-72-2	50	100	2900	9900	28,000	80 - 125	70	130
3-Nitrotoluene	99-08-1	50	100	6100	12,000	24,000	75 - 120	70	130
4-Amino-2,6-dinitrotoluene	19406-51-0	50	100	150,000	3600	9500	80 - 125	75	130
4-Nitrotoluene	99-99-0	50	100	30,000	22,000	52,000	75 - 125	70	135
HMX	2691-41-0	50	100	3,800,000	27,000	27,000,000	75 - 125	65	135
Nitrobenzene	98-95-3	50	100	4800	2260	14.5	75 - 125	70	130
Nitroglycerin	55-63-0	500	1000	6100	71,000	1,700,000	50 - 150	35	165
PETN	78-11-5	500	1000	120,000	100,000	1,400,000	30 - 140	15	155
RDX	121-82-4	75	100	5600	7500	45,000	70 - 135	65	145
Tetryl	479-45-8	50	100	240,000	990	100,000	10 - 150	0	172
Surrogate									
1,2-Dinitrobenzene	528-29-0	NA	NA	NA	NA	NA	50 - 150	NA	NA

Shading indicates an RSL or ecological benchmark that is lower than the associated LOD.

QAPP Worksheet #15.3
Reference Limits and Evaluation Table – Metals in Water by Method 6020A, Microbac

Analyte	CAS Number	Sensitivity Limits (µg/L)		RSL (µg/L)	Surface Water ESL (µg/L)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		LOD	LOQ				Lower Limit	Upper Limit
Antimony	7440-36-0	0.5	1.0	1.0[1]	30	80 - 120	NA	NA
Copper	7440-50-8	1.0	2.0	620	1.58	80 - 120	NA	NA
Lead	7439-92-1	0.5	1.0	15[2]	1.0	80 - 120	NA	NA
Zinc	7440-66-6	12.5	25	4700	30	80 - 120	NA	NA

[1] NCDENR groundwater protection standard
[2] Maximum contaminant level from the Safe Drinking Water Act.

µg/L = micrograms per liter

QAPP Worksheet #15.4
Reference Limits and Evaluation Table – Metals in Soil by Method 6020A, Microbac

Analyte	CAS Number	Sensitivity Limits (mg/kg)		RSL (mg/kg)	Soil ESL (mg/kg)	Sediment ESL (mg/kg)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		LOD	LOQ					Lower Limit	Upper Limit
Antimony	7440-36-0	0.08	0.16	31	0.27	2	80 - 120	75	NA
Copper	7440-50-8	0.3	0.6	3100	28	16	80 - 120	NA	NA
Lead	7439-92-1	0.1	0.2	400[1]	11	30.2	80 - 120	NA	NA
Zinc	7440-66-6	1.25	2.5	23,000	46	98	80 - 120	75	NA

[1] EPA maximum lead concentration in residential soil.

mg/kg = milligrams per kilogram

QAPP Worksheet #15.5
Reference Limits and Evaluation Table – Metals in Water by Method 6020A, Accutest-Mid-Atlantic

Analyte	CAS Number	Sensitivity Limits (µg/L)		RSL (µg/L)	Surface Water ESL (µg/L)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		LOD	LOQ				Lower Limit	Upper Limit
Antimony	7440-36-0	1.0	2.5	1.0[(1)]	30	80 - 120	NA	NA
Copper	7440-50-8	1.0	2.0	620	1.58	80 - 120	NA	NA
Lead	7439-92-1	0.5	1.0	15[(2)]	1.0	80 - 120	NA	NA
Zinc	7440-66-6	3.0	4.0	4700	30	80 - 120	NA	NA

[(1)] NCDENR groundwater protection standard
[(2)] Maximum contaminant level from the Safe Drinking Water Act.

µg/L = micrograms per liter

QAPP Worksheet #15.6
Reference Limits and Evaluation Table – Metals in Soil by Method 6020A, Accutest-Mid-Atlantic

Analyte	CAS Number	Sensitivity Limits (mg/kg)		RSL (mg/kg)	Soil ESL (mg/kg)	Sediment ESL (mg/kg)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		LOD	LOQ					Lower Limit	Upper Limit
Antimony	7440-36-0	0.25	0.625	31	0.27	2	80 - 120	75	NA
Copper	7440-50-8	0.6	1.0	3100	28	16	80 - 120	NA	NA
Lead	7439-92-1	0.15	0.25	400[(1)]	11	30.2	80 - 120	NA	NA
Zinc	7440-66-6	1.2	2.0	23,000	46	98	80 - 120	75	NA

[(1)] EPA maximum lead concentration in residential soil.

mg/kg = milligrams per kilogram

QAPP Worksheet #15.7
Reference Limits and Evaluation Table – Perchlorate in Water by Method 6850, Microbac

Analyte	CAS Number	Microbac Sensitivity Limits (µg/L)		RSL (µg/L)	Surface Water ESL(µg/L)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		LOD	LOQ				Lower Limit	Upper Limit
Perchlorate	14797-73-0	0.1	0.2	2.0[1]	NV	80-120	NA	NA

[1] NCDENR groundwater protection standard

NV = no value available

QAPP Worksheet #15.8
Reference Limits and Evaluation Table – Perchlorate in Water by Method 6850, Accutest-Southeast

Analyte	CAS Number	Accutest Sensitivity Limits (µg/L)		RSL (µg/L)	Surface Water ESL (µg/L)	Accuracy Control Limits (%)	Marginal Exceedance (%R)	
		LOD	LOQ				Lower Limit	Upper Limit
Perchlorate	14797-73-0			2.0[1]	NV	80-120	NA	NA

[1] NCDENR groundwater protection standard

QAPP Worksheet #16
Project Schedule/Timeline Table

See Schedule in WP Appendix B.

QAPP Worksheet #17
Sampling Design and Rationale

See Sections 3.3 and 3.4 of the WP.

QAPP Worksheet #18
Sampling Locations and Methods/SOP Requirements Table

Geophysical transect locations are shown on Figures 3.1 through 3.3 of the WP (presented in Appendix B). See Sections 3.2 and 3.3 of the WP for procedures for identification of sampling locations. Locations will be determined for the ISM SUs based on the following: (1) Reconnaissance transect and geophysical survey data evaluating the extent of surface MEC/MD and subsurface anomalies; and (2) MEC characterization (intrusive investigation data) evaluating the extent of subsurface MEC/MD. Based on this data, surface soil ISM SU locations will be proposed to the project team for concurrence. Based on the results of the initial ISM data, additional ISM and/or discrete subsurface soil samples will be collected. Required parameters are presented in Table 3.1 of the WP. The field SOPs that will be used to collect project samples are listed in Worksheet #21. HGL field SOPs are presented in Appendix I of the WP.

QAPP Worksheet #19
Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/ SOP Reference	Sample Size	Containers	Preservation Requirements	Maximum Holding Time[1]
Soil (ISM)	Explosives	Low	8330B (SOPs L-1, P-1)	Per SOP[1]	PE bag containing 1.5 kg	Cool ≤6°C	14 days to extract[2]/ 40 days to analysis
Soil (Grab)	Explosives	Low	8330B (SOPs L-1, P-1)	Per SOP[1]	4-ounce glass jar	Cool ≤6°C	14 days to extract/ 40 days to analysis
Soil (ISM)	Metals	Low	6020A (SOPs L-2, P-2)	Per SOP[1]	Subsampled at the laboratory from homogenized explosives sample prior to grinding		6 months
Soil (grab)	Metals	Low	6020A (SOPs L-2, P-2)	Per SOP[1]	4-ounce glass	Cool ≤6°C	6 months
Water (including QC samples)	Metals	Low	6020A (SOP L-2, P-3)	Per SOP[1]	250 mL PE bottle	Cool ≤6°C; HNO_3 to pH ≤2	6 months
Water (including QC samples)	Perchlorate	Low	6850 (SOP L-3)	Per SOP[1]	125 mL PE bottle	Filter in field; cool ≤6°C	28 days

[1] All project preparation and analytical methods have holding times greater than 72 hours and holding time compliance will be evaluated on the basis of elapsed calander days.
[2] Laboratory subsample size will be as indicated in the laboratory SOPs listed in Worksheet #23 and presented in Attachment C.
[3] Samples must be air dried prior homogenization. Holding time to preparation is measured from the conclusion of the air drying step.

EC = degrees Celsius
g = grams
HNO_3 = nitric acid
kg = kilogram
L = liter
mL = milliliters
PE = polyethylene

QAPP Worksheet #20
Field Quality Control Sample Summary Table[1]

Matrix	Analytical Group	Analytical and Preparation Method/ SOP Reference	Total Sampling Locations	Field Duplicate Pairs[2]	MS/MSD Pairs	Field Blanks	EBs	No. of QA Samples	Total Samples to Laboratory
All	HPLC, ICP-MS, and HPLC/ES/MS	See Worksheet #19	See WP Section 3.7	1 per 10 samples	1 per 20 samples	0	1 per day	1 per 10 samples	TBD

(1) All QC sample frequencies will be calculated on a per-site and per-matrix basis. Where both discrete sampling and ISM sampling is performed at the same site and matrix, the number of QC samples required will be calculated independently for each sampling method.
(2) Includes replicate (triplicate) samples collected by ISM.

ES/MS = electrospray ionization/mass spectrometry
HPLC = high performance liquid chromatography
ICP-MS = inductively coupled plasma-mass spectrometry

QAPP Worksheet #21
Project Sampling SOP References Table

Reference Number[1]	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work?	Comments
Field SOPs Referenced in this QAPP					
S-1	SOP 2.01: Sampling Equipment Cleaning and Decontamination	HGL	Bailers, trowels, ISM tool, and bowls	No	
S-2	SOP 2.03: Hand-Operated Auger Soil Sampling	HGL	Augers	No	
S-3	SOP 2.13: Surface and Shallow Depth Soil Sampling	HGL	Trowels and ISM tool	No	
S-4	SOP 2.15: Sediment Sampling	HGL	Trowels and bowls	No	
S-5	SOP 2.32: Domestic and Public Well Sampling	HGL	None[2]	No	
Other Relevant Field SOPs					
NA	SOP 2.04: Soil Sample Compositing	HGL	Trowels, IMS tool, and bowls	No	
NA	SOP 2.14: Geologic Borehole Logging	HGL	NA	No	
NA	SOP 4.07: Field Logbook Use and Maintenance	HGL	NA	No	
NA	SOP 15.00: Explosives Accountability and Management Program	HGL	NA	No	
NA	SOP 15.12: MEC Anomaly Avoidance Program	HGL	NA	No	
NA	SOP 15.50: Analog Geophysical Mapping with Real-Time Instrumentation and Anomaly Waypoint Mapping	HGL	Magnetometer and Global Positioning System (GPS)	No	
NA	SOP 15.60: DGM Using Geonics Ltd. EM61 Mk 2	HGL	Electromagnetic metal detector	No	

[1] All SOPs referenced in this worksheet are presented in Appendix I of the WP.
[2] Groundwater samples will only be collected from existing production wells. It is anticipated that these wells will not require development and will be sampled through direct ports.

QAPP Worksheet #22
Field Equipment Calibration, Maintenance, Testing, and Inspection Table

SOPs for calibration, maintenance, testing and inspection are provided in Appendix I of the WP.

QAPP Worksheet #23
Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analysis	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
L-1	HPLC02: SOP Nitroaromatics and Nitramines by HPLC Method 8330. Revision 15, 6/15/2010.	Definitive	Explosives	HPLC	Microbac	N
	GC 034.4: Analysis of Nitroaromatics and Nitramines by HPLC Method SW-846 8330B. Revision date: 10/15/10.	Definitive	Explosives	HPLC	Accutest-Southeast	N
L-2	ME700: SOP for the Perkin Elmer ELAN 6100 ICP/Mass Spectrometer (SW-846 6020/EPA Method 200.8). Revision 7, 4/15/2009.	Definitive	Metals	ICP-MS	Microbac	N
	EMA226-05: Metals by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Revision date: 12/20/11	Definitive	Metals	ICP-MS	Accutest-Mid-Atlantic	N
L-3	HPLC06: SOP Perchlorate Method 6850/331.0. Revision 3, 4/15/2011.	Definitive	Perchlorate	HPLC/ES/MS	Microbac	N
	MS 13.0: Analysis of Perchlorate by LC/MS/MS. Revision date: 6/11/12	Definitive	Perchlorate	HPLC/MS/MS	Accutest-Southeast	N
P-1	EXTNT02: SOP Solid Extraction of Nitroaromatics and Nitramines Method 8330. Revision 11, 3/15/10.	Preparation (Method L-1)	Organic Preparation	NA	Microbac	N
	OP 046.2: Standard Operating Procedure for the Extraction of Nitroaromatics and Nitramines (Explosives) from Solid Samples for HPLC Analysis by SW-846 8330B. Revision date: 2/17/11.	Preparation (Method L-1)	Organic Preparation	NA	Accutest-Southeast	N
P-2	ME406: SOP, Microwave Digestion of Sediments, Sludges, Soils and Oils (3051A). Revision 12, 11/15/2009.	Preparation (Method L-2)	Inorganic Preparation	NA	Microbac	N
	EMP070-14: Digestion of Soils for ICP-MS Analysis. Revision date: 9/1/09.	Preparation (Method L-2)	Inorganic Preparation	NA	Accutest-Mid-Atlantic	N
P-3	ME407: SOP, Microwave Digestion – Aqueous SW846-3015. Revision 11, 12/15/2010.	Preparation (Method L-2)	Inorganic Preparation	NA	Microbac	N
	EMP070-14: Digestion of Non-Potable Water for ICP or ICP-MS Analysis. Revision date: 9/8/11.	Preparation (Method L-2)	Inorganic Preparation	NA	Accutest-Mid-Atlantic	N

Laboratory SOPs referenced in this worksheet are presented in Attachment C.

QAPP Worksheet #24
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
HPLC	Five-point initial calibration for all target analytes	Initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	%RSD of calibration factor for each analyte ≤20%. linear – $r^2 \geq 0.99$	Correct problem then repeat initial calibration	Laboratory Manager/Analyst	L-1
	ICV (must be from a second source)	Immediately following initial calibration	All analytes within 20% of expected value	Correct problem then repeat initial calibration	Laboratory Manager/Analyst	L-1
	Retention time verification	Update at start of run or daily	All standards within RT window	Correct problem then reprocess or re-analyze all samples analyzed since the last retention time check	Laboratory Manager/Analyst	L-1
	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	All analytes within 20% of expected value	Correct problem then repeat initial CCV and re-analyze all samples since last successful CCV.	Laboratory Manager/Analyst	L-1

QAPP Worksheet #24
Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
ICP/MS	Initial Calibration	Daily, minimum of one blank and one standard	None	NA	Laboratory Manager/Analyst	L-2
	Initial Calibration	Daily, optional multipoint calibration	$r \geq 0.995$	1) Evaluate system 2) Recalibrate	Laboratory Manager/Analyst	L-2
	ICV; must be from a second source	Following initial calibration	%R = 90%-110%	1) Evaluate system 2) Recalibrate as necessary	Laboratory Manager/Analyst	L-2
	Low-level calibration check standard	Daily, spiked at analyte-specific LOQs; not required if multipoint calibration performed	%R = 80%-120%	1) Evaluate system 2) Recalibrate as necessary	Laboratory Manager/Analyst	L-2
	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	All analytes within 10% of expected value and RSD of replicate integrations <5%	Repeat calibration and reanalyze all samples since last successful calibration	Laboratory Manager/Analyst	L-2
	CCB	After every continuing calibration verification	Must be <LOD	Correct problem then analyze calibration blank and previous 10 samples	Laboratory Manager/Analyst	L-2
	ICS A	At the beginning of an analytical run	Spiked analytes: Within 20% of expected value Non-spiked analytes: <LOD (unless they are a verified trace impurity from one of the spiked analytes)	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples	Laboratory Manager/Analyst	L-2
	ICS AB	At the beginning of an analytical run	Within 20% of expected value	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples	Laboratory Manager/Analyst	L-2

QAPP Worksheet #24
Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
HPLC/ES/ MS and HPLC/MS/ MS	Initial Calibration	Daily multipoint calibration	r ≥ 0.995	1) Evaluate system 2) Recalibrate	Laboratory Manager/Analyst	L-3
	ICV; must be from a second source	Following initial calibration	Target analyte within 15% of expected value	1) Evaluate system 2) Recalibrate as necessary	Laboratory Manager/Analyst	L-3
	CCV	Before sample analysis, after every 10 samples, and at the end of the analysis sequence	Target analyte within 15% of expected value	Repeat calibration and reanalyze all samples since last successful calibration	Laboratory Manager/Analyst	L-3
	LOD verification standard	After each ICV and CCV	Target analyte within 30% of expected value	Repeat calibration and reanalyze all samples since last successful LOD verification	Laboratory Manager/Analyst	L-3
	CCB	After every LOD verification standard	Must be <LOD	Correct problem then analyze calibration blank and previous 10 samples	Laboratory Manager/Analyst	L-3
	ICS	One per preparation batch	%D ≤30%	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples	Laboratory Manager/Analyst	L-3

[1] Analytical SOP References Table (Worksheet #23).

QAPP Worksheet #25
Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

All analytical instruments used for this project will be maintained IAW the requirements presented in each analytical method SOP (included as Attachment C) and the laboratory-specific QA Plans (Attachment D). Each laboratory QA Plan also presents the documentation requirements for maintenance activities.

QAPP Worksheet #26
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Site staff/HGL
Sample Packaging (Personnel/Organization): Site staff/HGL
Coordination of Shipment (Personnel/Organization): Site Supervisor/HGL and Sample Receipt Manager/Laboratory
Type of Shipment/Carrier: Priority Overnight - FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Management Staff/Laboratory
Sample Custody and Storage (Personnel/Organization): Sample Management Staff/Laboratory
Sample Preparation (Personnel/Organization): Organic Preparation Staff; Inorganic Preparation Staff; Bench Chemists/Laboratory
Sample Determinative Analysis (Personnel/Organization): Bench Chemists/Laboratory
SAMPLE ARCHIVING
Field Sample Storage (number of days from sample collection): Not applicable
Sample Extract/Digestate Storage (number of days from extraction/digestion): For 30 days from report release
Biological Sample Storage (number of days from sample collection): Not applicable
SAMPLE DISPOSAL
Personnel/Organization: Sample management staff/Laboratory
Number of Days from Analysis: 30 from report release; up to 6 months on sample-specific request from HGL

QAPP Worksheet #27
Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to the laboratory):

SAMPLE COLLECTION:

- Soils: Surface soil samples will be collected throughout the MRS locations as part of the RI field activities. Discrete surface soil samples will be collected from the ground surface to 0.5 feet below ground surface (bgs) using decontaminated stainless steel equipment. Incremental samples will be collected using the Cold Regions Research and Engineering Laboratory (CRREL) ISM tool. QC samples will be collected using the same procedures used for primary environmental samples. Sample collection techniques and methods to be used to collect surface soil samples are summarized below.

  Surface soil incremental samples will be collected using a stainless steel ISM tool. Collected soil will be placed directly into PE bags holding a minimum of 1.5 kg. All sampling equipment and tools will be decontaminated prior to use. After each sample has been collected, all sample containers will be placed in a cooler and maintained at 4°C ± 2°C pending shipment to the laboratory.

  Discrete soil samples will be collected using stainless steel spoons and trowels. Collected soil will be placed into stainless steel sampling bowls. Samples will be homogenized and placed into glass jars using stainless-steel spoons, augers, or sampling equipment. All sampling equipment and tools will be decontaminated prior to use; all sample jars will be glass with Teflon® septa and will be certified clean by the manufacturer. After each sample has been collected, all sample containers will be placed in a cooler and maintained at 4°C ± 2°C pending shipment to the laboratory.

- Sediment Sampling: Ten sediment sample locations will be selected within each MRS, if possible. Sediment samples will be analyzed for selected metals (lead, copper, manganese, and zinc) and explosives.

  Sediment will be sampled with a decontaminated stainless-steel hand auger, coring device and/or stainless-steel spoon. Samples will be sealed and placed in coolers with ice immediately after collection.

- Groundwater Sampling: Groundwater samples may be collected using from existing groundwater production wells. Samples, if collected, will be obtained from spigots or existing infrastructure.

EQUIPMENT DECONTAMINATION: Equipment used in sampling activities must be properly cleaned and decontaminated to ensure that chemical analysis results are reflective of the actual concentrations at sampling locations. Therefore, equipment used to conduct sampling activities will be decontaminated before sampling activities begin, between sampling activities, and after sampling activities have been completed. SOPs for the decontamination of equipment are provided in Appendix I.

QAPP Worksheet #27 (continued)
Sample Custody Requirements

INVESTIGATION-DERIVED WASTE (IDW):. Personal protective equipment (PPE) is classified as IDW and will be containerized and disposed of in a manner approved by USACE and NCDENR. If for any reason soil or supplemental water needs to be containerized during the completion of the RI activities, all IDW will be segregated and containerized by medium.

IDW at Camp Butner will be identified and properly handled while it is being accumulated or stored on site. Hazardous waste will be contained and handled in compliance with the requirements listed below:

- HGL will provide USACE with a description of the process that generated the waste and will supply, when appropriate, laboratory analysis data to facilitate the determination of which wastes are hazardous and provide information necessary to prepare reports for regulatory agencies and higher commands.
- Wastes will be accumulated and/or stored at locations that comply with collection point operational standards.
- Waste generation will be minimized whenever possible or feasible.

FIELD DOCUMENTATION: Sample collection, storage, packing, and shipment will be properly documented to ensure chemical data integrity. The log will be a permanently bound field notebook. Field documentation will be entered using indelible ink. Corrections will be made by drawing a single line through the error, then initialing and dating the line. Each page will be dated, initialed, and sequentially numbered.

QC Reports will be prepared daily, dated, signed by the SUXOS, and sent to USACE upon completion of the fieldwork. These reports will include weather information at the time of sampling, sample identification, field instrument measurements, and calibrations. The cover of each notebook will bear the following:

- project name;
- project number; and
- opening and closing dates for data contained in the book.

The inside cover will include the address and telephone number of the HGL office.

At the beginning of each daily entry, the date, start time, weather, and planned activities will be recorded. The names of visitors and the purpose of their visits will be noted. Any deviations from the WP will be recorded along with the reason for the deviation. Additional information on QC documentation is contained in Section 3.12 of the WP.

QAPP Worksheet #27 (continued)
Sample Custody Requirements

Pre-Sampling Activities

Sampling personnel will record in the field logbook the preparation activities that may be pertinent to the sampling event at each sampling location. For soil sampling, documentation may include information on the presence of MEC\MD\CD, geophysical anomaly ID, site-specific munitions related factors for selection of sampling point (firing line, target, etc), the depth from which the samples were collected, and the equipment and materials that were used to collect the sample.

SAMPLE PACKAGING: The following procedures will be used for packing samples for shipping.

- Drain plug on cooler will be taped shut inside and out.
- Large plastic bag is placed in cooler as liner.
- Individual glass sample container will be wrapped in bubble wrap.
- Bubble-wrapped sample container is placed in small plastic bag.
- Bubble wrap or other packing material will be placed between individual sample containers in cooler.
- Samples will be packaged in thermally insulated, rigid coolers, according to U.S. Department of Transportation (DOT) Specifications 173, Subparts A and B, and 172, Subparts B, C, and D. Environmental samples and field QC blanks to be submitted to the analytical laboratory will be placed in a sample cooler along with ice and temperature blanks, and the final temperature blank temperature will be recorded.
- The cooler will be filled with enough ice to keep the temperature at 4°C ± 2°C during shipping and until arrival at laboratory; enough packing material will used so that individual sample jars are not insulated from the ice. (Note: Care must be taken to make sure jars are not touching each other to prevent breakage during shipment.)
- Cooler is closed and sealed with filament-style strapping tape or equivalent.
- At least two custody seals will be placed across the hinge line (one on the front and one on the side of the cooler) in a manner that will indicate whether tampering of the cooler has taken place.
- Posted on all four sides of the cooler will be “This Side Up” labels, and posted on two sides and on the top are “Fragile” labels.

QAPP Worksheet #27 (continued)
Sample Custody Requirements

SAMPLE SHIPMENT: Each individual sample will be identified with an identification (ID) label or tag that will be affixed to the sample container in a manner that will prevent it from coming off when the sample container is cold or wet. The information recorded on the label will include:

- Sample ID number
- Source or location of sample
- Date sample was obtained
- Time sample was collected
- Sampler's initials

Sample coolers will be shipped to the analytical laboratory by overnight delivery. All samples will be kept on ice in a cooler containing a temperature blank after sample collection. Sample preparation and packaging will be completed at the end of each day that samples are collected. When samples are collected over the weekend, the samples will undergo preparation as normal; however, the samples will not be packaged for shipment. Samples collected on the weekend will be kept within a cooler on ice until all samples for the next shipment have been collected. On Mondays following weekends when samples have been collected, the iced samples will be repacked for overnight shipment.

See Section 3.12 of the WP

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal):

The designated sample custodian(s) and staff are responsible for samples received at the laboratory. In addition to receiving samples, the sample receipt staff is also responsible for documentation of sample receipt and storage before and after sample analysis. Summaries of the minimal laboratory receipt procedures are as follows:

- Upon receipt, sign, date, and document the time of sample receipt on the airbills or other shipping manifests received from the couriers.
- Sign the CoC form assuming custody of the samples. If a CoC form is not received with a set of samples, the laboratory will immediately notify the HGL PM.
- Inspect the sample cooler for integrity and then document the following information:
    - Type of courier and whether the samples were shipped or hand delivered (copies of the airbills are maintained).
    - Availability and condition of custody information.
    - Sample temperature.
    - Actual temperature of the temperature blank.
    - Presence of leaking or broken containers and indication of sample preservation.

QAPP Worksheet #27 (continued)
Sample Custody Requirements

- Verify that the holding time has not been exceeded. If a sample has exceeded holding time, then the HGL Project Chemist must be notified.
- Match the sample container information (e.g., sample tag/label), CoC records, and all pertinent information associated with the sample. The sample custodian then verifies sample identity to ensure that all information is correct. Any inconsistencies are resolved with HGL through the Laboratory PM and CA measures are documented before sample analysis proceeds.

Samples submitted to off-site laboratories will be stored at 4°C for a minimum of 60 days following the completion of analyses or issue of final reports. Sample extracts and metals digestates will be stored for a period of 1 year following submittal of final reports. The laboratory is also responsible for the proper management and disposal of all sample residuals and extracts, following all applicable federal, state, and local laws; rules; and regulations.

Sample Identification Procedures: A sample identification system will be used to identify each environmental sample collected and field QC sample prepared during the Camp Butner RI field activities. This system will provide a tracking procedure to allow information about a particular sample or sample location to be retrieved easily and accurately and to ensure that each sample is unique. The HGL field manager and data manager will maintain a complete list of field sample numbers and site identifications. The first two letters will represent the sample type (SA - Shallow Anomaly, SB - Soil Boring, SS - Surface Soil, GW – Groundwater, SW/SD – Surface Water/Sediment). The next two numbers designate the Camp Butner site of concern: Army National Guard Property (ARNG); Range Complex No. 1 or 2 (RC1 or RC2); Flame Thrower Range (FTR); and Hand Grenade Range (HGN). The last two digits will represent the sample location number. The format of typical field sample numbers is as follows:

Site ID	Sample Description
SA-ARNG-05	Soil sample collected from shallow anomaly from Army National Guard Property at location 05
SS-HGR-03	Surface soil sample collected from the Hand Grenade Range at sample location 3

Field Sample Number – This is a unique designation assigned by the field team to each environmental sample and field QC sample collected. It is an alphanumeric code that indicates the sample number for a site. For example, a field sample number of HGL02 for site ID SA 03 05 would indicate that it is the second soil sample collected from a shallow anomaly location. Re-collected samples will be designated with an "R" at the end of the field sample number (e.g., HGL XXR).

Duplicate, Triplicate, and Field QC Blanks – The following QC test and flagging codes will be used to identify duplicate environmental and field QC blank samples:

- A "D" entered in the flagging code field will be used to identify all field duplicates collected in the field.
- A "T" entered in the flagging code field will be used to identify all field triplicates collected in the field.
- An "R" entered in the QC test code field will be used to identify all equipment rinsate blanks collected in the field.
- An "F" entered in the QC test code field will be used to identify all field blanks collected in the field.

QAPP Worksheet #27 (continued)
Sample Custody Requirements

Preprinted sample labels will be filled out at the time of sampling and will be attached to each container with waterproof tape. The label will be completed in indelible ink and contain the following information:

- Date and time sample collected;
- Media type;
- Method matrix;
- Purpose of the sample (parameter and sample group);
- MRS location;
- Field sample number;
- Depth;
- Installation;
- Preservative used (if any); and
- Initials of sample collector.

See Section 3.12 of the WP

Chain-of-Custody (CoC) Procedures: The primary objective of sample custody is to provide accurate, verifiable, and traceable records of sample possession and handling from preparation and shipment of bottle ware through laboratory receipt, sample analyses, and data validation. A sample is considered in custody if it is:

- in actual possession of the sampler or transferee,
- in view of the sampler or transferee after establishment of physical possession,
- sealed for sample integrity by the sampler, and/or
- in a secured area, with access restricted to authorized personnel.

<u>Container Preparation/Management</u>

Microbac will furnish sampling containers. Containers will be provided with batch number and the lot number for any preservatives provided to permit traceability. All standard custody procedures are maintained for pre-cleaned sample containers. If the containers must be stored between receipt by HGL and sample collection, they will be stored at the HGL field office or in a designated secure area near the site.

QAPP Worksheet #27 (continued)
Sample Custody Requirements

<u>CoC Documentation, Traceability, and Sample Integrity (Field)</u>

After sample collection, all sample containers will be labeled with an identification number that uniquely identifies the sample. The sample identification number will be logged in the field logbook, preprinted sample/data sheets, and on the CoC Record with the following information:

- sampling location (MRS)
- sampling personnel,
- date and time of collection,
- field sample location and depth (if appropriate),
- observations of ambient (weather) conditions,
- type of sampling (composite or grab),
- method of sampling,
- sampling matrix or source,
- intended analyses and type of container,
- preservation method, and
- observations of physical characteristics of the sample.

CoC is maintained for samples transported from the field to the laboratory by common carrier. Completed custody forms must accompany each sealed cooler and are placed in a plastic bag, which is taped to the inside lid of the cooler. The sampling team in the field seals coolers with a custody seal to ensure that tampering would be immediately evident.

A sample identification number is recorded with waterproof ink on the container label. A copy of each packing slip associated with a shipment of samples is maintained in the project files.

See Section 3.12 of the WP.

QAPP Worksheet #28.1
Method QC Table – Explosives by SW-846 Method 8330B

Matrix	Soil
Analytical Group	HPLC
Concentration Level	Low
Sampling SOP	S-1, S-2, S-3, and S-4
Analytical Method/ SOP Reference	L-1
Sampler's Name	TBD
Field Sampling Organization	HGL
Analytical Organization	Microbac and Accutest-Southeast
No. of Sample Locations	See WP Section 3.3

QC Element:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Retention Time Windows	Prior to initial calibration and after major maintenance	3 times standard deviation for each quantitation peak retention time from 72-hour study	Correct problem then reprocess or reanalyze all samples analyzed since the last retention time check	Laboratory Manager/ Laboratory Analyst	NA
MB	Every analytical batch (maximum of 20 samples)	Target analytes not detected ≥½ LOQ (see Worksheets 15.1 and 15.2) and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	1) Rerun 2) Evaluate batch 3) Reanalyze or qualify results as necessary	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Representativeness
LCS (and LCSD, if performed)	Every analytical batch (maximum of 20 samples)	Analyte-specific %R acceptance criteria (see Worksheets 15.1 and 15.2); RPD ≤30% if LCSD performed	1) Rerun 2) Evaluate batch 3) Reanalyze or qualify results as necessary	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias (and Precision)

QAPP Worksheet #28.1
Method QC Table – Explosives by SW-846 Method 8330B (continued)

QC Element:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
MS/MSD	As indicated on CoC forms, and as required for batch control	Analyte-specific %R acceptance criteria (see Worksheets 15.1 and 15.2); RPD ≤30% if MSD performed Not applicable if parent sample concentration ≥ 4H the spike level	1) Evaluate MS/MSD to assess matrix interference 2) Evaluate batch and qualify results as necessary	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Precision
Laboratory replicate analyses (ISM samples)	Every analytical batch (maximum of 20 samples)	%RSD ≤20%	1) Evaluate results to assess matrix interference 2) Evaluate batch and qualify results as necessary	Laboratory Manager/ Laboratory Analyst	Precision
Surrogate Recovery	Every sample	Surrogate-specific %R acceptance criteria (see Worksheets 15.1 and 15.2)	1) Rerun 2) Reanalyze or qualify results as necessary	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias

QAPP Worksheet #28.2
Method QC Table – Metals by SW-846 Method 6020A

Matrix	Water and soil
Analytical Group	ICP-MS
Concentration Level	Low
Sampling SOP	S-1, S-2, S-3, S-4, and S-5
Analytical Method/ SOP Reference	L-2
Sampler's Name	TBD
Field Sampling Organization	HGL
Analytical Organization	Microbac and Accutest-Mid-Atlantic
No. of Sample Locations	See WP Section 3.3

QC Element	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
ICB	Following ICV	Analytes not detected ≥½ LOQ (see Worksheets 15.3 through 15.6) and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater); no negative values > |LOD|	1) Rerun 2) Clean system 3) Qualify results as appropriate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Representativeness
ICS	Beginning of analytical sequence	ICS A (spiked analytes): %R = 80% to 120% ICS A (non-spiked analytes): Absolute value of concentration for all non-spiked analytes <LOD (unless a verified trace impurity from standard solution) ICS AB: %R = 80% to 120%	1) Evaluate system 2) Recalibrate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Representativeness

QAPP Worksheet #28.2
Method QC Table – Metals by SW-846 Method 6020A (continued)

QC Element	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
CCB	Following CCV	Analytes not detected ≥½ LOQ (see Worksheets 15.3 through 15.6) and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater); no negative values >|LOD|	1) Rerun 2) Clean system 3) Reanalyze affected samples or qualify results as appropriate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Representativeness
MB	Every analytical batch (maximum of 20 samples)	Analytes not detected ≥½ LOQ (see Worksheets 15.3 through 15.6) and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater); no negative values > |LOD|	1) Rerun 2) Evaluate batch 3) Re-digest affected samples or qualify results as appropriate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Representativeness
LCS (and LCSD, if performed)	Every analytical batch (maximum of 20 samples)	Analyte-specific %R acceptance criteria (see Worksheets 15.3 through 15.6); RPD ≤20% if LCSD performed	1) Rerun. 2) Evaluate batch 3) Reanalyze or qualify results as necessary	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Precision
MS (and MSD, if performed)	Every analytical batch (maximum of 20 samples)	Analyte-specific %R acceptance criteria (see Worksheets 15.3 through 15.6); RPD ≤20% if MSD performed Not applicable if parent sample concentration ≥ 4H the spike level	1) Rerun; if still out, perform post-digestion spike 2) Evaluate batch 3) Qualify sample results as appropriate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Precision

QAPP Worksheet #28.2
Method QC Table – Metals by SW-846 Method 6020A (continued)

QC Element	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Laboratory Duplicate (if performed)	Every analytical batch (maximum of 20 samples)	RPD ≤20% (water) or ≤30% (soil) if both results >5H the LOQ; absolute difference <LOQ for evaluation of low-level results (<5# LOQ)	1) Rerun 2) Evaluate batch 3) Qualify sample results as appropriate	Laboratory Manager/ Laboratory Analyst	Precision
Laboratory replicate analyses (ISM samples)	Every analytical batch (maximum of 20 samples)	%RSD ≤20%	1) Evaluate results to assess matrix interference 2) Evaluate batch and qualify results as necessary	Laboratory Manager/ Laboratory Analyst	Precision
Serial Dilution	Every analytical batch (maximum of 20 samples)	%D ≤10% for all analytes present in the parent sample at concentrations >100x DL	1) Rerun 2) Evaluate batch 3) Qualify sample results as appropriate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias
Post-Digestion Spike	Every analytical batch of 20 samples, only if serial dilution analysis fails or analyte < DL criterion in serial dilution parent sample	%R = 75% to 125%	1) Rerun 2) Evaluate batch 3) Qualify sample results as appropriate	Laboratory Manager/ Laboratory analyst	Accuracy/Bias

QAPP Worksheet #28.3
Method QC Table – Perchlorate by SW-846 Method 6850

Matrix	Water
Analytical Group	HPLC/ES/MS
Concentration Level	Low
Sampling SOP	NA
Analytical Method/ SOP Reference	L-3
Sampler's Name	TBD
Field Sampling Organization	HGL
Analytical Organization	Microbac and Accutest-Southeast
No. of Sample Locations	See WP Section 3.3

QC Element	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
ICB/CCB	Following each LOD verification standard	Analytes not detected ≥½ LOQ (see Worksheets 15.7 and 15.8) and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	1) Rerun 2) Clean system 3) Qualify results as appropriate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Representativeness
MB	Every analytical batch (maximum of 20 samples)	Analytes not detected ≥½ LOQ (see Worksheets 15.7 and 15.8) and ≥1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater)	1) Rerun 2) Evaluate batch 3) Re-digest affected samples or qualify results as appropriate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Representativeness
LCS (and LCSD, if performed)	Every analytical batch (maximum of 20 samples)	Analyte-specific %R and RPD acceptance criteria (see Worksheet 12.3)	1) Rerun. 2) Evaluate batch 3) Reanalyze or qualify results as necessary	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Precision

QAPP Worksheet #28.3
Method QC Table – Perchlorate by SW-846 Method 6850 (continued)

QC Element	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
MS (and MSD, if performed)	Every analytical batch (maximum of 20 samples)	Analyte-specific %R and RPD acceptance criteria (see Worksheet 12.3) Not applicable if parent sample concentration ≥4H the spike level	1) Rerun; if still out, perform post-digestion spike 2) Evaluate batch 3) Qualify sample results as appropriate	Laboratory Manager/ Laboratory Analyst	Accuracy/Bias and Precision
Laboratory Duplicate (if performed)	Every analytical batch (maximum of 20 samples)	RPD ≤15% if both results >5H the LOQ; absolute difference <LOQ for evaluation of low-level results (<5H LOQ)	1) Rerun 2) Evaluate batch 3) Qualify sample results as appropriate	Laboratory Manager/ Laboratory Analyst	Precision

QAPP Worksheet #29
Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field notes (bound logbook)	Equipment calibration logs	Sample receipt, custody, and tracking records	Data validation reports	Project planning documents
Sample documentation forms	Equipment maintenance, testing, and inspection logs	Standard traceability logs	Automated data review reports	Project deliverables
Daily Quality Control Reports (DQCRs)	Equipment calibration logs	Equipment calibration logs	Database QC spreadsheets	Telephone logs, emails, faxes, and correspondence
CoC records	Field sampling data sheets	Sample preparation logs	Telephone logs, emails, faxes, and correspondence	Permits
Air bills	Waste disposal records	Analytical run logs		Site maps
Custody seals		Equipment maintenance, testing, and inspection logs		
Telephone logs, e-mails, faxes, and correspondence		Analytical discrepancy forms		
CA forms		Reported analytical results		
Photographs		Reported results for standards, QC checks, and QC samples		
		Data package completeness checklists		
		Sample disposal records		
		Extraction and cleanup records		
		Raw data (stored electronically)		
		Telephone logs, emails, faxes, and correspondence		

QAPP Worksheet #30
Analytical Services Table

Matrix	Analytical Group	Concentration Level	Sample Locations/ ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization	Backup Laboratory/ Organization
All (Worksheet #21)	HPLC, ICP-MS, and HPLC/ES/MS (Worksheet #23)	Low	All	L-1, L-2, and L-3 (Worksheet #23)	21 Days	Microbac Laboratories Ohio Valley Division 158 Starlite Drive Marietta, Ohio 45750 PM: Stephanie Mossburg (800) 373-4071 (phone) (740) 373-4835 (fax) http://www.microbac.com	Microbac national laboratory network
All (Worksheet #21)	HPLC and HPLC/MS/MS (Worksheet #23)	Low	1 per 10 samples for each matrix	L-1 and L-3 (Worksheet #23)	21 Days	Accutest Laboratories Southeast 4405 Vineland Road Orlando FL 32811 (407) 425-6700 PM: Jean Dent-Smith http://www.accutest.com	Accutest national laboratory network
All (Worksheet #21)	ICP-MS (Worksheet #23)	Low	1 per 10 samples for each matrix	L-2 (Worksheet #23)	21 Days	Accutest Laboratories Mid-Atlantic 2235 U.S. Route 130 Dayton NJ, 08810 (732) 329-0200 PM: Tammy McCloskey http://www.accutest.com	Accutest national laboratory network

QAPP Worksheets #31
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Verification that a number of items are present at the site including RI/FS WP, Field Logbooks, Sample containers, Chemical Quality Control (CQC) Report Forms, CoC forms, sample shipping documents, sampling equipment, PPE, sample containers, preservatives, coolers and packaging materials, and IDW storage containers. Demonstration of sampling procedures	Preparatory Phase (prior to sampling at the site). The activities during this phase include a review of all work requirements, a discussion of all required materials and equipment, and examination of sample location areas, and a discussion of all field activities.	Internal	HGL	HGL Field Team Lead	SUXOS	UXOSO	PM
Inspection of field notes to ensure that all pertinent data are recorded according to project requirements Inspection of individual sample labels and CoC forms for accuracy, completeness and consistency Inspection of the packaging of all samples Ensuring that primary and QA samples are correctly matched and recorded in the field logbook and CQC Reports	Initial Phase (during sampling activities). This initial phase inspection will be performed by the field manager who will oversee sampling activities and review the work for compliance with contract requirements.	Internal	HGL	HGL Field Team Lead	SUXOS	UXOSO	PM

QAPP Worksheets #31 (continued)
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
General procedures and documentation will be checked to ensure that they are complete, accurate, and consistently, executed throughout the duration of the sampling phase Review of any field data, as required Monitoring of soil sampling to make sure that samples are properly collected, composited, stored, packaged and shipped.	Follow-up Phase (after sampling activities are completed). This phase inspection will be performed on an as-needed basis to ensure continued compliance with project requirements.	Internal	HGL	HGL Field Team Lead	SUXOS	UXOSO	PM
Review of QAPP, SOPs, and DQCR with Field Staff	Prior to sampling startup	Internal	HGL	HGL Field Team Lead	SUXOS	UXOSO	PM
Daily Logbook and Field Forms	Daily	Internal	HGL	HGL Field Team Lead	SUXOS	UXOSO	PM
Laboratory Assessment for Appropriate Certifications, Capacity, and QAPP Review with Staff	Prior to sampling mobilization	Internal	HGL	Ken Rapuano HGL Project Chemist	Laboratory PM	Laboratory QA Manager	Ken Rapuano HGL Project Chemist

QAPP Worksheets #31 (continued)
Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Daily Tailgate Safety Meeting	Daily	Internal	HGL	HGL Field Team Lead or SUXOS	UXOSO or HGL Technical Manager	UXOSO or HGL Technical Manager	Mark McGowan, HGL Corporate H&S Manager
Field Sampling and CoC Form Review Against QAPP Requirements	Daily	Internal	HGL	TBD HGL Sample Coordinator	HGL Field Team Lead	Project Chemist	PM
Data Validation	Per sample delivery group (SDG)	Internal	HGL	TBD AMEC Data Validator	Ann Bernhardt AMEC Data Quality Manager	TBD AMEC Data Validator	Ann Bernhardt AMEC Data Quality Manager
Laboratory Report Deliverables and Analytical Results Against QAPP Requirements	As discrepancies are identified in the validation process	Internal	HGL	Ken Rapuano HGL Project Chemist	Laboratory PM	Laboratory QA Manager	Laboratory QA Manager Ken Rapuano HGL Project Chemist

QAPP Worksheet #32
Assessment Findings and CA Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Time Frame of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Time Frame for Response
Laboratory Assessment for Appropriate Certifications, Capacity and QAPP Review with Staff	Receipt of copies of certifications. Email traffic concerning lab capacity prior to sampling startup. QAPP sign-off sheet received from laboratory.	Derek Anderson HGL PM	48 hours	Response to email	Derek Anderson HGL PM Michael Cox HGL FTL	48 hours after notification
Daily Safety Meeting	Verbal debriefing and daily sign-off log. If a safety incident occurs, a Supervisor Injury Employee Report is completed.	Derek Anderson HGL PM	Immediately	Included as part of the process of the Supervisor Injury Employee Report	Derek Anderson HGL PM Mark McGowan, HGL Corporate H&S Manager	24 hours after notification
Daily Field Reporting and Field Forms	Contained with written report.	Michael Cox HGL FTL	24 hours	DQCR would be amended with CA	HGL Field Team Lead	24 hours after notification
Field Sampling and CoC Form Review Against QAPP Requirements	Communication may be in the form of email traffic	Derek Anderson HGL PM Michael Cox HGL FTL	24 hours after sampling	Response to email	Derek Anderson HGL PM HGL Field Team Lead	48 hours after notification

QAPP Worksheet #32
Assessment Findings and CA Responses (continued)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Time Frame of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Time Frame for Response
Laboratory Report Contents and Analytical Results Against QAPP Requirements	Communication may be in the form of email traffic	Derek Anderson HGL PM HGL Field Team Lead	72 hours after receipt of analytical report	If required laboratory reports will be amended and corrections noted in the analytical narrative.	Derek Anderson HGL PM HGL Field Team Lead	72 hours after notification
Data Validation	Communication may be in the form of email traffic clarification of the analytical report or CAs due to deficiencies identified in the validation process.	Laboratory PM	24 hours after finding of deficiency	If required, laboratory reports will be amended and corrections noted in the analytical narrative and contained with the validation report.	Ken Rapuano HGL Project Chemist	Up to 7 days

QAPP Worksheet #33
QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Analytical discrepancy forms	As needed	Initiated on discovery of deficiency; completed within 3 days of CA	Project Staff/Section Manager (Laboratory)	Laboratory PM Ken Rapuano, Project Chemist (HGL)
Daily QC Reports	Daily for each day of field work	Appendix to project report. If discrepancy identified, transmitted by fax to HGL PM the same business day.	HGL Field Team Lead UXOSO	Derek Anderson, PM (HGL)
SUXOS Daily Report	Daily for each day of field work	Submit to HGL PM weekly. Compile after action report as appendix to RI report.	Scott Schroepfer, SUXOS, (HGL)	Derek Anderson, PM (HGL)
Data Validation Report	1/analytical method reported in each SDG	Completed within 3 weeks of data package receipt	Ann Bernhardt, Data Quality Manager (AMEC)	Ken Rapuano, Project Chemist (HGL)
QCSR	1/sampling event after all data are reviewed and database is complete	Included as appendix to individual project reports	Ann Bernhardt, Data Quality Manager (AMEC)	USACE - Draft USACE and Tier 1 - Final
Project Reports (RI Report, FS, Proposed Plan, and Decision Document)	Appendix B, Figure 2.2	Appendix B, Figure 2.2	Derek Anderson, PM (HGL)	See Section 2.4

QAPP Worksheet #34
Verification (Data Review Step I) Process Table

Verification Input	Description	Internal (I)/ External (E)	Responsible for Verification
CoC (shipping)	CoC forms will be reviewed upon completion and verified against the packed sample coolers and site sampling requirements. This QC check will be verified by initialing the CoC form next to the shipper's signature. A copy of the CoC form will be retained in the project file and the original and one copy will be taped inside the cooler in a waterproof bag.	E	HGL Field Team Lead
Log review	Log reviews will be performed on a daily basis. This review will be performed to verify that all field monitoring equipment was maintained, calibrated, and operated properly. In addition, the review denotes all required information has been correctly documented in the field logbooks and sample documentation sheets.	E	HGL Field Team Lead
CoC (receipt)	CoC forms will be reviewed and compared to cooler contents. Any discrepancies (sample bottles, sample IDs, requested methods) will be communicated to the Laboratory PM for resolution with the HGL PM.	I	Laboratory Sample Receipt Manager and PM
Analytical data package	All data used to prepare analytical data packages will be reviewed at multiple levels throughout the laboratory. The requirements for this review process are described in Appendix D. No data packages will be delivered to HGL without the necessary approval.	I	Laboratory PM
Analytical data package	Ensure that the appropriate analytical samples have been collected, appropriate site identifications have been used, and the correct analytical methods have been applied.	E	Sample Coordinator, HGL
Analytical data package[1]	Review the analytical reports to establish that all required forms, case narratives, samples, CoC forms, logbooks, and raw data have been included.	E	Data Validator, AMEC
EDD (export)	All EDDs will be verified against the requirements of the SEDD database prior to transmittal to HGL.	I	Laboratory Database Manager

QAPP Worksheet #34
Verification (Data Review Step I) Process Table (continued)

Verification Input	Description	Internal (I)/ External (E)	Responsible for Verification
EDD (import)	Any EDD non-conformances from the laboratory are reviewed and addressed before the data is processed further. This check is performed on the EDD to ensure that it is in the correct format and that it contains the correct standard values. Any errors or warnings are addressed before processing the data further.	E	Jeff Martin, HGL Database Manager
Project database	All data qualifiers applied to the project database by manual entry will receive a 100% QC check for accuracy and completeness. Prior to final approval, each EDD output will receive a 10% QC check of electronically reported results against the hardcopy laboratory reports.	E	Jeff Martin, HGL Database Manager

[1] This verification step corresponds to Data Validation Stage 1 described in Worksheets #35 and #36.

QAPP Worksheet #35
Validation (Data Review Steps IIa and IIb) Process Table

Validation Stage	Validation Input	Description	Person Responsible for Validation
Data Review Step IIa			
Data Verification	Laboratory data reports	100 percent of data packages: The validator will verify data package completeness, review case narratives, evaluate sample delivery and condition, and evaluate preparation and analysis holding times (Worksheet #19).	TBD, AMEC
Automated Data Review (ADR) with Manual Review	Laboratory data reports	100% of data packages: The ADR program will perform initial evaluation of sample- and batch-related QC results (see Attachment A, Table A.1). The validator will review and evaluate ADR outputs and complete the review of those items not able to be addressed by ADR.	TBD, AMEC
Data Review Step IIb			
Peer Review	Data validation reports	100 percent of data validation reports: Peer review of reports to ensure all QC issues are identified and to approve application of qualifiers.	Ann Bernhardt, AMEC
Senior Review	Data validation reports	100 percent of data validation reports: Review of AMEC data validation reports to approve of all validation results and final qualifiers; overall evaluation of analytical performance against QAPP and WP requirements.	Ken Rapuano, HGL
Overall Assessment	Project documentation (Worksheet #33)	Complete project data set and documentation: Determine whether the sampling plan was executed as specified (i.e., the number, location, and type of field samples were collected and analyzed as specified in the WP); evaluate whether sampling procedures were followed with respect to equipment and proper sampling support (e.g., techniques, equipment, decontamination, volume, temperature, preservatives).	HGL Field Team Lead

QAPP Worksheet #36
Validation (Data Review Steps IIa and IIb) Summary Table

Validation Stage	Matrix	Analytical Group	Concentration Level	Validation Criteria[1]	Data Validator
Data Review Step IIa					
1	Water and soil	All	Low	Package Completeness Holding Times: Worksheet #19 Narrative: Additional items noted for resolution or clarification	ADR; validator TBD (AMEC)
2A and 2B	Water and soil	Explosives	Low	DQIs: Worksheets #12.1, #15.1, #15.2, and #28.1 Qualification: Attachment A, Table A.1	ADR; validator TBD (AMEC)
2A and 2B	Water and soil	Metals	Low	DQIs: Worksheets #12.2, #15.3, #15.4, and #28.2 Qualification: Attachment A, Table A.1	ADR; validator TBD (AMEC)
2A and 2B	Water and soil	Perchlorate	Low	DQIs: Worksheets #12.3, #15.5, #15.6, and #28.3 Qualification: Attachment A, Table A.1	ADR; validator TBD (AMEC)
2A and 2B	Water and soil	White phosphorus	Low	DQIs: Worksheets #12.3, #15.7, #15.8, and #28.4 Qualification: Attachment A, Table A.1	ADR; validator TBD (AMEC)
Data Review Step IIb					
NA	Water and soil	All	Low	See Worksheet #37	Ann Bernhardt (AMEC), Ken Rapuano, Project Chemist (HGL)
NA	Water and soil	All	Low	See Worksheet #37	Derek Anderson, PM (HGL)

[1] In **all** cases, the method-specific requirements as presented in this QAPP will supersede any conflicting requirements.

QAPP Worksheet #37
Data Usability Assessment (Step III)

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used: The data assessment team will perform the operations summarized in Worksheets #33, #34, and #35 to evaluate sampling team and laboratory compliance with the requirements with this QAPP and other project planning documents. ADR will be used to evaluate sample- and batch-specific QC elements. Evaluation activities will be documented in the QA reports listed in Worksheet #33 and will be used to assess the usability of project data in levels of detail ranging from an analyte- and sample-specific basis to the overall data set for the sampling event. A full description of the activities listed in this summary is presented in Attachment B.

Describe the evaluative procedures used to assess overall measurement error associated with the project: The assessment will include an evaluation of the QC elements relating to precision, accuracy, representativeness, comparability, completeness (both sample collection and analytical), and sensitivity (see Attachment B). The impact of any data gaps resulting from sampling incompleteness or rejected data will be evaluated in the project reports and will reference the findings of the QCSR prepared by AMEC.

Identify the personnel responsible for performing the usability assessment: Derek Anderson, PM, HGL; Ken Rapuano, Project Chemist, HGL; Jeff Martin, Database Manager, HGL

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies: Evaluation activities will be documented in the QA reports listed in Worksheet #33. An overall assessment of the impact of data usability issues will be presented in the project report. The usability assessment will evaluate the overall data set.

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ATTACHMENT A

DATA MANAGEMENT AND VALIDATION

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ATTACHMENT A
DATA MANAGEMENT AND VALIDATION

1.0 INTRODUCTION

Following sample collection and analysis, the data must be reviewed, reported, and validated. The procedures described in this appendix are conducted to ensure that the data were collected and obtained in accordance with this quality assurance project plan (QAPP), the applicable guidance documents, and good practices. The overall goal is to ensure that the data quality requirements of the project are met.

2.0 LABORATORY DATA MANAGEMENT REQUIREMENTS

Microbac Laboratories, Inc., (Microbac) and Accutest Laboratories (Accutest) are responsible for providing complete and correct data to HydroGeoLogic, Inc. (HGL) for all requested analyses. The QAPP addresses the project-specific requirements for analyses in Worksheets #12, #15, #24, and #28. Following analysis of the samples, the laboratories will perform a series of steps in order to deliver an acceptable final data report to HGL.

2.1 DATA REDUCTION

Data reduction is the process for collecting and transforming measurements, through mathematical and/or statistical formulas, into final reportable measurements. The calculations may be performed manually or electronically. Data reduction is performed by the analyst and consists of calculating concentrations in samples from the raw data. The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings, and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values. Calculations and data reduction steps for various methods are summarized in the respective laboratory standard operating procedures (SOPs) (see Attachment D) or program requirements.

Copies of all raw data and the calculations used to generate the final results, such as bound laboratory notebooks, strip-charts, chromatograms, spreadsheets, and computer record files, are retained on file as specified in this QAPP. Should HGL determine that the laboratory's data reduction processes require an in-depth review, these calculations and the associated raw data will be provided to HGL on request.

2.2 DATA REVIEW

Data review is performed to assess whether the quality control (QC) requirements are met. Project laboratories will perform data review on 100 percent of the data deliverables. No data may be released to HGL without the appropriate analyst and supervisory review performed and documented.

The individual analyst continually reviews the quality of data through evaluating the results of calibration checks, QC samples, and performance evaluation samples. The analyst performs data review during, immediately following, and after the completed analysis. The laboratory supervisor, analyst, or data specialist performs a secondary review of the data. The data reviewer is trained by the quality assurance (QA) manager or section leader to perform the data review.

The analytical laboratory data reviewer who has the initial responsibility for the correctness and completeness of the data will conduct the first level of review, which may contain multiple sublevels of all project related data. Data reduction, QA review, and reporting by the laboratory will be completed as follows:

- Raw data produced by the analyst are processed and reviewed for attainment of QC criteria as outlined in the SOPs, laboratory QA manual, and established U.S. Environmental Protection Agency (EPA) methods, as well as for overall reasonableness. These general QC criteria are modified by the requirements of this QAPP and the *DoD Quality Systems Manual for Environmental Laboratories* (QSM), version 4.2.
- After entry into the laboratory information management system (LIMS), a computerized report is generated and sent to the laboratory data reviewer.
- The data reviewer will decide whether any sample reanalysis is required.
- Upon acceptance of the preliminary reports by the data reviewer, final reports will be generated.

The laboratory data reviewer will evaluate the quality of the work based on an established set of laboratory guidelines. This person will review the data package to ensure the following:

- Sample preparation information is correct and complete,
- Analysis information is correct and complete,
- The appropriate SOPs have been followed,
- Analytical results are correct and complete,
- QC samples are within project-specific control limits, and
- Special sample preparation and analytical requirements have been met.

Documentation is complete when all anomalies in the preparation and analysis have been documented.

The laboratory will perform the in-house analytical data reduction and QA review under the direction of the laboratory QA director. The laboratory program administrator (PA) is responsible for assessing data quality and advising the project manager of any data that were rated “preliminary” or “unacceptable,” or other notations that would caution the data user of possible unreliability.

2.3 LABORATORY DOCUMENTATION

Analytical reports transmit final results, methods of analysis, levels of reporting, associated QC data, and method performance data. The laboratory will submit the data report for each sample delivery group using a reporting format that presents the information for a Stage 2B deliverable as described in *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009). In addition, issues affecting the analytical process will be noted in the case narrative included in each report. The number of significant figures reported will be consistent with the limits of uncertainty inherent in the analytical method. Consequently, most analytical results will be reported to no more than two or three significant figures.

Data are normally reported in units commonly used for the analyses performed. Concentrations in liquids are expressed in terms of weight or activity per unit volume (e.g., micrograms per liter [µg/L] or milligrams per liter [mg/L]). Concentrations in solid or semisolid matrices are expressed in terms of weight or activity per unit weight of sample (e.g., micrograms per kilogram [µg/kg] or milligrams per kilogram [mg/kg]). Solid and semisolid matrices will also be reported on a dry weight basis. The sample-specific sensitivity limits (detection limits [DLs], limits of detection [LODs], and limits of quantitation [LOQs]) are reported adjusted for subsample size and percent moisture, as well as all appropriate concentration, dilution, and extraction factors.

If any analytical anomalies are encountered during the analyses (e.g., an out-of-control matrix duplicate), it will be documented in a case narrative and copies of the sample discrepancy reports or corrective action reports must be included in the laboratory data reports.

2.4 LABORATORY RECORD-KEEPING

At a minimum, Microbac will retain all data related to sample preparation, analysis, and general observations in appropriate hardbound laboratory notebooks or files. Laboratory notebook pages must be reviewed, signed, and dated by the author and receive an independent secondary review by a peer or supervisor who signs/initials and dates the data pages.

Corrections to notebook entries are made by drawing a single line through the erroneous entry and writing the correct entry next to the one that is crossed out. All corrections are initialed and dated by the individual performing the correction.

After delivering acceptable hard copy and/or electronic data deliverables, the laboratory will store the original project data for at least 5 years unless otherwise specified in the subcontract agreement.

2.5 LABORATORY ACCREDITATION

Project analytical data will be produced by the Marietta, Ohio, facility of Microbac. The Orlando, Florida, facility of Accutest will perform QA analyses for explosives and perchlorate. The Dayton, New Jersey, facility of Accutest will perform QA analyses for metals.

2.5.1 Department of Defense Requirements

This project requires that the analytical data be generated by a laboratory that has been accredited under the Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP). This accreditation involves the successful completion of an on-site audit by an auditing firm contracted by the DoD and the evaluation of performance evaluation sample results. Microbac and Accutest are required to maintain current DoD ELAP accreditation for all analyses, matrices, and analytes applicable to this project throughout the duration of this work.

2.5.2 State Requirements

The North Carolina Department of Environment and Natural Resources (NCDENR) has an accreditation program for laboratories analyzing environmental samples. Microbac and Accutest are accredited by NCDENR for all analyses to be performed, with the exception of perchlorate, which is not included in NCDENR's fields of accreditation.

2.5.3 Other Assessment and Audit Tasks

No subcontractor laboratory technical system audits are planned for this project; however, an audit may be performed at any time during this program at HGL's discretion or at client direction. In the event that laboratory performance does not meet QAPP requirements and/or significant data quality issues arise, HGL reserves the right to perform additional system/project audits at any time throughout the program.

3.0 SUBCONTRACTOR DATA MANAGEMENT REQUIREMENTS

Upon receipt of a laboratory data package and the associated electronic database deliverables (EDD), HGL will perform data management tasks required to ensure that all analyses were performed in accordance with project requirements. The data management requirements include conducting data verification, data evaluation, and data validation to determine the usability of the data for the original project objectives. Data verification, data evaluation, and data validation are each separate levels of review that can be performed by themselves or in conjunction with each other. Evaluation activities will be documented in the QA reports listed in Worksheet #33 and will be used to assess the usability of project data in levels of detail ranging from an analyte- and sample-specific basis to the overall data set for the sampling event (see Attachment C).

3.1 DATA VERIFICATION

Initially, laboratory deliverables are received at HGL in both .pdf (laboratory data report) and EDD formats, as discussed previously. HGL will perform data verification on every report submitted by a laboratory. Upon receipt of the laboratory deliverables, a data management staff member will perform the following actions:

- The deliverable will be inspected to verify that results were received for each requested analysis for each sample. If a result is missing, the staff member will determine whether the laboratory submitted a deficiency report that accounts for the missing data.
- The data deliverable will be inspected for completeness based on the requirements specified in this plan. Inspection will verify only that all required report elements are present, not that the data within the report are complete.

3.2 ELECTRONIC DATA VERIFICATION

All analytical results are required to be submitted to HGL in a format that meets the requirements of the Staged Electronic Data Deliverable (SEDD). EDDs will also be required to support Stage 2A automated data review (ADR). Once HGL verifies that each EDD meets format requirements, it will be loaded into the project's electronic database management program as "unvalidated" for user access on the network. These analytical results will be considered preliminary until data validation is complete.

The EDDs will be compared to the pdf version of the laboratory data report by the HGL data management coordinator. HGL will perform this review on 10 percent of the electronic data results. If a discrepancy is identified, the laboratory will be required to correct the error.

3.3 DATA EVALUATION

Data evaluation is performed to assess whether the QC requirements for field duplicates, laboratory duplicates, equipment blanks, surrogates, matrix spikes (MSs)/matrix spike duplicates (MSDs), percent solids, method blanks, and laboratory control samples (LCSs) were met. Data evaluation will be performed on 100 percent of the laboratory deliverables generated during this program. This data evaluation procedure will be performed in conjunction with the data validation performed on each data report and described below.

The first stage of data evaluation will be performed using the latest version of the ADR software program. The ADR software must be able to import a SEDD deliverable from the laboratory and export a SEDD deliverable (with the appropriate data review qualifiers). Following ADR, an AMEC chemist will evaluate ADR outputs and integrate those results into the manual review process in accordance with Appendix D of HGL's corporate data validation SOP.

3.4 DATA VALIDATION

Data validation is a systematic process to ensure that all chemical analytical information meet uniform requirements and to determine that the usability and defensibility of the data are adequate for their intended use. Validation of analytical results will be performed by an AMEC chemist and another AMEC chemist will perform peer review of each data validation report. All applicable analytical data packages will be validated to ensure compliance with specified analytical, QA/QC requirements, data reduction procedures, data reporting requirements, and required accuracy, precision, and completeness criteria. Each validation report will be subject to peer review. Once finalized, each report will be transmitted to HGL.

Data validation will be performed on 100 percent of the results for environmental samples. Validation will consist of a review of those elements that compose a Stage 2B data validation as described in *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009). All data will be validated by ADR; ADR review will be supplemented by a manual review by an AMEC chemist to ensure that the outputs from ADR are consistent with conventional technical approached to data validation and to evaluate QC elements not reviewed by ADR. The data will be validated against the acceptance criteria presented in Appendices F and G of the QSM, version 4.2 and other applicable guidance; a full list of the applicable data validation guidance is presented in Worksheet #36 of the QAPP. Data validation guidelines are presented below in Table A.1, and data qualifiers are defined in Table A.2. The data validation guidelines are based on the requirements of the QSM, version 4.2, and the analytical methods. The qualification requirements and data qualifiers are based on the EPA National Functional Guidelines for data review. These guidelines were developed for the review of data generated using Contract Laboratory Program analytical methods, and the qualification guidelines presented in Table A.1 have been modified to accommodate differences between Contract Laboratory Program method requirements and the method requirements presented in the SW-846 methods and the QSM.

Upon completion, the data validator will provide a data validation report and will provide an annotated EDD that contains all final data result qualifiers. Each data validation report These data qualifiers will then be uploaded into the project database, which will then be made accessible to the HGL project team and will be available for upload to ERIS.

Table A.1
Data Qualification Guidelines

CONTROL PARAMETER	EXCEEDANCE OF CONTROL LIMITS	QUALIFICATION OF DETECTED RESULTS (1)	QUALIFICATION OF NON-DETECTED RESULTS (2)	ASSOCIATED RESULTS
Data Verification to be conducted manually by an AMEC chemist				
Case narrative	The case narrative should be reviewed to determine if additional issues affected the sample analyses that could have an impact on data quality or be brought to the attention of the project chemist to initiate corrective action.			
Chain of custody	Review the chain of custody against the laboratory sample summary to ensure no transcription errors have occurred and no samples have been misidentified.			
Sample temperature	Evidence of frozen samples	J	UJ	All method results in affected sample or cooler
	12 °C ≥temperature > 6 °C (organic methods)	J	UJ	All method results in affected sample or cooler
	temperature >12 °C (organic methods)	J	R	All method results in affected sample or cooler
Sample condition	Issues noted	Validator discretion	Validator discretion	All method results in affected sample
Data Validation Elements to be Evaluated by ADR with Manual Review				
Holding time(3)	Holding time exceeded	J	UJ	All method results in affected sample
	Holding time exceeded by greater than a factor of 2	J	R	All method results in affected sample
Analyte quantitation	Analyte concentration below calibrated range	J	Not applicable	Affected results in sample
	Analyte concentration above calibrated range, no corresponding diluted result	J	Not applicable	Affected results in sample
Method (preparation) blanks	Analyte detected in blank≥DL Multiply value by 10 for common lab contaminants, or by 5 for other analytes, to obtain action level	B (detected results below action level)	Not applicable	Affected analyte results in preparation batch
Method (preparation) blanks (inorganic methods)	Negative drift with absolute value ≥DL Same as laboratory blanks; convert to equivalent soil units if necessary Absolute value <LOD Absolute value ≥LOD	 J J	 UJ R	Analyte results in preparation batch
Equipment blanks	Same as laboratory blanks	B (detected results below action level)	Not applicable	Affected analyte results in samples in the same sampling event (same day)

Table A.1 (continued)
Data Qualification Guidelines

CONTROL PARAMETER	EXCEEDANCE OF CONTROL LIMITS	QUALIFICATION OF DETECTED RESULTS (1)	QUALIFICATION OF NON-DETECTED RESULTS (2)	ASSOCIATED RESULTS
Surrogate recovery (organic methods)	recovery > UCL 10% < recovery < LCL recovery < 10% 1 or more mixed high and low (>10%)	J J J J	Not applicable UJ R UJ	All method results in affected sample
	Manual Review: If poor surrogate performance is due to sample dilution ≥5x, qualification is considered not to be necessary.			
LCS recovery	recovery > UCL LCL > recovery > ME recovery < ME	J J J	Not applicable UJ R	Affected analyte results in the preparation batch
LCS/LCSD RPD	RPD > CL	J	Not applicable	Affected analyte results in the preparation batch
MS/MSD (3) (organic methods)	recovery > UCL recovery < LCL Precision > CL	J J J	Not applicable UJ Not applicable	Parent sample only
MS/MSD (3) (inorganic methods)	recovery > UCL 30% < recovery < LCL recovery < 30% Precision > CL	J J J J	Not applicable UJ R Not applicable	Affected analyte results in the preparation batch
MS/MSD (all methods)	*Manual Review*: 1) If an analyte concentration native in the sample is greater than 4x the concentration spiked, MS/MSD results are considered not to be applicable for that analyte and no qualification should be applied based on MS/MSD results. 2) MS/MSD discrepancies noted in samples requiring dilution are unlikely to be caused by matrix effects. 3) If, in the judgment of the reviewer, the spiked sample is not considered represented of the other samples in the preparation batch, only the parent sample is qualified. 4) If an MS/MSD from another SDG is reported as batch control, determine if that MS/MSD is from a project sample and applicable to the reported sample results or from a sample from a different project and the MS/MSD results are not applicable.			
Laboratory duplicate RPD (inorganic methods)	RPD >CL and both sample and duplicate results >5x LOQ	J	NA	Affected analyte results in the preparation batch
	Result difference >LOQ and either sample or duplicate result ≤5x LOQ or non-detect (4)	J	Not applicable (lower result is a detect) or UJ (lower result is a non-detect)	Affected analyte results in the preparation batch
Field duplicate RPD	Same as laboratory duplicate	Same as laboratory duplicate	Same as laboratory duplicate	Parent and duplicate samples only
All duplicate results	*Manual Review*: 1) ADR is only able to evaluate the RPD of duplicate results. For those results that are considered low-level (less than 5x LOQ), the reviewing chemist should verify that the results meet the absolute difference requirement. 2) If, in the judgment of the reviewer, the laboratory duplicate parent sample is not considered represented of the other samples in the preparation batch, only the parent sample is qualified.			
Laboratory replicate %RSD	%RSD ≤20% (use LOD as the nominal value for non-detected results)	J	UJ	Affected analyte results in the preparation batch
Field replicate %RSD	Same as laboratory replicate	Same as laboratory replicate	Same as laboratory replicate	Parent and replicate samples only

Table A.1 (continued)
Data Qualification Guidelines

CONTROL PARAMETER	EXCEEDANCE OF CONTROL LIMITS	QUALIFICATION OF DETECTED RESULTS (1)	QUALIFICATION OF NON-DETECTED RESULTS (2)	ASSOCIATED RESULTS
Completeness and compliance checks of instrument-related QC (all performed by manual review)				
Instrument tuning	Method tuning requirements	R	R	All sample analyses associated with affected tune
Initial calibration linearity	Method-specific criteria (Worksheet #24)	J	UJ	Affected analyte results associated with the initial calibration
Low-level calibration verification at LOQ (metals)	recovery >120% 80% > recovery ≥ 50% recovery <50%	J J J	Not applicable UJ R	Analyte results in the analytical batch: all non-detections and detections ≤10x LOQ; if associated CRDL standard results within 90-110%, then only detections ≤2x LOQ are affected
LOD verification standard (perchlorate)	recovery >130% 70% > recovery ≥ 50% recovery <50%	J J J	Not applicable UJ R	Analyte results in the analytical batch: all non-detections and detections ≤10x LOD
CCV %D (organic methods)	Method-specific criteria (Worksheet #24)	J	UJ	Affected analyte results associated with the continuing calibration
ICV and CCV recoveries (inorganic methods)	%R above method-specific criteria (Worksheet #24)	J	Not applicable	Affected analyte results bracketed by the ICV or CCV
	%R less than method-specific criteria (Worksheet #24) but ≥75%	J	UJ	Affected analyte results bracketed by the ICV or CCV
	Recovery <75%	J	R	Affected analyte results bracketed by the ICV or CCV
ICBs and CCBs (metals and perchlorate)	Positive results ≥DL: Same as method blanks; convert to equivalent soil units if necessary	B (detected results below action level)	Not applicable	ICB: Analyte results in analytical batch CCB: Analyte results bracketed by the CCB

Table A.1 (continued)
Data Qualification Guidelines

CONTROL PARAMETER	EXCEEDANCE OF CONTROL LIMITS	QUALIFICATION OF DETECTED RESULTS (1)	QUALIFICATION OF NON-DETECTED RESULTS (2)	ASSOCIATED RESULTS
	Metals: Negative drift with absolute value ≥DL Same as method blanks; convert to equivalent soil units if necessary Absolute value <LOD Absolute value ≥LOD	J J	UJ R	ICB: Analyte results in analytical batch CCB: Analyte results bracketed by the CCB
ICS A (metals)	Spiked analyte >120% 79% > recovery ≥ 50% Spiked analyte <50%	J J J	Not applicable UJ R	Analyte results in the analytical batch
	Non-spiked analyte ≥LOD: multiply by 10 for action level; convert to equivalent soil units if necessary	J	Not applicable	Analyte results bracketed by the ICS A
	Non-spiked analyte ≥LOQ: multiply by 10 for action level; convert to equivalent soil units if necessary	R	Not applicable	Analyte results bracketed by the ICS A
	Non-spiked analyte with negative result with absolute value ≥LOD: multiply by 10 for action level; convert to equivalent soil units if necessary	J	UJ	Analyte results bracketed by the ICS A
	Non-spiked analyte with negative result with absolute value ≥LOQ: multiply by 10 for action level; convert to equivalent soil units if necessary	J	R	Analyte results bracketed by the ICS A
ICS AB (metals)	Spiked analyte >120% 79% > recovery > 50% Spiked analyte <50%	J J J	Not applicable UJ R	Analyte results bracketed by the ICS AB
ICS (perchlorate)	recovery >130% 70% > recovery ≥ 50% recovery <50%	J J J	Not applicable UJ R	Analyte results in the analytical batch
Serial dilution (metals)	%D > 10% for analytes ≥100x DL	J	UJ	Affected analyte results in the preparation batch. If PDS results are in control, no qualification is necessary.
PDS (metals)(3) [*Only required if serial dilution results do not meet criteria or if analytes not present >100x DL in serial dilution parent sample*]	recovery >125% 75% > recovery ≥ 50% recovery <50%	J J J	Not applicable UJ R	Analyte results in the preparation batch

Table A.1 (continued)
Data Qualification Guidelines

CONTROL PARAMETER	EXCEEDANCE OF CONTROL LIMITS	QUALIFICATION OF DETECTED RESULTS (1)	QUALIFICATION OF NON-DETECTED RESULTS (2)	ASSOCIATED RESULTS
Internal standards (metals and perchlorate)	Method response criteria (Worksheet #12) not met	J	R	Target analytes quantitated using affected IS in affected sample.
Additional Items to be Addressed during Manual Review				
Multiple results reported for an analyte in a single sample/method combination due to multiple dilution levels or reanalysis due to QC issue	NA; the validator will review the available data and associated QC results and determine the 'best' data point for each analyte reported for each sample	X	X	Applied to all results not selected as the 'best' data point.
Calculation and transcription verification	Errors or inconstancies noted	Validator judgment	Validator judgment	Results associated with the error; also notify HGL Project Manager or Senior Chemist
General data review	QC element not performed	Validator judgment	Validator judgment	Results associated with missing QC element

Notes:
(1) The priority of qualifiers for detected results is: X > R > B > J >no qualifier.
(2) The priority of qualifiers for non-detected results is: X > R > UJ > U.
(3) All project preparation and analytical methods have holding times greater than 72 hours and holding time compliance will be evaluated on the basis of elapsed calander days.
(4) MS/MSD and post-digestion spike results for an analyte are not considered applicable if the concentration in the parent sample is >4x the spike concentration.
(5) When comparing the results of a duplicate pair which consists of a detected result and a non-detected result, the numerical value of the non-detected result should be considered to be the LOD. Two results below the LOQ or a result below the LOQ and a non-detection are always considered to be in control.

CCB - continuing calibration blank
CCV - continuing calibration verification
CL - control limit
%D - percent difference
DL - detection limit
ICB - initial calibration blank
ICP-MS - inductively coupled plasma-mass spectrometry
ICS - interference check sample
IS - internal standard
LOD - limit of detection
LOQ - limit of quantitation
PDS - post-digestion spike
RPD - relative percent difference
%RSD - percent relative standard deviation
UCL - upper control limit

Table A.2
Data Qualifier Definitions

Qualifier	Definition
No qualifier	Confirmed identification. The analyte was positively identified at the reported concentration. The reported concentration is within the calibrated range of the instrument and the result is not affected by any deficiencies in the associated QC criteria.
B	Not detected substantially above that level reported in the associated field or laboratory blanks. The concentration is considered an artifact.
J	The analyte was detected at the reported concentration; the quantitation is an estimate.
R	The result is rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria.
U	Not detected. The associated number indicates the analyte LOD.
UJ	Not detected. The associated number indicates the analyte LOD, which may be inaccurate.
X	Excluded. The data point is associated with reanalyses or diluted analyses and is excluded because another result has been selected as the definitive result for the analyte.

ATTACHMENT B

USABILITY ASSESSMENT

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ATTACHMENT B
USABILITY ASSESSMENT

1.0 INTRODUCTION

Assessment of the data usability is an important project component and will be performed as a preliminary step of the data interpretation phase. The assessment process summarized in Worksheet #37 is described in more detail in this attachment. The HydroGeoLogic, Inc. (HGL) personnel with primary responsibility for completing the data usability assessment process are the HGL project manager, the HGL project chemist, and the HGL database manager.

The data usability assessment is considered the final step in the data evaluation process and can be performed only on data of known and documented quality. As described in Worksheet #36, data generated for this project will undergo a formalized evaluation/validation process. Data usability goes beyond validation in that it evaluates the achievement of the data quality objectives (DQOs) based on the comparison of the project data quality indicator (DQIs) and individual study-specific work plans with the obtained results. The results of the data usability assessment, and particularly any changes to the DQOs necessitated by the data not meeting usability criteria, will be included in the final report.

2.0 INTERFACE WITH VALIDATION ACTIVITIES

AMEC Environmental & Infrastructure, Inc., (AMEC) is HGL's teaming partner for this project. AMEC will be tasked with performing data validation, data quality evaluation (including authoring the project Quality Control Summary Report [QCSR]), and risk assessment. Prior to performing the usability assessment, AMEC will perform the data verification, evaluation, and validation activities described in Attachment A (summarized in Worksheets #33 through #36). AMEC will evaluate sampling team and laboratory compliance with the requirements with this quality assurance project plan (QAPP) and other project planning documents. HGL will perform senior review of AMEC's data validation findings and HGL's data management team will incorporate the final data qualifiers into the project database. Once data validation is complete, the results of the validation will guide AMEC's usability assessment. The usability assessment will examine the performance of the quality control elements relating to precision, accuracy, representativeness, comparability, completeness (both sample collection and analytical), and sensitivity. The assessment will also identify the existence and impact of any data gaps resulting from sampling incompleteness (e.g., due to insufficient water in a well) or from rejected data. The findings of the usability assessment will be reported in the QCSR.

3.0 USABILITY ASSESSMENT PROCEDURES

The assessment of data usability will primarily follow procedures described in appropriate U.S. Environmental Protection Agency (EPA) guidance documents, particularly *Guidance for Data Usability in Risk Assessment* (Publication No. 9285.7-05FS, September 1992), and will be conducted according to the process outlined below.

3.1 REVIEW OF SAMPLING AND ANALYSIS PROGRAM

The first step of the data usability assessment will include a review of the sampling and analysis activities in comparison to the requirements of the project planning documents (work plan and QAPP) and to the project-specific DQIs. Specific limitations to the data, such as the effect of results that are qualified as estimated (J/UJ) or rejected (R), will be determined and documented in the database.

3.2 ACHIEVEMENT OF DQIS

The second part of data usability pertains to the achievement of the program-specific DQIs. The performance achieved for each data quality criterion will be evaluated against the expected and planned performance. In general, this comparison will follow from the DQIs used to define each DQO. This comparison is the most critical component of the assessment process. Any deviation from planned performance will be documented and evaluated to determine whether corrective action is advisable. Potential corrective actions will range from resampling and/or reanalysis of data, to qualification or exclusion of the data for use in the data interpretation. In the event that corrective action is not possible, the limitations, if any, of the data with regard to achieving the DQOs will be noted.

In conjunction with the review of performance against the DQI requirements, the investigators will need to make decisions for the use of qualified values, which are a consequence of the formalized evaluation/validation process. Data qualifiers will be applied to individual data results. Data usability decisions will be made based on the assessment of the usability of each of these results for the intended purpose. Evaluation will describe the uncertainty (such as bias and imprecision) of the qualified results. Multiple discrepancies in DQIs may require technical judgment to determine the overall effect on the usability of the associated data. Decisions about usability of qualified data for use in risk assessment will be based on the EPA guidance, which allows for the use of estimated values. Finally, data users may choose to determine final data usability qualifiers as a result of this overall examination and decision process.

3.3 ACHIEVEMENT OF DQOS

The third step in the data usability process concerns achievement of the DQOs. Once the data set has been assessed to be of known quality, data limitations have been documented, and overall result applicability/usability for its intended purpose has been determined, the final data assessment can be initiated by considering the answers to the following questions:

- Are the data adequate to determine the extent to which hazardous substances have migrated or to what extent they were expected to migrate from potential hazardous substance source areas?
- Do the data collected adequately characterize the nature and extent of potential hazardous substance source areas at the site?
- Are the data statistically adequate to evaluate likely exposure concentrations on a per chemical and per medium basis?

- Do the data collected allow assessment of factors that may influence contaminant migration/distribution?
- Is the sample set sufficient to develop site-specific removal and disposal treatment methodologies?
- Have sufficient data been collected to evaluate how factors, including physical characteristics of the site and climate and water table fluctuations, affect contaminant fate and transport?
- Have sufficient data been collected to determine the toxicity, environmental fate, and other significant characteristics of each hazardous substance present?
- Is the data set sufficient to evaluate the potential extent and risk of future releases of hazardous substances, which may remain as residual contamination at the source facility?

The study principal investigators, in conjunction with the project team, will need to formulate solutions if data gaps are found as a result of problems, biases, trends, etc., in the analytical data, or if conditions exist that were not anticipated in the development of the DQOs. It is particularly important that each data usability evaluation specifically address any limitations on the use of the data that may result from a failure to achieve the stipulated DQO. If the project scope changes, the DQOs will be expanded. The DQOs will address the specific action limits and measurable performance criteria, in order to make appropriate decisions on the analytical data.

3.4 QUALITY ASSURANCE SAMPLE EVALUATION

Quality assurance (QA) samples will be collected at the frequency presented in Worksheet #20. QA samples for explosives and perchlorate will be submitted to the Orlando, Florida, facility of Accutest Laboratories (Accutest). QA samples for metals will be submitted to the Dayton, New Jersey, facility of Accutest. QA analysis results will be compared to the corresponding primary sample results; this comparison will determine if the each primary and QA sample result shows agreement, disagreement, or a major disagreement. The comparison will be made on an analyte-by-analyte basis. The critieria for evaluating QA sample results are presented in Table B.1. The results of the QA comparison will be included in the QCSR, along with any conclusions based on these results.

4.0 COMPLETENESS

Project-specific completeness goals account for all aspects of sample handling, from collection through data reporting. The level of completeness can be affected by loss or breakage of samples during transport, as well as external problems that prohibit collection of the sample.

The formula for sampling completeness is as follows:

$$\text{\% Field Sampling Completeness} = \frac{\text{Number of data points collected}}{\text{Number of data points planned}} \times 100$$

The formula for analytical completeness is as follows:

$$\text{\% Analytical Completeness} = \frac{\text{Number of usable results (not qualified R)}}{\text{Number of results reported}} \text{ X 100}$$

The ability to meet or exceed completeness objectives is dependent on field team performance, site conditions, the nature of samples submitted for analysis, and laboratory performance. The following table lists the completeness goals for this program. If the completeness goals are not met because of controllable circumstances, then the need for samples to be recollected and reanalyzed will be evaluated. If the completeness goals are not met because of uncontrollable circumstances, such as inaccessible sample points or matrix interferences, then the impact of the deficiency will be evaluated.

Task	Subtask	Completeness Goal
Sampling	Sample Collection	95%
Analytical Measurements	All Laboratory Analyses	95% of collected analytes (total)
		80% per target analyte

It should be noted that evaluation of completeness is a screening tool and that completeness alone does not determine whether a data set is sufficient to meet project DQOs. The completeness determined for the investigations performed at each site can guide the data assessment process, but is only a component of this process. Data sets that do not meet the overall completeness goals may still be determined to be usable without resampling or reanalysis, and data sets that do meet completeness goals may still be determined to have significant data gaps at critical data points or for critical target analytes that will require resampling or reanalysis.

Table B.1
QA Sample Comparison Criteria[1]

Matrix	Parameter	Concentration	Disagreement	Major Disagreement
All	All	Both not detected	NA – results agree	NA – results agree
All	All	One result detected, one non-detected	Detected concentration >5x LOD of non-detected result	Detected concentration >10x LOD of non-detected result
All	All	Both results detected, at least one result <LOQ	Higher detected concentration >3x lower detected concentration	Higher detected concentration >5x lower detected concentration
Water	Metals and perchlorate	Both results detected ≥LOQ	Higher detected concentration >2x lower detected concentration	Higher detected concentration >3x lower detected concentration
Soil	Explosives	Both results detected ≥LOQ	Higher detected concentration >4x lower detected concentration	Higher detected concentration >5x lower detected concentration
Soil	Metals	Both results detected ≥LOQ	Higher detected concentration >2x lower detected concentration	Higher detected concentration >3x lower detected concentration

[1] Based on the comparison criteria presented in Engineer Manual 200-1-6: Chemical Quality Assurance for Hazardous, Toxic and Radioactive Waste (HTRW) Projects (USACE, 1997).

ATTACHMENT C

ANALYTICAL SOPS

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STANDARD OPERATING PROCEDURE
NITROAROMATICS AND NITRAMINES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY
METHOD 8330

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Table of Contents

1.0 SCOPE AND APPLICATION

1.1 Methods 8330A and 8330B are designed to determine trace level concentrations of explosives and their residues in solid, soil and water samples. A list of target analytes appears in Tables 1 and 2. PETN may also be analyzed by modifications of this method presented in Appendix II.

1.2 This SOP also contains special analytical procedures to comply with the unique requirements presented in DoD's "Guide for Implementing SW-846 Method 8330B", July 7, 2008. The laboratory will use the LIMS to indicate when the special DoD/EDQW procedures must be followed.

1.3 The method involves analysis with a high performance liquid chromatograph (HPLC) of samples that have been prepared using a solid-phase extraction (SPE) for aqueous samples or solvent extracted for soil/solid samples.

1.4 The RL for this method is approximately 0.1 mg/kg (wet weight) for soil/sediment samples and 0.25 ug/L for water samples. RLs will be proportionately higher for sample extracts that required dilution to avoid detector saturation. RLs for projects following the Department of Defense Quality Systems Manual will be set at three times the method detection limit.

1.5 This method is restricted to use by or under the supervision of analysts experienced in the use of HPLC and interpretation of gas chromatographs. Each analyst must demonstrate the ability to generate acceptable results with this method.

1.6 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

CCV	Continuing calibration verification
COA	Certificate of analysis
HMX	Octahydo-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC	High performance liquid chromatography
ICAL	Initial calibration
ICV	Initial calibration verification
LCS	Laboratory control sample
LCV	Low calibration verification
LQAP	Laboratory Quality Assurance Program
MDL	Method detection limit
MS	Matrix spike

MSD	Matrix spike duplicate
NCR	Nonconformance report
PETN	Pentaerythritol tetranitrate
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RL	Reporting limit
RSD	Relative standard deviation
SOP	Standard operating procedure
QC	Quality control

For a more comprehensive list of common terms and definitions, consult Appendix A in Microbac SOP LQAP.

2.0 SAFETY PRECAUTIONS

2.1 Methanol and acetonitrile solvents are used in this method. Both solvents are extremely hazardous and must be used only with proper ventilation and personal protective equipment including gloves. A fume hood is in place to ensure operation safety.

2.2 Explosive Standards

The lab will only use low-level explosive standards while performing this method. The levels, which are 1000 ppm or less, should pose no danger. If neat standards are used the analyst is reminded of the dangers associated with handling high-level explosive compounds. These compounds are shock sensitive and care must be taken to ensure safe handling. Explosive shields should be used.

3.0 SAMPLE PRESERVATION AND STORAGE

3.1 Sample size and collection requirements are beyond the scope of the SOP; refer to extraction lab SOPs and SW-846 for details.

3.2 After the samples have been extracted, they must be stored at ≤ 6° C until the instrumental analysis can proceed. The samples must be analyzed within 40 days from the day of the extraction.

4.0 METHOD PERFORMANCE

4.1 Table 1 summarizes the performance data for water analysis; Table 2 summarizes performance data for soil/solid waste analysis. These tables include the analyte list, ranges for accuracy and precision, nominal laboratory RL, and the current laboratory MDLs.

4.2 The laboratory performed an initial assessment of the MDL using the procedures outlined in 40 CFR Part 136. Results are filed electronically at H:\DATA\COMMON\MDL.

4.3 The limit(s) of detection (LOD), or verified MDL, are presented in Tables 1 and 2, and were established using verification procedures outlined in Microbac SOP 45.

4.4 The limit(s) of quantitation (LOQ) are the nominal laboratory RLs and were established as per Microbac SOP 45.

4.5 Method performance data for PETN can be found in Tables 5 and 6.

4.6 Precision and accuracy data were derived from an initial demonstration of capability using spiked control samples. Going forward, the laboratory will use results from LCS to assess precision/accuracy and to annually evaluate the associated control limits.

4.7 Project specific QA objectives may be found in the appropriate statement-of-work or QAPP.

5.0 INTERFERENCES AND CORRECTIVE ACTION

5.1 All possible measures are taken to eliminate interferences from glassware and other equipment. Possible interferences from this source include artifact peaks and elevated baselines.

5.2 Only HPLC grade solvents are used.

5.3 Tetryl may decompose rapidly in methanol/water solutions or with the presence of heat.

6.0 EQUIPMENT AND SUPPLIES

6.1 HPLC and related equipment:

- Agilent 1100 or 1200 series HPLC system
- Quaternary HPLC pump
- Autosampler unit
- UV-Diode Array Detector
- Vacuum Degasser
- HP 3D Chemstation Software for LC
- Primary column: Phenomenex Ultracarb 5u ODS (20) column (250 x 4.60 mm)/with guard cartridge system or equivalent
- Confirmation column: Dionex Acclaim E2 5u (250 x 4.60 mm) column or equivalent

6.2 Filter - 0.45 um

6.3 Syringe (gas tight) - 10 uL, 100 uL, 1 mL

7.0 STANDARDS AND REAGENTS

7.1 All purchased stock standards and reagents are logged into the LIMS system and assigned certificate of analysis (COA) numbers. All intermediate and working solutions are similarly logged into the LIMS and assigned STD or RGT numbers. Detailed information regarding solution concentrations, aliquot volumes and final volumes and concentrations are included under the STD or RGT number.

7.2 Water - HPLC grade (J.T. Baker 4218-03 or equivalent)
Methanol - HPLC grade (J.T. Baker 9093-33 or equivalent)
Acetonitrile - HPLC grade (J.T. Baker 9017-03 or equivalent)

7.3 Commercial surrogate stock, 1,2-dinitrobenzene, at 1000 ug/mL in MeOH is purchased from Accustandard (M-8330-SS) or equivalent.

7.4 Stock calibration standard: Commercial standards at 1000 ug/mL in MeOH:AcCN (1:1) are purchased from Accustandard: M-8330-A-10X (mix A), M-8330-B-R-10-X (mix B) and M-8330-ADD-1 (nitroglycerin).

7.4.1 Fifty (50) microliters each of each standard mix and fifty (50) microliters of surrogate stock (7.4) are added to a ten milliliter volumetric flask, which is partially filled with HPLC grade acetonitrile. The flask is filled to the mark with acetonitrile, stoppered, and inverted three (3) times to mix before the contents are transferred to an amber bottle with a teflon lined cap. This intermediate alternate source standard contains 5000 ug/L of each explosive and the surrogate, 1,2-

dinitrobenzene. This intermediate standard can be stored at 4º C and used for up to one month.

7.4.2 A dilution solvent, which resembles the eluent, and/or the final extract solvent is prepared for use in diluting the calibration standards. Ten (10) mL of acetonitrile is placed into a 40 mL amber vial and mixed with ten (10) mL of HPLC water.

7.4.3 Calibration standards are prepared in amber vials from the intermediate standard using the following scheme:

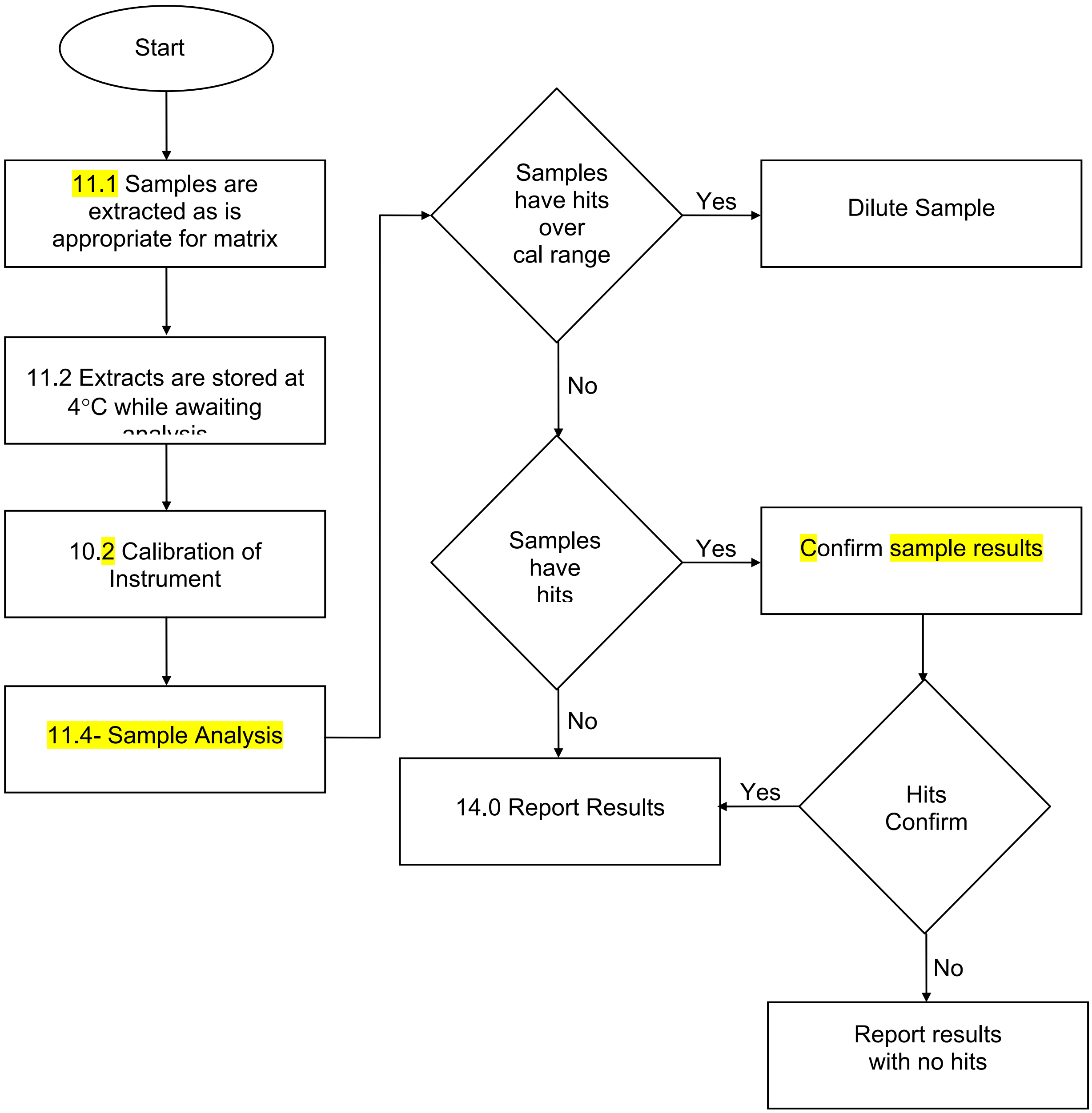
Calibration Std. #	Concentration	Preparation
6	2500 ug/L	600 uL of intermediate (7.6) plus 600 uL HPLC H_2O
5	1000 ug/L	400 uL of std. 6 plus 600 uL of solution 7.7
4	500 ug/L	400 uL of std. 5 plus 400 uL of solution 7.7
3	100 ug/L	200 uL of std. 4 plus 800 uL of solution 7.7
2	50 ug/L	100 uL of std. 4 plus 900 uL of solution 7.7
1	25 ug/L	400 uL of std. 2 plus 400 uL of solution 7.7

7.5 ICV standards at 100 ug/mL are purchased from Supelco (8330 Mix A #4-7283, 8330 Mix B #4-7284, Nitroglycerin #31498 or equivalents).

7.5.1 Two hundred (200) uL each of mix A, mix B and nitroglycerin (7.4) are added to a ten mL volumetric flask, which is partially filled with HPLC grade acetonitrile. Twenty (20) uL of surrogate stock (7.5) is also added to the volumetric flask. The flask is filled to the mark with acetonitrile, stoppered, and inverted three (3) times to mix before the contents are transferred to an amber bottle with a teflon lined cap. This intermediate alternate source standard contains 2000 ug/L of each explosive and the surrogate, 1,2-dinitrobenzene. This intermediate standard can be stored at 4º C and used for up to one month.

The ICV standard is prepared in amber vials using an intermediate dilution. First, 600 uL of the intermediate alternate source standard (7.5) is added to a vial with 600 uL of HPLC grade water and mixed yielding a 1000 ug/L standard. Then, 600 uL of this 1000 ug/L standard is added to a vial with 600 uL of dilution solvent (7.4.2) and mixed yielding the 500 ug/L ICV standard.

8.0 DIAGRAM OR TABLE TO OUTLINE PROCEDURES



9.0 SAMPLE PREPARATION

9.1 The preparation of the samples is beyond the scope of this SOP. Please refer to Microbac SOP's EXTNT01 and EXTNT02 for details on sample preparation.

10.0 CALIBRATION PROCEDURES

10.1 Recommended HPLC conditions:

Column:	Ultracarb 5u ODS (250 x 4.6 mm)
Injection Volume:	100 uL
Flow Rate:	0.8 mL/min
Eluent (isocratic):	51.9% methanol/48.1% water
UV Detector	254 nm

10.2 The initial calibration is accomplished by injecting 100 uL of each calibration standard. A linear curve is determined for concentration versus peak area count for each analyte. The correlation coefficient must be ≥ 0.995. If this criteria is not met then the problem must be discerned and the calibrations repeated.

10.2.1 The use of a linear regression fit can cause significant bias at the lower calibration points. A weighing factor (1/X or $1/X^2$) may be used to minimize this bias.

10.3 LCV: For DoD projects, the low calibration standard is reanalyzed immediately following the calibration. All target analyte recoveries must be within 80-120% of the true value.

10.4 ICV: After the analysis of the calibration the second source standard at the continuing calibration level is analyzed. The ICV should have a %D ≤ 30. If corrective action is not taken and analysis proceeds with a failing ICV, results for those compounds that fail to meet the %D limit must be qualified as estimated. For DoD/EDQW projects, the %D must be less than 15% for 8330A and less than 20% for 8330B.

10.5 CCV: At the beginning of each daily analysis and after every ten (10) samples, a 500 ug/L continuing calibration verification must be analyzed. This is done to determine if the response of the analytical system has changed. Details for calculating the %D for the CCV can be found in Section 12.0 of this document. The %D should be ≤ 20%. If a CCV fails to meet this criteria, a second CCV may be analyzed. Failure of two consecutive CCV's requires that the problem be discerned and recalibration may be required. Any samples not bracketed between two passing CCV's must be re-analyzed. If only a few analytes fail the CCV criteria, analysis may proceed but the resulting data must be qualified as estimated.

10.5.1 Projects requiring the use of Method 8330A (e.g. South Carolina) require the CCV %D to be ≤ 15%.

10.6 Recommended HPLC conditions for 2nd column confirmation:

Column:	Acclaim Explosives E2 5um 120Å (4.6 x 250mm)
Injection Volume:	100 uL
Flow Rate:	0.80 mL/min
Eluent:	48% MeOH, 17.5% AcCN, 52% water
UV Detector:	254 nm

10.7 The second column is calibrated using the same scheme as indicated for the primary analysis (10.2). The confirmation column must meet the same calibration criteria as the primary column.

NOTE: If there is insufficient resolution of analytes then it will be necessary to process two (2) separate sets of calibration standards. This can be done by modifying the preparation of the intermediate standard (7.5) and the alternate intermediate standard (7.5). In both situations two (2) intermediate standards are made; one from mix A stock standard and one from mix B stock standard. Both intermediate standards are then used to prepare six (6) calibration standards in the same scheme as 10.2.

11.0 ANALYTICAL PROCEDURES

11.1 The instrument(s) are calibrated and the analytical sequence proceeds as follows:

Analytical batch sequence:

ICAL or CCV
Method blank
LCS, LCSD
7 samples (8 if no LCSD; including MS/MSD, sample/sample duplicate)
Solvent rinse (optional)
CCV
10 samples
CCV standard
etc., with a CCV as the last injection of the sequence

11.2 A report of ND (not detected) is a form of quantitation and must therefore adhere to these rules. The list of compounds requested by the client will constitute the target compounds to be analyzed. Calibration standards which fail criteria for compounds not on the target compound list, will not be considered when interpreting the check standard. Only target compounds, as defined by the clients request will be reported.

11.3 Retention time windows are established in accordance with SW-846 Method 8000B. They are established at initial method setup and repeated when there is a column change or a major modification to the method. The width of retention time windows are defined as ± three times the standard deviation of the retention time of a standard analyzed on three consecutive days. The retention time windows are calculated by analyzing three injections of a standard over the course of a 72 hour period, calculating the standard deviation of the target analytes' retention time, and multiplying each of the standard deviations by 3. The retention time window for a particular analyte then is ± this value. The center of the retention time window is the retention time of each analyte taken from the continuing calibration verification standard run at the beginning of a daily sequence.

11.4 After sample analysis, the data system produces a quantitation report listing target analytes and concentrations found in the sample. A compound is considered tentatively identified if it falls within the calculated retention time window.

11.5 Tentatively identified compounds are confirmed either by reanalysis using an Acclaim Explosives E2 column or by UV diode array detector. Second-column confirmation is a requirement for DoD projects.

11.6 To confirm a tentatively identified compound using the UV diode array detector, a UV scan from 190 nm to 400 nm is stored during analysis for each chromatographic peak. Any compound, which is tentatively identified because of its presence in the retention time window of a calibrated explosive is then compared to a stored library of the explosive compounds. The Agilent software is directed to perform a spectrum search for each tentatively identified compound. This action produces a table of match quality along with an overlay of the target peak's spectrum with the library spectrum. Match quality will be a number with a maximum value of 1000. Tentatively identified compounds are confirmed if the match number is ≥ 950. If a compound does not confirm at this match level but has resulted in a spectral overlay which has similarities to the library compound then a second column confirmation will be needed. This may occur when sample matrix effects limit the resolution of the analytes spectrum from the background reference. If the match number is < 950 and no spectral similarity is seen then the compound is not confirmed.

11.7 To confirm a tentatively identified compound by second column the sample is re-analyzed utilizing an Acclaim Explosives E2 column which yields different retention times for the explosive compounds. If the RPD for the confirmed results are ≥ 40%, report both results and apply the “P” qualifier. For DoD/EDQW samples, report both results and apply the “J” qualifier, if the RPD exceeds 40%. Address all anomalies in the case narrative.

11.8 If the response for any target analyte exceeds the initial calibration range, the sample must be diluted. Dilutions are prepared so that the majority of compounds above the calibration range fall near the midpoint of the calibration. Dilutions are prepared in a 1:1 mix of acetonitrile: water using syringes to transfer aliquots of extract into appropriate amounts of solvent in autosampler vials. Examples are presented below:

Dilution	Amount sample extract (uL)	Amount Solvent (uL)	Final dilution volume (uL)
2x	200	200	400
5x	100	400	500
10x	100	900	1000
20x	50	950	1000

Higher dilutions are prepared by performing serial dilutions, e.g. for a 100x dilution, a 10x dilution is diluted again by a factor of 10.

11.9 After the raw data is processed, it is uploaded into the LIMS.

11.10 The analyst will perform a primary review and data verification, followed by a secondary review by a peer for quality and completeness.

12.0 DETAILS OF CALCULATIONS

12.1 The calibration factor (CF) from the initial calibration is calculated using the formula:

$$CF = \frac{C_s}{A_s}$$

where:

A_S = Peak area for the analyte or surrogate in the external standard
C_S = Concentration of the external standard (ug/L)

12.2 The slope is calculated using the formula:

$$\frac{n\left(\sum_{1}^{n}(C_s)(A_s)\right)-\left(\sum_{1}^{n}C_s\right)\left(\sum_{1}^{n}A_s\right)}{n\left(\sum_{1}^{n}C^2{}_s\right)-\left(\sum_{1}^{n}C_s\right)^2}$$

12.3 The intercept of the area axis is calculated using the formula:

$$\frac{\left(\sum_{1}^{n}A_s{}^2\right)\left(\sum_{1}^{n}C_s\right)-\left(\sum_{1}^{n}A_s\right)\left(\sum_{1}^{n}A_sC_s\right)}{n\left(\sum_{1}^{n}C_s{}^2\right)-\left(\sum_{1}^{n}C_s\right)^2}$$

12.4 The % drift is calculated using the formula:

$$\%D=\left[\frac{(C_t-C_x)}{C_t}\right]100$$

where:

C_t = True concentration of the analyte or surrogate in the standard
C_x = Measured concentration of analyte or surrogate in the standard

12.5 The % RSD is calculated using the formula:

$$RSD=\left(\frac{s}{\overline{CF}}\right)100$$

where:

s = standard deviation
$\overline{CF}$ = mean calibration factor

12.6 Linear calibration calculations (external standard method)

12.6.1 The response ratio is plotted vs. the concentration ratio giving a linear equation:

$y = mx + b$

where:

y = Response (area) = R
x = Concentration = C_i
And m and b are the slope and intercept from the regression equation

For a given response ratio we can solve for C_i:

12.6.2 $$C_i = [R - b]/m$$

Use equations 12.8 or 12.9 to calculate the sample concentration, C_x.

12.7 Solving for the concentration in water sample:

For a given concentration, compute the unknown, C_x

$$C_x = (C_i)\left(V_f / V_i \right)(D)(1000)$$

where:

C_i = concentration in the extract (ug/mL)
V_f = final sample (extract) volume (mL)
V_i = initial sample volume (mL)
D = dilution factor
C_x = concentration in the sample (ug/L)

12.8 Solving for the concentration in soil sample:

$$C_x = (C_i)\left(V_f / W_i \right)(D)(1000)$$

where:

C_i = concentration in the extract (ug/mL)
V_f = final sample (extract) volume (mL)
W_i = initial sample weight (g)
D = dilution factor
C_x = concentration of the sample (ug/kg) (as received)

12.9 The LCS recovery is calculated as follows:

$$\%R = \left(\frac{C_x}{C_T}\right)100$$

where:

C_x = the concentration of the analyte in the LCS.
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

12.10 The % Recovery of the matrix spike is calculated using the formula:

$$\%R = \left[\frac{(C_{spk} - C_x)}{C_t}\right]100$$

where:

C_{spk} = the concentration of the analyte in the spiked sample
C_x = the concentration of the analyte in the reference (parent) sample
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

12.11 The relative percent difference is calculated using the formula:

$$RPD = \left[\frac{|C_1 - C_2|}{(C_1 + C_2)}\right]200$$

where:

C_1 = Concentration of the first sample
C_2 = Concentration of the second sample

13.0 QUALITY CONTROL REQUIREMENTS

13.1 The quality control procedures discussed in this section are intended to monitor and control the entire analytical process. Batch quality samples are specified for method blanks (MB), LCS, MS, MSD and surrogate compounds. A batch is defined as a group of samples, which are extracted together. A batch contains a maximum of 20 samples. Additional procedures were defined in Section 8.0 for initial calibration, ICV using a second source, and CCV, and are included in the overall review process. The procedures, required frequency, acceptance criteria, and the required corrective action measures are outlined in Table 4. The MS/MSD samples may be waived if insufficient sample is available. All QC samples must undergo the identical extraction and cleanup procedures as each sample in the batch. A standard containing the analytes of interest is used as the spike in the LCS, MS, and MSD. The LCS, MS and MSD will all be spiked so as to yield a concentration that falls within the mid point of the curve.

13.2 The method blank cannot contain amounts of any target analytes, which are above the RL. If any target analytes are found in the method blank with concentrations higher than the RL, the entire batch must be re-extracted and the analysis performed again. All blanks are evaluated down to the current MDL for the presence of target analytes. Any amount of target analytes found in the blank at a level greater than the current MDL are reported in the LIMS and these values will appear on the QC summary sheet for the batch. For DoD projects, the blank is evaluated to one-half of the RL.

13.3 The LCS must be evaluated for the acceptance criteria listed in Tables 1 and 2, and for any project specific criteria which may be more, or less, stringent. Upon completion of a batch of samples, LCS summary reports are generated by the analyst, which compare the actual recoveries to the applicable acceptance ranges for the samples in the batch. The standard laboratory limits specified in Tables 1 and 2 are used in the absence of a project QAPP, or program specified control limits. If more than 10% of the LCS analytes are out of the laboratory limits, the analyst must stop the analysis, prepare a nonconformance report (NCR), and contact the department supervisor for the appropriate corrective action. If any of the identified project specific chemicals of concern (COC) are outside the control limits, the analyst must stop the analysis and prepare a (NCR) to be reviewed by the department supervisor. Corrective action consists of re-extraction and re-analysis of the affected samples for, at a minimum, the COC for which a result was derived outside control limits, unless the client's representative and the Quality Assurance Officer (QAO) approve of another course of action.

13.5 A standard reference material (SRM) is used in lieu of the normal soil LCS for all DoD/EDQW projects performed under reference 17.2. The laboratory derived acceptance limits for the SRM (ERA Cat. # 093) are presented in Table 3.

13.6 In order to monitor the extraction efficiency in each sample, a surrogate solution containing 1,2-dinitrobenzene is added to each sample in the extraction batch. The recoveries for this surrogate must fall within the limits given in Tables 1 and 2. If any individual sample has the surrogate outside the given limit, then the sample must be re-extracted. Surrogate limits are listed in Tables 1 and 2.

Compounds are normally confirmed by diode array detector; however, when required by a specific project i.e. DoD they may be confirmed by re-analysis using an alternate column. If the results between the primary and secondary column vary by more than 40%, the higher of the results is reported unless sample matrix effects (e.g. interfering peaks) are present. The confirmation column must meet all quality control acceptance criteria.

13.7 Triplicate Analysis (DoD/EDQW and other projects as specified)

Selected projects that are conducted in strict accordance with the DoD/EDQW guide, may require triplicate analysis of selected samples. Normally, samples are selected by the client that are expected to contain explosives above the RL. The %RSD for these the reportable analytes must not exceed 20%. Corrective action and/or data flagging must be initiated when these criteria are not met.

13.9 Control of Nonconforming Data

The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred. The policies and procedures are found in Section 13.0 of Microbac SOP LQAP (Laboratory Quality Assurance Program), Microbac SOP GP-CAPA (Corrective Action/Preventive Action: Initiating, Tracking and Monitoring) and Microbac SOP GP-RCA (Root Cause Analysis).

13.9.1 Nonconformances Requiring Corrections

A nonconformance occurs when any aspect of the method QC in an analysis, as outlined in Table 4 does not meet acceptance criteria. When nonconforming data occurs the employee initiates a Nonconformance Report (NCR) and proceeds with indicated corrections as per Table 4.

All data shall be scrutinized by the analysts for method and project specific compliance. Checklists are utilized and accompany each data batch (Figure 1).

A nonconformance shall be documented in the NCR followed by one or more of the following actions.

- Reanalysis of the sample(s) in question

- Discussion and qualification of data (report and narrative)
- Client notification with approval
- Data qualification (Q-flagging)
- Re-sampling and reanalysis (client decision)

13.9.2 Nonconformances Requiring Corrective Action

Corrective action is required when a nonconformance is recurring, if the correction is ineffective or if the departure is so significant that it negatively effects data quality, sample integrity or customer satisfaction. When an event requiring corrective action is identified, the employee shall initiate a Corrective Action/ Preventive Action form as per Microbac SOP GP-CAPA. The corrective action process includes a root cause analysis as per Microbac SOP GP-RCA, corrections, corrective action(s) and evidence of effectiveness.

13.9.3 Nonconformances Not Requiring Corrections

There are some standard contingencies to the traditional corrections that may be invoked. In many situations it may not be necessary to perform sample reanalysis or re-extraction for the following quality control departures, provided they are not a chronic problem or indicative of a trend, and the laboratory provides documentation in the report narrative and project files. In addition, the employee is required to initiate a NCR to record the event. The data may be reported as per the following exceptions.

- An LCS or surrogate recovery exceeds the upper control limit, but the corresponding sample results are non-detect.
- A method blank is greater than or equal to the reporting limit, but the corresponding sample results are non-detect.
- One or more surrogates are high and the samples are non-detect.
- The continuing calibration verification (bracketing) is biased high and the samples are non-detect.
- There is insufficient sample volume or weight to perform a corrective action.
- The sample has exceeded holding time.

14.0 DATA REVIEW AND REPORTING REQUIREMENTS

14.1 Data Review

Prior to data entry into the LIMS (either manual or automatic), all data must undergo two (2) levels of review in the department. The primary review is performed by the analyst and the secondary review is performed by either the department supervisor (or a designee) or another qualified analyst.

14.2 Data Reporting

The reporting requirements depend upon the need of the client. Microbac offers four levels of data reporting which are described in some detail below.

14.2.1 Level 1 reporting provides the client with the results for all samples submitted for analysis. No other documents or raw data are provided with this level of report.

14.2.2 Level 2 reporting provides the client with all of the information contained in a Level 1 report plus a summary of all of the QC analysis associated with the samples submitted by the client.

14.2.3 Level 3 reporting is essentially a custom report provided to the client that contains any additional data from the analysis that the client might request.

14.2.4 Level 4 reporting is provided in those cases where the client wishes to perform full data validation. All raw data, lab generated logs, and other associated data are provided.

14.2.5 Results for water samples are reported in ug/L to three significant figures.

14.2.6 Results for soil samples are reported in ug/kg, or mg/kg, on a dry weight basis to three significant figures.

15.0 PREVENTIVE MAINTENANCE

15.1 All extracts analyzed should be put through a 0.45 um filter prior to analysis.

15.2 A guard column may be used. Connect the guard column just before the analytical column.

16.0 WASTE MANAGEMENT AND POLLUTION CONTROL

16.1 Microbac is dedicated to eliminating or minimizing any and all laboratory waste, which requires disposal or contributes to pollution of any type. To that extent

Microbac has implemented new technology and converted to micro techniques when available to facilitate these goals.

Each laboratory generates specific waste streams which are segregated and collected in labeled satellite containers. The analysts in each department are responsible for proper disposal of the spent samples and chemical waste in the specified satellite waste collection vessel. The waste management technician checks the satellite containers either daily, or as needed. They are then combined into waste drums in our explosion-proof waste building located outside of the Microbac laboratory facility. These drums are labeled with start date and a manifest is created for each. They are picked up on a regular basis for disposal at a licensed disposal facility.

16.2 This method generates wastes in the form of sample extracts in vials, which are placed in the satellite waste container labeled for Waste Vials/Sample Extracts (D001, F002).

16.3 Laboratory policies and procedures for management of hazardous waste are found in Microbac SOP 33 Laboratory Waste Management and the waste management section of the analytical SOPs contain procedures specific to each method. All laboratory waste is accumulated, stored and disposed in accordance with all federal and state laws and regulations Each employee receives training in the proper handling and disposal of hazardous waste that is specific to their job description. As a hazardous generator, we are subject to inspection from the Ohio EPA.

16.4 The waste streams generated by the HPLC are as follows:

- Non – halogenated solvents (methanol and acetonitrile)
- Solid waste (auto-sampler vials)

17.0 REFERENCES

17.1 SW-846 Method 8330B, Revision 2, October 2006

17.2 Guide for Implementing EPA SW-846 Method 8330B, DoD Environmental Quality Workgroup (EDQW), July 2008.

17.3 SW-846 Method 8330A, Revision 1, February 2007.

17.4 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Method 8000B, Revision 2, December 1996.

17.5 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Method 8000C, Revision 3, March 2003.

17.6 Microbac SOP33, "Laboratory Waste Management"

17.7 Microbac SOP LQAP, "Laboratory Quality Assurance Plan"

17.8 Microbac SOP45, "Standard Operating Procedures for Method Validation Procedures"

17.9 Microbac SOP GC-CAPA, "Corrective Action/Preventive Action: Initiating, Tracking and Monitoring"

17.10 Microbac SOP GP-RCA, "Root Cause Analysis"

APPENDIX I
South Carolina Requirements

The state of South Carolina requires the use of Method 8330A for sample analysis.

APPENDIX II
Analysis of PETN

The following changes are made to SOP HPLC02 for the analysis of pentaerythritol tetranitrate (PETN) by HPLC:

1.0 The primary stock standard is purchased from Restek (31600) at a concentration of 1,000ug/ml. Working standards are made as in Section 7.4 of HPLC02.

2.0 The alternate source stock standard is purchased from AccuStandard (M-8330B-ADD-2) at a concentration of 100ug/ml and prepared as in Section 7.5 of HPLC02.

3.0 Recommended HPLC conditions;

Column:	Restek Pinnacle II C18 100 mm X 4.6 mm
Injection Volume:	100 uL
Flow rate:	1.0 mL/min
Eluent:	52% H_2O, 48% Methanol
UV detector:	Diode Array Detector @ 210 nm

TABLE 1
MICROBAC's OBJECTIVES AND ANALYTICAL METHODS FOR NITROAROMATIC EXPLOSIVES ANALYSES OF WATER SAMPLES

PARAMETER	CAS #	ACCURACY (% RECOVERY)*	PRECISION (% RPD)*	OBSERVED MDL WATER (ug/L)	REPORTING LIMITS WATER (ug/L)
1,3,5-trinitrobenzene	99-35-4	65-140	0-20	0.25	1
1,3-dinitrobenzene	99-65-0	45-160	0-20	0.25	1
2,4,6-trinitrotoluene	118-96-7	40-145	0-20	0.25	1
2,4-dinitrotoluene	121-14-2	60-135	0-20	0.25	1
2,6-dinitrotoluene	606-20-2	60-135	0-20	0.25	1
2-amino-4,6-dinitrotoluene	35572-78-2	50-155	0-20	0.25	1
2-nitrotoluene	88-72-2	45-135	0-20	0.25	1
3-nitrotoluene	99-08-1	50-130	0-20	0.25	1
4-amino-2,6-dinitrotoluene	19406-51-0	55-155	0-20	0.25	1
4-nitrotoluene	99-99-0	50-130	0-20	0.25	1
HMX	2691-41-0	80-115	0-20	0.25	1
Nitrobenzene	98-95-3	50-140	0-20	0.25	1
RDX	121-82-4	50-160	0-20	0.25	1
Tetryl	479-45-8	20-175	0-20	0.25	1
Nitroglycerin	55-63-0	50-150	0-20	0.25	1
1,2-dinitrobenzene (surr)	528-29-0	50-140	-	-	-

* Values are statistically derived from laboratory control samples and are evaluated annually. Actual control limits may vary.

TABLE 2
MICROBAC's OBJECTIVES AND ANALYTICAL METHODS FOR NITROAROMATIC EXPLOSIVES ANALYSES OF SOIL SAMPLES

PARAMETER	CAS #	ACCURACY (% RECOVERY)*	PRECISION (% RPD)*	OBSERVED MDL SOIL (mg/Kg)	REPORTING LIMITS SOIL (mg/Kg)
1,3,5-trinitrobenzene	99-35-4	75-125	0-20	0.1	0.25
1,3-dinitrobenzene	99-65-0	80-125	0-20	0.1	0.25
2,4,6-trinitrotoluene	118-96-7	40-130	0-20	0.1	0.25
2,4-dinitrotoluene	121-14-2	80-125	0-20	0.1	0.25
2,6-dinitrotoluene	606-20-2	80-120	0-20	0.1	0.25
2-amino-4,6-dinitrotoluene	35572-78-2	80-125	0-20	0.1	0.25
2-nitrotoluene	88-72-2	80-125	0-20	0.1	0.25
3-nitrotoluene	99-08-1	75-120	0-20	0.1	0.25
4-amino-2,6-dinitrotoluene	19406-51-0	80-125	0-20	0.1	0.25
4-nitrotoluene	99-99-0	75-125	0-20	0.1	0.25
HMX	2691-41-0	75-125	0-20	0.1	0.25
Nitrobenzene	98-95-3	75-125	0-20	0.1	0.25
RDX	121-82-4	70-130	0-20	0.1	0.25
Tetryl	479-45-8	10-150	0-20	0.1	0.25
Nitroglycerin	55-63-0	50-150	0-20	0.1	0.25
1,2-dinitrobenzene (surr)	528-29-0	50-140	-	-	-

* Values are statistically derived from laboratory control samples and are evaluated annually. Actual control limits may vary.

TABLE 3

STANDARD REFERENCE MATERIAL CONTROL LIMITS

PARAMETER	TRUE VALUE (ug/Kg)	ACCEPTANCE LIMITS (ug/Kg)
4-amino-2,6-dinitrotoluene	946	437-931
2-amino-4,6-dinitrotoluene	650	365-700
1,3-dinitrobenzene	1010	698-1170
2,4-dinitrotoluene	639	410-768
2,6-dinitrotoluene	1320	789-1600
HMX	620	333-715
Nitrobenzene	1400	444-1660
2-nitrotoluene	1460	685-1710
3-nitrotoluene	1020	654-1260
4-nitrotoluene	1840	1150-2270
RDX	586	349-682
1,3,5-trinitrobenzene	701	407-814
2,4,6-trinitrotoluene	810	493-842
Nitroglycerin	1000	603-1150
Pentaerythritol tetranitrate (PETN)	1000	603-1150

TABLE 4
Quality Control Criteria
Nitroaromatics and Nitramines
Method 8330

Control Item	Frequency	Acceptance Criteria	Corrective Action
Initial Calibration (ICAL)	Initially and upon failure of two consecutive CCV's	Correlation coefficient (R) for linear regression ≥0.995.	Evaluate cause; Repeat calibration; Or qualify data and discuss in narrative (1)
Second source calibration verification (ICV)	After each initial calibration	≤30% drift; ≤ 15% drift (DoD 8330A) ≤ 20% drift (DoD 8330B) (1)	Re-analyze ICV; upon second failure, repeat initial calibration (1)
Low calibration verification (LCV)	After each initial calibration	Recovery between 80-120% of true value.	Evaluate cause, repeat calibration.
Continuing calibration verification (CCV)	Daily, before sample analysis, every ten samples, and at the end of the analysis sequence	8330A: ≤ 15% drift; 8330B: ≤ 20% drift (1)	Samples bracketed by an unacceptable CCV must be reanalyzed. Repeat initial calibration after two consecutive failures of the CCV (1).
Method Blank (MB)	One per matrix/batch: Maximum of 20 samples per batch	< project reporting limit for each target analyte; (< 1/2 reporting limit for DoD). (1)	Notify supervisor and initiate NCR; Investigate; re-extract/ reanalyze samples or qualify data and address in the report narrative (3)
Laboratory Control Sample (LCS) or Standard Reference Material (SRM)	One per matrix/batch: Maximum of 20 samples per batch	Target compounds within the designated ranges; use project QAPP or standard control criteria (1,2)	Notify supervisor and initiate NCR; Investigate; re-extract/ reanalyze samples or qualify data and address in the report narrative (3)
Matrix Spikes/ Matrix Spike Duplicate (MS/MSD)	One per matrix/batch; maximum of 20 samples per batch	Target compounds within the designated range (1)	Qualify data and/or address in the report narrative.
Surrogate Spike	Every sample, standard, and quality control sample	Recoveries within the designated rages; use project QAPP or standard control criteria (1)	Notify supervisor and initiate NCR; investigate; re-extract/ reanalyze sample (s) or qualify data and address in the report narrative (3)

(1) Evaluation criteria are often project specific. Check the project QAPP.
(2) Standard criteria are set at three standard deviations from the mean. 10% marginal failure allowed, otherwise re-extract and re-analyze batch; consult supervisor and project QAPP for any exceptions.
(3) Data will be qualified if sample volume is insufficient for re-extraction/re-analysis.

TABLE 5
MICROBAC'S QA OBJECTIVES AND ANALYTICAL METHODS FOR THE ANALYSIS OF PETN IN WATER SAMPLES

PARAMETER	CAS #	ACCURACY (% RECOVERY)*	PRECISION (%RPD)*	VERIFIED MDL (ug/L)**	REPORTING LIMIT (ug/L)
Pentaerythritol tetranitrate (PETN)	78-11-5	40-130	0-40	0.25	1

TABLE 6
MICROBAC'S QA OBJECTIVES AND ANALYTICAL METHODS FOR THE ANALYSIS OF PETN IN SOIL SAMPLES

PARAMETER	CAS #	ACCURACY (% RECOVERY)*	PRECISION (%RPD)*	VERIFIED MDL (mg/kg)**	REPORTING LIMIT (mg/kg)
Pentaerythritol tetranitrate (PETN)	78-11-5	30-140	0-40	0.1	0.25

*Values are currently nominal, will be derived from laboratory control samples, and may be revised.
**Values are statistically verified annually.

FIGURE 1

Checklist ID: 28305

Microbac Laboratories Inc.

Data Checklist

Date: 06-MAY-2008
Analyst: JWR
Analyst: NA
Method: 8330
Instrument: HPLC5
Curve Workgroup: NA
Runlog ID: 22091
Analytical Workgroups: 04-0001,2,3,4 (MDL-Q'S) 04-0660 (WATER & SOIL) 2ND COLUMN RUN

ANALYTICAL	
System Performance Check	X
DFTPP (MS)	NA
Endrin/DDT breakdown (8081/MS)	NA
Pentachlorophenol/benzidine tailing (MS)	NA
Eluent check (IC)/system pressure (HPLC)	X
Window standard (FID)	NA
Initial Calibration	NA
Average RF	NA
Linear regression or higher order curve	NA
Alternate source standard (ICV) % Difference	NA
Continuing Calibration (CCV)	X
% D/% Drift	X
Minimum response factors (MS)	NA
Continuing calibration blank (CCB) (IC)	NA
Special standards	NA
Blanks	X
TCL hits	X
Surrogate recoveries	X
LCS/LCSD (Laboratory Control Sample)	X
Recoveries	X
Surrogate recoveries	X
MS/MSD/Sample duplicates	NA
Recoveries	NA
%RPD	NA
Samples	X
TCL hits	X
Mass spectra (MS/HPLC)/2nd column confirmations (ECD/FID/HPLC)	X
Surrogate recoveries	X
Internal standard areas (MS)	NA
Library searches (MS)	NA
Calculations & correct factors	X
Compounds above calibration range	NA
Reruns	NA
Manual integrations	NA
Project/client specific requirements	X
REPORTING	
Upload batch form	X
KOBRA workgroup data/forms/bench sheets	X
Case narratives	X
Check for completeness	X
Primary Reviewer	JWR
SUPERVISORY/SECONDARY REVIEW	
Check for compliance with method and project specific requirements	X
Check the completeness/accuracy of reported information	X
Data qualifiers	X
Secondary Reviewer	MDC

Primary Reviewer:
08-MAY-2008
John Richards

Secondary Reviewer:
09-MAY-2008
Michael Cochran

CHECKLIST1 - Modified 03/05/2008
Generated: MAY-09-2008 09:11:29

Figure 2

Run Log ID: **22091**

Microbac Laboratories Inc.
Instrument Run Log

Instrument: HPLC5 Dataset: 050608
Analyst1: JWR Analyst2: NA
Method: 8330 SOP: HPLC02 Rev: 10

Maintenance Log ID: 24069

Column 1 ID: ACCLAIM E2 Column 2 ID: NA
Workgroups: WG270401 WG270402
Internal STD: NA Surrogate STD: STD25780 Calibration STD

Comments: These are the Second Column Confirmations.
Nitroglycerin results were confirmed using Diode Array on the initial analysis of these samples.

Seq.	File ID	Sample Information	Mat	Dil	Reference	Date/Time
1	5L001829.F	Solvent Rinse	1	1		05/06/08 14:02
2	5L001830.F	Solvent Rinse	1	1		05/06/08 14:20
3	5L001831.F	Solvent Rinse	1	1		05/06/08 15:14
4	5L001832.F	WG270490-01 CCV	1	1		05/06/08 16:07
5	5L001833.F	WG270401-01 MRL	7	1		05/06/08 17:27
6	5L001834.F	WG269664-01 BLK	7	1		05/06/08 18:44
7	5L001835.F	WG269664-02 LCS	7	1		05/06/08 19:37
8	5L001836.F	WG269664-03 LCS2	7	1		05/06/08 20:30
9	5L001837.F	L08040003-01 MDL	7	1		05/06/08 21:23
10	5L001838.F	L08040004-01 MDL	7	1		05/06/08 22:17
11	5L001839.F	L08040660-01 10X	7	10		05/06/08 23:10
12	5L001840.F	Solvent Rinse	1	1		05/07/08 00:03
13	5L001841.F	Solvent Rinse	1	1		05/07/08 00:21
14	5L001842.F	Solvent Rinse	1	1		05/07/08 01:14
15	5L001843.F	WG270401-02 MRL	7	1		05/07/08 02:08
16	5L001844.F	WG270490-02 CCV	1	1		05/07/08 03:01
17	5L001845.F	WG270402-01 MRL	1	1		05/07/08 03:54
18	5L001846.F	WG269634-01 BLK	1	1		05/07/08 04:47
19	5L001847.F	WG269634-02 LCS	1	1		05/07/08 05:40
20	5L001848.F	WG269634-03 LCS2	1	1		05/07/08 06:33
21	5L001849.F	L08040001-01 MDL	1	1		05/07/08 07:26
22	5L001850.F	L08040002-01 MDL	1	1		05/07/08 08:18
23	5L001851.F	L08040660-02 100X	1	100		05/07/08 09:11
24	5L001852.F	Solvent Rinse	1	1		05/07/08 10:04
25	5L001853.F	Solvent Rinse	1	1		05/07/08 10:22
26	5L001854.F	Solvent Rinse	1	1		05/07/08 11:16
27	5L001855.F	WG270402-02 MRL	1	1		05/07/08 12:09
28	5L001856.F	WG270490-03 CCV	1	1		05/07/08 13:30

Comments

Seq.	Rerun	Dil.	Reason	Analytes

Page: 1 Approved: 09-MAY-08

Michael Cochran

Microbac

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STANDARD OPERATING PROCEDURE FOR THE PERKIN ELMER ELAN 6100 INDUCTIVELY COUPLED PLASMA/MASS SPECTROMETER (SW-846 6020 / EPA Method 200.8)

Issue/Implementation Date: 15 April 2009

Last Review Date: 15 April 2011

Microbac Laboratories, Inc.
Ohio Valley Division
158 Starlite Drive
Marietta, Ohio 45750

Approved By:

Maren M Beery — 04/14/11

Maren M. Beery, Metals Supervisor — Date

Leslie S. Bucina — 4/14/11

Leslie S. Bucina, Quality Assurance Officer — Date

4/14/11

David E. Vandenberg, Managing Director — Date

Document Control # 266 — Issued to: Document Master File

Table of Contents

Section **Page**

1.0 SCOPE AND APPLICATION

1.1 This Standard Operating Procedure describes the daily operation, tuning, optimization, and analysis procedures for the analysis of samples according to U.S. EPA Methods 6020, 6020A and 200.8 for the elements listed as analytes in Table I using the ELAN 6100 ICP-MS.

1.2 This method is applicable to the following sample matrices: ground waters, surface waters, industrial wastes, sludges, and soil samples.

1.3 Acid digestion prior to filtration and analysis is required for groundwater, aqueous samples, industrial wastes, soils, sludges, sediments, and for other solid wastes for which total (acid leachable) elements are required. Sample preparation methods may be found in EPA Publication SW-846 as Methods 3015 and 3051 and are detailed in SOP ME407 and ME406.

1.4 Routine operation and maintenance procedures for the ELAN 6100 ICP-MS may be found in the ELAN Hardware Manual provided by the instrument manufacturer.

1.5 Detailed instructions on operating of the ELAN 6100 ICP-MS operating software may be found in the ELAN 6100 Software Manual.

1.6 Following the appropriate digestion procedure, aqueous sample digestates, leachates, etc. are nebulized into a spray chamber where a stream of argon carries the sample aerosol through a quartz torch and injects it into a R.F. plasma. There the sample is ionized. The ions produced are entrained in the plasma gas and by means of a water-cooled, differentially pumped interface, introduced into a high-vacuum chamber that houses a quadrupole mass spectrometer. The ions are sorted according to their mass-to-charge ratio and measured with a detector.

1.7 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

CCB	Continuing calibration blank
CCV	Continuing calibration verification
COA	Certificate of analysis
COC	Coefficient of Correlation
HCl	Hydrochloric acid
HNO_3	Nitric Acid

ICB	Initial calibration blank
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
ICS	Interference check sample
ICV	Initial calibration verification
LCS	Laboratory control sample
LCS Dup	Laboratory control sample duplicate
LLCCV	Low level continuing calibration verification
LLICV	Low level initial calibration verification
MB	Method blank
MDL	Method detection limit
MS	Matrix spike
MSA	Method of standard additions
MSD	Matrix spike duplicate
QC	Quality control
RF	Radio frequency
RL	Reporting limit

Calibration blank – a calibration standard prepared with deionized water and carried through the digestion procedure used in establishing the calibration curve.

For a more comprehensive list of common terms and definitions, consult Appendix A in Microbac SOP LQAP.

1.8 Updates that effect concentration, vendor choices, reagents, MDLs, RLs and QC limits are subject to change without notice.

2.0 SAFETY PRECAUTIONS

2.1 The use of laboratory equipment and chemicals exposes the analyst to several potential hazards. Good laboratory technique and safety practices must be followed at all times.

2.2 Safety glasses & gloves must be worn at all times when handling samples, reagents, or when in the vicinity of others handling these items.

2.3 Liquid argon represents a potential cryogenic hazard and safe handling procedures must be used when handling liquid argon tanks at all times.

2.4 The ELAN 6100 is fully interlocked to protect the user from dangers such as high voltages, radio frequency generators, and intense ultra-violet light. At no time should the operator attempt to disable these interlocks or operate the ELAN if any safety interlock is known to be disabled or malfunctioning.

2.5 Spilled samples, reagents, and water must be cleaned up from instrument and autosampler surfaces immediately. In the case of acid spills the acid must be neutralized with sodium bicarbonate solution before cleanup.

2.6 All additional company safety practices must be followed at all times.

3.0 SAMPLE PRESERVATION AND STORAGE

Measurement	Digestion Vol./Wt. Req.*	Collection Vol./Wt.	Preservative	Holding Time **
Total recoverable	40 mL	250 - 1000 mL	HNO_3 to pH <2	6 months
Dissolved	40 mL	250 - 1000 mL	Filter on-site HNO_3 to pH <2	6 months
Suspended	40 mL	250 - 1000 mL	Filter on-site	6 months
Total	40 mL	250 - 1000 mL	HNO_3 to pH <2	6 months
Soil	0.5 g	200 g		6 months

* If insufficient sample volume is received a smaller volume of sample will be used and the reagents ratio will be reduced accordingly except for soils.

** Storage time allowed between sample collection and analysis when properly preserved and stored.

3.1 Water samples received unpreserved will be acid preserved in the laboratory and must then rest for at least 18 hours prior to digestion.

4.0 METHOD PERFORMANCE

Instrument Detection Limits (IDLs)

4.1 IDLs are determined according to the procedure outlined in Section 8.2 of Method 6020 (Section 9.3, Method 6020A). This is accomplished by calculating the average of the standard deviations of the three runs on three nonconsecutive days from the analysis of a reagent blank solution with seven consecutive measurements per day. Each measurement must be performed as though it were a separate sample (ie, with rinsing in between).

IDLs must be determined quarterly and kept with the instrument log book.

Method Detection Limits

4.2 The laboratory performed an initial assessment of the MDL using the procedures outlined in 40 CFR Part 136. Results are filed electronically at H:DATA\COMMON\MDL.

4.3 The limit(s) of detection (LOD), or verified MDL, are presented in Table 1 and were established using verification procedures outlined in Microbac SOP 45.

4.4 The limits(s) of quantitation (LOQ) are the nominal laboratory RLs and were established per Microbac SOP 45. Actual project reporting limits may be higher.

4.5 Precision and accuracy data were derived from an initial demonstration of capability using spiked control samples. Going forward, the laboratory will use results from LCS to assess precision/accuracy and to annually evaluate the associated control limits.

4.6 MDL check samples are analyzed quarterly to verify the MDLs listed in Table 1.

4.7 MDLs must be redetermined whenever there is any change to the sample preparation procedure, or any significant change to the instrument (new detector or different sample introduction system used).

Linear calibration ranges

4.8 Calibrate the instrument, as described in Section 10.0.

4.9 Run a series of increasing concentration standards close to the upper linear range of the instrument. It is suggested that multi-element standards be used for the procedure whenever possible.

4.10 The definition of the Linear Range is not specifically addressed in either SW-846 Method 6020 or in Chapter 1 (Quality Control) of the SW-846 Methods manual. In order to use an established definition of linear range, the definition from EPA Method 200.8 will be used. In this reference, the linear range is defined as the highest concentration where the measured value is within 10% of the actual prepared value of the standard. The values reported in Table 1 are 90% of the verified upper linear range.

4.11 The upper Linear Dynamic Range must be redetermined when ever one of the following occurs. A new detector is installed. The detector (analog and/or pulse count) voltages are changed. A new PA tube is installed in the RF generator. A different sample introduction system (change in nebulizer or spray chamber type) is installed.

5.0 INTERFERENCES AND CORRECTIVE ACTION

5.1 Isobaric Interferences occur when an isotope of one element is at the same nominal mass as an isotope of another element (e.g., Mo 98 and Ru 98).

Corrections for isobaric interferences must be made by measuring the intensity due to the interfering element at another isotope and using its natural abundance ratios to correct for its presence at the analytical mass of interest. Most commonly used corrections for isobaric interferences are already present as default interference equations in the ELAN NT software. Care should be taken that the isotope measured for correction purposes does not suffer from overlap with other isotopes that may be present in the sample.

5.2 Molecular interferences are caused by molecular species formed in the plasma with plasma or matrix ions (examples of common molecular interferences include ArCl, ClO, Nitrogen dimer, oxygen dimer, oxide species, double charged species, etc.) Predictions about the type of molecular interferences must be made using knowledge about the sample matrix. Molecular interferences can often be corrected for in the same manner as isobaric interferences, i.e., measuring the intensity present at another isotope and using isotope ratios to calculate the amount of the interfering species. For example, corrections for interferences of Ar40Cl35 on As at mass 75 must be made by measuring the intensity of ArCl present at mass 77 (Ar40Cl37) and converting to the apparent intensity of ArCl at mass 75 by using the isotopic ratio of Cl37 to Cl35. A list of the corrections used is given in the listing of the isotopes monitored in the ELAN NT 6020 method in Table 2.

6.0 EQUIPMENT AND SUPPLIES

6.1 Perkin-Elmer ELAN 6100 ICP-MS system.

6.1.1 Includes ELAN 6100 instrument, computer system, ELAN NT software, printer, and autosampler.

6.2 Peristaltic pump tubing:

6.2.1 Black/White - 0.125 mm I.D. (for drain)

6.2.2 Yellow/Orange - 0.51 mm I.D. (for internal standard introduction)

6.2.3 Black/Black – 0.76 mm I.D. (for sample introduction)

6.3 Mixing Block

6.4 Calibrated mechanical pipettes:

6.4.1 10-100 µL

6.4.2 100 - 1000 µL

6.4.3 1000 - 5000 µL

6.5 Metal-free plastic pipette tips (for the pipettes specified in 6.4).

6.6 Metal-free15-mL plastic test tubes

6.7 Metal-free 50-mL plastic test tubes

6.8 Class A glass pipettes – for preparation of standard solutions.

7.0 STANDARDS AND REAGENTS

7.1 All reagents may contain impurities that may affect the integrity of the analytical results. Due to the high sensitivity of ICP-MS, high-purity reagents, water, and acids must be used whenever possible. All acids used for this method must be of ultra high-purity grade. Nitric acid is preferred for ICP-MS in order to minimize polyatomic interferences. It should be noted that hydrochloric acid is required to maintain stability in solutions containing antimony and silver. When hydrochloric acid is used, corrections for poly-atomic ion interferences must be used. All purchased stock standards and reagents are logged into the LIMS system and assigned certificate of analysis (COA) numbers. All intermediate and working solutions are similarly logged into the LIMS and assigned STD or RGT numbers. Detailed information regarding solution concentrations, aliquot volumes and final volumes and concentrations are included under the STD or RGT number.

7.2 Nitric acid and hydrochloric acid, Instra-analyzed reagent, J.T. Baker or equivalent.

7.3 Reagent water equivalent to ASTM Type II water (ASTM D 1193).

7.4 2% HNO_3 (in reagent water) – 20 mL HNO_3 in 1000 mL reagent grade water.

Internal Standard Stocks

7.5 ICP-MS Internal Standard - 100 mg/L Li, Sc, Y, In, Tb and Bi in 1% HNO_3, CPI International or equivalent.

7.6 Germanium – 1000 mg/L in 2% HNO_3, CPI International or equivalent.

7.7 Internal Standard Working Solutions - Prepare the working solution by pipetting 40 mL of nitric acid into approximately 1000 mL of reagent water in a 2000 mL

volumetric flask. Pipette 1 mL of ICP-MS internal standard and 1 mL of germanium single-element standard into the flask. Dilute to 2000 mL with reagent water. The concentrations of the working internal standard solution can be found in
Table 7-1.

Tuning Solution

7.8 6020TS – 10 mg/L Co, In, Li and Tl in 2% HNO_3 – Inorganic Ventures or equivalent

7.9 Rhodium, - 1000 mg/L in 5% Hcl – Inorganic Ventures, Inc. or equivalent

7.10 Barium, - 1000 mg/L in 0.1% HNO_3 – Inorganic Ventures, Inc. or equivalent

7.11 Cerium – 1000 mg/L in 5% HNO_3 – Inorganic Ventures, Inc. or equivalent

7.12 Lead – 1000 mg/L in 0.35% HNO_3 – Inorganic Ventures, Inc. or equivalent

7.13 Magnesium, 1000 mg/L in 0.1 HNO_3 – Inorganic Ventures, Inc. or equivalent

7.14 Beryllium, 1000 mg/L in 2% HNO_3 – Inorganic Ventures, Inc. or equivalent

7.15 Working Tuning Solution - Prepare the working tuning solution by pipetting 20 mL of nitric acid into approximately 500 mL of reagent water in a 1000 mL volumetric flask. Pipette 1 mL each of 6020TS and 0.01 mL each of single element rhodium, barium, cerium, lead, beryllium and magnesium into the flask. Dilute to 1000 mL with deionized water. The concentrations of the working tuning solution can be found in Table 7-2.

Calibration Solutions

7.16 Purchased Standard Mixes:

CAL-MS1 – 10 mg/L Al, Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, Ag, Tl, V and Zn in 3.5% HNO_3 – Inorganic Ventures, Inc. or equivalent

CAL-MS2 - 1000 mg/L Ca, Fe, Mg, K and Na in 2% HNO_3 – Inorganic Ventures, Inc. or equivalent

7.17 1000 ug/mL Mo – Inorganic Ventures, Inc. or equivalent

7.18 1000 ug/mL Ti – Inorganic Ventures, Inc. or equivalent

7.19 1000 ug/mL Sn – Inorganic Ventures, Inc. or equivalent

7.20 1000 ug/mL U – Inorganic Ventures, Inc. or equivalent

7.21 Working Calibration Solution - Prepare the working solution (high standard) by pipetting 10 mL of nitric acid into approximately 250 mL deionized water in a 500 mL volumetric flask. Pipette 5 mL each of CAL-MS1 and CAL-MS2 into the flask. Add 0.1 mL each of the single element solutions Mo and Ti; and 0.05 mL of Sn and U. Dilute to 500 mL with deionized water. The concentration of the working solution can be found in Table 7-3.

7.22 Working Calibration Solutions - Prepare calibration standards using a 2% HNO_3 solution (7.4) and the working solution (high standard) (7.21).

7.23 Blank (for establishing internal standard intensities) and S1 (STD 1) – 2 % HNO_3 Solution. (7.4).

7.24 S2 (Std 2) – 1/200 high standard: 2% HNO_3

7.25 S3 (Std 3) – 1/2 high standard: 2% HNO_3

7.26 S4 (Std 4) – high standard solution (7.20)

7.27 Working Continuing Calibration Verification Solution (CCV) - Prepare the working solution (CCV-QC STD 6) by pipetting 20 mL of nitric acid into approximately 500 mL deionized water in a 1000 mL volumetric flask. Pipette 5 mL each of CAL-MS1 and CAL-MS2 into the flask. Add 0.1 mL each of the single element solutions Mo and Ti; and 0.05 mL of Sn and U. Dilute to 1000 mL with deionized water. The concentration of the working solution can be found in Table 7-4

Internal Calibration Verification Solutions

7.28 ICV – QCStd 1: This must originate from a different source than that of the calibration standard (i.e. second vendor).

7.29 Purchased Standard Mixes: Microbac QC-MS1 – 10 mg/L As, Al, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Sb, Se, Ag, Tl, V and Zn in 2% HNO_3 and tr HF – CPI International or equivalent

7.30 Microbac QC-MS2-1000 mg/L Ca, Fe, Mg, K and Na in 5% HNO_3 – CPI or equivalent

7.31 1000 ug/mL Mo – CPI or equivalent

7.32 1000 ug/mL Ti – CPI or equivalent

7.33 1000 ug/mL Sn – CPI or equivalent

7.34 1000 ug/mL U – SCP Science or equivalent

7.35 Working ICV Solution - Prepare working solution by pipetting 10 mL of HNO_3 into approximately 250 mL of deionized water into a 500 mL volumetric flask. Pipette 2.5 mL each of QC-MS1 and QC-MS2 into the flask. Add 0.05 mL of the single element solutions Mo and Ti and 0.025 mL of Sn and U. Dilute to 500 mL with reagent water. The concentrations can be found in Table 7-4.

7.36 ICB – QCStd 2 and Continuing Calibration Blank (CCB – QCStd 7). – 2% HNO_3 solution (7.4).

Interference Check Solutions (ICSA and ICSAB)

7.37 6020ICS-9A – 21215 mg/L Cl^-, 2000 mg/L C, 3000 ppm Ca, 25000 mg/L Fe and Na, 1000 mg/L Al, Mg, P, K and S and 20 ppm Mo and Ti in 1% HNO_3 – Inorganic Ventures, Inc. or equivalent

7.38 1000 ug/ML U – SCP Science or equivalent

7.39 Microbac QC-MSI -10 mg/L As, Al, Ba, Be, Cd, Co, Cr, Cu, Pb, Mn, Ni, Sb, Se, Ag, Tl, V and Zn in 2% HNO_3 and trHF–CPI International or equivalent

7.40 Working ICSA Solution - Prepare working solution by pipetting 2 mL of HNO3 into approximately 50 mL of deionized water in a 100 mL volumetric flask. Pipette 0.5 mL 6020ICS-9A and dilute to 100 mL with deionized water. The concentrations can be found in Table 7-5.

7.41 Working ICSAB Solution - Prepare the working solution by pipetting 2 mL of HNO3 into approximately 50 mL of deionized water in a 100 mL volumetric flask. Pipette 0.5 mL of 6020ICS-9A, 1 mL of Microbac QC-MSI and 0.01 mL of 1000ppm U – SCP Science into the flask. Dilute to 100 mL with deionized water. The concentration can be found in Table 7-5.

Low Level Calibration Verification Solutions

7.42 The LLICV Solution is used to establish and/or verify the lower limit of quantitation.

7.43 The solution from 7.42 is also used as the LLCCV solution and is analyzed for 6020A only.

7.44 Single Element Standards 1000 ug/mL As, Ba, Cd, Cr, Co, Cu, Mn, Ni, Se, Tl, Sb, Ag, V, Pb, Zn-InorganicVentures

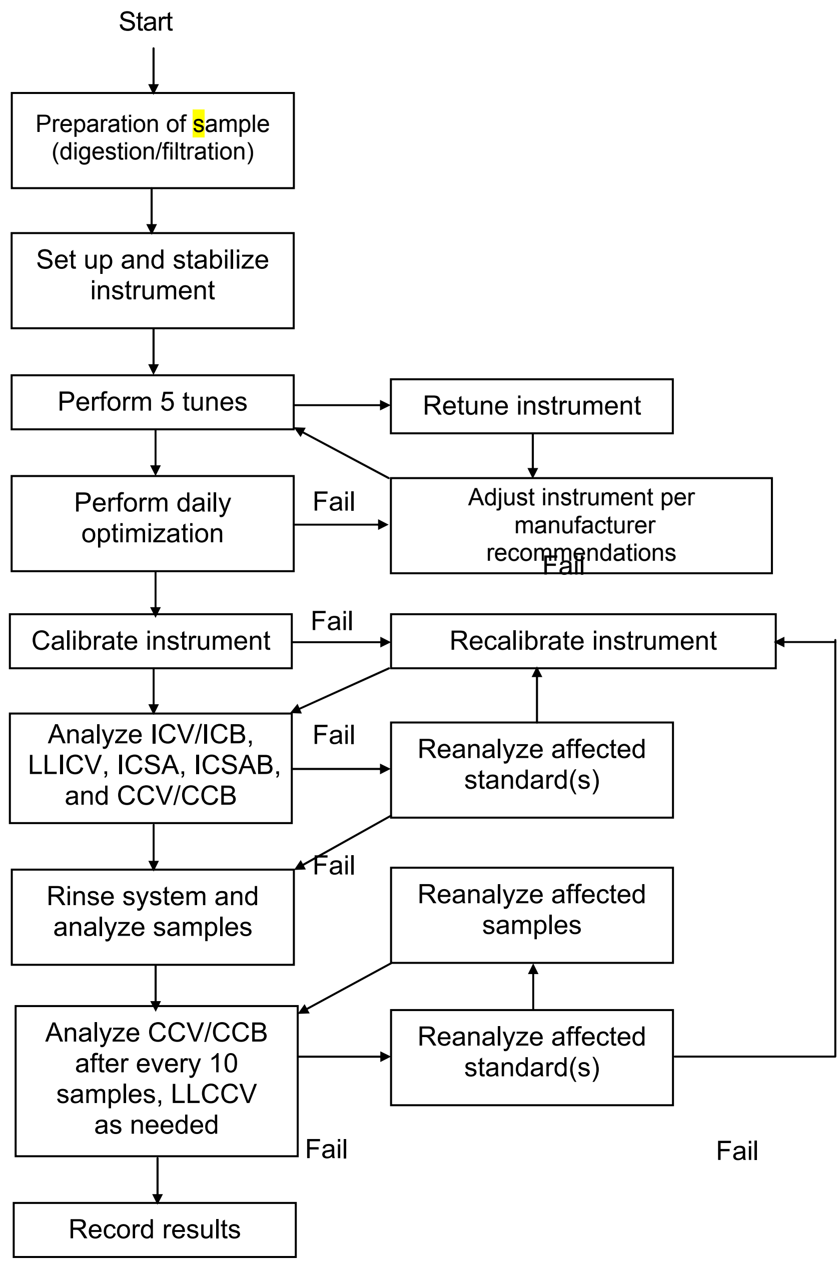
1000 ug/mL U – SCP Science

7.45 Intermediate Low Level Calibration Verification Solutions – Prepare the intermediate solution by pipetting 1.0 mL of HNO_3 into approximately 20 mL of deionized water in a 50 mL volumetric flask. Add the individual single element standards in the amounts indicated in Table 7-6 to give the corresponding intermediate concentrations listed in the table after dilution to 50 mL volume with deionized water.

7.46 Working Low Level Calibration Verification Solutions (LLICV/LLCCV) – Prepare the working solution by pipetting 10 mL of HNO_3 into approzimately 250 mL of deionized water in a 500 mL volumetric flask.

Pipette 0.025 mL of the intermediate solution from 7.45 into the flask and bring to 500 mL final volume with deionized water. The concentrations can be found in Table 7-6.

8.0 DIAGRAM OR TABLE TO OUTLINE PROCEDURES


Start
Preparation of sample (digestion/filtration)
Set up and stabilize instrument
Perform 5 tunes
Retune instrument
Perform daily optimization
Fail
Adjust instrument per manufacturer recommendations
Fail
Calibrate instrument
Fail
Recalibrate instrument
Analyze ICV/ICB, LLICV, ICSA, ICSAB, and CCV/CCB
Fail
Reanalyze affected standard(s)
Fail
Rinse system and analyze samples
Reanalyze affected samples
Analyze CCV/CCB after every 10 samples, LLCCV as needed
Reanalyze affected standard(s)
Fail
Fail
Record results

9.0 SAMPLE PREPARATION

9.1 Sample preparation is dependent on matrix and digestion type. Refer to the following methods:

ME406 - Microwave Digestion of Sediments/Sludges/Soils/Oils

ME407 - Microwave Digestion - Aqueous

10.0 CALIBRATION PROCEDURES

10.1 Initial Calibration - The instrument is calibrated before analysis of any samples with a blank and three calibration standards. The concentrations of the standards used must be entered into the calibration page of the analytical method in the ELAN software according to the values of the standards prepared in Section 7.23, 7.24, 7.25 and 7.26. A Weighted Linear (with calculated intercept) curve type must be selected for all analytes. A blank (7.23) will be run as a blank, before the analysis of any actual calibration standards. This blank is used to monitor the internal standard intensities throughout the analytical sequence. The first standard run must be the calibration blank, followed by standards of increasing concentration in order to minimize cross-contamination and carryover. The prepared calibration standards are analyzed in three replicates with the reported results being the arithmetic mean (average) of the three replicate readings. See Appendix A for the weighted linear calibration algorithm.

The low calibration standard must contain the elements of interest at concentrations at or below the reporting limit or a low level calibration check standard at or below the reporting limit must be analyzed after calibration and before sample analysis. See Tables 13-1, 13-4, and 13-6 for acceptance criteria and corrective action for the curve and low level calibration check standard.

10.2 ICV Analysis – The ICV analysis must be performed immediately after calibration standards to verify calibration. See Tables 13-1, 13-4, and 13-6 for acceptance criteria and corrective actions.

10.3 CCV Analysis - The CCV is required to be run after every 10 samples, at the end of the analysis and prior to sample analysis. See Tables 13-1, 13-4, and 13-6 for acceptance criteria and corrective action.

10.4 Initial and CCB Analysis - The solution used is the calibration blank (7.23). See Tables 13-1, 13-4, and 13-6 for acceptance criteria and corrective action.

10.5 LLICV Analysis – The LLICV analysis is performed after the calibration but prior to sample analysis. See Tables 13-1, 13-4, and 13-6 for acceptance criteria and corrective action.

10.6 LLCCV Analysis – The LLCCV analysis is performed for Method 6020A and as required by specific QAPPS. The LLCCV is analyzed minimally at the end of each relevant batch or more frequently (eg: following every 10 samples) as desired. See Table 13-6 for acceptance criteria and corrective action.

10.7 ICSA and ICSAB Analysis – Required at the beginning of analytical run or every 12 hours, whichever is more frequent. See Tables 13-1, 13-4, and 13-6 for acceptance criteria and corrective action.

10.8 Internal Standards – An internal standard is a non-analyte isotope that is added to standards and samples before a determination. Internal standards allow you to correct for changes in instrument hardware response or for sample-to-sample variations in sensitivity. Intensities must be monitored in all solutions. Intensities of internal standards in all subsequent analyses of CCV and CCB solutions must be greater than 80% and less than 120% of the levels in the original calibration blank. Failure action is to terminate the analysis, correct the problem, re-calibrate, and reanalyze all affected samples. See Tables 13-1, 13-4, and 13-6 for acceptance criteria and corrective actions for analytical and quality control samples. See 12.8 for an example calculation of how the internal standard is used to adjust measured intensities of analyte elements.

11.0 ANALYTICAL PROCEDURES

11.1 Initiate the plasma and allow a warm-up of at least 30 minutes. The tuning procedures must be carried out after warm-up

11.2 Perform the tuning procedure with five acceptable integrations at least once a day prior to analysis.

11.1.1 Place a tube containing tuning solution in cup position 8.

11.2.2 Open the Method window by clicking on Method on the ELAN tool bar. Select File/Open from the tool bar. When the Open window appears, choose Service/6020 Methods/EPA 6020 TUNING.mth.

11.2.3 In the Method window, select the Sampling tab and click on Probe. Designate cup 8 by clicking the right arrow on the horizontal bar until it reads "Tube Number: 8" Depress the Go to Tube # button. Click on OK.

11.2.4 Open Tuning window by clicking on Tuning on the ELAN Tool Bar. Depress the Tune Mass Spec button. The instrument will now perform the tuning procedure and the results will automatically print when the procedure is completed.

11.2.5 The measured mass of each isotope must be ± 0.1 amu of the exact mass and the RSD must not exceed 5%.

11.2.6 This procedure must be repeated with five integrations each time until a successful tune has been performed.

11.2.7 Save the last tune by selecting File/Save and saving under the file for the current month.

11.2.8 Close the Tuning window.

11.3 Perform a daily optimization before calibration to ensure the instrument is functioning at optimum levels.

11.3.1 Open the Method window. Select File/Open. When the Open window appears, choose Service/6020 Methods/6020 daily.mth.

11.3.2 Open the Sampling window on the ELAN tool bar. Select the Manual tab and the Details button. Edit the following settings:

A/S Location: 8
Sample Flush (s): 35
Read Delay (s):35
(rpm): -15
Click on OK

11.3.3 Depress the Analyze Sample button. The instrument will now perform the daily performance check. The results will print automatically upon completion of analysis.

11.3.4 The following criteria must be met for best results:

Mg intensity > 20,000 cps
Rh intensity > 150,000 cps
Pb intensity > 100,000 cps

$Ba^{+2}/Ba < 0.03$
CeO/Ce < 0.03
Bkgd < 30 cps @ mass 220

11.3.5 If these criteria are not met, further optimizations may be needed. See the instrument manuals for assistance.

11.4 Calibrate the instrument at least once a day followed by the analysis of the ICV, ICB, LLICV, ICSA, ICSAB, CCV and CCB prior to the analysis of samples. See Tables 13-1, 13-4, and 13-6 for acceptance criteria and corrective actions.

11.4.1 Prepare the four calibration solutions using the high standard and/or 2% HNO_3 (in polished water). The calibration standards are prepared as follows:

Blank: 2% HNO_3 water
S1: 2% HNO_3 water (analyzed from Blank cup)
S2: 1/200 high standard in 2% HNO_3 water
S3: 1/2 high standard in 2% HNO_3 water
S4: high standard solution
Load Blank, S1, S2 and S3, S4 into cups 1,2,3, and 4 respectively.

11.4.2 Pour the ICV/CCV solution into a tube and place it in cup 5. Pour the LLICV / LLCCV solution into a tube and place it in cup 9.

11.4.3 Put the ICSA in cup 6 and the ICSAB in cup 7.

11.4.4 The ICB/CCB will read from S0 in cup 1.

11.4.5 Select the sample window from the ELAN tool bar. Click on batch tab.

11.4.5.1 Enter sample numbers (including digest workgroup numbers) in the Sample ID column.

11.4.5.2 Enter the autosampler location number for each sample in the A/S Loc. Column.

11.4.5.3 Make sure the appropriate command appears in the measurement action column for each sample. It must read “Run Sample” for samples that will not be auto-diluted by the instrument and “Run Diluted Sample” for samples that will be auto-diluted by the instrument. If the instrument is to be calibrated before the first sample is analyzed, then the measurement action cell for that sample only must read “Run Blank, Stds, and Sample” if the sample is not to be auto-diluted, and “Run Blank, Stds, and Dil. sample” if the sample is to be auto-diluted. This is edited by clicking the right mouse button on the cell that is to be edited and selecting the desired command from the list that appears using the left mouse button.

11.4.5.4 Enter the factor which indicates the "fold" of dilution in the description column for each sample. For instance, if the sample is to be analyzed at a 1 to 5 dilution, then enter 5 in the description column for that sample. If the sample is not to analyzed at a dilution, then enter 1 in the description column. This must be entered regardless of whether the operator or the instrument will be performing the dilutions.

11.4.5.5 It is not necessary to enter the sample preparation factors. These will be applied during the data upload to LIMS procedure.

11.4.5.6 Make sure "35" appears in the Sample Flush column, "-48" in the Sample Flush Speed, "35" in Read Delay, "15" in Delay & Analysis Speed, "200 in Wash and "-48" in the Wash Speed column for each sample to be analyzed. These cells can be edited directly.

11.4.5.7 Save the sample file.

11.4.5.8 Print the run list by selecting the print command from the file menu and clicking on the print button in the ELAN file print window that appears.

11.4.6 Select the method button from the Elan tool bar. Select File/Open. When the open window appears, choose Service 6020 Methods/6020A.mth.

11.4.6.1 Select the sampling tab. Edit the Dil. Factor cell only if the auto-dilutor will be used. Again this factor should reflect the "fold" of dilution. The Dil to vol. Cell must read "5" and the 1st Dil. Pos. must read "71". If no dilutions will be performed or if the operator will be performing the dilutions, this section does not need to be edited.

11.4.6.2 Select the QC tab. Enter an "X" in the initial column next to the appropriate QC Std # for all the QC standards that must be analyzed after the calibration is finished (if the instrument is to be calibrated). A list of the names and the standards to which they correspond follows:

QC Std 1 - ICV
QC Std 2 - ICB
QC Std 3 - LLICV
QC Std 4 - ICSA
QC Std 5 - ICSAB
QC Std 6 - CCV

QC Std 7 - CCB
QC Std 8 - LLCCV

In the final column, enter an “X” beside the QC Std # that corresponds to the QC standards that must be analyzed after all the sample have been analyzed. In the before A/S Loc. Column, enter the number that corresponds to the autosampler position of the sample that will run after the standards. For instance, 12 samples are loaded in autosampler positions 11-22, and a CCV and CCB must be analyzed after the sample in A/S position 20 and at the end. An “X” must be entered next to QC Std 6 and QC Std 7 in the final column and “21” must be entered in the first before A/S Loc. Next to QC Std 6 and QC Std 7.

11.4.6.3 Click on the report tab located on the right edge of the window. Edit the cell report filename in the following manner. The file path must read “c:\elandata\ReportOutput\mmddyy.rep” where mmddyy is the current date. Edit only the current date portion of the file path. Do not edit anything else in this section.

11.4.6.4 Save the Method.

11.4.7 Prepare samples and load into autosampler positions indicated in sample file.

11.4.8 Click on the sample window from the ELAN tool bar. Choose the batch tab.

11.4.8.1 Select the samples to be analyzed by highlighting the row of the first number and, while holding down the left mouse button, moving down the row numbers until all the samples to be analyzed have been highlighted.

11.4.8.2 Aspirate the rinse for at least 10 minutes after daily optimization before beginning analysis to avoid carry-over and contamination.

11.4.8.3 Click on analyze batch button in the upper left corner of the window. The instrument should now begin analysis.

11.4.8.4 The sample results are an arithmetic mean (average) of three replicate readings per analyte. For any analyte with at result greater than the reporting detection limit, the % RSD between the replicate readings must be less than ten.

12.0 DETAILS OF CALCULATIONS

12.1 Each metal is analyzed within the calibration range. Refer to Table 1 for upper limits. Dilutions must be performed if the upper limit is exceeded.

12.2 After the calibration is complete, the software performs a weighted linear regression with a calculated intercept. The weighting factor equals the inverse of the square of the concentration of the standard. Weighting emphasizes measurements in the low concentration region of the calibration curve. The instrument calculates the correlation coefficients for each metal and the analyst can view each curve for acceptance. The results are calculated from the calibration curve. See Appendix A for the weighted linear calibration algorithm.

12.3 Dilution factors and preparation factors are calculated into the final result, which is computed from the mean of three exposures, during the data upload procedure.

12.3.1 For Liquid Samples:

$$mg/L \text{ metal in sample} = mg/L \text{ in digestate} \times \frac{\text{Final Prepared Volume }(mL)}{\text{Initial Volume }(mL)} \times \frac{\text{Total Diluted Volume}}{\text{Sample aliquot}}$$

12.3.2 For Solid Samples:

$$mg/kg \text{ metal in sample} = mg/L \text{ in digestate} \times \frac{\text{Final Prepared Volume }(mL)}{\text{Initial Weight }(g)} \times \frac{\text{Total Diluted Volume}}{\text{Sample aliquot}}$$

12.4 LCS

$$\%R = \left(\frac{C_x}{C_t}\right)100$$

where:

C_x = the concentration of the analyte in the reference (parent) sample
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

12.5 Spike Percent Recovery is calculated as follows:

$$\%R = \left[\frac{(C_{spk} - C_x)}{C_t}\right]100$$

where:

C_{spk} = the concentration of the analyte in the spiked sample
C_x = the concentration of the analyte in the reference (parent) sample
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

12.6 Relative Percent Difference (RPD) is calculated as follows:

$$RPD = \left[\frac{|C_1 - C_2|}{(C_1 + C_2)/2} \right] 100$$

where:

C_1 = Concentration of the first sample
C_2 = Concentration of the second sample

12.7 Percent Difference is calculated as follows:

$$\%D = \left[\frac{|C_1 - C_2|}{C_1} \right] 100$$

where:

C_1 = Concentration of the first sample
C_2 = Concentration of the second sample

12.8 Adjusted Analyte Intensity is calculated from the internal standard as follows:

$$\frac{A_{meas}}{I_{meas}} \times I_{std} = A_{adjusted}$$

where:

A_{meas} = Measured intensity of analyte
$A_{adjusted}$ = Adjusted intensity of analyte
I_{meas} = Measured intensity of the internal standard
I_{std} = Intensity of the internal standard in the blank solution analyzed prior to calibration

12.9 See Figure 12.1 for a sample calculation summary.

13.0 QUALITY CONTROL REQUIREMENTS

Overview

13.1 Refer to Section 10.0 for instrument calibration and instrument quality control samples. Each preparation batch (or workgroup) consists of a maximum of twenty (20) samples plus QC Samples. The QC samples are prepared and digested identically to the analytical samples. The following QC are digested and or analyzed with every preparation batch. The frequency, acceptance criteria and corrective action for this QC is listed in Table 13-1, 13-4, and 13-6.

Batch Quality Control

13.2 Method blank (Prep Blank (PB)) - An aliquot of deionized water that is digested with the sample batch and contains all reagents identical with the sample.

13.3 LCS, LCS Dup - A LCS or LCS/LSC Dup must be analyzed using the same sample preparations, analytical methods, and QA/QC procedures used for test samples. One LCS must be prepared and analyzed for each sample batch of 20 samples. Acceptance ranges are 80 – 120% for method 6020 and 85 – 115% for 200.8. The final concentration is outlined in Table 13-2. QC Acceptance ranges are outlined in Tables 13-3 and 13-5.

13.4 Duplicate sample analysis (200.8 only) - Analyze one duplicate sample in a batch of twenty samples or less. The formulas for calculation of the RPD between the duplicate determinations is located in Section 12.6. A control limit of 20% RPD must not be exceeded for analyte values greater than 100 times the IDL. If the control limit is exceeded, the reason for the out of control situation must be corrected and any samples analyzed during the out of control condition reanalyzed.

13.5 MS and MSD – A sample that is spiked in duplicate and then digested with the sample batch. It is prepared by taking 3 aliquots of sample, 2 of which are spike with 0.5 mL of CAL-MS-1 for each 50 mL of sample. The final concentration spiked into the two spiked samples is outlined in Table 13-2 Batches that include samples for method 200.8 must include a spiked sample for every ten 200.8 samples.

Interference Tests – Post Digestion

13.6 Dilution Test - If the analyte concentration is within the linear range of the instrument and is a factor of at least 100 times the MDL, the analysis of a five-fold dilution of the sample must agree within 10% of the original determination. If not, an interference must be suspected. The dilution is prepared by adding 1 mL of sample to 4 mL of 2% HNO3 in deionized water.

One dilution test must be performed for each twenty samples or less of each matrix in a sample batch.

13.7 Post digestion spike - An analyte spike added to a portion of a prepared sample or its dilution must be recovered to within 75-125% of the known value of the spike (80-120% for 6020A) or within laboratory derived acceptance criteria. The final concentration spiked into the two spiked samples is outlined in Table 13-2. The spike value should be based upon the indigenous level of the analyte in the sample. If the spike is not recovered within the acceptance limits, the sample must be diluted and reanalyzed to compensate for the matrix effect. The results of the dilution must agree within 10% of the original determination (see Section 13.6). The use of the method of standard additions may be used to compensate for matrix effects.

Control of Nonconforming Data

13.8 The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred. The policies and procedures are found in Section 13.0 of Microbac SOP LQAP (Laboratory Quality Assurance Program), Microbac SOP GP-CAPA (Corrective Action/Preventive Action: Initiating, Tracking and Monitoring) and Microbac SOP GP-RCA (Root Cause Analysis.

13.8.1 Nonconformances Requiring Corrections

A nonconformance occurs when any aspect of the method QC is an analysis, as outlined in Sections 11.0 and 13.0 and Tables 13-1, 13-4, and 13-6 does not meet acceptance criteria. When nonconforming data occurs the employee initiates a Nonconformance Report (NCR) and proceeds with indicated corrections as per Sections 11.0 and 13.0 and Tables 13-1, 13-4, and 13-6.

All data shall be scrutinized by the analysts for method and project specific compliance. Checklists are utilized and accompany each data batch Figure 14.1. A nonconformance shall be documented in the NCR followed by one or more of the following actions.

- Reanalysis of the sample(s) in question
- Discussion and qualification of data (report and narrative)
- Client notification with approval
- Data qualification (Q-flagging)
- Re-sampling and reanalysis (client decision)

13.8.2 Nonconformances Requiring Corrective Action

Corrective action is required when a nonconformance is recurring, if the correction is ineffective or if the departure is so significant that it negatively effects data quality, sample integrity or customer satisfaction. When an event requiring corrective action is identified, the employee shall initiate a Corrective Action/ Preventive Action form as per Microbac SOP GP-CAPA. The corrective action process includes a root cause analysis as per Microbac SOP GP-RCA, corrections, corrective action(s) and evidence of effectiveness.

13.8.3 Nonconformances Not Requiring Corrections

There are some standard contingencies to the traditional corrections that maybe invoked, provided they comply with the project QAPP requirements. In many situations it may not be necessary to perform sample reanalysis or re-extraction for the following quality control departures, provided they are not a chronic problem or indicative of a trend, and the laboratory provides documentation in the report narrative and project files. In addition, the employee is required to initiate a NCR to record the event.

- An LCS or surrogate recovery exceeds the upper control limit, but the corresponding sample results are non-detect.
- A method blank exceeds the upper limit, but the corresponding sample results are non-detect.
- A method blank exceeds the upper limit, but the corresponding sample results are greater than ten (10) times the level in the blank.

14.0 DATA REVIEW AND REPORTING REQUIREMENTS

14.1 Data Review

Data is archived from the instrument computer to the LIMS where it is stored in a CSV format. When analysis is complete the analyst must upload the relevant CSV files including calibration, check standards, QA/QC samples and client samples into Kobra. This is done via Microbac's customized upload program. When the upload is complete, the analyst must check the sample data for correct digestion factors, dilutions and reporting limits. Any elements that are not to be reported must be checked in the "Excl" box next to the element. This will be determined by the primary analyst through real time review of all quality control elements as summarized in Tables 13-1, 13-4, and 13-6. The analyst must certify that this primary review has been carried out by completing the Data Review Checklist (Figure 14.1), signing and dating. The analyst generates batch QA/QC summary forms automatically through an oracle program. The analyst must then assemble the hardcopy raw data with QA/QC summaries, batch upload reports, digestion logs and runlogs, case narratives if required and Kobra workgroup reports. The Data Review Checklist acts as a cover page and must be archived with the hardcopy data. The completed package is then submitted for secondary review.

The secondary review consists of an additional 100% review of the hardcopy data for QA/QC compliance. The secondary reviewer also signs and dates the Data Review Checklist.

This review also consists of a double check of the batch QA/QC summary and associated post spikes and serial dilutions. Sample results are reviewed for completeness, reasonableness and compliance with any special project or client requirements. The case narrative, if any, is also checked for accuracy and completeness.

When all levels of review have been completed. The elements being reported on each sample are taken to a done status in Kobra.

14.2 See figure 14.1 for an example date review checklist.

15.0 PREVENTIVE MAINTENANCE

The following sections describe some commonly occurring problems and proposed solutions.

15.1 Poor recovery on selected Quality Control Analytes: If poor recoveries are obtained on only particular analytes in a Quality Control Standard and it had been verified that the sample has been properly prepared, it may be possible that the problem could be related to a problem with the internal standard used. Look at the entire list of elements grouped with an internal standard. If the results for all elements is not satisfactory but the results for other elements not grouped with that internal standard are acceptable, there could be a problem with the internal standard used for that grouping.

15.1.1 Try using a different internal standard and reprocessing the data.

15.1.2 Look at the monitored intensities of the internal standards. If the internal standard used for the elements with unacceptable results is not within the allowable range or the percent recovery for this internal standard significantly different that the others, use a different internal standard and reprocess the data.

15.2 Poor relative standard deviation (precision (RSD)) on standards and samples.

15.2.1 Poor RSDs can be caused by many things. First check that the interface cones are in good condition and the orifices of both cones are round and of the proper size.

15.2.2 Check that the nebulizer is operating properly by checking the aerosol with the plasma off and the spray chamber removed. Turn on the nebulizer gas and the peristaltic pump - must be a visible aerosol leaving the spray chamber. If there is not, clean or replace the nebulizer gem tips.

15.2.3 Check that the peristaltic pump tubing is in good condition and not worn. When the autosampler probe is removed and reinserted in the wash solution an air bubble will be visible in the tubing. Watch the progress of this bubble and adjust the tension on the pump tubing so the flow is smooth without any pulsations.

15.3 Sequence occurs improperly on startup of a batch analysis. The sample file has either not been saved or re-opened properly. Save the sample file and then reopen this same sample file. The full path name of the method must appear in the Method field of the sample list.

16.0 WASTE MANAGEMENT AND POLLUTION CONTROL

16.1 Microbac is dedicated to eliminating or minimizing any and all laboratory waste which requires disposal or contributes to pollution of any type. To that extent Microbac has implemented new technology and converted to micro techniques when available to facilitate these goals.

16.2 Each laboratory generates specific waste streams which are segregated and collected in labeled satellite containers. The analysts in each department are responsible for proper disposal of the spent samples and chemical waste in the specified satellite waste collection vessel. The waste management technician checks the satellite containers either daily, or as needed. They are then combined into waste drums in our explosion-proof waste building located outside of the Microbac laboratory facility. These drums are labeled with start date and a manifest is created for each. They are picked up on a regular basis for disposal at a licensed disposal facility.

16.2.1 The waste streams are as follows:

Metals Laboratory - acid waste is neutralized and disposed of in the sewer per agreement with the city of Marietta.

16.3 Laboratory polices and procedures for management of hazardous waste are found in Microbac SOP 33-Laboratory Waste management and the waste management section of the analytical SOPs contain procedures specific to each method. All laboratory waste is accumulated, stored and disposed in accordance with all federal and state laws and regulations. Each employee receives training in the proper handling and disposal of hazardous waste that is specific to their job descriptions. As a hazardous generator, we are subject to inspection from the Ohio EPA.

17.0 REFERENCES

17.1 Inductively Coupled Plasma-Mass Spectrometry@, US EPA SW-846 Method 6020, Revision 0, September 1994, EPA Publication SW-846.

17.2 Inductively Coupled Plasma-Mass Spectrometry @, US EPA SW-846 Method 6020A, Revision 1, February 2007, EPA Publication SW-846.

17.3 ELAN 6100 Hardware Manual, 1995, Perkin-Elmer Corporation.

17.4 ELAN 6100 ICP-MS Software Manual, 1995, Perkin-Elmer Corporation.

17.5 Methods for the Determination of Metals in Environmental Samples - Supplement 1@, EPA-600/R-94-111, May 1994, Available at NTIS, PB 94-184942, Method 200.8 Rev. 5.4.

17.6 Microbac SOP ME407 “Microwave Digestion for Aqueous Matrices – SW3015”.

17.7 Microbac SOP ME406 “Microwave Digestion of Sediments, Sludges, Soils and Oils 3051A”.

17.8 Microbac SOP LQAP “Laboratory Quality Assurance Plan”.

17.9 Microbac SOP 45 “Method Validation Procedures”.

17.10 Microbac SOP GP-CAPA “Corrective Action/Preventative Action: Initiating, Tracking and Monitoring”.

17.11 Microbac SOP GP-RCA “Root Cause Analysis”.

17.12 Microbac SOP 33 “Laboratory Waste Management”.

Appendix A

Weighted Linear Calibration Algorithm

When working at low level concentrations it provides an alternative calibration scheme that weighs the low standards to a greater degree.

Determine the slope, intercept, and correlation coefficient for the equation:

$$y = b_0 + b_i x$$

Where y is the measured net corrected intensity (blank subtracted). The weights are applied by multiplying the intensity by the weighting factor for each standard. In this calibration the weighting factor is the reciprocal of the square of the user entered concentration value for each standard.

where:

x = concentration value of the standard
y = measured intensity of the standard
n = number of standards
i = index for the standards
b_0 = intercept
b_1 = slope
COC = correlation coefficient

$$w_1 = \sum \frac{1}{x_i^2} \qquad w_4 = \sum \frac{y_i}{x_i^2}$$

$$w_2 = \sum \frac{x_i}{x_i^2} \qquad w_5 = \sum \frac{y_i^2}{x_i^2}$$

$$w_3 = \sum \frac{x_i^2}{x_i^2} = n \qquad w_6 = \sum \frac{x_i y_i}{x_i^2}$$

Intercept: $$b_0 = \frac{(w_4 w_3) - (w_6 w_2)}{(w_1 w_3) - w_2^2}$$

Slope: $$b_1 = \frac{(w_1 w_6) - (w_4 w_2)}{(w_1 w_3) - w_2^2}$$

Weighted Linear Calibration Algorithm (continued)

Correlation Coefficient:

$$COC = \frac{(w_1 w_6) - (w_2 w_4)}{\sqrt{\left[(w_1 w_3) - w_2^{\,2}\right]\left[(w_1 w_5) - w_4^{\,2}\right]}}$$

Table 1

ELAN 6100 IDLs, MDLs, and Linear Ranges

Analyte	Symbol	Mass	IDL* (µg/L)	Linear Range ** (µg/L)	Water MDL (µg/L)	Water RL (µg/L)	Soil MDL (mg/Kg)	Soil RL mg/Kg
Vanadium	V	51	0.093	100	0.5	1.0	0.25	0.5
Chromium	Cr	52	0.206	100	1.0	2.0	0.2	0.4
Manganese	Mn	55	0.167	100	1.0	2.0	0.1	0.2
Cobalt	Co	59	.0.037	100	0.5	1.0	0.25	0.5
Nickel	Ni	60	0.177	100	2.0	4.0	0.4	0.8
Copper	Cu	65	0.107	100	1.0	2.0	0.3	0.6
Zinc	Zn	66	1.544	100	12.5	25.0	1.25	2.5
Arsenic	As	75	0.163	100	0.5	1.0	0.15	0.3
Selenium	Se	82	0.453	100	0.5	1.0	0.1	0.2
Silver	Ag	107	0.007	100	0.5	1.0	0.1	0.2
Cadmium	Cd	114	0.018	100	0.3	0.6	0.05	0.1
Antimony	Sb	123	0.111	100	0.5	1.0	0.05	0.1
Barium	Ba	135	0.04	100	1.5	3.0	0.15	0.3
Thallium	Tl	203	0.005	100	0.1	0.2	0.02	0.04
Lead	Pb	208	0.044	100	0.5	1.0	0.1	0.2
Uranium	U	238	0.001	100	0.5	1.0	0.2	0.4

* Updated quarterly
** Values reported are 90% of the verified upper linear range

Table 2
Table of Isotopes Monitored and Equations Used

Analyte	Symbol	Isotopes Monitored	Correction Equations
Aluminum	Al	27	
Antimony	Sb	121,123	Sb 123 = Sb 123 – 0.127189 * Te 125
Arsenic	As	75	As 75 = As 75 – 3.127 * [ArCl 77 – (0.815 * Se 82)]
Barium	Ba	135,137	
Beryllium	Be	9	
Cadmium	Cd	106,108,111,114	Cd 111 = Cd 111 – 1.073 * [MoO 108 – (0.712*Pd 106)] Cd 114 = Cd 114 – 0.026826 * Sn 118
Chromium	Cr	52,53	
Cobalt	Co	59	
Copper	Cu	63,65	
Lead	Pb	206,207,208	Pb 208 = Pb 208 + 1 * Pb 206 + 1 * Pb 207
Manganese	Mn	55	
Nickel	Ni	60,62	
Selenium	Se	77,82	Se 82 = Se 82 – 1.008696 * Kr 83
Silver	Ag	107,109	
Thallium	Tl	203,205	
Vanadium	V	51	V 51 = V 51 – 3.127 * [ClO 53 – (0.113 * Cr 52)]
Zinc	Zn	66,67,68	
Internal Standards			
Lithium	Li	6	
Scandium	Sc	45	
Yttrium	Y	89	
Rhodium	Rh	103	
Indium	In	115	
Terbium	Tb	159	
Bismuth	Bi	209	
Germanium	Ge	72	
(Information Only)			
Molybdenum	Mo	95,97,98	Mo 98 = Mo 98 – 0.110588 * Ru 101
Thorium	Th	232	
Uranium	U	238	
Calcium	Ca	44	
Magnesium	Mg	24	
Sodium	Na	23	
Potassium	K	39	
Iron	Fe	54	Fe 54 = Fe 54 – 0.028226 * Cr 52

Table 7-1
Internal Standard Solution

Analyte	Symbol	Stock Concentration (mg/L)	Secondary Concentration (mg/L)
Lithium	Li	100	0.05
Scandium	Sc	100	0.05
Germanium	Ge	1000	0.5
Yttrium	Y	100	0.05
Indium	In	100	0.05
Terbium	Tb	100	0.05
Bismuth	Bi	100	0.05

Table 7-2
Tuning Solution

Analyte	Symbol	Stock Concentration (mg/L)	Secondary Concentration (mg/L)
Barium	Ba	1000	0.01
Cerium	Ce	1000	0.01
Cobalt	Co	10	0.01
Indium	In	10	0.01
Lead	Pb	1000	0.01
Lithium	Li	10	0.01
Magnesium	Mg	1000	0.01
Rhodium	Rh	1000	0.01
Thallium	Tl	10	0.01
Beryllium	Be	1000	0.01

Table 7-3
Calibration Solutions

Analyte	Symbol	Stock Conc. (mg/L)	S1 (mg/L)	S2 (mg/L)	S3 (mg/L)	S4 (mg/L)
Aluminum	Al	10	0	0.0004	0.05	0.1
Antimony	Sb	10	0	0.0004	0.05	0.1
Arsenic	As	10	0	0.0004	0.05	0.1
Barium	Ba	10	0	0.0004	0.05	0.1
Beryllium	Be	10	0	0.0004	0.05	0.1
Calcium	Ca	1000	0	0.04	5	10
Cadmium	Cd	10	0	0.0004	0.05	0.1
Chromium	Cr	10	0	0.0004	0.05	0.1
Cobalt	Co	10	0	0.0004	0.05	0.1
Copper	Cu	10	0	0.0004	0.05	0.1
Iron	Fe	1000	0	0.04	5	10
Lead	Pb	10	0	0.0004	0.05	0.1
Magnesium	Mg	1000	0	0.04	5	10
Manganese	Mn	10	0	0.0004	0.05	0.1
Molybdenum	Mo	1000	0	0.0008	0.1	0.2
Nickel	Ni	10	0	0.0004	0.05	0.1
Potassium	K	1000	0	0.04	5	10
Selenium	Se	10	0	0.0004	0.05	0.1
Silver	Ag	10	0	0.0004	0.05	0.1
Sodium	Na	1000	0	0.04	5	10
Titanium	Ti	1000	0	0.0008	0.1	0.2
Tin	Sn	1000	0	0.0004	0.05	0.1
Thallium	Tl	10	0	0.0004	0.05	0.1
Uranium	U	1000	0	0.0004	0.05	0.1
Vanadium	V	10	0	0.0004	0.05	0.1
Zinc	Zn	10	0	0.0004	0.05	0.1

Table 7-4
ICV/CCV Solutions

Analyte	Symbol	Stock Concentration (mg/L)	ICV/CCV Concentration (mg/L)
Aluminum	Al	10	0.05
Antimony	Sb	10	0.05
Arsenic	As	10	0.05
Barium	Ba	10	0.05
Beryllium	Be	10	0.05
Calcium	Ca	1000	5
Cadmium	Cd	10	0.05
Chromium	Cr	10	0.05
Cobalt	Co	10	0.05
Copper	Cu	10	0.05
Iron	Fe	1000	5
Lead	Pb	10	0.05
Magnesium	Mg	1000	5
Manganese	Mn	10	0.05
Molybdenum	Mo	1000	0.1
Nickel	Ni	10	0.05
Potassium	K	1000	5
Selenium	Se	10	0.05
Silver	Ag	10	0.05
Sodium	Na	1000	5
Titanium	Ti	1000	0.1
Tin	Sn	1000	0.05
Thallium	Tl	10	0.05
Uranium	U	1000	0.05
Vanadium	V	10	0.05
Zinc	Zn	10	0.05

Table 7-5
Interference Check Solutions

Analyte	Symbol	Stock Concentration (mg/L)	ICSA Concentration (mg/L)	ICSAB Concentration (mg/L)
Aluminum	Al	1000	5	5
Antimony	Sb	0	0	0.1
Arsenic	As	10	0	0.1
Barium	Ba	0	0	0.1
Beryllium	Be	0	0	0.1
Calcium	Ca	3000	15	15
Cadmium	Cd	10	0	0.1
Chromium	Cr	20	0	0.1
Cobalt	Co	20	0	0.1
Copper	Cu	20	0	0.1
Iron	Fe	2500	12.5	12.5
Lead	Pb	0	0	0.1
Magnesium	Mg	1000	5	5
Manganese	Mn	20	0	0.1
Nickel	Ni	20	0	0.1
Potassium	K	1000	5	5
Selenium	Se	10	0	0.1
Silver	Ag	5	0	0.1
Sodium	Na	2500	12.5	12.5
Thallium	Tl	0	0	0.1
Uranium	U	1000	0	0.1
Vanadium	V	20	0	0.1
Zinc	Zn	10	0	0.1
Chlorine	Cl^-*	21215	106.1	106.1
Carbon	C*	2000	10	10
Phosphorus	P*	1000	5	5
Sulfur	S*	1000	5	5

- Although these are non-metals, they are essential for verifying the absence of mass interferences.

Table 7-6

LLICV / LLCCV Solutions

Analyte	Symbol	Volume of Single Element Standard (mL)	Intermediate Concentration (mg/L)	LLICV / LLCCV Concentration (ug/L)
Antimony	Sb	0.4 (0.25 Soil)	8 (5 Soil)	0.4 (0.25 Soil)
Arsenic	As	0.4	8	0.4
Barium	Ba	0.75	15	0.75
Cadmium	Cd	0.24	4.8	0.24
Chromium	Cr	0.8	16	0.8
Cobalt	Co	0.4	8	0.4
Copper	Cu	0.8	16	0.8
Lead	Pb	0.4	8	0.4
Manganese	Mn	0.5	10	0.5
Nickel	Ni	1.6	32	1.6
Selenium	Se	0.4	8	0.4
Silver	Ag	0.4	8	0.4
Thallium	Tl	0.08	1.6	0.08
Uranium	U	0.4	8	0.4
Vanadium	V	0.4	8	0.4
Zinc	Zn	6.25	125	6.25

Table 13-1

Quality Control Criteria
Total Metals – ICP/MS Method 6020

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA (1)	CORRECTIVE ACTION
Initial calibration	Daily at beginning of analytical run	Correlation coefficient must be ≥ 0.998	Investigate, reanalyze the aberrant standard or recalibrate
Initial Calibration Verification (ICV)	After calibration	90 – 110%	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate
Continuing Calibration Verification (CCV)	Minimum every 10 samples	90 - 110%	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate, reanalyze all samples run after the last compliant CCV
Low Level Initial Calibration Verification (LLICV) (at or below RL)	Minimum of once per calibration prior to sample analysis unless multipoint calibration with low std at or below RL is performed	All analyte(s) within ± 50% of expected value for SW-846 and AFCEE QAP 3.1. All analytes within ± 20 % of expected value for DOD Version 3 and AFCEE QAP 4.0	Correct problem then reanalyze
MS Tune	Daily prior to calibration minimum of four integrations	Measured mass within 0.1 amu of exact mass; RSD < 5%	Retune Instrument
Initial Calibration Blank	After ICV	< RL < 1/2 RL < 3 x IDL < MDL	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate
Continuing Calibration Blank	minimum every 10 samples	< RL < 1/2 RL < 3 x IDL < MDL	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate, reanalyze all samples run after the last compliant CCB
Method Blank	One per batch (20 samples maximum per batch)	< RL or <MDL x 2	Stop analysis, investigate, reanalyze. If still > limit, redigest batch (required by Ohio VAP projects) or qualify data and address in narrative
ICP interference check	Run at beginning of each run (12 hour maximum)	All non-spiked analytes <2 x MDL (unless they are a verified trace impurity from one of the spiked analytes) Spiked analytes ± 20% of expected value.	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate.
Laboratory Control Sample (LCS) Laboratory Control Sample Duplicate (LCS Dup)	One per batch (20 samples maximum per batch)	Control Limits 80 - 120%	Stop analysis, investigate, reanalyze. If still outside limits, redigest batch (required by Ohio VAP projects) or qualify data and address in narrative
Matrix spike/Matrix Spike Duplicate	One per batch (20 samples maximum per batch)	75 - 125% recovery RPD ≤ 20%	Perform post digestion spike and/or serial dilution. Qualify data and address in narrative if client specified
Duplicate (optional)	One per batch (20 samples maximum per batch)	RPD ≤ 20%	Qualify data and address in narrative if client specified
Post digestion spike	5%, or minimum of 1 per batch	75 - 125% recovery	Serial dilution
Serial Dilution	If post digestion spike fails	± 10% of original determination	Dilute and repeat Post digestion spike
Internal Standards	Every sample	Intensity >30% <120% of that of initial calibration blank. See Appendix I for OVAP requirements.	Stop analysis, investigate, dilute sample if interference is apparent or recalibrate and reanalyze affected samples.
Daily Performance Report (Manufacturer's recommendations)	Daily after MS Tune	Background <30 cps @ Mass 220 Rh sensitivity > 150000 cps Mg sensitivity > 20000 cps Pb sensitivity >100000 cps CeO/Ce = ≤ 0.03 Ba^{+2}/Ba = ≤ 0.03	Stop analysis, investigate, reanalyze. If still outside limit, examine and replace cones.

(1) Acceptance criteria are project specific. Consult QAPP.

Table 13-2
Spike Concentrations
Total Metals – ICP/MS Method 6020

Analyte	Symbol	LCS		MS/MSD		Post Spike	
		Water mg/L	Soil mg/Kg	Water mg/L	Soil mg/Kg	Water mg/L	Soil mg/Kg
Silver	Ag	0.125	10.0	0.125	10.0	0.125	10.0
Antimony	Sb	0.125	10.0	0.125	10.0	0.125	10.0
Arsenic	As	0.125	10.0	0.125	10.0	0.125	10.0
Lead	Pb	0.125	10.0	0.125	10.0	0.125	10.0
Selenium	Se	0.125	10.0	0.125	10.0	0.125	10.0
Thallium	Tl	0.125	10.0	0.125	10.0	0.125	10.0
Barium	Ba	0.125	10.0	0.125	10.0	0.125	10.0
Cadmium	Cd	0.125	10.0	0.125	10.0	0.125	10.0
Chromium	Cr	0.125	10.0	0.125	10.0	0.125	10.0
Cobalt	Co	0.125	10.0	0.125	10.0	0.125	10.0
Copper	Cu	0.125	10.0	0.125	10.0	0.125	10.0
Manganese	Mn	0.125	10.0	0.125	10.0	0.125	10.0
Nickel	Ni	0.125	10.0	0.125	10.0	0.125	10.0
Uranium	U	0.125	10.0	0.125	10.0	0.125	10.0
Vanadium	V	0.125	10.0	0.125	10.0	0.125	10.0
Zinc	Zn	0.125	10.0	0.125	10.0	0.125	10.0

Table 13-3
Microbac's QA Objectives and Analytical Methods for Inorganic Metals Analyses of Groundwater

Analyte	Symbol	CAS #	EPA SW-846 Method	Accuracy (% Recovery)	Precision (% RPD)	MDL Water (ug/L)	Reporting Limits Water (ug/L)
Antimony	Sb	7440-36-0	6020	80-120	20	0.5	1.0
Arsenic	As	7440-38-2	6020	80-120	20	0.5	1.0
Lead	Pb	7439-92-1	6020	80-120	20	0.5	1.0
Selenium	Se	7782-49-2	6020	80-120	20	0.5	1.0
Thallium	Tl	7440-28-0	6020	80-120	20	0.1	0.2
Silver	Ag	7440-22-4	6020	80-120	20	0.5	1.0
Barium	Ba	7440-39-3	6020	80-120	20	1.5	3.0
Cadmium	Cd	7440-43-9	6020	80-120	20	0.3	0.6
Chromium	Cr	7440-47-3	6020	80-120	20	1.0	2.0
Cobalt	Co	7440-48-4	6020	80-120	20	0.5	1.0
Copper	Cu	7440.50-8	6020	80-120	20	1.0	2.0
Manganese	Mn	7439-96-5	6020	80-120	20	1.0	2.0
Nickel	Ni	7440-02-0	6020	80-120	20	2.0	4.0
Uranium	U	7440-61-1	6020	80-120	20	0.5	1.0
Vanadium	V	7440-62-2	6020	80-120	20	0.5	1.0
Zinc	Zn	7440-66-6	6020	80-120	20	12.5	25.0

Table 13-3 (continued)

Microbac's QA Objectives and Analytical Methods for Inorganic Metals Analyses of Solid Waste

Analyte	Symbol	CAS #	EPA SW-846 Method	Accuracy (% Recovery)	Precision (% RPD)	MDL Soil (ug/Kg)	Reporting Limits Soil (ug/Kg)
Antimony	Sb	7440-36-0	6020	80-120	20	50	100
Arsenic	As	7440-38-2	6020	80-120	20	150	300
Lead	Pb	7439-92-1	6020	80-120	20	100	200
Selenium	Se	7782-49-2	6020	80-120	20	100	200
Thallium	Tl	7440-28-0	6020	80-120	20	20	40
Silver	Ag	7440-22-4	6020	80-120	20	100	200
Barium	Ba	7440-39-3	6020	80-120	20	150	300
Cadmium	Cd	7440-43-9	6020	80-120	20	50	100
Chromium	Cr	7440-47-3	6020	80-120	20	200	400
Cobalt	Co	7440-48-4	6020	80-120	20	250	500
Copper	Cu	7440-50-8	6020	80-120	20	300	600
Manganese	Mn	7439-96-5	6020	80-120	20	100	200
Nickel	Ni	7440-02-0	6020	80-120	20	400	800
Uranium	U	7440-61-1	6020	80-120	20	200	400
Vandium	V	7440-62-2	6020	80-120	20	250	500
Zinc	Zn	7440-66-6	6020	80-120	20	1250	2500

Table 13-4
Quality Control Criteria
Total Metals – ICP/MS Method 200.8

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA (1)	CORRECTIVE ACTION
Initial calibration	Daily at beginning of analytical run	Correlation coefficient must be ≥ 0.998	Investigate, reanalyze the aberrant standard or recalibrate
Initial Calibration Verification (ICV)	After calibration	90 – 110%	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate
Continuing Calibration Verification (CCV)	Minimum every 10 samples	85 - 115%	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate, reanalyze all samples run after the last compliant CCV
Low Level Initial Calibration Verification (LLICV) (at or below RL)	Minimum of once per calibration prior to sample analysis unless multipoint calibration with low std at or below RL is performed	All analyte(s) with ± 50% of expected value for SW-846 / EPA Method 200.8 and AFCEE QAP 3.1. All analytes within ± 20 % of expected value for DOD Version 3 and AFCEE QAP 4.0	Correct problem then reanalyze
MS Tune	Daily, minimum of five integrations	Measured mass within 0.1 amu of exact mass; RSD < 5% Peak width < 0.75 amu at 5% peak height	Retune Instrument
Initial Calibration Blank	After ICV	< RL < 1/2 RL < 3 x IDL < MDL	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate
Continuing Calibration Blank	minimum every 10 samples	< RL < 1/2 RL < 3 x IDL < MDL	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate, reanalyze all samples run after the last compliant CCB
Method Blank	One per batch (20 samples maximum per batch)	< RL or <MDL x 2	Stop analysis, investigate, reanalyze. If still > limit, redigest batch (required for Ohio VAP projects) or qualify data and address in narrative
ICP interference check	Run at beginning of each run (12 hour maximum)	All non-spiked analytes < RL (unless they are a verified trace impurity from one of the spiked analytes) Spiked analytes ± 20% of expected value.	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate.
Laboratory Control Sample (LCS),Laboratory Control Sample Duplicate (LCS Dup)	One per batch (20 samples maximum per batch)	Control Limits 85 - 115%	Stop analysis, investigate, reanalyze. If still outside limits, redigest batch (required by Ohio VAP projects) or qualify data and address in narrative
Matrix spike/Matrix Spike Duplicate	One per ten 200.8 samples	70 - 130% recovery RPD ≤ 20%	Perform post digestion spike and/or serial dilution. Qualify data and address in narrative if client specified
Duplicate	One per batch (20 samples maximum per batch)	RPD ≤ 20%	Qualify data and address in narrative if client specified
Post digestion spike	5%, or minimum of 1 per batch	75 - 125% recovery	Serial dilution
Serial Dilution	If post digestion spike fails	± 10% of original determination	Dilute and repeat Post digestion spike
Internal Standards	Every sample	60 - 125%	Stop analysis, investigate, dilute sample if interference is apparent or recalibrate and reanalyze affected samples.
Daily Performance Report (Manufacturer's recommendations)	Daily after MS Tune	Background <30 cps @ Mass 220 Rh sensitivity > 150000 cps Mg sensitivity > 20000 cps Pb sensitivity >100000 cps CeO/Ce = ≤ 0.03 Ba^{+2}/Ba = ≤ 0.03	Stop analysis, investigate, reanalyze. If still outside limit, examine and replace cones.
Quality Control Sample (QCS) (120 ppb)	Run Quarterly	90-110%	Stop analysis, investigate, reanalyze. If still outside limit, recalibrate.

(1) Acceptance criteria are project specific. Consult QAPP.

TABLE 13-5
Microbac's QA Objectives and Analytical Methods for Inorganic Metals Analyses

Analyte	Symbol	CAS #	EPA SW-846 Method	Accuracy (% Recovery)	Precision (% RPD)	MDL Water (ug/L)	Reporting Limits Water (ug/L)
Antimony	Sb	7440-36-0	200.8	85-115	20	0.5	1.0
Arsenic	As	7440-38-2	200.8	85-115	20	0.5	1.0
Lead	Pb	7439-92-1	200.8	85-115	20	0.5	1.0
Selenium	Se	7782-49-2	200.8	85-115	20	0.5	1.0
Thallium	Tl	7440-28-0	200.8	85-115	20	0.1	0.2
Silver	Ag	7440-22-4	200.8	85-115	20	0.5	1.0
Barium	Ba	7440-39-3	200.8	85-115	20	1.5	3.0
Cadmium	Cd	7440-43-9	200.8	85-115	20	0.3	0.6
Chromium	Cr	7440-47-3	200.8	85-115	20	1.0	2.0
Cobalt	Co	7440-48-4	200.8	85-115	20	0.5	1.0
Copper	Cu	7440.50-8	200.8	85-115	20	1.0	2.0
Manganese	Mn	7439-96-5	200.8	85-115	20	1.0	2.0
Nickel	Ni	7440-02-0	200.8	85-115	20	2.0	4.0
Uranium	U	7440-61-1	200.8	85-115	20	0.5	1.0
Vanadium	V	7440-62-2	200.8	85-115	20	0.5	1.0
Zinc	Zn	7440-66-6	200.8	85-115	20	12.5	25.0

Table 13-6
Quality Control Criteria
Total Metals – ICP/MS Method 6020A

CONTROL ITEM	FREQUENCY	ACCEPTANCE CRITERIA (1)	CORRECTIVE ACTION
Initial calibration	Daily at beginning of analytical run	Correlation coefficient must be ≥ 0.998	Investigate, reanalyze the aberrant standard or recalibrate
Initial Calibration Verification (ICV)	After calibration	90 – 110%	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate
Continuing Calibration Verification (CCV)	Minimum every 10 samples	90 - 110%	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate, reanalyze all samples run after the last compliant CCV
Low Level Initial and Continuing Calibration Verification (LLICV / LLCCV) (at or below RL)	Following Calibration prior to sample analysis and minimally at the close of each analytical batch	All analyte(s) within ± 30% of expected value or QAPP specific limits	Correct problem then reanalyze
MS Tune	Daily prior to calibration minimum of four integrations	Measured mass within 0.1 amu of exact mass; RSD < 5%	Retune Instrument
Initial Calibration Blank	After ICV	< RL < 1/2 RL < 3 x IDL < MDL	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate
Continuing Calibration Blank	minimum every 10 samples	< RL < 1/2 RL < 3 x IDL < MDL	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate, reanalyze all samples run after the last compliant CCB
Method Blank	One per batch (20 samples maximum per batch)	< RL or < MDL x 2 < 10% of RL, regulatory limit or lowest sample concentration	Stop analysis, investigate, reanalyze. If still > limit, redigest batch or qualify data and address in narrative
ICP interference check	Run at beginning of each run (12 hour maximum)	All non-spiked analytes <2 x MDL (unless they are a verified trace impurity from one of the spiked analytes) Spiked analytes ± 20% of expected value.	Stop analysis, investigate, reanalyze. If still outside limits, recalibrate.
Laboratory Control Sample (LCS) Laboratory Control Sample Duplicate (LCS Dup)	One per batch (20 samples maximum per batch)	Control Limits 80 - 120%	Stop analysis, investigate, reanalyze. If still outside limits, redigest batch or qualify data and address in narrative
Matrix spike/Matrix Spike Duplicate	One per batch (20 samples maximum per batch)	75 - 125% recovery RPD ≤ 20%	Perform post digestion spike and/or serial dilution. Qualify data and address in narrative if client specified
Duplicate (optional)	One per batch (20 samples maximum per batch)	RPD ≤ 20%	Qualify data and address in narrative if client specified
Post digestion spike	5%, or minimum of 1 per batch	80 – 120% recovery	Serial dilution
Serial Dilution	If post digestion spike fails	± 10% of original determination	Dilute and repeat Post digestion spike
Internal Standards	Every sample	≥ 70% recovery of that of initial calibration blank. No upper limit.	Stop analysis, investigate, dilute sample if interference is apparent or recalibrate and reanalyze affected samples.
Daily Performance Report (Manufacturer's recommendations)	Daily after MS Tune	Background <30 cps @ Mass 220 Rh sensitivity > 150000 cps Mg sensitivity > 20000 cps Pb sensitivity >100000 cps CeO/Ce = ≤ 0.03 Ba^{+2}/Ba = ≤ 0.03	Stop analysis, investigate, reanalyze. If still outside limit, examine and replace cones.

(1) Acceptance criteria are project specific. Consult QAPP.

Figure 12.1

Example 6020 Calculations
Perkin Elmer ELAN 6100

1.0 Initial Calibration (ICAL) Parameters
The system performs linear regression from data consisting of a blank and three standards.

2.0 Calculating the concentration (C) of an element in water using data from prep log, run log, and quantitation report (note:the data system performs this calculation automatically when correction factors have been entered):

$$Cx = Cs \times \frac{Vf}{Vi} \times D$$

Where:	**Example:**
Cs = Concentration computed by the data system (ug/L)	0.1
Vf = Final volume	100
Vi = Initial volume	40
D = Dilution factor as a multiplier (10X = 10)	1
Cx = Concentration of element in (ug/L)	0.25

3.0 Calculating the concentration (C) of an element in soil using data from prep log, run log, and quantitation report (note: the data system performs this calculation automatically when correction factors have been entered):

$$Cx = Cs \times \frac{Vf}{Vi} \times D$$

Where:	**Example:**
Cs = Concentration computed by the data system (ug/L)	0.1
Vf = Final volume	200
Vi = Initial volume	0.5
D = Dilution factor as a multiplier (10X = 10)	1
Cx = Concentration of element in (ug/kg)	40

4.0 Adjusting the concentration to dry weight:

$$Cdry = \frac{Cx \times 100}{Px}$$

Where:	**Example:**
Cx = Concentration calculated as received (wet basis)	40
Px = Percent solids of sample (%wt)	80
$Cdry$ = Concentration calculated as dry weight (ug/kg)	50

50 ug/kg = 0.050 mg/kg

Figure 14.1

Checklist ID: 36971

Microbac Laboratories Inc.

Data Checklist

Date: 20-MAR-2009
Analyst: JYH
Analyst: NA
Method: 6020
Instrument: ELAN
Curve Workgroup: 297905
Runlog ID: 27152
Analytical Workgroups: 297854,297897,297856,297750

Calibration/Linearity	X
ICV/CCV	X
ICB/CCB	X
ICSA/ICSAB	X
CRI	X
Blank/LCS	X
MS/MSD	X
Post Spike/Serial Dilution	X
Upload Results	X
Data Qualifiers	X
Generate PDF Instrument Data	X
Sign/Annotate PDF Data	X
Upload Curve Data	X
Workgroup Forms	
Case Narrative	420,435,437,419,438,427
Client Forms	X
Level X	
Level 3	427
Level 4	420,437,419,438
Check for compliance with method and project specific requirements	X
Check the completeness of reported information	X
Check the information for the report narrative	X
Primary Reviewer	JYH
Secondary Reviewer	SLP
Comments	

Primary Reviewer:

Secondary Reviewer:
24-MAR-2009

CHECKLIST1 - Modified 03/05/2008
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Microbac

STANDARD OPERATING PROCEDURE
PERCHLORATE
METHOD 6850/331.0

Issue/Implementation Date: 15 April 2011

Last Review Date: 15 April 2011

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Approved by:

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1.0 SCOPE AND APPLICATION

1.1 This method is utilized for the analysis of perchlorate (ClO_4-) in water and soil samples using high pressure liquid chromatography (HPLC) combined with tandem mass spectrometry (MS/MS). The procedures in this method are based on EPA method 6850 and have been modified based on the Department of Defense Perchlorate Handbook. Modifications to this SOP for the analysis of Method 331 can be found in Appendix I.

1.2 After preparation, samples are injected onto the HPLC for separation, after which the perchlorate is introduced to the first mass spectrometer and fragmented for detection in the second mass spectrometer. Water samples are a direct aqueous injection after filtration. Soil samples are prepared by vortex and sonication prior to filtration and analysis.

1.3 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

CCV	Continuing Calibration Verification
HPLC	High Pressure Liquid Chromatography
ICS	Interference Check Sample
ICV	Initial Calibration Verification
LCS	Laboratory Control Sample
LCSD	LCS Duplicate
LOD	Limit of Detection
LODV	Limit of Detection Verification
LOQ	Limit of Quantitation
MB	Method Blank
MCT	Method Conductivity Threshold
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSDS	Material Safety Data Sheets

For a more comprehensive list of common terms and definitions, consult Appendix A in Microbac SOP LQAP.

2.0 SAFETY PRECAUTIONS

2.1 Concentrated standards and acetonitrile are used in this method. Contact with these chemicals must be minimized. Working under a functioning vent hood and proper safety equipment such as gloves, lab coat, and safety glasses will normally provide adequate protection from contact. The MSDS should be consulted if questions about safe handling on a particular chemical requires additional personal protective clothing.

3.0 SAMPLE PRESERVATION AND STORAGE

3.1 Water samples are collected in 125 mL polyethylene bottles and should be stored with headspace to reduce anaerobic biodegradation. No preservation is required.

3.2 Soil samples are collected in 4 oz amber glass bottles.

3.3 Soil samples must be extracted within 28 days of collection and analyzed within 28 days of preparation. Water samples must be analyzed within 28 days of collection.

3.4 Samples are stored at ≤6° C.

4.0 METHOD PERFORMANCE

4.1 Table 1 summarizes the performance data for water analysis; Table 2 summarizes performance data for soil analysis. These tables include ranges for accuracy and precision, nominal laboratory RL, and the current laboratory MDLs.

4.2 The laboratory performed an initial assessment of the MDL using the procedures outlined in 40 CFR Part 136. Results are filed electronically at H:\DATA\COMMON\MDL.

4.3 The LOD, or verified MDL, are presented in Tables 1 and 2 and were established using verification procedures outlined in Microbac SOP 45.

4.4 The LOQ are the nominal laboratory RLs and were established as per Microbac SOP 45.

4.5 Precision and accuracy data were derived from an initial demonstration of capability using spiked control samples. The laboratory uses results from LCS to assess precision/accuracy and to annually evaluate the associated control limits.

5.0 INTERFERENCES AND CORRECTIVE ACTION

5.1 All possible measures are taken to eliminate interferences from glassware and other equipment. Possible interferences from this source include artifact peaks and elevated baselines.

5.2 Only HPLC grade solvents are used.

5.3 All samples are filtered through 0.45 um filters to remove particulates that may damage the column and instrumentation.

5.4 If competing ions are present in samples at sufficient concentrations, they may take up active sites on the column and cause perchlorate to elute earlier than in the calibration standards; the internal standard peak will also shift and can be used to confirm the identification of the perchlorate peak.

5.5 If high concentrations of total dissolved solids are present in samples, ionization suppression may occur in the mass spectrometer, resulting in reduced peaks for perchlorate and the internal standard. A matrix conductivity threshold (MCT) study is performed to determine the concentration at which suppression occurs and samples are diluted accordingly.

6.0 EQUIPMENT AND SUPPLIES

6.1 Major Instrumentation

6.1.1 High performance liquid chromatograph: Shimadzu Prominence UFLC XR

6.1.2 Analytical column: K' (Prime) Technologies, Inc. reversed-phase HPLC column, 4 x 250mm (KP-RPPX250).

6.1.3 Mass spectrometer system: Applied Biosystems API-4000 triple quadrupole mass spectrometer with TurboIonspray probe.

6.1.4 Data system: Applied Biosystems Analyst software running with a Microsoft Windows platform

6.1.5 Nitrogen generator: Parker NitroFlowLab

6.2 Apparatus or Equipment

6.2.1 Syringe pump: New Era Pump Systems NE-300 for use in mass calibration.

6.2.2 Hamilton 1001TLL 1 mL syringe, for use with syringe pump

6.2.3 Pipetter

6.2.4 Conductivity meter

6.2.5 Sonic bath: VWR Model 50T or equivalent

6.2.6 Analytical balance

6.2.7 Centrifuge

6.2.8 Vortexer

6.2.9 Centrifuge tubes – 15 mL and 50 mL

6.2.10 10 mL disposable syringes

6.2.11 PTFE syringe filters 25 mm x 0.45mm

7.0 STANDARDS AND REAGENTS

7.1 All purchased stock standards and reagents are logged into the LIMS system and assigned certificate of analysis (COA) numbers. All intermediate and working solutions are similarly logged into the LIMS and assigned STD or RGT numbers. Detailed information regarding solution concentrations, aliquot volumes and final volumes and concentrations are included under the STD or RGT number.

7.2 HPLC grade water (J.T. Baker 4218-03 or equivalent)

7.3 Deionized (DI) water (ASTM Type 2 or better)

7.4 HPLC grade acetonitrile (J.T. Baker 9017-03 or equivalent)

7.5 Perchlorate standard: A 1000 ug/L stock standard is prepared by diluting 100 uL of a 1000 ug/mL perchlorate standard (Ultra ICC-013-5) in 100 mL of deionized water.

7.5.1 A 10 ug/L intermediate standard is prepared daily from the 1000 ug/L stock standard by diluting 100 uL in 10 mL of deionized water.

7.5.2 A minimum of 5 calibration standards are required, with the lowest standard at a concentration at or below the LOQ. Working calibration standards are prepared from the stock standard using the following scheme:

10 ug/L	(intermediate standard)
5.0 ug/L	(500 uL intermediate standard: 500 uL DI water)
2.0 ug/L	(200 uL intermediate standard: 800 uL DI water)
1.0 ug/L	(100 uL intermediate standard: 900 uL DI water)
0.5 ug/L	(100 uL 5.0 ug/L standard: 900 uL DI water)
0.2 ug/L	(100 uL 2.0 ug/L standard: 900 uL DI water)
0.1 ug/L	(100 uL 1.0 ug/L standard: 900 uL DI water)

7.6 Second source standard: A 1000 ug/L stock standard is prepared by diluting 100 uL of a 1000 ug/mL perchlorate standard (Accustandard IC-PER-10X-1) in 100 mL of DI water.

7.6.1 The working alternate source standard at 1.0 ug/L is prepared by diluting the alternate source stock as in Sections 7.5.1 and 7.5.2 above.

7.7 Internal standard: O18 labeled perchlorate ($Cl^{18}O_4$-) purchased from Dionex (062923) at 1000 ug/L. Every working calibration standard and sample is spiked with this solution in the ratio of 50 uL internal standard: 10 mL sample, yielding a final concentration of 5 ug/L.

7.8 ICS solution: Dissolve 4 g NaCl, 3.72 g Na_2SO_4, 4.4 g Na_2CO_3 in 100 mL of DI water. Dilute 11 mL of this solution in 200 mL of DI water to yield a final conductivity of approximately 10,000 uS/cm. Verify the conductivity with a conductivity meter.

7.9 The internal standard solution is stored at ≤6° C. All other standards are stored at room temperature.

8.0 SAMPLE PREPARATION

8.1 Samples are prepared in batches of up to 20 (twenty) field samples using the following procedures:

8.2 Water samples

8.2.1 Pour approximately 30-50 mL of sample into a disposable cup and measure the matrix conductivity of the sample using a conductivity meter.

8.2.2 Filter 5-10 mL of sample using a plastic syringe and 0.45 um nylon filter into a 15 mL disposable centrifuge tube.

8.2.3 Transfer 1 mL of sample into an autosampler vial, add 5 uL of internal standard, cap and shake well. If the conductivity measurement is >10,000 uS/cm, prepare a dilution using reagent water to achieve an acceptable level of conductivity (see 10.6).

8.2.4 With each preparation batch, include a method blank, LCS and MCT/ICS. The method blank and LCS are prepared using 10 mL of reagent water. The MCT/ICS is prepared using 10 mL of MCT solution. The LCS and MCT/ICS are spiked with 0.2 mL of the 10 ug/L intermediate standard. The blank, LCS and MCT/ICS are filtered in the same manner as field samples.

8.2.5 If a MS/MSD is included in the sample batch, they are spiked in the same manner as the LCS. If no MS/MSD are included, prepare an LCSD sample.

8.3 Soil samples

8.3.1 Sample Homogenization

8.3.1.1 Remove the sample bottle contents and place in tray lined with aluminum foil.

8.3.1.2 Mix sample with an inert rod or scoop and break up lump. Remove all large stones, sticks, leaves, etc. Do not overmix the sample.

8.3.1.3 Obtain representative sample either by random removal of 3-10 portions of the sample from the pan or by using a “standard” scoop designed to retrieve a linear cross-section of the pan contents.

8.3.1.4 The analyst will not attempt to target and exact weight once a method specified minimum amount is weighed.

8.3.1.5 The remaining sample will be returned to the sample container.

8.3.2 Weigh 5.0 g of homogenized sample into a tared 50 mL centrifuge tube and record the weight. Add enough reagent water to the tube to bring the total volume to 50 mL and add 250 uL of internal standard 018LP.

8.3.3 Invert 2-3 times to mix, then place in an ultrasonic bath for 30 min, then invert again.

8.3.4 Centrifuge the sample for 10 min to separate solids from the extract solution.

8.3.5 Transfer the extract into a 15 mL glass screw-cap vial and label.

8.3.6 Filter 5-10 mL of sample using a plastic syringe and 0.45 um PTFE filter into a 15 mL disposable centrifuge tube. Measure the matrix conductivity of remaining extract.

8.3.7 Transfer 1 mL of sample into an autosampler vial, cap and shake well. If the conductivity measurement is >10,000 uS/cm, prepare a dilution using reagent water to achieve an acceptable level of conductivity (see 10.6).

8.3.8 With each preparation batch, include a method blank and LCS using 5.0 g lab sand spiked with 250 uL of internal standard. The LCS is also spiked with 1 mL of the 10 ug/L intermediate standard. The blank and LCS are filtered in the same manner as field samples.

8.3.9 If a MS/MSD is included in the sample batch, they are spiked in the same manner as the LCS. If no MS/MSD are included, prepare an LCSD sample.

8.3.10 Soil extract cleanup

8.3.10.1 If soil extracts are not clear or are highly colored, there may be large quantities of organic contaminants present. These may be removed using a C_{18} column and the following procedure.

8.3.10.2 Activate the C_{18} column by pushing approximately 5 mL of methanol through the column, followed by 5 mL of reagent water at a flow rate of approximately 0.5 mL/min. Do not let the column become dry.

8.3.10.3 Gently push approximately 6 mL of the extract through the column. Discard the first 2 mL and collect the remainder for analysis.

8.4 ICS: With each preparation batch, spike a 5.0 g lab sand sample with 1 mL at the 10 ug/L intermediate standard and bring to a 50 mL final volume with the ICS solution.

8.5 If samples are not analyzed immediately after preparation, they should be stored at room temperature with headspace until analysis can proceed.

9.0 CALIBRATION PROCEDURES

9.1 Mass tuning: the MS/MS system is optimized for detection of m/z ratios 83 (ClO_3-), 85 ($^{37}ClO_3$-) and 89 ($Cl^{18}O_3$-), using a syringe pump and the manufacturer's instructions.

9.2 A laboratory reagent blank, prepared by spiking 10 mL of DI water with 50 uL of internal standard, is analyzed to assess the cleanliness of the system under these circumstances:

9.2.1 Prior to initial calibration.

9.2.2 After every 10 field samples.

9.2.3 Following samples found to have perchlorate concentrations above the calibration range (unless the instrument is running unattended).

In all cases, the concentration of perchlorate in the reagent blank must be <1/2 of the RL. If not, the blank must be reanalyzed until this criteria is met. Field samples not bracketed by passing reagent blanks must be reanalyzed.

9.3 Initial calibration

9.3.1 Initial calibration recommended conditions:

9.3.1.1 HPLC system:

Mobile phase: 47% H_2O/0.1% acetic acid: 53% Acetonitrile/0.1% acetic acid
Injection volume: 10 uL
Flow rate: 0.5 mL/min

9.3.1.2 Mass spectrometer:

Interface: Turbospray ion source
Curtain gas: 105 psi

Exhaust gas:	105 psi
Gas 1/Gas 2:	50 psi
Polarity:	Negative
Resolution:	Unit
Dwell time:	200 msec

SIM parameters:

Compound	Q1 mass	Q2 mass
Perchlorate	98.8	83.2
O18LP	107.0	89.0
Perchlorate confirmation	100.8	85.2

The same conditions are used for sample analysis.

9.3.2 Inject each calibration standard into the HPLC. After analysis, establish an initial calibration curve using linear regression (see Section 11.1). After The correlation coefficient (r) must be ≥0.995 (see Section 11.2). Because linear calibrations tend to favor numbers at the higher end of the calibration range, a weighting factor (see Section 11.3) can be used to reduce this tendency.

9.4 ICV: Following the initial calibration, inject the 1.0 ug/L secondary source standard and evaluate the % drift using the calculation in Section 11.8. The %D must be ≤15 before sample analysis can begin. If the ICV exceeds the control limit, corrective action must be taken and the instrument recalibrated.

9.5 CCV: The calibration must be verified daily prior to sample analysis and after every 10 field samples by the analysis of the 1.0 ug/L calibration standard. The %D must be ≤15 before sample analysis can begin, and samples must be bracketed by passing CCV standards. Samples not bracketed by passing CCVs must be reanalyzed.

9.5.1 If a CCV fails to meet acceptance criteria, it may be reanalyzed once. If it still fails, corrective action must be taken followed by two consecutive CCV analyses in order to demonstrate a return to control.

9.6 LODV: The 0.2 ug/L calibration standard is analyzed daily prior to sample analysis and after every 10 field samples. The %D must be ≤30; if not, samples bracketed by failing LODV standards must be reanalyzed unless perchlorate concentrations in the samples are above the reporting limit.

10.0 ANALYTICAL PROCEDURES

10.1 The instrument is calibrated as in Section 9.0.

10.2 After calibration, batch QC and up to 10 field samples are analyzed, followed by a CCV, LODV and laboratory reagent (batch and instrument QC need not be included in the count of 10). If the second set of standards is acceptable, analysis may continue with another set of 10 samples, etc. All samples must be bracketed by passing QC checks.

10.3 After sample analysis, the computer produces a quantitation report listing all target analytes and concentrations found in the sample. Extracted Ion Chromatograms (XIC) are generated for each analyte found at or above the minimum detection limit and are evaluated for validity.

10.4 Qualitative analysis: Perchlorate is qualitatively identified by verifying the ratios of m/z 83 and 85. The ratio must be within 2.3 to 3.8 to verify the presence of perchlorate.

10.5 If the response for perchlorate is above the upper limit of the initial calibration, a laboratory reagent blank should be analyzed and evaluated as in Section 8.2 in order to verify that no carryover is present.

10.6 Sample over the calibration range must be diluted in order to yield results within the range. Samples are diluted using the following scheme:

Dilution	Amount Sample (mL)	Amount water (mL)	Final dilution volume (mL)	Amount ISTD (uL)
2x	0.5	0.5	1	5
5x	0.2	0.8	1	5
10x	0.1	0.9	1	5

Higher dilutions are prepared by using serial dilutions, e.g. for a 100x dilution, a 10x dilution is again diluted by a factor of 10.

11.0 DETAILS OF CALCULATIONS

11.1 Linear calibration calculations:

11.1.1 The response ratio is plotted vs. the concentration ratio giving a linear equation:

$y = mx + b$

where:

y = Response ratio = Response(x)/Response(istd) = R_x / R_{istd}
x = Concentration ratio = Conc(x)/Conc(istd) = C_x / C_{istd}
And m and b are the slope and intercept from the regression equation

11.1.2 For a given response ratio we can solve for C_x / C_{istd} :

$$C_x / C_{istd} = [R_x / R_{istd} - b] / m$$

Use equations 12.4 or 12.5 to calculate the unknown concentration, C_x.

11.2 Coefficient of correlation

$$\frac{\sum XY - \sum X \sum Y / n}{\sqrt{\left(\sum X^2 - (\sum X)^2 / n\right)\left(\sum Y^2 - (\sum Y)^2 / n\right)}}$$

where:

X = individual values of the independent variable, i.e. concentration
Y = individual values of the dependent variable, i.e. response
n = number of pairs of data

11.3 Linear regression weighing factor:

$$W_1 = 1 / y_1$$

where:

w_1 = weighing factor
y_1 = instrument response

11.4 Calculating concentration from a water sample:

$C_x = (C)(D)$

where:

C_x = final concentration of perchlorate (ug/L)

D = dilution factor

11.5 Calculating concentration from a soil sample:

$$C_x = \frac{(C)(V_f)(D)}{V_i}$$

where:

C_x = final concentration of perchlorate (ug/g)
V_f = final volume of extract (L)
D = dilution factor
V_i = initial sample weight (g)

11.6 The dry weight concentration of a target analyte is further calculated as follows:

$$C_d = \frac{(C_x)(100)}{(\%solids)}$$

where:

C_x = The uncorrected wet weight concentration
% solids = the percent solids content of the sample

11.7 Precision

Precision is expressed as relative standard deviation

$$RSD = \left(\frac{s}{x}\right)100$$

11.8 Accuracy as % difference:

$$\%D = \left[\frac{(C_t - C_x)}{C_t}\right]100$$

where:

C_t = True concentration of the analyte in the standard
C_x = Measured concentration of analyte in the standard

11.9 Precision of duplicate measurements

Precision of duplicate measurements is expressed as relative percent difference

$$RPD = \left[\frac{|C_1 - C_2|}{(C_1 + C_2)/2}\right]100$$

where:

C_1 = Concentration of the first sample
C_2 = Concentration of the second sample

11.10 The LCS recovery is calculated as follows:

$$\%R = \left(\frac{C_x}{C_T}\right)100$$

where:

C_x = the concentration of the analyte in the LCS.
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

11.11 Accuracy as Percent Recovery

$$\%R = \left[\frac{(C_{spk} - C_x)}{C_t}\right]100$$

where:

C_{spk} = the concentration of the analyte in the spiked sample
C_x = the concentration of the analyte in the reference (parent) sample
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

12.0 QUALITY CONTROL REQUIREMENTS

12.1 The quality control procedures discussed in this section are intended to monitor and control the entire analytical process. Batch quality samples are specified in Section 8.0 for MB, LCS, MS, MSD and ICS. Additional procedures were defined in Section 10.0 for initial calibration, ICV, CCV, LODV and laboratory reagent blanks and are included in the overall review process. The procedures, required frequency, acceptance criteria, and the required corrective action measures are outlined in Table 3.

12.2 The MB cannot contain a concentration of perchlorate above the one-half of the RL, or greater than 1/10 the amount measured in any sample, whichever is greater. If the blank fails to meet this criteria, the entire batch must be re-prepped and the analysis performed again. All blanks are evaluated down to the current MDL for the presents of target analytes. Any amount of target analytes found in the blank at a level greater than the current

MDLs are reported in the LIMS and these values appear on the QC summary sheet for the batch.

12.3 The LCS is spiked at 0.2 ug/L. Upon completion of a batch of samples, LCS summary reports are generated by the analyst, which compare the actual recoveries to the applicable acceptance ranges for the samples in the batch. The standard laboratory limits specified in Tables 1 and 2 are used in the absence of a project QAPP, or program specified control limits. If the LCS is beyond the laboratory limits, the analyst must stop the analysis, prepare a corrective action report (CAR), and contact the department supervisor for the appropriate corrective action. Corrective action will consist of re-preparation and re-analysis of the affected samples, unless the client's representative and the Quality Assurance Officer (QAO) approve of another course of action. If an LCSD is included in the preparation batch, it must meet the sample criteria as the LCS.

12.4 The MS and MSD are spiked at 0.2 ug/L. The results are included in the QC Summary Report and the data is used to monitor matrix accuracy and precision.

12.5 Internal standard areas must be between ± 50% of the average areas from the initial calibration and the relative retention times must be within 0.98-1.02. All samples failing to meet this criteria must be reanalyzed at increasing dilutions until the acceptance criteria are met.

12.6 Back Up: All raw data files are automatically saved to the Microbac server on a daily basis.

12.7 When new standards are made, they must be checked against the existing curve before they can be used. Compare with old standards.

12.8 Control of Nonconforming Data

The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred. The policies and procedures are found in Section 13.0 of Microbac SOP LQAP (Laboratory Quality Assurance Program), Microbac SOP GP-CAPA (Corrective Action/Preventive Action: Initiating, Tracking and Monitoring) and Microbac SOP GP-RCA (Root Cause Analysis).

12.8.1 Nonconformances Requiring Corrections

A nonconformance occurs when any aspect of the method QC in an analysis, as outlined in Table 3 does not meet acceptance criteria. When nonconforming data occurs the employee initiates a Nonconformance Report (NCR) and proceeds with indicated corrections as per Table 3.

All data shall be scrutinized by the analysts for method and project specific compliance. Checklists are utilized and accompany each data batch (Figure 1). A nonconformance shall be documented in the NCR followed by one or more of the following actions.

- Reanalysis of the sample(s) in question
- Discussion and qualification of data (report and narrative)
- Client notification with approval
- Data qualification (Q-flagging)
- Re-sampling and reanalysis (client decision)

12.8.2 Nonconformances Requiring Corrective Action

Corrective action is required when a nonconformance is recurring, if the correction is ineffective or if the departure is so significant that it negatively effects data quality, sample integrity or customer satisfaction. When an event requiring corrective action is identified, the employee shall initiate a Corrective Action/ Preventive Action form as per Microbac SOP GP-CAPA. The corrective action process includes a root cause analysis as per Microbac SOP GP-RCA, corrections, corrective action(s) and evidence of effectiveness.

12.8.3 Nonconformances Not Requiring Corrections

There are some standard contingencies to the traditional corrections that maybe invoked, provided they comply with the project QAPP requirements. In many situations it may not be necessary to perform sample reanalysis or re-extraction for the following quality control departures, provided they are not a chronic problem or indicative of a trend, and the laboratory provides documentation in the report narrative and project files. In addition, the employee is required to initiate a NCR to record the event.

- An LCS or surrogate recovery exceeds the upper control limit, but the corresponding sample results are non-detect.
- A MB exceeds the upper limit, but the corresponding sample results are non-detect.
- A MB exceeds the upper limit, but the corresponding sample results are greater than ten (10) times the level in the blank.

13.0 DATA REVIEW AND REPORTING REQUIREMENTS

13.1 Data Review

Prior to data entry into the LIMS (either manual or automatic), all data must undergo two (2) levels of review in the department. The primary review is performed by the analyst and the secondary review is performed by either the department supervisor (or a designee) or another qualified analyst.

13.2 Data Reporting

The reporting requirements depend upon the need of the client. Microbac offers four (4) levels of data reporting which are described in some detail below.

13.2.1 Level 1 reporting provides the client with the results for all samples submitted for analysis. No other documents or raw data are provided with this level of report.

13.2.2 Level 2 reporting provides the client with all of the information contained in a Level 1 report plus a summary of all of the QC analysis associated with the samples submitted by the client.

13.2.3 Level 3 reporting is essentially a custom report provided to the client that contains any additional data from the analysis that the client might request.

13.2.4 Level 4 reporting is provided in those cases where the client wishes to perform full data validation. All raw data, lab generated logs, and other associated data are provided.

14.0 PREVENTIVE MAINTENANCE

14.1 The curtain plate and nebulizer tip must be monitored for buildup and cleaned when necessary.

14.2 The oil in the vacuum pumps should be changed every six (6) months.

14.3 The source is cleaned and mass calibration performed on an as-needed basis.

15.0 WASTE MANAGEMENT AND POLUTION CONTROL

15.1 Microbac is dedicated to eliminating or minimizing any and all laboratory waste, which requires disposal or contributes to pollution of any type. To that extent Microbac has implemented new technology and converted to micro techniques when available to facilitate these goals.

Each laboratory generates specific waste streams which are segregated and collected in labeled satellite containers. The analysts in each department are responsible for proper disposal of the spent samples and chemical waste in the specified satellite waste collection vessel. The waste management technician checks the satellite containers either daily, or as needed. They are then combined into waste drums in our explosion-proof waste building located outside of the Microbac laboratory facility. These drums are labeled with start date and a manifest is created for each. They are picked up on a regular basis for disposal at a licensed disposal facility.

15.2 This method generates wastes in the form of sample extracts in vials, which are placed in the satellite waste container labeled for Waste Vials/Sample Extracts (D001, F002).

15.3 Laboratory policies and procedures for management of hazardous waste are found in SOP 33 Laboratory Waste Management and the waste management section of the analytical SOPs contain procedures specific to each method. All laboratory waste is accumulated, stored and disposed in accordance with all federal and state laws and regulations. Each employee receives training in the proper handling and disposal of hazardous waste that is specific to their job description. As a hazardous generator, we are subject to inspection from the Ohio EPA.

16.0 REFERENCES

16.1 USEPA Method 6850, Revision 0, January 2007

16.2 USEPA Method 8000C, Revision 3, March 2003

16.3 DoD Perchlorate Handbook, Revision 1 Change 1, August 2007.

16.4 DoD Quality Systems Manual for Environmental Laboratories, Version 4.1, 5 June 2003

16.5 EPA Document #: 815-R-05-007, Method 331.0, Determination of Perchlorate in Drinking Water by Liquid Chromatography Electrospray Ionization Mass Spectrometry, Revision 1.0, January 2005

16.6 Microbac SOP LQAP "Laboratory Quality Assurance Plan"

16.7 Microbac SOP 33, "Laboratory Waste Management"

16.8 Microbac SOP 45, "Method Validation Procedures"

16.9 Microbac SOP GP-CAPA, "Corrective Action/Preventive Action: Initiating, Tracking and Monitoring"

16.10 Microbac SOP GP-RCA, "Root Cause Analysis"

Appendix I
Method 331.0

For EPA Method 331.0 analysis, the following modifications are made to this SOP:

1.3 Additional definitions:

QCS	Quality Control Sample
LFSSM	Laboratory Fortified Synthetic Sample Matrix
LSSM	Laboratory Synthetic Sample Matrix
LSSMB	Laboratory Synthetic Sample Matrix Blank

3.1 Samples are collected in a polypropylene beaker and filtered into sterile 125 mL plastic bottles using a sterile 20 cc syringe and 0.2 um sterile syringe filter.

3.4 Sample must be received at <10° C.

4.0 Method performance data for Method 331.0 are presented in Table 4.

6.2.10 20 cc sterile silicone free disposable syringe Fisher cat# 14-817-33

6.2.11 Sterile syringe filters Corning 26 mm surfactant free cellulose acetate 0.2 um, Fisher catalog number 09-754-13.

7.5.2

10ug/L	(intermediate standard)
5.0ug/L	(5000uL intermediate standard: 5000uL DI water)
1.0ug/L	(1000uL intermediate standard: 9000uL DI water)
0.5ug/L	(5000uL 1.0ug/L standard: 5000uL DI water)
0.1ug/L	(1000uL 1.0ug/L standard: 9000uL DI water)
0.05ug/L	(1000uL 0.5ug/L standard: 9000uL DI water)
0.02ug/L	(2000uL 0.1ug/L standard: 8000uL DI water)
0.01ug/L	(1000uL 0.1ug/L standard: 9000uL DI water)

7.6.1 The working alternate source standard at 0.1 ug/L is prepared by diluting the alternate source stack as in Sections 7.4.1 and 7.4.2.

7.7 Internal Standard: O18 labeled perchlorate purchased from Dionex at 1000 ug/L is diluted 1:10 in DI water. Every working calibration standard and sample is spiked with this solution in the ratio of 50 uL internal standard: 10 mL sample, yielding a final concentration of 0.5 ug/L.

7.8 The ICS solution is not used.

7.9 LSSM: dissolve 1.40 g $NaHCO_3$, 1.48 g Na_2SO4, 1.54 g NaCl, in one L of reagent water.

8.2.4 With each preparation batch, include a MB, LCS and MS/MSD. The MB and LCS are prepared using 10 mL of reagent water spiked with 50 uL of internal standard solution from Section 7.6 above. The LCS, MS/MSD are spiked at rotating levels low, medium and high with the 10 ug/L intermediate standard.

A LSSMB and LFSSM are required to be analyzed quarterly and do not have to be included in each analytical batch. The LFSSM is spiked at 0.5 ug/L using the 10 ug/L intermediate standard. The LSSMB and LFSSM are prepared using 10 mL of LSSM solution from Section 7.8 above.

The method blank, LCS and LSSMB and LFSSM are filtered in the same manner as field samples.

9.2.3 In all cases, the concentration of perchlorate in the Reagent blank must be <1/3 of the method reporting limit (MRL).

9.3.1.1 Mobile phase: 60% H_20/0.1% acetic acid: 40% Acetonitrile/0.1% acetic acid

Injection volume: 100uL
Flow rate: 0.75 mL/min

9.3.2 The validation of the calibration is determined by calculating the concentration of the analyte from each of the analyses used to generate the calibration curve. Calibration points that are ≤ MRL should calculate to be 50-150% of their true value. All other calibration points should calculate to be 80-120% of their true value. If these criteria cannot be met, the analyst will have difficulty meeting ongoing QC criteria. In this case, corrective action should be taken to reanalyze the calibration standards, restrict the range of calibration, or select an alternate method of calibration.

9.4 ICV: Analyze a QCS sample fortified near the midpoint of the calibration range. The QCS should be from a different source than the source of the calibration standards. The acceptance criterion for the QCS is that the calculated amount of perchlorate must be 80-120% of the true value. If the measured analyte concentration does not meet this criterion, check the entire analytical procedure to locate and correct the problem before analyzing any field samples.

9.5 CCV: The beginning CCV for each analysis batch must include a CCV at or below the MRL and a CCV fortified at a level near the midpoint of the curve. Subsequent CCVs should alternate between a low, medium, and high concentration. CCVs fortified at or below the MRL must calculate to be 50-150% of the true value. CCVs fortified at all other levels must calculate to be 80-120% of the true value.

10.2 See Table 7 for an example sequence for Method 331.0.

10.4 Perchlorate is qualitatively identified by verifying the ratio of m/z 83 and 85. The ratio must be within 25% of theoretical value of 3.08 (2.31-3.85). If this ion ratio requirement is not met in any QC sample, then all samples in the analysis batch are considered invalid and must be reanalyzed after reestablishing acceptable instrument performance.

12.1 Quality control criteria for Method 331.0 are presented in Tables 5 and 6.

12.5 The internal standard area of the first CCV should be ≥ 50% of the average IS area counts of the initial calibration standards. The internal standard area of the analysis batch must be within 30% of the internal standard area of the first CCV. Relative retention times must be within 0.98-1.02 for a peak to be identified as perchlorate.

16.0 Reference: USEPA Method 331.0, Revision 1, January 2005

TABLE 1
MICROBAC'S QA OBJECTIVES FOR
THE ANALYSIS OF METHOD 6850 WATER

PARAMETER	CAS #	ACCURACY (% RECOVERY)*	PRECISION (% RPD)*	LOD (ug/L)	LOQ (ug/L)
Perchlorate	14797-73-0	80-120	0-15	0.1	0.2

* Limits are currently multi-lab performance limits from the method, will be derived from LCS data, and may be revised.

TABLE 2
MICROBAC'S QA OBJECTIVES FOR
THE ANALYSIS OF METHOD 6850 SOIL

PARAMETER	CAS #	ACCURACY (% RECOVERY)*	PRECISION (% RPD)*	LOD (ug/Kg)	LOQ (ug/Kg)
Perchlorate	14797-73-0	80-120	0-15	1	2

* Limits are currently multi-lab performance limits from the method, will be derived from LCS data, and may be revised.

TABLE 3
QUALITY CONTROL CRITERIA
METHOD 6850

Control Item	Frequency	Acceptance Criteria	Corrective Action
Mass calibration	At instrument setup and as-needed thereafter.	Ions should be within +/- 0.3 m/z of masses 83, 85 and 89.	Recalibrate, contact manufacturer if necessary.
Initial calibration	When continuing calibration is out of control or after major maintenance	r ≥0.995	Correct problem, repeat ICAL.
Initial calibration verification (ICV)	After initial calibration	≤ 15% drift	Reanalyze ICV; upon second failure, repeat initial calibration.
Continuing calibration verification (CCV)	At beginning of daily analytical sequence and after every 10 field samples.	≤ 15% drift	Reanalyze CCV; upon second failure perform maintenance. Two consecutive CCVs must pass following maintenance.
Limit of detection verification (LODV)	Daily prior to sample analysis and after every 10 field samples.	≤ 30% drift	Reanalyze samples not bracketed by passing LODV unless results >RL.
Internal standard	Every standard, sample and batch QC sample.	Areas within ±50% of average ISTD areas from ICAL. RRT 1.0 +/-2% from ICAL.	Reanalyze at dilutions until area is acceptable.
Method blank	One per matrix/batch.	Perchlorate < 1/2 RL or > 1/10 amount detected in samples.	Reprep and reanalyze blank and all associated samples
Laboratory control sample (LCS)	One per matrix/batch.	Recovery within 80-120%	Reprep and reanalyze LCS and all associated samples
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per matrix/batch if specified by client.	Recovery within 80-120%. RPD <15%.	Qualify data and/or address in the report narrative
Interference check sample (ICS)	Extracted with every batch of 20 samples.	≤ 30% drift	Correct problem, reprep and reanalyze samples.
Laboratory reagent blank	Prior to calibration, at the end of analytical sequence and after samples with perchlorate over calibration range.	Perchlorate < 1/2 RL.	Reanalyzed blank until carryover is eliminated, repeat sample analysis.

TABLE 4
MICROBAC'S QA OBJECTIVES FOR
THE ANALYSIS OF METHOD 331.0 WATER

PARAMETER	CAS #	ACCURACY (% RECOVERY)*	PRECISION (% RPD)*	LOD (ug/L)	LOQ (ug/L)
Perchlorate	14797-73-0	See Table 6	See Table 6	0.005	0.02

* Limits are currently multi-lab performance limits from the method, will be derived from LCS data, and may be revised.

TABLE 5
METHOD 331.0 INITIAL DEMONSTRATION OF CAPABILITY
QUALITY CONTROL REQUIREMENTS

Requirement	Specification and Frequency	Acceptance Criteria
Demonstration of Low System Background	Analyze a Reagent blank and LSSMB prior to any other IDC steps.	Demonstrate that the target analyte is <1/3 of the MRL and that possible interferences from sampling devices do not prevent the identification and quantitation of perchlorate.
Test for System Carryover	Analyze a reagent water blank after the high ICAL standard during the IDC calibration.	Demonstrate that the target analyte is <1/3 of the MRL and that carry-over from previous samples does not prevent the identification and quantitation of perchlorate.
Demonstration of Precision	Analyze seven (7) replicate LCSs and seven (7) replicate LFSSMs fortified near the midrange concentration.	%RSD must be ≤20%
Demonstration of Accuracy	Calculate average recovery for replicates used in Section 11.11.	Mean recovery 80-120% of the true value
Minimum Reporting Limit (MRL) Confirmation	Fortify and analyze seven (7) replicate LCSs at the proposed MRL concentration. Calculate the mean and the Half Range (HR). Confirm that the Upper PIR and Lower PIR (Section 9.2.4.2) meet the recovery criteria.	Upper PIR ≤150% Lower PIR ≥50%

TABLE 6
METHOD 331.0
ONGOING QUALITY CONTROL REQUIREMENTS (SUMMARY)

Requirement	Specification and Frequency	Acceptance Criteria
Sample Holding Time	28 days when processed and stored according to Sections 3.0 and Appendix I.	Sample results are valid only if samples are analyzed within the sample holding time.
Initial Calibration	Use the Internal standard calibration technique to generate a linear or quadratic calibration curve. Use at least five (5) standard concentrations.	When each calibration standard is calculated as an unknown using the calibration curve, the lowest level standard should be within 50-150% of the true value. All other points should be within 80-120% of the time value.
Blank	Daily, or with each analysis batch of up to twenty (20) field samples, whichever is more frequent.	Results must be <1/3 the MRL. If the background exceeds 1/3 the MRL, the results for Perchlorate in the analysis batch are invalid.
Continuing Calibration Check (CCC)	Verify initial calibration by analyzing a Low CCC and a Mid CCC at the beginning of each analysis batch. Subsequent CCCs are required after every ten (10) field samples, and after the last field sample in a batch.	The lowest level CCC must be within 50-150% of the true value. All other points must be within 80-120% of the true value. Results are field samples that are not bracketed by acceptable CCCs are invalid.
Laboratory Control Sample (LCS)	Daily, or with each analysis batch of up to twenty (20) field samples, whichever is more frequent.	For LCSs fortified at concentrations ≤MRL, the result must be within 50-150% of the true value. All other LCSs must be within 80-120% of the true value.
Internal Standard (IS)	Compare IS area to the IS area of the first CCC in the analysis batch for all QC and field samples.	Peak area counts for the IS must be within ±30% of the IS area of the first CCC of the analysis batch. If the IS area does not meet this criterion, the corresponding perchlorate results are invalid.
Isotope Area Count Ratio	Monitor the isotope ratio for all QC and field samples in the analysis batch.	The calculated area count ratio (m/z 99/101 for SIM, or m/z 85/83 MRM) must be within ±25% (2.31-3.85) of the theoretical value of 3.086.
Relative Retention Time	Monitor the relative retention time for all QC and field samples in the analysis batch.	The relative retention time for perchlorate vs. the IS must be between 0.98-1.02.
Matrix Spike (MS)	Analyze one MS per analysis batch. Fortify the MS with perchlorate at a concentration close to but greater than the native concentration (if known). Calculate MS recoveries.	For MS fortified at concentrations ≤MRL, the result must be within 50-150% of the true value. All other MSs must be within 80-120% of the true value.
Matrix Spike Duplicate (MSD) or Laboratory Duplicate	Analyze at least one MSD or LD daily, or with each analysis batch of up to twenty (20) field samples, whichever is more frequent.	For MSDs or LDs having perchlorate concentrations ≤2 x MRL, the RPD must be within 50-150%. All other MSDs and LDs must have RPDs within 80-120%
Quality Control Sample (QCS)	Analyzed with every new calibration curve.	Results must be 80-120% of the true value.

TABLE 7
EXAMPLE SEQUENCE FOR
A METHOD 331.0 ANALYTICAL BATCH

Sample	Sample Description	*Acceptance Criteria
1	CCC ≤MRL	50-150% of true value
2	Mid level CCC	80-120% of true value
3	Reagent Blank	<1/3 MRL
4	LCS	≤MRL 50-150% of true value >MRL 80-120% of true value
5	Field Sample-1	
6	Field Sample-2	
7	Field Sample-3	
8	Field Sample-4	
9	Field Sample-5	
10	Field Sample-6	
11	Field Sample-7	
12	Field Sample-8	
13	Field Sample-9	
14	Field Sample-10	
15	CCC (rotate level)	≤MRL 50-150% of true value >MRL 80-120% of true value
16	MS	≤MRL 50-150% of true value >MRL 80-120% of true value
17	MSD	≤2 x MRL 50-150% of true value >2 x MRL 80-120% of true value
18	Field Sample-11	
19	Field Sample-12	
20	Field Sample-13	
21	Field Sample-14	
22	Field Sample-15	
23	Field Sample-16	
24	Field Sample-17	
25	Field Sample-18	
26	Field Sample-19	
27	Field Sample-20	
28	CCC (rotate level)	≤MRL 50-150% of true value >MRL 80-120% of true value

* Additionally, all samples must meet the isotope area count ratio criteria and the relative retention time criteria.

Figure 1
Checklist

Checklist ID: 40695

Microbac Laboratories Inc.

Data Checklist

Date: 06-AUG-2009
Analyst: WTD
Analyst: NA
Method: 6850
Instrument: LCMS1
Curve Workgroup: NA
Runlog ID: 29520
Analytical Workgroups: 308952

ANALYTICAL	
System Performance Check	NA
DFTPP (MS)	NA
Endrin/DDT breakdown (8081/MS)	NA
Pentachlorophenol/benzidine tailing (MS)	NA
Eluent check (IC)/system pressure (HPLC)	NA
Window standard (FID)	NA
Initial Calibration	NA
Average RF	NA
Linear regression or higher order curve	NA
Alternate source standard (ICV) % Difference	NA
Continuing Calibration (CCV)	X
% D/% Drift	X
Minimum response factors (MS)	X
Continuing calibration blank (CCB) (IC)	NA
Special standards	NA
Blanks	X
TCL hits	X
Surrogate recoveries	NA
LCS/LCSD (Laboratory Control Sample)	X
Recoveries	X
Surrogate recoveries	NA
MS/MSD/Sample duplicates	NA
Recoveries	NA
%RPD	NA
Samples	X
TCL hits	X
Mass spectra (MS/HPLC)/2nd column confirmations (ECD/FID/HPLC)	NA
Surrogate recoveries	NA
Internal standard areas (MS)	X
Library searches (MS)	NA
Calculations & correct factors	X
Compounds above calibration range	NA
Reruns	X
Manual integrations	X
Project/client specific requirements	X
REPORTING	
Upload batch form	X
KOBRA workgroup data/forms/bench sheets	X
Case narratives	NA
Check for completeness	X
Primary Reviewer	WTD
SUPERVISORY/SECONDARY REVIEW	
Check for compliance with method and project specific requirements	X
Check the completeness/accuracy of reported information	X
Data qualifiers	X
Secondary Reviewer	MDC

Primary Reviewer:
07-AUG-2009

Secondary Reviewer:
11-AUG-2009

CHECKLIST1 - Modified 03/05/2008
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Figure 2
Run Log

Run Log ID: 29520

Microbac Laboratories Inc.
Instrument Run Log

Instrument: LCMS1 Dataset: 080609.TXT
Analyst1: WTD Analyst2: NA
Method: 6850 SOP: Rev:

Maintenance Log ID: 29718

Column 1 ID: KP-RPPX250 Column 2 ID: NA
Workgroups: 308952
Internal STD: COA14015 Surrogate STD: NA Calibration STD STD34502
Comments:

Seq.	File ID	Sample Information	Mat	Dil	Reference	Date/Time
1	1LM.LM00155	CCB	1	1		08/06/09 09:23
2	1LM.LM00156	0.1 STD	1	1	STD34502	08/06/09 09:37
3	1LM.LM00157	0.2 STD	1	1	STD34502	08/06/09 09:52
4	1LM.LM00158	0.5 STD	1	1	STD34502	08/06/09 10:06
5	1LM.LM00159	1.0 STD	1	1	STD34502	08/06/09 10:21
6	1LM.LM00160	2.0 STD	1	1	STD34502	08/06/09 10:35
7	1LM.LM00161	5.0 STD	1	1	STD34502	08/06/09 10:49
8	1LM.LM00162	10.0 STD	1	1	STD34502	08/06/09 11:04
9	1LM.LM00163	ICV 1.0	1	1	STD34503	08/06/09 11:18
10	1LM.LM00164	MCT 0.2	1	1	STD34500	08/06/09 11:32
11	1LM.LM00165	CCB	1	1		08/06/09 11:47
12	1LM.LM00166	CCV 1.0	1	1	STD34502	08/06/09 12:01
13	1LM.LM00167	QCMRL 0.2	1	1	STD34502	08/06/09 12:16
14	1LM.LM00174	CCB	1	1		08/06/09 15:19
15	1LM.LM00175	QCMRL 0.2	1	1	STD34502	08/06/09 15:34
16	1LM.LM00176	CCV 1.0	1	1	STD34502	08/06/09 15:48
17	1LM.LM00177	MET BLK	1	1		08/06/09 16:02
18	1LM.LM00178	LCS	1	1	STD34502	08/06/09 16:17
19	1LM.LM00179	LCSD	1	1	STD34502	08/06/09 16:31
20	1LM.LM00180	L09070297-01 A 2X	1	2		08/06/09 16:45
21	1LM.LM00181	L09080013-01 A 2X	1	2		08/06/09 17:00
22	1LM.LM00182	L09080013-02 A 2X	1	2		08/06/09 17:14
23	1LM.LM00183	CCV 1.0	1	1	STD34502	08/06/09 17:29
24	1LM.LM00184	QCMRL 0.2	1	1	STD34502	08/06/09 17:43

Comments

Seq.	Rerun	Dil.	Reason	Analytes

Page: 1 Approved: 11-AUG-09

Michael Cochran

Microbac

ALS LABORATORY GROUP

STANDARD OPERATING PROCEDURE APPROVAL SHEET

SOP TITLE: Analytical Determination of White Phosphorus (P_4) using EPA method 7580

DOCUMENT CONTROL NUMBER: OP-SW-7580 – Revision 6~~5~~

EFFECTIVE DATE: August 10, 2009~~March 2, 2009~~

APPROVALS:

MANAGER ______________________________ Date __________________

QA MANAGER ______________________________ Date __________________

LAB DIRECTOR ______________________________ Date __________________

STANDARD OPERATING PROCEDURE

ANALYTICAL DETERMINATION USING EPA METHOD 7580

1.0 SCOPE AND APPLICATION

1.1 This SOP provides instructions to ALS Laboratory Group (ALS) for the determination of white phosphorus (P_4) in water and sediment/soil samples.

1.2 White phosphorus in pure form is a colorless or white, transparent, crystalline solid that has been used in poisons, smoke screens, matches, and fireworks, and has been used as a raw material in the production of phoshphoric acid. It has been used in smoke-producing munitions since World War I. White phosphorus is thermodynamically unstable in the presence of atmospheric oxygen. As a result, until recently, the prospect of long-term environmental contamination from smoke munitions was considered unlikely. However, a catastrophic die-off of waterfowl at a US military facility has been traced to the presence of P_4 in salt marsh sediments, and lead to the realization that P_4 can persist in anoxic sedimentary environments.

1.3 This SOP is based on a gas chromatographic procedure and is restricted to use by, or under the supervision of, analysts experienced in the use of gas chromatographic systems and skilled in the interpretation of the chromatograms and their use as a quantitative tool.

1.4 Confirmation of white phosphorus is not included in this SOP. Typically, samples are collected at sites where white phosphorus is known to be present. When confirmation is required samples should be submitted to more than one laboratory.

2.0 MODIFICATIONS FROM EPA METHOD 7580

2.1 No substantial modifications from the promulgated method have been made.

2.2 The volume of water extracted in Method 7580 is 30 mL, however, to enhance the detection limit, 120mL of water is used in this SOP.

2.3 The P_4 stock standards are not prepared in a glove bag or box as stated in the method, please refer to section 10. An equivalency study was completed which showed that preparation of the stock solution under nitrogen in a glove bag is not necessary. The equivalency study is on file with QA. ~~is in process with preliminary results being inconsistent with the use of a glove bag. The study will be completed by February 28, 2009~~.

3.0 SUMMARY OF METHOD

3.1 A 120 mL water sample is extracted once with 3.0 mL isooctane. A 1.0-µL aliquot of the extract is analyzed by GC/FPD.

3.2 Wet soil or sediment samples are analyzed by extracting a 40 g wet-weight aliquot of the sample with a mixture of 10.0 mL of reagent water and 10.0 mL of isooctane. The extraction is performed in a glass jar on a shaker for 18 hours. A 2.0-µL aliquot of the extract is analyzed by GC/FPD.

3.3 The concentration of P_4 in the extract is calculated using peak area ~~(or height)~~ and an external standard calibration procedure. The sample concentration is determined from the extract concentration using the final volume of the sample extract, sample volume (water samples) or sample weight (soils/sediments). Results from soils and sediments are reported on a wet weight basis.

3.4 A second column analysis is not performed.

4.0 SAFETY

4.1 P_4 should be treated as a potential health hazard, and exposure should be minimized. Each laboratory is responsible for maintaining awareness of OSHA regulations regarding safe handling of chemicals used in this method. Additional references to laboratory safety are available for the information of the analyst.

4.2 Because P_4 will spontaneously combust in air, caution should be taken. A NIOSH/MESA approved toxic gas respirator should be worn when the analyst handles high concentrations of these toxic compounds.

4.3 Refer to: ALS SOP LAB-005, "General Laboratory Safety and Chemical Hygiene" and the Safety Manual and Chemical Hygiene Plan of ALS Laboratory Group (ALS).

5.0 INSTRUMENTATION AND EQUIPMENT

5.1 A gas chromatograph equipped with a flame photometric detector with a phosphorus lens, on column split/splitless injector, auto sampler, and TurboChrom Pro data system, or equivalent.

5.1.1 Columns

5.1.1.1 This method uses a 30-m x 0.53-mm ID with 1.5 µm film thickness DB-I. Other columns can be substituted if deemed necessary if the substitute columns meet the QC requirements of the Method.

5.1.2 Instrument Parameters: The temperature program is set to facilitate adequate separation of all analytes. Gas flows are also set to facilitate separation and sensitivity. Temperature programs and flows depend on the actual column used. Suggested initial parameters are:

5.1.2.1 Column flow – 5 to 10 mL/min. using helium as the carrier gas. Detector flows- hydrogen 75 mL/min., air 90 mL/min.

5.1.2.2 Temperatures:

Injectors – On column

Detectors – 250 °C

Oven – 80 °C for 6 minutes

5.1.2.3 Injection Volume – approximately 2 µL splitless, open split valve at 45 seconds (0.75 minutes).

5.2 120 mL amber glass jars with Teflon-lined lid for water extractions.

5.3 4 oz amber glass wide mouth jars with Teflon lined lids for soil extractions.

5.4 Syringes: 10 µL thru 10 mL.

5.5 Vials: Glass 2-mL capacity with aluminum Teflon-lined crimp caps.

5.6 Platform shaker or equivalent.

5.7 Analytical balance.

5.8 Forceps for handling P_4.

5.9 Razor blades or scalpels for cutting P_4.

6.0 SAMPLING HANDLING REQUIREMENTS

6.1 All samples must be stored at 4 °C ± 2 °C. The temperature must be checked daily and recorded.

6.2 Samples and extracts must not be stored with the analytical standards.

6.3 Water samples must be extracted within 5 days of the date of collection. Soil samples must be extracted within 30 days.

6.4 Refer to: ALS SOP QS-DC-001, "Sample Receipt and Log-In (Environmental)" and the Environmental Quality Assurance Program Plan of ALS, Appendix 14.8, "Sample Preservation and Holding Times".

7.0 PRACTICAL QUANTITATION LIMITS (PQLs)

7.1 The practical quantitation limits for Method 7580 are 0.05 µg/L for water and 1.2 ~~0.5~~ µg/kg for soil.

8.0 INTERFERENCES

8.1 No chromatographic interferences with this SOP have been observed, in part due to the selectivity of the flame photometric detector in the phosphorous mode. Typically, P_4 is the only peak in each chromatogram. DataChem has determined that organophosphorous pesticides do not coelute with P_4.

9.0 REAGENTS

9.1 Solvents: Toluene and Isooctane, pesticide-grade or equivalent.

9.2 Reagent Water: ASTM Type II water free of interfering compounds, degassed.

10.0 STANDARDS

10.1 Stock Standard Solutions

10.1.1 A stock solution is prepared by tare weighing a volumetric flask containing toluene and transferring an aliquot of P_4, to the volumetric flask. Cut a piece of P_4 under the water so that all sides are lustrous on all surfaces. Transfer to the tared volumetric flask. The volumetric flask is reweighed to determine the weight of the P_4 and then diluted~~ing~~ to volume in toluene. 10.2 Intermediate Standards

10.2.1 Intermediate standards are prepared as needed through dilution in toluene of the stock standard solutions from section 10.1 above.

10.3 Working Standards

10.3.1 Prepare working standards by diluting the intermediate standard with isooctane. Prepare ~~W~~working standards at a minimum of five concentration levels for linear calibration ~~(~~and a minimum of six levels for quadratic fit.~~)~~ ~~are prepared through dilution of the intermediate standards with isooctane.~~ The concentration of the low standard must be at the concentration equal to the PQL. The remaining concentration levels correspond to the expected range of concentrations found in actual samples or define the working range of the GC.

10.4 Aqueous Spiking Solutions for ICV/LCS/MS/MSD~~LCS/MS/MSD~~

10.4.1 ~~Preparation of~~ An aqueous P_4 stock solution is prepared independently from the calibration standards by a second person.

10.4.1.1 Place excess P_4 in water, stir continuously.

10.4.1.2 The P_4 concentration of saturated water ~~is~~ is not consistent and will change dramatically with conditions.

10.4.2 Dilute the stock solution into range so that 10 mL extracted with 10 mL isooctane will fall in the calibration range. ~~Extract an aliquot of the aqueous stock solution and analyze following section 12.~~ Analyze the extract and ~~D~~determine the concentration of the stock solution.

10.4.3 For water samples spike 50 uL of the aqueous solution into each LCS, MS, MSD. ~~Prepare a water spiking solution at 0.14 µg/mL by diluting the aqueous stock solution in water. A one-mL spike in a 120-mL extraction yields a spike concentration of 1.2 µg/L.~~

10.4.4 For soil spike 250 µL of the aqueous stock solution into each LCS, MS, MSD.~~Prepare a soil spiking solution at 0.04 µg/mL by diluting the aqueous stock solution. A one-mL spike yields a concentration of .001 µg/g for a 40-gram sample.~~

10.5 Initial Calibration Verification (ICV)

10.5.1 The LCS sample is also the ICV and is prepared independently by a second person.

10.6~~5~~ Storage and Expiration

10.6~~5~~.1 All standards and spiking solutions must be stored in the dark at 4 °C ± 2 °C in screw-cap bottles or test tubes.

10.6~~5~~.2 Concentrated Stock Solutions have an expiration date of one year from preparation. The vendor's expiration date may be used for purchased solutions.

10.6~~5~~.3 All intermediate solutions have an expiration period of up to six months from preparation, but must not exceed the expiration date of the parent solution from which the intermediate is prepared.

10.6~~5~~.4 Working standards have an expiration period of up to six months but must not exceed the expiration of the intermediate or stock solutions from which the working standards are prepared.

11.0 CALIBRATION AND STANDARDIZATION

11.1 Calibration and Standardization

11.1.1 Analyze the calibration standards prepared in Section 10.3. Six concentration levels are required for a quadratic fit and five for a linear fit. ~~Prepare and analyze a minimum of six standards of varying concentration (five for linear fit). One standard should contain the method analytes at the PQL for each compound.~~ The standards should bracket the concentration range expected in samples. Analyze one standard at the PQL.

11.1.2 Analyze each calibration standard and tabulate peak area response versus the concentration in the standard. ~~The results can be used to prepare a calibration curve for each compound.~~

11.1.3 An initial calibration curve is constructed by the TotalChrom data system for P_4 using the concentration and peak areas of the initial calibration standards. The calibration curve is constructed using a linear or quadratic fit of the data.

11.2 Calibration Criteria

~~11.2.1 An initial calibration curve is constructed by the TotalChrom data system for~~ ~~P_4~~ ~~using the concentration and peak areas (or peak heights) of the initial calibration standards at a minimum of six different concentration levels for quadratic and five for linear. The calibration curve is constructed using a linear or quadratic fit of the data.~~

11.2.1~~2~~ The initial calibration acceptance criterion using linear curve fitting is that the correlation coefficient (r) must be equal to or greater than 0.99.

11.2.2~~3~~ The initial calibration acceptance criterion using quadratic curve fitting is that the coefficient of determination (COD) must be greater than or equal to 0.99.

11.3 Continuing Calibration Verification (CCV)

11.3.1 A CCV is analyzed at the beginning, and end of each sequence and after every ten samples.

11.3.2 Acceptance criteria for the CCV is that the result for the CCV quantitated against the curve is within ±15% of the target value.

11.3.3 Samples must be bracketed with CCV standards that meet the 15% criterion.

11.4 Refer to: the Environmental Quality Assurance Program Plan of ALS, Appendix 14.7, “Summary of Calibration and Corrective Action”.

12.0 ~~SAMPLE~~ PROCEDURE

12.1 ~~Water~~Sample Preparation for Water

12.1.1 Water samples must be extracted within five days of collection and analyzed within thirty days from extraction.

12.1.2 Measure out 120 mL of sample using a graduated cylinder. To avoid cross-contamination use a different clean graduated cylinder for each sample. Place 120 mL of water sample in an amber glass jar with Teflon lined cap, add 3.0 mL of isooctane and shake for five minutes.

12.1.3 Transfer an aliquot of the isooctane extract to an autosampler vial with Teflon lined cap, for analysis.

12.2 ~~Soil~~Sample Preparation for Soil

12.2.1 Soil samples do not have a method established holding time. Samples are extracted within thirty days of sample collection and analyzed within thirty days from preparation.

12.2.2 Weigh out 40 grams of soil sample and transfer a 4-oz wide mouth amber glass jar with Teflon lined cap. Add 10 mL of water and 10mL of isooctane and shake for 18 hours.

12.2.3 Transfer the isooctane extract to an autosampler vial with Teflon lined cap for analysis.

12.3 Analysis of Soil and Water Extracts

12.3.1 Inject ~~2 µL~~ of each standard, QC blank and field sample into the gas chromatograph.

12.3.2 The instrument must meet calibration criteria provided in Section 11 before sample analysis can begin.

13.0 CALCULATIONS

13.1 Typically a linear fit of the calibration data is used. The general equation is:

y = ax + b

where a and b are determined by the calibration data.

13.2 ~~Typically quadratic curve fitting is used~~ A quadratic fit may also be used for the initial calibration standards. This part of the procedure is identical for soil and water matrices. The general quadratic equation is:

$$y = \text{instrument response} = ax^2 + bx + c,$$

where x is the concentration and a, b, and c are parameters determined by the best fit to the calibration data.

$$\text{Note: } x = \left[\frac{-b \pm \sqrt{b^2 - 4a(c - y)}}{2a}\right]$$

13.3~~2~~ The concentration of a water~~the~~ sample is expressed in µg/L~~ for water samples~~:

$$\text{Conc. Sample} = (\mathrm{D})(C_S)\left(\frac{3mL}{120mL}\right)\left(\frac{1000mL}{L}\right) = \frac{\mu g}{L}$$

Where:
D = Dilution factor, if dilution was made for the sample prior to analysis. If no dilution was made, D = 1; dimensionless.
C_s = Sample concentration in µg/mL~~L~~ (from the calibration curve).

13.4 The concentration of a soil sample is expressed in µg/Kg:

$$\text{Conc. Sample} = (\mathrm{D})(C_S)\left(\frac{10mL}{40g}\right) = \frac{1000g}{Kg} = \frac{\mu g}{Kg}$$

Where:
D = Dilution factor.
C_s = Sample concentration µg/mL (from the calibration curve).

14.0 QUALITY CONTROL

14.1 Each laboratory that uses this method is required to operate a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and an ongoing analysis of CCV, method blank, laboratory control sample LCS, matrix spike and matrix spike duplicate (MS/MSD), and to evaluate and document data quality. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method.

14.1.1 ~~An MDL study will be performed annually.~~Reporting Limit Verification Sample (RLVS) is analyzed with each batch and is used to calculate MDL's.

14.1.2 Each day of analysis, the analyst must analyze a method blank to demonstrate that interferences from the analytical system are under control before any samples are analyzed. In general, background interferences coeluting with method analytes should be below half the PQL.

14.1.3 The laboratory must, on an ongoing basis, demonstrate through the analyses of laboratory control samples (LCS) that the operation of the measurement system is in control. The frequency of the LCS analyses is one for each sample batch of up to twenty field samples. The LCS is prepared by spiking the reference blank matrix with the matrix spiking solution and then extracting and analyzing as a sample.

14.1.4 The LCS acceptance criterion is 75 to 125% recovery. Calculated control limits for LCS will be used as required for specific projects.

14.1.5 A matrix spike and matrix spike duplicate will be analyzed with each sample batch of up to 20 field samples. Acceptance limits for MS/MSD are 65% to 135%.

14.2 The analyst must establish the ability to achieve low detection limits and generate acceptable accuracy and precision using this method before analysis of samples.

14.3 Refer to: ALS SOP XX-DC-018, "Evaluation of Quality Control Data" and the ALS Environmental Quality Assurance Program Plan, Section 10, "Quality Control Procedures", Section 11, "Data Reduction, Verification, and Reporting", Section 12, "Corrective Action", Appendix 14.7, "Summary of Calibration and Corrective Action", and Appendix 14.10, "Batch QC and Corrective Action Flowcharts". Nonconformance procedures are in accordance with ALS SOP LAB-020, "Nonconformance/Corrective Action Report (NC/CAR) Procedures".

15.0 REPORTING RESULTS

15.1 All results are reported on an ALS ~~DataChem Laboratories~~ Analytical Report Form or equivalent in either µg/L or µg/Kg .

15.2 Quality Control Data must be submitted with each analytical batch.

16.0 PREVENTIVE MAINTENANCE

16.1 Refer to: ALS SOP LAB-002, “Preventive Maintenance for Analytical Instrumentation”.

17.0 WASTE MANAGEMENT

17.1 Refer to: ALS SOPs LAB-004, “Hazardous Waste Handling and Disposal” and LAB-005, “General Laboratory Safety and Chemical Hygiene”.

18.0 DEFINITIONS

18.1 Refer to: the Environmental Quality Assurance Program Plan of ALS, Appendix 14.12, “Definitions and Terms”.

STANDARD OPERATING PROCEDURES
SOLID EXTRACTION OF NITROAROMATICS AND NITRAMINES
METHOD 8330

Issue/Implementation Date: 15 March 2010

Last Review Date: 01 August 2011

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Approved by:

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Leslie S. Bucina, Quality Assurance Officer — Date: 8/1/11

David E. Vandenberg, Managing Director — Date: 8/1/11

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1.0 SCOPE AND APPLICATION

1.1 Soil and sediment samples are extracted using acetonitrile in an ultrasonic bath, filtered and analyzed using SW 846 Methods 8330A or 8330B.

1.2 This SOP also contains special sample preparation procedures to comply with the unique requirements presented in DoD's "Guide for Implementing SW-846 Method 8330B", July 7, 2008. The laboratory uses the LIMS to indicate when the special DoD/EDQW procedures must be followed.

1.3 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

GC/MS	Gas Chromatography/Mass Spectrometer
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MDL	Method Detection Limit
QC	Quality Control
RL	Reporting Limit
SOP	Standard Operating Procedure
L	Liter
mL	Milliliter
N	Normality
ug	Microgram

For a more comprehensive list of common terms and definitions, consult Appendix A in Microbac SOP LQAP.

2.0 SAFETY PRECAUTIONS

2.1 Standard precautionary measures used for handling other organic compounds should be sufficient for the safe handling of the analytes targeted by Method 8330. The only extra caution that should be taken is when handling the analytical standard neat material for the explosives themselves and in rare cases where soil or waste samples are highly contaminated with the explosives. Follow the note for drying the neat materials at ambient temperatures.

2.2 It is advisable to screen soil or waste samples using Method 8510 to determine whether high concentrations of explosives are present. Soil samples as high as 2% 2,4,6-TNT have been safely ground. Samples containing higher concentrations should not be ground in the mortar and pestle. Method 8510 is for 2,4,6-TNT, however, the other nitroaromatics will also cause a color to develop and provide a rough estimation of their concentrations. 2,4,6-TNT is the analyte most often detected in high concentrations in soil samples. Visual observation of a soil sample is also important when taken from a site expected to contain explosives. Lumps of material that have a chemical appearance should be suspect and not ground. Explosives are generally a very finely ground grayish-white material.

2.3 Proper lab coats, gloves and safety glasses must be worn while performing this extraction.

3.0 SAMPLE PRESERVATION AND STORAGE

3.1 Samples should be collected in widemouth glass containers with teflon lined caps.

3.2 Sample preservation should be at ≤ 6° C and the sample maximum holding time from date of collection is 14 days. Samples and sample extract must be kept in the dark at ≤ 6° C.

3.3 Sample dried and crushed weight needed for extraction is 2.0 g if using 8330A and 10.0 g if using 8330B. Contact the Customer Service Representative if insufficient sample is provided for extraction.

3.4 For DoD projects that specify multi increment sampling, a minimum of 1 kg of soil is required.

4.0 INTERFERENCES AND CORRECTIVE ACTION

4.1 Solvents, reagents, glassware and other sample processing hardware may yield discrete artifacts and/or elevated baseline, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences.

4.2 2,4-DNT and 2,6-DNT elute at similar retention times (retention time difference of 0.2 minutes). A large concentration of one isomer may mask the response of the other isomer. If it is not apparent that both isomers are present (or are not detected), an isomeric mixture is reported.

4.3 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. All samples expected to contain tetryl should not be exposed to temperatures above room temperature.

4.4 Degradation products of tetryl appear as a shoulder on the 2,4,6-TNT peak. Peak heights rather than peak area should be used when tetryl is present in concentrations that are significant relative to the concentration of 2,4,6-TNT.

5.0 EQUIPMENT AND SUPPLIES

5.1 Major Instrumentation

5.1.1 Temperature controlled ultrasonic bath

5.2 Apparatus or equipment

5.2.1 Balance ± 0.01 g

5.2.2 Mortar and pestle

5.2.3 Coffee grinder Kitchen Aid (14 cup, 4 oz. 120 mL) or equivalent

5.2.4 Puck Mill – Lab Tech Essa Lm2-P or equivalent

5.3 Glassware

5.3.1 Pipets - Class A, glass

5.3.2 Pasteur pipets

5.3.3 Scintillation Vials - 40 mL amber, glass

5.3.4 Vials - amber, glass, Teflon-lined cap

5.3.5 Graduated cylinder – 10 mL TD

5.4 Other supplies

5.4.1 Syringes – 1 mL

5.4.2 Sieve – 10 mesh [2.00 mm], 200 mesh [75 um], and 30 mesh [600 um]

5.4.3 Drying trays

5.5 Glassware cleaning should be performed by following Microbac SOP 37.

6.0 STANDARDS AND REAGENTS

6.1 All purchased stock standards and reagents are logged into the LIMS system and assigned certificate of analysis (COA) numbers. All intermediate and working solutions are similarly logged into the LIMS and assigned STD or RGT numbers. Detailed information regarding solution concentrations, aliquot volumes and final volumes and concentrations are included under the STD or RGT number.

6.2 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, 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 lowering the accuracy of the determination.

6.3 Acetonitrile, CH_3CN - HPLC grade.

6.4 Organic-free reagent water - All references to water in this method refer to organic-free reagent water, as defined in Chapter One of SW846.

6.5 Surrogate: 1,2-Dinitrobenzene 5.0 ug/mL (Accustandard M-8330-SS).

6.6 Spike: (ACCUSTANDARD M-8330-R) or equivalent.

2-Amino-4,6-dinitrotoluene	5.0 ug/mL
4-Amino-2,6-dinitrotoluene	5.0 ug/mL
1,3-Dinitrobenzene	5.0 ug/mL
2,4-Dinitrotoluene	5.0 ug/mL
2,6-Dinitrotoluene	5.0 ug/mL
HMX	5.0 ug/mL
RDX	5.0 ug/mL
Nitrobenzene	5.0 ug/mL
2-Nitrotoluene	5.0 ug/mL

3-Nitrotoluene	5.0 ug/mL
4-Nitrotoluene	5.0 ug/mL
Tetryl	5.0 ug/mL
TNT	5.0 ug/mL
1,3,5-Trinitrobenzene	5.0 ug/mL
Nitroglycerin	5.0 ug/mL

Other compounds of concern may be:

PETN	5.0 ug/mL

6.7 LCS for 8330B DoD – ERA Custom SRM – Cat. No. 093

6.8 Soil Blank Media

6.9 Calcium chloride ($CaCl_2$) – Reagent grade prepared aqueous solution at 5 g/L.

7.0 DIAGRAM OR TABLE TO OUTLINE PROCEDURES

Start

↓

Place 2.0 g or 10.0 g of sample into 40 mL vial

↓

Add spike solution to LCS, MS and MSD.
Add surrogate solution to blank, QC and all samples

↓

Add 10 mL or 20 mL of acetonitrile

↓

Put on cooled ultrasonic bath for 18 hours.
The bath temperature must not exceed 30º C

↓

After sonication let sample settle for 30 minutes, then remove 5 mL and dilute with 5 mL of DI H_2O*

↓

Place supernatant into syringe and filter through 0.45 um filter

* 8330A uses $CaCl_2$

8.0 SAMPLE PREPARATION

8.1 Microbac will follow these procedures for drying, sieving, grinding, and multi-Increment subsampling of soil samples in preparation for SW-846 method 8330B. The laboratory obtained additional guidance for these procedures from "DoD Guide for Implementing EPA SW-846 Method 8330B", July 7, 2008.

NOTE: When following 8330A samples are dried to a constant weight at room temperature. The samples are then ground and homogenized to pass through a 30 mesh sieve. The rest of Section 8.0 does not apply to 8330A.

8.2 Sample Drying

Record the date, time, and ambient temperature of the drying room for each day of the drying period.

Before proceeding to the sieving step, the laboratory must verify that the samples have percent solids level of 99%, or higher, or that they reached a constant weight, with consecutive weights agreeing within 1%.

Once dry weigh the entire sample to the nearest 0.1 g and record on the benchsheet. Remove the entire contents of the 8330 sample container and spread the soil evenly in a shallow pan lined with aluminum foil.

8.3 Sieving Procedure

Gently crush the air-dry soil using a large spoon or glass rod and transfer to a clean 2 mm sieve. Stir, shake, and mix the sample and allow it to pass through the sieve, and collect in a foil-lined pan. Do not use excessive force in this step, as this may damage the screens. Do not intentionally include vegetation in the portion that passes the sieve. Remove all large pebbles, sticks, and other solids too large to pass through a 2 mm screen. Collect and weigh any portion that does not pass the sieve. The sample is now the portion that passes the 2 mm screen.

8.4 Grinding Procedure

Transfer the sieved sample to a puck mill, coffee grinder, or mortar and pestle. The choice of the grinding equipment will be project defined. Grind entire sample reducing the particle size to 75 micron, or less.

NOTE: The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to < 75 um by passing representative portions of ground sample through a 200 mesh sieve.

8.5 Sub-sampling

Transfer the entire ground sample to a clean shallow pan, spreading the soil to thickness of 1–2 cm. Using a small spatula, randomly remove at least thirty increments of approximately 0.33 g each, giving a representative subsample of 10.0 g. Record the weight of the subsample to the nearest 0.01 g. This is the sample aliquot to be taken for extraction via ultrasonic bath.

8.6 Triplicate Analysis and MS/MSD (EDQW or other projects as specified)

For each sample delivery batch of 1–20 samples, process the client-specified sample(s) in triplicate by processing three discrete 10.0 g sub-samples as per 8.4. Individual projects may vary the rate of samples processed in triplicate. Repeat the subsampling procedure two more times for each sample specified for MS/MSD. Do not perform triplicate analysis on any type of blank material.

8.7 Grinding Blanks (EDQW or other projects as specified)

A grinding blank with each batch of samples is used to verify the effectiveness of the cleaning procedures. Some projects may require grinding blanks after each sample. The project QAPP specifies the frequency of these blanks, and are logged into the LIMS accordingly. The grinding blank(s) must meet the same criteria as the 8330B method blank (no target analytes ≥ one-half the RL).

8.8 Grinder Cleaning Procedures

Use the following procedures to clean the mortar and pestle, coffee grinder(s), or puck and bowl between samples:

1. Remove bowl/blade from base of grinder or bowl and puck from mill.
2. Immerse bowl/blade or puck in soapy water and remove all visible soil residue
3. Rinse with tap water
4. Rinse with Deionized (DI) Water
5. Wipe with paper towel and air dry and with puck and bowl can use acetone.

8.9 MDL Verification Procedures

The laboratory will verify MDLs with blank spikes at approximately two (2) times the current MDLs . These samples are spiked pre-grinding (step 8.4). Perform these verification procedures after the initial MDL study, and quarterly thereafter.

9.0 ANALYTICAL PROCEDURES

9.1 Place 10.0 g sub-sample (sample homogenized, dried, and ground as in Section 8.0) of each soil in a 40 mL amber vial. Add 1 mL of surrogate to all samples, blanks, LCS and spikes. Add 1 mL of spike to all designated QC. Add 20 mL of acetonitrile, cap with a Teflon-lined cap, and swirl for 1 minute. Place in a cooled ultrasonic bath for 18 hours. The temperature of the bath must not exceed 30° C. [For screening purposes, the ultrasonic bath time may be cut to 4 hours] **NOTE:** If performing 8330A, only 2.0 g of sub-sample is needed and 10 mL of acetonitrile is used.

9.2 Remove 5 mL of extract and dilute with 5 mL of DI H_2O. After extraction, allow the sample to settle for thirty (30) minutes. If performing 8330A, dilute with 5 mL of $CaCl_2$ instead of DI H_2O.

9.3 Using a 10 mL disposable syringe, remove 8 mL of the extract and filter through a 0.45 um PTFE filter, discarding the first mL. You may remove any remaining solids using centrifugation.

10.0 QUALITY CONTROL REQUIREMENTS

10.1 Standard Requirements

10.1.1 A reagent blank, LCS, MS and MSD are extracted with each batch. The only exception is if the client does not send enough sample to perform a MS and MSD, then a reagent blank, LCS and a LCSD is performed at the client's request.

10.1.2 All batch quality control samples are subjected to exactly the same extraction and clean-up procedures as those used on actual samples in the extraction batch.

10.2 DoD DoD/EDQW Requirements (This does not apply if using 8330A.)

10.2.1 Each preparation batch must consist of a minimum of a method blank and an LCS using the DoD SRM. The batch may also include MS/MSD samples, triplicate samples, and additional grinding blanks as specified in the LIMS project details. The laboratory will subject the batch QC samples to the sample preparation procedures (Section 8.0) as the field samples.

10.2.2 For the method blank, weigh a nominal 10.0 g subsample of ground soil blank media (6.8), record the weight to 0.01 g, and perform normal extraction.

10.2.3 For the LCS and LCSD, weigh a nominal 10.0 g subsample of the dry, ground DoD SRM (6.7), record the weight to 0.01 g, and perform the normal extraction.

10.2.4 For MS/MSD samples, weigh a nominal 10.0 g subsample of the ground parent, record the weight to 0.01 g, spike with 1000 uL of spike solution (6.6), and perform the normal extraction.

10.3 Control of Nonconforming Data

The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred. The policies and procedures are found in Section 13.0 of Microbac SOP LQAP (Laboratory Quality Assurance Program), Microbac SOP GP-CAPA (Corrective Action/Preventive Action: Initiating, Tracking and Monitoring) and Microbac SOP GP-RCA (Root Cause Analysis).

11.0 WASTE MANAGEMENT AND POLLUTION CONTROL

11.1 Microbac is dedicated to eliminating or minimizing any and all laboratory waste, which requires disposal or contributes to pollution of any type. To that extent Microbac has implemented new technology and converted to micro techniques when available to facilitate these goals.

Each laboratory generates specific waste streams which are segregated and collected in labeled satellite containers. The analysts in each department are responsible for proper disposal of the spent samples and chemical waste in the specified satellite waste collection vessel. The waste management technician checks the satellite containers either daily, or as needed. They are then combined into waste drums in our explosion-proof waste building located outside of the Microbac laboratory facility. These drums are labeled with start date and a manifest is created for each. They are picked up on a regular basis for disposal at a licensed disposal facility.

11.2 Laboratory policies and procedures for management of hazardous waste are found in Microbac SOP 33 – Laboratory Waste Management and the waste management section of the analytical SOPs contain procedures specific to each method. All laboratory waste is accumulated, stored and disposed in accordance with all federal and state laws and regulations. Each employee receives training in the proper handling and disposal of hazardous waste that is specific to their job description. As a hazardous generator, we are subject to inspection from the Ohio EPA.

11.3 The following are waste streams in the sample preparation area, for the solid extraction Methods 8330A and 8330B.

11.3.1 Non-Halogenated solvents: Hexane, Ether, Methanol, Acetone

11.3.2 Acetonitrile: Acetonitrile

11.3.3 Solid Waste: Filters, tongue depressors, gloves, any solid material that is a waste after being processed in the lab. These wastes are all kept in satellite containers in each lab and are combined into the proper 55 gallon waste drums in our explosion proof waste building located outside of the Microbac laboratory facility by a waste disposal technician. These drums are labeled and a manifest is created for each drum.

12.0 REFERENCES

12.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Method 8330A and 8330B, 8510.

12.2 "Guide for Implementing, SW-846 Method 8330B", DoD Environmental Data Quality Workgroup, July 7, 2008.

12.3 Microbac SOP37 "Standard Operating Procedure for Extraction Glassware Washing"

12.4 Microbac SOP 33 "Laboratory Waste Management"

12.5 Microbac SOP LQAP "Laboratory Quality Assurance Plan"

12.6 Microbac SOP GP-CAPA "Corrective Action/Preventive Action: Initiating, Tracking and Monitoring"

12.7 Microbac SOP GP-RCA "Root Cause Analysis"

12.8 Microbac SOP 45 "Method Validation Procedures"

STANDARD OPERATING PROCEDURE
LIQUID EXTRACTION OF NITROAROMATICS AND NITRAMINES
SW846 METHOD 8330

Issue/Implementation Date: 15 March 2010

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Approved by:

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Chad E. Barnes, Extraction Supervisor — Date

Leslie S. Bucina / WTD — 6-29-11
Leslie S. Bucina, Quality Assurance Officer — Date

/ DLB — 6/29/11
David E. Vandenberg, Managing Director — Date

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1.0 SCOPE AND APPLICATION

1.1 This method is intended for the extraction of trace analysis of explosive residues by High Performance Liquid Chromatography (HPLC) using a UV detector. Water samples are extracted using acetonitrile and analyzed by HPLC. This method is from SW-846 Methods 8330A and 8330B.

1.2 Solid-phase Extraction Method (SPE): Aqueous samples are extracted using SPE media. Target analytes are eluted from the SPE media using the appropriate solvent.

1.3 High-level Direct Injection Method: Aqueous samples of higher concentration can be diluted 1/1 (v/v) with methanol or acetonitrile, filtered separated on a C-18 reverse phase column, determine at 254 nm, and confirmed on a CN reverse phase column. If HMX is an important target analyte, methanol is preferred.

1.4 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

GC/MS	Gas Chromatography/Mass Spectrometer
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MDL	Method Detection Limit
QC	Quality Control
RL	Reporting Limit
SOP	Standard Operating Procedure
L	Liter
mL	Milliliter
N	Normality
ug	Microgram

For a more comprehensive list of common terms and definitions, consult Appendix A in Microbac SOP LQAP.

2.0 SAFETY PRECAUTIONS

2.1 Standard precautionary measures used for handling other organic compounds should be sufficient for the safe handling of the analytes targeted by Method

8330B. The only extra caution that should be taken is when handling the analytical standard neat material for the explosives.

2.2 Proper lab coats, gloves and safety glasses must be worn while performing this extraction.

3.0 SAMPLE PRESERVATION AND STORAGE

3.1 Samples should be collected in 1 L glass containers with teflon lined caps.

3.2 Sample preservation should be at ≤ 6° C and the sample maximum holding time from date of collection is 7 days. Samples and sample extracts must be stored in the dark at ≤ 6° C.

3.3 The sample volume needed to perform this extraction is 1 L. Contact the Customer Service Representative if insufficient sample is provided.

4.0 INTERFERENCES AND CORRECTIVE ACTION

4.1 Solvents, reagents, glassware and other sample processing hardware may yield discreet artifacts and/or elevated baseline, causing misinterpretation of the chromatograms. All of these materials must be demonstrated to be free from interferences.

4.2 2,4-DNT and 2,6-DNT elute at similar retention times (retention time difference of 0.2 minutes). A large concentration of one isomer may mask the response of the other isomer. If it is not apparent that both isomers are present (or are not detected), an isomeric mixture is reported.

4.3 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. All samples expected to contain tetryl should not be exposed to temperature above room temperature.

4.4 Degradation products of tetryl appear as a shoulder on the 2,4,6-TNT peak. Peak heights rather than peak areas should be used when tetryl is present in concentrations that are significant relative to the concentration of 2,4,6-TNT.

5.0 EQUIPMENT AND SUPPLIES

5.1 Apparatus or Equipment

5.1.1 Extraction manifold

5.1.2 Balance: Capable of weighing 100 g to nearest 0.01 g.

5.2 Glassware

5.2.1 Scintillation Vials - 20 mL, glass.

5.2.2 Vials - 15 mL, glass Teflon-lined cap.

5.2.3 SPE filtration flask

5.2.4 SPE collection vials

5.3 Other Supplies

5.3.1 High performance solid phase extraction disk: SDB-RPS (Reverse phase sulfonate) 47 mm or equivalent

5.3.2 Syringes - various sizes

5.4 Glassware cleaning should be performed by following MICROBAC SOP 37.

6.0 STANDARDS AND REAGENTS

6.1 All purchased stock standards and reagents are logged into the LIMS system and assigned certificate of analysis (COA) numbers. All intermediate and working solutions are similarly logged into the LIMS and assigned STD or RGT numbers. Detailed information regarding solution concentrations, aliquot volumes and final volumes and concentrations are included under the STD or RGT number.

6.2 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, 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 lowering the accuracy of the determination.

6.2.1 Acetonitrile, CH_3CN - HPLC grade.

6.2.2 Methanol, CH_3OH - HPLC grade.

6.3 Organic-free reagent water - All references to water in this method refer to organic-free reagent water, as defined in Chapter One of SW846.

6.4 Surrogate - 1,2-Dinitrobenzene 5.0 ug/mL (Accustandard M-8330-SS).

6.5 Spike (Accustandard M-8330-R) or equivalent

2-Amino-4,6-dinitrotoluene	5.0 ug/mL
4-Amino-2,6-dinitrotoluene	5.0 ug/mL
1,3-Dinitrobenzene	5.0 ug/mL
2,4-Dinitrotoluene	5.0 ug/mL
2,6-Dinitrotoluene	5.0 ug/mL
HMX	5.0 ug/mL
RDX	5.0 ug/mL
Nitrobenzene	5.0 ug/mL
2-Nitrotoluene	5.0 ug/mL
3-Nitrotoluene	5.0 ug/mL
4-Nitrotoluene	5.0 ug/mL
Tetryl	5.0 ug/mL
TNT	5.0 ug/mL
1,3,5-Trinitrobenzene	5.0 ug/mL
Nitroglycerin	5.0 ug/mL

Other compounds of concern may be:

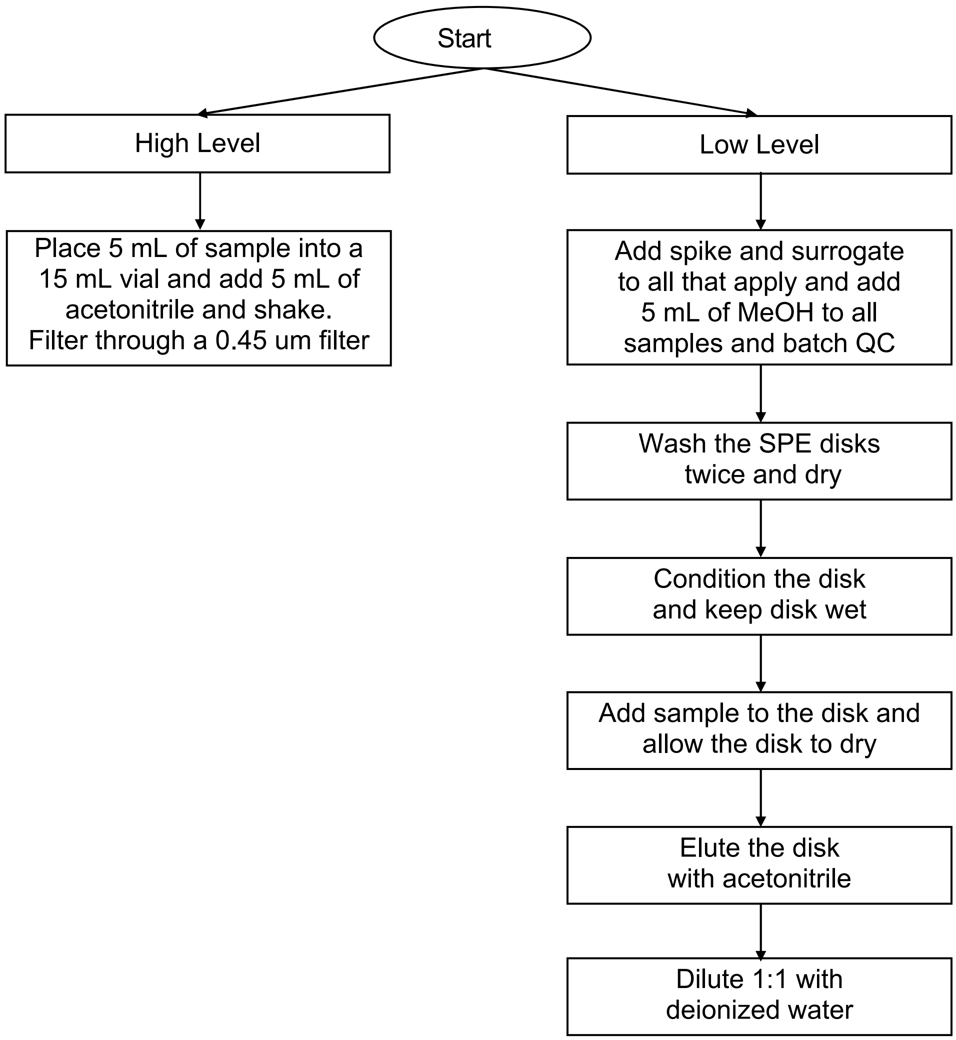
PETN	5.0 ug/mL

6.6 Filter Aid 400

7.0 SAMPLE PREPARATION

7.1 Extraction Methods 8330A, 8330B and 3535A from SW-846.

8.0 DIAGRAM OR TABLESTO OUTLINE PROCEDURES



9.0 ANALYTICAL PROCEDURES

9.1 High-Level Method

9.1.1 It is highly recommended that process waste samples be screened with the high-level method to determine if the low level method (1-50 ug/L) is required. Most groundwater samples will fall into the low level method.

9.1.2 Sample filtration: Place a 5 mL aliquot of each water sample in a scintillation vial add 5 mL of acetonitrile. Add 100 uL of surrogate to all samples, spike LCS and blanks. Add 100 uL of spike to the LCS and to the samples designated as matrix spikes. Cap the vials and shake thoroughly. Once shaken, filter through a 0.45 um Teflon filter using a 10 mL luer lock disposable syringe. Discard the first 3 mL of filtrate, and retain the remainder in a Teflon-capped vial for RP-HPLC analysis. HMX quantitation can be improved with the use of methanol rather than acetonitrile for dilution before filtration.

9.2 Solid-phase Extraction (SPE)

9.2.1 Mark the level of the sample on the outside of the sample container for later determination of the sample volume used. Shake the container for several minutes, with the cap tightly sealed, to ensure that any particulate matter is evenly distributed throughout the sample.

9.2.2 Prepare a method blank and a LCS from a 1 L volume of organic free reagent water, or a volume of reagent water similar to that being used for the samples (e.g., a 250 mL blank should be used when the samples size is 250 mL, etc.). The blank may be prepared in a graduated cylinder, beaker, or other suitable container.

9.2.3 Add 1 mL of surrogate to all samples and batch QC and add 1 mL of spike to the spiked samples and/or LCS. Add 5 mL of methanol to all samples and batch QC.

9.2.4 Shake the sample to mix the surrogates and allow the sample to stand for at least several minutes. This will permit the surrogates to dissolve in the sample and will also allow the particulate matter to settle after spiking, which will speed the filtration process, somewhat.

9.2.5 There is no pH adjustment. The samples are extracted as received.

9.2.6 Assemble a manifold for multiple disk extractions using 47 mm or 90 mm extraction disks. Use a filter flask with the standard filter apparatus for single extractions, using 47 mm or 90 mm extraction disks.

9.2.7 If samples contain significant quantities of particulates, the use of a filter aid or pre-filter is advisable for disk extractions. Empore Filter Aid 400, Whatman GMF 150, or equivalent pre-filters are recommended.

9.2.7.1 Pour about 40 g of Filter Aid 400 onto the surface of the disk after assembling the standard filter apparatus.

9.2.7.2 Alternatively, place the Whatman GMF 150 on top of the extraction disk prior to clamping the glass reservoir into the standard filter apparatus.

9.2.8 Prior to use, the extraction disks must undergo two separate washing steps, the first washing step is performed by rinsing 5 mL of acetonitrile down the sides of the glass reservoir. Pull a small amount of solvent through the disk with a vacuum. Turn off the vacuum and allow the disk to soak for about one (1) minute. Pull the remaining solvent through the disk and allow the disk to dry. **NOTE:** When using a filtration aid adjust the volume of all wash solvents so the entire filtration bed is submerged. The second wash uses 15 mL of acetonitrile and is performed just like the first wash step.

9.2.9 The extraction disks are composed of hydrophobic materials, which will not allow water to pass unless they are pre-wetted with a water-miscible solvent before being used for sample extraction. This step is referred to as conditioning.

NOTE: Beginning with the conditioning step, it is **CRITICAL** that the disk **NOT** go dry until after the extraction steps are completed. Should a disk accidentally go dry during the conditioning steps, the conditioning steps for that disk **MUST** be repeated prior to adding the sample.

9.2.10 Add 15 mL of acetonitrile to the extraction apparatus. Apply a vacuum until a few drops of solvent pass through the disk ensuring that the disk is soaked with solvent. Turn off the vacuum and allow the disk to soak for 3 minutes.

NOTE: When using a filtration aid, adjust the volume of conditioning solvents so that the entire filtration bed remains submerged until the extraction is completed.

9.2.11 Once the soaking time is over, apply the vacuum again, drawing all but a thin layer of solvent through the disk. Stop the vacuum just before the disk goes dry.

9.2.12 Add the 30 mL of deionized (DI) water and apply vacuum to draw the water through the disk. Stop the vacuum just before the disk goes dry, leaving 2-3 mm of water above the surface of the disk.

9.2.13 After performing the washing and conditioning steps, pour the sample into the reservoir and, under full vacuum, filter it as quickly as the vacuum will allow (at least 10 minutes). Transfer as much of the measured volume of water as possible.

NOTE: With heavily particle-laden samples, allow the sediment in the sample to settle and decant as much liquid as is practical into the reservoir. After most of the aqueous portion of the sample has passed through the disk, swirl the portion of the sample containing sediment and add it to the reservoir. Use additional portions of deionized water to transfer any remaining particulates to the reservoir. Particulates must be transferred to the reservoir before all of the aqueous sample has passed through the disk.

9.2.14 After the sample has passed through the solid-phase media, dry the disk by maintaining vacuum for about 3 minutes.

9.2.15 Remove the entire standard filter assembly (do not disassemble) from the manifold and insert a collection tube. The collection tube is used to prevent analyte loss due to splattering when vacuum is applied. When using a filter flask for single extractions, empty the water from the flask before inserting the collection tube.

9.2.16 With the collection tube in place, add 5 mL of acetonitrile to the extraction apparatus. Allow the solvent to spread out evenly across the disk (or insert filter) then quickly turn the vacuum on and off to pull the first drops of solvent through the disk. Allow the disk to soak for 3 minutes.

9.2.17 Once soaking time is over, apply a vacuum and pull all the solvent through the disk.

9.2.18 Pour the eluent into a graduated cylinder and dilute 1:1 with Deionized water. Record the final volume.

10.0 QUALITY CONTROL REQUIREMENTS

10.1 A reagent blank, LCS, MS and MSD are extracted with each batch of twenty (20) samples or less. The only exception is if the client does not send enough sample to perform a MS and MSD. Then a reagent blank, LCS and LCSD is performed at the client's request.

10.2 All batch quality control samples are subjected to exactly the same extraction and clean-up procedures as those used on actual samples in the extraction batch.

10.3 Control of Nonconforming Data

The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred. The policies and procedures are found in Section 13.0 of Microbac SOP LQAP (Laboratory Quality Assurance Program), Microbac SOP GP-CAPA (Corrective Action/Preventive Action: Initiating, Tracking and Monitoring) and Microbac SOP GP-RCA (Root Cause Analysis).

11.0 WASTE MANAGEMENT AND POLLUTION CONTROL

11.1 Microbac is dedicated to eliminating or minimizing any and all laboratory waste, which requires disposal or contributes to pollution of any type. To that extent Microbac has implemented new technology and converted to micro techniques when available to facilitate these goals.

Each laboratory generates specific waste streams which are segregated and collected in labeled satellite containers. The analysts in each department are responsible for proper disposal of the spent samples and chemical waste in the specified satellite waste collection vessel. The waste management technician checks the satellite containers either daily, or as needed. They are then combined into waste drums in our explosion-proof waste building located outside of the Microbac laboratory facility. These drums are labeled with start date and a manifest is created for each. They are picked up on a regular basis for disposal at a licensed disposal facility.

11.2 Laboratory policies and procedures for management of hazardous waste are found in Microbac SOP 33 – Laboratory Waste Management and the waste management section of the analytical SOPs contain procedures specific to each method. All laboratory waste is accumulated, stored and disposed in accordance with all federal and state laws and regulations. Each employee receives training in the proper handling and disposal of hazardous waste that is specific to their job description. As a hazardous generator, we are subject to inspection from the Ohio EPA.

11.3 The following are waste streams in the sample preparation area, for the water extraction of Methods 8330A, 8330B and 3535A.

11.3.1 Non-Halogenated solvents: Hexane, Ether, Methanol, Acetone

11.3.2 Acetonitrile: acetonitrile

11.3.3 Solid Waste: Filters, tongue depressors, gloves, any solid material that is a waste after being processed in the lab.

12.0 REFERENCES

12.1 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Edition, Methods 8330A, 8330B, 3535A.

12.2 "Guide for Implementing, SW-846 Method 8330B", DoD Environmental Data Quality Workgroup, July 7, 2008.

12.3 Microbac SOP37, "Standard Operating Procedure for Extraction Glassware Washing"

12.4 Microbac SOP33, "Laboratory Waste Management"

12.5 Microbac SOP LQAP "Laboratory Quality Assurance Plan"

12.6 Microbac SOP GP-CAPA, "Corrective Action/Preventive Action: Initiating, Tracking and Monitoring"

12.7 Microbac SOP GP-RCA, "Root Cause Analysis"

12.8 Microbac SOP 45 "Method Validation Procedures"

STANDARD OPERATING PROCEDURE
MICROWAVE DIGESTION OF SEDIMENTS, SLUDGES, SOILS AND OILS (3051A)

Issue / Implementation Date: 15 November 2009

Last Review Date: 15 April 2011

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Approved by:

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Maren Beery, Metals Supervisor	04/11/2011 Date
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1.0 SCOPE AND APPLICATION

1.1 This procedure references SW-846 method 3051 and is applicable to the microwave assisted acid digestion of sediments, sludges, soils, and oils. Samples prepared by this method are analyzed by inductively coupled argon plasma spectroscopy (ICP), or by ICP-MS for the metals listed in Table 1.1. Samples prepared by this method may be analyzed by ICP for additional metals if the QC criteria of the method can be achieved.

1.2 Homogenize and transfer a representative sample aliquot to a digestion vessel. The appropriate acids are added and the vessels sealed. The samples are microwave digested, cooled and transferred to centrifuge tubes. Following centrifugation the supernatant is transferred to a clean digestion tube and brought to volume. In the event of centrifuge mechanical failure, the samples may be optionally filtered using the filter paper described in Section 6.3.1.

1.3 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

HCl	Hydrochloric Acid
HNO_3	Nitric Acid
ICP	Inductively Coupled Plasma
ICP-MS	Inductively Coupled Plasma – Mass Spectrometry
LCS	Laboratory control sample
LCS Dup	Laboratory control sample duplicate
MB	Method blank
MDL	Method detection limit
MS	Matrix spike
MSD	Matrix spike duplicate
QC	Quality control
RL	Reporting limit
SOP	Standard Operating Procedure

For a more comprehensive list of common terms and definitions, consult Appendix A in Microbac SOP LQAP.

1.4 Updates that effect concentration, vendor choices, reagents, MDLs, RLs and QC limits are subject to change without notice.

2.0 SAFETY PRECAUTIONS

2.1 Safety glasses, gloves and lab coats must always be worn when doing this procedure.

2.2 Always use a fume hood when adding concentrated HNO_3 and HCl to the vessels and when manually venting the vessels to avoid exposure to toxic fumes.

3.0 SAMPLE PRESERVATION AND STORAGE

3.1 All samples must have been collected using a sampling plan that addresses the considerations discussed in SW-846.

3.2 All sample containers are certifiable pre-cleaned from the manufacturer.

3.3 Samples must be refrigerated upon receipt.

3.4 The 180 day holding time for digestion and analysis begins at the time of sampling and ends after 180 days. Samples processed or analyzed after the expiration of 180 days are out of hold.

4.0 METHOD PERFORMANCE

4.1 For estimated RLs and working linear ranges refer to Section 4.0 of the ME600 and ME700 series SOPs. Method performance data are acquired as per Microbac SOP 45.

5.0 INTERFERENCES AND CORRECTIVE ACTION

5.1 Very reactive or volatile materials that create high pressure when heated may cause venting of the vessels with potential loss of sample and analytes. Samples that contain carbonates or other carbon dioxide generating compounds may cause enough pressure to vent the vessel. If this situation is anticipated the analyst may wish to use a smaller amount of sample.

6.0 EQUIPMENT AND SUPPLIES

6.1 Major Instrumentation

6.1.1 MARS Express microwave unit or equivalent. Microwave unit must provide programmable power with a minimum of 574W and can be programmed to within ± 10W of required power.

6.1.2 75 mL and 50 mL vessels for the Mars Express.

6.2 Apparatus or Equipment

6.2.1 Beckman GS-6 centrifuge or equivalent.

6.2.2 Analytical balance (600 g capacity) or equivalent.

6.3 Other Supplies

6.3.1 0.45 micron syringe filters or 0.45 micron filter paper

6.3.2 Volumetric pipettes

6.3.3 50 mL disposable centrifuge tubes or equivalent.

7.0 STANDARDS AND REAGENTS

7.1 Acids used in the preparation of standards and for sample processing must be reagent grade or better. Redistilled acids may be used.

All purchased stock standards and reagents are logged into the LIMS system and assigned certificate of analysis (COA) numbers. All intermediate and working solutions are similarly logged into the LIMS and assigned STD or RGT numbers. Detailed information regarding solution concentrations, aliquot volumes and final volumes and concentrations are included under the STD or RGT number.

7.2 ICP-MS Spiking Solutions

QC-MS-1, CPI International, or equivalent containing:
10 ug/mL As, Al, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Sb, Se, Ag, Tl, V, Zn, U

7.2.1 LCS – for ICP-MS analysis, 0.5 g or approximately 6 Teflon chips, that is spiked with 0.5 mL spiking solution and digested with the sample batch.

7.2.2 LCS Dup – a LCS prepared in duplicate. This is only required if the batch has no MS/MSD due to lack of sample volume.

7.2.3 MS and MSD – two additional aliquots of a sample that are spiked with 0.5 mL spiking solution and digested with the sample batch.

7.3 ICP Spiking Solutions

7.3.1 MIC-SPK-1A Inorganic Ventures, or equivalent containing:

250 mg/L:	K, Na
50 Mg/L:	Al, Ca, Mg
25 mg/L:	Si
20 mg/L:	Fe
6 mg/L:	Sb
5 mg/L:	Ba, Li, Mo, Ti, V, Zn, Sr
2.5 mg/L:	Cr, Cu, Mn, Ni, Pb, Tl
2 mg/L:	Ag, As, Se
1 mg/L:	Co
0.25 mg/L:	Be, Cd
10 mg/L:	B

7.3.2 Single element Tin: 1000 ug/mL from Inorganic Venutres, or equivalent

7.3.3 Single element Phosphorus: 1000 ug/mL from Inorganic Ventures, or equivalent

7.3.4 Single element Zirconium: 1000 ug/mL from Inorganic Ventures, or equivalent

7.3.5 LCS – For ICP analysis, use 1.0 g of Teflon chips, approximately 12 Teflon chips, that is spiked with 5.0 mL spiking solution MIC-SPK-1A, and 25 uL of tin. 25 uL of phosphorus and zirconium are added when needed. The LCS is digested with the sample batch.

7.3.6 LCS Dup – a LCS prepared in duplicate. This is only required if the batch has no MS/MSD due to lack of sample volume.

7.3.7 MS and MSD – two additional aliquots of a sample that are spiked as in 7.3.5 and digested with the sample batch.

7.4 Nitric acid (concentrated), HNO_3. Baker Instra analyzed grade or equivalent.

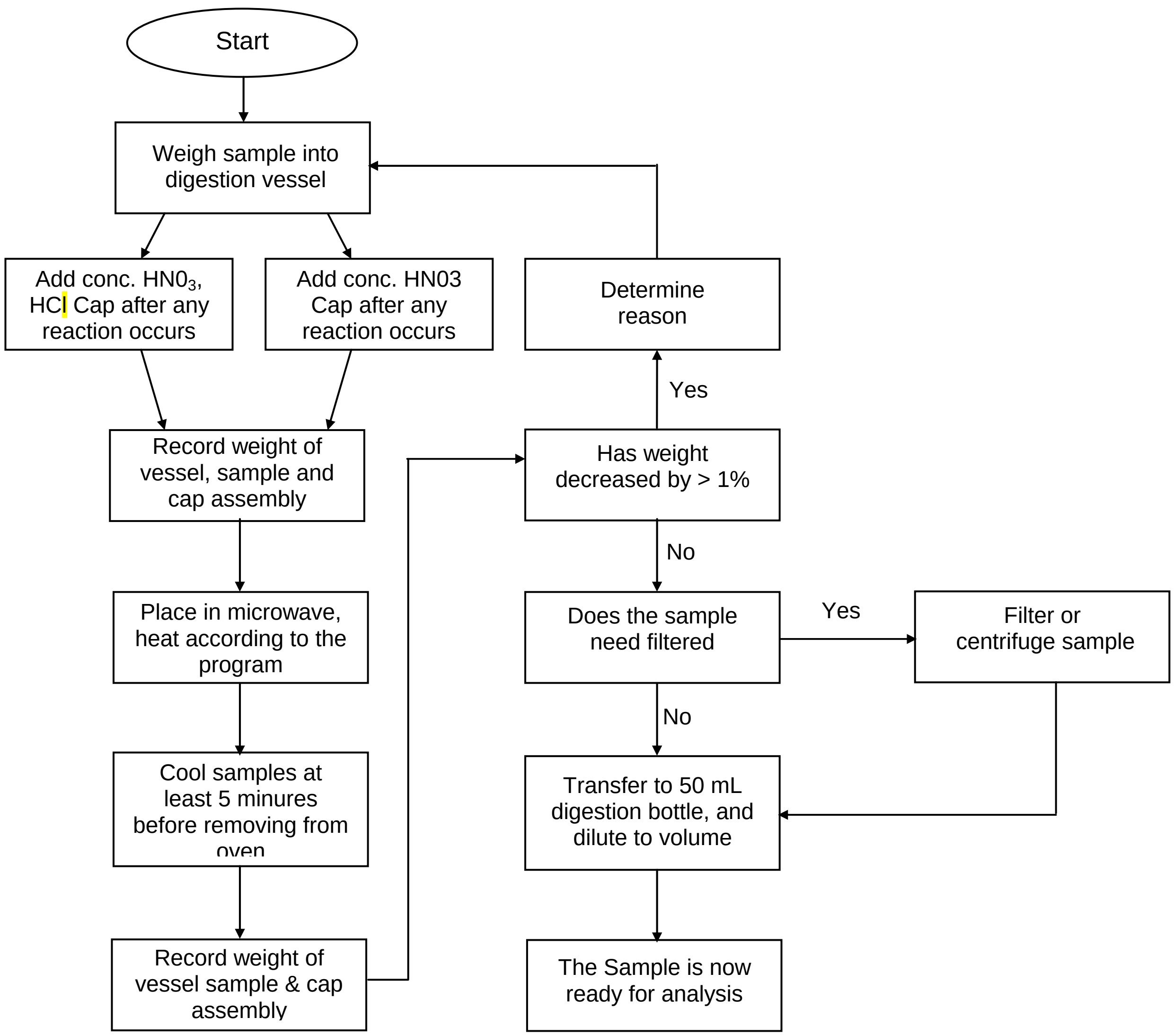
7.5 Hydrochloric acid (concentrated), HCl. Baker Instra analyzed grade or equivalent.

7.6 ASTM type II Water (ASTM D1192): Water must be monitored for impurities.

7.6.1 MB – for ICP-MS analysis, weigh 0.5 g or approximately 6 Teflon chips. 10 mL of concentrated nitric acid is digested with the sample batch. For ICP analysis, weigh 1.0 g or approximately 12 Teflon chips, 9 mL of concentrated HNO_3 and 3 mL of concentrated HCl is used.

8.0 DIAGRAM OR TABLE TO OUTLINE PROCEDURES

8.1 Microwave Digestion of Sediments, Sludges, Soils and Oils



9.0 SAMPLE PREPARATION

9.1 Samples are digested using SW-846 Method 3051A utilizing the appropriate acids.

9.2 Soil subsampling

a) Remove sample bottle contents and place in a tray lined with wax paper mix sample with an inert rod or scoop and break up lumps. Remove all large stones, sticks, leaves, etc. Do not over mix the sample
b) Obtain representative sample either by random removal of 3-10 portions of the sample from the pan or by using a “standard” scoop designed to retrieve a linear cross-section of the pan contents
c) The analyst will not attempt to target an exact weight once a method specified minimum amount is weighed.
d) The remaining sample will be returned to the sample container.

10.0 CALIBRATION PROCEDURES

10.1 The Mars Express is calibrated annually by the service engineer.

11.0 ANALYTICAL PROCEDURES

11.1 MARS Express – follow these guidelines.

11.1.1 Choose no more than 20 soil samples in a preparation batch.

11.1.2 Following making of workgroup, go to “Sample Data”, “Digestions”, then “Microwave”. Here is where initial weights are recorded.

11.1.3 For ICP-MS analysis except antimony and silver, weigh a 0.5 g portion of a well mixed sample into a digestion vessel. Add 10 mL of HNO_3 to each vessel. For Blanks and LCS/LCS Dup weigh 0.5 g or approximately 6 Teflon chips. Add 10 mL of HNO_3 to the blank and LCS. The LCS, MS, and MSD are spiked with 0.5 mL of microwave spike (7.2). In addition, when digestion for antimony and/or silver, perform digestion as per the paragraph above with the exception of adding 9 mL of HNO_3 and 3 mL of HCl to each vessel.

For ICP analysis, weigh out 1.3 - 1.5 g of a well mixed sample into a digestion vessel. The LCS, MS, and MSD are spiked with 5 mL of MIC-SPK-1A (7.3.1). 25 uL of tin is added to each LCS. 25 uL of phosphorus and zirconium are added when needed. Teflon chips are used for blanks and LCS, approximately 12 Teflon chips. Add 9 mL of HNO_3 and 3 mL of HCl to each vessel. For oils weigh out 0.25 g. Add 10 mL of HNO_3 to the vessels. For Blank, LCS and LCS Dup weigh 0.25 g or approximately 3 Teflon chips. Add 10 mL of HNO_3. Spike LCS/LCS Dup with 5 mL of MIC-SPK-1A (7.3.1).

Seal all samples with rubber stoppers and also the vessel cap. Hand tighten vessel cap only.

Weigh vessels and record weight under “Sample Data”.

Place vessels in Carousel making sure they are pushed down completely.

Select “Load Method” from main menu.

Select “User Directory”.

Select appropriate 3051 method to be used (EPA 3051-8V-Xpress, - 16 Xpress, -24 Xpress).

Push start button.

11.1.4 After the program has run, allow samples to cool down.

11.1.5 Remove Carousel from unit and reweigh vessels and record weight under “Sample Data”. If the weight has decreased more than 1% from the original weight, discard sample and start the sample over again.

11.1.6 Transfer the solution to a graduated centrifuge tube. Rinse the microwave vessel two times with deionized (DI) water and transfer the rinsates to the tube.

11.1.7 Centrifugation: Place sample in centrifuge for at least 10 minutes at 2,000 – 3,000 RPM. Slowly decant sample into a clean digest tube, add volume up to 50 mL with the DI water. Digestion tubes are calibrated volumetrically by lot number when received as per Microbac SOP K0002 “Calibration Procedures”. The sample is now ready for analysis unless filtration is required.

11.1.8 If filtration is needed after centrifugation, filtering is done either by 0.45 micron filter paper and vacuum pump or by the 0.45 micron syringe filter. The sample is now ready for analysis.

11.2 See Figure 11 for an example of the Metals Digest Log.

12.0 DETAILS OF CALCULATIONS

12.1 Refer to Microbac SOPs ME600E, ME600G, and ME700.

13.0 QUALITY CONTROL REQUIREMENTS

13.1 Each batch of up to 20 samples requires the following:

13.1.1 Method blank

13.1.2 LCS

13.1.3 LCS Dup – an LCS prepared in duplicate. This is only required if the batch has no MS/MSD due to lack of sample volume.

13.1.4 MS and MSD

13.2 Results of the analysis of the QA/QC samples are kept for easy reference.

13.3 All batch QC samples are subjected to exactly the same digestion as those used on actual samples in the digestion batch.

13.4 Control of Nonconforming Data

The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred. The policies and procedures are found in Section 13.0 of Microbac SOP LQAP (Laboratory Quality Assurance Program), Microbac SOP GP-CAPA (Corrective Action/Preventive Action: Initiating, Tracking and Monitoring) and Microbac SOP GP-RCA (Root Cause Analysis).

13.4.1 Nonconformances Requiring Corrections

A nonconformance occurs when any aspect of the method QC in an analysis, as outlined in Section 13.0 of Microbac SOPs ME600E or G and Microbac SOP ME700, does not meet acceptance criteria. When nonconforming data occurs the employee initiates a Nonconformance Report (NCR) and proceeds with indicated corrections as per in Section 13.0 of Microbac SOPs ME600E or G and Microbac SOP ME700.

All data shall be scrutinized by the analysts for method and project specific compliance. Checklists are utilized and accompany each data batch (Figure

14.1 of Microbac SOPs ME600E and G and ME700). A nonconformance shall be documented in the NCR followed by one or more of the following actions.

- Reanalysis of the sample(s) in question
- Discussion and qualification of data (report and narrative)
- Client notification with approval
- Data qualification (Q-flagging)
- Re-sampling and reanalysis (client decision)

13.4.2 Nonconformances Requiring Corrective Action

Corrective action is required when a nonconformance is recurring, if the correction is ineffective or if the departure is so significant that it negatively effects data quality, sample integrity or customer satisfaction. When an event requiring corrective action is identified, the employee shall initiate a Corrective Action/ Preventive Action form as per Microbac SOP GP-CAPA. The corrective action process includes a root cause analysis as per Microbac SOP GP-RCA, corrections, corrective action(s) and evidence of effectiveness.

13.4.3 Nonconformances Not Requiring Corrections

There are some standard contingencies to the traditional corrections that maybe invoked, provided they comply with the project QAPP or program requirements. In many situations it may not be necessary to perform sample reanalysis or re-extraction for the following quality control departures, provided they are not a chronic problem or indicative of a trend, and the laboratory provides documentation in the report narrative and project files. In addition, the employee is required to initiate a NCR to record the event.

- An LCS or surrogate recovery exceeds the upper control limit, but the corresponding sample results are non-detect.
- A method blank exceeds the upper limit, but the corresponding sample results are non-detect.
- A method blank exceeds the upper limit, but the corresponding sample results are greater than ten (10) times the level in the blank.

14.0 DATA REVIEW AND REPORTING REQUIREMENTS

14.1 The appropriate log books are checked and signed by the department supervisor for completeness.

15.0 PREVENTIVE MAINTENANCE

15.1 Monthly examine the door, door seals and door interlocks to verify they are clean and working properly. Ensure that the door closes securely.

15.2 Clean the inside of the microwave cavity, including the exhaust screen at the back of the cavity, with warm soapy water applied with a soft cloth. Rinse and thoroughly dry all cleaned areas.

15.3 Clean the exhaust outlet by removing the exhaust hose and wiping the space inside the exhaust outlet with a disposable cloth. To clean the exhaust hose, disconnect if from the blower exhaust duct, flush it with water and allow it to dry before reconnecting it to the blower duct.

16.0 WASTE MANAGEMENT AND POLLUTION CONTROL

16.1 Laboratory policies and procedures for management of hazardous waste are found in Microbac SOP 33 – Laboratory Waste Management and the waste management section of the analytical SOPs contain procedures specific to each method. All laboratory waste is accumulated, stored and disposed in accordance with all federal and state laws and regulations. Each employee receives training in the proper handling and disposal of hazardous waste that is specific to their job description. As a hazardous generator, we are subject to inspection from the Ohio EPA.

Each laboratory generates specific waste streams which are segregated and collected in labeled satellite containers. The analysts in each department are responsible for proper disposal of the spent samples and chemical waste in the specified satellite waste collection vessel. The waste management technician checks the satellite containers either daily, or as needed. They are then combined into waste drums in our explosion-proof waste building located outside of the Microbac laboratory facility. These drums are labeled with start date and a manifest is created for each. They are picked up on a regular basis for disposal at a licensed disposal facility.

16.2 The following are waste streams in the sample preparation area.

16.2.1 Non – Halogenated solvents: Acetone

16.2.2 Solid Waste: Filters, tongue depressors, gloves, any solid material that is a waste after being processed in the lab.

16.2.3 Acid: Dilute acid waste from soak tanks.

NOTE: 16.2.1 and 2 are all kept in satellite containers in each lab and are combined into the proper 55 gallon waste drums in our explosion proof waste building located outside of the Microbac laboratory facility by a waste disposal technician. 16.2.3 is neutralized and disposed in the municipal sewer system as per agreement with the city.

17.0 REFERENCES

17.1 Microwave Assisted Acid Digestion of Sediments, Sludges, Soils and Oils, US EPA SW-846 Method 3051A, Revision 1, February 2007, EPA Publication SW-846.

17.2 Microbac SOP LQAP “Laboratory Quality Assurance Plan“

17.3 Microbac SOP 45 “Method Validation Procedures“

17.4 Microbac SOP 600E “Perkin Elmer Optima 4300 Inductively Coupled Plasma Atomic Emission Spectroscopy”

17.5 Microbac SOP 600G “Thermo iCAP 6000 Series Inductively Coupled Plasma Atomic Emission Spectroscopy”

17.6 Microbac SOP 700 “Perkin Elmer Elan 6100 Inductively Coupled Plasma/Mass Spectometer:

17.7 Microbac SOP K0002 “Calibration Techniques”

17.8 Microbac SOP 33 “Laboratory Waste Management”

17.9 Microbac SOP GP-CAPA “Corrective Action/Preventive Action: Initiating, Tracking and Monitoring”

17.10 Microbac SOP GP-RCA “Root Cause Analysis”

Appendix I

California ELAP samples digested by method 3051A (SOP ME406) will not have valid results reported below the nominal reporting limit. Should such "J" flagging of results occur, they must be considered insignificant.

TABLE 1.1
METHOD ANALYTES

Name	Symbol	Wavelength	Cas Number
Aluminum	Al	308.2	7429-90-5
Antimony	Sb	206.8	7440-36-0
Arsenic	As	189.0	7440-38-2
Barium	Ba	455.4	7440-39-3
Beryllium	Be	313.1	7440-41-7
Boron	B	249.6	7440-42-8
Cadmium	Cd	228.8	7440-43-9
Calcium	Ca	422.6	7440-70-2
Chromium	Cr	267.7	7440-47-3
Cobalt	Co	228.6	7440-48-4
Copper	Cu	224.7	7440-50-8
Iron	Fe	261.1	7439-89-6
Lead	Pb	220.3	7439-92-1
Lithium	Li	670.7	7439-93-2
Magnesium	Mg	279.0	7439-95-4
Manganese	Mn	257.6	7439-96-5
Molybdenum	Mo	202.0	7439-98-7
Nickel	Ni	231.6	7440-02-0
Potassium	K	766.4	7440-09-7
Selenium	Se	196.0	7782-49-2
Silicon	Si	212.4	7440-21-3
Silver	Ag	328.0	7440-22-4
Sodium	Na	589.5	7440-23-5
Strontium	Sr	407.7	7440-24-6
Thallium	Tl	190.8	7440-28-0
Tin	Sn	189.9	7440-31-5
Titanium	Ti	337.2	7440-32-6
Vanadium	V	292.4	7440-62-2
Zinc	Zn	206.2	7440-66-6
Phosphorus	P	214.9	7723-14-0
Zirconium	ZR	339.1	7704-67-7
Calculated			
Hardness, Calculated (as $CaCO_3$)	CaCO3	NA	72608-12-9
Silica (as SiO_2)	SiO_2	NA	99439-28-8

Figure 11

Microbac Laboratories Inc.
Microwave Digestion Log

Workgroup: WG345781
Analyst: REK
Spike Analyst: ERP
Run Date: 10/15/2010 10:27
Method: 3051A

SOP: ME406 Revison 12
Spike Solution: STD41851
Spike Witness: VC
HNO3 Lot #: COA14980
HCL Lot #: COA14983
Digestion Tubes Lot #: COA14948

	SAMPLE #	Type	Matrix	Initial Amount	Final Volume	Initial Vessel Wt	Final Vessel Wt	Spike Amount	Due Date
1	WG345781-02	BLANK	7	1 g	50 mL	177.387 g	177.377 g		
2	WG345781-03	LCS	7	1 g	50 mL	177.812 g	177.807 g	.5 mL	
3	L10100261-01	SAMP	7	1.462 g	50 mL	176.633 g	176.6 g		10/18/10
4	L10100261-02	SAMP	7	1.306 g	50 mL	180.067 g	179.99 g		10/18/10
5	L10100261-03	SAMP	7	1.315 g	50 mL	179.901 g	179.867 g		10/18/10
6	L10100261-04	SAMP	7	1.345 g	50 mL	179.905 g	179.887 g		10/18/10
7	L10100261-05	SAMP	7	1.022 g	50 mL	179.612 g	179.439 g		10/18/10
8	L10100261-06	SAMP	7	1.361 g	50 mL	178.824 g	178.787 g		10/18/10
9	L10100261-07	SAMP	7	1.405 g	50 mL	179.439 g	179.401 g		10/18/10
10	L10100261-08	SAMP	7	1.329 g	50 mL	176.486 g	176.483 g		10/18/10
11	L10100322-24	SAMP	7	1.317 g	50 mL	176.677 g	176.617 g		10/20/10
12	L10100322-25	SAMP	7	1.406 g	50 mL	179.139 g	178.781 g		10/20/10
13	L10100322-26	SAMP	7	1.404 g	50 mL	175.564 g	175.561 g		10/20/10
14	L10100322-27	SAMP	7	1.308 g	50 mL	175.457 g	175.44 g		10/20/10
15	L10100322-28	SAMP	7	1.381 g	50 mL	178.337 g	178.284 g		10/20/10
16	WG345781-01	REF	7	1.348 g	50 mL	177.654 g	177.655 g		
17	L10100322-29	RS02	7	1.348 g	50 mL	177.654 g	177.655 g		10/20/10
18	WG345781-04	MS	7	1.348 g	50 mL	180.688 g	180.683 g	.5 mL	
19	L10100322-30	MS02	7	1.348 g	50 mL	180.688 g	180.683 g	.5 mL	10/20/10
20	WG345781-05	MSD	7	1.348 g	50 mL	177.045 g	177.024 g	.5 mL	
21	L10100322-31	SD02	7	1.348 g	50 mL	177.045 g	177.024 g	.5 mL	10/20/10
22	L10100322-32	SAMP	7	1.323 g	50 mL	176.44 g	176.435 g		10/20/10
23	L10100322-33	SAMP	7	1.382 g	50 mL	176.367 g	176.3 g		10/20/10
24	L10100322-34	SAMP	7	1.419 g	50 mL	177.258 g	176.863 g		10/20/10
25	L10100322-35	SAMP	7	1.333 g	50 mL	178.678 g	178.633 g		10/20/10
26	L10100322-36	SAMP	7	1.324 g	50 mL	176.391 g	176.375 g		10/20/10
27	L10100322-37	SAMP	7	1.301 g	50 mL	178.277 g	178.093 g		10/20/10

Analyst: [illegible]

Reviewer: Brenda Gregory

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Microbac

STANDARD OPERATING PROCEDURE
MICROWAVE DIGESTION - AQUEOUS
SW846-3015

Issue/Implementation Date: 15 December 2010

Last Review Date: 15 December 2010

Microbac Laboratories, Inc.
Ohio Valley Division
158Starlite Drive
Marietta, Ohio 45750

Approved By:

Robert Kyer, Metals Digestion Group Leader	12/6/10 Date
Maren Beery, Metals Supervisor	12/08/10 Date
Leslie S. Bucina, Quality Assurance Officer	12/10/10 Date
David E. Vandenberg, Managing Director	12/10/10 Date

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1.0 SCOPE AND APPLICATION

1.1 This procedure utilizes SW-846 method 3015 and is an acid digestion procedure used to prepare surface water, groundwater, TCLP and mobility procedure extracts, and waste samples that contain suspended solids for analysis by inductively coupled argon plasma spectroscopy (ICP) or by ICP-MS. Samples prepared by this method may be analyzed by ICP or ICP-MS for the metals in Table 1.

1.2 For the analysis of dissolved metals, the sample is filtered at the time of collection, prior to acidification with nitric acid.

1.3 Forty millimeters or less of a well shaken sample is transferred to a digestion vessel. Nitric acid is added and the closed vessels are microwave digested. The cooled digestates are transferred to graduated digestion tubes and brought to final volume. Samples are centrifuges prior to transfer and voluming if necessary.

1.4 Definitions and Acronyms

The following is a list of terms, definitions, and acronyms referenced in this SOP that are unique to the method.

ICP – Inductively Couples Plasma
OES – Optical Emission Spectroscopy
MS – Mass Spectrometry
HNO_3 – nitric acid

For a more comprehensive list of common terms and definitions, consult Appendix A in SOP LQAP.

2.0 SAFETY PRECAUTIONS

2.1 Safety glasses, gloves and lab coats must always be worn when doing this procedure.

2.2 Always use a fume hood when adding concentrated Nitric acid (HNO_3) to the vessels.

2.3 Venting of the vessels must only be done when contents are at room temperature inside a hood with shield lowered to avoid the potential for chemical burns.

3.0 SAMPLE PRESERVATION AND STORAGE

Measurement	Digestion Volume Requirement (mL)	Collection Volume (mL)	Preservative/ Holding Time*
Total	40	600	HNO_3 to pH <2 / 6 months
Dissolved	40	600	Filter on site; HNO_3 to pH <2 / 6 months
Suspended	40	600	Filter on site / 6 months

* Holding time is the storage time allowed between sample collection and analysis when properly preserved and stored.

3.1 All samples must be collected by the use of techniques that prevent contamination and cross-contamination between samples.

3.2 All sample containers must be pre-cleaned. Glass or plastic are both acceptable.

3.3 Total recoverable metals: All samples must be acidified at the time of collection with concentrated nitric acid (HNO_3)(5 mL/L).

3.4 Dissolved metals: All samples must be filtered through a 0.45 micrometer filter and then acidified at the time of collection with concentrated nitric acid (HNO_3)(5 mL/L).

3.5 Aqueous samples must be preserved to pH less than 2 with HNO_3. The pH is checked and adjusted if necessary by the sample receiving department prior to login. For determinations of dissolved and suspended metals, the sample must be filtered before preservation on site. Samples that are received unpreserved are preserved on site and must sit for 18 hours prior to digestion.

4.0 METHOD PERFORMANCE

4.1 For estimated quantitation limit and working linear range, refer to Section 4.0 of the ME600 and ME700 series SOPs. Method performance data and acquired as per SOP 45.

5.0 INTERFERENCES AND CORRECTIVE ACTION

5.1 Very reactive or volatile materials that create high pressure when heated may cause venting of the vessels with potential loss of sample and analytes. Samples that contain carbonates or other carbon dioxide generating compounds may cause enough pressure to vent the vessel. If this situation is anticipated the analyst may wish to use a smaller amount of sample.

6.0 EQUIPMENT AND SUPPLIES

6.1 Major Instrumentation

6.1.1 Mars Xpress unit. Microwave unit must provide programmable power with a minimum of 574W and can be programmed to within ±10W of required power.

6.1.2 75 mL Vessels for the Mars Express

6.2 Apparatus or Equipment

Beckman GS-6 centrifuge or equivalent.

Analytical balance (600g capacity) or equivalent.

6.3 Other Supplies

Graduated digest tubes (50 mL or 100 mL Capacity)

Quantitative filter paper, Whatman 41 or equivalent

Volumetric pipettes

VWR 50 mL disposable centrifuge tubes or equivalent

7.0 STANDARDS AND REAGENTS

Acids used in the preparation of samples must be reagent grade or better. Redistilled acids may be used.

All purchased stock standards and reagents are logged into the LIMS system and assigned certificate of analysis (COA) numbers. All intermediate and working solutions are similarly logged into the LIMS and assigned STD or RGT numbers. Detailed information regarding solution concentrations, aliquot volumes and final volumes and concentrations are included under the STD or RGT number.

7.1 QC-MS-1 Spike – 10 mg/L, As, Al, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Ni, Sb,Se, Ag, Tl, U, V and Zn in 2% HNO3 and tr HF – CPI International or equivalent.

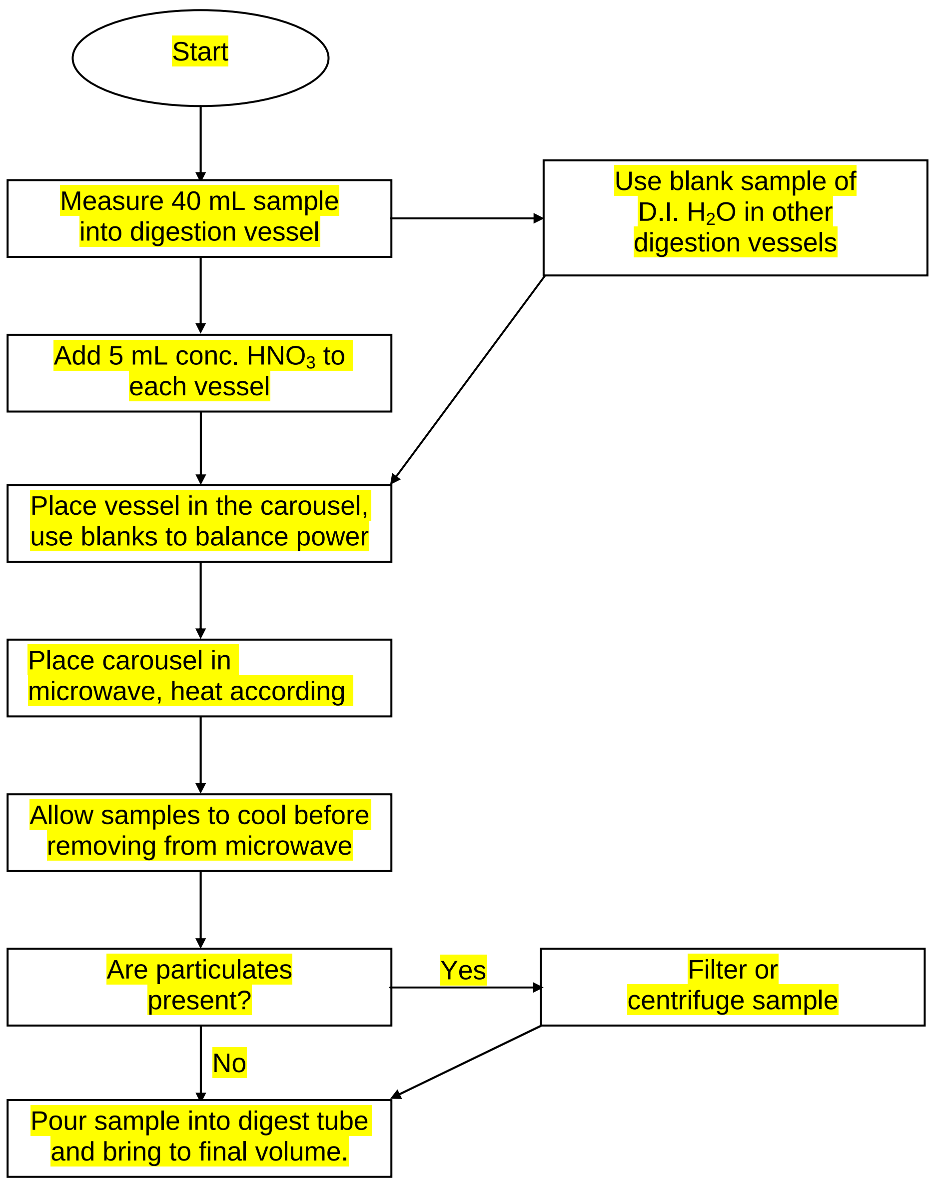
7.2 Custom multi-element solution MIC-SPK-1A from Inorganic Ventures or equivalent containing:

250 mg/L :	K, Na
50 mg/L :	Al, Ca, Mg
25 mg/L :	Si
20 mg/L :	Fe
6 mg/L :	Sb
5 mg/L :	Ba, Li, Mo, Ti, V, Zn, Sr
2.5 mg/L :	Cr, Cu, Mn, Ni, Pb, Tl,
2 mg/L :	Ag, As, Se
1 mg/L :	Co
0.25 mg/L :	Be, Cd
10 mg/L:	B

7.3 Concentrated Nitric Acid (HNO_3) (Baker Instra analyzed or equivalent).

7.4 ASTM Type II Water (ASTM D1192): Water must be monitored for impurities.

8.0 DIAGRAM OR TABLE TO OUTLINE PROCEDURES



9.0 SAMPLE PREPARATION

9.1 Samples are shaken to homogenize prior to digestion.

10.0 CALIBRATION PROCEDURES

10.1 The Mars Express is calibrated annually by the Manufacturer.

11.0 ANALYTICAL PROCEDURES

11.1 Choose 20 samples of similar matrix for the preparation batch.

11.2 Measure 40 mL of a well shaken sample into a digest tube and transfer the aliquot into a digestion vessel. Add 5 mL concentrated nitric acid (HNO_3) to each vessel. **NOTE** - If a high organic content is suspected, such as in TCLP extracts, 5 mL or less of sample may be used (the difference is made up with deionized (DI) water). The blank and laboratory control sample are made by using 40 mL of deionized water. The LCS and MS/MSD's are spiked with the appropriate spike.

11.2.1 Water batches for ICP-MS analysis are spiked with 0.25 mL of QC-MS-1 spike (7.1) CPI International or equivalent.

11.2.2 TCLP batches are spiked with 5 mL of custom multielement solution MIC-SPK-1A (7.2) Inorganic Ventures or equivalent.

11.2.3 As per method 200.8, there must be a sample duplicate per every batch of twenty (20) samples or less and a sample matrix spike (MS) per every ten (10) samples or less.

11.3 Mars Xpress – Follow these guidlines

11.4 Seal all samples with rubber stoppers and also the vessel cap. Hand tighten vessel cap only.

Weigh vessels and record weight in microwave electronic benchsheet.

Place vessels in Carousel making sure they are pushed down completely.

Select "Load Method" from main menu.

Select "User Directory".

Select appropriate 3015 method to be used (EPA 3015-8V-Xpress, - 16 press, - 24 Xpress).

Push start button.

11.4.1 After the program has finished, allow sample to cool down.

11.4.2 Remove Carousel from unit and reweigh vessels and record weight in electronic benchsheet. If the weight has decreased more than 1% from the original weight, discard sample and start the sample over again.

11.4.3 Transfer the solution to a graduated digest tube and bring up to a 50 ml volume with DI H_2O.

Digestion tubes are calibrated volumetrically by lot number when received as per Microbac SOP K0002 “Calibration Procedures”.

11.4.4 Centrifugation: Transfer sample in 50 graduated centrifuge tube and place in centrifuge for at least 10 minutes at 2,000 – 3,000 RPM. Slowly decant sample into a clean digest tube and bring up to a 50 mL volume with DI Water. The sample is now ready for analysis. If filtration is needed after centrifugation, this is done by filtering sample through a funnel lined with whatman 934-AH filter paper right into a clean digest tube and bringing up to a 50 mL volume with DI water. The sample is now ready for analysis.

11.5 See Figure 11.1 for an example of the Metals Digest Log.

12.0 DETAILS OF CALCULATIONS

12.1 Refer to individual methodology.

13.0 QUALITY CONTROL REQUIREMENTS

13.1 Each batch of up to 20 samples requires the following:

13.1.1 Method blank (MB) – a 40ml aliquot of deionized water that is digested with the sample batch.

13.1.2 Laboratory Control Sample (LCS) – a 40 ml aliquot of deionized water that is spiked with spiking solution and digested with the sample batch.

13.1.3 Sample duplicate – Batches that include samples for method 200.8 will include a sample prepared in duplicate, both carried through the batch digestion.

13.1.4 Matrix spike and matrix spike duplicate (MS/MSD) – two additional aliquots of a sample that are spiked with spiking solution and digested with the sample batch. Sn spike is added to each MS/MSD that Sn is needed. Batches that include samples for method 200.8 will include a spiked sample for every ten 200.8 samples.

13.2 Results of the analysis of the quality assurance/quality control (QA/QC) samples are kept for easy reference.

13.3 All batch quality control samples are subjected to exactly the same digestion as those used on actual samples in the digestion batch.

13.4 Control of Nonconforming Data

The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred. The policies and procedures are found in Section 13.0 of SOP LQAP (Laboratory Quality Assurance Program), SOP GP-CAPA (Corrective Action/Preventive Action: Initiating, Tracking and Monitoring) and SOP GP-RCA (Root Cause Analysis).

13.4.1 Nonconformances Requiring Corrections

A nonconformance occurs when any aspect of the method QC in an analysis, as outlined in Tables 13.1 and 13.2 of SOPs ME600E, ME600F and ME600G and Tables 13.1 and 13.4 of SOP ME 700, does not meet acceptance criteria. When nonconforming data occurs the employee initiates a Nonconformance Report (NCR) and proceeds with indicated corrections as per Tables 13.1 and 13.2 of SOPs ME600E, ME600F and ME600G and Tables 13.1 and 13.4 of SOP ME 700.

All data shall be scrutinized by the analysts for method and project specific compliance. Checklists are utilized and accompany each data batch Figure 14.1 of SOPs ME600E, ME600F, ME600G and ME700. A nonconformance shall be documented in the NCR followed by one or more of the following actions.

- Reanalysis of the sample(s) in question
- Discussion and qualification of data (report and narrative)
- Client notification with approval

- Data qualification (Q-flagging)
- Re-sampling and reanalysis (client decision)

13.4.2 Nonconformances Requiring Corrective Action

Corrective action is required when a nonconformance is recurring, if the correction is ineffective or if the departure is so significant that it negatively effects data quality, sample integrity or customer satisfaction. When an event requiring corrective action is identified, the employee shall initiate a Corrective Action/ Preventive Action form as per SOP GP-CAPA. The corrective action process includes a root cause analysis as per SOP GP-RCA, corrections, corrective action (s) and evidence of effectiveness.

13.4.3 Nonconformances Not Requiring Corrections

There are some standard contingencies to the traditional corrections that maybe invoked, provided they comply with the project QAPP requirements. In many situations it may not be necessary to perform sample reanalysis or re-extraction for the following quality control departures, provided they are not a chronic problem or indicative of a trend, and the laboratory provides documentation in the report narrative and project files. In addition, the employee is required to initiate a NCR to record the event.

- An LCS or surrogate recovery exceeds the upper control limit, but the corresponding sample results are non-detect.
- A method blank or calibration blank exceeds the upper limit, but the corresponding sample results are non-detect.
- A method blank or calibration blank exceeds the upper limit, but the corresponding sample results are greater than ten (10) times the level in the blank.

14.0 DATA REVIEW AND REPORTING REQUIREMENTS

14.1 The appropriate log books must be checked and signed by the department supervisor for completeness.

15.0 PREVENTIVE MAINTENANCE

15.1 Monthly examine the door, door seals and door interlocks to verify they are clean and working properly. Ensure that the door closes securely.

15.2 Clean the inside of the microwave cavity, including the exhaust screen at the back of the cavity, with warm soapy water applied with a soft cloth. Rinse and thoroughly dry all cleaned areas.

15.3 Clean the exhaust outlet by removing the exhaust hose and wiping the space inside the exhaust outlet with a disposable cloth. To clean the exhaust hose, disconnect if from the blower exhaust duct, flush it with water and allow it to dry before reconnecting it to the blower duct.

16.0 WASTE MANAGEMENT AND POLLUTION CONTROL

16.1 Microbac is dedicated to eliminating or minimizing any and all laboratory waste which requires disposal or contributes to pollution of any type. To that extent Microbac has implemented new technology and converted to micro techniques when available to facilitate these goals.

16.2 The following are waste streams in the sample preparation area.

16.2.1 Non – Halogenated solvents: Acetone

16.2.2 Solid Waste: Filters, tongue depressors, gloves, any solid material that is a waste after being processed in the lab.

16.2.3 Acid: Dilute acid waste from soak tanks.

16.3 Laboratory polices and procedures for management of hazardous waste are found in SOP 33- Laboratory Waste Management and the waste management section of the analytical SOPs contain procedures specific to each method. All laboratory waste is accumulated, stored and disposed in accordance with all federal and state laws and regulations. Each employee received training in the proper handling and disposal of hazardous waste that is specific to their job description. As a hazardous generator, we are subject to inspection from the Ohio EPA.

17.0 REFERENCES

17.1 Microwave Assisted Acid Digestion of Aqueous Samples and Extracts, US EPA SW-846 Method 3015, Revision 0, September 1994, EPA Publication SW-846.

17.2 Microwave Assisted Acid Digestion of Aqueous Samples and Extracts, US EPA SW-846, Method 3015A, Revision 1, February 2007, EPA Publication SW-846.

17.3 Microbac SOP LQAP "Laboratory Quality Assurance Plan"

17.4 Microbac SOP 33 “Laboratory Waste Management”

17.5 Microbac SOP 45 “Method Validation Procedures”

17.6 Microbac SOP GP-CAPA “Corrective Action and Preventive Action; Initiating, Tracking, and Monitoring”

17.7 Microbac SOP GP-RCA “Root Cause Analysis”

17.8 Microbac SOP 600E “Perkin Elmer OPTIMA 4300 Inductively Coupled Plasma Atomic Emission Spectroscopy”

17.9 Microbac SOP 600F “Thermo Jarrell Ash IRIS Advantage Inductively Coupled Plasma Atomic Emission Spectroscopy”

17.10 Microbac SOP ME600G “Thermo iCAP 6000 Series Inductively Coupled Plasma Atomic Emission Spectroscopy”

17.11 Microbac SOP ME700 “Perkin Elmer Elan 6100 Inductively Coupled Plasma/Mass Spectrometer”

17.12 Microbac SOP K0002 “Calibration Procedures”

Table 1
Method Analytes

Name	Symbol	Cas Number
Aluminum	Al	7429-90-5
Antimony	Sb	7440-36-0
Arsenic	As	7440-38-2
Barium	Ba	7440-39-3
Beryllium	Be	7440-41-7
Boron	B	7440-42-8
Cadmium	Cd	7440-43-9
Calcium	Ca	7440-70-2
Chromium	Cr	7440-47-3
Cobalt	Co	7440-48-4
Copper	Cu	7440-50-8
Iron	Fe	7439-89-6
Lead	Pb	7439-92-1
Lithium	Li	7439-93-2
Magnesium	Mg	7439-95-4
Manganese	Mn	7439-96-5
Molybdenum	Mo	7439-98-7
Nickel	Ni	7440-02-0
Potassium	K	7440-09-7
Selenium	Se	7782-49-2
Silicon	Si	7440-21-3
Silver	Ag	7440-22-4
Sodium	Na	7440-23-5
Strontium	Sr	7440-23-5
Thallium	Tl	7440-28-0
Tin	Sn	7440-31-5
Titanium	Ti	7440-32-6
Vanadium	V	7440-62-2
Zinc	Zn	7440-66-6
Calculated		
Hardness, Calculated (as $CaCO_3$)	$CaCO_3$	72608-12-9
Silica (as SiO_2)	SiO_2	99439-28-8

Figure 11.1

Microbac Laboratories Inc.
Microwave Digestion Log

Workgroup: WG346402
Analyst: VC
Spike Analyst: VC
Run Date: 10/22/2010 06:16
Method: 3015

SOP: ME407 Revison 11
Spike Solution: STD39374
Spike Witness: ERP
Digestion Tubes Lot #: COA14948
HNO3 Lot #: COA14980

	SAMPLE #	Type	Matrix	Initial Amount	Final Volume	Initial Vessel Wt	Final Vessel Wt	Spike Amount	Due Date
1	WG346402-02	BLANK	1	40 mL	100 mL	206.128 g	206.125 g		
2	WG346402-03	LCS	1	40 mL	100 mL	208.537 g	208.534 g	.25 mL	
3	L10100496-09	SAMP	1	40 mL	100 mL	207.184 g	207.171 g		10/25/10
4	L10100496-10	SAMP	1	40 mL	100 mL	206.81 g	206.806 g		10/25/10
5	L10100543-01	SAMP	1	40 mL	100 mL	207.826 g	207.807 g		10/29/10
6	L10100561-01	SAMP	1	40 mL	100 mL	205.445 g	205.434 g		11/03/10
7	L10100561-02	SAMP	1	40 mL	100 mL	207.579 g	207.564 g		11/03/10
8	L10100561-03	SAMP	1	40 mL	100 mL	205.861 g	205.852 g		11/03/10
9	L10100561-04	SAMP	1	40 mL	100 mL	209.453 g	209.442 g		11/03/10
10	L10100561-05	SAMP	1	40 mL	100 mL	207.956 g	207.944 g		11/03/10
11	L10100561-06	SAMP	1	40 mL	100 mL	206.353 g	206.344 g		11/03/10
12	L10100561-07	SAMP	1	40 mL	100 mL	206.21 g	206.198 g		11/03/10
13	L10100561-08	SAMP	1	40 mL	100 mL	207.139 g	207.134 g		11/03/10
14	L10100561-09	SAMP	1	40 mL	100 mL	208.202 g	208.197 g		11/03/10
15	L10100561-10	SAMP	1	40 mL	100 mL	207.766 g	207.763 g		11/03/10
16	L10100567-01	SAMP	1	40 mL	100 mL	205.947 g	205.948 g		11/01/10
17	L10100567-02	SAMP	1	40 mL	100 mL	206.693 g	206.687 g		11/01/10
18	L10100584-01	SAMP	1	40 mL	100 mL	209.577 g	209.568 g		11/04/10
19	L10100584-02	SAMP	1	40 mL	100 mL	206.725 g	206.714 g		11/04/10
20	WG346402-01	REF	1	40 mL	100 mL	206.759 g	206.756 g		
21	L10100584-03	SAMP	1	40 mL	100 mL	206.759 g	206.756 g		11/04/10
22	WG346402-04	MS	1	40 mL	100 mL	206.072 g	206.072 g	.25 mL	
23	WG346402-05	MSD	1	40 mL	100 mL	206.393 g	206.383 g	.25 mL	

Analyst: Vicki Collins

Reviewer: Erin Potter

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ATTACHMENT D

LABORATORY QUALITY ASSURANCE PLANS

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STANDARD OPERATING PROCEDURES
MICROBAC LABORATORIES
OHIO VALLEY DIVISION
LABORATORY QUALITY ASSURANCE PLAN

Issue / Implementation Date: 15 February 2011

Last Review Date: 15 February 2011

Microbac Laboratories, Inc.
Ohio Valley Division
158 Starlite Drive
Marietta, Ohio 45750
(740) 373-4071

Leslie S. Bucina, Quality Assurance Officer — Date: 3/24/11

David L. Bumgarner, Technical Director — Date: 3/24/11

David E. Vandenberg, Managing Director — Date: 4/1/11

Laboratory Quality Assurance Plan

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3.0 STATEMENT OF POLICY

This Quality Manual summarizes the policies and operational procedures of Microbac Laboratories, Inc. Ohio Valley Division (OVD), located at 158 Starlite Drive in Marietta, Ohio. Specific protocols for sample handling and storage, chain-of-custody, laboratory analyses, data reduction, correction action, and reporting are described. All policies and procedures have been structured in accordance with the National Environmental Laboratory Accreditation Conference (NELAC) standards adopted in June 2003 (current as of the date of this publication) and applicable Environmental Protection Agency (EPA) requirements, regulations, guidance, and technical standards. This manual has been prepared in accordance with the guidance documents listed in Section 17.0. Further details on these policies and procedures are contained in Standard Operating Procedures (SOP) and related documents. This Quality Manual, SOPs, and related documentation describe the quality system for Microbac. Top management makes the following quality policy statements and commitments:

- Laboratory management is committed to good professional practice, to the quality of our testing, and to providing excellent service to our customers.

- Microbac's management commitment to providing the highest standard of service, with respect to data quality and information to our clients, is embodied in Microbac's corporate policy on quality assurance.

- The purpose of our management system is to ensure that all of our work shall be performed in an absolutely professional manner, and all data shall be scientifically valid, legally defensible, of known precision and accuracy.

- Management will assure through documented, annual refresher training that all laboratory staff are familiar with relevant and applicable aspects of the quality management, and will implement these policies and procedures in their work.

- Laboratory management has established policies and procedures to comply with the quality system requirements of ISO/IEC 17025:2005, and is committed to a mission of continuous quality improvement.

Every level of management, the laboratory staff, and project scientists are committed to the quality assurance (QA) program described in this Quality Manual and as such ensure that the appropriate facilities and resources are available before producing any analytical results.

All of our work will be performed in accordance with standards developed by the NELAC and any applicable state or EPA regulations or requirements. A Certification Statement (see Appendix A) has been recorded to this effect.

This program will be revised as needed to address special client or project requirements and to keep pace with developing technologies, good laboratory practices and total management of testing services.

All new employees are educated and trained in their ethical and legal responsibilities including the potential punishments and penalties for improper, unethical or illegal actions. Our written policy for ethical standards of behavior exists in a separate document entitled “Ethics Policy”.

Microbac performs chemical analyses for inorganic and organic constituents in water, solid, and hazardous waste. Microbac’s goal’s are as follows:

- to protect our clients’ interests by providing them with fully documented, legally defensible data useable for sound environmental decisions;
- ensure our client’s confidentiality through safeguards related to data reporting by telephone, facsimile, modem, diskette, mail or other means;
- shelter our company’s two most important resources, our people and our reputation, by maintaining an environment that fosters excellence and;
- guard against and correct performance shortcomings which could erode data or technical quality

Microbac-OVD is licensed and/or accredited by several state programs. A copy of each license and a list of licensed parameters is maintained in a notebook in the laboratory reception area. Another copy is maintained electronically on the network COMMON drive.

4.0 ORGANIZATION AND RESPONSIBILITY

Microbac Laboratories, Inc. has its corporate headquarters in Pittsburgh, Pennsylvania. The corporate organizational chart for Microbac Laboratories, Inc. is given in Figure 4-1. Microbac’s laboratory in Marietta, Ohio (Ohio Valley Division) is a full service environmental laboratory facility for analysis of groundwater, municipal and industrial waste water, soil and solid waste. The Ohio Valley Division’s organizational chart is presented in Figure 4-2 along with a laboratory floor plan, which is provided in Figure 4-3. Microbac’s Analytical Statement of Qualifications provides the qualifications and experience summaries for key professionals within Microbac. The duties and responsibilities of all key positions at the Ohio Valley facility are provided below.

4.1 Responsibilities and Authorities

All employees, including the Managing Director, have the responsibility and authority to identify and report nonconforming work, to initiate actions to prevent QMS departures and nonconformances, to participate in internal audits and corrective action investigations, and to adhere to the QMS procedures.

4.2 Key Personnel

See Appendix D for job descriptions.

4.3 Coverage for Temporary Absence of Key Personnel

Microbac has sufficient staff redundancy and level of experience to cover for extended absence of all personnel described above. The production and report review duties of the Laboratory Director are covered by the Technical Director / QAO. The duties of the QAO are delegated to a senior staff QC chemist with oversight from the Laboratory Director. Responsibilities of departmental supervisors are delegated to the senior chemist or analyst in the department, with oversight from the Laboratory Director. A senior programmer is assigned the duties of the IT Manager in his absence. All key personnel have an average of over ten years experience and are cross-trained for multiple positions.

Figure 4-1

Microbac Laboratories, Inc.
Corporate Organizational Chart
31 January 2011

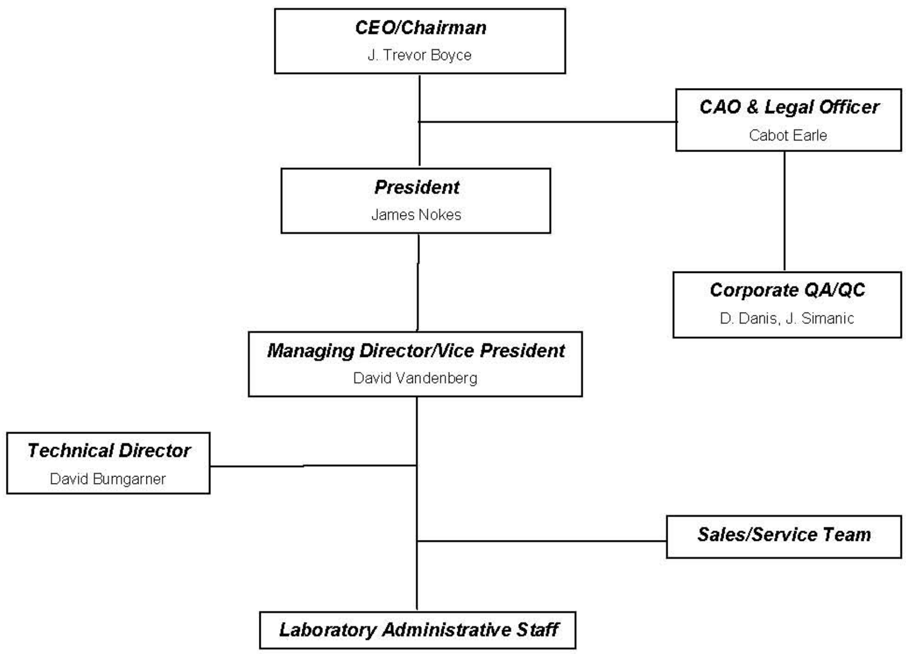


Figure 4-2

Microbac Laboratories, Inc.
Organizational Chart
31 January 2011

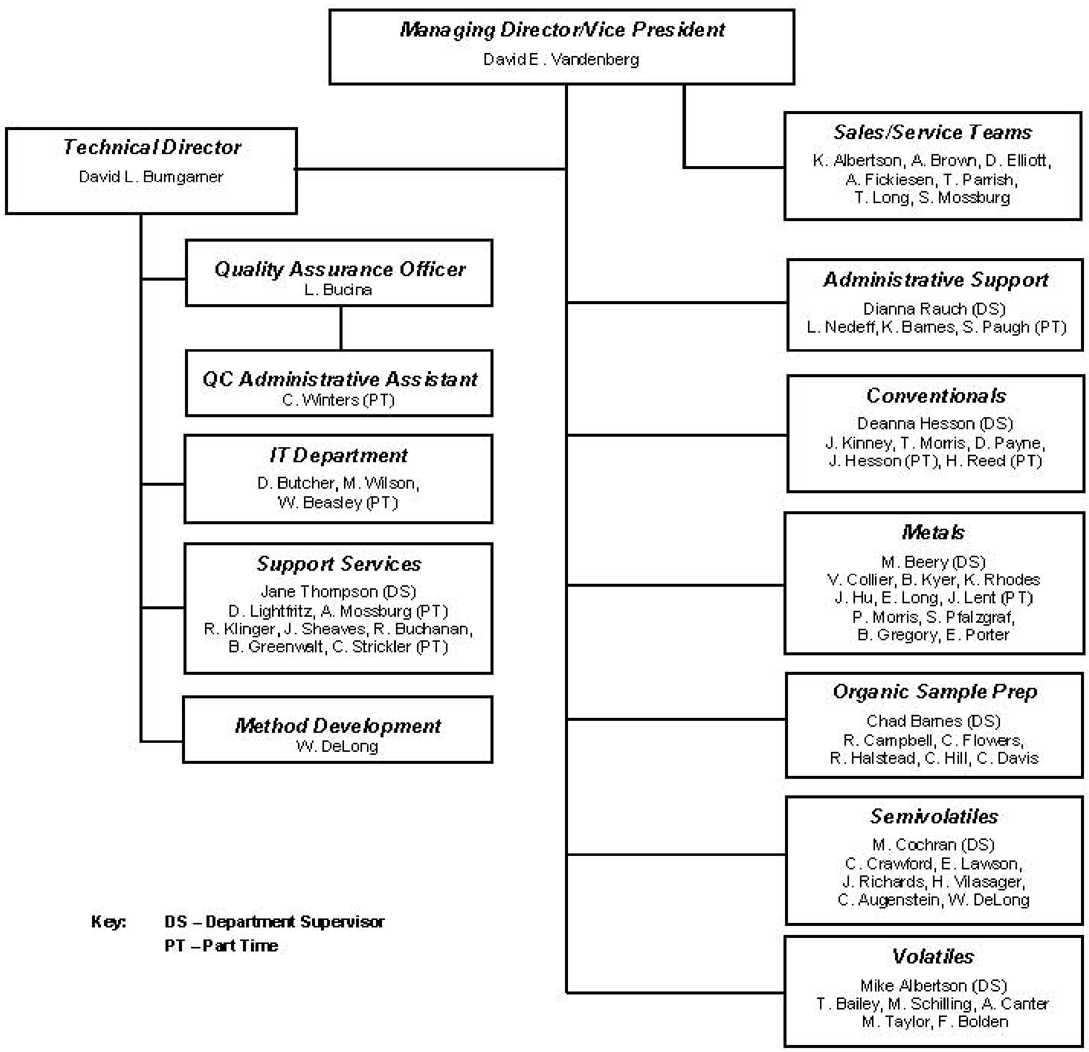
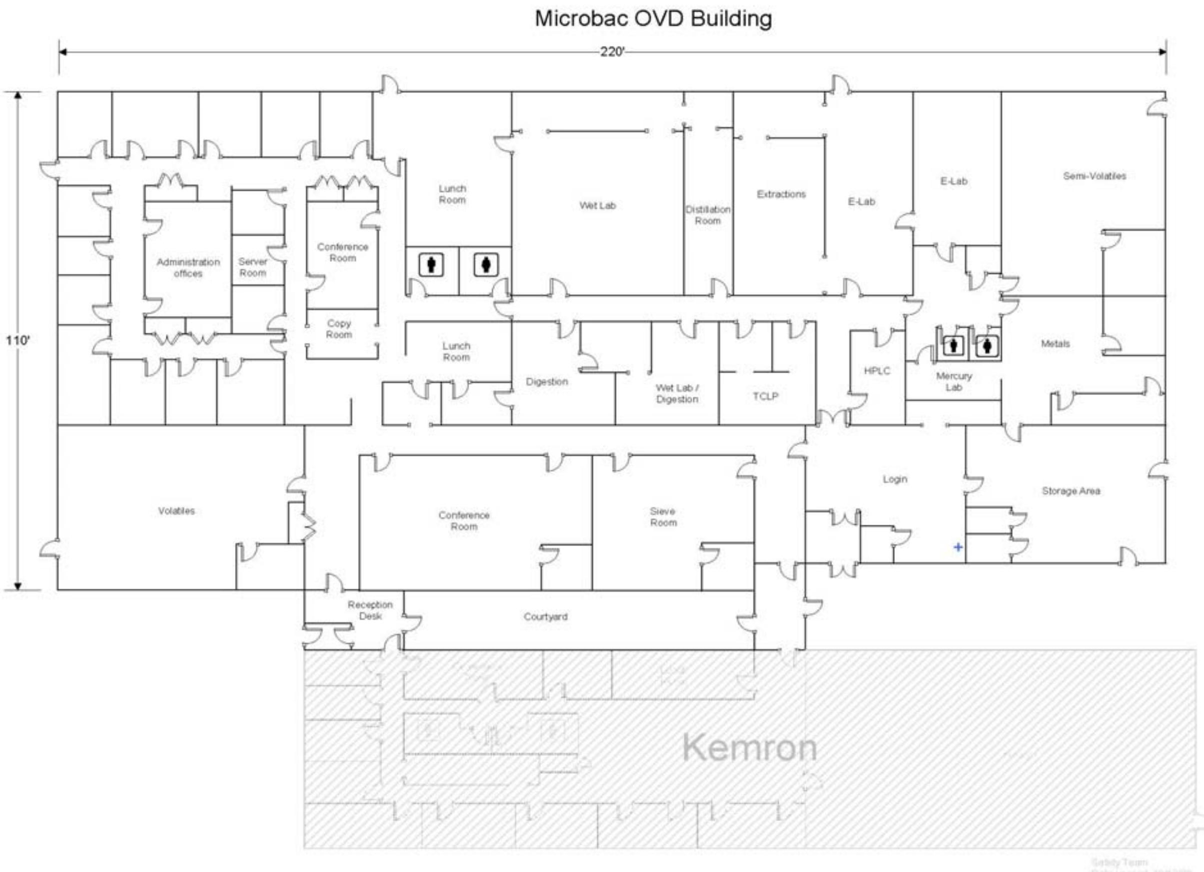


Figure 4-3
Microbac Laboratories, Inc.
Laboratory Floor Plan



5.0 GENERAL POLICIES AND PROCEDURES

5.1 NELAC Policy Statement

This quality manual, also known as the Laboratory Quality Assurance Plan (LQAP), addresses the elements defined in Section 5.4.2 of the NELAC. A list of National Environmental Laboratory Accreditation Program (NELAP) approved test methods and analytes is presented in Appendix C to this manual. Microbac will comply with all NELAC requirements for all laboratory work covered by our NELAP accreditation.

5.2 Employee Protection from Undue Pressure

It is the policy of this company to protect laboratory employees from undue outside pressures from commercial, financial, or other sources originating from management or clients. This protection is afforded through the implementation of related policies for capacity evaluation, ethics training, and an "open door" policy from upper management. All employees are encouraged to discuss their concerns about such pressures with management.

5.3 Ethics Training

The laboratory requires all new employees to participate in formal training sessions on professional laboratory ethics. Refresher training is also provided to all employees on an annual basis. All employees are educated and trained in their ethical and legal responsibilities including the potential punishments and penalties for improper, unethical, or illegal actions. All training is documented in accordance with the policy "Ethical Conduct and Data Integrity Agreement". The Ethics Policy is presented in Microbac SOP ETH01. Microbac has an "Employee Handbook" that specifies requirements for ethical behavior and general performance expectations. The handbook provides formal policies for disciplinary action and consequences of unethical behavior and other general policy violations.

5.4 Departures from Documented Policies and Procedures

All workload performed under our NELAP certification will be in accordance with this quality manual and all supporting standard operating procedures and policies. In the unlikely event that departures from documented policies and procedures (either technical or non-technical) becomes necessary, only the Managing Director or Technical Director have the authority to approve such deviations.

5.5 Reviewing New Work and Capacity Evaluation

The laboratory adheres to the following mechanism to evaluate new work. The first step is the evaluation of method capability, which includes an initial review of the procedure supplied by the client requesting the work. Management then assesses the laboratory's ability to perform the work with existing apparatus, instrumentation, facilities, and personnel. If management determines that the capability exists, or may be developed, it then evaluates the financial feasibility of performing the new work. The managing director has the sole authority for approval of new work after the above evaluation is completed. All new method development is performed in accordance with Microbac SOP 45 – ***Method Validation Procedures***.

Laboratory capacity is periodically evaluated in conjunction with scheduling and forecasting tools, status updates on outstanding proposals, and the current backlog. The laboratory requires client notification of all sample shipments and clients are advised when large shipments may tax the laboratory ability to meet holding times or delivery dates. It is the policy of laboratory management to evaluate production capacity prior to acceptance of all major delivery orders.

5.6 Complaints

Microbac Laboratories is committed to complete satisfaction of customers and other interested parties. If for any reason a party believes we have not complied with agreed upon specifications or policies, then the following procedures will be implemented:

1. Documentation of Complaint

The appropriate service representative or manager will document in writing the nature of the complaint. The contact form displayed as Figure 5-1 will be used and all appropriate correspondence and records shall be attached.

2. Investigation of Complaint

The problem will be investigated to verify the validity of the complaint or concern. If the issue is one of quality control, or breach of policy or procedure, an internal audit will be conducted. If Microbac is found negligent in meeting the written specifications or policies, or if our data is judged to be invalid or unusable for any reason, the problem is referred to the Technical Director/Quality Assurance Officer (QAO), or other authorized laboratory representative, for a resolution. If the proposed course of action is not acceptable, the problem is referred to the Managing Director. In cases of laboratory negligence the following courses of action are offered:

- Offer to perform services/analyses again at no charge; or
- refund or credit for specific services
- Assist client in dealing with the consequences, i.e. consultation with agency, letter of explanation, re-sampling assistance; and
- seek a resolution that is acceptable to all involved parties.

Written documentation of problem and resolution is maintained in the document control office with an additional copy in the master project (report) file. Summary reports are generated periodically outlining complaints for a specified period of time. These are discussed in management and laboratory staff meetings to verify trends and to establish preventive measures.

5.7 Document Control and Maintenance

Microbac-OVD has written procedures for controlling both internally generated and external documents that comply with the requirements of ISO 17025:2005, Section 4.3.1. These procedures are presented in detail in Microbac SOP GP-DOC-CONTROL.

5.7.1 Laboratory management shall approve, prior to distribution, all internal and external documents that are part of the management system.

5.7.2 The laboratory shall uniquely identify all quality system documents and include date of issuance, revision number, page numbering, total number of pages, and the issuing authority.

5.7.3 The document control officer, under the oversight of the QAO, shall maintain a master list that uniquely identifies each document, revision status, and record of distribution of all controlled documents. The master list shall be readily available for review.

5.7.4 The document control system and associated master list shall preclude the use of any invalid or obsolete documents.

5.7.5 Authorized versions shall be made available (either electronically or hardcopy) to all laboratory units where documents are essential to effective operations.

5.7.6 All controlled documents are reviewed periodically and revised as necessary to comply with all applicable requirements.

5.7.7 All obsolete or invalid documents are promptly removed to prevent any unintended use.

5.7.8 All obsolete documents are retained in an archive system to meet legal requirements and to maintain historical continuity.

5.7.9 All changes in documents shall be reviewed by the same function (management personnel) that performed the original review. These personnel shall have access to the pertinent background and information that is needed for review and approval.

5.7.10 Document Integrity

Laboratory management will ensure the integrity of the quality management system as required by ISO 17025:2005, Section 4.2.7. An important element of the annual document reviews will be to assess and eliminate any contradictions within and between internal documents.

5.7.11 Archiving

The QAO is responsible for maintaining an archive copy of each controlled document. Archive copies will be retained for ten years.

5.8 Laboratory Records

The laboratory has written procedures for managing laboratory records and established policies for records retentions that comply with ISO 17025:2005, Section 4.13.1.1. The laboratory has established a policy to archive and retain analytical data, reports, and other records in electronic format, consisting of magnetic tape, CDs, or other equivalent media. Most contracts specify a minimum retention time of five or ten years, however, Microbac will retain all electronically archived data in accordance with contractual and regulatory agency requirements. The disposition or transfer of laboratory records will be negotiated with individual clients upon any change in business status. Additional details are found in Microbac SOP GP-RECORDS.

5.9 Analyst Training and Demonstration of Capability

All analysts must go through a formal training program that includes initial and annual Demonstration(s) of Capability (DOC) for each procedure they perform.

These demonstrations are performed in accordance with the requirements of NELAC Section 5.0 Appendix C, and details are presented in Microbac SOP 47 - Employee Training. Alternatively, the laboratory uses the following option to assess Demonstration of Capability when the method is not amenable to Proficiency Testing evaluation, or standard measures of precision and accuracy:

- Four consecutive samples are analyzed with direct observation from another certified analyst, or;

- Results of four analyses are compared to those performed by another certified analyst.

5.10 Protecting Confidentiality and Proprietary Rights

Two factors must be observed regardless of the method chosen to convey information and data to a client. These are client confidentiality and accurate record keeping. The need to preserve the clients' confidentiality must never prevent recording of the date, time, person contacted and subject of the communication. Data capture software allows entire case files/final reports to be captured and put into a file format. This then can be put on disk, or sent by email to a client. This has great value for providing preliminary data to clients on quick turn projects.

5.10.1 Confidentiality Agreements

Protecting the confidentiality of client information and data is of the utmost importance to Microbac. All Microbac employees, as a condition of employment, must sign the Employee Confidential Information and Non-compete Agreement, which was developed to protect the proprietary records and data of Microbac and all of our clients. Upon request from Ohio Environmental Protection Agency (OEPA), Microbac will provide access to OEPA data and documents or information related to Ohio Voluntary Action Program (OVAP).

5.10.2 Client Data

The following standard operating procedures provide methods for ensuring that, where clients require transmission of test results by telephone, facsimile or other electronic or electromagnetic means, confidentiality is preserved.

5.10.2.1 Telephone Communications

In cases where analytical results must be communicated by telephone, a Client Service Specialist (CSS) calls the contact person/client whose name has been provided by the client at telephone number also supplied by the client. Verbal results are not released to any other person unless explicit instructions are received from the relevant client. The date and time of the client contact is recorded in the CSS telephone log.

5.10.2.2 Facsimile Transmissions

Analytical results are transmitted by facsimile to the attention of the contact person/client whose name has been provided by the client at a fax number also provided by the client. Following each fax transmission, a fax return sheet is printed automatically by the fax machine. This sheet is carefully checked against the originals. The confirmation sheet must be added to the client case file along with a copy of materials faxed. If this is not possible, the CSS must maintain a fax folder.

5.10.2.3 Electronic (Modem) Deliverables

All modem transmissions are done on direct lines to the client and are set up through our modem system using our dedicated lines. The client, where applicable, supplies telephone numbers and passwords.

5.10.2.4 Data Diskette and CD ROM Deliverables

Diskette deliverables are shipped to the client or designated contact person accompanying the hard copy report to which they apply. The client supplies the address and attention name.

5.10.2.5 Email

Where possible, email will be used to transmit information and data to a client. Care must be taken to insure the client receives the email and that the sender at Microbac maintains a record of the transmission. This can be done with our current email system by maintaining a sent file directory.

5.10.2.6 SOP's

Care must also be taken to protect client confidentiality in Standard Operating Procedures because they are often read by clients that may be considered a competitor of the client mentioned in the SOP. The utmost care must be taken to not identify specific or specialized procedures as belonging to any one client if possible. If it is necessary to name a client in an SOP then the information naming the client will have to be sanitized or removed before the SOP is given to any other potential or current client for review.

5.11 Identification of Approved Signatories

The Managing Director has the authority to sign contracts, approve new company policies and procedures (SOP's) and certify (sign) laboratory reports. The Technical Director / QAO has the authority to approve laboratory policies and procedures (SOP's) and to certify laboratory reports. The Managing Director may grant authority to other qualified personnel to certify laboratory reports or other official documents for special projects, or in case of emergency.

5.12 Monitoring and Controlling System Time

The system date and time reported by our KOBRA LIMS (and all networked data systems) is synchronized to the data/time of the mail server, which is further synchronized with the internet using network time protocol. Hourly adjustments in time are made automatically, and laboratory staff are not authorized to make manual changes. Unauthorized changes in data system date or times may be considered a violation of the laboratory ethics policy (see also Section 5.3).

5.13 Changes of Ownership/Key Staff

In the event of change in ownership, the laboratory must notify all customers, certifying bodies, and relevant agencies within 30 days of any changes in ownership. This letter will clearly identify the extent of these changes, and discuss policies for ownership, storage, and access to historical data and records. The laboratory must also notify certifying bodies within 30 days or any changes in any key management staff, including the Managing Director or Technical Director(s).

5.14 Method References

The laboratory will include the official method references on laboratory documents including benchsheets, laboratory SOP cover pages, and laboratory analysis reports. These references shall correspond to those listed in the NELAP Scope of Accreditation.

5.15 A2LA Advertising Policy

The laboratory will adhere to the most recent directives established by The American Association for Laboratory Accreditation (A2LA) in regard to display and use of symbols and documents reflecting its accreditation by A2LA. The laboratory will ethically and accurately represent areas of products and services for which this accreditation is applicable, and where used, the laboratory will assure clear exception of products and services outside the scope of that accreditation. Where used, the following restrictions are to be observed:

- The A2LA symbol cannot be used by the laboratory for any purpose. Only the A2LA Accredited symbol can be used by the laboratory to indicate its accreditation by A2LA. The A2LA Accredited Symbol may be modified for size and/or color, but the integrity of the symbol must be maintained in all respects.

- The laboratory can use the A2LA accredited symbol on business cards, but the location of the symbol is important. The symbol should not be placed near the name of the individual, to in any way suggest accreditation of that individual.

- Only the individual laboratory accredited by A2LA can use the A2LA Accredited symbol; therefore, corporate stationary, websites and marketing materials, which encompass all laboratories under the corporate structure, cannot carry the A2LA Accredited symbol.

As acknowledged by the A2LA directive, not every possible inappropriate use of the A2LA Accredited symbol is addressed in P101-Reference to A2LA Accredited Status-A2LA Advertising Policy; however, all laboratory personnel involved in the promotion of the laboratory's capabilities and credentials are required to review the specific examples, including graphics presented in the Appendix, for unacceptable usage of the A2LA Accredited Symbol. Review and training of staff to insure clear and unambiguous understanding of the proper use of the A2LA Accredited Symbol and ramifications of non-compliance will be conducted annually.

5.16 Purchasing Supplies and Services

The laboratory has developed written policies and procedures in Microbac SOP GP-PURCHASING for the selection and purchasing services and supplies that comply with ISO 17025:2005, Section 4.6.1.

5.17 Uncertainty - Estimating Uncertainty of Measurement

Microbac states on the cover page all laboratory reports that uncertainty data is available when requested by the client. Microbac will produce a separate report in comma separated value (CSV) format that presents the data as a concentration interval about the reported value for each analyte. The lower and upper limits of the interval express the uncertainty estimate for each result, and where applicable are based on the analyte's quality control limits for laboratory control samples (LCS). The expressed uncertainly makes no attempt to address sampling error. Detailed procedures for estimating measurement uncertainty in accordance with ISO 17025:2005, Section 5.4.6.2, are found in SOP GP-UNCERTAINTY.

5.18 Review of Requests, Proposals, and Contracts

Microbac-OVD has established policies, procedures, and a system of record for the review of requests (RFP), tenders (proposals), and contracts. The review includes any work that is subcontracted, and all contract amendments. The customer is informed of any deviations to contracts before the work begins. Details of the procedures are found in Microbac SOP GP-CONTRACTS.

6.0 SAMPLING PROCEDURES

Microbac functions as an environmental analytical facility and as such is not directly responsible for the sampling events. However, Microbac does utilize independent field personnel. Below are sampling guidelines that were developed to outline the primary objective of any external sampling event. The objective is the collection of samples which, when analyzed, will consistently generate accurate, precise and representative data. By developing comprehensive standard sampling procedures and training personnel in the procedures, this objective can be met. These sampling procedures are offered as guidance to field project managers to assure sample integrity. Following the sampling procedures promotes sample integrity and the highest degree of quality control throughout the sampling event.

6.1 General Sampling Guidelines

SOPs should be utilized by all field project managers for potential sample sources. The SOPs should be based on State and USEPA guidance documents. SOPs should be available to and reviewed by all field personnel. Following are general guidelines to be used in the collection of environmental samples:

6.1.1 Sample containers which are prepared in the laboratory may contain measured volumes of preservative. Such containers must not be rinsed prior to filling with sample.

6.1.2 Sample containers for VOA, pH, and TOX must be completely filled with no headspace. All other sample analyte containers must be filled to approximately 95% capacity.

6.1.3 VOA samples must be collected in a manner which minimizes disturbance of the sample and potential for volatilization. Fill vials until a convex meniscus forms then carefully place the septum cap on the vial. Invert the vial and check for the presence of air bubbles.

6.1.4 Field sampling equipment must always be appropriately decontaminated before and after use.

6.1.5 During the collection of all environmental samples, appropriate personal protective gear must be worn. Gloves and safety glasses are the minimum acceptable level of personal protective equipment (PPE) to be worn when samples are collected.

6.1.6 Use pre-cleaned laboratory prepared glassware for the collection of samples whenever possible.

6.2 Microbac Sampling Containers

The measurement of trace constituents in environmental samples demands methods capable of maximum precision and sensitivity. The selection and proper care of laboratory glassware and sample containers is an important part of the quality control program to eliminate errors due to contamination from improper cleaning procedures.

Laboratory supplied containers constructed of materials which are both compatible and non-reactive with the material to be sampled will be used. Microbac uses commercial sample containers which are certified pre-cleaned to EPA standards. These containers are shipped in sealed boxes with custody seals. Glassware is certified cleaned according to Protocol A, B, or C described below. Sample containers used by Microbac follow washing procedures equivalent to these protocols.

Table 6-1
Glassware Cleaning Protocol

Protocol A	Protocol B	Protocol C
Laboratory-grade detergent wash and rinse	Laboratory-grade detergent wash and rinse	Laboratory-grade detergent wash and rinse
Acid, deionized water, and solvent rinse	Multiple deionized water rinses	Acid rinse Multiple deionized water rinses
Oven drying, capping, and packing under quality control conditions	Oven drying, capping, and packing under quality control conditions	Oven drying, capping, and packing under quality control conditions

Table 6-2 lists the container type and volume required for each sample type.

6.3 Sample Preservation

Use of cooling, pH control, and chemicals to retard biological activity or to stabilize the chemical species of a sample is known as preservation. Sample kits prepared by the laboratory include sample containers prepared with the appropriate type and volume of preservative for the analyte of interest. Addition of preservative to samples in the field is not normally required when using the prepared kits. This procedure minimizes the potential for incorrect or inadequate sample preservation. The most common form of preservation is cooling the sample to 0-6° C using ice or refrigeration. Other common preservatives used include:

- Hydrochloric acid - dilute 1:1
- Nitric acid - dilute 1:1
- Sulfuric acid - dilute 1:1
- Sodium hydroxide - 50% solution
- Sodium thiosulfate - for dechlorination

Table 6-2 lists the preservation techniques and holding times employed by Microbac for each sample type. Holding time is defined as time elapsed from sample collection date and time to the analysis date and time with the exception of semivolatile extractables. Semivolatile holding times in the table denote designated timing allowed from collection to sample extraction. Hold time for semivolatile analysis from date of extraction is 40 days.

6.4 Sample Documentation

6.4.1 Sample labels

When using laboratory prepared sample kits, pre-labeled and preserved sample containers are provided. Each sample collected by Microbac is clearly labeled using waterproof ink with the following information:

- Client name
- Date and time of collection
- Sample source
- Preservative required
- Name(s) of sampler
- Analyses requested
- Sample identification

6.4.2 Field records

Sampling personnel should maintain complete and accurate records of all field activities. Bound field notebooks and/or field logs specific to the media sampled should be completed during each sampling project. All pertinent information on the sampling event is included in the field record.

6.4.3 Chain-of-Custody

All samples should be accompanied by a completed chain-of-custody form when shipped or hand delivered to the laboratory. Information required on the chain-of-custody includes:

- Sample date and time
- Name(s) of sampler(s)
- Sample ID
- Project name and number
- Analyses requested
- Number of sample containers
- Signature and date of all individuals who have custody of the samples

6.5 Sampling Equipment Decontamination

All field sampling equipment must be appropriately pre-cleaned prior to leaving the base of operations. Use phosphate-free detergent, hot tap water, and analyte free rinse water for this cleaning following the procedure specified for analytes of interest. Cleaned equipment must be wrapped or enclosed to maintain cleanliness during transport to the field for use. Adequate quantities of sampling equipment must be provided for each event to minimize the need for field decontamination.

Decontamination procedures for sampling equipment may include:

- Phosphate-free detergent and tap water wash
- Rinse with tap water

For equipment to be used for trace metals sampling, rinse with 1:1 reagent grade nitric acid solution. **Do not rinse stainless steel sampling equipment with nitric acid**.

- Rinse thoroughly with deionized water
- Rinse with isopropanol or methanol
- Thoroughly rinse with analyte-free water (if available)
- Air dry
- Wrap securely to prevent contamination if equipment is to be stored

Information on specific decontamination procedures are provided in each sampling SOP. Special decontamination procedures will be implemented as necessary, based upon contaminant encountered.

Equipment which is heavily soiled may require steam cleaning and/or high pressure washing. Drilling equipment and other heavy equipment used in field sampling activities will likely require this type of cleaning. If equipment cannot be adequately decontaminated, it will be discarded.

6.6 Field Waste Disposal Practices

Field generated waste must be disposed as required by project specifications and in accordance with applicable local, state, and federal requirements. Wastes commonly generated include drill cuttings, drilling fluids, well development water, well purge water, decontamination fluids, and contaminated personal protective equipment.

Based upon site and project specific requirements, liquid wastes should be containerized for characterization and disposal or discharged directly to an appropriate discharge location. Solid wastes should be containerized and left on-site for disposal or, if appropriate, disposed as general refuse.

Prior to initiating any sampling activity the waste handling requirements should be determined to ensure timely disposal in compliance with regulatory requirements.

6.7 Laboratory Sub-Sampling Procedures

6.7.1 Soil

Microbac employs the following procedures for taking soil subsamples in all methods and departments except for percent moisture determinations and volatile organic analyses:

a) Remove sample bottle contents and place in tray lined with wax paper (metals lab) or aluminum foil (organics extraction lab). Alternatively, remove vertical core section(s) (top to bottom) that is representative of the bottle contents and transfer to the tray.
b) Mix sample with an inert rod or scoop and break up lump. Remove all large stones, sticks, leaves, etc. Do not over mix the sample.
c) Obtain representative sample either by random removal of 3-10 portions of the sample from the pan or by using a “standard” scoop designed to retrieve a linear cross-section of the pan contents.
d) The analyst will not attempt to target an exact weight once a method specified minimum amount is weighed.
e) The remaining sample will be returned to the sample container.

NOTE: These procedures do not apply to samples for volatile organics analysis, except the requirement not to target a specific mass of sample

6.7.2 Water and Liquid Wastes

Unless otherwise stated in the method SOPs, the analyst will homogenize water and low viscosity liquid wastes by shaking each sample vigorously immediately prior to taking the sample aliquot. Viscous liquids such as oils shall be stirred with a glass rod prior to aliquot removal.

6.7.3 Multiphasic Samples

The laboratory will attempt to identify multiphasic sample prior to login. Our policy is to contact the client to determine whether to attempt homogenization, or to do a phase separation, and log as separate samples. Homogenization may require special procedures such as the use of a blender, however, our recommended approach is to separate the phases. The analyst should notify the project chemist if a muliphasic sample is discovered after receipt.

6.8 Sample Dilutions

The laboratory may dilute samples prior to analysis for the following reasons:

- A previous analysis yielded a result above the upper calibration range for the method.
- The sample contains a target, or non-target analyte, at sufficient concentration to damage sensitive instrumentation.
- Sample matrix interference, confirmed by poor surrogate or spike recoveries, prevents accurate analysis without dilution.

In each case the laboratory will document the sample dilution by reporting the dilution factor, adjusting the reporting and detection limits by that factor. The report narrative will provide additional detail as needed. If dilution analysis is not performed, the laboratory will assign appropriate qualifiers to any results reported above the upper calibration range.

Table 6-2
Sample Containers, Preservation and Hold Times

CONVENTIONALS - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Acidity	100	P, G	Cool, 4° C	14 Days
Alkalinity	100	P, G	Cool, 4° C	14 Days
Total Solids	50	P, G	Cool, 4° C	7 Days
Ash Content @ 750° C	25	P, G	Cool, 4° C	---
Biochemical Oxygen Demand	500	P, G	Cool, 4° C	48 Hours
Boron	20	P	Cool, 4° C	6 Months
Bromide	1000	P, G	Cool, 4° C	28 Days
BTU	10	P, G	Cool, 4° C	---
Formaldehyde	20	G	Cool, 4° C	7 Days
Chloride	25	P, G	Cool, 4° C	28 Days
Chloride, Total Residual	100	P, G	Cool, 4° C	6 Hours
Cyanide (midi)	50	P, G	Cool, 4° C, NaOH, pH>12	14 Days
Cyanide, Amenable to Chlorination (midi)	100	P,G	Cool, 4° C, NaOH, pH>12	14 Days
Chemical Oxygen Demand	25	G	Cool, 4° C, H_2SO_4, pH<2	28 Days
Color, Platinum-Cobalt	50	P, G	Cool, 4° C	48 Hours
Coliform, Fecal	120	P, G	Cool, 4° C, $Na_2S_2O_3$	6 Hours
Fecal Streptococcus	100	P, G	Cool, 4° C, $Na_2S_2O_3$	6 Hours
Coliform, Total	100	P, G	Cool, 4° C, $Na_2S_2O_3$	6 Hours
Specific Conductance	100	P, G	Cool, 4° C	28 Days
Corrosivity	500	P, G	Cool, 4° C	---
Corrosivity (pH)	40	P, G	Cool, 4° C	---
Chromium, Trivalent	200	P, G	Cool, 4° C	---
Chromium, Hexavalent	150	P, G	Cool, 4° C	24 Hours
Dissolved Oxygen	300	G	Cool, 4° C	6 Hours
Fluoride	25	P, G	Cool, 4° C	28 Days
Ignitability	75	P, G	Cool, 4° C	---
Fluoride, Total (Distilled/Non-Distilled)	200	P, G	Cool, 4° C	28 Days
Hardness	100	P, G	Cool, 4° C, HNO3, pH<2	6 Months
Iodide	400	P, G	Cool, 4° C	24 Hours
Surfactants (MBAS)	100	P, G	Cool, 4° C	48 Hours
Coliform Fecal (MPN)	100	P, G	$Na_2S_2O_3$	6 Hours
Nitrogen, Ammonia (Distilled/Non-Distilled)	100	P, G	Cool, 4° C, H_2SO_4, pH<2	28 Days
Nitrogen, Nitrite	50	P, G	Cool, 4° C	48 Hours
Nitrogen, Nitrate	75	P, G	Cool, 4° C	48 Hours
Nitrogen, Nitrate-Nitrite	25	P, G	Cool, 4° C, H_2SO_4, pH<2	28 Days
Nitrogen, Organic	100	P, G	Cool, 4° C, H_2SO_4, pH<2	28 Days
Threshold Odor	1000	G	Cool, 4° C	48 Hours
Oil and Grease	1000	G	Cool, 4° C, H_2SO_4, pH<2	28 Days

1. P = Polyethylene (preferred when acceptable)
2. G = Borosilicate glass with Teflon lined cap

Table 6-2 (continued)
CONVENTIONALS - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Phenolics, Total	100	Amber, G	Cool, 4° C, H_2SO_4, pH< 2	28 Days
Phosphorus, Total	50	P, G	Cool, 4° C, H_2SO_4, pH< 2	28 Days
pH Lab	40	P , G	Cool, 4° C	6 Hours
Orthophosphate	50	P, G	Cool, 4° C	48 Hours
Reactivity, Cyanide	10	P, G	Cool, 4° C	---
Reactivity, Sulfide	10	P, G	Cool, 4° C	---
Sulfite	50	P, G	Cool, 4° C	24 Hours
Settleable Solids	1000	P, G	Cool, 4° C	48 Hours
Silica, Dissolved	100	P	Cool, 4° C	28 Days
Sulfate	100	P, G	Cool, 4° C	28 Days
Specific Gravity	50	P, G	Cool, 4° C	---
Total (Organic) Sulfur	10	P, G	Cool, 4° C	---
Sulfide	200	P, G	Cool, 4° C, Zinc Acetate, NaOH, pH> 9	7 Days
Total Dissolved Solids	50	P, G	Cool, 4° C	7 Days
Total Suspended Solids	200	P, G	Cool, 4° C	7 Days
Turbidity	50	P, G	Cool, 4° C	48 Hours
Volatile Dissolved Solids	50	P, G	Cool, 4° C	7 Days
Total Volatile Solids	50	P, G	Cool, 4° C	7 Days
Volatile Suspended Solids	200	P, G	Cool, 4° C	7 Days

VOLATILE ORGANICS (VOA) - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Gasoline Range Organics	40 mL	G, Septa Caps	Cool, 4° C, HCl, pH< 2	14 Days
Volatile Aromatics	40 mL	G, Septa Caps	Cool, 4° C, HCl, pH< 2	14 Days
Volatile Organics (VOA)	40 mL	G, Septa Caps	Cool, 4° C, HCl, pH< 2	14 Days
VOA – Method 624	40 mL	G, Septa Caps	Cool, 4° C, $Na_2S_2O_3$	7 Days

Table 6-2 (continued)
SEMIVOLATILE ORGANICS - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Diesel Range Organics	1000 mL	G	Cool, 4° C	7 Days
Pesticides/PCBs	1000 mL	G	Cool, 4° C	7 Days
Polyaromatic Hydrocarbons	1000 mL	G	Cool, 4° C	7 Days
Herbicides	1000 mL	G	Cool, 4° C	7 Days
Semivolatile Organics	1000 mL	G	Cool, 4° C	7 Days

1. P = Polyethylene (preferred when acceptable)
2. G = Borosilicate glass with Teflon lined cap

METALS - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
All Metals (26)	500 mL	P, G	HNO_3, pH< 2	6 Months*
Mercury	50 mL	P, G	HNO_3, pH< 2, 4°C	28 Days
Furnace Metals	100 mL	P, G	HNO_3, pH< 2	6 Months

TCLP - WATER

PARAMETER	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
TCLP Volatiles	100 mL	G	Cool, 4° C	14 Days
TCLP Semi-Volatiles	100 mL	G	Cool, 4° C	14 Days
TCLP Pesticides	100 mL	G	Cool, 4° C	14 Days
TCLP Herbicides	100 mL	G	Cool, 4° C	14 Days
TCLP Metals	100 mL	P, G	Cool, 4° C	6 Months*

* For (1) TCLP parameter 100 mL required; for full TCLP (2) 1000g
* Mercury is 28 days

Notes:

1. P = Polyethylene (preferred when acceptable)
2. G = Borosilicate glass with Teflon lined cap
3. Triple the volumes above for MS/MSD samples

Table 6-2 (continued)
SOIL HOLD TIME

METHOD	MINIMUM VOLUME	CONTAINER TYPE	PRESERVATIVE	HOLD TIME
Coliform Fecal	1g	G	Cool, 4° C	6 Hours
Chromium, Hexavalent	50g	G	Cool, 4° C	24 Hours
5035	5 g	P, G	Cool, 4° C	48 Hours
TCLP-VOA	105g	G	Cool, 4° C	14 Days
TCLP-SV	105g	G	Cool, 4° C	14 Days
TCLP-Pest/Herb	105g	G	Cool, 4° C	14 Days
TCLP-Metals	105g	G	Cool, 4° C	6 Months*
Total Metals (except Hg)	3g	G	Cool, 4° C	6 Months
Hg	2g	G	Cool, 4° C	28 Days
TPH	30g	G	Cool, 4° C	28 Days
Semi-Volatiles	30g	G	Cool, 4° C	14 Days
Herbicides	50g	G	Cool, 4° C	14 Days
Volatiles	1g	G	Cool, 4° C	14 Days
Conventionals (where applicable)	1g – 100g	G	Cool, 4° C	14 Days
Petroleum Hydrocarbons	30g	G	Cool, 4° C	14 Days
Percent Moisture	25 g	P, G	Cool, 4° C	---
Percent Solids	25 g	P, G	Cool, 4° C	---
Paint Filter Liquids Test	100 g	P, G	Cool, 4° C	---

* Mercury is 28 days
** All soils stored at 4° C

7.0 SAMPLE CUSTODY

In recognition of the critical nature of sample custody protocols, Microbac Laboratories has implemented stringent standard operating procedures, designed to ensure sample integrity and thorough documentation. This section provides a clear description of sample traceability from sampling kit to final sample disposition.

7.1 Sampling Kits

Microbac Laboratories, at the client's request, will provide sampling kits to the client. Additional information on sampling kits can be found under Section 6.0 of this document and in Microbac SOP KP01.

7.2 Field Custody (Also see Section 6.1)

A vital component of Microbac's quality assurance program is to ensure that a clear and detailed record is kept of all samples and sampling activity. Chain-of-Custody (COC) forms (Figure 7-1) are submitted with all samples. These are kept in the appropriate project files. Water-proof ink is used to label samples as protection against loss of information due to accidental erasure. Microbac's sample custody protocol requires that the following information be recorded.

7.2.1 Date and Time of Sample Collection

7.2.2 Specific description of sample location. This may include a monitoring well number in the case of groundwater sampling. For soil sampling, sample points may be sketched on a site map and confirmed via surveying. For surface water and sediment sampling, the drum number, (if labeled), drum location, suspected contents and phase of drum materials (liquid, solid, or sludge) may be noted, as well as, which layer or layers within the drum were sampled.

7.2.3 Name(s) of sampler(s) will be identified.

7.2.4 A description of weather conditions and general site conditions (disturbed soils, standing water, ongoing activities, etc.) may be provided.

7.2.5 A description of the sampling equipment used, including method for purging monitoring wells may be indicated.

7.2.6 The specific field ID number for a sample may be recorded. The sample sequence number is the order in which a particular sample was taken with respect to all other samples retrieved at the site. The sample sequence number may also be recorded.

7.2.7 Components or constituents of sample to be analyzed are to be noted.

7.2.8 Signature(s) of sampler(s) will be provided.

7.2.9 Types of preservatives and, if necessary, the results of field check (pH, etc.) may be recorded.

7.2.10 Field measurement data (such as VOA reading, pH, specific conductance) may be recorded.

7.3 Sample Transport

Samples are transported to Microbac's laboratory by one of three modes:

7.3.1 Microbac Courier - on many projects, Microbac will have responsibility for preparation of sample bottles, sample kit assembly and delivery of sample kits to the project site. Microbac will also pick up the samples at the project site and transport them to the laboratory. Microbac drivers will follow these established protocols:

- They will carry proper Microbac identification, which they will be prepared to display before entering project sites;
- They will sign the Chain-of-Custody forms when picking up the samples;
- They are responsible for the integrity and security of samples while in their custody;
- They must secure the vehicle at all times when it is necessary to stop and be away from the vehicle for any reason during the transportation of samples to the laboratory.

All samples returned by Microbac personnel are delivered immediately to the Sample custodian in the sample logging station. The Shipping and Receiving entrance is to be used for such deliveries. If delivery is made after hours, the driver will take the cooler temperature, fill out the appropriate form for the sample custodian and store the cooler in a locked sample storage unit.

7.3.2 UPS, FEDEX, or Other Common Carrier - Transporters are directed to the Shipping and Receiving entrance and the samples are delivered to the Sample custodian.

7.3.3 Client Deliveries - Clients may deliver samples in person via the designated Receiving entrance but must be escorted while within the facility.

7.4 Laboratory Custody Procedures

The National Enforcement Investigations Center (NEIC) of EPA defines custody of evidence in the following manner:

- It is in your possession, or;
- It is in your view after being in your possession, or;
- It was in your possession and then you locked or sealed it to prevent tampering, or;
- It is in a secure area.

7.4.1 Normal Custody Procedures

For the purpose of sample custody, Microbac Laboratories maintains that the laboratory in its entirety is a secure area and all samples received and logged into the laboratory remain in the custody of the Sample custodian, Supervisor or Analyst, until time of disposal. Refrigerators, freezers and other designated sample storage areas will be securely maintained or locked. Only the designated Sample custodian or supervisory personnel will have keys to locked sample storage units until removed for sample preparation or analysis. The following minimum custody procedures are followed for all samples:

- All samples are received and inspected in accordance with Section 7.5.
- The sample custodian signs and dates the chain-of-custody form provided by the client.
- The samples are stored in the appropriate storage unit. (The storage unit is also designated in the KOBRA LIMS when the samples are logged in.)
- Several laboratory documents are used to document which laboratory personnel handled the samples, including bench sheets, sample preparation logbooks, and instrument run logbooks.
- The original copy of the chain-of-custody form is included in the laboratory report to the client and a copy is maintained in the laboratory files.

7.4.2 Internal Laboratory Custody (Internal Chain of Custody (ICOC))

- In order to satisfy more stringent chain-of-custody requirements, the following standard operating procedures can be implemented by Microbac Laboratories, Inc. upon the request of the client:

- The work request prepared by the CSS must specify which projects require extended internal laboratory custody. All sample bottles designated for ICOC are identified on the label for easy identification.

- After the samples are logged into the KOBRA LIMS, a unique container number and barcode is generated and printed on the bottle label (Figure 7-4). Each laboratory staff member is also assigned a badge and barcode in order to quickly record all exchanges.

- Samples must remain in secure sample storage units until removed for sample preparation or analysis. All transfers of samples into and out of storage will be posted to the KOBRA LIMS using a standard barcode reader.

- Removal of samples from storage requires a barcode scanning procedure that produces an electronic record of the transaction in the KOBRA LIMS.

- After a sample container has been removed from storage, the analyst is responsible for the custody and integrity of the sample. While the samples are in the custody of the laboratory, they must be locked in the storage units if not in immediate custody of the analyst.

- Samples returned to the storage units must be scanned to document the transfer from analyst back to the custodian.

- The custodian will scan each container at the time of disposal of the sample container. (Transfer of sample extracts and digests are documented on the laboratory preparation benchsheets.)

- A special report from the KOBRA LIMS is used to produce an Internal Sample Custody Form (See Figure 7-3). These records are included in the final report to the client as well as the signed original copy of the field COC form.

7.5 Sample Receipt and Inspection

The sample custodian or designated assistant will receive all incoming samples. The following procedures are outlined in Microbac SOP LOGIN 01. The following information is documented on the Sample Receipt Form (Figure 7-2). The custodian will frisk the cooler for radioactivity if required by the project Quality Assurance Project Plans (QAPP). The custodian will open the shipping containers and note the presence/absence of Chain-of-Custody forms and seals, airbills, or bills-of-lading. The sample temperature is then read. The custodian will examine the shipping container to verify the integrity of the sample(s) and examine the sample documentation and identification to assure it is correct and the proper preservative has been used. The preservatives are checked by the sample custodian. If inspection indicates samples were damaged in transit, the shipping container will be moved to the hood in Log-in, assessments of the damage will be made and the appropriate services representative will be notified. The client will be immediately contacted and determination of the degree of hazard will be made. If damage is minimal and the client requests it, an attempt to salvage the sample(s) will be made if it can be done safely. In the event of damaged hazardous samples, Microbac's Spill Response Team will be notified per the Chemical Hygiene Plan.

Samples received after hours, when the sample custodian is absent, will be placed in the walk-in refrigerator. The person receiving the shipping container will sign for the container, take the cooler temperature if appropriate and place the dated forms on the Custodian's desk. The sample custodian will log in the samples on the next business day. The KOBRA LIMS system will indicate the actual date and time received and the original receipt documentation will be included with the COC form.

The sample custodian will compare the COC forms and labels to verify agreement of information contained therein. If major discrepancies are found, they will be documented on the Sample Receipt Form and the services representative will be immediately notified. Written documentation of all problem resolutions will be placed in the project/case file. If there are no problems with the samples received, the sample custodian files the signed COC form and Sample Discrepancy Form in the project/case file. After the sample is logged in, it will be immediately stored under the proper conditions.

Sample labels or other sample documents that appear to be contaminated due to sample breakage or other problems will be dried under a fume hood and be separately sealed in plastic bags, if necessary, prior to being placed in case files. The services representative must also be notified.

7.6 Sample Logging Procedures

The following procedures are outlined in Microbac SOP LOGIN01. The sample custodian is responsible for logging all samples into the Laboratory Information Management System (KOBRA LIMS), signing the COC form, completing the Sample Receipt Form, reporting all problems, inconsistencies, or anything questionable to the services representative, placing all samples in storage, monitoring conditions in sample storage areas, and maintaining records for laboratory COC.

As a new login number is initiated in the KOBRA LIMS, the sample custodian generates and/or enters the following information about the project shipment:

- Microbac Login Number
- Client Project Identification
- Mode of Transportation
- Date and Time Received/Date Due
- Matrix/Sample ID
- Date and Time of Sample Collection
- Storage Location/Container Size/Type/Preservative
- List of Analyses
- Notation of Problems/Special Instructions

In order to maintain sample identity, each sample received will be assigned a unique sample I.D. number. The KOBRA LIMS will assign the unique Microbac Sample Number at the time of log-in, as shown in the following example:

EXAMPLE: L08010001-01

The first nine digits identify a group of related samples and becomes the login number and report number. The two-digit number after the dash identifies a specific sample in the order. These numbers are used by Microbac for continuous identification of the sample from receipt to completion of analysis. In the event of multiple samples for a single analysis, such as 2 vials for volatile organic compounds, letter designations will be added to the end of the identification number. Sample containers will be clearly identified with the appropriate sample number. The sample labeling process is accomplished by the KOBRA LIMS system which prints the required number of computer labels (Figure 7-5). Extract vial numbers and metal digests will correspond to the Microbac sample number from which they originated. These numbers will also be recorded on sample tracking documentation.

7.7 Sample Storage

Samples and extracts will be stored in uniquely identified refrigerators which are in secure areas of the laboratory. The sample custodian or designated assistant will check the temperature of each refrigerator in the log-in area, twice daily (once on weekends and holidays) and maintain a record book. This record book will be reviewed on a monthly basis by the Support Services Supervisor to note any trends or inconsistencies. The acceptable range for sample storage is 0-6° C. The sample custodian will notify the Support Services Supervisor of any refrigerator temperature problem which cannot be corrected by simple thermostat adjustment. A list of emergency repair numbers for the refrigeration units is attached to the walk-in refrigerator's exterior.

7.8 Sample Distribution and Tracking

Both the preparation and the analysis of samples will be documented using special forms (logbooks). Once analysis is complete, the analyst will return the unused sample to the sample custodian area for return to the main cooler or to the Sample Archive Room, whichever is appropriate. Figure 7-3 provides an Microbac Internal Sample Custody form. Samples will be returned to their original storage units after completion of analyses. Samples which have exceeded their regulated holding period will be placed in the Sample Archive Room. They are routinely stored in this area for a minimum of 14 days after the due date for the analytical report. They are then disposed per protocol listed in Microbac's "Waste Management SOP". Extended archive beyond 14 days with refrigeration is available for specific projects or as required by contract.

It is important to note that samples received for analysis of VOA are segregated from other samples. Standards are also segregated from all samples in designated storage units.

7.9 Sample Security

All sample storage refrigerators are equipped with a lock. The units are monitored by the sample custodian during business hours. After business hours, the unit is kept locked and only selected personnel have access (by key) to the sample storage unit. All samples, extracts and digests will be stored in segregated areas.

7.10 Laboratory Building Security

All access doors to the building, with the exception of the main entrance to the reception area and the employee entrance, remain locked. Only select Microbac employees have keys to the access doors to the building. The main entrance and the employee entrance is unlocked only on business days between the hours of 8:00 AM and 5:00 PM. The facility is also equipped with an electronic alarm system and employees are assigned unique pass codes for entry.

7.10.1 Employee Access

All employees must enter the building through the employee entrance. Keys are required except during normal business hours. Employees may exit through the employee entrance when it is locked without the use of a key, but keys are required for re-entry.

7.10.2 Visitors, Vendors and Deliveries

All visitors to the office or laboratory must enter the main lobby through the main entrance and sign in with the receptionist. Visitors must be escorted at all times and in all areas of the facility. Vendors and delivery personnel are directed to use the door to the Shipping and Receiving area. Access to this door is controlled by the Microbac employee on duty, and upon entrance, the visitor must be escorted at all times.

7.11 Sample Subcontracting/Shipping

For certain projects, it may be necessary for Microbac to subcontract some analyses. Samples to be analyzed will be shipped to the contracted laboratory using the Microbac sample kit. To prevent sample breakage, only EPA-approved sample containers will be used. Freezer packs will be included in each sample kit to serve as a separation divider for the samples and to increase the cooling capacity.

In order to maintain the temperature of samples at ≤6° C, wet ice will be supplied by the client when required. Each shipping kit will contain the following:

- Partitions to hold sample bottles;
- Freezer pack(s) (if ice is not used);
- Chain-of-Custody form/Log-out form;

The sample kit will be packed in a hardside cooler. The sample kit will be sealed with Microbac Chain-of-Custody seals.

7.12 Electronic Data Security

Data integrity is insured through KOBRA LIMS multi-level security. Access to the specific user privileges can be individually controlled. Each user has their own user name and password which allows certain privileges. Hard copy data, which contains all of the data regarding a group of samples, are kept in a master file, labeled with the login numbers. Microbac provides electronic data deliverables (EDD) in client specified formats. Both e-mail and CD-ROM are commonly used for electronic transfer of data.

7.13 Automated Field Procedures

Microbac has developed electronic field tools for special projects to assist the sampler and sample custodian in many of the activities described previously in this section. The use of pre-programmed personal data assistants (PDA), barcode technology, and laptop computers enable the field personnel to focus on sample collection, while relying on the electronic tools to handle the laborious paper handling chores. Microbac enters the project sampling locations and the required analytical methods into the KOBRA LIMS, and downloads the information to the PDAs database tables prior to sampling. The sampler uses the barcode enabled PDA and the pre-labeled sample containers to more quickly and accurately collect the appropriate samples. After each sampling event the data from the PDA is transferred to a laptop computer, and the associated files are then uploaded to the KOBRA LIMS. Thus, many of the manual data field and laboratory data handling chores are handled electronically.

Figure 7-1
MICROBAC CHAIN-OF-CUSTODY RECORD

COC No. A 15107

158 Starlite Drive
Marietta, OH 45750

Microbac
CHAIN-OF-CUSTODY RECORD

Phone: 740-373-4071
Fax: 740-373-4835

Company Name:	
Project Contact:	Contact Phone #:
Turn Around Requirements:	Location:
Project ID:	
Sampler (print):	Signature:

Program
☐ CWA
☐ RCRA
☐ DOD
☐ AFCEE
☐ Other ____________

ADDITIONAL REQUIREMENTS

Sample I.D. No.	Comp	Grab	Date	Time	Matrix*	NUMBER OF CONTAINERS	Hold														TOTAL # (LAB USE)

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received for Laboratory by: (Signature)	Date	Time	Remarks:	

*Water (W), Soil (S), Solid Waste (SD), Unknown (X)

Page ________ of ________

Figure 7-2
Sample Receipt Form

1000001675

COOLER INSPECTION

Received: 09/14/2009 10:02
Delivery Method: UPS
Opened By: Robin Klinger
Comments:

Login(s): L09090265 L09090266 L09090267

Cooler(s)

Cooler #	Temp Gun	Temp	Tracking #	COC #	Comments
0013836	H	18.0	1Z63V9170192071486	091209-01-R	

1	Yes	Were shipping coolers sealed?
2	Yes	Were custody seals intact?
3	NA	Were cooler temperatures in range of 0-6?
4	NA	Was ice present?
5	Yes	Were COC's received/information complete/signed and dated?
6	Yes	Were sample containers and labels intact and match COC?
7	Yes	Were the correct containers and volumes received?
8	Yes	Were correct perservatives used? (water only)
9	Yes	Were pH ranges acceptable? (voa's excluded)
10	NA	Were VOA samples free of headspace (<6mm)?
11	Yes	Were samples received within EPA hold times?

Look closer. Go further. Do more.

Microbac - Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750
Tel: (740)373-4071 Fax: (740)373-4835

Figure 7-3
MICROBAC INTERNAL SAMPLE CUSTODY FORM

Microbac Laboratories Inc.
Internal Chain of Custody Report
Login: L08040017
Account: 2781
Project: 2781.002
Samples: 2
Due Date: 11-APR-2008

Samplenum	Container ID	Products
L08040017-01	441751	TOC

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish
1	LOGIN	COOLER	W1	01-APR-2008 10:44	RLK	
2	ANALYZ	W1	WET	02-APR-2008 13:58	DIH	RLK

Samplenum	Container ID	Products
L08040017-02	441752	TKN

Bottle: 1

Seq.	Purpose	From	To	Date/Time	Accept	Relinquish
1	LOGIN	COOLER	W1	01-APR-2008 10:44	RLK	

A1 - Sample Archive (COLD)
A2 - Sample Archive (AMBIENT)
F1 - Volatiles Freezer in Login
V1 - Volatiles Refrigerator in Login
W1 - Walkin Cooler in Login

Figure 7-4
MICROBAC BOTTLE LABEL

Workorder: B220

151019

Project:

ID:____________________________________

Date:____/____/_____ Time: __________

Taken By: _____________________________________

Preservative: 4C 01/26/2006
Matrix: WATER
Parameters:

8.0 ANALYTICAL PROCEDURES, STANDARDS, AND REAGENTS

This section provides information about the method selection process and provides general analytical policies and procedures which are common to all methods in use in the laboratory. The process for method selection is described along with our policy on multiple versions of the same method, and addresses method validation and project specific criteria. Procedures are outlined for selection and cleaning of laboratory glassware, the requirements for Class A glassware, and the preparation and documentation for reagents and analytical standards. Also included are procedures for logbooks, proper container labeling, and requirements for storage and disposal. This information is addressed in more detail for each analytical method in the specific SOPs which are listed in Appendix B.

8.1 Analytical Methods

8.1.1 Selection

Methods which are used for compliance with local, state, US-EPA or other regulatory authorities must meet minimum performance criteria. Methods for which Microbac maintains performance criteria are listed in the SOP list found in Appendix B. Other methods exist that can be used for screening, or for estimating concentrations, or may not have defined performance specifications. Such methods are used for limited applications, or when written approval is granted by the client or agency. In general, analytical methods that are selected for implementation by Microbac must meet one of the following criteria:

- It is a promulgated version of an EPA approved method;
- It is another version of an EPA method that is specified in writing by the client or the project specific QAPP;
- It is a modified EPA method, or a standard method other than EPA which has been specified by the client or in the project specific QAPP. Examples include American Society for Testing and Materials (ASTM), National Institute for Occupational Safety and Health (NIOSH), or a client written method for which an official authorization has been given for use.

8.1.2 Method References

It is Microbac's policy to reference preparatory and analytical methods in appropriate documents including SOPs, preparation logsheets, instrument runlogs, method detection limit (MDL) studies, and analysis reports. The SOP will reference the official source the current version of each method. Unless directed otherwise, Microbac will use the latest version of a method for which a validation study and SOP exists. It is our goal to implement the latest promulgated version of a method within the deadlines established by the agency or project specific QAPP. It may be necessary to maintain multiple versions of the same method due to project specific QAPPs which are often several years old. Project management tools are used by the client Chemist/Data Specialist (CDS) to assure proper versions are used. Additional information on this process may be found in Microbac SOP 44.

8.1.3 Method Validation

The procedures employed for method validation are found in Microbac SOP 45. The basic requirements include meeting all the reference method criteria for sample preparation, calibration and linearity checks, analytical precision and accuracy, MDL, method blank, surrogates, and the development and approval of the method SOP. Complete records of each validation study are maintained on file.

8.1.4 Project or Client Specific Criteria

The performance criteria established in the tables found in Microbac's analytical SOPs represent laboratory generated statistics often from multiple analysts and instruments. The reporting limits (RL), for example do not necessarily represent the lowest analyte concentrations that can be achieved by the method, nor are they guaranteed for every sample. In other cases, these basic laboratory statistics are superseded by client or project specific requirements for MDL, RL, acceptable control limits, or other special requirements. These situations will require the use of project specific QAPPs and/or SOPs. These are separate documents that are reproduced and distributed in project "kick-off" meetings in which specific project requirements are communicated to the QC and production staff. In such cases, project specific analysis codes are programmed into the KOBRA LIMS which specify the required RLs and control limits.

8.2 Glassware

The measurement of trace constituents in water, demands methods capable of maximum precision and sensitivity. Since the very sensitive analytical systems are subject to errors from improper choice of apparatus, as well as, the contamination effects due to improper cleaning procedures, the selection and proper care of laboratory glassware and sample containers play an important role in our quality control program. Laboratory vessels serve three functions: storage of reagents and samples, measurement of solution volumes, and confinement of reactions. Borosilicate glass, i.e., "Pyrex" or "Kimax," is the mainstay of the laboratory. The analytical method usually states whether or not borosilicate type glassware is acceptable. A notable example is the analysis of boron, where the digestions are carried out in plastic or Vycor.

8.2.1 Volumetric Glassware

The precision of volumetric work depends in part, on the precision with which volumes of samples and other reagents can be measured. By common usage, accurately calibrated glassware for precise measurement of volume has become known as volumetric glassware. Glassware that meets Federal Specification for Volumetric Glassware is designated as Class A. Except for The National Institute of Standards and Technology (NIST) certified glassware, Class A is the most precise grade and is available in burettes, volumetric flasks, and volumetric pipettes. Class A glassware must be used in the following laboratory procedures:

- Preparation of all primary standards require Class A volumetric flasks and pipettes;
- Preparation and dilution of stock standards require Class A flasks and Class A pipettes;
- All titrimetic standardizations require the use of Class A burette, volumetric flasks and pipettes;
- Class A glassware will be used at all times as specified in the standard analytical method.

8.2.2 Glassware Cleaning Requirements

Table 8-1 summarizes the general cleaning procedures to be used for all laboratory glassware and reusable sample bottles (glass). All glassware must be scrupulously cleaned in order to remove any possibility of contamination of the sample. (**NOTE**: Under no circumstances are sample containers for trace level inorganic or organic analyses ever cleaned and reused).

8.3 Reagents and Solvents

8.3.1 Reagent Water

Reagent water produced at Microbac meets the standards of ASTM Type II Water (for the electrical conductivity and resistivity requirements). Reagent water is produced by an IonPure System maintained by US Filter and consists of a series of 5 filter beds:

- Carbon bed (removes chlorine and organics)
- Cation bed (removes heavy metals)
- Anion bed (removes negatively charged ions)
- Mixed bed (removes remaining negatively and positively charged ions)
- Mixed bed (removes remaining negatively and positively charged ions)

The electrical resistivity is checked daily by means of a remote sensor electrical resistivity meter and recorded by login department personnel. This remote sensor is located in-line, immediately following the filter beds. The finished reagent water must maintain at a minimum a resistivity of 17 MΩ-cm at 25° C. This is an in-house point of reference for monitoring only.

The two mixed bed tanks are both equipped with a 5 range purity light. These tanks are in series so a light monitoring system is utilized as a control to determine when tanks need to be replaced. When the first in the series shows an indicator light change from green to red, US Filter is called and service is requested. The second mixed bed tank continues to service the laboratory during this periods of time. The tanks indicator lights and the electrical resistivity meter are checked twice daily until the tanks are changed. After the tanks are changed, the lines are flushed and the electrical resistivity is rechecked. This system maintains if not exceeds a resistivity of 1.0 MΩ-cm resistivity and 1.0 µS/cm conductivity.

The electrical conductivity is checked daily (Monday – Friday) by means of an electrical conductivity meter and recorded by conventional laboratory personnel. The finished reagent water must have a maximum electrical conductivity of 1.0 µS/cm at 25° C to meet acceptance criteria. This reading is taken on water from the deionized water tap in the conventionals laboratory. This is the furthest point-of-use tap from the filter beds. Additional UV polishing systems are used in the volatile laboratory to eliminate any trace organics and an ion polishing system is used in the metals laboratory.

8.3.2 Raw Materials

The raw materials which are used in the laboratory must be of a grade which meets or exceeds the method specifications. Inorganic reagents must be American Chemical Society (ACS) reagent grade or better. Acids used for preservatives or digestion for metals methods must be of a grade specified for trace metals. Solvents which are used to prepare standards, reagents and to extract samples must be of the highest grade available for the applicable method. Each lot of solvents or acids must be tested prior to use in the laboratory by using the analysis of a solvent (or reagent) blank which is concentrated to the same level as the sample extracts. Analysis by the method must confirm the absence of interfering substances before the lot is introduced for client sample analysis. Reagents which are used in the digestion/extraction/analysis process are certified as an ultra pure grade by the manufacturer with certification papers kept on file. All chemicals and reagents are labeled with the date received, date opened and date of expiration.

The laboratory will ensure that all solvents, reagents, standards, and other materials that affect the quality of the analyses, will not be used until they have been inspected for compliance with required method or program specifications. The laboratory will not report data from any analysis, if quality control checks fail to confirm acceptability of solvents, reagents, standards, or materials consumed in the analysis. The laboratory will test and verify all reagents, solvents, and standards prior to use on Department of Defense (DoD) samples.

8.3.3 Preparation Logbooks

The preparation of reagents is done in accordance with requirements and the method specific SOP. The laboratory maintains detailed recipes and preparation records within the KOBRA LIMS, or in hardcopy, for each analytical reagent. Required content of the reagent records are outlined below and an example KOBRA LIMS record is presented as Figure 8-1.

- Reagent ID
- Recipe – lists the preparation details
- Preparer’s initials
- Date prepared
- Expiration Date
- Disposal Date
- Concentrations of constituents
- Units
- Reviewer’s initials

The preparation date and expiration date must be the same for all reagents prepared fresh daily. The department supervisor is required to perform a periodic review of the logbooks.

8.3.4 Labeling

Labeling of laboratory reagents must contain the following minimum content:

- Reagent name
- Concentration and units
- Initials of preparer

- Date prepared (mm-dd-yy)
- Expiration Date (mm-dd-yy)
- Reagent ID

The reagent ID provides traceability to the KOBRA LIMS records for the preparation described in Section 8.3.3.

8.3.5 Storage

All reagent storage at Microbac is done in such a way that safety is always considered first. All flammable compounds are stored in a flammable cabinet. Volatile reagents are always stored and used in a well-ventilated area. Table 8-2 gives a list of common reagents and solvents used at Microbac and the method with which they are stored. Unless otherwise stated, borosilicate glass or polyethylene bottles are acceptable for storage of reagents used in inorganic analyses.

8.3.6 Waste Disposal

Since all laboratory work with chemicals eventually produces waste, we are aware of our moral and regulatory obligations to utilize sound waste management policies and procedures. Therefore, the disposal of reagent waste at our facility is an issue of great importance and one which has been given much attention. The specifics of Microbac's waste management system are included in the Microbac SOP33 – Laboratory Waste Management, a copy of which may be reviewed upon request.

8.4 Analytical Standards

This section describes all of the procedures required to document the preparation and use of calibration and quality control standards. Policies covered include source material selection, receipt, traceability, preparation and labeling of stock, intermediate, and working standards, KOBRA LIMS records, labeling, storage, and disposal. Microbac maintains complete records for standards preparation and traceability electronically within the KOBRA LIMS. Figures 8-2 through 8-5 present example records from the electronic system.

8.4.1 Standard Sources and Preparation

The accuracy of data produced from analytical instrumentation depends primarily on the quality of calibration standards. Microbac uses fully documented procedures to assure that calibration and quality control standards are prepared to the highest level of accuracy available for a particular analyte.

Concentrated stocks are prepared only with the highest purity standards available. Only standards that are certified traceable to NIST or are A2LA certified will be used.

8.4.2 Standard Receipt and Traceability

Once purchased standards are received, they are immediately brought to the area in which they are to be used. At this point, the supervisor or analyst will place the standard in its proper storage area. Volatile standards are stored in a freezer. Semi-volatile standards which are purchased neat are stored at room temperature. Stock standards purchased commercially are stored according to the following:

- Water or methanol based standards are stored at 4° C.
- Methylene chloride or hexane based standards are stored in a freezer.
- Standards of compounds which easily precipitate are stored at room temperature.
- PCB spiking standards are stored at room temperature.

All standards will be stored separately from samples. Material Safety Data Sheets (MSDS) provided with all standards, will be stored in a notebook and will be freely available to any analyst. Other certification sheets will be kept on file within each lab division and stored for future reference. Since much of the important information is provided on the label, (manufacturer, lot number, concentration, purity, formula, compound name and health information), it also serves as a good source of information.

8.4.3 Certificate of Analysis

The laboratory will maintain a system for identifying and filing certificates of analysis (COA) for all purchased standards. The analyst will log the COA into the KOBRA LIMS, which assigns a unique serial COA number. The laboratory will file electronic (pdf) copies of each COA in the COA folder of the network. The filename is in the format <COA#.pdf>. See Figure 8-2.

8.4.4 Primary Standards

Primary standards are used in the classical chemistry laboratory to standardize selected titrants. These chemicals must specify “primary standard grade” to be acceptable for this purpose. The laboratory maintains primary standards for potassium hydrogen phthalate (KHP) and potassium dichromate, which can be used to standardize a wide variety of acid/base and redox titrants, if necessary.

The department supervisor is responsible for the custody of these and other standard reference materials.

8.4.5 Neat Standard Materials

Most calibration and quality control standards are purchased as a concentrated stock solution from an approved vendor, however high purity neat standards may be used in some custom applications. Only materials of a known, certified purity are chosen for this purpose. Certificates of analysis for each of these neat materials are archived in KOBRA LIMS to provide complete documentation and traceability.

8.4.6 Stock Solutions

A record of the preparation of concentrated stock standards will be maintained for each parameter. When a primary standard or concentrated stock standard is prepared, a number is assigned to that standard, along with the date, analyst, compound, lot number, purity net weight, weight adjusted for purity, dilution volume and actual concentration are recorded. When a standard solution is prepared from a neat compound, if the entire sample is used the label is removed from the container and attached to the standards form. When the parent stock is purchased through a commercially prepared source, these standards (i.e., 1000 ppm metal standards for atomic absorption) must have the vendor, concentration, expiration date and lot number of this stock recorded into the standard logbook. Often commercially prepared mixes are purchased.

8.4.7 Intermediate Standards

Once the stock standards are prepared, they are then diluted to prepare intermediate-level standards and/or final working standards using volumetric pipettes and glassware. The choice of the correct apparatus is very important (see Section 8.0). It is in the intermediate stage that more than one parameter is mixed in the right concentration for the final mix. This dilution must also be documented in the same manner as the concentrated stocks. An example KOBRA LIMS record is presented in Figure 8-3.

8.4.8 Working Standards

These are the final dilutions that are used in the calibration or analysis stage of the method. The same procedures and KOBRA LIMS documentation that were described for intermediate standards also apply to the working solutions.

8.4.9 Electronic Records

Electronic records for the preparation, documentation, and traceability of calibration and quality control standards are maintained in the KOBRA LIMS. Each stock, intermediate, and working standard has a unique number that is cross-referenced to the electronic tables. See Figures 8-2- 8-5.

8.4.10 Labeling

Labeling of calibration and quality control standards must contain the following minimum content:

- Standard name
- Concentration and units
- Initials of preparer
- Date prepared
- Expiration date
- Standard number (unique reference)

Due to the very small size of standard containers employed in gas chromatographic analyses, space may not allow for all of the above information.

8.4.11 Storage

Analytical and quality control standards are stored in the individual laboratories. (See Table 8-3) The conventionals, extraction, semivolatile organic, and volatile organic have refrigerators which are dedicated to reagents and standards. Standards for organic methods are stored in borosilicate glass containers with a Teflon lined cap which have been cleaned and solvent rinsed. Standards used in the conventionals laboratory are stored in containers compatible with the analyte and solvent i.e., of the same composition as the required sampling container. Metals standards are stored at room temperature and placed in a storage cabinet. Storage of standards used in atomic absorption analyses must be in a polyethylene container, except where noted in the method, i.e., silver. Standards which have expired must be immediately removed from the storage unit and taken to the support services supervisor for proper disposal. Samples and standards must never be stored in the same refrigerator.

8.4.12 Disposal

The disposal of all standards is done in accordance with procedures outlined in the Microbac "Waste Management SOP" referenced previously.

8.5 Standardization of Titrating Solutions

Table 8-4 gives a listing of the reagents used as titrants. All solutions are purchased pre-standardized by the manufacturer. The manufacturer's certificate of analysis provides the following information:

- Nominal Concentration (Normality)
- Concentration Limits
- Lot Number
- Primary Standard (Certified traceable to NIST)

As a daily quality control check on the commercial solutions, the laboratory verifies the certified values through the analyses of a laboratory control sample. The standardization is checked monthly using the primary standard. If the results of this analysis indicates a problem, i.e. an out of control situation, then re-standardization against primary standards is required. Alternatively, the out-of-specification solutions are discarded and fresh solutions are obtained as replacements.

TABLE 8-1
LAB GLASSWARE CLEANING PROCEDURES

Analysis/Parameter	Cleaning Procedure (in order specified)
Extractable Organics (including Pesticides and Herbicides)	1-3, 8, 4, 7, 10, 12, 13
Purgeable Organics	Use either disposable glassware or steps 2, 3, 4, 7
Trace Metals: glass plastic	1-6 1-4, 15, 6
Nutrients	1-4, 12
Minerals, COD,BOD, Radiochemistry, Cyanide, Phenols	1-4, 12
Residues	1-4, 9 or 10, 12
MBAS	1-4, 14, 12
Petroleum Hydrocarbons	1-4, 7, 14, 13
Oil & Grease	1-4, 7, 14, 9

Cleaning Procedures:

1. Remove all labels using sponge or acetone.
2. Wash with hot tap water and a brush to scrub inside of glassware, stopcocks, and other small pieces, if possible, using a suitable laboratory-grade detergent.
   Organics - Liquinox, Alconox or equivalent
   Inorganic anions - Liquinox or equivalent
   Inorganic cations - Liquinox, Alconox, Micro or equivalent
   Bacteriologicals - must pass an inhibitory residue test
3. Rinse thoroughly with hot tap water.
4. Rinse thoroughly with deionized water.
5. Rinse or soak with 10% Nitric Acid.
6. Rinse 3 times with deionized water.
7. Rinse thoroughly with pesticide grade Methanol.
8. Rinse with 25% sulfuric acid.
9. Bake at 105°C for 3-4 hours.
10. Bake at 180°C for 3-4 hours (prior to use as per method).
11. After use, rinse with last solvent used.
12. Store inverted or capped with suitable material or suitable container stopper.
13. Last step (prior to use) must be a rinse with the solvent used in analysis.
14. Rinse thoroughly with acetone.
15. Rinse or soak with 1:1 HCl (Hydrochloric Acid).

TABLE 8-2
REAGENT STORAGE

REAGENT	METHOD OF STORAGE
Hydrochloric Acid (HCl) Sulfuric Acid (H_2SO_4) Nitric Acid (HNO_3) Acetic Acid ($C_2H_4O_2$) Phosphoric Acid (H_3PO_4)	Stored in original containers in a vented cabinet designed for acid storage.
Ammonium Hydroxide (NH_4OH)	Stored in original containers in a vented cabinet designed for base storage.
Acetone (C_3H_6O) Methanol (CH_3OH) Propyl Alcohol (C_3H_8O) Isopropyl Alcohol (C_3H_8O) Pyridine (C_5H_5N) Ethyl Acetone ($C_4H_8O_2$)	Stored in original containers in a vented cabinet designed for flammable materials.
Chloroform ($CHCl_3$) Methylene Chloride (CH_2Cl_2) Ethyl Ether ($C_4H_{10}O$) Hexane (C_6H_{14})	Stored in original containers in a vented cabinet designed for volatile organics storage.
Freon-113	Stored in original containers in a vented corner of the liquid-liquid continuous extraction sample prep area.

TABLE 8-3
STANDARD PREPARATION AND SOURCES

Instrument Group	Concentration	Storage	Preparation from Source	Standard Expiration
Volatile				
Gas Chromatography/ Mass Spectrometry (GC/MS)	primary stock mixture is at variable concentrations	Freezer	primary stock mixtures are commercially prepared solution mixes	6 months or manufacturer recommended expiration date
	intermediate standards are at variable concentrations	Freezer	intermediate standards are prepared from commercially purchased stock mixes	6 months
	working concentration	Used immediately	working standards are prepared from intermediates	prepared fresh daily
Semi-volatile				
Gas Chromatography (GC)	primary stock mixture is at variable concentrations	Freezer	primary stock mixtures are commercially prepared solution mixes	6 months or manufacturer recommended expiration date
	intermediate standards are at variable concentrations	Freezer	intermediate standards are prepared from commercially purchased stock mixes	6 months
	working concentration	Used immediately	working standards are prepared from intermediates	prepared fresh daily
Gas Chromatography/ Mass Spectrometry (GC/MS)	primary stock mixture is at variable concentrations	Freezer	primary stock mixtures are commercially prepared solution mixes	6 months or manufacturer recommended expiration date
	intermediate standards are at variable concentrations	Freezer	intermediate standards are prepared from commercially purchased stock mixes	6 months
	working concentration	Freezer	working standards are prepared from intermediates	1 months
HPLC	primary stock mixture is at variable concentrations # 100 ppm	Freezer	primary stock mixtures are commercially prepared solution mixes	6 months (8310),1 month (8330) or manufacturer recommended expiration date
	working concentration	Freezer	working standards are prepared from commercial stocks	24 hours
Atomic Absorption furnace and cold vapor	primary stock mixture is at variable concentrations ≥ 1000 ppm	Room temperature	primary stock mixtures are commercially prepared solution mixes	12 months or manufacturer recommended expiration date
	intermediate standards are at variable concentrations ≥ 10 ppm (high standard)	Room temperature	intermediate standards are prepared from commercially purchased stock mixes	6 months
	working concentration	Room temperature	working standards are prepared from intermediates	24 hours

TABLE 8-3 (continued)
STANDARD PREPARATION AND SOURCES

Instrument Group	Concentration	Storage	Preparation from Source	Standard Expiration
Inductively Coupled Plasma	primary stock mixture is at variable concentrations ≥ 1000 mg/L	room temperature	primary stock mixtures are commercially prepared solution mixes	12 months or manufacturer recommended expiration date
	intermediate standards are at variable concentrations ≥ 10 mg/L (high standard)	room temperature	intermediate standards are prepared from commercially purchased stock mixes	1 month
	Working concentration	room temperature	working standards are prepared from intermediates	prepared fresh daily
Total Organic Carbon (TOC)	primary stock 1000 mg/L solution	room temperature	primary stock is a commercially prepared solution	6 months or manufacturer recommended expiration date
	Working concentration	used immediately	working standards are prepared from intermediate	prepared fresh daily
pH Meters	pH = 4,7,10 Premixed	room temperature	used as received commercial stocks	fresh daily
Turbidimeters	Pre-mixed 4 Gelex Standards NTU 0-1 NTU 1-10 NTU 10-100 NTU 100-1000 scale Check Standard Primary (Formazin)	room temperature	used as received commercial stocks prepared from 4000 NTU Stock	restandardized quarterly manufacturer recommended expiration date
Specific Conductivity Meter	Neat	Room temperature.	stock: 14,130 umho/cm working Standard:	6 months
	Working concentration	4° C	1413 umho/cm	24 hours
Conventional (SmartChem)				
Ammonia	primary stock = 1000 mg/L	Room temperature	used as received commercially prepared	Manufacturer recommended expiration date
	working standards are at variable concentrations	Room temperature	working standards are prepared from commercially prepared primary stock	1 month
Chloride	primary stock = 1000 mg/L	Room temperature	used as received commercially prepared	manufacturer recommended expiration date
	working standards are at variable concentrations	Room temperature	working standards are prepared from commercially prepared primary stock	1 month

TABLE 8-3 (continued)
STANDARD PREPARATION AND SOURCES

Instrument Group	Concentration	Storage	Preparation from Source	Standard Expiration
Nitrate	primary stock = 100 mg/L	Room temperature	used as received commercially prepared	manufacturer recommended expiration date
	working standards are at variable concentrations	Room temperature	working standards are prepared from commercially prepared primary stock	1 month
Alkalinity	primary stock = 1000 mg/L	Room temperature	prepared by Microbac from sodium carbonate	6 months
	working standards are at variable concentrations	Room temperature	working standards are prepared from Microbac's prepared primary stock	1 month
Sulfate	primary stock = 1000 mg/L	Room temperature	used as received commercially prepared	Manufacturer recommended expiration date
Phosphorus	primary stock = 200 mg/L	Room temperature	prepared by Microbac from KH_2PO_4	6 months
	working standards are at variable concentrations	Room temperature	working standards are prepared from Microbac's prepared primary stock	1 month
Total Kjeldahl Nitrogen	primary stock = 200 mg/L	Room temperature	prepared by Microbac from $(NH_4)_2SO_4$	6 months
	working standards are at variable concentrations	Room temperature	working standards are prepared from Microbac's prepared primary stock	1 month

TABLE 8-4
STANDARDIZATION OF TITRATING SOLUTIONS

Parameter	Titrating Solution	Primary Standard	Frequency of Standardization
Acidity	NaOH	KHP NIST traceable	Prestandardized by the manufacturer checked monthly
Alkalinity	H_2SO_4	Sodium Carbonate Standard Solution NIST traceable	Prestandardized by the manufacturer checked monthly
Hardness	EDTA	Calcium carbonate as $CaCl_2$ NIST traceable	Prestandardized by the manufacturer checked monthly

Note: All titration solutions are purchased pre-standardized.

Figure 8-1
Example – KOBRA LIMS Reagent Record

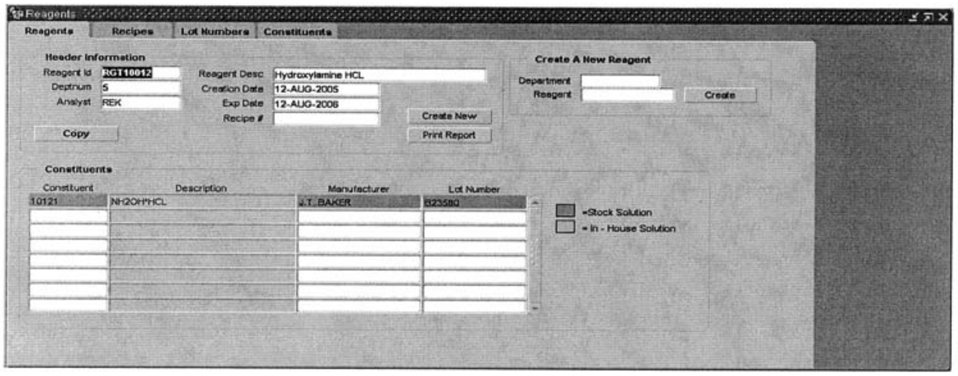


Figure 8-2
Example – KOBRA LIMS Certificate of Analysis Record

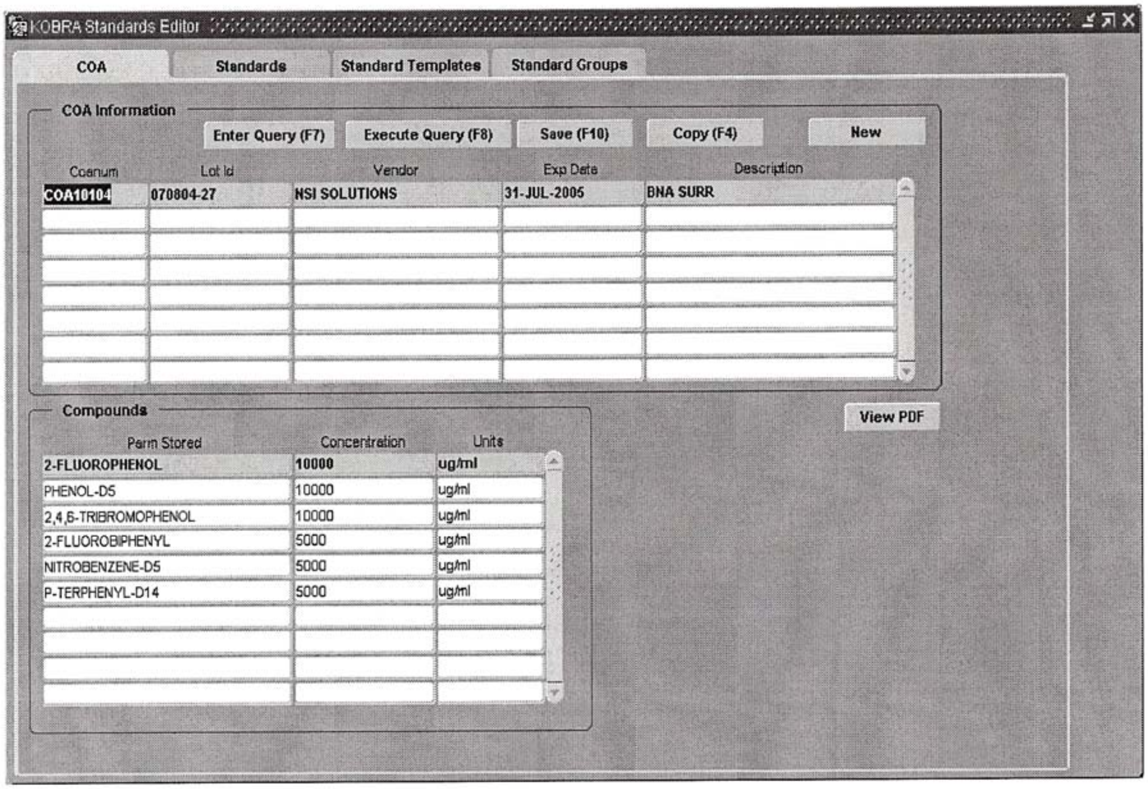


Figure 8-3
Example – KOBRA LIMS Standard Record

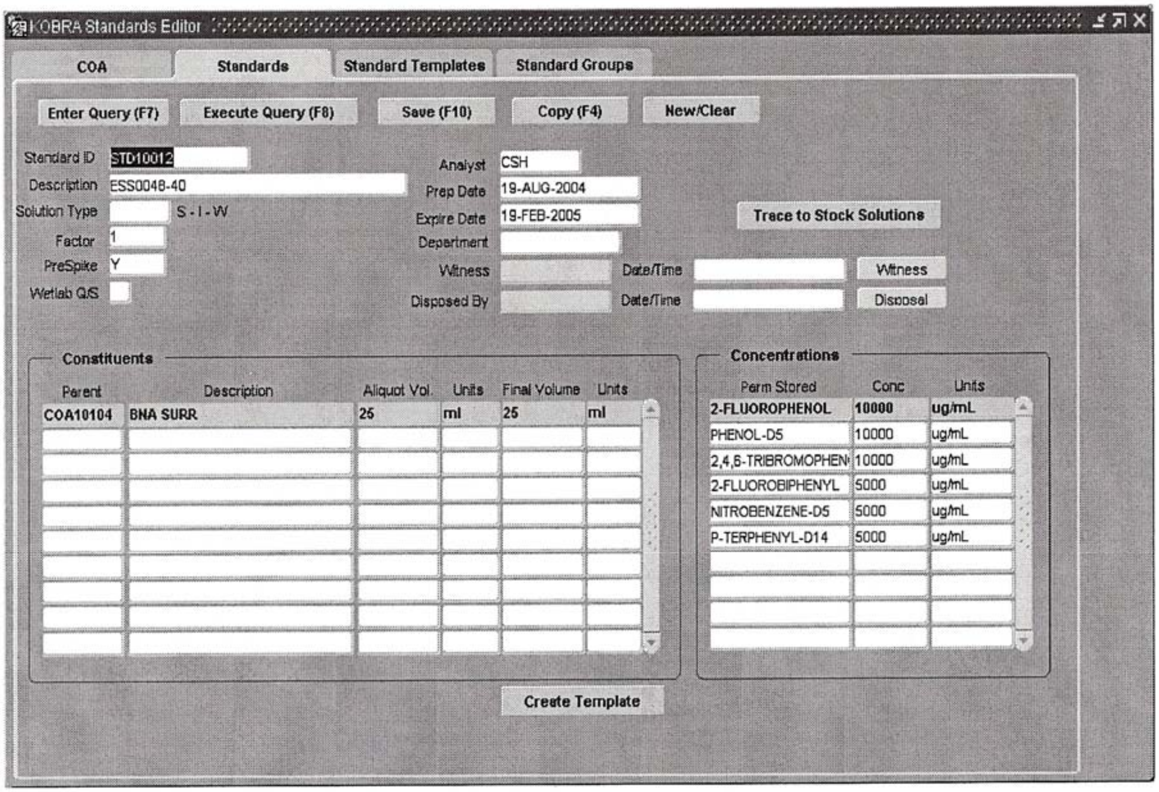


Figure 8-4
Example – KOBRA LIMS Standard Template

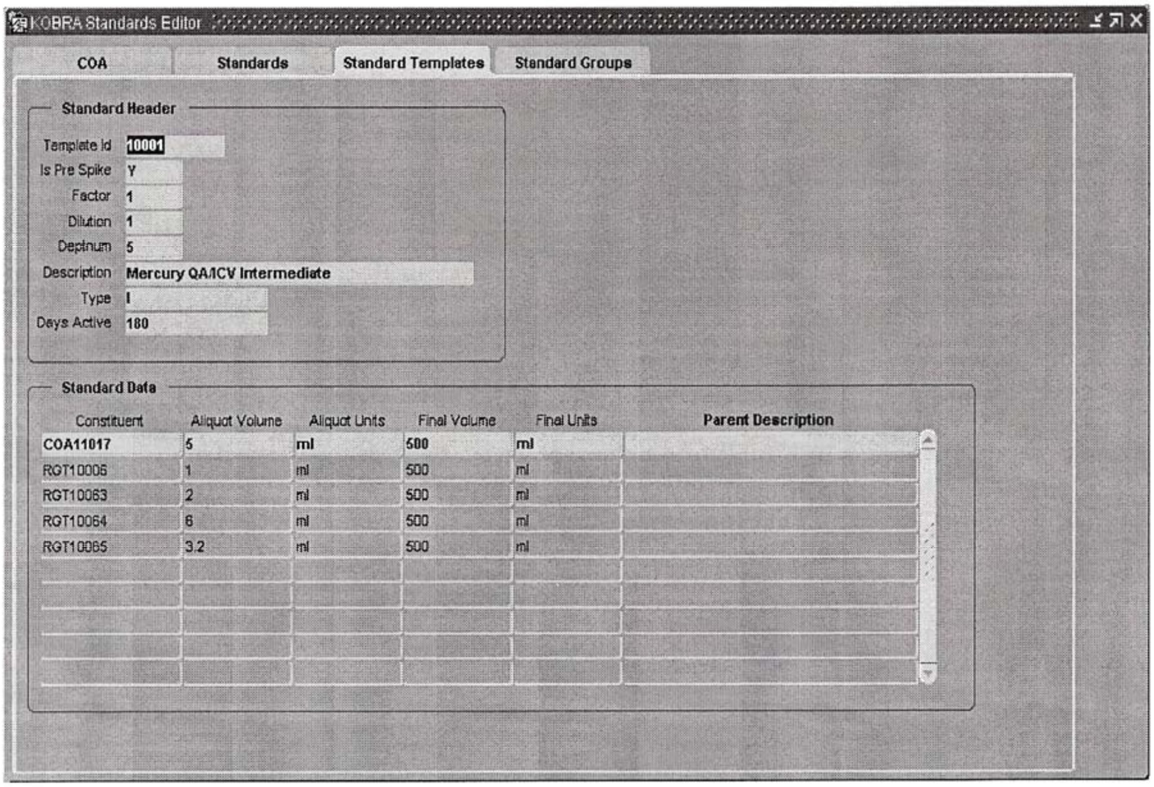
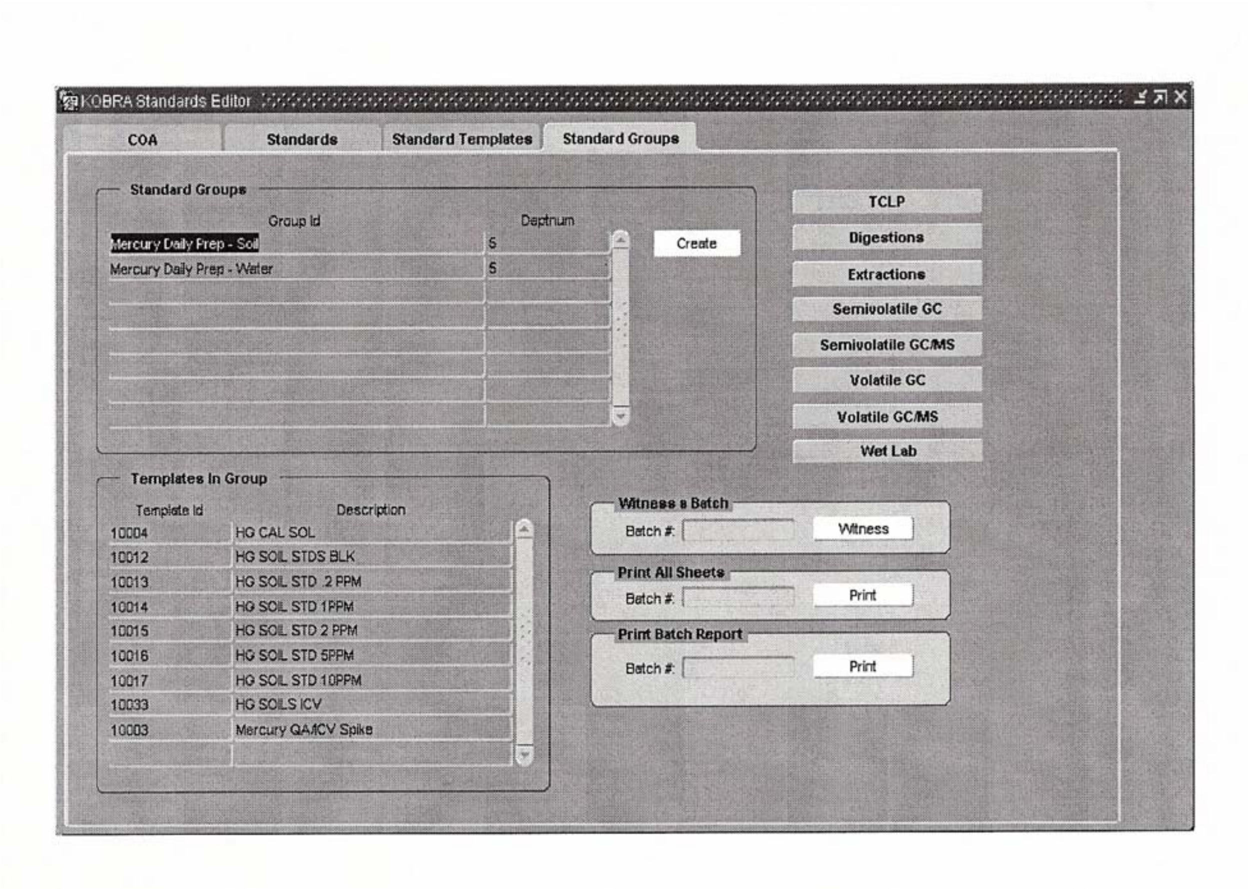


Figure 8-5
Example – KOBRA LIMS Standard Group



9.0 CALIBRATION PROCEDURES AND FREQUENCY

9.1 Instrumentation

Since the modern analytical laboratory depends heavily upon instrumentation, their calibration, operation and maintenance must be a primary concern in the production of satisfactory data. Below is a list of the instruments commonly used by Microbac in the analysis of various sample matrices.

Table 9-1
Microbac Laboratories
Equipment List

Location	Instrument Name	Date Acquired	Condition At Purchase	Serial Number
Extractions	Puck Mill	9/09	New	217510007
Extractions	ASE200 Accelerated Solvent Extractor	5/99 1/03	New New	99040590 02110605
Extractions	TurboVap II Workstation	01/96	New	TV9602N6596
Extractions	TurboVap II Workstation	09/96	New	TV9633N7004
Extractions	TurboVap II Workstation	04/97	New	TV9715N7428
Extractions	TurboVap II Workstation	04/97	New	TV9715N7427
Extractions	TurboVap II Workstation	06/05	New	TV0156N12265
Extractions	TurboVap II Workstation	06/05	New	TV0516N12264
Extractions	Misonix XL 2020 Ultrasonicator	01/96	New	G2664
Extractions	Misonix XL 2020 Ultrasonicator	01/99	New	G4338
Extractions	Balance - OHAUS TS600	06/01	New	29515505
Extractions	Balance - AND FX1200i	08/09	New	15608655
Extractions TCLP	PE Spectrum RX 1 Infrared Spectrometer	07/05	New	73781
Volatile	HPMS 16 5973 - 6890 w Varian Archon Gas Chromatograph Mass Spec Tekmar Sample Concentrator	08/03	New	GC-CN1033019 MS-US30965929
Volatiles	HP16 - Gas Chromatograph/FID/TCD with RSK auto- sampler	11/04	New	GC-CN10429033 AS-IT00428012
Volatiles	HPMS 11 5973 - 6890 w Varian Archon Gas Chromatograph Mass Spec Tekmar Sample Concentrator	8/00	New	GC-US00036002 MS-US94260126
Volatiles	HPMS 9 5973 - 6890 w Varian Archon Gas Chromatograph Mass Spec Tekmar Sample Concentrator	10/98	New	GC-US00022637 MS-US72821183

Table 9-1 (continued)
Microbac Laboratories
Equipment List

Location	Instrument Name	Date Acquired	Condition At Purchase	Serial Number
Volatiles	HPMS 6 5973 - 6890 w Varian Archon Gas Chromatograph Mass Spec Tekmar Sample Concentrator	12/96	New	GC-Us00006300 MS-US63810266
Volatiles	HPMS 10 5973 – 6890 w Varian Archon Gas Chromatograph Mass Spec Tekmar Sample Concentrator	8/99	New	GC-US00029166 MS-US91922575
Volatiles	HP 5 5890 w Varian Archon Gas Chromatograph PID/FID, Tekmar Sample Concentrator	7/92	New	3203A41712
Volatiles	Balance - AND EK-200i	5/07	New	P1845012
Volatiles	Balance - OHAUS N02120	6/03	New	1121242247
Semivolatile	LCMS1 API 4000 Applied Biosystems LC/MS/MS	7/09	New	J0200104
Semivolatile	HP18 FID Gas Chromatograph	01/11	New	CN10481154
Semivolatile	HP17 6890 Dual/ECD Gas Chromatograph	04/07	New	CN10704083
Semivolatile	HP15 AG 6890N Gas Chromatograph – ECD	9/04	New	CN10428037
Semivolatile	HPMS 7 5973 – 6890 Gas Chromatograph Mass Spec	4/97	New	GC-US00007949 MS-US70820650
Semivolatile	HPMS 5 5973 – 6890 Gas Chromatograph Mass Spec	9/96	New	GC-US00004989 MS-US62510073
Semivolatile	HP 9 6890 Gas Chromatograph – ECD	5/98	New	US00021274
Semivolatile	HP 4 5890 Gas Chromatograph- ECD	11/90	Used	2950A26244
Semivolatile	HP 14 AG 6890 Gas Chromatograph - FID	11/02	New	US10207074
Semivolatile	HPMS 12 AG 5973 – 6890 Gas Chromatograph/Mass Spec	5/03	New	US10249164
Semivolatile	HPMS 15 AG 5975 – 6890 Gas Chromatograph/Mass Spec	04/07	New	CN10710041
Semivolatile	VWR Ultrasonic Cleaner	10/03	New	01TS37915
Semivolatile	HP 8 5890 Gas Chromatograph – FID	5/94	New	2728A13203
Semivolatile	HP 18 Agilent 6890 Gas Chromatograph – FID	09/07	Used	DE00000787

Table 9-1 (continued)
Microbac Laboratories
Equipment List

Location	Instrument Name	Date Acquired	Condition At Purchase	Serial Number
Semivolatile HPLC	HPLC 3 1100 Liquid Chromatograph	12/97	New	US72102126
Semivolatile HPLC	HPLC 4 1100 Liquid Chromatograph	11/99	New	DE91605474
Semivolatile HPLC	HPLC 5 1200 Liquid Chromatograph	09/06	New	DEG0555260
Semivolatile HPLC	HPLC 6 Shimadzu Prominence XR Liquid Chromatograph	08/10	New	L20454600114
Semivolatile	IC1 Dionex 500 Ion Chromatograph	12/98	New	98080641
Semivolatile	IC2 Ion Chromatograph	8/01	New	01080138
Metals	ES SC-8 DX FAST Autosampler	07/10	New	X8DX-HS-TSP-16-100602
Metals	ES SC-8 DX FAST Autosampler	02/10	New	X8DX-HS-TSP-16-100102
Metals	Thermo Scientific iCAP 6000	02/08	New	20080504
Metals	Thermo Scientific iCAP 6000	08/08	New	20083006
Metals	Perkin Elmer Sciex ELAN 6100 ICP-MS	1/00	New	1129909
Metals	Perkin Elmer Optima 4300 ICP-AES	1/04	New	930S4010403
Metals Mercury	Leeman Hydra AA CV_AAS	4/03	New	2054 112-0064-1
Metals Digest	CEM MARS XPRESS	08/10	New	MD3721
Metals Digest	CEM MARS XPRESS Microwave	09/08	New	MD1790
Metals Digest	CEM MARS XPRESS Microwave	07/05	New	MD7719
Metals Digest	Balance - OHAUS Explorer	03/06	New	E3121119410947
Metals Digest	Balance - AND600	09/06	New	14699618
Metals Digest	Balance - AND GR202	06/05	New	14221258
Metals Digest	Balance - AND300	07/08	New	14697360
Metals Digest	Balance - AND300	07/08	New	14697359
Metals Digest	Balance - ANDFX-1200iWP	10/08	New	15801769

Table 9-1 (continued)
Microbac Laboratories
Equipment List

Location	Instrument Name	Date Acquired	Condition At Purchase	Serial Number
Metals Digest	Balance - GF-300	05/06	New	14662980
Conventionals	Westco Easy Distillation	8/99	New	1061
Conventionals	CN – Easy Dist Universal Distallation System	12/02	New	483-W001-01
Conventionals	Orion pH/ISE 710A	1/98	New	B08320
Conventionals	Orion pH/ISE Model 710A pH Ion Meter	4/95	New	002576
Conventionals	Shimadzu UV-1201V Spectrophotometer	8/99	New	A108036800041
Conventionals	TOC Shimadzu	12/02	New	39624467
Conventionals	COD Reactor (HACH) I Block Digester	1987	New	930100008493
Conventionals	COD Reactor (HACH) II	3/09	Used	NA
Conventionals	YSI Model 32 Conductivity Meter	8/93	New	93G07466
Conventionals	VWR Turbidity Meter	3/01	New	800 1682
Conventionals	SmartChem Automated Chemistry Analyzer	04/04	New	W0402048
Conventionals	Horizon Oil & Grease Fully Automated Extractor System	09/05	New	05-123
Conventionals	Orion pH/ISE Model 4Star	08/08	New	B08320
Conventionals	Bante pH Model 922	06/10	New	20100517020
Conventionals	Horizon Controller Model 50-0412-02	06/09	New	09-1056
Conventionals	Balance - Explorer Pro ED2102	10/07	New	L291 1128353643P
Conventionals	Balance - AND GR202	01/06	New	14214584

9.2 General Calibration Requirements

All laboratory instrumentation must be properly calibrated before it is put into official use. Some general policies and guidelines are provided in the following sections, but complete details are found in the Microbac SOP for the particular method. Specific program or project requirements may be provided in the project QAPP or the sampling and analysis plan (SAP) and may supercede the method and Microbac's SOP.

9.2.1 Initial Calibration

The initial calibration (ICAL) must meet the minimum requirements for the method in use. The calibration must contain the minimum number of points and the curve must pass the method criteria. If more than the minimum number of calibration points are analyzed for initial calibration, it is acceptable to eliminate points only at the top or bottom of the range, in order to get the curve to pass ICAL criteria. Points may not be eliminated from the middle portion of curve unless the entire ICAL is repeated.

9.2.2 Second Source Verification

It is the general policy of Microbac to verify the initial calibration with the analysis of a standard from a second source (different vendor). Acceptance criteria for the second source initial calibration verification (ICV) may be found in the specific SOP or the project QAPP or SAP. Any problems with the ICV that can not be resolved by corrective action must be noted in the report narrative and the data properly qualified.

9.2.3 Continuing Calibration Verification

Continuing calibration verification (CCV) must be performed at the method specified frequency and meet the method SOP, QAPP, or SAP requirements. When required by the method, all samples must be bracketed by passing CCVs. Samples not bracketed by passing CCVs must be reanalyzed. Any problems with the CCV that cannot be resolved by corrective action must be noted in the report narrative and the data properly qualified.

9.3 Gas Chromatography

- ECD (Pesticides/PCBs/Herbicides)
- FID (Polynuclear Aromatic)
- Hydrocarbons/DRO/8015/GRO
- PID (Aromatic Volatile Organics)
- ELCD (Halogenated Volatile Organics)

Initial calibration is at least a 5-point standard curve of all target compounds, (concentrations are in detector linear range) performed on failure of two continuing calibration standards. The lowest calibration standard has a concentration that is equal to or less than the Reporting Limit. Curves are checked by calculating the %RSD for all compounds.

Initial calibration and run sequence:

1. Initial calibration
2. ICV
3. Analyze 10 samples (includes reagent blanks, LCS, spikes and duplicates)
4. Run check standard
5. Continue with steps 3 and 4 for entire run

Daily continuing calibration and run sequence:

1. CCV
2. Analyze 10 samples (includes reagent blanks, LCS, spikes and duplicates)
3. Analyze check standard
4. Continue with analysis steps 2 and 3 for entire run

Samples must be bracketed by passing CCVs. If the CCV does not meet criteria, all affected samples must be rerun. Exceptions will be noted on corrective action forms and approved by management.

9.4 Gas Chromatography/Mass Spectrometry

- Volatile Organic Analysis
- Semivolatile Organic Analysis

Initial calibration is at least at a minimum 5 point standard curve of target compounds (concentrations are in detector linear range) performed on failure of two continuing calibration standards. The lowest calibration standard has a concentration that is equal to, or less than, the Reporting Limit. Method 624 requires a minimum of a 3 point standard curve.

Curves are checked by calculating the %RSD for the calibration check compounds (CCC). The system performance check compounds (SPCC) must meet method specific requirements.

Initial calibration and run sequence:

1. Run BFB or DFTPP. Achieve acceptance criteria based on Key Ion and Abundance Tables 9-2 and 9-3.
2. Initial calibration
3. ICV
4. Analyze samples (including blanks, LCS, spikes and duplicates) within the specified tune time for BFB or DFTPP.

Daily continuing calibration and run sequence:

1. Run BFB or DFTPP. Achieve acceptance criteria based on Key Ion and Abundance Tables 9-2 and 9-3.
2. CCV
3. Check to see if CC meets criteria. If not, make necessary corrections in GC/MS system and run CCV again.
4. If standard passes, run samples (including blanks, LCS, spikes, and duplicates) for 12 hours from the time BFB or DFTPP was run.
5. At the end of the method specified tune time, repeat steps 1 - 5.

TABLE 9-2
KEY IONS AND ABUNDANCE CRITERIA FOR BFB

Mass	Ion Abundance Criteria
40	15 to 40% of m/z 95
75	30 to 60% of m/z 95
95	base peak - 100% relative abundance
96	5 to 9% of m/z 95
173	less than 2% of m/z 174
174	greater than 50% of m/z 95
175	5 to 9% of m/z 174
176	greater than 95% but less than 101% of m/z 174
177	5 to 9% of m/z 176

TABLE 9-3
KEY IONS AND ABUNDANCE CRITERIA FOR DFTPP

Mass	Ion Abundance Criteria
51	30 to 60% of m/z 198
68	less than 2% of m/z 69
70	less than 2% of m/z 69
127	40 to 60% of m/z 198
197	less than 1% of m/z 198
198	base peak 100% relative abundance
199	5 to 9% of m/z 198
275	10 to 30% of m/z 198
365	greater than 1% of m/z 198
441	present, but less than m/z 443
442	greater than 40% of m/z 198
443	17 to 23% of m/z 442

9.5 HPLC - VWD/FD (PNA and Explosives)

The initial calibration is a 6 point standard curve of all target analytes. The lowest calibration standard has a concentration equal to or less than the Reporting Limit. The curves are checked by calculating the %RSD for all analytes. The %RSD must be # 20%.

Initial Calibration and Run Sequence:

1. Initial Calibration
2. ICV
3. Analyze 10 samples
4. CCV
5. Continue steps 3 & 4 for entire run

Daily Continuing Calibration and Run Sequence:

1. CCV
2. Analyze 10 samples (includes reagent blanks, LCS, spikes and duplicates)
3. Analyze check standard
4. Continue with analysis steps 2 and 3 for entire run

Samples must be bracketed by passing CCVs. If the CCV does not meet criteria, all affected samples must be rerun. Exceptions will be noted on corrective action forms and approved by management.

9.6 IC - Conductivity Detector (Anions)

The initial calibration is a linear or quadratic regression based on six points for all seven analytes plus a blank. The initial calibration verification requires that the response not vary by more than ± 10%. Initial Calibration and Run Sequence:

1. Initial Calibration
2. ICV
3. Analyze 10 samples
4. Analyze one in every ten samples in duplicate
5. CCV
6. Continue steps 3, 4 & 5 for entire run

Daily Continuing Calibration and Run Sequence:

1. CCV - response must not vary more than 10%
2. Analyze 10 samples
3. Analyze one in every 10 samples in duplicate
4. CCV – response must not vary more than 5%
5. Continue steps 2, 3 and 4 for entire run

Samples must be bracketed by passing CCVs. If the CCV does not meet criteria, an initial calibration must be run and all affected samples rerun. Exceptions will be noted on corrective action forms and approved by management.

9.7 Atomic Absorption – Cold Vapor

Initial calibration is a minimum of four standards and a blank and must be within the linear part of the calibration curve. The lowest calibration standard has a concentration that is equal to the Reporting Detection Limit. Calculation is by computer software using linear regression.

Initial Calibration and Run Sequence:

1. Initial Calibration
2. ICV
3. ICB
4. CCV
5. CCB
6. Analyze 10 or less samples, including all batch related QA/QC (LCS, Method Blank, MS/MSD).
7. CCV
8. CCB
9. Continue running samples in groups of 10 or less followed by the CCV and CCB.

Samples must be bracketed by passing CCVs. If the CCV does not meet criteria, an initial calibration must be run and all affected samples must be rerun. Exceptions will be noted on corrective action forms and approved by management.

9.8 ICP-AES, MS

Initial calibration is a minimum of 3 standards and a blank. Calculation is by computer software using linear regression.

Initial Calibration and Run Sequence:

1. Initial calibration
2. ICV
3. ICB
4. Run Interference check samples
5. CCV
6. CCB
7. Analyze 10 or less samples, including all batch related QA/QC (LCS, Method Blank, MS/MSD)
8. CCV
9. CCB
10. Continue running samples in groups of 10 or less followed by the CCV and CCB

Samples must be bracketed by passing CCVs. If the CCV does not meet criteria, all affected samples must be rerun. Exceptions will be noted on corrective action forms and approved by management.

9.9 Support Equipment

9.9.1 pH Meter

The pH meter is recalibrated before each use or after 2 hours of use.

9.9.2 Turbidimeter

The Turbidimeter is calibrated before each use.

9.9.3 Thermometers

Each thermometer in use in the laboratory is identified with a unique I.D. number which is printed on an attached tag. When a thermometer is put into use, it is checked against an NIST certified thermometer and documented in the thermometer calibration logbook. Any variation from the certified thermometer is indicated on the I.D. tag. If no adjustment is necessary, it is indicated by writing “No Correction Necessary” or “NCN” in the book and “NCN” on the tag. If temperature correction is required, it is added to or subtracted from the actual thermometer reading. Microbac records only the corrected temperature. Each thermometer is rechecked annually against the certified thermometer using the procedures outlined in Microbac SOP K0002 and documented in the thermometer logbook.

9.9.4 Mechanical Pipets and Syringes

The laboratory will verify mechanical pipets and syringes employing the procedures found in Microbac SOP K0002. Mechanical pipets are verified daily and gas tight syringes are checked quarterly. The laboratory maintains electronic or hardcopy records of all checks of these devices.

9.9.5 Balances

The most important piece of equipment in any laboratory is the analytical balance. The accuracy of data related to weight-prepared standards can be no better than that of the analytical balance. For this reason, proper care and use of the analytical balance should be of highest priority. The following section describes the standard operating requirements at Microbac for the calibration and care of analytical balances:

- Analytical balances are mounted on a heavy, shock-proof table, constructed of either marble or concrete, and placed in an area of low traffic. The balance level is checked daily and adjusted when necessary.

- Balances must be protected from extreme temperature and humidity change. A beaker of silica gel desiccant must be placed in the balance and changed frequently.

- All spills on the pan or inside the balance must be avoided, and the balance must be kept scrupulously clean at all times.

- Balances will be checked and adjusted at least twice a year under service contract with a professional balance specialist.

- Balances must be checked prior to each day's use applying the criteria specified in Table 9-4. The weights selected must bracket the range of use.

Table 9-4
BALANCE CALIBRATION ACCEPTANCE CRITERIA

Balance Type	Weight (grams)	Criteria
Analytical (0.0001)	0.1	+/-0.0005
	0.2	+/-0.0005
	0.5	+/-0.0005
	1.0	+/-0.0005
	5.0	+/-0.001
	10.0	+/-0.001
	50.0	+/-0.005
	100.0	+/-0.005
Top Loading (0.001)	0.5	+/-0.02
	1.0	+/-0.02
	5.0	+/-0.05
	10.0	+/-0.05
	50.0	+/-0.05
	100.0	+/-0.1
	200.0	+/-0.1
Top Loading (0.01)	1.0	+/-0.05
	5.0	+/-0.05
	10.0	+/-0.05
	50.0	+/-0.05
	100.0	+/-0.1
	200.0	+/-0.1

9.10 Logbooks

Logbooks are kept for each analytical instruments, balances, refrigerators, and incubators in the laboratory. All logbooks are bound controlled documents with numbered pages.

9.10.1 Balances

Each balance has a logbook to record daily calibrations checks. Maintenance and service records must be entered in the logbook. The daily calibration records must include the date, time, the initials of the operator, and the weights for the standard checks using the procedure described earlier. Each balance is checked with weights which are at or near the weight of samples routinely weighed on each balance. Acceptance criteria is outlined in Table 9-4.

9.10.2 Refrigerators

Each refrigerator has a logbook to record its daily temperature checks. Each refrigerator has a calibrated thermometer inserted in a container of water. This thermometer is read daily and more often if necessary. The temperature is recorded in the logbook to document the proper temperature and stability of each refrigerator.

9.10.3 Ovens and Incubators

Each oven and incubator has a logbook to record its daily operating temperatures. Each oven and incubator has a calibrated thermometer which is read during its operation. The operating temperatures are recorded in the logbook to document that the proper operating temperature has been utilized.

9.10.4 Instrument Logbooks

Each analytical instrument in the laboratory has a logbook. Daily operational notes, problems, routine maintenance procedures and repairs are kept in the instrument maintenance logbook. Calibrations, QC samples, and sample run information is documented in the instrument runlog.

10.0 PREVENTIVE MAINTENANCE

10.1 Routine Maintenance Activities

All of Microbac's instruments undergo routine maintenance, cleaning, and inspection on a daily, weekly, or monthly basis, according to the manufacturer's recommendation, and/or the requirements of the standard methods employed. Maintenance logs and instrument maintenance checklists are kept, noting problems and the steps taken to correct them. Records are kept on repairs requiring non-Microbac service repairmen. Table 10-1 provides a complete list of the preventive maintenance for all major laboratory instrumentation. Each instrument has an electronic log, which contains the records of any maintenance or repairs performed.

10.2 Contingency Plan

In the event of a major instrument failure, most of Microbac's instrumentation has a back-up. There are multiple volatile and semivolatile GC/MS's, as well as, multiple ECD's, ELCD's, FID's and PID's. In the inorganic laboratory there are multiple pH meters, spectrophotometers, an AAS and an ICP-MS (for low-level analyses) and ICP-AES's (3). This instrumentation is listed in Section 9.0, Table 9-1, pages 1-3 of 12. In the event that no backup is available and the sample has holding time left, the sample will be held until repairs have been completed. If the sample is getting close to the end of its holding time, the sample will be subcontracted out to another certified laboratory, or a new sample will be requested from the client. This decision will be left up to the client. Microbac, under no circumstance, will analyze samples out of holding time or subcontract to another laboratory, without client notification.

TABLE 10-1
LABORATORY INSTRUMENTATION PREVENTIVE MAINTENANCE

EQUIPMENT	ACTIVITY
Gas Chromatographs Semivolatile Organics	change septum change liners check carrier gas change carrier gas change in-line filters remove first foot of capillary column replace ECD replenish Electrolytic Conductivity Detector Solvents change ion exchange resin replace nickel tubing bake out column at completion of sample batch run check system for gas leaks at each column change sylonize injection port liners every liner
Gas Chromatographs Volatile Organics	check gases change gases clip chromatographic column clean PID Lamp clean FID Lamp change Trap bake out column
Gas Chromatograph/ Mass Spectrometers Semivolatile Organics	clean mass spectrometer source change septum change liners check carrier gas change carrier gas change in-line filters remove first foot of capillary column replace nickel tubing bake out column check system for gas leaks sylonize injection port liners
Gas Chromatograph/ Mass Spectrometers Volatile Organics	clean mass spectrometer check helium change helium change trap clip column change Purge and Trap ferrules bake out column

TABLE 10-1 (continued)
LABORATORY INSTRUMENTATION PREVENTIVE MAINTENANCE

EQUIPMENT	ACTIVITY
HPLC - VWD/FD	monitor system pressure change guard cartridges reverse column filter samples at 0.45 microns filter eluents at 0.20 microns if needed monitor eluent reservoir content
IC - Conductivity Detector	monitor system pressure monitor baseline detector output change guard column filter samples at 0.45 microns filter eluents at 0.20 micron if needed degas eluent monitor eluent volume monitor waste volume
CV-AAS(mercury)	change tubing check optics check gases check rinse change drying tube
ICP	clean nebulizer check torch check gases change tubing check optics
pH Meters	clean probe
TOC Meter	clean detector
Specific Conductivity Meters	clean probe check cell constant replenish/replace probe redetermine cell constant
DO Meter	clean probe check membrane change membrane
Analytical Balance	check pans and compartment check alignment and balance cleaning/calibration/service
Ovens	temperature monitoring
Refrigerators	temperature monitoring
Incubators	temperature monitoring
LC/MS/MS	monitor system pressure change guard cartridges filter samples at 0.45 microns monitor eluent reservoir content check curtain plate for residue buildup

11.0 QUALITY CONTROL CHECKS, ROUTINES TO ASSESS PRECISION, ACCURACY, AND CALCULATION OF METHOD DETECTION LIMIT

This section describes the basic techniques of laboratory quality control and quality assessment normally used to evaluate analytical proficiency. General concepts are defined and discussed as measurement tools for evaluation of data quality. Topics addressed include analytical methods, the concept of batch control, specific types of quality control samples, routines to assess accuracy and precision, statistical control, method detection limits and reporting limits, and internal and external performance evaluation samples. For additional information on related subjects, the reader is referred to Section 9.0 for instrument calibration procedures and to Section 13.0 for corrective action criteria.

11.1 Analytical Methods

An important element in Microbac's Quality Assurance/Quality Control (QA/QC) program is strict adherence to the referenced analytical methods. Whenever possible, Microbac will use only methods that are US-EPA approved and promulgated for analytical investigations. The quality control samples described in Section 11.4 are designed to meet requirements of SW-846, Chapter 1, as well as, the specific method QA/QC criteria. However if program or project A/QC requirements are more stringent, Microbac will comply with the specific project requirements or document the individual variances.

11.2 The Batch Concept

The basic unit for laboratory production and quality control is the **batch**. Samples are most effectively handled and processed in related groups. Examples of batches and their corresponding laboratory identifiers are discussed briefly below. The Sample Delivery Group (SDG) is a group of samples received in one shipment for a specific project and client and become a login batch. They are assigned a unique login number by the KOBRA LIMS at the time of login. The login number also is the unit for the **laboratory reporting batch.**

The **preparation batch** is a group of twenty or less samples of the same matrix type that are prepared for analysis by a unique analytical procedure (SOP). Examples include extraction batches for semivolatile organics and digestion of samples prior to analysis for metals. A preparation batch employs the same analysts, reagents, equipment, method (SOP), clean up, and concentration procedures. Each preparation batch has associated with it the appropriate quality control samples required by the method and usually includes the preparation blank (method blank), the laboratory control sample, matrix spike, sample duplicate or matrix spike duplicate. Each preparation batch is assigned a unique KOBRA LIMS tracking number referred to as **workgroup**.

The **analytical batch** refers to a group of samples analyzed by a specific analytical method, technique, or instrument, and is the analysis prior to data reduction and reporting. The analytical batch can be identical in sample makeup to the preparation batch, but can include parts of preparation batches, or multiple preparation batches. They include samples that are analyzed together within the same time period by the same analyst and/or instrument. They are always associated with the required method instrument quality control samples such as GC/MS tunes, instrument blanks, initial calibrations and/or continuing calibration verifications. A separate workgroup number is assigned to the analytical batch for the purposes of scheduling and tracking.

The **data entry batch** refers to a group of client and laboratory QC samples for which the analytical results are entered and verified in the KOBRA LIMS. A unique identifier referred to as the run ID is assigned to this data entry batch.

11.3 Batch Quality Control Samples

Each preparation and analytical batch is assigned a unique number by the KOBRA LIMS called a workgroup. For analyses such as wet chemical procedures and purge and trap methods for volatile organics, the preparation batch and analytical batch are one and the same. Other methods require a separate extraction or digestion prior to analysis by the instrument and separate preparation workgroups are applicable. The following analytical quality control samples will be associated with each workgroup if the control procedure is applicable to the analysis. Data tabulation and control charting procedures for these quality control samples are described in more detail in Section 11.0. Acceptance criteria and corrective action measures are presented in the specific laboratory SOP.

11.3.1 Method blank

A method blank (MB), or preparation blank (PB), is analyzed with each preparation batch as a check on analytical system contamination. A sample consisting of laboratory reagent water or analyte free laboratory sand is processed through the entire analytical method including all sample preparation procedures such as extraction, digestion, and filtration. As a quality control sample, the results are used in conjunction with other control data to validate overall system performance and data quality. Client samples are associated with the method blank by sharing a common preparation workgroup number.

11.3.2 Laboratory Control Sample

The LCS is used to assess the general performance of the analytical procedure. The LCS is a quality control sample, similar in composition to the method blank, spiked with the analytes of concern at a known concentration, and is processed through the entire analytical procedure. The purpose of these samples is to monitor analysis control and to assess the accuracy of the procedure in the absence of matrix interference. The results of the LCS are charted or tabulated and must meet the criteria established by the project data quality objectives or the laboratory derived statistical control limits. The LCS is normally used to verify system control, but evaluation should take into consideration several factors including the number of spiked analytes, their performance characteristics, and the severity of the non-compliance. NELAC requires that all certified analytes be included in the LCS over a two year period, including all EPA Appendix IX organics, pesticides and Aroclors. When the spike list is extensive, there exists a high probability of having a few analytes outside the acceptance limits. If the spiking concentrations are not specified in the project QAPP, an attempt is made to spike a level near the mid-range for the method. Client samples are associated with a specific LCS by sharing a common preparation workgroup number.

11.3.3 Laboratory Control Sample Duplicate

An Laboratory Control Sample Duplicate (LCSD) is prepared with the LCS for those batches that do not have another measure of precision, such as a sample duplicate, or matrix spike/ matrix spike duplicate (MS/MSD).The LCSD must meet the same acceptance requirements for accuracy (% recovery) as the LCS and the same precision requirements (RPD) as the sample duplicate (or MS/MSD).

11.3.4 Matrix Spikes

MS are analyzed with each batch of samples of a similar matrix. They consist of a field sample that is spiked with the same analytes as the LCS and normally at the same concentration. The MS is used to assess the performance of the method in client's sample matrix. The percent recoveries are tabulated in a summary report and the results are used to assess bias or other matrix effects. The MS analyses are not used to establish laboratory control, but can be used to properly qualify data.

If sufficient sample quantity is available, the laboratory will select samples for matrix spiking based on the following approach:

- All client specified MS, MSD or duplicate samples are logged into the KOBRA LIMS and reported to the client.

- If no client specified samples have been submitted, the laboratory will randomly select a sample for the MS/MSD or duplicates based on sample availability and client approval requirements.

- If there is insufficient sample volume to perform MS/MSD or duplicate analysis the laboratory will perform an LCS and LCS duplicate in order to provide a measure of precision and accuracy for the analytical batch.

11.3.5 Duplicates and Matrix Spike Duplicates

Duplicate samples (DUP) or MSD may be with each batch of samples of a similar matrix to monitor the method precision. The results in relative percent difference (RPD) are tabulated as outlined in Section 11.7. This data may be used to evaluate the precision of the method in real sample matrices. For analytical methods for which spiking is inappropriate, sample duplicates are used to assess precision.

11.3.6 Selecting Samples for MS/MSD/DUP (Batch QC)

The laboratory will implement one of the following procedures for selecting samples for duplicate analysis (DUP), MS, and MSD.

a) If client samples are specified for batch QC in the KOBRA LIMS or in the project QAPP, the analyst must select these sample(s).

b) If there are no client-specified samples, but extra sample aliquots are available for batch QC, the analyst will randomly select sample(s) for the MS/MSD or DUP. This option <u>must not</u> be used if it depletes all remaining sample. There must be enough field sample volume remaining to allow for re-analysis if necessary.

c) If there is insufficient volume of field samples available for DUP/MS/MSD and re-analysis, the analyst will include an LCS duplicate in the batch in lieu of MS, MSD or DUP.

11.4 Quality Assurance Summary Reports

Quality assurance summary reports are prepared for each analytical workgroup. Whenever samples are analyzed, the batch quality control sample results described in Section 11.4 are entered into the laboratory database.

Reports are generated by workgroup for review by department supervisors, QA/QC personnel, and general management. Copies of the quality assurance summary reports are provided to the client upon request. They are included in all laboratory reports designated as Level 2, or higher, as described in Section 12.0.

11.5 Measuring Precision, Accuracy and Method Detection Limits

This section discusses method performance parameters and how they are related to data quality objectives (DQO). Definitions are given for precision, accuracy, representativeness, completeness, comparability (PARCC), MDL and RL. Tables which provide current statistics for methods including MDLs, RLs, precision and accuracy are updated annually and are available in the individual method SOPs (listed in Appendix B). The following definitions that are used establish baseline data quality objectives for all analytical projects. The PARCC parameters and MDL/RL data are a useful template for development of SAP and QAPP for a wide scope of programs.

11.5.1 Precision (% RPD)

The laboratory objective is to equal or exceed the precision data generated by the applicable method validation studies on similar matrices. Relative percent difference (% RPD) as derived from duplicate matrix spike results (or duplicate sample results for metals) will be used to evaluate precision. With each analysis of a duplicate sample, or matrix spike/matrix spike duplicate, the RPD is calculated from the following formula:

$$RPD = \left[\frac{|C_1 - C_2|}{(C_1 + C_2)/2} \right] 100$$

where:

C_1 = Concentration of the first sample
C_2 = Concentration of the second sample

Method precision can be evaluated through the analysis of duplicate samples or matrix spike duplicates. For most inorganic methods, the results of duplicate analyses are used to calculate advisory limits, but the upper limit for the RPD is usually set at 20%. Another measure of precision is the method standard deviation. The standard deviation determined from the analysis of laboratory control samples can also be used to estimate the upper control limit for the RPD. The later procedure, which is taken from Method 1020B (Standard

Methods – 18th Edition), is used for organic methods having long lists of analytes. However, for most projects the advisory upper limit for the RPD of organic analytes is set at 40%.

11.5.2 Accuracy (% recovery)

The laboratory objective is to equal or exceed the accuracy data generated by the applicable method validation studies on similar matrices. Percent recovery, as derived from the analysis of LCS will be used to evaluate accuracy. The LCS contains all of the analytes of interest at the concentration of interest, either at the midrange of the method, or as specifically defined in the QAPP.

Accuracy statements (ranges) are derived from statistical analysis of the percent recoveries for the LCS for the applicable media. Criteria are established at three standard deviations from the mean LCS recoveries. The ranges for accuracy are generally used as control limits, however, projects DQO's, laboratory policies, or performance method requirements may dictate exceptions. Recovery is defined mathematically as follows:

For a laboratory control samples:

$$\%R = \left(\frac{C_x}{C_t}\right)100$$

where:

C_x = the measured concentration of the analyte in the LCS
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

Calculating recovery for matrix spikes (MS/MSD):

$$\%R = \left[\frac{(C_{spk} - C_x)}{C_t}\right]100$$

where:

C_{spk} = the concentration of the analyte in the spiked sample
C_x = the concentration of the analyte in the reference (parent) sample
C_t = the theoretical spike concentration.
$\%R$ = percent recovery

Representativeness

Representativeness ensures that a set of data accurately depicts the distinguishing characteristics of the sample source. This is usually achieved through sample collection in accordance with statistically defined bounds of the population mean and variance, and by following existing sampling protocols.

Comparability

To achieve a performance level in terms of accuracy and precision for sample parameters in similar matrices, so that one set of data is comparable to another in terms of quality of measurement on a consistent basis. This assures that all Microbac analyses fall within an acceptable range.

Completeness

Refers to the percentage of measurements made which are judged to be valid. The completeness goals for most methods are 95% on all water analyses and 90% on all soil analyses.

11.6 Statistical Evaluation of Data

11.6.1 Statistical Methods

Microbac has established its statistical approach to quality control based on the following standards:

Handbook for Analytical Quality Control in Water and Wastewater Laboratories, EPA-60014-79-019, March 1979.

Standard Methods for the Examination of Water and Wastewater, 18th Edition, APHA/AWWA/WEF, Methods 1010, 1020, 1030.

Test Methods for Evaluating Solid Waste - Physical/ Chemical Methods, SW-846, 3rd Edition, Chapter 1.

The KOBRA LIMS report is found in menu system: Reports, Others, LCS Limits

11.6.2 LCS Control Limits

The laboratory shall establish statistically derived control limits for laboratory control samples. The laboratory will evaluate the data from at least thirty (30) LCS data points to compute the mean and standard deviation(s).

The lower control limit (LCL) shall be established at the mean –3s

The upper control limit (UCL) shall be established at the mean +3s

11.6.3 MS/MSD Control Limits

Microbac will use the LCS control limits to evaluate MS/MSD data, unless the project QAPP specifies otherwise.

11.6.4 Annual Evaluation

The laboratory will also generate an annual LCS summary report from the KOBRA LIMS menu system. The summary report will display the individual LCS results in concentration and percent recovery, computing the mean, standard deviation, and limits at +/-3 sigma. This evaluation will occur concurrently with the annual SOP review. The supervisor and QAO will compare the statistics to the existing default control limits, to determine if these limits are supported by the new statistic. The laboratory will update the KOBRA LIMS QC tables and the appropriate SOP tables as necessary. The laboratory supervisory will review the data for method bias, trends, and shifts, and forward the data package to the QAO. The QAO will review, approve, and /or initiate investigations based on the data.

11.7 General Control Charting Procedure

The laboratory constructs control charts using percent recovery data from LCS. X-Charts are constructed for all inorganic analytes and a representative group of organic analytes from each method. In constructing an initial chart, twenty or more consecutive data points are necessary and the time required to generate such a chart will vary with the frequency of the analysis (daily, weekly, monthly, etc.). This data is charted against the control limits effective during the evaluation period. Control charts are used not only to monitor system control and to evaluate accuracy and precision, but also to check for general trends. Each analyst is trained to interpret and identify problems such as shifts, trends and biases. This method ensures continued evaluation of laboratory and personnel performance. An example Microbac X-Chart is presented in Figure 11-1 of this section.

11.8 Method Detection Limits

The MDL is defined as the minimum concentration of an analyte that can be determined with 99 percent confidence to be greater than zero. All MDL determinations provided by Microbac are made in accordance with Microbac SOP 45, which is derived from the US-EPA procedures outlined in 40 CFR part 136, Appendix B. MDL's are evaluated annually and/or verified quarterly. Verification consists of analyzing a detectability check standard (DCS), which is a fortified blank spiked at a concentration near the concentration of the laboratory MDL and must not exceed the standard reporting limit. This check confirms that the laboratory MDL, which is derived from multiple instruments and analysts, is routinely achievable on a specific instrument and method over the course of time. In order to be considered acceptable, the MDL verification must give a measurable response that also meets the method's qualitative criteria, or is at least distinguishable from the response in a blank sample. The laboratory will perform an MDL verification immediately after each (initial) MDL study and quarterly thereafter. The laboratory will perform a verification if MDLs must be lowered for any reason.

The laboratory shall evaluate the acceptability of MDLs at the time of the SOP review for the method. This review shall include the status and acceptability of the MDL data for water and soil in the initial (EPA) studies and quarterly verification data, if applicable. Based on these reviews, the laboratory may choose to revise current MDLs, or determine the need for additional studies.

11.9 Quantitation Limits and Reporting Limits

Practical Quantitation Limits (PQL) and Limits of Quantitation (LOQ) are defined as the smallest concentration of analyte that can be reported to a known level of accuracy. The PQL is often defined as 3-10 times the MDL, but Microbac normally estimates the PQL as the concentration of the lowest standard in the initial calibration curve for the method. Laboratory RLs are often used in place of the PQL, since they are generally accepted by the environmental industry. They can be adjusted for specific projects requirements but are independent of instrument variation and statistics. At Microbac, the RL/LOQ is usually at least two times the laboratory observed MDL for that analyte, and is normally equivalent to the concentration of the lowest standard on the calibration curve. For some programs such as DoD, it is necessary to report both the MDL and the RL. The standard laboratory reporting limits may be found in the applicable SOP and the KOBRA LIMS.

11.10 Proficiency Testing Studies (PT)

Microbac currently participates in several government administered and private sector single blind PT studies. For each of these programs, it is our internal policy to evaluate each department's performance and prepare corrective action plans for all unacceptable results. All performance summaries and our corrective action plans are made available to clients and state agencies upon request. See also Section 14.2.

Figure 11-1
X-CHART
LABORATORY CONTROL SAMPLE

ID#	INSTRUMENT	METHODREF2	METHOD CLASS	MAT. CLASS	MATRIX	COLUMN	TYPE1	TYPE2	QAPP	LAST POINT
380	%	ALK-COLOR	300	WATER	1	F	LCS	LCS2	STD	08/31/2009

Analyte: ALKALINITY
Number of Points: 30

Mean: 103.591
Standard Deviation: 3.586
Upper Control Limit: 114.35
Lower Control Limit: 92.83

Sample #	Analysis Date	Numvalue	Recovery	Lower	Upper	SJ#	Q
WG308001-02	07/27/2009 10:53	201.814	100.907	85.0	115.0	SJ8150808	
WG308001-03	07/27/2009 10:54	207.652	103.826	85.0	115.0	SJ8150809	
WG308333-02	07/29/2009 14:35	201.272	100.636	85.0	115.0	SJ8159084	
WG308333-03	07/29/2009 14:36	213.24	106.62	85.0	115.0	SJ8159085	
WG308335-02	07/29/2009 14:51	201.475	100.738	85.0	115.0	SJ8159137	
WG308335-03	07/29/2009 14:52	210.059	105.03	85.0	115.0	SJ8159147	
WG308770-02	08/04/2009 14:07	203.719	101.86	85.0	115.0	SJ8172378	
WG308784-02	08/04/2009 14:23	208.341	104.17	85.0	115.0	SJ8172450	
WG308784-03	08/04/2009 14:24	210.616	105.308	85.0	115.0	SJ8172454	
WG308770-03	08/04/2009 14:40	206.542	103.271	85.0	115.0	SJ8172506	
WG308907-02	08/04/2009 15:48	204.922	102.461	85.0	115.0	SJ8172681	
WG308907-03	08/04/2009 15:49	218.434	109.217	85.0	115.0	SJ8172697	
WG309312-02	08/10/2009 11:20	201.445	100.723	85.0	115.0	SJ8185373	
WG309312-03	08/10/2009 11:20	214.549	107.274	85.0	115.0	SJ8185386	
WG309315-02	08/10/2009 11:35	208.036	104.018	85.0	115.0	SJ8185424	
WG309315-03	08/10/2009 11:36	218.717	109.359	85.0	115.0	SJ8185430	
WG309738-02	08/14/2009 14:09	204.406	102.203	85.0	115.0	SJ8200086	
WG309738-03	08/14/2009 14:10	210.105	105.052	85.0	115.0	SJ8200092	

Figure 11-1 (continued)
X-CHART
LABORATORY CONTROL SAMPLE

Sample #	Analysis Date	Numvalue	Recovery	Lower	Upper	SJ#	Q
WG309752-02	08/14/2009 15:20	201.277	100.638	85.0	115.0	SJ8200183	
WG309752-03	08/14/2009 15:21	201.899	100.949	85.0	115.0	SJ8200188	
WG310316-02	08/21/2009 15:01	210.902	105.451	85.0	115.0	SJ8220503	
WG310316-03	08/21/2009 15:02	220.044	110.022	85.0	115.0	SJ8220522	
WG310336-02	08/21/2009 16:08	205.945	102.972	85.0	115.0	SJ8220641	
WG310336-03	08/21/2009 16:09	209.788	104.894	85.0	115.0	SJ8220658	
WG310812-02	08/28/2009 12:02	191.84	95.9202	85.0	115.0	SJ8245978	
WG310812-03	08/28/2009 12:03	192.12	96.0598	85.0	115.0	SJ8245979	
WG310813-02	08/28/2009 12:18	210.343	105.171	85.0	115.0	SJ8246061	
WG310813-03	08/28/2009 12:18	195.055	97.5277	85.0	115.0	SJ8246073	
WG310832-02	08/28/2009 13:59	215.889	107.945	85.0	115.0	SJ8247650	
WG310832-03	08/28/2009 14:00	215.013	107.507	85.0	115.0	SJ8247666	

12.0 DATA REDUCTION, REVIEW, VERIFICATION, AND REPORTING

This section describes the process of data reduction, data review, data validation, data entry, and editing that begins with the raw data generated at the bench level in the laboratory and culminates with a useful collection of information in the form of summary laboratory reports and data deliverables packages.

12.1 Data Reduction

Data reduction is the conversion of raw data from instrument readings to reportable results. The raw data is converted into reportable values by instrument hardware and software or by other manual procedures suggested in the required reference method.

12.1.1 General Analyst Duties

It is the responsibility of the primary analyst to perform the data reduction procedures. These general duties are common to all departments and all analytical methods.

- Recording and maintaining accurate laboratory records including sample identifications, weights or volumes, dilution factors, analysis date and method, analyst's initials, and maintaining the computer record file identification system.
- Performing the proper instrument and method calibrations and verifying calibration integrity.
- Following established laboratory QA/QC protocol.
- Confirming results of the analytical sequence or batch, including QA/QC verification.
- Converting raw data to final form by applying proper procedures for calculations, rounding, and significant figures.
- Transcribing sample results from the instrument report onto the results data sheet.
- Maintaining internal chain-of-custody records as described in Section 7.0.

12.1.2 Preparation Analysts

Preparation analysts are responsible for recording accurate data used in final calculations. This includes maintaining extraction and digest logbooks, bench sheets and chemist's notebooks which contain sample weights or volumes, final extract volumes, surrogate and spike amounts, standard reference numbers, etc.

12.1.3 Wet Chemistry Analysts

Wet chemistry analyst duties include recording results from direct readout instruments such as pH meters, turbidimeters, and thermometers onto a data sheet. Selected wet chemistry parameters require that the analyst enter the results into a computer spreadsheet for reduction. Final results are recorded on a data sheet and then entered into the KOBRA LIMS.

12.1.4 Instrument Analysts

All instrument analysts are responsible for verifying calculations, analyte identifications, all related QA/QC calculations, and generation of the sample results. This includes calculation of surrogate spike recoveries, LCS recoveries, precision for sample duplicates and matrix spikes, and results for method and matrix specific blanks. Lab results are recorded by the analyst onto a data sheet and the associated QA/QC data sheet. Parameters utilizing computer/integrator reduction include volatile and semivolatile Gas Chromatography (GC) and Gas Chromatography/Mass Spectrometry (GC/MS), graphite furnace metals, Inductively Coupled Plasma (ICP) metals, mercury and some wet chemistry parameters. The results are reported from instrument reports generated by the instrument data system. The raw data are reduced (calculated) into reportable values and the sample components are identified by the instrument data systems. A quantitation report is generated by the instrument and sample results are calculated, either by computer integration, spreadsheet or manual calculation, taking into account dilution factors. Sample results are either uploaded into the KOBRA LIMS or transcribed by the instrument analyst onto the sample results sheet.

12.1.5 Record Keeping

Bench sheets for sample extraction, digestion, and analysis by wet chemistry are maintained in laboratory notebooks issued and numbered by the document control officer. The document number and page number are printed in red on each page of the laboratory notebook. Data from each notebook are scanned and archived on CD-ROM. Chromatographic data records and documentation include extraction logs, bench sheets, instrument logs, instrument tune reports, quantitation reports and instrument printouts, including chromatograms and mass spectra. Inorganic data documentation records include analyst notebooks, digestion logs, instrument runlogs and instrument printouts. Logs are kept of sample preparation prior to analysis. Records for instrument analyses are recorded in run logbooks. The run log has an entry for injection of every standard, quality control sample, and client sample. The unused portion of the daily run log page is crossed out and initialed. Each instrument also has a respective maintenance log. Chain of custody records and forms are always maintained in accordance with Section 7.0.

12.2 Laboratory Data Review

Each laboratory department is responsible for the validity of the data produced. The major part of validation responsibilities lies with the department supervisors and the senior peer review staff. Internal laboratory verification is performed with data review. This process must not be confused with third-party validation, which is performed by contractors independent of Microbac. Guidelines for data validation and qualification are derived from the official reference method, EPA documents such as "National Functional Guidelines for Organic Data Review" (US EPA, 2/94) and the "National Functional Guidelines for Inorganic Data Review" (US EPA, 2/94), and the project specific QAPP if applicable.

Data flow starts with the generation of data by the analyst and continues through a multi-level review and validation process. Data is sequentially passed through a tiered review consisting of the primary analyst, secondary or peer review, and a project level administrative review. The laboratory report is then certified by the laboratory manager, or designee. Each step in the review process is performed to assure the integrity and validity of the data generated by the laboratory. The key elements of the laboratory data review procedures are as follows:

- Holding times
- Calibration requirements
- Batch quality control
- Raw data
- Information for report narrative
- Check for reasonableness and general acceptability

12.2.1 Primary Review

The analyst performing the analysis has the primary responsibility to verify the completeness, accuracy, and general acceptability of the data. Using a data review checklist, the analyst checks all data for accuracy, conformance with the standard operating procedures, and method compliance. The analyst reviews all raw data in the run, including tune, calibration, internal standards, and batch related quality control samples. See also Section 12.2 – 12.4 and the method SOPs. Examples of these checklists are found in the SOPs.

12.2.2 Secondary Review

A secondary reviewer is the department supervisor, an analyst certified in the same type of analysis, or a senior staff member who specializes in data review.

At the secondary review level, all of the elements of review performed by the primary analyst are re-checked and this secondary review is also documented on the checklists. All chromatographic manual integrations are reviewed and approved in accordance with Microbac SOP41.

12.2.3 Data Entry and Verification

Data that has been through the review and validation process is then entered into the KOBRA LIMS. The KOBRA LIMS has been programmed to retrieve data directly from instrumentation using a datafile uploading process. Other data must be manually entered by a data specialist or technician. Data verification is a check on the data that is entered into the KOBRA LIMS. This is performed by experienced staff who are independent of the data entry functions. This step and any required editing is performed prior to generation of the final draft of the laboratory report. Data is entered by the analyst or a clerical staff assistant and is checked for accuracy by the department supervisor or a designated peer reviewer. Data printouts and reports are checked for correct entry of results, units of measure, detection limits, analysis dates, analyst initials and any other information to be included on the final reports. Incorrect entries are immediately corrected. Obvious anomalies (i.e.: detection limits larger than reported result, analysis date before prep date, etc.) are brought to the attention of the departmental supervisor for verification before correction. EDDs are generated by Information Technologies (IT) personnel. Electronic files are verified by either the IT staff or the CDS before being sent to the client by mail, or electronically.

12.3 Report Content and Levels

Microbac provides four levels of laboratory reports in order to match the documentation level required by specific projects. A summary of the four levels of data reporting follows:

Level 1 - Standard Laboratory Report

- Cover page with signature
- Results of analysis
- Reporting units
- Reporting/detection limits
- Analysts and analysis dates
- Method references
- Chain-of-custody form
- Surrogate recovery

Level 2 - Standard Report with QA/QC Summary of method blanks, LCS, MS/MSD, and duplicate results.

Level 3 - A Level 2 report with additional summary forms and no raw data.

Level 4 – CLP - Like report with summary forms and raw data.

Reporting level requirements are logged into the KOBRA LIMS system with the sample set. Level 1 and 2 data packages are assembled upon printout of the final report by the data entry staff. Copies of the raw analytical data for level and data packages are turned in by the analysts upon completion of analysis. Data summary forms are printed from specialized software packages by the analysts in each laboratory. For a list of standard Microbac data qualifiers see Figure 12-1. Customized "Level – X" reports are available for special projects.

12.4 Data Package Review

Analytical project management, in light of a complicated regulatory and technical environment, requires thorough organization, planning, documentation as well as client specific requirements and certification specifications. Microbac recognizes the importance of strict compliance with client-defined, project/program-specific protocols, and has created Sales/Service teams to address their inherent diversity. Each Sales/Service team is responsible for all facets of their projects from inception to invoice, insuring in-depth, aggregate understanding of the client's requirements. Each team consists of a Leader, a Chemist/Data Specialist and a Client Services Specialist, all reporting to the Managing Director. Collectively, the Team performs all pre-production and post-production administrative, logistical and technical functions, as follows:

- Project Requirement Review
- Project Implementation
- Communication
- Review of Each Login (Sample Delivery Group)
- Status and Progress Reports
- Review of Final Reports and Deliverables
- Invoicing

Additional details may be found in Microbac SOP 44.

12.4.1 Administrative Review

The laboratory project management team is responsible for an administrative review of the final data package. The purpose of this review is to assure that all project specific requirements are met and that all discrepancies are fully documented in the report narrative. This review is documented on the report cover with signature and date.

12.4.2 Quality Assurance Review

The team project chemists are responsible for a quality assurance review of at least 10% of the final data packages. The purpose of this review is to assess technical compliances with program, project, and method requirements. Such review shall be documented and any problems or discrepancies will be reported to the QAO.

12.5 Data Integrity, Storage and Archive

Insuring data integrity is one of Microbac's main objectives. QA controls, as well as, Good Laboratory Practice are instituted by Microbac to achieve this objective. In the daily flow of data, laboratory personnel initial and date any corrections introduced into the data. Unused areas of the daily bench sheets and instrument logs are crossed out, initialed and dated by the corresponding analyst or technician. Controlled benchsheets and log books are required to maintain data integrity. Each sample delivery group is assigned a unique login number when initially logged into the KOBRA LIMS system. The report master files are stored in order of the login number and can be easily retrieved using this system. Hardcopies of each login are maintained in filing cabinets in the filing room for six to eight months and then removed to CD-ROM archive storage for a period of five to ten years depending on contractual agreements. OVAP requires notification prior to disposal of any records.

Computer records from the Microbac KOBRA LIMS are maintained on the system for one year and are then archived on magnetic tape. Two backup copies of the system are maintained on magnetic tape at all times. The backup and archive tapes are stored in a fireproof safe at the laboratory indefinitely. Extraction lab logbooks and bench sheets are maintained chronologically and stored in the laboratory for five years. Inorganics raw data, including analyst notebooks, bench sheets, computer printouts and instrument logs, are stored by parameter in the individual laboratories or in the archive area for a period of five years. GC data is stored as hardcopy in the individual master files. GC/MS data is stored as hardcopy for three-five years in the workorder files and on magnetic tape for at least one year. GC/MS Data stored on magnetic tape can be retrieved by the file numbers assigned to them at the time of analysis.

12.6 Policy on Significant Figures

The following policies relate to the use of significant figures for reporting analytical data apply in general to all departments and methods except as noted in the individual method SOPs. All analytical results which are taken from bench sheets, instrument quantitation reports, or other raw data shall be rounded to three (3) significant figures as per Section 12.7 and entered without adjustment into the KOBRA LIMS. The KOBRA LIMS shall be programmed to generate the final analytical report with the appropriate number of significant figures based on the project requirements.

- All results for performance evaluation samples will be reported with three (3) significant figures using the rounding rules specified in Section 12.7.
- All quality control sample results will be reported with three (3) significant figures.
- All results for surrogate compound recovery will be reported with three (3) significant figures.
- All results for client (real world) samples will be reported with three (3) significant figures (except as noted below).
- Project specific requirements may override these general guidelines and the KOBRA LIMS products and data entry screens will be modified accordingly.

12.7 Rules for Rounding

For rounding off numbers to the appropriate level of precision (significant figures), the laboratory staff shall follow these rules:

- If the figure following the digit to be retained is less than five (5), drop it (round down).
- If the figure following the digit to be rounded is greater or equal to five, round up.

Examples:

Three significant figures:	**Two significant figures:**	**One significant figure:**
6.014 rounds to 6.01	0.0511 rounds to 0.051	0.015 rounds to 0.02
6.016 rounds to 6.02	0.0519 rounds to 0.052	0.016 rounds to 0.02
6.015 rounds to 6.02	0.0515 rounds to 0.052	1.9 rounds to 2
		25 rounds to 30
		26 rounds to 30
		24 rounds to 20

Figure 12-1

Microbac Laboratories, Inc.
List of Valid Qualifiers
August 5, 2002

Standard Qualifiers

These are Microbac's Standard Report Qualifiers

B	Present in the method blank
C	Confirmed by GC/MS
CG	Confluent growth
D	The analyte was quantified at a secondary dilution factor
DL	Surrogate or spike was diluted out
E	Estimated concentration due to sample matrix interference
FL	Free liquid
I	Semi-quantitative result, out of instrument calibration range
J	Present below nominal reporting limit
L	Sample reporting limits elevated due to matrix interference
N	Tentatively Identified Compound (TIC)
NA	Not applicable
ND	Not detected at or above the reporting limit (RL)
NF	Not found
NFL	No free liquid
NI	Non-ignitable
NS	Not spiked
P	Concentration >40% difference between The two GC columns
QNS	Quantity not sufficient to perform analysis
RA	Re analysis confirms reported results
RE	Re analysis confirms sample matrix interference
S	Analyzed by method of standard addition
SMI	Sample matrix interference on surrogate
SP	Reported results are for spike compounds only
TNTC	Too numerous to count
U	Analyzed for but not detected
W	Post-digestion spike for furnace AA out o f control limits
X	Exceeds regulatory limit
Z	Can not be resolved from isomer.***
+	Correlation coefficient for the MSA is less than 0.995
<	Less than
>	Greater than
*	Surrogate or spike compound out of range

***** Special Notes for Organic Analytes**

1. Acrolein and acrylonitrile by method 624 are semi-quantitative screens only
2. 1,2-Diphenylhydrazine is unstable and is reported as azobenzene
3. N-nitrosodiphenylamine cannot be separated from diphenylamine
4. 3-Methyphenol and 4-Methyphenol are unresolvable compounds
5. m-Xylene and p-Xylene are unresolvable compounds
6. The reporting limits for Appendix II/IX compounds by method 8270 are based on EPA estimated PQLs referenced in 40 CFR Part 264, Appendix IX. They are not always achievable for every compound and are matrix dependent.

AFCEE Qualifiers

These are Microbac's AFCEE Report Qualifiers

J	The analyte was positively identified, the quantitation is an estimation
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the MDL
F	The analyte was positively identified but the associated numerical value is below the RL
R	The data is unusable due to deficiencies in the ability to analyze the sample and meet QC criteria
B	The analyte was found in an associated blank, as well as in the sample
M	The matrix effect was present
S	To be applied to all field screening data
T	Tentatively identified compound (using GC/MS)

13.0 CONTROL OF NONCONFORMING WORK

13.1 Nonconforming Work

The laboratory implements general procedures to be followed when departures from documented policies, procedures and quality control have occurred or when any aspect of testing, result generation or reporting does not conform to established procedures or contract requirements of the customer. The procedures detailed in Microbac SOP GP-RCA, "Root Cause Analysis" and Microbac SOP GP-CAPA, "Corrective Action and Preventive Action: Initiating, Tracking and Monitoring", are to be followed when such occurs. The department supervisor and/or the analyst has the ultimate authority and responsibility for the management of nonconforming work and the appropriate actions to be taken. The department supervisor, analyst and/or the QA department have the authority, under their scope of responsibilities, to initiate the necessary procedure; the procedure insures that:

- An evaluation of the significance of the nonconforming work is made.
- Corrective actions are taken immediately, as necessary
- When necessary, the customer is notified and the work is recalled.

Where there is doubt about the compliance of laboratory operations with policies or procedures, with the ISO17025:2005 standard or determination is made that nonconforming work could recur, the QA department will audit the appropriate areas of activity as discussed in Microbac SOP GP-INTAUDIT, Internal Audit Guidelines and the procedures described in Microbac SOP GP-CAPA, "Corrective Action and Preventive Action: Initiating, Tracking and Monitoring" are to be followed.

13.2 Corrective Action

Corrective action may be required as a result of both analytical and non-analytical events. The purpose of the corrective action is not only to provide documentation of the event, but also to correct and prevent recurrence of the nonconformance or departure from the policies and procedures.

The procedures in Microbac SOP GP-RCA, Root Cause Analysis and Microbac SOP GP-CAPA, Corrective Action and Preventative Action: Initiating, Tracking and Monitoring detail and insure the following:

- An investigation is made to determine the root cause(s) of the problem.
- Potential corrective actions are identified and subsequently the most appropriate are implemented.

- Corrective actions are chosen appropriate to the magnitude of the problem.
- The entire process is properly documented.
- Follow-up is made to monitor and determine the effectiveness.

13.3 Preventive Action

Preventive action is the proactive identification of potential problems or areas for improvement. No nonconforming event needs to take place in order to stimulate a preventive action. This practice applies to the quality management system. Needed improvements and potential sources of nonconformance, whether administrative, technical or quality related are identified, selected, implemented, monitored and documented following Microbac SOP GP-CAPA, “Corrective Action and Preventive Action: Initiating, Tracking and Monitoring”. Effectiveness of these actions is evaluated during the management review process.

13.4 General Analytical Requirements

Analysts have the primary responsibility for assessing method compliance and evaluating the acceptability of the batch quality control samples. Laboratory criteria that must be met and the resultant corrections are addressed in detail in the individual SOPs. An example of the contents is outlined in Tables 13-1. Some methods have additional control criteria such as surrogates, ICVs, CCVs etc. A departure occurs if a blank, calibration standard, laboratory control sample, sample replicate, or spike recovery analyses fail to meet the quality control criteria outlined in the SOPs. An investigation to find the cause of the problem is undertaken by the analyst and department supervisor and a nonconforming work report (Figure 13-1) is initiated. This form is used to document the problem, its resolution and to provide the means to inform management (including the QAO) of chronic quality problems and non-compliant systems. Corrective action must be approved by the QAO who will ensure implementation and documentation of the corrective action. More specific discussion of the various laboratory corrections due to nonconformance are discussed in the sections that follow. The special requirements of the OVAP are presented in Section 16.1.

13.5 Calibration Requirements

Instrument calibration is fundamental to all quantitative chemical analysis. Each US-EPA or other reference analytical method has specified calibration criteria that must be met in order for the data to be fully useable. Proper initial calibration must be performed in accordance with the method specifications for number, source and level of calibration standards, as well as, meet the linearity requirements. Each initial calibration must be verified at the specified frequencies and meet acceptance limits. Repeated failure of CCV standards necessitates that the analysis be stopped, the instrument evaluated, and the initial calibrations repeated. Data for problematic analytes that do not pass the method specification must be qualified appropriately in the final laboratory summary reports and narratives.

13.6 Method Blanks

Method blanks are used to evaluate the analytical system for contamination. For most analytes the upper limit for blank contamination is the reporting limit, however, it is our policy to evaluate the source of any contamination greater than two times the MDL.

The criteria used to determine the acceptability of method blanks varies with the particular analyte. Factors such as the level of analyte in the sample and the existence of established regulatory limits, or action limits, must be taken into consideration. No correction other than documentation is required when the levels of analyte in the samples are at least ten times the level in the blank. Laboratory action involving blank contamination would include an investigation documented by a nonconformance report and one of the following actions:

- re-preparation and re-analysis of the affected samples
- B-flagging of the data
- documentation of the problem in the report narrative along with the effects on data quality, if any

13.7 Laboratory Control Samples

The data from the LCS is crucial to assessing the usability of the data from samples in the same batch. Normally, the LCS is approached from the stand point of pass/fail. If the LCS is out-of-control, the samples in the associated batch are re-analyzed, starting from the preparation step. This is the standard laboratory policy for single analyte methods such as wet chemistry or metals. For multi-analyte methods such as volatile and semi-volatile organics, both the number and severity of LCS outliers must be evaluated. A certain amount of professional judgment is required of the laboratory management as to what constitutes an out-of-control LCS. If the number of failing analytes is excessive (i.e. > 10% the analytes spiked), indicating a general system failure, then correction shall include the re-preparation and re-analysis of the entire batch. When the outliers are out high, there is no correction required if the samples do not contain reportable levels of these analytes. Furthermore, if the analytes are out low, but only marginally, this also might not indicate a method problem. The results of the LCS are included in the QC Summary Report and all outliers are appropriately identified. The report narrative will discuss any problems with non-compliant LCS data, and the proper flags used to qualify the analytical results.

13.8 Matrix Spikes and Duplicates

Evaluating the data from MS, MSD, and duplicate samples is more complex than for method blanks and LCSs. In general, Microbac does not base batch control on the results of these analyses due to matrix effects and the issues of heterogeneity and sampling. The control limits for the LCS will be used to assess the acceptability of the MS/MSD data for the purposes of data flagging only.

13.9 Nonconformance Reports

Nonconformance reports (NCR) are used to document out of control events which consists of but are not limited to the non-fulfillment of a requirement of a customer, quality management system or regulatory agency (Figure 13.1). This report can be generated by any employee when nonconformances are identified. The form describes the event, correction and signifies a return to control if achieved. Further action is required if there is not a return to control and/or the out of control event is recurring. Further actions include but are not limited to corrective action procedures.

13.10 Corrective Action/Preventive Action Reports

Corrective Action/Preventive Action Reports (CAPA's) are used to document nonconformances requiring corrective action, as well as, actions designed to prevent initial occurrences of a nonconformance (Figure 13-2). These reports are typically generated by the analyst or individual who has encountered the nonconforming or potential nonconforming situation. This individual would be responsible for generating the CAPA form by describing the nonconformance issue and recommending or describing the correction taken. After the correction is performed the root cause is determined and the solution(s) implemented, the CAPA form is reviewed and signed by the department supervisor, a member of the QA department and the laboratory managing director. Post closure monitoring is performed and recorded in the monthly corrective action spreadsheet.

Figure 13.1

Ohio Valley Division

NONCONFORMANCE REPORT

Date: ______________ **Department:** ______________ **Initiator:** ____________________

Prep WG# __________ **Preparation Date:** __________ **Parameter:** __________________

I. Description of Nonconformance:

Sample ID(s) ____

____

☐ Method Blank ____

☐ LCS Failures ______ analytes out ______________________________________

☐ Other ____

____

____

II. Correction:

☐ Reprep affected samples only ______________________________________

☐ Reprep entire workgroup ______________________________________

☐ Reanalyze affected samples only ______________________________________

☐ Report data with qualifiers ______________________________________

☐ Other ____

____

III. Return to Control?: Not Applicable __________ Yes __________ No __________

Control Verification ____

IV. Further Action Required?: (required if No is checked in III.)

____

____

____

Approvals:

Department Supervisor: ________________________________ Date: __________________

QA Department: ________________________________ Date: __________________

Document Control Form #454

Figure 13.2

Ohio Valley Division

CORRECTIVE ACTION/PREVENTIVE ACTION REPORT

Date:__________ Department:________ Initiator:____________________

I. Description of Nonconformance:

II. Correction (CAR only):

III. Root Cause Analysis Results (optional for PAR):

IV. Action to be Taken:

V. Describe evidence of effectiveness:

Approvals:

Department Supervisor: ____________________ Date: ________

QA Department: ____________________ Date: ________

Director/Manager: ____________________ Date: ________

Document Control Form #455

14.0 PERFORMANCE AND SYSTEMS AUDITS

14.1 External Audits

Microbac actively participates in several Federal and State performance evaluation testing programs and system audits. External systems audits of the Microbac facility occur on a regular basis. These include audits by the West Virginia Department of Natural Resources (WVDNR), the OEPA, and the Florida Department of Health (FLDOH) (NELAC Primary Accreditor). Additionally, audits are conducted every 2 - 3 years by the California Department of Health Services, and the US Army Corps of Engineers.

14.2 Performance Audits and Proficiency Testing

Performance audits are required for numerous state and federal programs. These certifications include the submittal of single blind analytical proficiency testing (PT) samples from NIST certified providers. Microbac formally participates semiannually in the following performance evaluation programs:

- NELAC/WP/DMRQA
- NELAC Soil
- NELAC UST

If problems are identified in any of these programs, the QAO will submit internal PT samples to verify the effectiveness of our corrective actions.

14.3 Internal Audits

The QAO will perform an annual internal audit of the laboratory operations to assure continued adherence to the LQAP, including the referenced methods and SOPs. The QAO may conduct the audit over the course of the year, with assistance from other technical directors or supervisors. The results of the audit shall be documented using the checklist in Figure 14-1, or an equivalent form, and the results are presented in a report to the Managing Director. The QAO may perform additional internal audits based on results of internal and external performance feedback. If the laboratory receives a customer complaint, an audit will be used to investigate the appropriate areas. The laboratory will perform corrective actions and notify the client(s) within three business days if any data are affected by findings resulting from an internal or external audit. The laboratory shall have thirty (30) days to close out any internal audit finding.

The procedures for conducting the internal audit are presented in Microbac SOP GP-INTAUDIT

14.4 Management Review Procedures (Managing Director)

Senior Management annually conducts a Quality Systems Review. Each system is reviewed for client responsiveness, overall efficiency, value towards quality and economic value. Human resources and equipment needs are evaluated. With the summation of the review, changes are made (corrective action) as appropriate, equipment is purchased and overall business strategy is adjusted. The procedures for conducting the management reviews in accordance with ISO 17025:2005, Section 4.15.1 are presented in Microbac SOP GP-QMSR. This review includes but is not limited to:

- Laboratory Quality System
- Report Generation/Content (Hard Copy & EDD)
- Laboratory Data QA/QC
- KOBRA LIMS development and improvement
- Sales/Marketing Function/System
- Proposal/Quotation generation
- Project Management/Technical Service
- Production efficiencies
- Volume of work
- Internal audit reports
- Performance evaluation studies
- Client satisfaction
- Client feedback

Figure 14-1
MICROBAC INTERNAL SYSTEM AUDIT FORM

Microbac Laboratories, Inc.
Interal Audit Checklist

Auditor Name: ______________________________
Date: ______________________________

I. Sample Receipt and Storage Area

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for receipt and storage of samples?			
Is the appropriate portion of the SOP available to the analyst at the sample receipt/storage area?			
Has SOP been reviewed in the last 12 months?			
Are samples that require preservation stored in such a way as to maintain their preservation?			
Are volatile samples stored separately from semi-volatile samples?			
Are refrigerator blanks used for volatile storage?			
Are adequate facilities provided for storage of samples, including cold storage?			
Is the temperature of the cold storage recorded daily in a logbook?			
Does the cold storage temperature logbook contain acceptance criteria?			
Are the sample receipt/storage and temperature logbooks maintained in a manner consistent with GLP?			
Is the sample pH measured and recorded by the sample custodian?			
Does the supervisor periodically examine and review all notebooks, logbooks, etc. and sign his/her name therein, together with the date and appropriate comments as to whether or not the notebook is being maintained in an appropriate manner?			
Are proper records kept of standards preparation?			
Are materials properly labeled with concentrations, date of preparation, and the identity of the person preparing the sample?			

Additional Comments:

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

II. Inorganics Sample Preparation Area

Item	Yes	No	Comments
Is the laboratory maintained in a clean and organized manner?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with volatile materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Is the analytical balance away from draft and area subject to rapid temperature changes?			
Has the balance been calibrated within one year by a certified technician?			
Is the balance routinely checked with class 1 weights before each use and the results recorded in a logbook?			
Does the balance logbook contain acceptance criteria?			
Is the appropriate portion of the SOP available to the analyst at the sample preparation area?			
Are reagent grade or higher purity chemicals used to prepare standards?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labeled with identity of materials, concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Do the analysts record bench data in a neat and accurate manner?			
Are standards stored separately from sample extracts?			
Is the temperature of the refrigerator/freezer recorded daily?			
Does the temperature logbook contain acceptance criteria?			

Additional Comments:

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

III. Organics Sample Preparation Area

Item	Yes	No	Comments
Is the laboratory maintained in a clean and organized manner?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with volatile materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Is the analytical balance away from draft and area subject to rapid temperature changes?			
Has the balance been calibrated within one year by a certified technician?			
Is the balance routinely checked with class 1 weights before each use and the results recorded in a logbook?			
Does the balance logbook contain acceptance criteria?			
Is the appropriate portion of the SOP available to the analyst at the sample preparation area?			
Are reagent grade or higher purity chemicals used to prepare standards?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labeled with identity of materials, concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Do the analysts record bench data in a neat and accurate manner?			
Are standards stored separately from sample extracts?			
Is the temperature of the refrigerator/freezer recorded daily?			
Does the temperature logbook contain acceptance criteria?			

Additional Comments:

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

IV. VOA GC Instrumentation

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for all methods used in this area?			
Is the appropriate portion of the SOP available to the analyst at the various instruments?			
Is the laboratory maintained in a clean and organized manner?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with volatile materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labeled with identity of materials, concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Are standards stored separately from sample extracts?			
Is the temperature of the refrigerator/freezer recorded daily?			
Is there a calibration protocol in use by the operator?			
Are calibration results kept in a permanent record?			
Do the analysts record bench data in a neat and accurate manner?			
Is preventive maintenance applied?			
Is a permanent service record maintained in a logbook?			
Is an electronic data storage service available?			
Is there evidence that at least one GC or GC/MS system can be reasonably expected to be operating acceptably at any given time?			
Are refrigerator blanks analyzed to monitor contamination free sample storage?			
Is a balance logbook maintained?			
Is the balance routinely checked with Class 1 weights before each use and results recorded in the balance logbook?			
Have expired standards been disposed of?			
Are instrument run logbooks maintained?			
Are system blanks analyzed to check for carryover contamination?			
Are solvent bottles (e.g. methanol for VOA) labeled with receipt date, open date, and initials?			
Do the analysts maintain statistical process control charts for each method?			
Do the analysts use control charts to monitor method performance?			
Are analysts familiar with applicable QA/QC method requirements?			
Is positive pressure maintained in rooms where volatile organic samples are analyzed?			

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

V. VOA GCMS Instrumentation

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for all methods used in this area?			
Is the appropriate portion of the SOP available to the analyst at the various instruments?			
Is the laboratory maintained in a clean and organized manner?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with volatile materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labeled with identity of materials, concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Are standards stored separately from sample extracts?			
Is the temperature of the refrigerator/freezer recorded daily?			
Is there a calibration protocol in use by the operator?			
Are calibration results kept in a permanent record?			
Do the analysts record bench data in a neat and accurate manner?			
Is preventive maintenance applied?			
Is a permanent service record maintained in a logbook?			
Is an electronic data storage service available?			
Is there evidence that at least one GC or GC/MS system can be reasonably expected to be operating acceptably at any given time?			
Are refrigerator blanks analyzed to monitor contamination free sample storage?			
Is a balance logbook maintained?			
Is the balance routinely checked with Class 1 weights before each use and results recorded in the balance logbook?			
Have expired standards been disposed of?			
Are instrument run logbooks maintained?			
Are system blanks analyzed to check for carryover contamination?			
Are solvent bottles (e.g. methanol for VOA) labeled with receipt date, open date, and initials?			
Do the analysts maintain statistical process control charts for each method and matrix?			
Do the analysts use control charts to monitor method performance?			
Are analysts familiar with applicable QA/QC method requirements?			
Is positive pressure maintained in rooms where volatile organic samples are analyzed?			

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

VI. SEMI-VOA GC Instrumentation

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for all methods used in this area?			
Is the appropriate portion of the SOP available to the analyst at the various instruments?			
Is the laboratory maintained in a clean and organized manner?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with volatile materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labeled with identity of materials, concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Are standards stored separately from sample extracts?			
Is the temperature of the refrigerator/freezer recorded daily?			
Is there a calibration protocol in use by the operator?			
Are calibration results kept in a permanent record?			
Do the analysts record bench data in a neat and accurate manner?			
Is preventive maintenance applied?			
Is a permanent service record maintained in a logbook?			
Is an electronic data storage service available?			
Is there evidence that at least one GC or GC/MS system can be reasonably expected to be operating acceptably at any given time?			
Have expired standards been disposed of?			
Are instrument run logbooks maintained?			
Are system blanks analyzed to check for carryover contamination?			
Are solvent bottles (e.g. methanol for VOA) labeled with receipt date, open date, and initials?			
Do the analysts maintain statistical process control charts for each method?			
Do the analysts use control charts to monitor method performance?			
Are analysts familiar with applicable QA/QC method requirements?			
Is positive pressure maintained in rooms where volatile organic samples are analyzed?			

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

VII. SEMI-VOA GCMS Instrumentation

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for all methods used in this area?			
Is the appropriate portion of the SOP available to the analyst at the various instruments?			
Is the laboratory maintained in a clean and organized manner?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with volatile materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labeled with identity of materials, concentrations, date of preparation, and the identity of the person preparing the sample?			
Is a standards preparation and tracking logbook maintained?			
Are standards stored separately from sample extracts?			
Is the temperature of the refrigerator/freezer recorded daily?			
Is there a calibration protocol in use by the operator?			
Are calibration results kept in a permanent record?			
Do the analysts record bench data in a neat and accurate manner?			
Is preventive maintenance applied?			
Is a permanent service record maintained in a logbook?			
Is an electronic data storage service available?			
Is there evidence that at least one GC or GC/MS system can be reasonably expected to be operating acceptably at any given time?			
Have expired standards been disposed of?			
Are instrument run logbooks maintained?			
Are system blanks analyzed to check for carryover contamination?			
Are solvent bottles (e.g. methanol for VOA) labeled with receipt date, open date, and initials?			
Do the analysts maintain statistical process control charts for each method?			
Do the analysts use control charts to monitor method performance?			
Are analysts familiar with applicable QA/QC method requirements?			
Is positive pressure maintained in rooms where volatile organic samples are analyzed?			

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

VIII. AA/ICP Instrumentation

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for all methods used in this area?			
Is the appropriate portion of the SOP available to the analyst at the various instruments?			
Are contamination-free areas provided for trace level analytical work?			
Are exhaust hoods provided to allow contamination-free work with corrosive materials?			
Is the air flow of the hoods periodically checked and recorded?			
Does the laboratory have a source of distilled/ demineralized water?			
Can the laboratory supervisor document that trace-free water is available for preparation of standards and blanks?			
Are fresh analytical standards prepared at a frequency consistent with good QA?			
Are reference materials properly labeled with concentrations, date of preparation, and the identity of the person preparing the sample?			
Is the standards preparation and tracking logbook maintained?			
Are standards stored separately from sample extracts?			
Is the laboratory maintained in a clean and organized manner?			
Is there a calibration protocol in use by the operator?			
Are calibration results kept in a permanent record?			
Is preventive maintenance applied?			
Is a permanent service record maintained in a logbook?			
Is there evidence that at least one AA/ICP system can be reasonably expected to be operating acceptably at any given time?			

Additional Comments:

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

IX. Data Handling and Review/QC

ITEM	YES	NO	COMMENTS
Are written Standard Operating Procedures (SOP) developed for data review?			
Is the appropriate portion of the SOP available to data review personnel?			
Are data calculations spot-checked by a second person?			
Do records indicate corrective action that has been taken on rejected data?			
Have standard curves been adequately documented?			
Are in-house quality control charts maintained for analysis (i.e. internal standard control charts)?			
Do QC records show corrective action when analytical results fail to meet QC criteria?			
Do supervisory personnel review the data and QC results?			

Additional Comments:

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

X. Purchasing

ITEM	YES	NO	COMMENTS
Does the laboratory have a formal purchase or requisition system for purchasing equipment, supplies and chemicals?			
Do purchases have to be approved by management?			
Are the proper grades of chemicals purchased for the intended use?			
Are only ACS grade or better chemicals used n the laboratory?			
Does the laboratory have a system to track lots for the following categories of supplies:			
a) Acids for preservation?			
b) Acids for metal digestion?			
c) Solvents for extraction?			
d) Sample bottles?			
Does the laboratory maintain certificates for standards, reagents, and sample bottles?			
Is an inventory system used to reserve specific lot numbers of extraction solvents and other critical reagents?			

Additional Comments:

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

XI. Training

ITEM	YES	NO	COMMENTS
Does the laboratory have a formal training program and documentation files?			
Are the files current in the following departments?			
a) Wet Chemistry?			
b) Metals?			
c) Extraction?			
d) Volatile Organics?			
e) Semivolatile Organics?			
Does documentation exist that each analyst has performed a proficiency demonstration for each method for which they are certified in the following departments?			
a) Wet Chemistry?			
b) Metals?			
c) Extraction?			
d) Volatile Organics?			
e) Semivolatile Organics?			
Are the analyst's certificates up to date?			

Additional Comments:

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

XII. Document Control

ITEM	YES	NO	COMMENTS
Is the document control system outlined in SOP 46 of the LQAP in use in each department?			
Are controlled copies of the laboratory SOPs available in each department?			
Have "unofficial" or uncontrolled copies of SOPs been removed from the laboratory?			
Does the document control system provide a means to identify out-of-date SOPs and documents?			
Does the system requiring acknowledgment of receipt of control copies appear to be working?			

Additional Comments:

Figure 14-1 (continued)
MICROBAC INTERNAL SYSTEM AUDIT FORM

XIII. Project Management and Reporting

ITEM	YES	NO	COMMENTS
Are "kick-off" meeting for new projects used effectively to communicate specifications to the laboratory staff?			
Are written work orders being used?			
Are the TSRs performing a review of 100% of each project or sample delivery group (login number)?			
Are data in the LIMS being checked at each of the following stages:			
a) Analyst review?			
b) Peer review?			
c) Supervisory/QC review?			
d) Data entry?			
e) Data verification and editing?			
f) Final report review?			
Does each report have a certification and signature by the laboratory manager or appropriate designee?			

Additional Comments:

15.0 QUALITY ASSURANCE REPORTS

The QAO and other laboratory technical directors perform an annual review of the quality system. This review includes all of the following elements:

- Results of internal audits
- Results of external audits
- Results of Proficiency Testing (PT) studies
- Summary of review of Corrective Action Reports
- Reports and deliverables
- Electronic Data Deliverables (EDD)
- Annual revision of the Quality Assurance Manual

15.1 Laboratory Quality Assurance Reports

The QAO prepares a monthly report for the Managing Director and to Microbac's corporate Director of Quality Improvement. The report summarizes laboratory activities for audits, PT studies, corrective action closure, certification changes, training, customer feedback, and other significant events.

The QAO also presents a written annual report to the Managing Director that summarizes the annual system review activities. Any significant quality assurance or quality control problems along with the recommended solutions for the problems will be listed.

15.2 Quality System Review Report

The Quality System Review is conducted annually (see Section 14.3) and a report of this review is issued to the president of the company. This report is included in the Annual Business Plan with the recommendations, observations, and adjustments incorporated in the business plan/strategy for the following year.

15.3 Special Reports

The QAO shall prepare special quality assurance reports as necessary to document special concerns and problems. These reports may indicate the discussion of chronic PT performance problems, evaluation of Corrective Action Reports, results of storage blanks, follow-up from internal and external audits, customer complaints, and any trends determined from periodic evaluation of statistical data.

16.0 SPECIAL PROGRAM REQUIREMENTS

This section identifies the specific requirements of various state and federal programs that have requirements that go beyond what is outlined in this quality manual and the laboratory policies and procedures (SOPs) referenced in Appendix B. It is not the intent to list all of the QA/QC requirements of these programs, since these documents are incorporated by reference. Only the specifications that more stringent than our standard protocols will be identified.

16.1 Department of Defense

Microbac performs analyses for projects that must comply with the DoD's Quality Systems Manual (QSM). The QSM is based on the NELAC standards, but has special requirements that are identified in the DoD "gray boxes". The appendices to the QSM summarize the QA/QC requirements for several common methods and list special surrogate and LCS control limits. To assure compliance with the DoD's QSM, Microbac has implemented the following special procedures.

16.1.1 QAPP and Control Limits

The DoD QSM has special QA/QC acceptance limits for the LCS, MS/MSD, and surrogates. The KOBRA project set up specifications shall identify the QAPP and QC-Key i.e. DOD3. The KOBRA QC Table is populated with the correct LCS/surrogate acceptance limits for DoD3. These steps will assure that the correct control limits are used for all QSM projects.

16.1.2 Internal Standards

Methods 8260 and 8270 must compare the internal standard (IS) area to the mid-point of the ICAL curve. Use KOBRA project set-up to indicate this requirement.

16.1.3 Soil Sub-sampling – Method 8330B

Microbac will follow these procedures for drying, sieving, grinding, and multi-increment sub-sampling of soil samples in preparation for SW-846 method 8330B. The laboratory obtained additional guidance for these procedures from "DoD" Guide for Implementing EPA SW-846 Method 8330B", July 7, 2008.
Sample Drying

Remove the entire contents of the 8330 sample container and spread the soil evenly in a shallow pan lined with aluminum foil. Remove all large pebbles, sticks, and other solids too large to pass through a 2 mm screen. Air-dry the soil at room temperature in the soil drying room or other low traffic area of the laboratory.

Sieving Procedure

Gently crush the air-dry soil using a large spoon or glass rod and transfer to a clean 2 mm sieve. Stir, shake, and mix the sample and allow it to pass through the sieve, and collect in a foil-lined pan. Do not use excessive force in this step, as this may damage the screens. The sample is now the portion that passes the 2 mm screen.

Grinding Procedure

Transfer the sieved sample to a mill grinder or a mortar and pestle. Grind entire sample reducing the particle size to 75 micron, or less.

Sub-sampling

Transfer the entire ground sample to a clean shallow pan, spreading the soil to thickness of 1 – 2 cm. Using a small spatula, randomly remove at least thirty increments of approximately 0.33 g each, giving a representative sub-sample of 10 g. Record the weight of the subsample to the nearest 0.01 g. This is the sample aliquot to be taken for extraction via ultrasonic bath.

Triplicate Analysis and MS/MSD (Optional)

For each sample delivery batch of 1-20 samples, process the client-specified sample(s) in triplicate by processing three discrete 10 g sub-samples as per Section 7.4. Individual projects may vary the rate of samples processed in triplicate. Repeat the sub-sampling procedure two more times for each sample specified for MS/MSD.

Grinding Blanks

A grinding blank with each batch of samples will be used to verify the effectiveness of the cleaning procedures. Some projects may require grinding blanks after each sample. The project QAPP will specify the frequency of these blanks, and they will be logged into the LIMS accordingly. The grinding blank(s) must meet the same criteria as the 8330B method blank (no target analytes > one-half the RL).

Grinder Cleaning Procedures

Use the following procedures to clean the mortar and pestle and coffee grinder(s) between samples:

1. Remove bowl/blade from base of grinder
2. Immerse bowl/blade in soapy water and remove all visible soil residue
3. Rinse w/ tap water
4. Rinse w/ DI Water
5. Wipe with paper towel and air dry

16.1.4 Soil Sub-sampling – Metals

Microbac will use the following procedures for the drying, sieving, grinding, and sub-sampling of soil samples in preparation for metals digestion by SW-846 methods 3050 or 3051. This procedure may be extended to other methods if specified in the project QAPP.

Sample Drying

Remove the entire contents of the metals sample container and spread the soil evenly in a shallow pan lined with wax paper. Remove all large pebbles, sticks, and other solids too large to pass through a 2 mm screen. Air-dry the soil room temperature in a secure, low traffic area of the laboratory.

Sieving Procedure

Gently crush the air-dry soil using a large plastic, wood or glass rod and transfer to a clean 2 mm sieve. Stir, shake, and mix the sample and allow it to pass through the sieve, and collect in a foil-lined pan. Do not use excessive force in this step, as this may damage the screens. The sample is now the portion that passes the 2 mm screen.

Grinding Procedure

Transfer the sieved sample to a mortar and pestle. Grind entire sample reducing the particle size to 75 micron, or less.

Sub-sampling

Transfer the entire sample to a clean shallow pan, spreading the soil to thickness of 0.3-0.5 cm. Using a rectangular micro-spatula, remove representative cross-section(s) of the soil giving a sample in the range of 1.0-2.0 g. Record the weight of the sub-sample to the nearest 0.01 g. This is the aliquot to be taken for microwave digestion using SW-846 method 3051A.

16.2 Air Force Center for Environmental Excellence (AFCEE)

Microbac performs project work that must meet the requirements of various documents prepared by the AFCEE. We have provided analytical support to prime contractors under QAPP versions 1.0 – 4.0.02. Each version has special QA/QC requirements, the details of which are identified in the specific QAPP reference. To assure compliance with the AFCEE QAPPs, Microbac has implemented the following special procedures.

16.2.1 QAPP and Control Limits

The AFCEE QAPPs have special QA/QC acceptance limits for the LCS, MS/MSD, and surrogates. The KOBRA project set up specifications shall identify the QAPP and QC-Key, i.e AF40, AF31, etc.. The KOBRA QC Table is populated with the correct LCS/surrogate acceptance limits for each AFCEE QAPP These steps will assure that the correct control limits are used for all AFCEE projects.

16.2.2 AFCEE Reporting Limits

AFCEE QAPPs specifies that the MDL must be no greater than one-half the project's RL. The KOBRA project review system shall assure use of the special reporting lists created just for AFCEE projects (pkeys). Microbac has/will adjust the RLs accordingly to comply with the projects requirement, but in some cases it may be necessary to repeat MDL studies, if a lower RL is required. Microbac will get client approval of all reporting limits before proceeding with an AFCEE project.

17.0 REFERENCES

17.1 NELAC Standards, June 2003.

17.2 Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, December 29, 1980, Office of Monitoring Systems and Quality Assurance, ORD, U.S. EPA, Washington, DC 20460.

17.3 RCRA QAPP Instructions, U.S. EPA Region 5, Revision: April 1998.

17.4 ASTM D-5283-92. Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation.

17.5 "American National Standards Specification and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E-4)", 1994.

17.6 EPA 2185 – Good Automated Laboratory Practices, 1995.

17.7 ANSI/ISO/IEC 17025 - 2005 General requirements for the competence of calibration and testing laboratories.

17.8 QA/R-2: EPA Requirements for Quality Management Plans, August 1994.

17.9 QA/G-4: Guidance for the Data Quality Objectives Process EPA/600/R-96/055, September, 1994.

17.10 QA/R-5: EPA Requirements for Quality Assurance Project Plans Draft – November 1997.

17.11 QA/G-5: Guidance on Quality Assurance Project Plans EPA/600/R-98/018, February, 1998.

17.12 QA/G-6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November, 1995.

17.13 QA/G-9: Guidance for the Data Quality Assessment: Practical Methods for Data Analysis EPA/600/R-96/084, January, 1998.

17.14 Manual for the Certification of Laboratories Analyzing Drinking Water EPA/570/9-90/008.

APPENDIX A
DEFINITIONS

The following definitions are used in the production of this Comprehensive Quality Assurance Plan.

Analytical Batch:

The basic unit for analytical quality control. The analytical batch is defined as samples which are analyzed (or sampled together) with the same method sequence, the same lots of reagents, and with the same treatment common to all samples. The samples should have been analyzed (or collected) within the same specified time period or in continuous sequential time periods. Samples in each batch should be of similar composition.

Audits:

A systematic check to determine the quality of operation of some function or activity.

1. **Performance Audits:** Quantitative data are independently obtained for comparison with routinely obtained data in a measurement system. Examples of these audits are EPA performance evaluation programs, commercial performance evaluation programs, split sampling programs involving at least two laboratories, and blind spike samples.

2. **Systems Audit:** These are qualitative in nature and consist of an on-site review and evaluation of a laboratory or field operation quality assurance system and physical facilities for sampling, calibration and measurements.

Calibration:

Process by which the correlation between instrument response and actual value of a measured parameter is determined.

1. **Calibration Curve:** A curve which plots the concentration of known analyte standards against the instrument response to the analyte. Also known as a Standard Curve or the ICAL.

2. **Calibration Standard:** Solutions or dilutions of a substance or material with a verifiable accuracy which are used to evaluate the sample property of an unknown sample. In analytical terms, these standards are used to establish a calibration curve or standard instrument response factors.

3. **Continuing Calibration Verification:** Standards that are analyzed during an analytical set to verify the accuracy of the calibration curve.

4. **Internal Standard:** A compound having similar chemical characteristics to the compounds of interest, but which is not normally found in the environment or does not interfere with the compounds of interest. A known and specified concentration of the standard is added to each sample prior to analysis. The concentration in the sample is based on the response of the internal standard relative to that of the calibration standard and the compound in the standard.

Confidence Level:

The statistical probability associated with an interval of precision (or accuracy) values in a QC chart. The values of confidence intervals are generally expressed as percent probability. It is a commonly accepted convention that the result being tested is significant if the calculated probability is greater than 99 percent.

Data Quality Objectives:

A set of specifications that the environmental data should meet in order to be acceptable for its intended use in a program area. DQO’s are commonly established for limits of detection and quality of data (precision, accuracy, representativeness and comparability).

1. **Accuracy:** The degree of agreement of a measurement X (or an average of measurements of the same thing), with an accepted reference or true value, T, usually expressed as the difference between the two values, X-T, or the difference as a percentage of the percentage of the reference or true value, 100 (X/T)/T, and sometimes expressed as a ratio, X/T. Accuracy is a measure of the bias in a system.

2. **Precision:** A measure of mutual agreement among individual measurements of the same property, usually prescribed similar conditions. Precision is best expressed in terms of the standard deviation. Various measures of precision exist, depending upon the “prescribed similar conditions.”

3. **Representativeness:** Expresses the degree to which data accurately and precisely represents, a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

4. **Comparability:** Expresses the confidence with which one data set can be compared to another.

5. **Completeness:** Completeness refers to the percentage of measurements made which are judged to be valid. The completeness goal is the same for all data uses: that we achieve 95% completeness on our first analysis. Subsequently our goal is to achieve 100% completeness by resampling or doing additional analysis.

Detection Limits:

The smallest concentration/amount of an analyte of interest that can be measured with a stated probability of significance.

1. **Method Detection Limit (MDL):** The smallest concentration of an analyte of interest that can be measured and reported with 99 percent confidence that the concentration is greater than zero. The MDL's are determined from the analysis of a sample in a given matrix containing the analyte at a specified level. Determination of MDL's should be done by procedures determined in Appendix B of 40 CFR, Part 136. Equivalent procedures to determine MDL's may be used.

2. **Detection Limit (DL):** This is the "detection limit" (DL) referenced in DoD QSM Version 4.1 Box D-13. It is the MDL determined by the EPA procedure defined by 40 CFR Part 136 – Appendix B. It normally under-estimates the true MDL and is unreliable. This is particularly true when the spike/MDL ratio is > 10. If used for reporting purposes, the EPA MDL must be verified by a detectability check standard (DCS).

3. **Limit of Detection (LOD):** The current revision of the DoD Quality Systems Manual (QSM) defines the LOD as "the smallest amount or concentration of a substance that must be present in the sample in order to be detected at a high level of confidence (99%). At the LOD, the false positive rate (Type II error) is 1%." The LOD must be verified with or immediately after the initial MDL study, and quarterly thereafter. Microbac, Ohio Valley Division has historically used the term "verified MDL" to signify the same concept as the LOD.

4. **Limit of Quantitation (LOQ):** The most current version of the DoD Quality Systems Manual (QSM) defines the LOQ as "the minimum levels, concentrations, or quantities of a target variable (e.g. target analyte) that can be reported with a specified degree of confidence." The LOQ is a concentration within the normal calibration range, i.e. the concentration of the lowest standard in the curve must be at or below the LOQ. The laboratory shall verify the LOQ for each method, matrix, and instrument combination quarterly. An acceptable verification shall consist of a sample spiked at 1-2 times the LOQ that gives a recovery within the nominal LCS Limits. Exceptions are made for poor performing analytes for marginal exceedances. Other terms in common usage having definitions ad applications analogous to the LOQ include reporting limit (RL) and method quantitation limit (MQL).

5. **Practical Quantitation Limit (PQL):** The smallest concentration of an analyte of interest that can be reported with a specific degree of confidence. PQL's shall be determined in the same way as MDL's by using the procedures outlined in Appendix B of 40 CFR, Part 136. The standard deviation (sd) derived from the procedure will be used to calculate the PQL: PQL = 10sd, which corresponds to an uncertainty of $\pm$ 30 percent in the measures value at the 99 percent confidence level.

6. **Instrument Detection Limit (IDL):** The smallest amount of an analyte of interest that generates an instrument response (signal) under prescribed conditions, so that the magnitude of the signal is larger than the absolute uncertainty (error) associated with it.

Environmental Sample:

Means any sample from a natural source or source that reasonably may be expected to contribute pollution to or receive pollution from groundwaters or surface waters of the State. This includes, but is not limited to: receiving waters; waters used to define natural background conditions; soils; sediments; industrial, domestic or municipal discharge effluents; chemical storage or handling facilities; waste disposal facilities or areas; industrial or agricultural chemical handling or application areas; surface water run-off; and facilities for the handling or applying of chemicals for weed or insect control.

Holding Time:

Sample hold time is defined as time elapsed from sample collection date and time to sample analysis date and time.

Parameter Group:

Is defined as a group of samples that have been preserved in the same manner, prepared by similar protocols and analyzed using instruments of similar technology (also known as analyte group). Examples of parameter groups are:

- Volatiles (EPA methods 601, 602, and 624)
- Pesticides (EPA methods 608, 614, and 622)
- Trace Metals (All metals except mercury)
- Nutrients (Total Kjeldahl Nitrogen, Nitrate-Nitrite, Total Phosphorus)

Performance Evaluation Samples:

A sample submitted for analysis whose composition and concentration are known to the submitter but unknown to the analyst. Also known as a Blind Sample.

Quality Assurance:

A system of activities whose purpose is to provide the producer or user of environmental data the assurance that it meets defined standards of quality with a stated level of confidence.

Quality Assurance Plans (QAP):

An orderly assembly of detailed and specific procedures which delineates how data of a known and accepted quality is produced.

Quality Assurance Project Plans (QAPP):

A QA plan that is written for a specific project outlining specific QA targets and data quality objectives as well as protocols and QC measures needed to meet the project specific objectives.

Quality Control Measures:

1. Blanks:

An artificial sample of an analytical matrix designed to monitor the introduction of artifact into the system.

a) Field Quality Control Blanks

- Field Blanks: Blanks of analyte-free water prepared on-site by filling the pre-preserved sample containers with the water, sealing the containers, and completing the documentation. These blanks should be prepared during the middle to end of a sampling event by filling sample containers with water from the equipment decontamination water transport containers. They are to be treated, stored, transported, and analyzed in the same manner as the sample group for which it was intended. These blanks may be submitted for all water parameter groups.

- Equipment Blanks: Blanks of analyte-free water that are prepared on-site by pouring the equipment decontamination water through decontaminated field equipment. Appropriate pre-preserved sample containers for each analyte group should be used, and documentation should be completed. These blanks are to be stored, transported and analyzed with the intended parameter groups. At least one equipment blank is required for each water and solid matrix analytical group, and should be collected at the beginning of the sampling episode. If field decontamination is performed on-site, additional equipment blanks should be submitted for all water and solid matrix analytical groups.

- Trip Blanks: These blanks are required for volatile organic compound (VOC) water samples only. Blanks of volatile organic-free water are prepared by the organization providing the sample containers. These are transported to the site with the empty VOC sample containers, and shipped to the analyzing laboratory in the same containers. They remain unopened for the entire trip. Proper labeling and documentation should be completed. One trip blank for VOC sent per project unless client requests more.

b) Laboratory

- Method Blank: A blank of an analyte-free matrix that is processed (digested, extracted, etc.) and analyzed with a specified sample set.

- Reagent Blank: An aliquot of analyte-free water or solvent that is analyzed with a sample set.

2. Spiked Samples:

   These are samples fortified to a known and validated concentration of analyte. Percent recoveries are calculated for each compound in the spike.

   a) Field

   - An environmental sample fortified to a known and validated concentration in the field. These may be submitted as blind spike (laboratory does not know they are spiked) or as identified field spikes.

   b) Laboratory

   - LCS (Laboratory Control Sample): Samples of an analyte-free matrix (deionized water, sand, soil, etc.) that are fortified to a known and validated concentration of analyte(s) before sample preparation.

   - Sample (Matrix Spikes): Environmental sample selected from a set (not blanks) that is fortified to a known and validated concentration of analyte(s) before sample preparation. The concentration of each analyte in the spiking solution should be approximately 3-5 times the level expected in the sample.

   - Surrogate Spikes: A compound having similar chemical characteristics to the compounds of interest, but which is not normally found in environmental samples. Known concentrations of these compounds are added to all samples in the set before sample preparation.

3. Replicate Sample:

Samples that have been collected at the same time from the same source (field replicates) or aliquots of the sample that are prepared and analyzed at the same time (laboratory replicates).

a) Duplicate samples: Samples that are one type of a replicate sample. The analytical results from replicates are used to determine the precision of a system. If the concentration of analytes in the sample is below detectable limits, Duplicate Spike Samples may be used to determine precision.

b) Blind Replicates (Duplicates): Samples that are replicates that have been collected (field replicate) or prepared (laboratory replicate) and are submitted and analyzed as separate samples (analyst does not know they are replicates).

4) Quality Control Checks:

Standards or samples from an independent source that are analyzed at a specific frequency.

a) Quality Control Check Standards: Standard solutions from a source other than normal calibration standards that are certified and traceable. These standards are used to check the accuracy of a calibration curve.

b) Quality Control Check Samples: (also known as Reference Materials): Samples obtained from an independent source for which the level(s) of analytes have been validated. These samples are prepared and analyzed with a sample set of similar matrix. If these samples have been obtained from the National Institute of Standards and testing (formerly National Bureau of Standards), they are referred to as Standard Reference Materials.

5) Split Samples:

Replicate of the same sample that is given to two independent laboratories for analysis.

Sample Custody:

All record and documentation required to trace a sample from point of origin to disposal after analysis. These records should include, but are not limited to:

a) Field notebooks;
b) Field sample ID tags
c) Laboratory transmittal forms (if applicable);
d) Laboratory sample receipt logs;
e) Sample extraction/preparation logs or worksheets;
f) Analytical (instrument) logs or worksheets;
g) Calibration and quality control data associated with a sample set;
h) Instrument maintenance logs;
i) Sample disposition logs; and
j) Final reports.

Legal Chain of Custody is a special type of sample custody in which all events associated with a specific sample should be documented in writing. In addition to the records described above, chain of custody records should include the following:

a) Sample transmittal forms or tags that have adequate spaces for the dated, original signatures of all individuals who handle the sample (or cleaned sample containers if obtained for a contracted laboratory) from time of collection (or container receipt) to laboratory delivery.

b) Laboratory sample storage logs that identify date, time, and individuals who remove samples from storage.

c) Secure, limited access storage areas.

Sample Matrix:

This means that characteristic of an environmental laboratory sample, associated with its physical and chemical properties, which defines how such a sample is handled when subjected to the intended analytical process. The following samples matrices (major matrix groups), defined below should be used in QA plans whenever specifying data quality objectives:

1. **Reagent Water:** A sample of water which conforms to ASTM TYPE II, III, IV.

2. **Drinking Water:** Includes finished (treated) or raw source water designated as potable water. Such resources may be from surface or ground water.

3. **Surface Water:** Includes fresh or saline waters from streams, canals, rivers, lakes, ponds, bays and estuaries (natural or manmade).

4. **Groundwater:** Includes all waters found below ground in confined or unconfined aquifers.

5. **Wastewater:** Includes any influent or effluent associated with domestic or industrial waste treatment facilities.

6. **Chemical Waste:** Includes sludges and residuals from domestic or industrial wastewater processing, and liquid or solid chemicals no longer used for their intended purpose.

7. **Soil/Sediment:** Surface or subsurface soils and sediments of fresh or salt water origin.

8. **Biological Tissue:** Includes tissue of plant or animal origin. The most common of these are shellfish, finfish, and aquatic plants.

APPENDIX B

STANDARD OPERATING PROCEDURES (SOP)
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Conventionals	17	Deanna Hesson	Leslie Bucina	03-15-2011	26	K3501	Nitrogen, Ammonia (Automated Phenate) - EPA 350.1 / SM 4500-NH3 B
Conventionals	9	Deanna Hesson	David Bumgarner	06-15-2009	18	K3502	Acidity - Titrametric - SM2310-B
Conventionals	10	Deanna Hesson	David Bumgarner	05-15-2010	12	K1604	Volatile Solids (Total/Dissolved/Suspended) Gravemetric, ignition 550C - EPA Method 16.04/SM 2540E
Conventionals	3	Deanna Hesson	David Bumgarner	2009-11-15	18	K3500	Ferrous Iron Method - SM3500 Fe-B
Conventionals	1	Deanna Hesson	David Bumgarner	04-15-2010	16	K5468	Gross Calorific Value of Waste Materials (BTU) - ASTM D5468
Conventionals	10	Deanna Hesson	David Bumgarner	06-15-2010	15	K3051	Acidity - Titrimetric(H2O2) - SM2310-B (4a)/EPA 305.1
Conventionals	13	Deanna Hesson	Leslie Bucina	08-15-2010	23	K4151	Organic Carbon, Total (Oxidation) - EPA 415.1/SW846 9060A/SM5310C
Conventionals	11	Deanna Hesson	David Bumgarner	04-15-2010	19	K5050	Total Halides - SW 5050
Conventionals	9	Deanna Hesson	David Bumgarner	11-15-2009	10	K9095	Paint Filter Liquids Test - SW846 Method 9095
Conventionals	7	Deanna Hesson	David Bumgarner	06-15-2010	12	K3601	Dissolved Oxygen - Method 4500-O-C,G/EPA 360.1
Conventionals	12	Deanna Hesson	David Bumgarner	05-15-2010	14	K1603	Residue, Total (TS, Gravemetric, 103 - 105 Degrees C - EPA Method 16.03, SM2540B
Conventionals	11	Deanna Hesson	Leslie Bucina	02-15-2011	13	K0103	Most Probable Number of Fecal Coliforms - SM 9221 B,C,E
Conventionals	7	Deanna Hesson	David Bumgarner	01-15-2009	14	K1140	Particle Size
Conventionals	13	Deanna Hesson	Leslie Bucina	02-15-2011	17	K3541	Nitrite Nitrogen (Spectrophotometric) Method 4500-NO2B/EPA 354.1
Conventionals	11	Deanna Hesson	Leslie Bucina	02-15-2011	20	K9030	Sulfide (Acid Soluble/Acid Insoluble - Method SW846 9030B/9034
Conventionals	5	Deanna Hesson	Leslie Bucina	10-15-2010	20	K1664	n-Hexane Extractable Material - Method 1664A
Conventionals	17	Deanna Hesson	Leslie Bucina	02-15-2011	22	K3532	Nitrogen, Nitrate-Nitrite (Automated, Cadmium Reduction) - EPA 353.2
Conventionals	13	Deanna Hesson	Leslie Bucina	03-15-2011	18	K3402	Fluoride (Potentiometric, Ion Selective Electrode) - SM 4500-F C
Conventionals	9	Deanna Hesson	David Bumgarner	02-15-2010	20	K3401	Fluoride (Preliminary Distillation) - SM 4500-F B
Conventionals	9	Deanna Hesson	David Bumgarner	05-15-2010	10	K1605	Settleable Solids Method (Volumetric, IMHOFF Cone) - EPA Method 160.5 / SM 2540F
Conventionals	14	Deanna Hesson	Leslie Bucina	02-15-2011	17	K1010	Flash Point (Pensky-Martins Closed Cup Method) - SW1010A
Conventionals	12	Deanna Hesson	Leslie Bucina	05-15-2010	15	K1602	Residue, Non-Filterable (TSS, Gravemetric, 103C - EPA Method 160.2/SM2540D
Conventionals	16	Deanna Hesson	Leslie Bucina	10-15-2010	21	K4201	Phenolics, Total Recoverable - EPA 420.1
Conventionals	13	Deanna Hesson	David Bumgarner	06-15-2010	19	K3102	Alkalinity - Automated Methyl Orange
Conventionals	13	Deanna Hesson	Leslie Bucina	10-15-2010	17	K9075	Total Residual Chlorine - SM 4500-Cl, G
Conventionals	11	Deanna Hesson	Leslie Bucina	02-15-2011	10	K0003	Percent Solids(Percent Moisture) - ASTM D2216-90
Conventionals	6	Deanna Hesson	David Bumgarner	01-15-2010	12	K0104	Heterotropic Plate Count (Membrane Filter Method) - SM 9215D
Conventionals	15	Deanna Hesson	David Bumgarner	07-15-2010	20	K3754	Sulfate, Total (Turbidimetric) - EPA Method 375.4, SM 426 C (15th ed)

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Conventionals	11	Deanna Hesson	Leslie Bucina	02-15-2011	14	K1102	Color (Colorimetric-Platinum-Cobalt) - SM 2120 B
Conventionals	3	Deanna Hesson	David Bumgarner	11-15-2009	18	K3500	Ferrous Iron SM3500 FeB
Conventionals	00	Deanna Hesson	Leslie Bucina	11-15-2010	15	K0105	Escherichia Coli (E. Coli) m-Coliblue-24 - Hach Method 10029
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Digestions	10	Maren Beery	Leslie Bucina	12-15-2010	27	ME405	Mercury - SW-846 Method 7471A
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Digestions	11	Maren Beery	Leslie Bucina	12-15-2010	15	ME407	Microwave Digestion for Aqueous Matrices - SW 3015
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Extractions	1	Chad Barnes/Deanna Hesson	Leslie Bucina	10-15-2010	14	KNITRO-C-S	Nitrocellulose in Soil - USATHAMA
Extractions	16	Chad Barnes	Leslie Bucina	02-15-2011	16	EXB01	Continuous Liquid-Liquid Extraction Semivolatiles - Method 3520C
Extractions	17	Chad Barnes	David Bumgarner	04-15-2010	16	EXD01	Extraction of Diesel Range Organics
Extractions	14	Chad Barnes	Leslie Bucina	02-15-2010	10	EXB03	Waste Dilution for Semivolatiles - Method 3580A
Extractions	13	Chad Barnes	David Bumgarner	04-15-2010	15	EXP01	Extraction of Pesticides and PCBs - SW846 Method 3510C, 3500Cand CFR Method 608
Extractions	11	Chad Barnes	David Bumgarner	03-15-2010	12	EXTNT01	Liquid Extraction of Nitroaromatics and Nitramines - SW846 Method 8330B
Extractions	15	Chad Barnes	Leslie Bucina	02-15-2011	13	EXA01	Separatory Funnel Liquid-Liquid Extraction for Polynuclear Aromatic Hydrocarbons and Organophosphorus Pesticides - Method 3510C / 3520C
Extractions	8	Chad Barnes	Leslie Bucina	01-15-2011	20	ASE01	Accelerated Solvent Extractor - SW846 Method 3545
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Extractions	10	Chad Barnes	David Bumgarner	04-15-2010	9	EXP08	Extraction Procedure for PCB Wipes
Extractions	8	Chad Barnes	David Bumgarner	12-15-2009	9	K3987	ASTM Shake Test - ASTM-D3987-85
Extractions	7	Chad Barnes	David Bumgarner	03-15-2010	16	EXPRO	Extraction of Petroleum Range Organics - Florida PRO
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Extractions	12	Chad Barnes	Leslie Bucina	02-15-2011	14	EXB08	Separatory Funnel Liquid-Liquid Extractions for Semivolatiles (BNA) - Method 3510C
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Extractions	15	Chad Barnes	Leslie Bucina	10-15-2010	15	EXP02	Sonication Extraction of Pesticides and PCBs - SW846 Method 3500C and 3550B/C
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General	7	Sheri Pfalzgraf	Leslie Bucina	10-15-2010	14	SOP36	Emergency Response
General	2	Jane Thompson	David Bumgarner	03-15-2010	4	PAR01	Purchasing and Receipt of Consumables
General	3	Douglas Butcher	Leslie Bucina	02-15-2011	10	MISEDD01	Development and Maintenance of Electronic Datat Deliverables (EDD)
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General	00	Leslie Bucina	David Vandenberg	09-15-2010	5	GP-RCA	Root Cause Analysis
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OVAP	00	Maren Beery	Leslie Bucina	01-15-2011	40	OVAP ME700	OVAP PE ELAN 6100 ICP Mass Spectrometer - SW-846 Method 6020
OVAP	00	Mike Cochran	Leslie Bucina	02-15-2011	24	OVAP GCS02	OVAP Analysis of Middle and Heavy Distillates - Method 8015B
OVAP	00	Mike Albertson	Leslie Bucina	02-15-2011	29	OVAP GCV05	OVAP Light Distillates - Method SW846 8015B
OVAP	00	Chad Barnes	Leslie Bucina	02-05-2011	15	OVAP EXP01	OVAP Extractions for Pesticides and PCB's SW-846 Method 3510C and 3500C
OVAP	00	Chad Barnes	Leslie Bucina	02-15-2011	17	OVAP EXD01	OVAP Extraction of Middle and Heavy Distillates - Method 3550B and 3510
OVAP	00	Deanna Hesson	Leslie Bucina	03-15-2011	26	OVAP K3354	OVAP Total Cyanide (Spectrophotometric - EPA 335.2 (CLP-M)
OVAP	00	Mike Cochran	Leslie Bucina	03-15-2011	26	OVAP GCS10	OVAP Organic Analysis of PCB's - Method 8082
OVAP	00	Mike Albertson	Leslie Bucina	03-15-2011	47	OVAP MSV01	OVAP Analysis of Volatile Organic Compounds - Method 8260A and 8260B
OVAP	00	Mike Cochran	Leslie Bucina				OVAP Organic Analysis of Chlorinated Herbicides - Method 8151A
OVAP	00	Mike Cochran	Leslie Bucina	03-15-2011	28	OVAP GCS09	OVAP Organic Analysis of Pesticides - Method 8081A
Semivolatiles	11	Mike Cochran	Leslie Bucina	09-15-2010	25	GCS07	1,2 Dibromoethane (EDB) and 1,2 Dibromo-3-chloropropane (DBCP) Method SW-846 8011
Semivolatiles	13	Mike Cochran	David Bumgarner	01-15-2010	30	GCS09	Oranic Analysis of Pesticides - Method 8081A
Semivolatiles	7	Mike Cochran	David Bumgarner	02-15-2010	29	GCS05	TNRCC Method for Total Petroleum Hydrocarbons - Methods T1005/T1006
Semivolatiles	9	Mike Cochran	David Bumgarner	07-15-2009	28	GCS03	Petroleum Range Organics - SW 8015M
Semivolatiles	2	Mike Cochran	Leslie Bucina	02-15-2011	25	HPLC04	Formaldehyde - Method 8315A
Semivolatiles	11	Mike Cochran	David Bumgarner	02-15-2010	24	IC01	Determination of Inorganic Anions By Ion Chromatography - Method 9056/300.0
Semivolatiles	13	Mike Cochran	David Bumgarner	04-15-2010	26	GCS02	Analysis of Diesel Range Organics - Method 8015B
Semivolatiles	9	Mike Cochran	David Bumgarner	04-15-2010	30	GCS08	Organic Analysis of Pesticides and PCBs - Method 608
Semivolatiles	2	Mike Cochran	David Bumgarner	06-15-2010	24	HPLC06	Perchlorate - Method 6850
Semivolatiles	1	Mike Cochran	David Bumgarner	02-15-2010	22	HPLC05	Nitroguanidine by High Performance Liquid Chromatography - Method 8330-NG
Semivolatiles	15	Mike Cochran	David Bumgarner	06-15-2010	29	HPLC02	Nitroaromatics and Nitramines - SW 8330

Appendix B (continued)
SOP Table of Contents

SOP By Department Listing

Department	Rev.	Author	Approved By	Approval Date	# Pages	Name	Title
Semivolatiles	5	Mike Cochran	Leslie Bucina	09-15-2010	20	HPLC03	Metabolic Acids - SW 830MBA
Semivolatiles	17	Mike Cochran	David Bumgarner	01/15/2010	65	MSS01	Organic Analytes - Method 8270
Semivolatiles	9	Mike Cochran	David Bumgarner	02-15-2010	33	MSS03	Low Level PAHs - Method 8270C
Semivolatiles	6	Mike Cochran	Leslie Bucina	10-15-2010	22	GCS12	Alcohol - Method SW 8015B
Semivolatiles	12	Mike Cochran	David Bumgarner	03-15-2010	28	GCS10	Organic Analysis of PCBs - SW846 8082/8082A
Semivolatiles	13	Mike Cochran	Leslie Bucina	09-15-2010	24	GCS04	Organic Analysis of Chlorinated Herbicides - Method 8151A
Semivolatiles	2	Mike Cochran	Leslie Bucina	10-15-2010	21	HPLC07	Hexamethylphosphoramide and Daughter Products - Method XMPA-LCMS
Semivolatiles	00	Mike Cochran	Leslie Bucina	09-15-10	21	HPLC08	Thiodiglycol
Semivolatiles	00	Mike Cochran	Leslie Bucina	02-15-2011	31	GCS13	Determination of Extractable Petroleum Hydrocarbons (EPH) Fractions
Volatiles	13	Mike Albertson	Leslie Bucina	05-15-2010	16	PAT01	Purge and Trap for Volatile Organics - Methods SW-846 5030B, 5030C, 5035A
Volatiles	5	Mike Albertson	David Bumgarner	05-15-2010	5	VGW01	Cleaning Glassware in Organic Analyses
Volatiles	14	Mike Albertson	Leslie Bucina	09-15-2010	57	MSV01	Volatile Organic Analytes Methods 8260A and 8260B
Volatiles	14	Mike Albertson	Leslie Bucina	08-15-2010	25	RSK01	Dissolved Gases in Ground Water - EPA RSKSOP-175 (Modified)
Volatiles	12	Mike Albertson	David Bumgarner	03-15-2010	32	GCV05	Gasoline Range Organics - SW846 8015B/C/D
Volatiles	8	Mike Albertson	Leslie Bucina	09-15-2010	36	MSV10	Volatile Organic Analytes by GC/MS - EPA 624
Volatiles	00	Mike Albertson	Leslie Bucina	11-30-2010	30	GCV08	Volatile Petroleum Hydrocarbon

APPENDIX C

LIST OF ACCREDITED NELAP PARAMETERS

FLORIDA DEPARTMENT OF HEALTH

State of Florida
Department of Health, Bureau of Laboratories
This is to certify that

E87551

MICROBAC LABORATORIES, INC., OHIO VALLEY DIVISION
158 STARLITE DRIVE
MARIETTA, OH 45750

has complied with Florida Administrative Code 64E-1,
for the examination of Environmental samples in the following categories

NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - GENERAL CHEMISTRY, NON-POTABLE WATER - METALS, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, NON-POTABLE WATER - VOLATILE ORGANICS, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - GENERAL CHEMISTRY, SOLID AND CHEMICAL MATERIALS - METALS, SOLID AND CHEMICAL MATERIALS - VOLATILE ORGANICS

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

EFFECTIVE February 14, 2011 THROUGH June 30, 2011

Max Salfinger, M.D.
Chief, Bureau of Laboratories
Florida Department of Health
DH Form 1697, 7/04
NON-TRANSFERABLE E87551-19-02/14/2011
Supersedes all previously issued certificates

FLORIDA DEPARTMENT OF HEALTH

Rick Scott
Governor

Laboratory Scope of Accreditation

Attachment to Certificate #: E87551-19, expiration date June 30, 2011. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,1-Trichloroethane	EPA 624	Volatile Organics	NELAP	5/16/2003
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2,2-Tetrachloroethane	EPA 624	Volatile Organics	NELAP	5/16/2003
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2-Trichloro-1,2,2-trifluoroethane	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
1,1,2-Trichloroethane	EPA 624	Volatile Organics	NELAP	5/16/2003
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethane	EPA 624	Volatile Organics	NELAP	5/16/2003
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethylene	EPA 624	Volatile Organics	NELAP	5/16/2003
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	3/30/2006
1,2,4-Trichlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2003
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	Volatile Organics	NELAP	5/7/2008
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8011	Volatile Organics	NELAP	5/7/2008
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	5/16/2003
1,2-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2003
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2-Dichloroethane	EPA 624	Volatile Organics	NELAP	5/16/2003
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichloropropane	EPA 624	Volatile Organics	NELAP	5/16/2003
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	3/30/2006
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	3/30/2006
1,3-Butadiene	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 2/14/2011** **Expiration Date: 6/30/2011**

FLORIDA DEPARTMENT OF HEALTH

Rick Scott
Governor

Laboratory Scope of Accreditation

Attachment to Certificate #: E87551-19, expiration date June 30, 2011. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87551 EPA Lab Code: OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,3-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	5/16/2003
1,3-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2003
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	3/30/2006
1,4-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	5/16/2003
1,4-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2003
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Dioxane (1,4-Diethyleneoxide)	OVL MSS01/GC-MS	Extractable Organics	NELAP	7/30/2010
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	3/30/2006
1,4-Phenylenediamine	EPA 8270	Extractable Organics	NELAP	3/30/2006
1-Chlorohexane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1-Methylnaphthalene	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	3/30/2006
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	3/30/2006
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trichlorophenol	EPA 625	Extractable Organics	NELAP	5/16/2003
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	3/30/2006
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-Dichlorophenol	EPA 625	Extractable Organics	NELAP	5/16/2003
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dimethylphenol	EPA 625	Extractable Organics	NELAP	5/16/2003
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrophenol	EPA 625	Extractable Organics	NELAP	5/16/2003
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	Extractable Organics	NELAP	5/16/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	3/30/2006
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	3/30/2006

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. Issue Date: 2/14/2011 Expiration Date: 6/30/2011

Rick Scott
Governor

FLORIDA DEPARTMENT OF HEALTH

Laboratory Scope of Accreditation

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State Laboratory ID: E87551 **EPA Lab Code: OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	Extractable Organics	NELAP	5/16/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	3/30/2006
2-Acetylaminofluorene	EPA 8270	Extractable Organics	NELAP	3/30/2006
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	3/30/2006
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chloroethyl vinyl ether	EPA 624	Volatile Organics	NELAP	5/16/2003
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chloronaphthalene	EPA 625	Extractable Organics	NELAP	5/16/2003
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorophenol	EPA 625	Extractable Organics	NELAP	5/16/2003
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Hexanone	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Methyl-4,6-dinitrophenol	EPA 625	Extractable Organics	NELAP	5/16/2003
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Naphthylamine	EPA 8270	Extractable Organics	NELAP	3/30/2006
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrophenol	EPA 625	Extractable Organics	NELAP	5/16/2003
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/30/2006
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	3/30/2006
3,3'-Dichlorobenzidine	EPA 625	Extractable Organics	NELAP	5/16/2003
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	3/30/2006
3/4-Methylphenols (m/p-Cresols)	EPA 8270	Extractable Organics	NELAP	7/30/2010
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	3/30/2006
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/30/2006
4,4'-DDD	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDE	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 2/14/2011** **Expiration Date: 6/30/2011**

FLORIDA DEPARTMENT OF HEALTH

NELAP RECOGNIZED nelap

Rick Scott
Governor

Laboratory Scope of Accreditation

Attachment to Certificate #: E87551-19, expiration date June 30, 2011. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
4,4'-DDT	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	3/30/2006
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	3/30/2006
4-Bromophenyl phenyl ether	EPA 625	Extractable Organics	NELAP	5/16/2003
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloro-3-methylphenol	EPA 625	Extractable Organics	NELAP	5/16/2003
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	3/30/2006
4-Chlorophenyl phenylether	EPA 625	Extractable Organics	NELAP	5/16/2003
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Dimethyl aminoazobenzene	EPA 8270	Extractable Organics	NELAP	3/30/2006
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrophenol	EPA 625	Extractable Organics	NELAP	5/16/2003
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/30/2006
5-Nitro-o-toluidine	EPA 8270	Extractable Organics	NELAP	3/30/2006
7,12-Dimethylbenz(a) anthracene	EPA 8270	Extractable Organics	NELAP	3/30/2006
a-a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	3/30/2006
Acenaphthene	EPA 625	Extractable Organics	NELAP	5/16/2003
Acenaphthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 625	Extractable Organics	NELAP	5/16/2003
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acetic acid	OVL HPLC03/HPLC-UV	Extractable Organics	NELAP	5/7/2008
Acetone	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetophenone	EPA 8270	Extractable Organics	NELAP	3/30/2006
Acetylene	OVL RSK01/GC-FID	Volatile Organics	NELAP	5/7/2008
Acidity, as CaCO3	EPA 305.1	General Chemistry	NELAP	5/16/2003
Acidity, as CaCO3	SM 2310 B (4a)	General Chemistry	NELAP	4/17/2007
Acrolein (Propenal)	EPA 624	Volatile Organics	NELAP	5/16/2003
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acrylonitrile	EPA 624	Volatile Organics	NELAP	5/16/2003
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 2/14/2011** **Expiration Date: 6/30/2011**

Laboratory Scope of Accreditation

Attachment to Certificate #: E87551-19, expiration date June 30, 2011. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Aldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Alkalinity as CaCO3	EPA 310.2	General Chemistry	NELAP	5/16/2003
Alkalinity as CaCO3	SM 2320 B	General Chemistry	NELAP	5/16/2003
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	3/30/2006
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Aluminum	EPA 200.7	Metals	NELAP	5/16/2003
Aluminum	EPA 6010	Metals	NELAP	7/1/2003
Amenable cyanide	EPA 335.1	General Chemistry	NELAP	5/16/2003
Amenable cyanide	EPA 9010/9014	General Chemistry	NELAP	5/7/2008
Amenable cyanide	SM 4500-CN G	General Chemistry	NELAP	4/17/2007
Ammonia as N	EPA 350.1	General Chemistry	NELAP	5/16/2003
Aniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 625	Extractable Organics	NELAP	5/16/2003
Anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Antimony	EPA 200.7	Metals	NELAP	5/16/2003
Antimony	EPA 200.8	Metals	NELAP	5/16/2003
Antimony	EPA 6010	Metals	NELAP	7/1/2003
Antimony	EPA 6020	Metals	NELAP	7/1/2003
Aramite	EPA 8270	Extractable Organics	NELAP	3/30/2006
Aroclor-1016 (PCB-1016)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1221 (PCB-1221)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1232 (PCB-1232)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1242 (PCB-1242)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1248 (PCB-1248)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1254 (PCB-1254)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1260 (PCB-1260)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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FLORIDA DEPARTMENT OF HEALTH

Rick Scott
Governor

Laboratory Scope of Accreditation

Attachment to Certificate #: E87551-19, expiration date June 30, 2011. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: **E87551** **EPA Lab Code:** **OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Arsenic	EPA 200.7	Metals	NELAP	5/16/2003
Arsenic	EPA 200.8	Metals	NELAP	5/16/2003
Arsenic	EPA 6010	Metals	NELAP	7/1/2003
Arsenic	EPA 6020	Metals	NELAP	7/1/2003
Atrazine	OVL MSS01/GC-MS	Extractable Organics	NELAP	7/30/2010
Barium	EPA 200.7	Metals	NELAP	5/16/2003
Barium	EPA 200.8	Metals	NELAP	3/30/2006
Barium	EPA 6010	Metals	NELAP	7/1/2003
Barium	EPA 6020	Metals	NELAP	3/30/2006
Benzaldehyde	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
Benzene	EPA 624	Volatile Organics	NELAP	5/16/2003
Benzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Benzidine	EPA 625	Extractable Organics	NELAP	5/16/2003
Benzidine	EPA 8270	Extractable Organics	NELAP	3/30/2006
Benzo(a)anthracene	EPA 625	Extractable Organics	NELAP	5/16/2003
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)pyrene	EPA 625	Extractable Organics	NELAP	5/16/2003
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 625	Extractable Organics	NELAP	5/16/2003
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 625	Extractable Organics	NELAP	5/16/2003
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 625	Extractable Organics	NELAP	5/16/2003
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzoic acid	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Beryllium	EPA 200.7	Metals	NELAP	5/16/2003
Beryllium	EPA 6010	Metals	NELAP	7/1/2003
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Biochemical oxygen demand	EPA 405.1	General Chemistry	NELAP	5/16/2003
Biochemical oxygen demand	SM 5210 B	General Chemistry	NELAP	5/16/2003
Biphenyl	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
bis(2-Chloroethoxy)methane	EPA 625	Extractable Organics	NELAP	5/16/2003
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroethyl) ether	EPA 625	Extractable Organics	NELAP	5/16/2003

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State Laboratory ID: E87551 **EPA Lab Code: OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 625	Extractable Organics	NELAP	5/16/2003
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	Extractable Organics	NELAP	5/16/2003
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Boron	EPA 200.7	Metals	NELAP	5/16/2003
Boron	EPA 6010	Metals	NELAP	7/1/2003
Bromide	EPA 300.0	General Chemistry	NELAP	5/16/2003
Bromide	EPA 9056	General Chemistry	NELAP	5/7/2008
Bromobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromodichloromethane	EPA 624	Volatile Organics	NELAP	5/16/2003
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromoform	EPA 624	Volatile Organics	NELAP	5/16/2003
Bromoform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Butyl benzyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2003
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Butyric acid (Butanoic acid)	OVL HPLC03/HPLC-UV	Extractable Organics	NELAP	5/7/2008
Cadmium	EPA 200.7	Metals	NELAP	5/16/2003
Cadmium	EPA 200.8	Metals	NELAP	3/30/2006
Cadmium	EPA 6010	Metals	NELAP	7/1/2003
Cadmium	EPA 6020	Metals	NELAP	3/30/2006
Calcium	EPA 200.7	Metals	NELAP	5/16/2003
Calcium	EPA 6010	Metals	NELAP	7/1/2003
Caprolactam	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
Carbazole	EPA 8270	Extractable Organics	NELAP	3/30/2006
Carbon dioxide	RSK-175	Volatile Organics	NELAP	3/30/2006
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	7/1/2003
Carbon tetrachloride	EPA 624	Volatile Organics	NELAP	5/16/2003
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Carbonaceous BOD (CBOD)	SM 5210 B	General Chemistry	NELAP	5/16/2003
Chemical oxygen demand	EPA 410.4	General Chemistry	NELAP	5/16/2003
Chemical oxygen demand	HACH 8000	General Chemistry	NELAP	5/16/2003
Chlordane (tech.)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Chloride	EPA 300.0	General Chemistry	NELAP	5/16/2003
Chloride	EPA 325.2	General Chemistry	NELAP	5/16/2003
Chloride	EPA 9056	General Chemistry	NELAP	5/7/2008
Chloride	SM 4500 Cl- E	General Chemistry	NELAP	7/30/2010
Chlorobenzene	EPA 624	Volatile Organics	NELAP	5/16/2003
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chlorobenzilate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Chloroethane	EPA 624	Volatile Organics	NELAP	5/16/2003
Chloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroform	EPA 624	Volatile Organics	NELAP	5/16/2003
Chloroform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroprene	EPA 8260	Volatile Organics	NELAP	3/30/2006
Chromium	EPA 200.7	Metals	NELAP	5/16/2003
Chromium	EPA 200.8	Metals	NELAP	3/30/2006
Chromium	EPA 6010	Metals	NELAP	7/1/2003
Chromium	EPA 6020	Metals	NELAP	3/30/2006
Chromium VI	EPA 7196	General Chemistry	NELAP	3/30/2006
Chromium VI	SM 3500-Cr B (20th/21st Ed.)/UV-VIS	General Chemistry	NELAP	5/7/2008
Chromium VI	SM 3500-Cr D (18th/19th Ed.)/UV-VIS	Metals	NELAP	5/16/2003
Chrysene	EPA 625	Extractable Organics	NELAP	5/16/2003
Chrysene	EPA 8270	Extractable Organics	NELAP	3/30/2006
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
cis-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	5/16/2003
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Cobalt	EPA 200.7	Metals	NELAP	5/16/2003
Cobalt	EPA 200.8	Metals	NELAP	3/30/2006
Cobalt	EPA 6010	Metals	NELAP	7/1/2003
Cobalt	EPA 6020	Metals	NELAP	3/30/2006
Color	EPA 110.2	General Chemistry	NELAP	5/16/2003
Color	SM 2120 B	General Chemistry	NELAP	4/17/2007
Conductivity	EPA 120.1	General Chemistry	NELAP	5/16/2003
Copper	EPA 200.7	Metals	NELAP	5/16/2003
Copper	EPA 200.8	Metals	NELAP	3/30/2006
Copper	EPA 6010	Metals	NELAP	7/1/2003
Copper	EPA 6020	Metals	NELAP	3/30/2006

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State Laboratory ID: **E87551** **EPA Lab Code:** **OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Cyanide	EPA 335.2	General Chemistry	NELAP	5/16/2003
Cyanide	SM 4500-CN E	General Chemistry	NELAP	4/17/2007
Cyclohexane	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Cyclohexanone	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
delta-BHC	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Dibenz(a,h)anthracene	EPA 625	Extractable Organics	NELAP	5/16/2003
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibromochloromethane	EPA 624	Volatile Organics	NELAP	5/16/2003
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dibromofluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dibromomethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dieldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	3/30/2006
Diesel range organics (DRO)	TX1005	Extractable Organics	NELAP	3/30/2006
Diethyl ether	EPA 8260	Volatile Organics	NELAP	3/30/2006
Diethyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2003
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-isopropylether (DIPE)	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Dimethoate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Dimethyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2003
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dimethyl sulfide	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Dimethyldisulfide	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Di-n-butyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2003
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-octyl phthalate	EPA 625	Extractable Organics	NELAP	5/16/2003
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270	Extractable Organics	NELAP	3/30/2006
Diphenylamine	EPA 8270	Extractable Organics	NELAP	3/30/2006
Endosulfan I	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan II	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan sulfate	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin aldehyde	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Ethane	RSK-175	Volatile Organics	NELAP	3/30/2006
Ethanol	EPA 8015	Volatile Organics	NELAP	5/7/2008
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	3/30/2006
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	3/30/2006
Ethyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	3/30/2006
Ethylbenzene	EPA 624	Volatile Organics	NELAP	5/16/2003
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Ethylene	RSK-175	Volatile Organics	NELAP	3/30/2006
Ethyl-t-butylether (ETBE)	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Famphur	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Ferrous iron	SM 3500-Fe B (20th/21st Ed.)/UV-VIS	Metals	NELAP	7/30/2010
Fluoranthene	EPA 625	Extractable Organics	NELAP	5/16/2003
Fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 625	Extractable Organics	NELAP	5/16/2003
Fluorene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluoride	EPA 300.0	General Chemistry	NELAP	5/16/2003
Fluoride	EPA 340.2	General Chemistry	NELAP	5/16/2003
Fluoride	EPA 9056	General Chemistry	NELAP	5/7/2008
Fluoride	SM 4500 F-C	General Chemistry	NELAP	5/16/2003
Formaldehyde	EPA 8315	Extractable Organics	NELAP	5/7/2008
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Gasoline range organics (GRO)	EPA 8015	Volatile Organics	NELAP	3/30/2006
Hardness	EPA 130.2	General Chemistry	NELAP	5/16/2003
Hardness	SM 2340 B	General Chemistry	NELAP	5/16/2003
Hardness	SM 2340 C	General Chemistry	NELAP	4/17/2007
Hardness (calc.)	EPA 200.7	Metals	NELAP	7/30/2010
Heptachlor	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Heptachlor epoxide	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Hexachlorobenzene	EPA 625	Extractable Organics	NELAP	5/16/2003
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 625	Extractable Organics	NELAP	5/16/2003
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorocyclopentadiene	EPA 625	Extractable Organics	NELAP	5/16/2003
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloroethane	EPA 625	Extractable Organics	NELAP	5/16/2003
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorophene	EPA 8270	Extractable Organics	NELAP	3/30/2006
Hexachloropropene	EPA 8270	Extractable Organics	NELAP	3/30/2006
Hexamethylphosphoramide (HMPA)	OVL HPLC07/HPLC-MS-MS	Extractable Organics	NELAP	7/30/2010
Hexamethylphosphoramide (HMPA)	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
Ignitability	EPA 1010	General Chemistry	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 625	Extractable Organics	NELAP	5/16/2003
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	3/30/2006
Iron	EPA 200.7	Metals	NELAP	5/16/2003
Iron	EPA 6010	Metals	NELAP	7/1/2003
Isobutane	OVL RSK01/GC-FID	Volatile Organics	NELAP	5/7/2008
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	3/30/2006
Isodrin	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Isophorone	EPA 625	Extractable Organics	NELAP	5/16/2003
Isophorone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Isoprene	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Isopropyl alcohol (2-Propanol)	EPA 8015	Volatile Organics	NELAP	5/7/2008

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FLORIDA DEPARTMENT OF HEALTH

Rick Scott
Governor

Laboratory Scope of Accreditation

Attachment to Certificate #: E87551-19, expiration date June 30, 2011. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87551 **EPA Lab Code: OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Isosafrole	EPA 8270	Extractable Organics	NELAP	3/30/2006
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Kjeldahl nitrogen - total	EPA 351.2	General Chemistry	NELAP	5/16/2003
Lactic acid	OVL HPLC03/HPLC-UV	Extractable Organics	NELAP	5/7/2008
Lead	EPA 200.7	Metals	NELAP	5/16/2003
Lead	EPA 200.8	Metals	NELAP	5/16/2003
Lead	EPA 6010	Metals	NELAP	7/1/2003
Lead	EPA 6020	Metals	NELAP	7/1/2003
Lithium	EPA 200.7	Metals	NELAP	3/30/2006
Lithium	EPA 6010	Metals	NELAP	7/1/2003
m/p-Xylenes	EPA 8260	Volatile Organics	NELAP	7/30/2010
Magnesium	EPA 200.7	Metals	NELAP	5/16/2003
Magnesium	EPA 6010	Metals	NELAP	7/1/2003
Manganese	EPA 200.7	Metals	NELAP	5/16/2003
Manganese	EPA 200.8	Metals	NELAP	3/30/2006
Manganese	EPA 6010	Metals	NELAP	7/1/2003
Manganese	EPA 6020	Metals	NELAP	3/30/2006
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Mercury	EPA 245.1	Metals	NELAP	5/16/2003
Mercury	EPA 7470	Metals	NELAP	5/16/2003
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	3/30/2006
Methane	RSK-175	Volatile Organics	NELAP	3/30/2006
Methanol	EPA 8015	Volatile Organics	NELAP	5/7/2008
Methapyrilene	EPA 8270	Extractable Organics	NELAP	3/30/2006
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Methyl acetate	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Methyl bromide (Bromomethane)	EPA 624	Volatile Organics	NELAP	5/16/2003
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl chloride (Chloromethane)	EPA 624	Volatile Organics	NELAP	5/16/2003
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	3/30/2006
Methyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	3/30/2006
Methyl parathion (Parathion, methyl)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	3/30/2006

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Methyl tert-butyl ether (MTBE)	OVL MSV10/GC-MS	Volatile Organics	NELAP	7/30/2010
Methylcyclohexane	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Methylene chloride	EPA 624	Volatile Organics	NELAP	5/16/2003
Methylene chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Molybdenum	EPA 200.7	Metals	NELAP	5/16/2003
Molybdenum	EPA 6010	Metals	NELAP	7/1/2003
Naphthalene	EPA 625	Extractable Organics	NELAP	5/16/2003
Naphthalene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Naphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Butane	OVL RSK01/GC-FID	Volatile Organics	NELAP	5/7/2008
n-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	3/30/2006
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Nickel	EPA 200.7	Metals	NELAP	5/16/2003
Nickel	EPA 200.8	Metals	NELAP	3/30/2006
Nickel	EPA 6010	Metals	NELAP	7/1/2003
Nickel	EPA 6020	Metals	NELAP	3/30/2006
Nitrate	EPA 9056	General Chemistry	NELAP	5/7/2008
Nitrate	SM 4500-NO3 F	General Chemistry	NELAP	7/30/2010
Nitrate as N	EPA 300.0	General Chemistry	NELAP	5/16/2003
Nitrate as N	EPA 353.2	General Chemistry	NELAP	5/16/2003
Nitrate-nitrite	EPA 353.2	General Chemistry	NELAP	5/16/2003
Nitrite	EPA 9056	General Chemistry	NELAP	5/7/2008
Nitrite	SM 4500-NO2 B	General Chemistry	NELAP	4/17/2007
Nitrite as N	EPA 300.0	General Chemistry	NELAP	5/16/2003
Nitrite as N	EPA 354.1	General Chemistry	NELAP	5/16/2003
Nitrobenzene	EPA 625	Extractable Organics	NELAP	5/16/2003
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	3/30/2006
Nitrocellulose	OVL KNITRO-C-W/UV-VIS	General Chemistry	NELAP	5/7/2008
Nitroglycerin	EPA 8330	Extractable Organics	NELAP	6/13/2007
Nitroglycerin	OVL HPLC02/HPLC-UV	Extractable Organics	NELAP	5/7/2008
Nitroguanidine	OVL HPLC05/HPLC-UV	Extractable Organics	NELAP	5/7/2008
Nitroquinoline-1-oxide	EPA 8270	Extractable Organics	NELAP	3/30/2006
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	3/30/2006
n-Nitrosodimethylamine	EPA 625	Extractable Organics	NELAP	5/16/2003
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003

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E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: **Non-Potable Water**

Analyte	Method/Tech	Category	Certification Type	Effective Date
n-Nitroso-di-n-butylamine	EPA 8270	Extractable Organics	NELAP	3/30/2006
n-Nitrosodi-n-propylamine	EPA 625	Extractable Organics	NELAP	5/16/2003
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodiphenylamine	EPA 625	Extractable Organics	NELAP	5/16/2003
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosomethylethylamine	EPA 8270	Extractable Organics	NELAP	7/30/2010
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	3/30/2006
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	3/30/2006
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	3/30/2006
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
o,o,o-Triethyl phosphorothioate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	3/30/2006
Oil & Grease	EPA 1664A	General Chemistry	NELAP	5/16/2003
Organic nitrogen	TKN minus AMMONIA	General Chemistry	NELAP	5/16/2003
Orthophosphate as P	EPA 365.2	General Chemistry	NELAP	5/16/2003
Orthophosphate as P	SM 4500-P E	General Chemistry	NELAP	4/17/2007
o-Toluidine	EPA 8270	Extractable Organics	NELAP	3/30/2006
o-Xylene	EPA 8260	Volatile Organics	NELAP	3/30/2006
Pentachlorobenzene	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
Pentachloroethane	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
Pentachloronitrobenzene (Quintozene)	EPA 8270	Extractable Organics	NELAP	3/30/2006
Pentachlorophenol	EPA 625	Extractable Organics	NELAP	5/16/2003
Pentachlorophenol	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	6/13/2007
Pentamethylphosphoramide (PMPA)	OVL HPLC07/HPLC-MS-MS	Extractable Organics	NELAP	7/30/2010
Perchlorate	EPA 6850	General Chemistry	NELAP	7/30/2010
pH	EPA 150.1	General Chemistry	NELAP	5/16/2003
pH	SM 4500-H+-B	General Chemistry	NELAP	4/17/2007
Phenacetin	EPA 8270	Extractable Organics	NELAP	3/30/2006
Phenanthrene	EPA 625	Extractable Organics	NELAP	5/16/2003
Phenanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenol	EPA 625	Extractable Organics	NELAP	5/16/2003
Phenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phorate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006

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FLORIDA DEPARTMENT OF HEALTH

Rick Scott
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Laboratory Scope of Accreditation

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Phosphorus, total	EPA 200.7	Metals	NELAP	7/30/2010
Phosphorus, total	EPA 365.4	General Chemistry	NELAP	5/16/2003
Phosphorus, total	EPA 6010	Metals	NELAP	7/30/2010
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Potassium	EPA 200.7	Metals	NELAP	5/16/2003
Potassium	EPA 6010	Metals	NELAP	7/1/2003
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	3/30/2006
Propane	OVL RSK01/GC-FID	Volatile Organics	NELAP	5/7/2008
Propionic acid (Propanoic acid)	OVL HPLC03/HPLC-UV	Extractable Organics	NELAP	5/7/2008
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	3/30/2006
Propylene	OVL RSK01/GC-FID	Volatile Organics	NELAP	5/7/2008
Propyne	OVL RSK01/GC-FID	Volatile Organics	NELAP	5/7/2008
Pyrene	EPA 625	Extractable Organics	NELAP	5/16/2003
Pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pyridine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pyruvic acid	OVL HPLC03/HPLC-UV	Extractable Organics	NELAP	5/7/2008
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	3/30/2006
Residue-filterable (TDS)	EPA 160.1	General Chemistry	NELAP	5/16/2003
Residue-filterable (TDS)	SM 2540 C	General Chemistry	NELAP	4/17/2007
Residue-nonfilterable (TSS)	EPA 160.2	General Chemistry	NELAP	5/16/2003
Residue-nonfilterable (TSS)	SM 2540 D	General Chemistry	NELAP	4/17/2007
Residue-settleable	EPA 160.5	General Chemistry	NELAP	5/16/2003
Residue-settleable	SM 2540 F	General Chemistry	NELAP	4/17/2007
Residue-total	EPA 160.3	General Chemistry	NELAP	5/16/2003
Residue-total	SM 2540 B	General Chemistry	NELAP	4/17/2007
Residue-volatile	EPA 160.4	General Chemistry	NELAP	5/16/2003
Safrole	EPA 8270	Extractable Organics	NELAP	3/30/2006
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Selenium	EPA 200.7	Metals	NELAP	5/16/2003
Selenium	EPA 200.8	Metals	NELAP	5/16/2003
Selenium	EPA 6010	Metals	NELAP	7/1/2003
Selenium	EPA 6020	Metals	NELAP	5/16/2003
Silica as SiO2	EPA 6010	Metals	NELAP	7/1/2003
Silica-dissolved	EPA 200.7	General Chemistry	NELAP	5/16/2003
Silicon	EPA 200.7	Metals	NELAP	5/16/2003
Silicon	EPA 6010	Metals	NELAP	7/1/2003

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FLORIDA DEPARTMENT OF HEALTH

NELAP RECOGNIZED nelap

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Laboratory Scope of Accreditation

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State Laboratory ID: E87551 **EPA Lab Code: OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Silver	EPA 200.7	Metals	NELAP	5/16/2003
Silver	EPA 200.8	Metals	NELAP	3/30/2006
Silver	EPA 6010	Metals	NELAP	7/1/2003
Silver	EPA 6020	Metals	NELAP	3/30/2006
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Sodium	EPA 200.7	Metals	NELAP	5/16/2003
Sodium	EPA 6010	Metals	NELAP	7/1/2003
Strontium	EPA 200.7	Metals	NELAP	3/30/2006
Strontium	EPA 6010	Metals	NELAP	7/1/2003
Styrene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Sulfate	EPA 300.0	General Chemistry	NELAP	5/16/2003
Sulfate	EPA 375.4	General Chemistry	NELAP	5/16/2003
Sulfate	EPA 9056	General Chemistry	NELAP	5/7/2008
Sulfide	EPA 376.1	General Chemistry	NELAP	5/16/2003
Sulfide	SM 4500-S F	General Chemistry	NELAP	4/17/2007
Sulfotepp	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Surfactants - MBAS	SM 5540 C	General Chemistry	NELAP	4/17/2007
T-amylmethylether (TAME)	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
tert-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	7/1/2003
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tetrachloroethylene (Perchloroethylene)	EPA 624	Volatile Organics	NELAP	5/16/2003
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Tetrachlorvinphos (Stirophos, Gardona)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Tetraethyl pyrophosphate (TEPP)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Tetrahydrofuran (THF)	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Tetramethylphosphoramide (TMPA)	OVL HPLC07/HPLC-MS-MS	Extractable Organics	NELAP	7/30/2010
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	3/30/2006
Thallium	EPA 200.7	Metals	NELAP	5/16/2003
Thallium	EPA 200.8	Metals	NELAP	5/16/2003
Thallium	EPA 6010	Metals	NELAP	7/1/2003
Thallium	EPA 6020	Metals	NELAP	7/1/2003
Thionazin (Zinophos)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Tin	EPA 200.7	Metals	NELAP	5/16/2003
Tin	EPA 6010	Metals	NELAP	7/1/2003
Titanium	EPA 200.7	Metals	NELAP	5/16/2003
Titanium	EPA 6010	Metals	NELAP	3/30/2006

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Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Toluene	EPA 624	Volatile Organics	NELAP	5/16/2003
Toluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Total cyanide	EPA 9010/9014	General Chemistry	NELAP	5/7/2008
Total organic carbon	EPA 415.1	General Chemistry	NELAP	5/16/2003
Total organic carbon	EPA 9060	General Chemistry	NELAP	5/7/2008
Total organic carbon	SM 5310 C	General Chemistry	NELAP	4/17/2007
Total Petroleum Hydrocarbons (TPH)	FL-PRO	General Chemistry	NELAP	7/30/2010
Total Petroleum Hydrocarbons (TPH)	TX1006	Extractable Organics	NELAP	5/7/2008
Total phenolics	EPA 420.1	General Chemistry	NELAP	5/16/2003
Toxaphene (Chlorinated camphene)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
trans-1,2-Dichloroethylene	EPA 624	Volatile Organics	NELAP	5/16/2003
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,3-Dichloropropylene	EPA 624	Volatile Organics	NELAP	5/16/2003
trans-1,3-Dichloropropylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	3/30/2006
Trichloroethene (Trichloroethylene)	EPA 624	Volatile Organics	NELAP	5/16/2003
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichlorofluoromethane	EPA 624	Volatile Organics	NELAP	5/16/2003
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trimethylphosphoramide (TriMPA)	OVL HPLC07/HPLC-MS-MS	Extractable Organics	NELAP	7/30/2010
Turbidity	EPA 180.1	General Chemistry	NELAP	5/16/2003
Uranium	EPA 200.8	Metals	NELAP	7/30/2010
Uranium	EPA 6020	Metals	NELAP	7/30/2010
Vanadium	EPA 200.7	Metals	NELAP	5/16/2003
Vanadium	EPA 200.8	Metals	NELAP	3/30/2006
Vanadium	EPA 6010	Metals	NELAP	7/1/2003
Vanadium	EPA 6020	Metals	NELAP	3/30/2006
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Vinyl chloride	EPA 624	Volatile Organics	NELAP	5/16/2003
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Weak acid dissociable cyanide	SM 4500 CN-I	General Chemistry	NELAP	5/7/2008
Xylene (total)	EPA 624	Volatile Organics	NELAP	5/16/2003
Xylene (total)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Zinc	EPA 200.7	Metals	NELAP	5/16/2003
Zinc	EPA 200.8	Metals	NELAP	3/30/2006

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E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Zinc	EPA 6010	Metals	NELAP	7/1/2003
Zinc	EPA 6020	Metals	NELAP	3/30/2006
Zirconium	OVL ME600/ICP-AES	Metals	NELAP	7/30/2010

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,1,2-Trichloro-1,2,2-trifluoroethane	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2003
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2003
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2003
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	5/16/2003
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	5/16/2003
1,3-Butadiene	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2003
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	5/16/2003
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2003
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	5/16/2003
1,4-Dioxane (1,4-Diethyleneoxide)	OVL MSS01/GC-MS	Extractable Organics	NELAP	7/30/2010
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	5/16/2003
1,4-Phenylenediamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
1-Chlorohexane	EPA 8260	Volatile Organics	NELAP	5/16/2003
1-Methylnaphthalene	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008

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FLORIDA DEPARTMENT OF HEALTH

NELAP RECOGNIZED nelap

Rick Scott
Governor

Laboratory Scope of Accreditation

Attachment to Certificate #: E87551-19, expiration date June 30, 2011. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87551 **EPA Lab Code: OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	5/16/2003
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	5/16/2003
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	5/16/2003
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	5/16/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	5/16/2003
2-Acetylaminofluorene	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	5/16/2003
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	5/16/2003
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	5/16/2003
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	5/16/2003
2-Hexanone	EPA 8260	Volatile Organics	NELAP	5/16/2003
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Naphthylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
2-Nitropropane	EPA 8260	Volatile Organics	NELAP	5/16/2003
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	5/16/2003
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	5/16/2003
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	5/16/2003
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	5/16/2003

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FLORIDA DEPARTMENT OF HEALTH

NELAP RECOGNIZED nelap

Rick Scott
Governor

Laboratory Scope of Accreditation

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
3/4-Methylphenols (m/p-Cresols)	EPA 8270	Extractable Organics	NELAP	7/30/2010
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	5/16/2003
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	5/16/2003
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	5/16/2003
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	5/16/2003
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	5/16/2003
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	5/16/2003
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	5/16/2003
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	5/16/2003
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	5/16/2003
4-Dimethyl aminoazobenzene	EPA 8270	Extractable Organics	NELAP	3/30/2006
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	5/16/2003
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	5/16/2003
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	5/16/2003
5-Nitro-o-toluidine	EPA 8270	Extractable Organics	NELAP	5/16/2003
7,12-Dimethylbenz(a) anthracene	EPA 8270	Extractable Organics	NELAP	5/16/2003
a-a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
Acenaphthene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Acetone	EPA 8260	Volatile Organics	NELAP	5/16/2003
Acetonitrile	EPA 8260	Volatile Organics	NELAP	5/16/2003
Acetophenone	EPA 8270	Extractable Organics	NELAP	5/16/2003
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	5/16/2003
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	5/16/2003
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	3/30/2006
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aluminum	EPA 6010	Metals	NELAP	5/16/2003
Aniline	EPA 8270	Extractable Organics	NELAP	5/16/2003
Anthracene	EPA 8270	Extractable Organics	NELAP	5/16/2003

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FLORIDA DEPARTMENT OF HEALTH

NELAP RECOGNIZED nelap

Rick Scott
Governor

Laboratory Scope of Accreditation

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Antimony	EPA 6010	Metals	NELAP	5/16/2003
Antimony	EPA 6020	Metals	NELAP	5/16/2003
Aramite	EPA 8270	Extractable Organics	NELAP	5/16/2003
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Arsenic	EPA 6010	Metals	NELAP	5/16/2003
Arsenic	EPA 6020	Metals	NELAP	5/16/2003
Atrazine	OVL MSS01/GC-MS	Extractable Organics	NELAP	7/30/2010
Barium	EPA 6010	Metals	NELAP	5/16/2003
Barium	EPA 6020	Metals	NELAP	3/30/2006
Benzaldehyde	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
Benzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Benzidine	EPA 8270	Extractable Organics	NELAP	5/16/2003
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Benzoic acid	EPA 8270	Extractable Organics	NELAP	5/16/2003
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	5/16/2003
Beryllium	EPA 6010	Metals	NELAP	5/16/2003
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Biphenyl	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	5/16/2003
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	5/16/2003
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	5/16/2003
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	5/16/2003
Boron	EPA 6010	Metals	NELAP	5/16/2003
Bromide	EPA 9056	General Chemistry	NELAP	5/16/2003
Bromobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	5/16/2003

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FLORIDA DEPARTMENT OF HEALTH

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Laboratory Scope of Accreditation

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Bromoform	EPA 8260	Volatile Organics	NELAP	5/16/2003
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2003
Cadmium	EPA 6010	Metals	NELAP	5/16/2003
Cadmium	EPA 6020	Metals	NELAP	3/30/2006
Calcium	EPA 6010	Metals	NELAP	5/16/2003
Caprolactam	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
Carbazole	EPA 8270	Extractable Organics	NELAP	5/16/2003
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	5/16/2003
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	5/16/2003
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Chloride	EPA 9056	General Chemistry	NELAP	5/16/2003
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Chlorobenzilate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Chloroethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
Chloroform	EPA 8260	Volatile Organics	NELAP	5/16/2003
Chloroprene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Chromium	EPA 6010	Metals	NELAP	5/16/2003
Chromium	EPA 6020	Metals	NELAP	3/30/2006
Chromium VI	EPA 7196	General Chemistry	NELAP	3/30/2006
Chrysene	EPA 8270	Extractable Organics	NELAP	5/16/2003
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	5/16/2003
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Cobalt	EPA 6010	Metals	NELAP	5/16/2003
Cobalt	EPA 6020	Metals	NELAP	3/30/2006
Copper	EPA 6010	Metals	NELAP	5/16/2003
Copper	EPA 6020	Metals	NELAP	3/30/2006
Cyclohexane	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Cyclohexanone	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	5/16/2003
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
Dibromofluoromethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
Dibromomethane	EPA 8260	Volatile Organics	NELAP	5/16/2003

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FLORIDA DEPARTMENT OF HEALTH

NELAP RECOGNIZED nelap

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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: **Solid and Chemical Materials**

Analyte	Method/Tech	Category	Certification Type	Effective Date
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	11/5/2004
Diethyl ether	EPA 8260	Volatile Organics	NELAP	5/16/2003
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2003
Di-isopropylether (DIPE)	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Dimethoate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2003
Dimethyl sulfide	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Dimethyldisulfide	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2003
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	5/16/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270	Extractable Organics	NELAP	5/16/2003
Diphenylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Ethanol	EPA 8015	Volatile Organics	NELAP	5/16/2003
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	3/30/2006
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	5/16/2003
Ethyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	5/16/2003
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Ethylene glycol	EPA 8015	Volatile Organics	NELAP	5/16/2003
Ethyl-t-butylether (ETBE)	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Famphur	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Fluoranthene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Fluorene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Fluoride	EPA 9056	General Chemistry	NELAP	5/16/2003
Formaldehyde	EPA 8315	Extractable Organics	NELAP	5/16/2003
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003

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FLORIDA DEPARTMENT OF HEALTH

Rick Scott
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State Laboratory ID: E87551 **EPA Lab Code:** OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Gasoline range organics (GRO)	EPA 8015	Extractable Organics	NELAP	11/5/2004
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	5/16/2003
Hexachlorophene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Hexachloropropene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Hexamethylphosphoramide (HMPA)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Ignitability	EPA 1010	General Chemistry	NELAP	5/16/2003
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	5/16/2003
Iron	EPA 6010	Metals	NELAP	5/16/2003
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	3/30/2006
Isodrin	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Isophorone	EPA 8270	Extractable Organics	NELAP	5/16/2003
Isoprene	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Isopropyl alcohol (2-Propanol)	EPA 8015	Volatile Organics	NELAP	5/16/2003
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Isosafrole	EPA 8270	Extractable Organics	NELAP	5/16/2003
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Lead	EPA 6010	Metals	NELAP	5/16/2003
Lead	EPA 6020	Metals	NELAP	5/16/2003
Lithium	EPA 6010	Metals	NELAP	5/16/2003
Magnesium	EPA 6010	Metals	NELAP	5/16/2003
Manganese	EPA 6010	Metals	NELAP	5/16/2003
Manganese	EPA 6020	Metals	NELAP	3/30/2006
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Mercury	EPA 7471	Metals	NELAP	2/6/2004
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	5/16/2003
Methanol	EPA 8015	Volatile Organics	NELAP	5/16/2003
Methapyrilene	EPA 8270	Extractable Organics	NELAP	5/16/2003

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 2/14/2011** **Expiration Date: 6/30/2011**

FLORIDA DEPARTMENT OF HEALTH

Rick Scott
Governor

Laboratory Scope of Accreditation

Attachment to Certificate #: E87551-19, expiration date June 30, 2011. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87551 **EPA Lab Code: OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Methyl acetate	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	5/16/2003
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	5/16/2003
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	5/16/2003
Methyl methanesulfonate	EPA 8270	Extractable Organics	NELAP	5/16/2003
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	5/16/2003
Methylcyclohexane	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Methylene chloride	EPA 8260	Volatile Organics	NELAP	5/16/2003
Molybdenum	EPA 6010	Metals	NELAP	5/16/2003
Naphthalene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Naphthalene	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	3/30/2006
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
n-Hexane	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
Nickel	EPA 6010	Metals	NELAP	5/16/2003
Nickel	EPA 6020	Metals	NELAP	3/30/2006
Nitrate	EPA 9056	General Chemistry	NELAP	5/16/2003
Nitrite	EPA 9056	General Chemistry	NELAP	5/16/2003
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	5/16/2003
Nitrocellulose	OVL KNITRO-C-S/UV-VIS	General Chemistry	NELAP	5/7/2008
Nitroglycerin	EPA 8330	Extractable Organics	NELAP	6/13/2007
Nitroguanidine	OVL HPLC05/HPLC-UV	Extractable Organics	NELAP	5/7/2008
Nitroquinoline-1-oxide	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitroso-di-n-butylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitrosomethylethylamine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	5/16/2003
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
o,o,o-Triethyl phosphorothioate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	5/16/2003

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 2/14/2011** **Expiration Date: 6/30/2011**

FLORIDA DEPARTMENT OF HEALTH

NELAP RECOGNIZED nelap

Rick Scott
Governor

Laboratory Scope of Accreditation

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State Laboratory ID: E87551 **EPA Lab Code: OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	5/16/2003
o-Toluidine	EPA 8270	Extractable Organics	NELAP	5/16/2003
Paint Filter Liquids Test	EPA 9095	General Chemistry	NELAP	5/16/2003
Pentachlorobenzene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Pentachloroethane	OVL MSS01/GC-MS	Extractable Organics	NELAP	5/7/2008
Pentachloronitrobenzene (Quintozene)	EPA 8270	Extractable Organics,Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Pentachlorophenol	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	6/13/2007
Perchlorate	EPA 6850	General Chemistry	NELAP	7/30/2010
pH	EPA 9040	General Chemistry	NELAP	2/6/2004
pH	EPA 9045	General Chemistry	NELAP	2/6/2004
Phenacetin	EPA 8270	Extractable Organics	NELAP	5/16/2003
Phenanthrene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Phenol	EPA 8270	Extractable Organics	NELAP	5/16/2003
Phosphorus, total	EPA 6010	Metals	NELAP	7/30/2010
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Potassium	EPA 6010	Metals	NELAP	5/16/2003
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	5/16/2003
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	3/30/2006
Pyrene	EPA 8270	Extractable Organics	NELAP	5/16/2003
Pyridine	EPA 8270	Extractable Organics	NELAP	5/16/2003
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	5/16/2003
Reactive cyanide	Sec. 7.3 SW-846	General Chemistry	NELAP	5/16/2003
Reactive sulfide	Sec. 7.3 SW-846	General Chemistry	NELAP	5/16/2003
Safrole	EPA 8270	Extractable Organics	NELAP	5/16/2003
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Selenium	EPA 6010	Metals	NELAP	5/16/2003
Selenium	EPA 6020	Metals	NELAP	11/7/2003
Silver	EPA 6020	Metals	NELAP	3/30/2006
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Sodium	EPA 6010	Metals	NELAP	5/16/2003
Strontium	EPA 6010	Metals	NELAP	5/16/2003
Styrene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Sulfate	EPA 9056	General Chemistry	NELAP	5/16/2003

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FLORIDA DEPARTMENT OF HEALTH

NELAP RECOGNIZED nelap

Rick Scott
Governor

Laboratory Scope of Accreditation

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State Laboratory ID: E87551 **EPA Lab Code: OH00218** **(740) 373-4071**

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Sulfide	EPA 9030/9034	General Chemistry	NELAP	5/16/2003
Sulfotepp	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Synthetic Precipitation Leaching Procedure	EPA 1312	General Chemistry	NELAP	5/16/2003
T-amylmethylether (TAME)	OVL MSV01/GC-MS	Volatile Organics	NELAP	5/7/2008
tert-Butyl alcohol	EPA 8260	Volatile Organics	NELAP	5/16/2003
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	5/16/2003
Tetrachlorvinphos (Stirophos, Gardona)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Tetraethyl pyrophosphate (TEPP)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/30/2006
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	5/16/2003
Thallium	EPA 6010	Metals	NELAP	5/16/2003
Thallium	EPA 6020	Metals	NELAP	5/16/2003
Thionazin (Zinophos)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Tin	EPA 6010	Metals	NELAP	5/16/2003
Titanium	EPA 6010	Volatile Organics	NELAP	3/30/2006
Toluene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Total cyanide	EPA 9010/9014	General Chemistry	NELAP	7/30/2010
Total organic carbon	Lloyd Khan	General Chemistry	NELAP	5/7/2008
Total Petroleum Hydrocarbons (TPH)	FL-PRO	Extractable Organics	NELAP	5/16/2003
Total Petroleum Hydrocarbons (TPH)	TX1005	Extractable Organics	NELAP	3/30/2006
Total Petroleum Hydrocarbons (TPH)	TX1006	Extractable Organics	NELAP	3/30/2006
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	5/16/2003
Toxicity Characteristic Leaching Procedure	EPA 1311	General Chemistry	NELAP	5/16/2003
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	5/16/2003
trans-1,3-Dichloropropylene	EPA 8260	Volatile Organics	NELAP	5/16/2003
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	5/16/2003
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	5/16/2003
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	5/16/2003
Uranium	EPA 6020	Metals	NELAP	7/30/2010
Vanadium	EPA 6010	Metals	NELAP	5/16/2003
Vanadium	EPA 6020	Metals	NELAP	3/30/2006
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	5/16/2003
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	5/16/2003
Xylene (total)	EPA 8260	Volatile Organics	NELAP	5/16/2003
Zinc	EPA 6010	Metals	NELAP	5/16/2003
Zinc	EPA 6020	Metals	NELAP	3/30/2006

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FLORIDA DEPARTMENT OF HEALTH

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Laboratory Scope of Accreditation

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State Laboratory ID: E87551 EPA Lab Code: OH00218 (740) 373-4071

E87551
Microbac Laboratories, Inc., Ohio Valley Division
158 Starlite Drive
Marietta, OH 45750

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Zirconium	OVL ME600/ICP-AES	Metals	NELAP	7/30/2010

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. Issue Date: 2/14/2011 Expiration Date: 6/30/2011

APPENDIX D

KEY PERSONNEL
JOB DESCRIPTIONS

Job Description
Ohio Valley Laboratory

POSITION: Managing Director/Laboratory Director
CLASSIFICATION: Exempt
REPORTS TO: President/CEO

Position Summary and Interrelationships:

The Managing Director reports to the President of Microbac Laboratories, Inc. and manages the business development and technical staff presented in the organization charts of this section (Figures 1 and 2). The Managing Director has primary responsibility for assuring compliance with ISO/IEC 17025:2005. The Technical Director/QAO, Senior Chemist – QA/QC, and all departmental supervisors will assist in the implementation of the specific requirements of this standard. The Managing Director also serves as the Laboratory Director, and has general responsibility for business development and operations. Included are strategic planning, resource allocation and profit and loss for the analytical division as a whole. It is the Managing Director's responsibility to obtain and develop both financial and personnel resources in an effort to maintain quality services and to match resources with the market demands. Additional responsibilities include proposal development and review, production management. Other duties include oversight of the laboratory safety and waste management programs, certifying that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited, monitoring standards of performance in quality control and quality assurance, and ensuring that sufficient numbers of qualified personnel are employed to supervise and perform the work of the laboratory. The Managing Director has authority to:

Responsibilities and Authorities:

1. Reviews and approves quality policies, the quality manual, and laboratory standard operating procedures (SOP).

2. Maintains SOP documents file in hard copy and computer format and distributes revisions to the various laboratory departments.

3. Reviews laboratory quality assurance data, laboratory records for precision and accuracy, statistical control limits, and method detection limits, limits of detection (LOD), and limits of quantitation (LOQ).

4. Reviews statistical warning and control limits and analytical control charts.

5. Performs internal system and technical audits and recommends corrective action plans for areas of deficiency.

6. Introduces internal “blind” performance evaluation samples into the LIMS and reports results of studies to management.

7. Prepares monthly quality assurance reports to management.

8. Communicates any quality concerns to the Technical Director and Managing Director.

9. Communicates the QA program objectives and requirements to the laboratory staff and clients.

10. Schedules and orders proficiency testing (PT) samples and prepares reports for auditing or certifying agencies.

11. Reviews PT data and scores, communicates unacceptable analytical performance to the Managing Director, and prepares corrective action plans for auditing or certifying agencies.

12. Implements system for maintaining calibration records of balances, thermometers, etc.

13. Maintains all records of laboratory certification

14. Assists clients and field operations in the preparation of specific QA Project Plans (QAPPs).

15. Assists in the development of technical training procedures and performs staff training.

16. Reviews and approves laboratory and analyst demonstrations of capability.

17. Performs other duties as directed by the Managing Director.

18. Performs audits of sub-contractor laboratories as necessary.

19. Develops and maintains a system of quality control standards, which are independent of calibration standards.

20. Assists the Managing Director in development and maintaining the health and safety program and a waste disposal system.

21. Approve policies and procedures.

22. Implementation and maintenance of the quality management system.

23. Review and approve contracts and tenders.

24. Approve certificates-of-analysis (laboratory report).

25. Evaluating staff training effectiveness.

26. Stopping nonconforming work.

27. Resuming nonconforming work.

28. Quality Planning (Management Review).

Education/Experience Requirements:

1. BS/BA Degree - Chemistry Minor (20 semester hours) and ten years of laboratory experience.

or 2. BS/BA Degree – Chemistry Major (30 semester hours) and five years of laboratory experience.

or 3. MS/PhD Degree – Chemistry Major and three years of laboratory experience.

Job Description
Ohio Valley Laboratory

POSITION: Technical Director
CLASSIFICATION: Exempt
REPORTS TO: Managing Director

Position Summary and Interrelationships:

The Technical Director reports to the Managing Director and is responsible for the following departments and programs: QA/QC, IT, Support Services, and methods development. The Technical Director directs the activities of the Quality Assurance Officer (QAO), the Senior Chemist for Methods Development, the Computer Programmers and IT support staff, and the Support Services Supervisor.

Responsibilities and Authorities:

1. Directs/coordinates the QA/QC program with the assistance of the QAO.

2. Directs/coordinates the development and maintenance of the Laboratory Information Management System (LIMS), the network fileservers and work stations, and all hardware software applications.

3. Evaluates/coordinates the development of all new laboratory technology and new analytical methods with assistance of the Senior Chemist.

4. Directs/coordinates the activities of the Support Services department including sample login, sample custody, building maintenance, shipping/receiving, and waste management.

5. Reviews laboratory quality assurance data, laboratory records for precision and accuracy, statistical control limits, and method detection limits, limits of detection (LOD), and limits of quantitation (LOQ).

6. Performs internal system and technical audits and recommends corrective action plans for areas of deficiency.

7. Communicates any quality concerns to the Technical Director and Managing Director.

8. Communicates the QA program objectives and requirements to the laboratory staff and clients.

9. Assists clients and field operations in the preparation of specific QA Project Plans (QAPPs).

10. Assists in the development of technical training procedures and performs staff training.

11. Develops and maintains a system of quality control standards, which are independent of calibration standards.

12. Approves technical policies and procedures

13. Implementation and maintenance of the quality management system

14. Review and approve contracts and tenders

15. Approves certificates-of-analysis (laboratory reports)

16. Evaluates staff training effectiveness

17. Stops nonconforming work

18. Resumes nonconforming work

19. Performs internal audits

20. Performs other duties as directed by the Managing Director.

Education/Experience Requirements:

1. BS/BA Degree - Chemistry Minor (20 semester hours) and ten years of laboratory experience.

or 2. BS/BA Degree – Chemistry Major (30 semester hours) and five years of laboratory experience.

or 3. MS/PhD Degree – Chemistry Major and three years of laboratory experience.

Job Description
Ohio Valley Laboratory

POSITION: Quality Assurance Officer
CLASSIFICATION: Exempt
REPORTS TO: Technical Director

Position Summary and Interrelationships:

The Quality Assurance Officer (QAO) reports to the Technical Director and functions independently of the laboratory operations. The QAO supervises the QA Administrative Assistant and coordination with the Document Control Officer. The QAO is responsible for development, implementation, and oversight of the laboratory Quality Assurance Program. It is the QAO's responsibility to assess and ensure the quality of all work performed in the laboratory.

Responsibilities and Authorities:

1. Reviews and approves quality policies, the quality manual, and laboratory standard operating procedures (SOP).

2. Maintains SOP documents file in hard copy and computer format and distributes revisions to the various laboratory departments.

3. Reviews laboratory quality assurance data, laboratory records for precision and accuracy, statistical control limits, and method detection limits, limits of detection (LOD), and limits of quantitation (LOQ).

4. Reviews statistical warning and control limits and analytical control charts.

5. Performs internal system and technical audits and recommends corrective action plans for areas of deficiency.

6. Introduces internal "blind" performance evaluation samples into the LIMS and reports results of studies to management.

7. Prepares monthly quality assurance reports to management.

8. Communicates any quality concerns to the Technical Director and Managing Director.

9. Communicates the QA program objectives and requirements to the laboratory staff and clients.

10. Schedules and orders proficiency testing (PT) samples and prepares reports for auditing or certifying agencies.

11. Reviews PT data and scores, communicates unacceptable analytical performance to the Managing Director, and prepares corrective action plans for auditing or certifying agencies.

12. Implements system for maintaining calibration records of balances, thermometers, etc.

13. Maintains all records of laboratory certification.

14. Assists clients and field operations in the preparation of specific QA Project Plans (QAPPs).

15. Assists in the development of technical training procedures and performs staff training.

16. Reviews and approves laboratory and analyst demonstrations of capability.

17. Performs other duties as directed by the Managing Director.

18. Performs audits of sub-contractor laboratories as necessary.

19. Develops and maintains a system of quality control standards, which are independent of calibration standards.

20. Assists the Managing Director in development and maintaining the health and safety program and a waste disposal system.

21. Approve policies and procedures.

22. Implementation and maintenance of the quality management system.

23. Evaluating staff training effectiveness.

24. Has stop work authority.

25. Monitors the laboratory's corrective action processes.

Education/Experience Requirements:

1. BS/BA Degree - Chemistry Minor (20 semester hours) and ten years of laboratory experience.

or 2. BS/BA Degree – Chemistry Major (30 semester hours) and five years of laboratory experience.

or 3. MS/PhD Degree – Chemistry Major and three years of laboratory experience.

Job Description
Ohio Valley Laboratory

POSITION: Conventionals Laboratory Supervisor
CLASSIFICATION: Exempt
REPORTS TO: Managing Director

Position Summary and Interrelationships:

The Conventionals/Wet Chemistry Supervisor reports to the Managing Director. The Conventionals/Wet Chemistry Supervisor is responsible for coordinating the production and quality control of all work involving preparation and analysis of samples by wet chemical methods in accordance with company policies and Standard Operating Procedures (SOP). General duties include implementation of laboratory safety program in the Wet Chemistry department, implementation of the laboratory quality control program for wet chemical analysis in accordance with company SOPs and prudent laboratory practices, scheduling production of routine and non-routine work, supervising all technicians/analysts involved in sample preparation, standard preparation, and instrumental analyses.

Responsibilities and Authorities:

1. Schedules and reviews work of all analysts and lab assistants

2. Implements the laboratory Chemical Hygiene Plan and all laboratory SOPs

3. Schedules instrument maintenance

4. Performs employee orientation, training, and performance reviews

5. Performs QC review of all departmental data

6. Maintains inventory of supplies and chemicals

7. Performs general review of departmental data deliverables (Level 4)

8. Takes corrective action on all out-of-control analyses and submits reports to the QC Supervisor and Laboratory Manager

9. Evaluates staffing and instrumentation requirements and makes recommendations

to management.

10. Approves policies and procedures

11. Implementation and maintenance of the quality management system

12. Approves departmental data and reports

13. Evaluating staff training effectiveness

Education/Experience Requirements:

1. Advanced Degree in chemistry and two years of wet lab experience.

or 2. BS/BA Degree with chemistry major and three years of wet lab experience.

or 3. BS/BA Degree with Chemistry minor and four years of wet lab experience.

or 4. AS/BA Degree in science and 8-10 years of wet lab experience.

Job Description
Ohio Valley Laboratory

POSITION: Metals Laboratory Supervisor
CLASSIFICATION: Exempt
REPORTS TO: Managing Director

Position Summary and Interrelationships:

The Metals Laboratory Supervisor reports to the Managing Director. The Metals Laboratory Supervisor is responsible for coordinating the production and quality control of all work involving digestion and analysis of samples by AA and ICP methods in accordance with company policies and Standard Operating Procedures (SOP). General duties include implementation of laboratory safety program in the metals department, implementation of the laboratory quality control program for metals analyzed in accordance with company SOPs and prudent laboratory practices, scheduling, production of routine and non-routine work, supervising all technicians/analysts involved in standard preparation, sample digestion and instrumental analyses. Other duties include the scheduling of routine maintenance and emergency service for departmental instrumentation, preparing daily work schedules for full and part-time employees, monitoring departmental backlogs, turnaround time, priority analysis deadlines, reviewing and approving data generated by the metals department.

Responsibilities and Authorities:

1. Schedules and reviews work of all analysts and lab assistants;

2. Implements the laboratory Chemical Hygiene Plan, Comprehensive QA Plan, and all laboratory SOPs;

3. Schedules instrument maintenance;

4. Performs employee orientation, training, and performance reviews;

5. Performs QC review of all departmental data;

6. Maintains inventory of supplies and chemicals;

7. Performs general review of departmental data deliverables (Level 4);

8. Takes corrective action on all out-of-control analyses and submits reports to the QC Supervisor and Laboratory Manager;

9. Evaluates staffing and instrumentation requirements and makes recommendations to management;

10. Approve policies and procedures

11. Implementation and maintenance of the quality management system

12. Approve departmental reports and data packages.

13. Evaluating staff training effectiveness

Education/Experience Requirements:

1. Advanced Degree in chemistry and two years of environmental laboratory experience

or 2. BS/BA Degree with chemistry major and four years of environmental laboratory experience

or 3. BS/BA Degree with Chemistry minor and five years of environmental laboratory experience

or 4. AS/BA Degree in science and eight to ten years of environmental laboratory experience.

Job Description
Ohio Valley Laboratory

POSITION: Semivolatile Organics Laboratory Supervisor
CLASSIFICATION: Exempt
REPORTS TO: Managing Director

Position Summary and Interrelationships:

The Semivolatile Organics Supervisor reports to the Managing Director. The Semivolatile Organics Supervisor is responsible for coordinating the production and quality control of all work involving instrumental analysis of samples by HPLC, IC, GC/FID, GC/ECD, and GC/MS employing semivolatile methods in accordance with company policies and Standard Operating Procedures (SOP). General duties include implementation of laboratory safety program in the department, implementation of the laboratory quality control program for semivolatile organics analyzed in accordance with company SOPs and prudent laboratory practices. Other duties include scheduling production of routine and non-routine work, supervising technicians/analysts involved in standard preparation and instrumental analyses, scheduling routine maintenance and emergency service for departmental instrumentation, preparing daily work schedules of full and part-time employees, monitoring departmental backlogs, turnaround time, and priority analysis deadlines and reviewing and approving data generated by the department.

Responsibilities and Authorities:

1. Schedules and reviews work of all analysts and lab assistants;

2. Implements the laboratory Chemical Hygiene Plan, Comprehensive QA Plan, and all laboratory SOPs;

3. Schedules instrument maintenance;

4. Performs employee orientation, training, and performance reviews;

5. Performs QC review of all departmental data;

6. Maintains inventory of supplies and chemicals;

7. Performs general review of departmental data deliverables (Level 4);

8. Takes corrective action on all out-of-control analyses and submits reports to the QC Supervisor and Laboratory Manager;

9. Evaluates staffing and instrumentation requirements and makes recommendations to management;

10. Approve policies and procedures;

11. Implementation and maintenance of the quality management system;

12. Approves departmental data and reports;

13. Evaluating staff training effectiveness.

Education/Experience Requirements:

1. Advanced Degree in chemistry and two years of GC/MS experience.

or 2. BS/BA Degree with chemistry major and three years of GC/MS experience.

or 3. BS/BA Degree with Chemistry minor and four years of GC/MS experience.

or 4. AS/BA Degree in science and 8-10 years of GC/MS experience.

Job Description
Ohio Valley Laboratory

POSITION: Volatile Organics Laboratory Supervisor
CLASSIFICATION: Exempt
REPORTS TO: Managing Director

Position Summary and Interrelationships:

The Volatile Organics Supervisor reports to the Managing Director. The Volatile Organics Supervisor is responsible for coordinating the production and quality control of all work involving preparation and analysis of samples for volatile organics analysis (VOA) by GC/PID/FID/TCD and GC/MS methods in accordance with company policies, client QAPPs, and Standard Operating Procedures (SOP). Specific duties include, but are not limited to, implementation of laboratory safety program in the department, implementation of the laboratory quality control program, scheduling production of routine and non-routine work, supervising all technicians/analysts, instrumental analyses, scheduling routine maintenance and emergency service for departmental instrumentation, preparing daily work schedules for employees, monitoring departmental backlogs, turnaround time, and priority analysis deadlines and reviewing and approving data generated by the department.

Responsibilities and Authorities:

1. Schedules and reviews work of all analysts and lab assistants

2. Implements the laboratory Chemical Hygiene Plan, Comprehensive QA Plan, and all laboratory SOPs

3. Schedules instrument maintenance

4. Performs employee orientation, training, and performance reviews

5. Performs QC review of all departmental data

6. Maintains inventory of supplies and chemicals

7. Performs general review of departmental data deliverables (Level 4)

8. Takes corrective action on all out-of-control analyses and submits reports to the QC Supervisor and Laboratory Manager

9. Evaluates staffing and instrumentation requirements and makes recommendations to management

10. Approve policies and procedures

11. Implementation and maintenance of the quality management system

12. Approves departmental reports and data packages

13. Evaluating staff training effectiveness

Education/Experience Requirements:

1. Advanced Degree in chemistry and two years of GC/MS experience.

or 2. BS/BA Degree with chemistry major and three years of GC/MS experience.

or 3. BS/BA Degree with Chemistry minor and four years of GC/MS experience.

or 4. AS/BA Degree in science and 8-10 years of related experience.

Job Description
Ohio Valley Laboratory

POSITION: Extraction Laboratory Supervisor
CLASSIFICATION: Exempt
REPORTS TO: Managing Director

Position Summary and Interrelationships:

The Organic Sample Preparation Supervisor reports to the Managing Director. The Organic Sample Preparation Supervisor is responsible for all organic extractions. He ensures that all samples for organics analysis are prepared in accordance with the appropriate USEPA methods, that appropriate QC samples are prepared, and that all samples are extracted within the appropriate regulatory holding times. Other responsibilities include preparation of samples for extractable organic analysis, methods development for unusual matrices and preparation of standards, sample cleanup as required, TCLP extraction procedures, ordering of supplies and standards for extraction laboratory, and maintenance of extraction lab documentation.

Responsibilities and Authorities:

1. Schedules and reviews work of all analysts and lab assistants;

2. Implements the laboratory Chemical Hygiene Plan, Comprehensive QA Plan, and all laboratory SOPs;

3. Schedules instrument maintenance;

4. Performs employee orientation, training, and performance reviews;

5. Performs QC review of all departmental data;

6. Maintains inventory of supplies and chemicals;

7. Performs general review of departmental data deliverables (Level 4);

8. Takes corrective action on all out-of-control analyses and submits reports to the QC Supervisor and Laboratory Manager;

9. Evaluates staffing and instrumentation requirements and makes recommendations

to management;

10. Approve policies and procedures;

11. Implementation and maintenance of the quality management system;

12. Approves departmental data and reports;

13. Evaluating staff training effectiveness.

Education/Experience Requirements:

1. Advanced Degree in chemistry and two years of related experience.

or 2. BS/BA Degree with chemistry major and three years of related experience.

or 3. BS/BA Degree with Chemistry minor and four years of related experience.

or 4. AS/BA Degree in science and 8-10 years of related experience.

Job Description
Ohio Valley Laboratory

POSITION: Support Services Supervisor
CLASSIFICATION: Exempt
REPORTS TO: Technical Director

Position Summary and Interrelationships:

The Support Services Supervisor reports to the Technical Director. The Support Services Supervisor is responsible for the non-analytical operations of the laboratory. General duties include coordinating and supervising all activities associated with login, sample containers and kit preparation, sample disposal, and the Microbac courier services. Other responsibilities include supervision of shipping/receiving, peer review of login, logging, temperature blanks and coordination of the laboratory waste management system.

Responsibilities and Authorities:

1. Schedules or coordinates, and reviews as necessary, the work customer service representatives, sample custodians, and support service assistants.

2. Implements the laboratory Chemical Hygiene Plan, Comprehensive QA Plan, Waste Management Plan, and all other departmental standard operating procedures.

3. Assists in the development and regular revision of pertinent standard operating procedures.

4. Performs departmental employee orientation, training, and performance reviews.

5. Schedules Support Services vehicle maintenance.

6. Coordinates or schedules Microbac sample courier service.

7. Maintains inventory of supplies for sample kits.

8. Supervises the laboratory waste management system, including the proper disposal of all sample residuals in accordance with company policies and pertinent government regulations.

9. Assists in the maintenance of the physical facility through the efforts of departmental assistants or outside contractors.

10. Assists in proposal development, writing quotations, customer service activities, and selected project and account management.

11. Performs other duties as required in special projects or emergencies.

10. Approve policies and procedures

11. Implementation and maintenance of the quality management system

12. Evaluating staff training effectiveness

Education/Experience Requirements:

1.0 AS/BA Degree in science and 3-5 years of related experience.

or 2. 5 -10 years of laboratory experience.

Job Description
Ohio Valley Laboratory

POSITION: Chemists/Data Specialist
CLASSIFICATION: Exempt
REPORTS TO: Managing Director

Position Summary and Interrelationships:

The Chemist/Data Specialist reports to the Managing Director. The Chemist/Data Specialists (CDS) perform important functions at the beginning and end of the process chain. At project inception, they critically review all data quality objectives, EDD specifications, and regulatory/program requirements and customize instructions to the laboratory and MIS staff accordingly. Method builds, new regulatory/field applications and other non-routine requests are researched and processed by the CDS, with the support of senior management. All finalized data packages, including electronic data deliverables, are routed back to the CDS for a final review of completeness, accuracy and assured compliance to client specification. Post delivery, the CDS fields all technical questions associated with the data package, its validation and integration. Depending on the scale and scope of a project, the CDS may be assigned complete project management responsibilities. As project manager, they coordinate all facets of supporting services and are the client's primary contact for the duration of the project. In this role, the CDS initiates electronic reporting in a variety of media and configurations, including portal uploads and electronic data verifications.

Responsibilities and Authorities:

1. All technical review for proposals & new awards (methods, reporting limits, compound lists, QC). Creates "drop-in" technical narratives and tables for proposals based on technical review of RFP/QAP. Supports sales channels through clarification of discrepancies between lab capabilities and project specifications at proposal stage.

2. All workorders, kit requests and project set up in LIMS (p-keys, account level pricing, etc)

3. All interface with MIS for EDD development and progress tracking through final EDD design.

4. All interface with sampling crew as required

5. All subcontracting arrangements

6. Communication of client requirements to lab as well as communication of lab issues to the client

7. Review of all folders from log-in, resolution of anomalies with client and submittal of sample receipt acknowledgements.

8. Expediting work to insure turn around times (TAT) (no penalties, capture all premiums)

9. All forms of data review (complete, correct and compliant with contract provisions) including EDD

10. Interface with validators and auditors

11. Participation in on-going process improvement initiatives, and subsequent cross-training. Occasional research in methods development and changing regulations to support future product line expansions.

12. Some travel required as technical sales support (including some overnights) and for client-required project kick-offs.

13. Accept new work within the capacity guidelines of the Managing Director

14. Identify nonconforming work and potential preventative actions

15. Process client complaints

Education/Experience Requirements:

1. BS/BA Degree – Chemistry Minor (20 semester hours)

or 2. BS/BA Degree – Natural Science Major
1 year of related lab experience
8 hours college chemistry

Job Description
Ohio Valley Laboratory

POSITION: Client Services Specialists
CLASSIFICATION: Non-Exempt
REPORTS TO: Client Services Supervisor

Position Summary and Interrelationships

Client Services Specialists (CSS) have two primary roles. They function as project/account managers on routine and repeat events with an assigned list of clients. They also assist Chemists/Data Specialists in the logistical coordination of major projects and provide administrative support for those projects. Chemists/Data Specialists provide technical/chemistry support to the CSS's on an "as needed" basis.

Responsibilities and Authorities

1. Primary liaison with select list of clients. Gathers and transmits to the laboratory all essential order entry information via work orders and account/project setup in LIMS. Selects and issues orders to subcontracting labs as required. Performs all routine customer service functions for assigned clients (phones, e-mails, etc) and provides additional coverage as assigned backup to other CSS's.

2. Reviews in-process master folders following sample receipt from log-in. Reconciles any anomalies with client. Enters field data where required. Sends sample receipt confirmations to clients as required by contracts. Approves release of samples to the lab through a LIMS change in status.

3. Reviews deliverables post production as final check of case completeness, correctness and compliance with specifications. Deliverables include required EDD's, approval invoices and subcontracted reports.

4. Performs invoicing, transmittal and AR functions with accuracy and on-time.

5. Assists in the development and implementation of process changes to maximize efficiency, conserve resources and promote optimal customer care as directed by Client Services Supervisor.

6. Requires strong attention to detail, ability to work under pressure, excellent oral and written communication skills, computer aptitude, and superior interpersonal

skills to maintain established standards for client care and interaction with co-workers.

7. Work hours will have limited flexibility to insure coverage. Routine hours for this position have been established as 8-5. On occasion, the position may require you to stay later than 5:00 p.m. as the workload dictates.

Education/Experience Requirements:

1. AS Degree in Natural Science

or 2. High School Diploma
2 years related lab experience

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APPENDIX F

CONTRACTOR FORMS

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TABLE OF CONTENTS

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QUALITY CONTROL LOGS

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HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Daily Quality Control Report

Report No.:		**Date:**

Site/Installation Name:	**City:**	**State:**	**Date:**

Weather:

Clear ☐ Fog ☐ Cloudy ☐ Rain ☐ Snow ☐ Windy ☐ _______ mph

Temperature:

Minimum: _____ °F Maximum: _____ °F

Employer:	**Position:**	**Name:**	**Activity:**
	Project Manager		
	Site Manager		
	Senior UXO Supervisor		
	Senior Geophysicist		
	Site Safety and Health Officer		
	UXO Quality Control Specialist		
	UXO Safety Officer		
Team ONE			
Team TWO			
Team THREE			
Team FOUR			

1. Work performed today:

2. **Worked performed today by subcontractors:**

3. **Inspections performed (include name of team present, specifications, plans and submittals required for definable feature of work [DFOW]). Indicate 3-Phase inspection level with: Preparatory = P; Initial = I; Follow-up = F.**							
Phase	**Team Name:**	**DFOW**			**Comments**		
		Grid #	**Grid #**	**Grid #**	**Grid #**	**Grid #**	**Grid #**

GRID INSPECTIONS							
QC inspections completed today:				**QA inspections completed to date:**			
Pass	**Fail**	**Total**		**Pass**	**Fail**	**Total**	**Remaining**

DFOW:	**Team (indicate by: UXO = U; or Geo = G; and No:**					**Pass**	**Fail**	**NA**
Proper work attire (PPE)								
Equipment calibration check								
Vehicle condition								
Equipment condition								
Emergency equipment								
Proper grid layout								
Proper search techniques								
Team leader daily log								
SUXOS daily log								
GIS and map data								
Exclusion zone								
Field office interior								
Field office exterior								
Proper demolition operations								
Safety violations								

4.	**a**	**Soil samples taken:**			
		Pre-Detonation:	☐ No	☐ Yes	☐ None required
		Post-Detonation:	☐ No	☐ Yes	☐ None required

5.	**a**	**Verbal instructions received by the Government representative or client and actions taken:**

6.	**Non-conformances/deficiencies reported:**

CERTIFICATION: *I certify the above information is complete and correct and that I, or my representative, have inspected all work identified on this report performed by HGL and our subcontractor(s) and have determined to the best of my knowledge and belief that noted work activities are in compliance with the plans and specifications, except as may be noted above.*	
Contractor Quality Control Systems Manager	Signature

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Quality Control Preparatory Phase Checklist

Contract No.: ______________________________ Date: ___________________

Definable Feature of Work: _________________________ Spec. Section: __________________

I. Personnel Present:

Government Rep Notified: (circle) Y / N Hours in advance: _______________

Name Position Company/Government

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____
7. ____

(List additional personnel on reverse side)

II. Submittals

1. Review submittals and/or submittal log. Have all submittals been approved?

   Yes _____ No _____

   If No, what items have not been submitted?

   a. ____
   b. ____
   c. ____

2. Are all materials on hand? Yes _____ No _____

   If No, what items are missing?

   a. ____
   b. ____
   c. ____

3. Check approved submittals against delivered material. (This should be done as material arrives.)

   Comments: ____

III. Material Storage

Are materials stored properly? Yes _____ No _____

If No, what action is taken? ______________________________

____

IV. Specifications

1. Review each paragraph of specifications.

____

____

____

2. Discuss procedures for accomplishing the work.

____

____

____

3. Clarify any differences.

V. Preliminary Work and Permits

Ensure preliminary work is correct and permits are on file.

If not, what action is taken: ______________________________

____

____

VI. Testing

1. Identify test to be performed, frequency, and whom.

____

____

2. When is it required? ______________________________
3. Where is it required? ______________________________
4. Review Testing Plan: ______________________________

____

5. Has the test facility been approved: Yes _____ No _____

If not, what action has been taken?: ______________________________

____

VII. Safety

1. Review applicable portion of EM 385-1-1. ______________________________________

   ____

2. Activity Hazard Analysis approved? Yes _____ No _____

VIII. USACE Representative comments during meeting.

____

____

____

____

____
QC Manager / Date

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Quality Control Initial Phase Checklist

Contract No.: ______________________ **Date:** ______________

Title and No. of Technical Section: ______________________

Reference Contract Drawings: ______________________

A: Planned attendants:

	NAME	POSITION	COMPANY
1.			
2			
3.			
4.			

B. Materials being used are in strict compliance with the contract plans and specifications:
Yes ☐ **No** ☐ **If not explain:**

C. Procedures and/or work methods witness are in strict compliance with the contract specifications:
Yes ☐ **No** ☐ **If not explain:**

D. Workmanship is acceptable: **Yes** ☐ **No** ☐
State areas where improvement is needed:

E. Safety violation noted: **Yes** ☐ **No** ☐
If yes, corrective action taken:

______________________ ______________
Quality Control Representative **Date**

HGL MR Form 15.11 (Jul 2008)

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Quality Control Final Inspection Checklist

Contract No.: ______________________ **Date:** ______________

Delivery/Task Order No: ______________ **Project No:** ______________

Project/Area of Inspection: ______________________________

A: Definable Feature of Work: Status of Inspection:

1. ______________________ ______________________
2. ______________________ ______________________
3. ______________________ ______________________

I hereby certify, that to the best of my knowledge and belief, that the work inspected is complete and all materials and equipment used and work performed were completed in accordance with plans submitted and approved.

____

B. Final Acceptance is Approved, Subject to the Correction of the Punchlist Items below:

____

____

C. Persons in Attendance (see meeting attendance sheet attached:

D. Resolution of Punchlist:

____

____

HGL MR Form 15.12 (Jan 2012)

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Equipment/Instrument Calibration/Maintenance Log

Project Location (Name, City and State):					Contract No:
Team Number:		Instrument Description/Type:			Equipment/Instrument Serial Number:
Date	**Calibration Standard (example, Test Pit)**	**Test results (check box)**		**Name of Individual**	**Comments or Observations**
		Pass	**Fail**		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		

HGL MR Form 15.16 (Oct 2007)

SAFETY MEETING ATTENDANCE LOG

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Safety Meeting/Training Attendance Log

Date:		**Time:**		**Conducted by:**	
Site Name/Location:					
Contract Number:		**Delivery/Task Order Number:**			
Project Manager:		**Site Manager** (when applicable):			
(Senior) UXO Supervisor:		**Site Safety Officer/Unexploded Ordnance Safety Health Officer:**			

Training Provided: ☐ Initial Site Hazard ☐ Weekly Safety Training ☐ Daily Safety Meeting ☐ Task/Hazard Specific ☐ Other:

Weather Conditions: ☐ Fair ☐ Poor **Temperature (Low/High):** to °F **Wind speed:** mph **Direction:** **Precipitation:** % **Humidity:** %

I. TRAINING TOPICS COVERED

☐ Planned Site Activities	☐ Heat or Cold Stress	☐ Respirator Use
☐ Demolition Operations	☐ Biological Hazards	☐ Decontamination Procedures
☐ Site Controls	☐ Chemical Hazards	☐ Emergency Procedures/Route
☐ Exclusion Zone/Personnel Limits	☐ Routes of Chemical Exposure	☐ First Aid Procedures
☐ Site Communications	☐ Chemical Exposure Symptoms	☐ Buddy Team Procedures
☐ Physical Hazards	☐ Level/Type of PPE	☐ Other (describe topic(s) below)

Explain: ______________________________

Hospital/Clinic:	**Address:**	**Phone:**

II. SITE PERSONNEL / TRAINING ATTENDEES (Continued on 2nd page)

	Name	Signature	Company
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

III. SAFETYBRIEF / TRAINING VERIFICATION

I certify that the personnel listed on this roster have received the safety and health training described above.

______________________________ ______________________________

Site Manager or Senior UXO Supervisor — Site Safety and Health Officer or UXO Safety Officer

HGL MR Form 15.18 (Oct 2010)

Page ______ of ______.

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SITE VISITOR LOG

Project Name:		**Project Number:**		**Delivery/Task Order:**	
Site Name:		**Location:**			

This form shall be used to track entry into and departure from the ***EXCLUSION ZONE, CONTAMINATION REDUCTION ZONES, OR OTHER WORK ZONES*** on all HydroGeoLogic, Inc. sites. All Personnel shall sign in and out on the form by printing their name, initializing the form and noting the time in/out.

Date	**Name**	**Representing**	**Purpose of Visit**	**Escort Required**		**Equipment/ PPE Level**	**Time**	
				Yes	**No**		**In**	**Out**

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SAFETY INSPECTION LOG

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Site Safety Inspection Report

Dates (period covered):	Contract Number:	Delivery Order/Task Number:

Installation or Site Name:	Site Location (city and state):
Location of Inspection (Grid number or GPS coordinates,):	Activity:

Weather Conditions:	☐ Sunny	☐ Partly Cloudy	☐ Cloudy	☐ High temperatures	☐ Cold temperatures
Type of Inspection:	☐ Daily:	☐ Weekly	☐ Monthly	☐ Special	☐ Re-inspection

I. ACTVITY INSPECTED (indicate results by an "X")	SATISFACTORY	UNSATISFACTORY	NOT APPLICABLE
a. Site Mobilization/Demobilization			
b. Surface Sweep Operations			
c. Subsurface Operations			
d. Geophysical Operations			
e. Survey/Vegetation Removal Operations			
f. Heavy Equipment/Earth Moving Machinery			
g. Personal Protection Equipment			
h. Safe Work Practices			
i. Site Controls			
j. First Aid/Medical Equipment			
k. Fire Extinguisher/Fire Fighting Equipment			
l. Demolition Operations			
m. Explosive Storage			
n. Explosive Transportation Procedures			
o. Emergency Procedures			
II. OVERALL INSPECTION RESULTS			

III. COMMENTS:

IV. ACTIONS	**YES**	**NO**	**COMMENTS**
Work stopped due to safety violations:			
Safety violation noted:			
Personnel involved:			
Corrective measures:			
Re-inspection required:			
Demolitions Operations Conducted:			

V. SITE VISITORS	**NAME**	**ORGINIZATION**	**PURPOSE**

VI. SIGNATURES. *I acknowledge that I have been briefed on the results of this inspection and will take corrective actions as necessary.*

RECEPIENT (print name/signature)	SITE/UXO SAFETY OFFICER (print name/signature)	PROJECT MANAGER (print name/signature)

HGL MEC Form 15.20 (Sep 2008)

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DAILY REPORT OF MEC OPERATIONS

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Site Daily Production Report

Contract No:	Click here to enter	**Date:**	Click here to enter
Delivery Order No:	Click here to enter	**Report No:**	Click here to enter

1. Location of Work: Enter installation/ name, City and State

2. Personnel Summary:

Position/Company	Position/Team Assigned	Name

3. Manpower Summary

Position	Total Positions Assigned	Hours Per Position	Total Hours
Site Manager			
SUXOS			
UXOSO			
UXOQCS			
UXO Technician III			
UXO Technician II			
UXO Technician I			
UXO Sweep Personnel			
Geophysical Personnel			
Subcontractors			

4. Work Summary

Work Activity	Daily Total	Weekly Total	Project Total
Anomalies Dug			
Grids Completed			
Grids QC'd			
Grids QA'd			

Summary of today's work activities:

5. Inspections:

Inspection	Total Daily		Total Weekly		Total Project	
	Pass	Fail	Pass	Fail	Pass	Fail
Grids QC's						
Grids QA'd						
Safety						

6. Explosive Usage:

Item	Quantity	Comments

7. MEC Summary:

Item	Grid	Classification			Disposition
		UXO	MPPEH	DMM	

8. Non-MEC Scrap (pounds).

Type	Daily Total (lbs)	Weekly Cumulative Total	Project Total
Munitions Debris (MD)			
Cultural Debris (CD)			
Range Related Debris (RRD)			

9. Equipment Usage:

Item Description	Quantity	Hours (each)	Total Hours	Comments (Rent/Own)
Truck, pickup, 4x4				
Suburban, 4x4				
Mini Track Hoe				
Radio, handheld				
Radio, truck mount				
Radio, base station				
Radio, Repeater				
White XLT				
Schonstedt				
Camera, digital				
Range finder				
Lightning detector				
PDA/GPS				

GPS RTK Rover				
First aid kit				
Team gear				
Demo kit				
Site Safety Officer Kit				
Computer, laptop				
Computer, desktop				
Printer/copier/scanner/fax				
Telephone				
Cellular Telephones				

10. Discrepancies.

11. Guidance or Instructions Received From Client.

12. Attachment Summary.

13. Continuation/other.

14. Signature.

CERTIFICATION: I certify the above information is complete and correct and that I, and have determined to the best of my knowledge and belief that noted work activities are in compliance with the plans and specifications, except as may be noted above.	
Site Manager or SUXOS	Signature

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EXPLOSIVE ACCOUNTABILITY FORMS

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Munitions and Explosives of Concern/Unexploded Ordnance Accountability Record

Site Location:			
Contract Number:		**Delivery/Task Order Number:**	

Grid Coordinates	**Anomaly No.**	**Identification**	**Date Located**	**Date Disposed**	**Method of Disposal**	**Comments**

Reviewed and Accepted (print name)	**Senior UXO Supervisor Signature**	**Date**

HGL MR Form 15.04 (Nov 2010)

Page _____ of _____

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Magazine Data Card – Daily Summary of Magazine Transactions

Magazine Data Card—
Daily Summary of Magazine Transactions

Nomenclature/Brand Name of Manufacturer:	Lot No./Manufacturer Mark:	Hazard Class/Division:
Site Name:	Grid No./Lat/Long Coord:	Contract No.:

Date	Quantity Received	Quantity Issued	Current Balance	Signatures	
				Conducted or Issued by:	Conducted or Received by:

HGL MR Form 15.02 (Revised May 2011)

Page __________ of __________.

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Manufacturer of Explosives Record of Acquisition

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Manufacturer of Explosives Record of Acquisition

Site Name/Location:	Supervisor Name and Position

Date of Manufacture or other Acquisition	Lot Number or Manufacturer's Marks of Identification	Nomenclature/ Description	Quantity Acquired	Name, Address and License or Permit Number of Distributor

HGL MR Form 15.03 (Revised May 2011)

Page __________ of __________.

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Explosive Usage Record/Bill of Lading

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Explosive Usage Record/Bill of Lading

Demolition Team Number:	Date:	Project Name
Team Leader:	Work Area/Grid Number:	Location Name:

Explosives Issue:

Nomenclature/Brand Name	Quantity	Lot Number / Manufacturer's Marks	Checked by (Initials)

Demolition Team Leader Signature:	Explosive Driver Signature (required when transporting explosives by vehicle):

Explosives Expended:

Nomenclature/Brand Name	Quantity	Lot Number	Checked by (Initials)

Explosives Returned:

Nomenclature/Brand Name	Quantity	Lot Number	Checked by (Initials)

Explosive Driver Signature (required when transporting explosives by vehicle):

Demolition Team Leader Signature:	SUXOS/UXOQCS Signature:

1. The signatures in each section of this record indicate the items listed in that section were in fact issued, expended, or returned to storage and that the explosive quantities listed were verified by a true and accurate physical count.
2. This form will serve as a bill of lading when explosives listed herein are picked up, delivered and transported by vehicle on public transportation routes.

HGL MR 15.05 (Nov 2011)

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APPENDIX G

PERSONNEL QUALIFICATIONS CERTIFICATIONS LETTER

HGL
HydroGeoLogic, Inc
MUNITIONS RESPONSE TEAM

February 2, 2012

Ms. Lydia Tadesse
U.S. Army Engineering and Support Center
4820 University Square
Huntsville, AL 35816-1822

RE: Contract No. : W912DY-10-D-0023, Task Order 0009
Remedial Investigation / Feasibility Study, The Former Camp Butner, North Carolina

Dear Ms. Tadesse:

This letter is to certify that the following individuals from HydroGeoLogic, Inc. are fully qualified to fill the positions listed below in order to perform Munitions Response operations at the Former Camp Butner project. Additionally, these individuals are in full compliance with 18 U.S.C 842.

Name	Position	Corps #
Scott Schroepfer	SUXOS/UXOQCS/UXOSO	1483
Robert Paoletti	SUXOS/UXOQCS/UXOSO	2233
David Wilson	SUXOS/UXOQCS/UXOSO	0594
Ron Mulvey	SUXOS/UXOQCS/UXOSO	0221
Joel Sanders	SUXOS/UXOQCS/UXOSO	0813
Clifton Ancelet Sr.	SUXOS/UXOQCS/UXOSO	1853
Oscar Honne	UXO Tech 3	2905
Lamel Jones	UXO Tech 3	2104
Christopher Powers	UXO Tech 2	2517
Jeremy Amiotte	UXO Tech 2	1950
William Zow	UXO Tech 2	2365
Nathan Ancelet	UXO Tech 1	2337
Charles Brewer	UXO Tech 1	1167

The above mentioned individuals are fully qualified to fill the UXO positions and perform all required Munitions Response activities per DDESB TP-18 dated 20 December 2004.

Sincerely,

Digitally signed by Derek R. Anderson
DN: cn=Derek R. Anderson, o=HydroGeoLogic, Inc., ou=Professional Engineer, email=danderson@hgl.com, c=US
Date: 2012.02.03 07:43:54 -05'00'

Derek R. Anderson, P.E.
Project Manager

cc:
Chris Cochrane, CEHNC-OE-DC
Greg Parsons, CEHNC-OE-S

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Phone: (505) 341-2010 Fax: (505) 341-2011
www.hgl.com

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APPENDIX H

TPP WORKSHEETS

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U.S. Army Corps of Engineers

Final
Technical Project Planning Memorandum & Associated Documentation

In Support of

Remedial Investigation/Feasibility Study (RI/FS) Project

Project Site:
Munitions Response Sites (5)
Former Camp Butner
Butner, North Carolina

Project No. I04NC000902

March 2012

prepared for:
U.S. Army Engineering and Support Center, Huntsville
and
U.S. Army Corps of Engineers, Kansas City District

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Contract No. W912DY-10-D-0023
Task Order No. 009

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Technical Project Planning Memorandum

Subject: Documentation of Technical Project Planning Project Team Concurrence for Remedial Investigation / Feasibility Study Project

Site: Former Camp Butner Munitions Response Sites (5), Butner, North Carolina

Contract: Contract No. W912DY-10-D-0023, Delivery Order No. 009

Date: March 14, 2012

This document serves as a record of the Technical Project Planning (TPP) meeting for the Remedial Investigation / Feasibility Study (RI/FS) for the five Munitions Response Sites (MRS) associated with the former Camp Butner in Butner, North Carolina. The TPP Team members listed below indicated concurrence with the technical approach described during the TPP meeting held at the Army National Guard (ARNG) Range Conference Room in Butner, North Carolina, on November 10, 2011.

The five MRSs included in the scope of the RI/FS include the following:

- Flame Thrower Range (FTR)
- Hand Grenade Range (HGR)
- Range Complex 1 (RC-1)
- RC-2
- ARNG property

HydroGeoLogic, Inc. (HGL) developed an initial technical approach to characterize the nature and extent of munitions and explosives of concern (MEC) and munitions constituents (MC) at the five MRSs using available site information, including the Archives Search Report (ASR), Engineering Evaluation / Cost Analysis (EE/CA), and removal action reports and other pertinent documents. The approach was outlined in HGL's proposal and is also detailed in Section 4 of this TPP memorandum package. The technical approach was briefed during the TPP meeting and will be utilized in the development of the site-specific RI work plan, which will be submitted to the project stakeholders for review.

The TPP meeting began at 0900 eastern time and, following introductions, HGL presented a summary of past Department of Defense (DoD) activities at the site and proposed RI activities (See Section 10 for TPP Meeting Presentation Slides). As part of the TPP process, discussions were held by participants regarding the proposed activities for each MRS.

FTR and HGR - it was discussed that enough data exists through previous removal actions and EE/CAs to fully characterize the areas. No additional field work is planned for the RI but the site will be carried through the process through the Decision Document (DD) just as the other three MRSs.

The technical approach for RC-1, RC-2, and the ARNG sites are based upon the history of the sites in terms of munitions usage and past clearance activities and removal actions (RAs). During Camp Butner training activities, various types of munitions were utilized. Munitions deployed at Camp Butner include small arms; hand grenades; rifle grenades; practice landmines; 20 through 240 mm projectiles; 60 and 81mm mortars; and 2.36-inch rockets. During the completion of previous investigation activities, numerous areas have been investigated and/or cleared. Using the existing EE/CA and RA data, the nature and extent of MEC has been characterized for significant portions of RC1 and RC2. However, EE/CA and RA coverage was generally limited to low density residential dwellings, typically along main roadways; therefore, significant expanses of RC1 and RC2 have not been investigated or characterized. Furthermore, no characterization activities have been conducted on the ARNG property. Existing coverage and proposed coverage are discussed in the Conceptual Site Model (CSM), Section 6.

Utilizing data presented in the ASR, information produced during EE/CA field activities, and the TEC 2001 historical aerial photograph analysis HGL developed boundaries for interpreted impact areas. The technical approach for areas inside the interpreted impact areas includes the following: (1) mag-and-dig intrusive investigations of anomalies located along transects of varying spacing, and (2) Digital Geophysical Mapping (DGM) investigations of grids in areas of high, medium, and low anomaly density. A minimum of 20 percent% of the transect acreage will also be investigated using grids. Grids will be evaluated using DGM techniques that incorporate intrusive investigation of MEC-like anomalies in the grids. Intrusive transects will be placed within the HGL interpreted impact areas, which are based on the TEC 2001 GIS-Based Aerial Photo Analysis and past investigations.

The strategy for areas outside of the interpreted impact areas will be investigated in a similar fashion as the interpreted impact areas but with geophysical anomaly data collected along reconnaissance transects of varying spacing. Specifics for RC-1, RC-2, and the ARNG MRS are described below.

RC-1 – Transect spacing in areas within the interpreted impact areas that were not previously investigated will be based upon the munition types known or suspected to be in the area with the default or minimum spacing of 500 feet. Along these lines, 300 foot spacing will be done in areas known or suspected of containing 37mm projectiles. Areas outside of the interpreted impact areas will be assessed through reconnaissance transects. See Figure 1-A for estimated transects and grids including reconnaissance survey transects.

RC-2 – Transect spacing in areas within the interpreted impact areas that were not previously investigated will be based upon the munition types known or suspected to be in the area with the default or minimum spacing of 500 feet. Along these lines, 300 foot spacing will be done in areas known or suspected of containing 37mm projectiles. Areas outside of the interpreted impact areas will be assessed through reconnaissance transects. See Figure 1-B for estimated transects and grids including reconnaissance survey transects.

ARNG – Transect spacing in areas within the interpreted impact areas will be based upon the munition types known or suspected to be in the area with the default or minimum spacing of 500 feet. Along these lines, 300 foot spacing will be done in areas known or suspected of containing 37mm projectiles. Areas outside of the interpreted impact areas will be assessed through reconnaissance transects. See Figure 1-C for estimated transects and grids including reconnaissance survey transects.

Additional discussions were held concerning the ARNG area. The discussions are summarized below.

- CPT LeQuick mentioned that the National Guard utilizes the ranges to conduct approximately 70,000 man-days of training so scheduling access to the ARNG will have to be coordinated closely to minimize impacts to training schedules. He further indicated that the use of the ranges tends to be less during the winter months compared to the spring and summer.
- ARNG personnel indicated that control burns are performed over the ARNG property. The burns, usually conducted annually, are done on a cycle covering a portion or segment of the property each year. Scheduling of the RI fieldwork should be done to take advantage of the control burn schedule to reduce the vegetation clearance required for the RI.
- The ARNG property lies within the Falls Lake watershed, it was mentioned that any excavations covering more than a 1/4 acre of land would have to apply to for a permit. The permit requirement should not apply to the RI as the plan is to dig on individual anomalies across transects and grids and not clearing entire plots of land.
- ARNG has a process whereby they engage the local tribes regarding potential impacts to cultural issues. The ARNG does not foresee any issues but will look into engaging the tribes anyway to brief them on the project.

In addition to the TPP Team determinations stated above, the following specific issues and resolutions were noted:

- It was mentioned that LIDAR data may be available for the area that was collected through the State of North Carolina. The exact specifications of the data (e.g., resolution and file formats) was not known.
- No known endangered or federally recognized species are not to exist within the MRSs area of interest.
- Rights of Entry (ROE) may be an issue on some properties based upon previous removal actions. To support the ROE process, it was suggested that the Savannah District have a booth/kiosk setup at the public meeting to coordinate ROEs and to answer questions from the public.
- The U.S. Army Corps of Engineers (USACE) is looking into the potential use of the Metal Mapper and other geophysical survey discrimination tools for use at Camp Butner.

- The Data Item Descriptions (DiDs) for the contract have not been updated to include the use of Geophysical System Verifications (GSV) strips so the work plan will have to address the discrepancy.
- The HGL RI team should plot unexploded ordnance (UXO) discoveries from the Granville County Emergency Response (i.e., historically deed restricted area) and ARNG UXO finds (to be provided) during the RI as well as existing removal action data to ensure a comprehensive understanding is reflected in the RI.
- MC screening levels discussed - will include Screening levels as agreed upon by the Project Team will be based on the EPA Regional Screening Level (RSL), North Carolina Groundwater Protection Standards. Screening level standards are further discussed in Section 6, CSM.
- The approach for MC sampling will include 10 samples collected from each MRS. Incremental sampling (IS) will be performed on the surface. If that shows an exceedance of the screening values, a discrete sub-surface sample will be collected in the same general area. If no exceedance, subsurface discrete samples will not be taken from the respective general area.
- Pre-and Post-blow in place sampling on MEC disposal shots will not be conducted. Studies have shown that the amount of MC remaining from a high-order disposal shot is minimal.
- Public meeting will be scheduled in coordination with the Remedial Advisory Board (RAB) meeting in the April time frame. HGL will secure the meeting area (the school gym has been used in the past as well as the Soldiers Memorial Sports Arena on 24th Street). The community RAB chair, Vicki Cates, has reserved both the Gym and the Butner Town Hall. HGL will coordinate with Vicki to select which facility best fits the needs of the group. HGL will also be responsible for the logistics including refreshments (no bottled water provided). Local news publications include the Oxford Ledger and the Raleigh Times for advertising public meetings.
- The Administrative Record is at the County Library. A second location which has copies of documents related to Camp Butner is the Butner Town Hall at 415 Central Avenue, Suite A.
- As a quality control measure, the names and size (i.e., acreage) of the MRSs should be checked against the FUDSMIS database.
- Automated brush clearing technology may be available for use as government furnished equipment (GFE) through the USACE.

In conclusion, the project team agreed with the basic strategy presented for the site and concurred with the technical approach outlined for the RI. The technical approach will be further refined in the work plan, which will be made available to the stakeholders for review. The technical approach will not be modified without consultation with the TPP Team members listed below. RI results will be fully documented in an RI report for TPP Team review.

The meeting concluded around 1330.

TPP Participants:

Mr. Ray Livermore USACE, SAW Project Manager	Ms. Marti Morgan NCDENR Project Manager
Ms. Chris Cochrane USAESCH Project Manager / COR	Ms. Amy Walker USAESCH Geophysicist
Mr. Cecil 'Bud' Morgan USAESCH Environmental Manager	Mr. Derek Anderson HGL PM
Jonathan Sperka HGL Deputy PM	Mr. Tim Bohannon USACE Savannah District OESS
Ms. Sara Mathews AMEC Risk Assessor	Mr. Raye Lahti AMEC Geophysicist

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TECHNICAL APPROACH

REMEDIAL INVESTIGATION/FEASIBILITY STUDY

MUNITIONS RESPONSE SITES

FORMER CAMP BUTNER
GRANVILLE COUNTY, NORTH CAROLINA

Contract No. W912DY-10-D-0023, Task Order No. 0009
USACE Project No. B07KS025607

Prepared for:

U.S. Army Engineering and Support Center, Huntsville
and
U.S. Army Corps of Engineers, Wilmington District

Prepared by:

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November 2011

1.0 INTRODUCTION

HydroGeoLogic (HGL) has designed a technical approach to perform a Remedial Investigation / Feasibility Study (RI/FS) for five (5) Munitions Response Sites (MRSs) on the former Camp Butner, a formerly used defense site (FUDS) (Site No. B07KS025607) in Granville County, North Carolina. The five (5) MRSs include the following:

- Army National Guard Property (ANG)
- Flame Thrower Range (FTR)
- Hand Grenade Range (HGR)
- Range Complex 1 (RC1)
- Range Complex 2 (RC2)

Brief descriptions of each MRS are included in the Conceptual Site Model (CSM) Section 6.

The RI/FS is being conducted pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and in accordance with (IAW) Department of Defense (DoD), U.S. Army, and USACE regulations and guidance.

The primary goals of a CERCLA- based Military Munitions Response Program (MMRP) RI are (i) to collect and analyze the data necessary to determine the nature and extent of munitions and explosives of concern (MEC) and munitions constituents (MC) contamination, and (ii) to conduct a baseline risk assessment to quantify risk and explosives safety concerns to human health and the environment. The primary objective of an MMRP FS is to ensure that appropriate remedial alternatives are developed and evaluated and that an appropriate remedy is selected. For the MMRP, the FS is the mechanism in the remedial process for the development, screening, and detailed evaluation of alternative munitions response options that will result in timely and appropriate decisions for protecting human health, safety, and the environment. The accuracy and completeness of the RI characterization of the site conditions with respect to MEC and MC is critical to the evaluation of available technologies performed during the FS.

The scope of the work for the Camp Butner project also includes preparation of a Proposed Plan (PP) and a Decision Document (DD) for each MRS.

HGL has reviewed the performance work statement and the historical site-specific information provided by U.S. Army Engineering and Support Center Huntsville (USAESCH), including the prior Engineering Evaluation / Cost Analysis (EE/CA) and MEC removal actions (RA) activities as part of the development of the technical approach for the RI/FS.

HGL's proposed approach to the investigation is to perform a combination of instrument-assisted intrusive investigations (hereafter referred to as mag-and-dig), instrument-assisted surface reconnaissance, and digital geophysical mapping (DGM) across select grids to characterize the nature, density, and extent of MEC at each MRS. Locations and spacing of transects and sampling grids is based upon statistical analysis performed with the Visual Sampling Plan (VSP) and UXO Estimator tools.

Munitions Constituents (MC) sampling will be performed at applicable MRSs to augment existing environmental sampling data to fully characterize the nature and extent of MC in the RI in order to support the FS and follow-on DD.

HGL understands that the technical approach for MEC investigations and MC sampling are subject to change during the TPP process. The following provides a task-by-task discussion of the proposed technical approach.

2.0 PLANNING DOCUMENTS

A work plan (WP) will be developed to describe the goals, methods, procedures, and personnel for the field investigation and data gathering activities. The WP will discuss the procedures necessary to characterize the nature and potential threat to human health and/or the environment posed by MEC and will address plans for assessing risk in accordance with the U.S. Environmental Protection Agency (EPA) Risk Assessment Guidance (RAGs).

The WP will contain the methodology to gather data to support the analysis and design of potential response actions by assessing the following factors:

- ✓ Physical characteristics of the property.
- ✓ Characteristics/classification of surface water, groundwater, soil, and sediment.
- ✓ Characteristics of the MEC/MC (e.g., quantities, concentrations, toxicity, persistence, mobility, depth, nature and extent, etc.)
- ✓ Actual and potential pathways through environmental media.
- ✓ Actual and potential exposure routes.
- ✓ Other factors such as sensitive populations that pertain to the characterization of the site or support the analysis of potential remedial action alternatives.

In addition to the conceptual items listed above, the WP will contain various sub- plans and elements (e.g., technical management plan, accident prevention plan [APP], and sampling and analysis plan [SAP]) that will be used to identify specific procedures for execution of the technical approach. Based on recent project experience with the USACE on other MMRP RI/FS task orders (TOs) and a close evaluation of the Data Item Description (DID) requirements, it is noted that the Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) will be included as part of the SAP to address MC.

The data collected during the RI will be used to characterize the nature and extent of MEC and MC at the applicable MRSs and be used to identify Applicable or Relevant and Appropriate Requirements (ARARs), Preliminary Remediation Goals (PRGs), Remedial Action Objectives (RAOs) and to screen various technologies for the development of remedial alternatives.

HGL will also develop an explosives siting plan (ESP) for the RI IAW DoD 6055.09-STD, Chapter 12; EM 385-1-97, Errata Sheet #3; and DID WERS-003.01. The ESP will be a stand-alone document appended to the WP and will be reviewed and approved by the Department of Defense Explosive Safety Board (DDESB) prior to the commencement of field activities.

3.0 MANAGEMENT OF GEOGRAPHIC INFORMATION SYSTEM DATA

HGL will develop an initial conceptual site model (CSM) with geographic information system (GIS) software based upon data available for the project site. GIS project data will be managed in accordance with (IAW) Contract Data Item Description (DID) MR-005-07.01, EM 200-1-2, EM 1110-1-4009, and applicable IGDs. The GIS will be used to update the CSM as data are collected and analyzed throughout the project. The GIS will incorporate geospatial data and other information in the geodatabase provided by USAESCH as U.S. Government-furnished information.

A pre-RI version of the CSM will be included in the WP. After the RI fieldwork has been completed, the results of the fieldwork will be incorporated into the GIS database and CSM. These results will include the location of MEC found during the investigation; the locations and types of any incidental material potentially presenting and explosive hazard (MPPEH), and/or munitions debris (MD) finds; and the locations and results of environmental sampling activities conducted as part of the RI. At the conclusion of the project, the geodatabase will be delivered to the USAESCH in its native ArcGIS electronic format.

4.0 RI FIELD WORK

EE/CA and removal activities have been conducted at Camp Butner including 580 grids distributed throughout RC1 and RC2 (23,892 acres) and also grids within FTR and HGR. As a result, enough data exists to effectively characterize the nature and extent of MEC and MC at the FTR and HGR along with significant portions of RC1 and RC2. Therefore, the field efforts will focus on the remaining portions of RC1 and RC2 along with the ANG MRS.

Utilizing data presented in the Archives Search Report (ASR) and information produced during field activities, area boundaries were developed during the EE/CA. HGL has additionally defined "interpreted impact areas" within those boundaries based on a 2001 historical aerial photograph analysis and EE/CA and RA findings.

Strategy for Areas Inside of the HGL Interpreted Impact Area

The ANG Property, RC1, and RC2 MRSs are composed of various types and sizes of ranges as outlined in the 2003 ASR Supplement. The historic ranges associated with RC1 and RC2 as described in the ASR Supplement are as follows:

The investigation strategy proposed for the interpreted impact area portions of each of these areas is similar: (1) conduct mag-and-dig intrusive investigations of anomalies located along

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transects of varying spacing, and (2) incorporate DGM investigations of grids in areas of high, medium, and low anomaly density. A minimum of 20% of the transect acreage will also be investigated using grids. Grids will be evaluated using DGM techniques that incorporate intrusive investigation of MEC-like anomalies in the grids. Intrusive transects will be placed within the HGL interpreted impact areas.

Strategy for Areas Outside of the HGL Interpreted Impact Area

HGL will collect geophysical anomaly data along reconnaissance transects of varying spacing.

The 2001 aerial GIS-Based Aerial Photograph Analysis identifies small pockets of ground scars, cleared earth, and other similar disturbances that was not included in HGL interpreted impact areas.

The strategy for areas outside of the interpreted impact areas will be investigated in a similar fashion as the interpreted impact areas but with geophysical anomaly data collected along reconnaissance transects of varying spacing. Specifics for RC-1, RC-2, and the ARNG MRS are described below.

RC-1 – Transect spacing in areas within the interpreted impact areas that were not previously investigated will be based upon the munition types known or suspected to be in the area with the default or minimum spacing of 500 feet. Along these lines, 300 foot spacing will be done in areas known or suspected of containing 37mm projectiles. Areas outside of the interpreted impact areas will be assessed through reconnaissance transects.

RC-2 – Transect spacing in areas within the interpreted impact areas that were not previously investigated will be based upon the munition types known or suspected to be in the area with the default or minimum spacing of 500 feet. Along these lines, 300 foot spacing will be done in areas known or suspected of containing 37mm projectiles. Areas outside of the interpreted impact areas will be assessed through reconnaissance transects.

ARNG – Transect spacing in areas within the interpreted impact areas will be based upon the munition types known or suspected to be in the area with the default or minimum spacing of 500 feet. Along these lines, 300 foot spacing will be done in areas known or suspected of containing 37mm projectiles. Areas outside of the interpreted impact areas will be assessed through reconnaissance transects..

A percentage of grids will be placed in these outlying areas as described in the CSM. The grids will be evaluated with DGM and intrusive investigation of MEC-like anomalies.

4.1 SITE PREPARATION

HGL will establish a field office at a centrally located area. HGL will site an explosives magazine IAW the approved ESP for the storage of commercial demolition explosives. HGL will clear as little vegetation as possible in order to support the operations as HGL is aware that some property owners may have concerns that transect paths cut through wooded areas promote trespassing. Therefore, when transect pathway clearance is required, pathways will be limited to a nominal width of four 4 feet. Brush clearing will be accomplished by a small brush clearing team consisting of at least one a UXO Technician II and an equipment operator using a tracked loader with mulching head or brush-hog attachment. Brush clearing personnel will don appropriate personal protective equipment (PPE) during brush clearing activities. During brush clearing, any surface MEC items encountered will be marked for subsequent disposed of as described in the MEC Disposal section. MEC encounters during brush clearance activities will be documented for inclusion in the RI report.

4.2 EVACUATIONS

HGL will provide for evacuations and temporary relocation of local residences who are located within defined safety exclusion zones as needed to support the fieldwork. It is not anticipated that overnight lodging will be required for the evacuated personnel; rather, evacuations will occur during normal field hours (7:00 a.m. through 5:00 p.m.). HGL will make arrangements with the a local community center, church, or hotel, with handicap access, for individuals who do not have a place to stay during the time intrusive investigations are taking place. Transportation, if needed, will be provided and refreshments will be available. Schedules for garbage collection, school bus pick-up/drop- off, and mail delivery will be obtained to sequence field activities and minimize impacts to these services. To ensure safety of the public, road-guards will be posted to notify field teams of traffic in order to stop work to allow traffic to pass. If possible, and acceptable to the local police department, temporary road blocks may be erected to maintain efficiencies in fieldwork, thereby reducing the impact to local residents/businesses.

HGL will work closely with individuals and businesses whose property may be affected by intrusive investigations to ensure that everyone is kept informed throughout the process. Planned communication activities will include face-to-face meetings, mailings, and telephone contact. During the completion of the project, HGL will establish a toll-free telephone number for local public use as a way to obtain project-specific information. The Camp Butner website will be updated weekly to depict project activities and progress and to identify plans and locations for on-going and future work.

5.0 REMEDIAL INVESTIGATION REPORT

HGL will prepare an RI Report IAW DID WERS-010.01, US Army MMRP RI/FS guidance (US Army, 2009), EP 1110-1-18 (USACE, 2000), and IGD 06-04 (USACE, 2006) in draft, draft final, and final versions. Major components of the RI Report include Site Characterization, MRS Characterization for MEC, MC, Data Evaluation, Human Health and Ecological Risk Assessments based on current and future land use, and Recommendations including No Further Action and Assessment of Required Interim Measures.

HGL will incorporate all relevant previously collected data into the RI Report. If warranted, HGL will recommend MRS boundary changes within the RI Report. The following paragraphs detail some of the key aspects of these assessments.

Site Characterization: HGL will document the physical characteristics of the property, soil, sediment, surface water and groundwater, the types, quantity and concentration of MEC and MD, the extent of observations, actual and potential exposure routes to human and ecological receptors, and other factors that may affect characterization.

MRS Characterization for MEC: HGL will describe the technology selected for MEC characterization, the survey design utilized, analysis of the geophysical data, anomaly discrimination and interpretation and results of the intrusive investigation. Activities associated with this section are described in detail in Task 4, RI/FS Field Activities, herein.

MC Characterization: HGL will describe the media, environmental sample locations and techniques, sample interval selection and rationale, analytical methods and results, and data validation processes incorporated to ensure data representativeness and accuracy. Activities associated with this section are described in detail in the Environmental Sampling and Analysis Section below.

HHRA: HGL assumes that a comprehensive HHRA will not be conducted. Pending the results of the geophysical surveys, and supplemental sampling to determine the presence or absence of MC, a human health risk-based screening will be performed that compares the maximum site constituent concentration to the most stringent of USEPA RSLs and NCDENR human health screening criteria to identify chemicals of potential concern (COPCs). Identified COPCs will be evaluated further in the HHRA. Private land owners, recreational users, and workers are anticipated to be the primary exposure receptors. Upon review of existing information from TPP meetings, land use conditions, etc., a more detailed discussion of site conditions and potential exposure scenarios will be developed. A toxicity assessment and a risk characterization will also be included in the HHRA. The principal guidance include: Risk Assessment Guidance for Superfund (RAGS) (Parts A through E) (US EPA, 1989, 1991, 2001, and 2004) and EM 200-1-4, Volume I Human Health Evaluation (USACE, 1999). Ecological Risk Assessment: A screening level ecological risk assessment (SLERA) will be developed based on the existing data and all subsequent data collected from the various MRS locations to determine the presence/absence of MC. Available published ecological-based screening levels will be used including the USEPA ecological soil screening levels. A review of existing information as to the potential for sensitive habitats in the affected areas will be included. It is assumed that the ERA process will not continue beyond the SLERA. The principal guidance documents that will be used in conducting the ecological risk assessment include, but are not limited to: EM 200-1-4, Volume II Environmental Evaluation (USACE, 1996), Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997), and NCDENR guidance. If recommended by the PDT, a baseline risk assessment will be conducted.

The risk assessments will be prepared as an appendix to the RI report and summarized in the main body of the RI report. The risk assessments will be structured per the guidance materials to include an exposure evaluation that addresses chemical fate and transport to the receptors and the factors that may affect potential bioavailability, persistence, and bioaccumulation potential. Toxicity evaluations and characterization of risks will also be described. Output from software used during the risk assessment will be included in the appendix to the RI report.

MEC Risk Assessment: HGL will complete the MEC Risk Assessment IAW the guidance provided in the MEC HA Methodology, Interim (US EPA, 2008). The MEC HA methodology provides guidance assessing explosive hazards to human receptors at MRS locations and reflects the fundamental difference between assessing the chronic chemical exposure risk and assessing the acute MEC explosive hazards.

Munitions Response Site Prioritization Protocol (MRSPP): HGL will use the data from the RI field activities to update MRSPP forms for each resulting MRS, and compile information as a stand-alone document for insertion as an appendix into the RI Report. HGL will submit a draft RI report after completion of fieldwork as indicated in the project schedule. HGL defines completion of fieldwork as 100% completion the RI/FS Field Activities. The draft RI report will be submitted to the USACE. HGL will submit a draft final RI report within 21 days of receiving review comments on the draft version. The final RI report will be submitted within 14 days of receipt of review comments on the draft final version and the third TPP meeting. Our project schedule includes a 30-day review period for each deliverable.

6.0 FEASIBILITY STUDY REPORT

HGL will prepare an FS Report IAW DID WERS-010.01, EP 1110-1-18 (USACE, 2000), and IGD06-04 (USACE, 2006) in draft, draft final and final versions. The FS Report will be submitted in Task 5, Remedial Investigation Report. The FS will include the following subtask items: Preliminary ARARs Identification Technical Memorandum: This subtask includes the identification and description of site-specific, chemical-specific, and ARARs. Efforts to identify ARARs will be conducted throughout the RI process. HGL will identify and submit ARARs to the PDT in a Preliminary ARARs Identification Technical Memorandum in a format appropriate for direct incorporation into the FS report.

Remedial Action Alternatives Screening Memorandum: HGL will formulate remediation alternatives based upon ARARs identified throughout the RI process, and will separately consider environmental media as applicable.

Development of potential alternatives will include long-term management of waste or residuals, containment with little or no treatment, and/or no action. The memorandum will include remedial action objectives, preliminary remediation goals, general response actions, identification of applicable technologies, and development of alternatives. The memorandum will include screening alternatives for effectiveness, implementability, and cost. The memorandum will be presented in a format appropriate for direct incorporation into the FS report.

Remedial Alternatives Evaluation Memorandum: HGL will describe each alternative, outlining the strategy and ARARs associated with each alternative, including a discussion of the performance of each alternative with respect to selection criteria, while summarizing and tabulating the results. HGL will provide a detailed analysis of remedial alternatives addressing surface and subsurface soil, groundwater, surface water and sediment, as appropriate, and use USEPA's three-tiered approach in determining remedial alternatives. The evaluation criteria include 1) Threshold Criteria, 2) Modifying Criteria, and 3) Primary Balancing Criteria. Threshold Criteria includes a) Overall protection of human health and the environment and b) Compliance with identified ARARs. Modifying Criteria includes a) State regulatory acceptance and b) Community acceptance. Primary Balancing Criteria includes a) Long term effectiveness and permanence, b) Reduction of toxicity, mobility, and volume through treatment, c) Short term effectiveness, d) Implementability, and e) Cost.

7.0 PROPOSED PLAN

HGL will prepare a PP written in non-technical language that is understandable by the general public. HGL will prepare the PP IAW CERCLA, ER 200-3-1 (USACE, 2004b) and Errata Sheet #1 dated 4 December 2007, EP 1110-1-18 (USACE, 2000), and IGD 06-04 (USACE, 2006), and will include a brief summary description of the remedial alternatives evaluated in the FS. We will clearly outline the decision-making process, presenting the results of the data collection, rationale for interpreting analytical results, outcome of the risk assessments, and how all of these data relate to a remedial alternative. The PP will include a summary of formal comments received from regulators; a summary explanation of any proposed ARAR waiver(s), and will identify and provide a discussion of the rationale that supports the preferred remedial alternative. HGL will submit a draft PP to the USACE only within 14 days of the acceptance of the FS report. HGL will submit a draft final PP 14 days after receipt of comments on the draft PP. Following a 30-day public review period of the revised draft final PP, HGL will conduct a public meeting to discuss the PP with interested stakeholders. HGL will submit a final PP that incorporates and/or addresses public comments along with meeting minutes documenting the public discussions within 14 days following the public meeting.

8.0 DECISION DOCUMENT

HGL will prepare a DD for each MRS IAW CERCLA, ER 200-3-1 (USACE, 2004b), EP 1110-1-18 (USACE, 2000), IGD 06-04 (USACE, 2006), and Appendix C of the PWS. HGL will submit draft, draft-final, and final DD(s). The final DD will include a responsive summary.

9.0 COMMUNITY RELATIONS

HGL will provide community relations support throughout the project life to accomplish project requirements and objectives. The HGL Team will attend and participate in two public meetings and five RAB meetings to be held in the Butner, NC area. One of the public meetings will be held to discuss the PP with interested stakeholders. Community relations support tasks include delivery of presentations, graphics and development and production of handout materials. HGL will submit all presentation materials to USACE for approval not later than 21 days prior to the meetings and make them available to the public seven days prior to the meeting. HGL will also coordinate the logistical support for these meetings

10.0 PUBLIC INVOLVEMENT PLAN

A detailed PIP will be developed IAW USACE guidance documents ER 200-3-1 and EP 1110-3-8, EM CX Interim Guidance 06-04, and guidance provided in the FUDS Public Involvement Toolkit and on the DoD Environment, Safety and Occupational Health Network and Information Exchange (DENIX) website. Provisions of the National Contingency Plan will apply, as the project is scheduled to last more than 120 days. The PIP will document the concerns of the public about the site identified during community interviews and will provide a detailed description of the public involvement activities planned based on USACE guidance and information obtained from the interviews. Public involvement activities will include a project website, fact sheet, and public meetings. All documents developed for the public will be forwarded to USAESCH Operational Security for review and approval prior to public release.

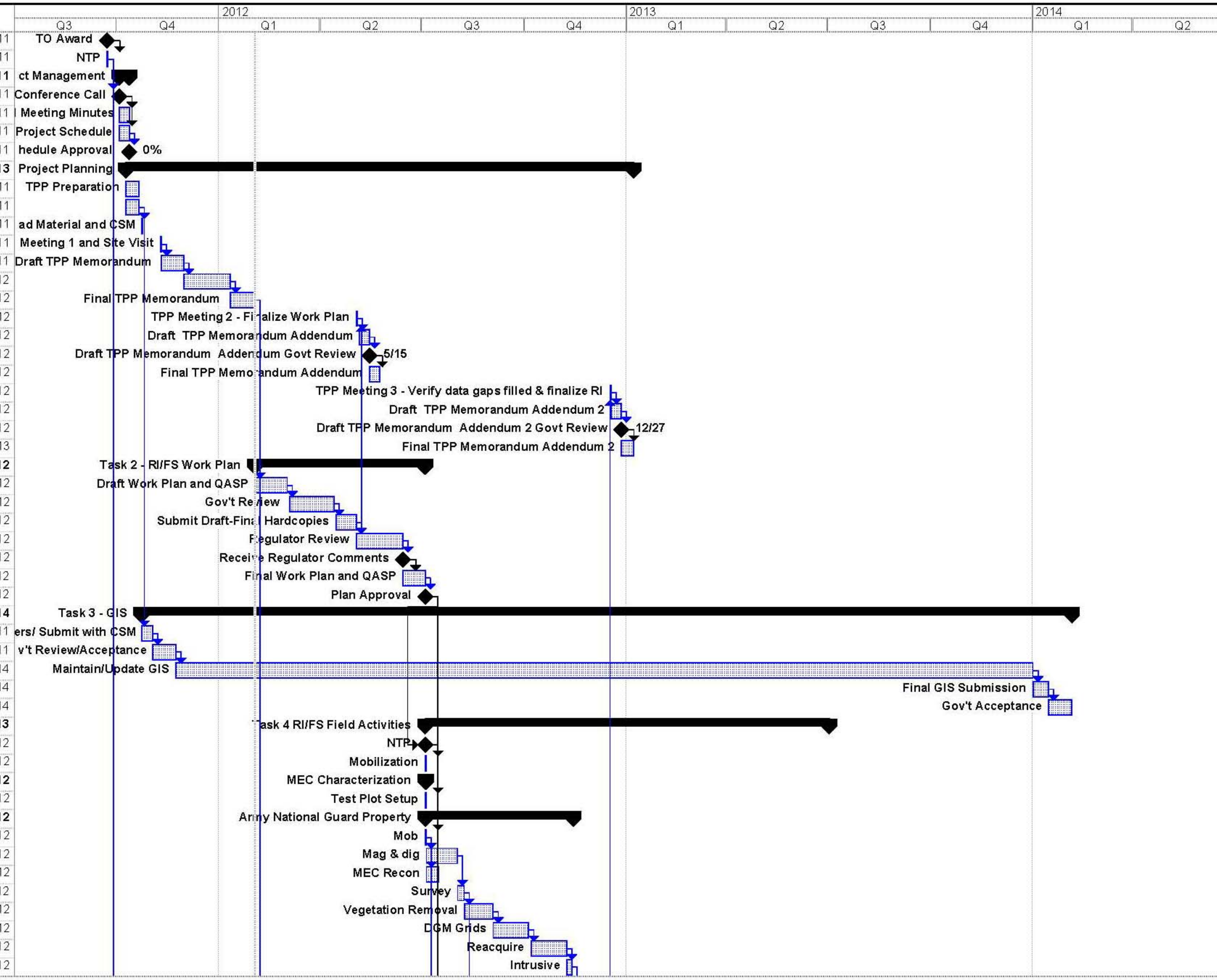
The PIP will also identify and provide contact information for key stakeholders, media outlets, and public meeting locations and will detail how stakeholders may become involved and provide feedback to the USACE. The PIP will be continually updated to provide the most current, complete information. HGL will submit a draft PIP at a time to be determined over the course of the project. A draft final PIP will be submitted 14 days after receipt of draft PIP comments, and a final version of the PIP will be submitted 7 days after receipt of draft final PIP comments.

11.0 ADMINISTRATIVE RECORD FILE

HGL will establish and maintain a project repository and Administrative Record (AR) IAW the guidance given in Chapter 4 (Establishing and Maintaining Administrative Records) of EP 1110-3-8 (USACE, 2004a) and Standard Operating Procedure for FUDS Records Management, Revision 5, dated January 2008. The documents available for public review will be housed at a local library or other suitable location. HGL will closely coordinate with the USACE to secure all required documents necessary to support the AR. The project repository and AR will be updated by HGL on a monthly basis, and made available to the public, for the duration of the contract. Final electronic document files will be in text-searchable (*.pdf) format. Final documents in the AR suitable for placement on the Project Information Retrieval System (PIRS) website will be provided on CD/DVD to appropriate entities, including USACE, at the end of the project.

Schilling AFB TPP Memorandum

ID	Task Name	Duration	Start	Finish
1	TO Award	0 days	Fri 9/23/11	Fri 9/23/11
2	NTP	1 day	Fri 9/23/11	Fri 9/23/11
3	**Project Management**	**7 days**	**Tue 10/4/11**	**Wed 10/12/11**
4	Kick-Off Conference Call	0 days	Tue 10/4/11	Tue 10/4/11
5	Kick-Off Conference Call Meeting Minutes	7 days	Tue 10/4/11	Wed 10/12/11
6	Project Schedule	7 days	Tue 10/4/11	Wed 10/12/11
7	Schedule Approval	0 days	Wed 10/12/11	Wed 10/12/11
8	**Task 1 - Technical Project Planning**	**326 days**	**Mon 10/10/11**	**Mon 1/7/13**
9	TPP Preparation	10 days	Mon 10/10/11	Fri 10/21/11
10	CSM Preparation	10 days	Mon 10/10/11	Fri 10/21/11
11	Submit Read Ahead Material and CSM	1 day	Mon 10/24/11	Mon 10/24/11
12	TPP Meeting 1 and Site Visit	1 day	Thu 11/10/11	Thu 11/10/11
13	Draft TPP Memorandum	14 days	Fri 11/11/11	Wed 11/30/11
14	Draft TPP Memorandum Govt Review	30 days	Thu 12/1/11	Wed 1/11/12
15	Final TPP Memorandum	16 days	Thu 1/12/12	Thu 2/2/12
16	TPP Meeting 2 - Finalize Work Plan	1 day	Fri 5/4/12	Fri 5/4/12
17	Draft TPP Memorandum Addendum	7 days	Mon 5/7/12	Tue 5/15/12
18	Draft TPP Memorandum Addendum Govt Review	0 days	Tue 5/15/12	Tue 5/15/12
19	Final TPP Memorandum Addendum	7 days	Wed 5/16/12	Thu 5/24/12
20	TPP Meeting 3 - Verify data gaps filled & finalize RI	1 day	Tue 12/18/12	Tue 12/18/12
21	Draft TPP Memorandum Addendum 2	7 days	Wed 12/19/12	Thu 12/27/12
22	Draft TPP Memorandum Addendum 2 Govt Review	0 days	Thu 12/27/12	Thu 12/27/12
23	Final TPP Memorandum Addendum 2	7 days	Fri 12/28/12	Mon 1/7/13
24	**Task 2 - RI/FS Work Plan**	**109 days**	**Fri 2/3/12**	**Wed 7/4/12**
25	Draft Work Plan and QASP	21 days	Fri 2/3/12	Fri 3/2/12
26	Gov't Review	30 days	Mon 3/5/12	Fri 4/13/12
27	Submit Draft-Final Hardcopies	14 days	Mon 4/16/12	Thu 5/3/12
28	Regulator Review	30 days	Fri 5/4/12	Thu 6/14/12
29	Receive Regulator Comments	0 days	Thu 6/14/12	Thu 6/14/12
30	Final Work Plan and QASP	14 days	Fri 6/15/12	Wed 7/4/12
31	Plan Approval	0 days	Wed 7/4/12	Wed 7/4/12
32	**Task 3 - GIS**	**598 days**	**Mon 10/24/11**	**Wed 2/5/14**
33	Establish Baseline GIS Layers/ Submit with CSM	8 days	Mon 10/24/11	Wed 11/2/11
34	Gov't Review/Acceptance	15 days	Thu 11/3/11	Wed 11/23/11
35	Maintain/Update GIS	550 days	Thu 11/24/11	Wed 1/1/14
36	Final GIS Submission	10 days	Thu 1/2/14	Wed 1/15/14
37	Gov't Acceptance	15 days	Thu 1/16/14	Wed 2/5/14
38	**Task 4 RI/FS Field Activities**	**259 days**	**Wed 7/4/12**	**Tue 7/2/13**
39	NTP	0 days	Wed 7/4/12	Wed 7/4/12
40	Mobilization	1 day	Thu 7/5/12	Thu 7/5/12
41	**MEC Characterization**	**1 day**	**Thu 7/5/12**	**Thu 7/5/12**
42	Test Plot Setup	1 day	Thu 7/5/12	Thu 7/5/12
43	**Army National Guard Property**	**95 days**	**Thu 7/5/12**	**Wed 11/14/12**
44	Mob	1 day	Thu 7/5/12	Thu 7/5/12
45	Mag & dig	20 days	Fri 7/6/12	Thu 8/2/12
46	MEC Recon	7 days	Fri 7/6/12	Mon 7/16/12
47	Survey	4 days	Fri 8/3/12	Wed 8/8/12
48	Vegetation Removal	18 days	Thu 8/9/12	Mon 9/3/12
49	DGM Grids	24 days	Tue 9/4/12	Fri 10/5/12
50	Reacquire	24 days	Mon 10/8/12	Thu 11/8/12
51	Intrusive	3 days	Fri 11/9/12	Tue 11/13/12



RI/FS at Camp Butner 09/06/2011 HydroGeoLogic, Inc	Task	Milestone	Project Summary	External Milestone	Progress
	Split	Summary	External Tasks	Inactive Task	Deadline

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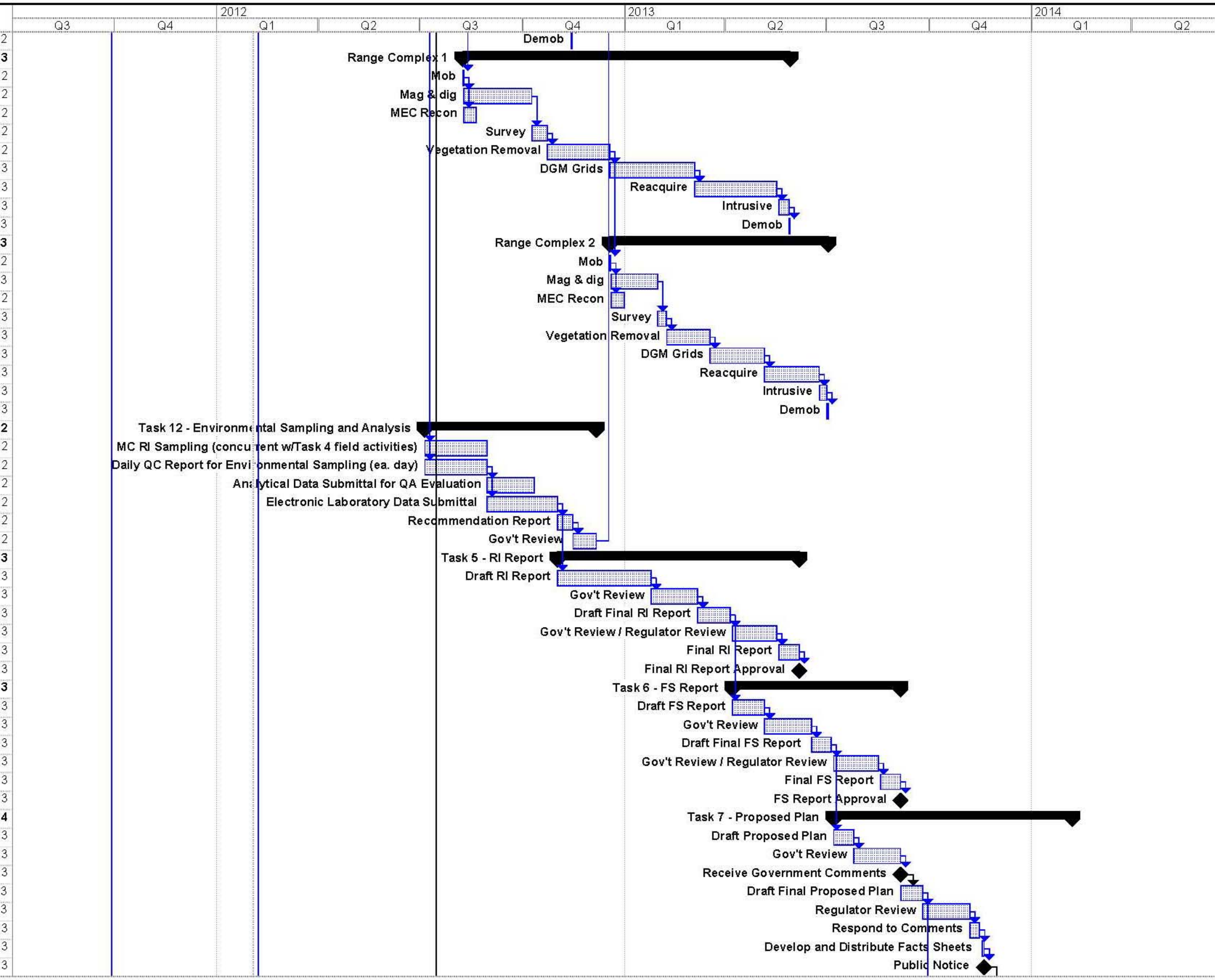
Schilling AFB TPP Memorandum

ID	Task Name	Duration	Start	Finish
52	Demob	1 day	Wed 11/14/12	Wed 11/14/12
53	**Range Complex 1**	**210 days**	**Thu 8/9/12**	**Wed 5/29/13**
54	Mob	1 day	Thu 8/9/12	Thu 8/9/12
55	Mag & dig	43 days	Fri 8/10/12	Tue 10/9/12
56	MEC Recon	7 days	Fri 8/10/12	Mon 8/20/12
57	Survey	10 days	Wed 10/10/12	Tue 10/23/12
58	Vegetation Removal	40 days	Wed 10/24/12	Tue 12/18/12
59	DGM Grids	54 days	Wed 12/19/12	Mon 3/4/13
60	Reacquire	54 days	Tue 3/5/13	Fri 5/17/13
61	Intrusive	7 days	Mon 5/20/13	Tue 5/28/13
62	Demob	1 day	Wed 5/29/13	Wed 5/29/13
63	**Range Complex 2**	**140 days**	**Wed 12/19/12**	**Tue 7/2/13**
64	Mob	1 day	Wed 12/19/12	Wed 12/19/12
65	Mag & dig	30 days	Thu 12/20/12	Wed 1/30/13
66	MEC Recon	8 days	Thu 12/20/12	Mon 12/31/12
67	Survey	6 days	Thu 1/31/13	Thu 2/7/13
68	Vegetation Removal	27 days	Fri 2/8/13	Mon 3/18/13
69	DGM Grids	35 days	Tue 3/19/13	Mon 5/6/13
70	Reacquire	35 days	Tue 5/7/13	Mon 6/24/13
71	Intrusive	5 days	Tue 6/25/13	Mon 7/1/13
72	Demob	1 day	Tue 7/2/13	Tue 7/2/13
73	**Task 12 - Environmental Sampling and Analysis**	**110 days**	**Fri 7/6/12**	**Thu 12/6/12**
74	MC RI Sampling (concurrent w/Task 4 field activities)	40 days	Fri 7/6/12	Thu 8/30/12
75	Daily QC Report for Environmental Sampling (ea. day)	40 days	Fri 7/6/12	Thu 8/30/12
76	Analytical Data Submittal for QA Evaluation	30 days	Fri 8/31/12	Thu 10/11/12
77	Electronic Laboratory Data Submittal	45 days	Fri 8/31/12	Thu 11/1/12
78	Recommendation Report	10 days	Fri 11/2/12	Thu 11/15/12
79	Gov't Review	15 days	Fri 11/16/12	Thu 12/6/12
80	**Task 5 - RI Report**	**155 days**	**Fri 11/2/12**	**Thu 6/6/13**
81	Draft RI Report	60 days	Fri 11/2/12	Thu 1/24/13
82	Gov't Review	30 days	Fri 1/25/13	Thu 3/7/13
83	Draft Final RI Report	21 days	Fri 3/8/13	Fri 4/5/13
84	Gov't Review / Regulator Review	30 days	Mon 4/8/13	Fri 5/17/13
85	Final RI Report	14 days	Mon 5/20/13	Thu 6/6/13
86	Final RI Report Approval	0 days	Thu 6/6/13	Thu 6/6/13
87	**Task 6 - FS Report**	**109 days**	**Mon 4/8/13**	**Thu 9/5/13**
88	Draft FS Report	21 days	Mon 4/8/13	Mon 5/6/13
89	Gov't Review	30 days	Tue 5/7/13	Mon 6/17/13
90	Draft Final FS Report	14 days	Tue 6/18/13	Fri 7/5/13
91	Gov't Review / Regulator Review	30 days	Mon 7/8/13	Fri 8/16/13
92	Final FS Report	14 days	Mon 8/19/13	Thu 9/5/13
93	FS Report Approval	0 days	Thu 9/5/13	Thu 9/5/13
94	**Task 7 - Proposed Plan**	**154 days**	**Mon 7/8/13**	**Thu 2/6/14**
95	Draft Proposed Plan	14 days	Mon 7/8/13	Thu 7/25/13
96	Gov't Review	30 days	Fri 7/26/13	Thu 9/5/13
97	Receive Government Comments	0 days	Thu 9/5/13	Thu 9/5/13
98	Draft Final Proposed Plan	14 days	Fri 9/6/13	Wed 9/25/13
99	Regulator Review	30 days	Thu 9/26/13	Wed 11/6/13
100	Respond to Comments	7 days	Thu 11/7/13	Fri 11/15/13
101	Develop and Distribute Facts Sheets	2 days	Mon 11/18/13	Tue 11/19/13
102	Public Notice	0 days	Tue 11/19/13	Tue 11/19/13



RI/FS at Camp Butner 09/06/2011 HydroGeoLogic, Inc	Task	Milestone	Project Summary	External Milestone	Progress	
	Split	Summary	External Tasks	Inactive Task	Deadline	

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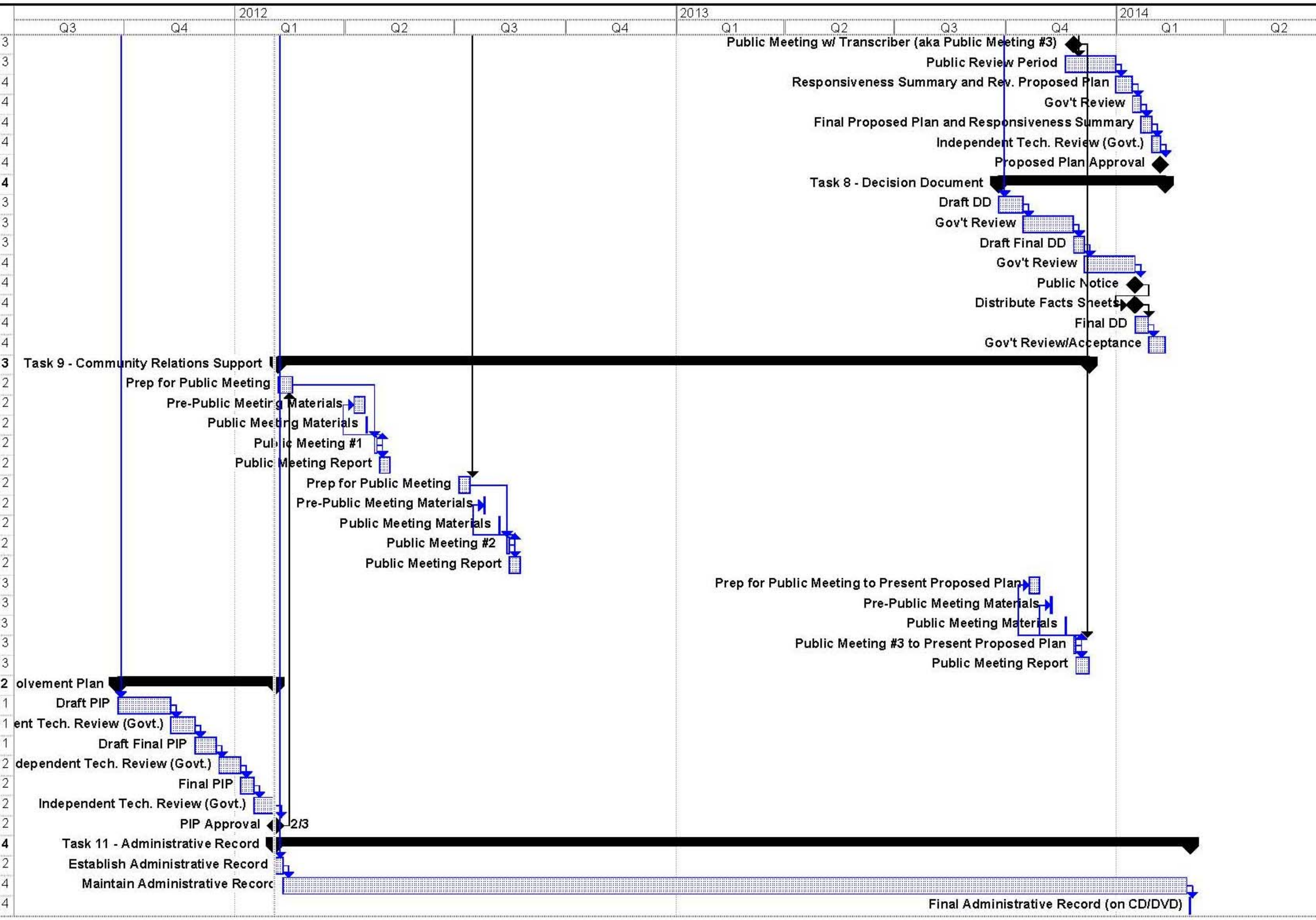
ID	Task Name	Duration	Start	Finish
103	Public Meeting w/ Transcriber (aka Public Meeting #3)	0 days	Tue 11/26/13	Tue 11/26/13
104	Public Review Period	30 days	Wed 11/20/13	Tue 12/31/13
105	Responsiveness Summary and Rev. Proposed Plan	10 days	Wed 1/1/14	Tue 1/14/14
106	Gov't Review	5 days	Wed 1/15/14	Tue 1/21/14
107	Final Proposed Plan and Responsiveness Summary	7 days	Wed 1/22/14	Thu 1/30/14
108	Independent Tech. Review (Govt.)	5 days	Fri 1/31/14	Thu 2/6/14
109	Proposed Plan Approval	0 days	Thu 2/6/14	Thu 2/6/14
110	**Task 8 - Decision Document**	**98 days**	**Thu 9/26/13**	**Mon 2/10/14**
111	Draft DD	14 days	Thu 9/26/13	Tue 10/15/13
112	Gov't Review	30 days	Wed 10/16/13	Tue 11/26/13
113	Draft Final DD	7 days	Wed 11/27/13	Thu 12/5/13
114	Gov't Review	30 days	Fri 12/6/13	Thu 1/16/14
115	Public Notice	0 days	Thu 1/16/14	Thu 1/16/14
116	Distribute Facts Sheets	0 days	Thu 1/16/14	Thu 1/16/14
117	Final DD	7 days	Fri 1/17/14	Mon 1/27/14
118	Gov't Review/Acceptance	10 days	Tue 1/28/14	Mon 2/10/14
119	**Task 9 - Community Relations Support**	**481 days**	**Mon 2/6/12**	**Mon 12/9/13**
120	Prep for Public Meeting	10 days	Mon 2/6/12	Fri 2/17/12
121	Pre-Public Meeting Materials	7 days	Mon 4/9/12	Tue 4/17/12
122	Public Meeting Materials	1 day	Thu 4/19/12	Thu 4/19/12
123	Public Meeting #1	2 days	Thu 4/26/12	Fri 4/27/12
124	Public Meeting Report	7 days	Mon 4/30/12	Tue 5/8/12
125	Prep for Public Meeting	7 days	Thu 7/5/12	Fri 7/13/12
126	Pre-Public Meeting Materials	1 day	Thu 7/26/12	Thu 7/26/12
127	Public Meeting Materials	1 day	Tue 8/7/12	Tue 8/7/12
128	Public Meeting #2	2 days	Tue 8/14/12	Wed 8/15/12
129	Public Meeting Report	7 days	Thu 8/16/12	Fri 8/24/12
130	Prep for Public Meeting to Present Proposed Plan	7 days	Mon 10/21/13	Tue 10/29/13
131	Pre-Public Meeting Materials	1 day	Fri 11/8/13	Fri 11/8/13
132	Public Meeting Materials	1 day	Wed 11/20/13	Wed 11/20/13
133	Public Meeting #3 to Present Proposed Plan	2 days	Wed 11/27/13	Thu 11/28/13
134	Public Meeting Report	7 days	Fri 11/29/13	Mon 12/9/13
135	**Task 10 - Public Involvement Plan**	**95 days**	**Mon 9/26/11**	**Fri 2/3/12**
136	Draft PIP	32 days	Mon 9/26/11	Tue 11/8/11
137	Independent Tech. Review (Govt.)	14 days	Wed 11/9/11	Mon 11/28/11
138	Draft Final PIP	14 days	Tue 11/29/11	Fri 12/16/11
139	Independent Tech. Review (Govt.)	14 days	Mon 12/19/11	Thu 1/5/12
140	Final PIP	7 days	Fri 1/6/12	Mon 1/16/12
141	Independent Tech. Review (Govt.)	14 days	Tue 1/17/12	Fri 2/3/12
142	PIP Approval	0 days	Fri 2/3/12	Fri 2/3/12
143	**Task 11 - Administrative Record**	**542 days**	**Fri 2/3/12**	**Mon 3/3/14**
144	Establish Administrative Record	5 days	Fri 2/3/12	Thu 2/9/12
145	Maintain Administrative Record	536 days	Fri 2/10/12	Fri 2/28/14
146	Final Administrative Record (on CD/DVD)	1 day	Mon 3/3/14	Mon 3/3/14



RI/FS at Camp Butner 09/08/2011 HydroGeoLogic, Inc	Task		Milestone		Project Summary		External Milestone	Progress	
	Split		Summary		External Tasks		Inactive Task	Deadline	

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Area Name	Acreage	Previous Land-Use	Past Investigations, Munitions Found or Suspected	Current Land Use	Future Land Use
Army National Guard Property	4,824ac	Army National Guard Property is situation in the southwestern portion of Range Complex 1, which contained an artillery impact area, 2 mortar ranges and several small arms ranges. Existing range fans for the artillery impact area were taken from historical maps, while the remainder of the range fans used were standard range fans for the individual type of range. All range fans remain within site boundaries and some range fans overlap with others within the complex.	Munitions types expected and/or identified included small arms, 2.36-inch rockets, rifle grenades, 37mm, 57mm, 105mm, and 155mm projectiles, 60mm and 81mm mortars based on data from the NCNG and the ASR. No known clearances.	Army National Guard Training	Army National Guard Training and Construction
Range Complex 1	12,363ac	Range Complex 1 (excluding Army National Guard Property) existed near the center of the site and contained an artillery impact area, 2 mortar ranges and several small arms ranges. Existing range fans for the artillery impact area were taken from historical maps, while the remainder of the range fans used were standard range fans for the individual type of range. All range fans remain within site boundaries and some range fans overlap with others within the complex.	Munitions types expected and/or identified included 37mm, 40mm, 57mm, 105mm, 155mm and 240mm projectiles, 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 2001 EE/CA: The EE/CA evaluated 77 acres primarily utilizing DGM to investigate ¼ acre grids (approximately total of 330 grids). Grids were distributed throughout suspected former munition use areas within RC1 and RC2. Intrusive results provided an indication of actual impact/munitions use areas. A total of 13 MEC and 1489 MD items were recovered during the EE/CA. 2003 Time Critical Removal Action: A TCRA was conducted at the Lakeview Residential Housing Subdivision within RC1 in 2003. Approximately 26 acres were intrusively investigated using analog techniques to a depth of 6-inches. MEC and MD were subsequently recovered. DGM was then conducted over areas previously investigated to a depth of six inches and identified additional anomalies. DGM was also conducted over portions of the properties in the Riley subdivision. A continuation of the TCRA was conducted in 2004 that included the investigation of anomalies identified at the Riley properties. MEC-like DGM anomalies were cleared to depth of detection. 2008, 2009, 2010 Non Time Critical Removal Actions: Portions of the Lakeview Subdivision that were previously only cleared to a depth of 6-inches were cleared to depth of detection. In addition, RA activities were completed at more than 250 parcels (average parcel was approximately 1.75ac).	ASR Supplement: Recreational Residential-Single Family Undeveloped	ASR Supplement: Recreational Residential-Single Family Undeveloped

Area Name	Acreage	Previous Land-Use	Past Investigations, Munitions Found or Suspected	Current Land Use	Future Land Use
			Land parcel grids investigated were distributed throughout RC1 and RC2. RA activities were generally focused around existing residential dwellings. Intrusive results indicate the presence of former impact and munitions-use areas. Munitions recovered included 37mm, 57mm, 105mm, and 155mm projectiles, 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 1958-69 Annual Surface Inspections: Area B: 2.36-inch rockets and 81mm mortars Area C: 2.36-inch rockets, 81mm mortars, 37mm, 105mm, 155mm, and 240mm projectiles Area D: 2.36-inch rocket, 37mm and 40mm projectiles Area E: 2.36-inch rocket Area F: No findings reported Other “Unrestricted” Areas: Hand grenades, 37mm, 40mm, 60mm, 81mm, 105mm, and 155mm projectiles and 2.36-inch rockets		
Range Complex 2	11,529ac	ASR Supplement: Range Complex 2 existed on the north side of the site and contained an artillery impact area, a mock village and 2 machine gun ranges. The range fan for the artillery impact area was taken from historical maps, while the remainder of the range fans used were standard range fans for the individual type of range. All range fans remain within site boundaries and some range fans overlap with others within the complex. The entire complex is currently under private ownership. West Artillery Impact Area Rifle/MG Range 1 Rifle/MG Range 2 Mock German Village	Munitions types expected and/or identified included 37mm, 40mm, 57mm, 105mm, 155mm and 240mm projectiles, 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 2001 EE/CA: The EE/CA evaluated 77 acres primarily utilizing DGM to investigate ¼ acre grids (approximately total of 330 grids). Grids were distributed throughout suspected former munition use areas within RC1 and RC2. Intrusive results provided an indication of actual impact/munitions use areas. A total of 13 MEC and 1489 MD items were recovered during the EE/CA. Munitions types identified at these MRSs included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles, 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 2008, 2009, 2010 Non Time Critical Removal Actions: RA activities were completed at more than 250 parcels (average parcel was approximately 1.75ac). Land parcel grids investigated were distributed throughout RC1 and RC2. RA activities were generally focused around existing residential dwellings. Intrusive results indicate the presence of former impact and munitions-use areas. Munitions recovered included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles, 60mm and 81mm mortars; 2.36-inch rockets; and	Recreational Residential-Single Family Undeveloped	Recreational Residential-Single Family Undeveloped

Area Name	Acreage	Previous Land-Use	Past Investigations, Munitions Found or Suspected	Current Land Use	Future Land Use
			hand and rifle grenades. 1958-69 Annual Inspections: Area A: Rifle grenade, 2.36-inch rockets, 37mm, 40mm, 81mm mortar, 105mm, 155mm, and 240mm projectiles		
Flame Thrower Range	5ac	ASR Supplement:This range was used to conduct flame thrower training during WWII. The layout of the range is unknown. It existed just north of the former cantonment area. The standard range fan for a flame thrower range as given in TM 9-855, August 1944, was used for the range fan. The range fan does not extend beyond site boundaries or overlap other range fans.	RA: The 2006 RA conducted at the FTR cleared approximately 20 acres to depth of detection using analog techniques. The RA activities identified and disposed of two MEC items and 530lbs of MD. Based on results of the RA, the nature and extent of MEC at the Flame Thrower Range have been adequately characterized.	Recreational Residential-Single Family Undeveloped	Recreational Residential-Single Family Undeveloped
Hand Grenade Range	25ac	ASR Supplement: The Hand Grenade Range is believed to have been used during WWII for live hand grenade training. Therefore, the standard range fan for a live hand grenade range as given in AR 750-10, January 1944, was used. The range fan does not extend beyond site boundaries or overlap with other range fans. There have been no reported incidents of OE on the range.	2001 EE/CA: Approximately 8.5 acres were geophysically mapped and intrusively investigated. No MEC or MD was identified at the HGR during the EE/CA. Based on EE/CA results, the nature and extent of MEC has been adequately characterized. Potential: Mk II, Hand Grenade	Recreational Residential-Single Family Undeveloped	Recreational Residential-Single Family Undeveloped

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MEC Data Quality Objective (DQO) Worksheet

Site: MRSs – ARNG, RC 1, and RC 2

Project: Former Camp Butner, NC

DQO Statement Number: 1 of 2

DQO Element Number [1]	DQO Element Description [1]	Site-Specific DQO Statement
Intended Data Use(s):		
1	Project Objective(s) Satisfied	Evaluate presence/absence of MEC and determine if further response actions are required to support current and future residential, commercial, agricultural, ARNG training, and recreational land use.
Intended Need Requirements:		
2	Data User Perspective(s)	Risk, Remedy
3	Contaminant or Characteristic of Interest	MEC, Munitions Debris distribution/density
4	Media of Interest	N/A
5	Required Locations or Areas	MRSs – ARNG, RC 1 and RC 2
6	Number of Samples Required	N/A
7	Reference Concentration of Interest or Other Performance Criteria	Digital Geophysical Mapping (DGM), Analog Investigation, Intrusive Investigation (as required) in areas cited above. Geophysical investigations will be conducted IAW Table 1 (based on DID WERS-004.01).
Appropriate Sampling and Analysis Methods:		
8	Sampling Method	DGM, Mag-and-Dig Intrusive Investigation.
9	Analytical Method	N/A

[1] Refer to EM 200-1-2, Para. 4.2.1

MC Data Quality Objective (DQO) Worksheet

Site: MRSs – ARNG, RC 1, and RC 2

Project: Former Camp Butner, NC

DQO Statement Number: 2 of 2

DQO Element Number[(1)]	DQO Element Description[(1)]	Site-Specific DQO Statement
Intended Data Use(s):		
1	Project Objective(s) Satisfied	Evaluate presence/absence of MC
Intended Need Requirements:		
2	Data User Perspective(s)	Risk, Remedy
3	Contaminant or Characteristic of Interest	See Tables 2 & 3
4	Media of Interest	Soil, Sediment, and Water
5	Required Locations or Areas	Incremental sampling (IS) will be conducted throughout the ARNG, RC1 and RC2 MRSs, based on confirmation of historical information, DGM analysis, and intrusive investigative results IAW the approved WP. These areas will be designated as sampling units (SUs). One discrete surface and subsurface soil sample will be collected if a surface IS unit has elevated levels of COPC. Based on the soil sampling results, sediment samples may be collected. Background groundwater sampling will be conducted offsite. If necessary, background sampling may also be conducted offsite using IS SU.
6	Number of Samples Required	Ten IS surface soil samples will be collected from the following MRSs: RC1, RC2 and ARNG. One discrete surface and subsurface soil sample will be collected at each IS sample location with elevated levels of COPC. Up to ten sediment samples will be collected at each MRS. Ten groundwater samples will be collected at offsite locations for establishing background. Ten offsite IS surface soil samples may be collected at offsite locations, if needed.
7	Reference Concentration of Interest or Other Performance Criteria	If MC is detected, comparison against background levels and screening levels to determine if further MC evaluation is warranted. Screening levels as agreed upon by the Project Team will be based on the EPA Regional Screening Level (RSL), NC GW Protection Standards. Background samples may be used to assess the possible presence of metals.
Appropriate Sampling and Analysis Methods:		
8	Sampling Method	Samples in accordance with SAP.
9	Analytical Method	IS will be analyzed for explosives (8330B) and select metals (6010C). Analysis of discrete samples will include explosives (8330A), select metals (6010C) and perchlorate (6850).

(1) Refer to EM 200-1-2, Para. 4.2.1

TABLE 2 - Human Health and Ecological Screening Values for Soil and Sediment

Analyte	Abbreviation	CAS #	Human Health Screening Values		Ecological Screening Values			
			EPA Regional Screening Levels for Residential Soil (mg/kg) (1)	EPA Noncarcinogenic Regional Screening Levels for Residential Soil divided by a factor of 10 (2) (mg/kg)	Ecological Soil Screening Values (mg/kg)	Eco Soil SV Source	Ecological Sediment Screening Values (mg/kg)	Eco Sediment SV Source
Trinitrobenzene, 1,3,5-	1,3,5-TNB	99-35-4	2,200*	220	0.376	B	1300	C
Dinitrobenzene, 1,3-	1,3-DNB	99-65-0	6.1*	0.61	0.655	B	0.00861	B
Trinitrotoluene, 2,4,6-	2,4,6-TNT	118-96-7	19		6.4	C	420	C
Dinitrotoluene, 2,4-	2,4-DNT	121-14-2	1.6		1.28	B	0.0144	B
Dinitrotoluene, 2,6-	2,6-DNT	606-20-2	61*	6.1	0.0328	B	0.0398	B
Dinitrotoluene, 2-Amino-4,6-	2-Am-DNT	35572-78-2	150*	15	10	C	34	C
Nitrotoluene, 2-	2-NT (o)	88-72-2	2.9		9.9	C	28	C
Nitrotoluene, 3-	3-NT (m)	99-08-1	6.1*	0.61	12	C	24	C
Dinitrotoluene, 4-Amino-2,6-	4-Am-DNT	19406-51-0	150*	15	3.6	C	9.5	C
Nitrotoluene, 4-	4-NT (p)	99-99-0	30		22	C	52	C
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	3,800*	380	27	C	27000	C
Nitrobenzene	NB	98-95-3	4.8		2.26	E	0.0145	B
Nitroglycerin	NG	55-63-0	6.1*	0.61	71	C	1700	C
Pentaerythritol Tetranitrate	PETN	78-11-5	120		100	C	1400	C
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	5.6		7.5	C	45	C
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8	240*	24	0.99	C	100	C
Copper	Cu	7440-50-8	3100*	310	28	A	16	E
Lead	Pb	7439-92-1	400***		11	A	30.2	B
Antimony	Sb	7440-36-0	31*	3.1	0.27	A	2	D
Zinc	Zn	7440-66-6	23,000*	2300	46	A	98	D
Perchlorate	ClO4	14797-73-0	55*	5.5				

(1) Based on "Regional Screening Levels for Chemical Contaminants at Superfund Sites" dated June 2011; Carcinogenic RSLs based on a Target Risk of 1E-06; Noncarcinogenic RSLs based on Hazard Quotient of 1.
(2) EPA Noncarcinogenic Regional Screening Levels for Residential Soil divided by a factor of 10.

* Noncancer Hazard Quotient (HQ) = 1.
** Neither Industrial/Residential EPA Regional Screening Level (RSL) are available.
***Lead value based on IEUBK Model

+ If the laboratory cannot meet any of the preferred QLs with routine SW846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL will be identified in Laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL. In those cases, the QL achievable with a routine SW846 methodology would be accepted.

Eco Screening Value Sources:
A - USEPA Eco SSLs
B - USEPA Region V Ecological Screening Levels
C - Los Alamos National Laboratory (LANL), ECORISK Database Release 3.0, 2011
D - Savannah River National Laboratory Ecological Screening Level
E - USEPA Region VI Ecological Screening Levels

TABLE 3 - Human Health and Ecological Screening Values for Surface Water/Groundwater

Analyte	Abbreviation	CAS #	Screening Values: Human Health EPA RSLs for Tap Water (mg/L)	Screening Values: Human Health EPA Noncarcinogenic RSLs for Tap Water divided by a factor of 10 (2) (mg/L)	Screening Values: North Carolina Groundwater Protection Standard 2L (3) (mg/L)	Screening Values: Ecological Screening Values (mg/L)	Eco SV Source
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4	1.1*	0.11		0.011	G
1,3-Dinitrobenzene	1,3-DNB	99-65-0	0.0037*	0.00037		0.02	G
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	0.0022			0.09	G
2,4-Dinitrotoluene	2,4-DNT	121-14-2	0.22		0.0001	0.023	E
2,6-Dinitrotoluene	2,6-DNT	606-20-2	0.037*	0.0037		0.06	E
2-Amino-4,6-dinitrotoluene	2-Am-DNT	35572-78-2	0.073*	0.0073		0.02	G
2-Nitrotoluene	2-NT	88-72-2	0.31			39	C
3-Nitrotoluene	3-NT	99-08-1	0.037*	0.0037		0.75	F
4-Amino-2,6-dinitrotoluene	4-Am-DNT	19406-51-0	0.073*	0.0073		43	C
4-Nitrotoluene	4-NT	99-99-0	0.0042			1.9	F
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	1.8*	0.18		0.15	F
Nitrobenzene	NB	98-95-3	0.00012			0.22	B
Nitroglycerin	NG	55-63-0	0.0037*	0.00037		0.138	F
Pentaerythritol Tetranitrate	PETN	78-11-5	0.017			85	F
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	0.00061			0.19	G
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8	0.15*	0.015		5.8	C
Copper	Cu	7440-50-8	1.5*	0.15	1	0.00158	B
Lead	Pb	7439-92-1	0.015 **		0.015	0.001	D
Antimony	Sb	7440-36-0	0.015*	0.0015	0.001	0.03	E, F
Zinc	Zn	7440-66-6	11*	1.1	1	0.03	D
Perchlorate	ClO4	14797-73-0	0.026*	0.0026	0.002		

(1) Based on "Regional Screening Levels for Chemical Contaminants at Superfund Sites" dated June 2011; Carcinogenic RSLs based on a Target Risk of 1E-06; Noncarcinogenic RSLs based on Hazard Quotient of 1.
(2) EPA Noncarcinogenic Regional Screening Levels for Tapwater divided by a factor of 10.
(3) North Carolina Administrative Code Title 15A, Subchapter 2L Groundwater Classification and Standards, last amended January 1, 2010.
* Noncancer Hazard Quotient (HQ) = 1.
** MCL for lead.

+ If the laboratory cannot meet any of the preferred QLs with routine SW846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL will be identified in Laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL. In those cases, the QL achievable with a routine SW846 methodology would be accepted.

<u>ECO Screening Value Sources</u>
B - USEPA Region V Ecological Screening Levels
C - Los Alamos National Laboratory (LANL), ECORISK Database Release 3.0, 2011
D - Savannah River National Laboratory Ecological Screening Level
E - USEPA Region VI Ecological Screening Levels
F USEPA Region III Freshwater Screening Benchmarks,
G Talmage, et. al. 1999

Camp Butner

TPP Team	**EM 200-1-2, Paragraph 1.1.1**	
Decision Makers		
Customer	USACE Wilmington District (CESAW) / SAS	
Project Manager	Ray Livermore, CESAW; Julie Hiscox	
Contract Manager	Chris Cochrane, USAESCH	
TPP Technical Manager	Bud Morgan, USAESCH	
Regulators	North Carolina Department of Environment and Natural Resources (NCDENR), Marti Morgan	
Primary Stakeholders	Property owners, tenants, government representatives, North Carolina Army National Guard (ARNG)	
Data Types	**Data Users**	**Data Gatherer**
Compliance/Regulatory (CR)	Regulatory Perspective (CESAW, NCDENR, USEPA, HGL)	HGL RI/FS Team
Demographics/Land Use	Risk, Responsibility, and Compliance Perspectives (CESAW, Town of Butner, Granville, Durham and Person Counties)	HGL RI/FS Team
Site Conditions	Remedy Perspective (CESAW, HGL)	HGL RI/FS Team
Munitions and Explosives of Concern (MEC)	Risk and Remedy Perspectives (CESAW, HGL)	HGL RI/FS Team
Munitions Constituents (MC)	Risk and Remedy Perspectives (CESAW, NCDENR, and HGL)	HGL RI/FS Team
Archaeology	Compliance and Remedy Perspectives (CESAW and HGL)	ARNG (REC)
Endangered Species	Risk and Compliance Perspectives (CESSAW, NCDENR, and HGL)	ARNG (REC)

CUSTOMER'S GOALS		**EM 200-1-2, Paragraph 1.1.2**	
Munitions Response Site (MRS)	**Contaminant Issues**	**Future Land Use**	**Site-specific Closeout Goal (if applicable)**
5 Munitions Response Sites: Flame Thrower Range (FTR), Hand Grenade Range (HGR), Army National Guard Property (ARNG), Range Complex 1 (RC1), and Range Complex 2 (RC2)	MEC, MC	Residential, Recreational, Agricultural, Guard Training	Remedy protective of human health/environment.

Site Closeout Statement
To manage the munitions and explosives of concern (MEC) and munitions constituents (MC) risk through a combination of characterization, administrative controls, remediation, and public education; thereby rendering the site as safe as reasonably possible to humans and the environment and conducive to the anticipated future land use.
Customer's Schedule Requirements
RI/FS process through Decision Document by March 2014.
Customer's Site Budget
RI/FS: Fully Funded Through Decision Document.

IDENTIFY SITE APPROACH		
EXISTING SITE INFORMATION & DATA EM 200-1-2, Paragraph 1.1.3 and 1.2.1		
TPP Information and Data	**Located at Repository**	**Preliminary Conceptual Site Model**
Archive Search Report (ASR)	TBD	No
ASR Supplement (2004)	TBD	No
EE/CA 2004	TBD	No
TC Removal Action - Blalock and Riley Properties	TBD	No
Time Critical Removal Action - Lakeview Subdivision	TBD	No
Interim Removal Actions (2008, 2009, 2010)	TBD	No
POTENTIAL POINTS OF COMPLIANCE EM 200-1-2, Paragraph 1.2.1.3		
Determination of absence or presence of MEC/MC		
If MC is detected, comparison against background concentrations and Soil Screening Levels (SSLs) will be conducted to determine if further MC evaluation during RI/FS is warranted. Screening levels as agreed upon by the project team to include the EPA Regional Screening Level (RSL) for Residential Soil, Tap Water and NC GW Protection Standards. Background samples will be used to assess metals concentrations, if needed. Background samples will also be used to assess perchlorate concentrations detected during past groundwater sampling events.		
MEDIA OF POTENTIAL CONCERN EM 200-1-2, Paragraph 1.2.1.4		
Qualitative review of MEC presence		
Quantitative screening of MC constituents for soil and sediment. Background sampling of surface soils for metals and groundwater for perchlorate and lead (total and dissolved).		
SITE OBJECTIVES EM 200-1-2, Paragraph 1.2.2		
Phased approach for geophysical evaluation and media sampling focused on areas of greatest concern (historical use and existing site conditions).		
MEC and MC sampling to adequately characterize site conditions		
Evaluation of MEC and MC data to determine if acceptable for completion of RI/FS		
Eliminate from further consideration those releases that pose no significant threat to public health or the environment.		
Completion of RI/FS		
Develop MRSPP scores for each MRS		
REGULATOR AND STAKEHOLDER PERSPECTIVES EM 200-1-2, Paragraph 1.2.3		
Regulators	**Community Interests**	**Others**
Regulators principal concern is the protection of human health and the environment. Also ensuring that sampling results are defensible by requiring the use of approved analytical laboratories and methods.	Landowners (including homeowners) primary concern is the presence of potential hazards (MEC and MC). Land is safe for intended/current land use.	Nearby towns concerned with potential for future land development. ARNG - safety of troops training on the site and future construction efforts
PROBABLE REMEDIES EM 200-1-2, Paragraph 1.2.4		
Remedial Action following RI/FS characterization.		
Institutional controls following RI/FS characterization.		
EXECUTABLE STAGES TO SITE CLOSEOUT EM 200-1-2, Paragraph 1.2.5		
Remedial Investigation/Feasibility Study (RI/FS)		
Public Involvement Plan (PIP)		
Proposed Plan		
Decision Document		
Follow work as stipulated in Decision Document		

IDENTIFY CURRENT PROJECT		
SITE CONSTRAINTS AND DEPENDENCIES EM 200-1-2, Paragraph 1.3.1		
Administrative Constraints and Dependencies		
Rights of Entry (ROE) will be executed by USACE (SAS), supported by HGL .		
Utility review and coordination.		
Coordination with ARNG and training schedules		
Cultural Resources		
Funding beyond the RI/FS		
Site Security		
Scheduling		
Technical Constraints and Dependencies		
Establishment of exclusion zone for munition of greatest fragmentation distance during excavation of MEC/UXO.		
Working depth of geophysical instruments.		
MEC avoidance		
Topography/Vegetation		
Heat stress consideration during summer activities		
Hunting seasons		
Legal and Regulatory Milestones and Requirements		
Consistent with CERCLA and NCP		
Public, stakeholder & regulatory involvement & review of key documents		
Screening levels as agreed upon by the Project Team to include EPA Regional Screening Levels (Residential Soil and Tap Water), NC GW Protection Standards, and various Ecological Screening Values (ESVs) and other applicable SSLs for Eco Risk Assessment. Background samples will be used to assess metals.		
CURRENT EXECUTABLE STAGE EM 200-1-2, Paragraph 1.3.3		
Technical Project Planning (TPP)		
Remedial Investigation/ Feasibility Study (RI/FS) Work Plan Development		
RI fieldwork		
RI/FS Reports		
Proposed Plans		
Decision Documents		
Basic (For Current Projects)	**Optimum** (For Future Projects)	**Excessive** (Objectives that do not lead to site closeout)
MEC investigation and MC sampling w/in MRSs	MEC and MC Removal Actions, if warranted.	

Acronyms

ASR - Archives Search Report
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CESAW - U.S. Army Corps of Engineers, Wilmington District
EPA - U.S. Environmental Protection Agency
EE/CA - Engineering Evaluation/Cost Analysis
ESV - Ecological Screening Value
FUDS - Formerly Used Defense Sites
HGL - HydroGeoLogic
HRS - Hazard Ranking System

MC - munitions constituents
MEC - munitions and explosives of concern
MRS - Munitions Response Site
MRSPP - Munitions Response Site Prioritization Protocol
NCP - National Contingency Plan
NCDENR _ North Carolina Department of Environmenta and Natural Resources
NDAI - No Department of Defense Action Indicated
PIP - Public Involvement Plan
PRG - Preliminary Remediation Goal
RAB - Restoration Advisory Board
RI/FS - Remedial Investigation and Feasibility Study
ROE - Rights of Entry
SSL - Soil Screening Level
TBD - To be determined
TPP - Technical Project Planning

PROJECT OBJECTIVES WORKSHEET

SITE: **MRSs - ARNG, RC 1 and RC 2**

PROJECT: **Former Camp Butner, NC**

Site Objective					Data Needs	Data Collection Methods	Data Users	Project Objective Classification [d]
Number	Executable Stage [b]		Description	Source [c]				
	Current	Future						
1	Yes		Assess MEC data, determine risk reduction alternatives.	ASR, EE/CA, RAs	Additional MEC investigation	Digital Geophysical Mapping, Mag-and-dig, intrusive investigation	Risk and Remedy Perspectives	Basic
2	Yes		Assess MC data to evaluate risk to human health or the environment	ASR, EE/CA, RAs	Additional MC sampling	Soil, sediment, and groundwater sample collection	Risk and Remedy Perspectives	Basic

a Refer to EM 200-1-2, Paragraph 1.2.2
b Refer to EM 200-1-2, Paragraph 1.2.5
c For example, Meeting with Customer/stakeholder/Regulator, State Regulation____,
d Classification of project objectives can only occur after the current project has been identified. Refer to EM 200-1-2,

ASR - Archive Search Report
IAW - In accordance with
MEC - Munitions and Explosives of Concern
LU - Land Use
MC - Munitions Constituents
SAP - Sampling and Analysis Plan

PROJECT OBJECTIVES WORKSHEET

SITE: **MRSs - FTR, HGR**

PAGE 1 of 1

PROJECT: **Former Camp Butner, NC**

Site Objective					Data Needs	Data Collection Methods	Data Users	Project Objective Classification [d]
Number	Executable Stage [b]		Description	Source [c]				
	Current	Future						
1	Yes		Assess MEC data, determine risk reduction alternatives.	ASR, EE/CA, Ras	None	Document Review	Risk and Remedy Perspectives	Basic
2	Yes		Assess MC data to evaluate risk to human health or the environment	ASR, EE/CA, Ras	None	Document Review	Risk and Remedy Perspectives	Basic

a Refer to EM 200-1-2, Paragraph 1.2.2
b Refer to EM 200-1-2, Paragraph 1.2.5
c For example, Meeting with Customer/stakeholder/Regulator, State Regulation____,
d Classification of project objectives can only occur after the current project has been identified. Refer to EM 200-1-2, Paragraph 1.3.3.

ASR - Archive Search Report
IAW - In accordance with
MEC - Munitions and Explosives of Concern
LU - Land Use
MC - Munitions Constituents
SAP - Sampling and Analysis Plan

Section 10

Technical Project Planning Meeting #1
Former Camp Butner
Presentation Slides

The following slides have been provided as a copy of the TPP Meeting #1 presentation. Changes to the technical approach, schedule, proposed sampling, and any other changes made during the TPP meeting area reflected in the TPP Memorandum and the remainder of the associated documents. The slides on the following pages are shown as they were presented.

U.S. Army Corps of Engineers

Former Camp Butner

Formerly Used Defense Site

Butner, North Carolina

Technical Project Planning Meeting

Remedial Investigation/

Feasibility Study

Munitions Response

Sites: FTR, HGR

ARNG, RC 1, and RC 2

10 November 2011

Anti-tank class at Camp Butner

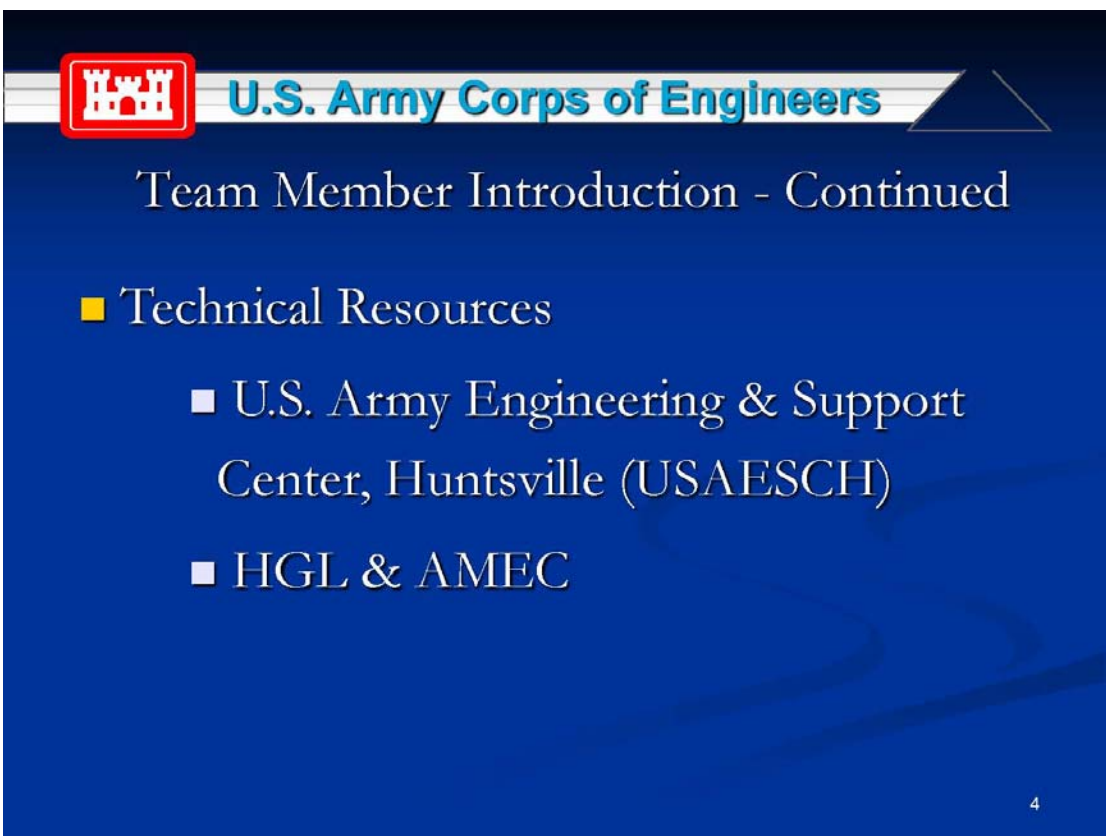
U.S. Army Corps of Engineers

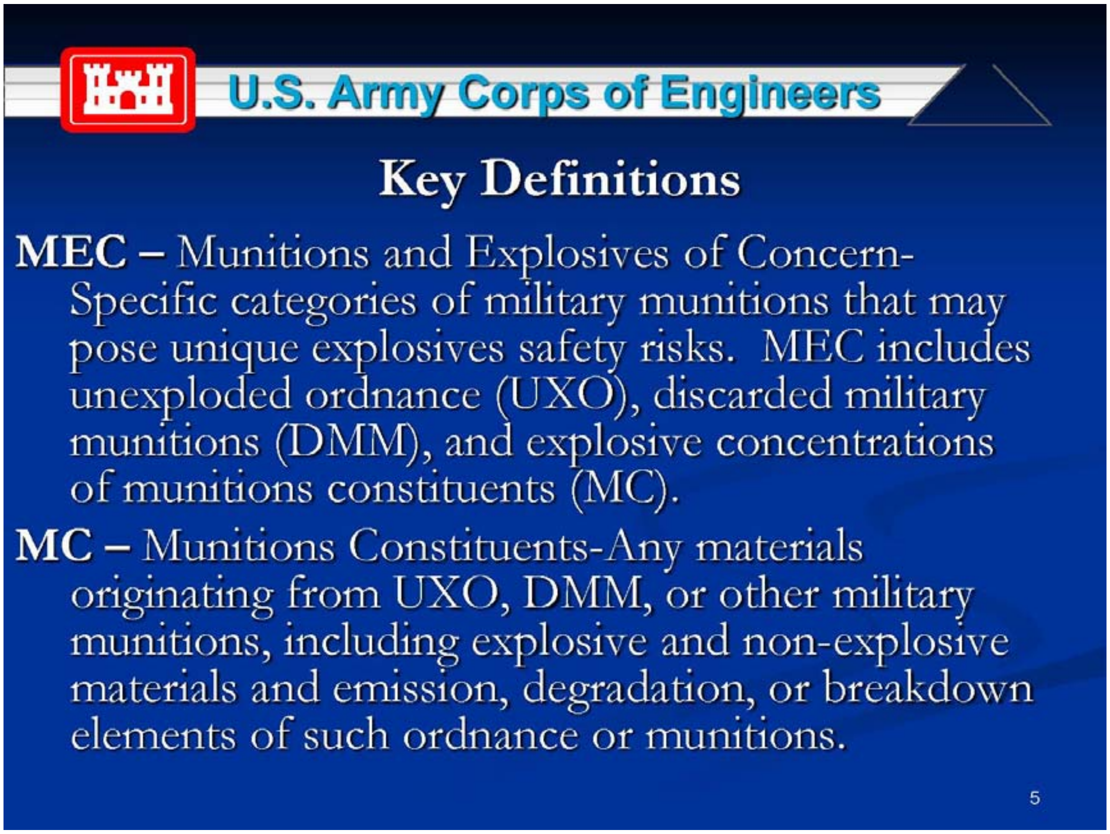
Meeting Agenda

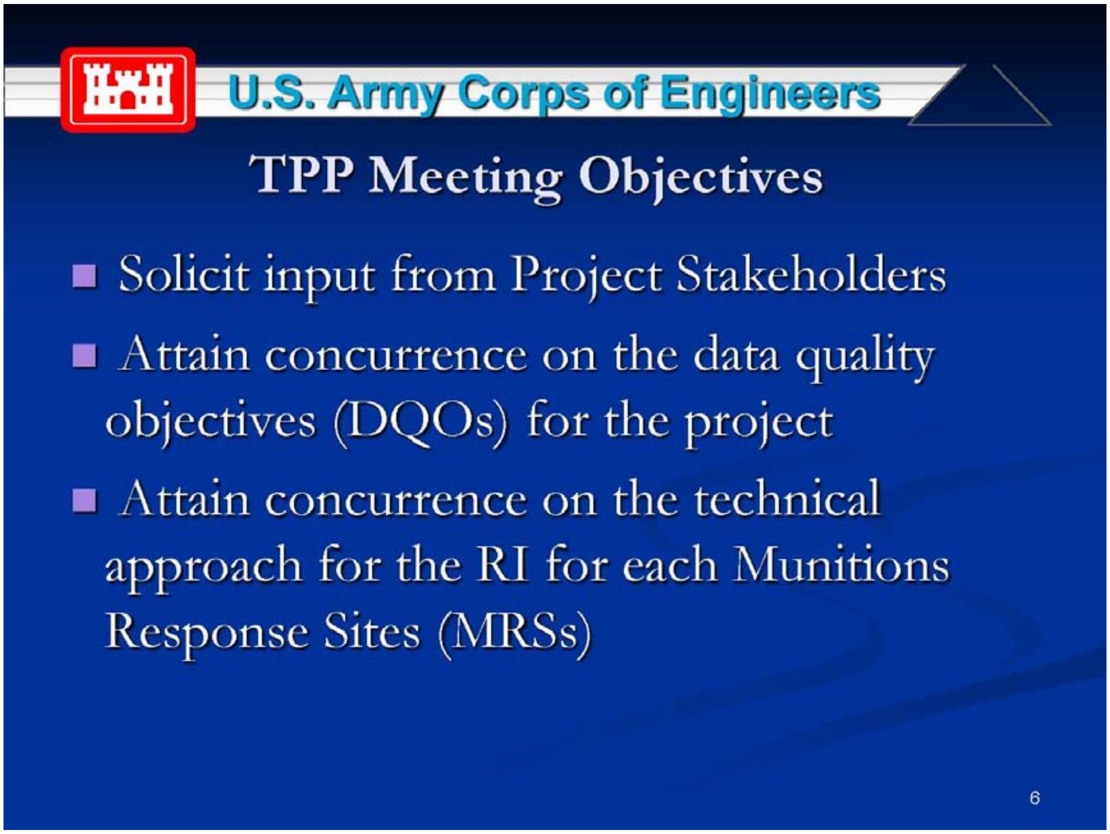
- Introductions
- Key Definitions
- RI Purpose / FS Purpose
- TPP Objectives
- Site Background
- Conceptual Site Models (CSM)
- RI Process / Field Activities
- TPP Worksheets (RI Data Quality Objectives - DQOs)
- Key Reports / Documentation
- Community Relations Support
- Schedule Overview
- Closing and Action Items Review

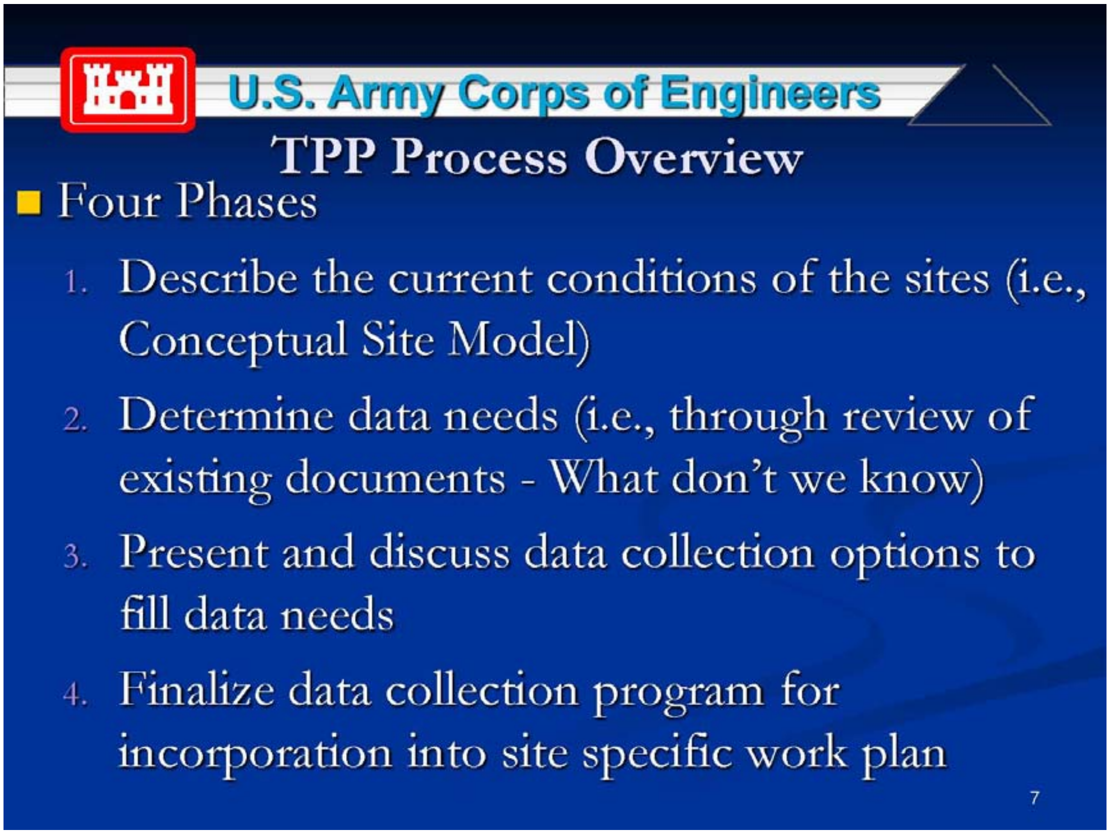
2

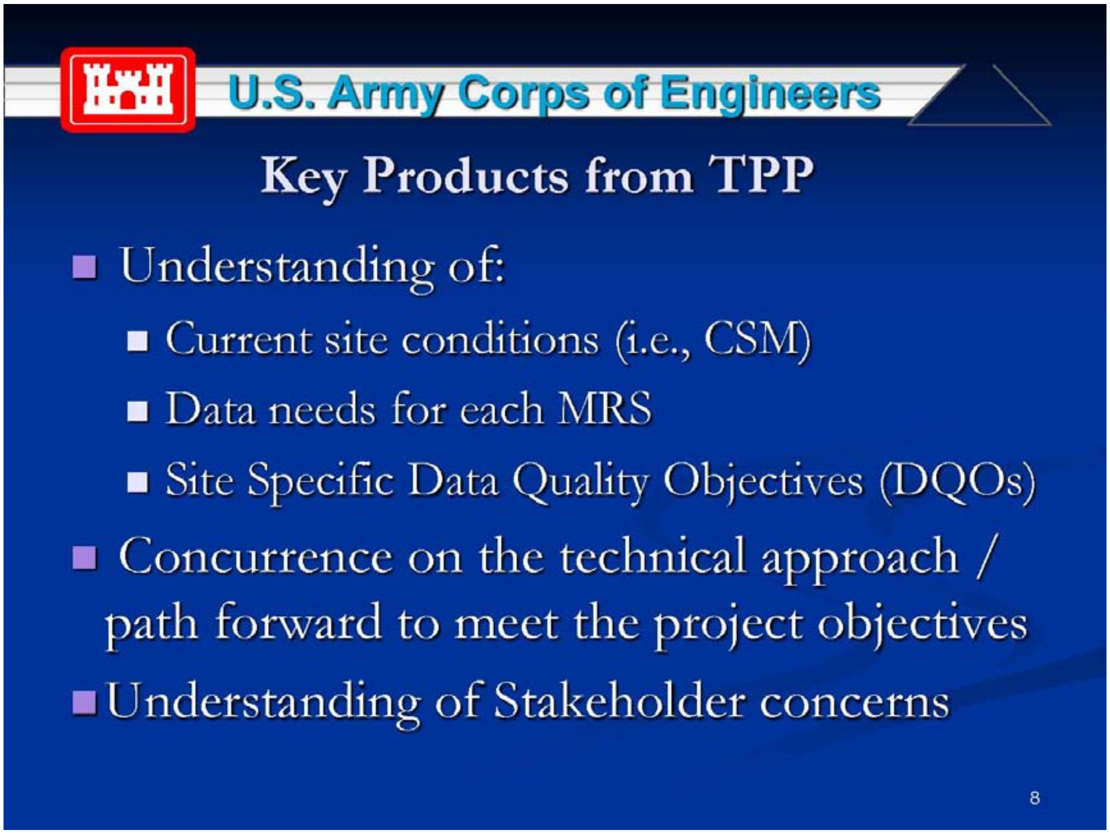

U.S. Army Corps of Engineers
Introductions
Government Agencies – Federal, State and Local
USACE (CESAW, CESAS, CEHNC)
North Carolina Department of Environment and Natural Resources (NCDENR)
North Carolina National Guard
Town of Butner, Granville, Durham, and Person Counties
3

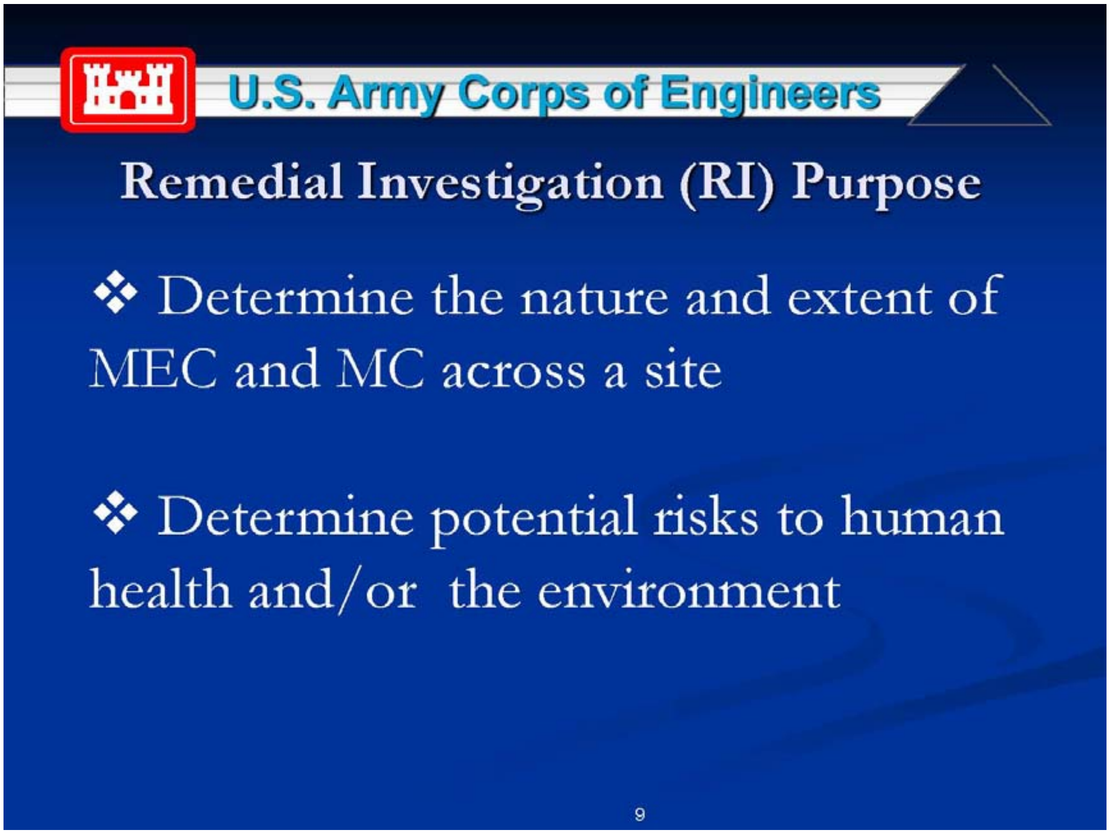

U.S. Army Corps of Engineers
Team Member Introduction - Continued
Technical Resources
U.S. Army Engineering & Support Center, Huntsville (USAESCH)
HGL & AMEC
4

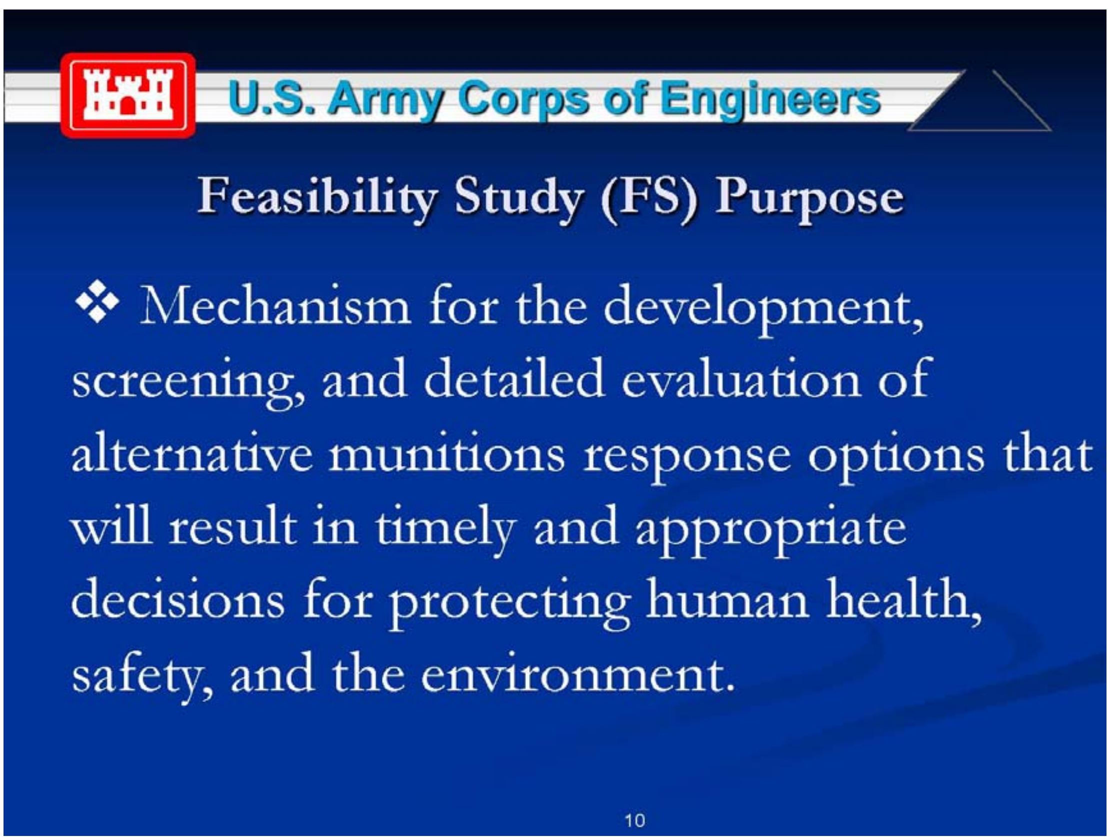

U.S. Army Corps of Engineers
Key Definitions
MEC – Munitions and Explosives of Concern-Specific categories of military munitions that may pose unique explosives safety risks. MEC includes unexploded ordnance (UXO), discarded military munitions (DMM), and explosive concentrations of munitions constituents (MC).
MC – Munitions Constituents-Any materials originating from UXO, DMM, or other military munitions, including explosive and non-explosive materials and emission, degradation, or breakdown elements of such ordnance or munitions.
5

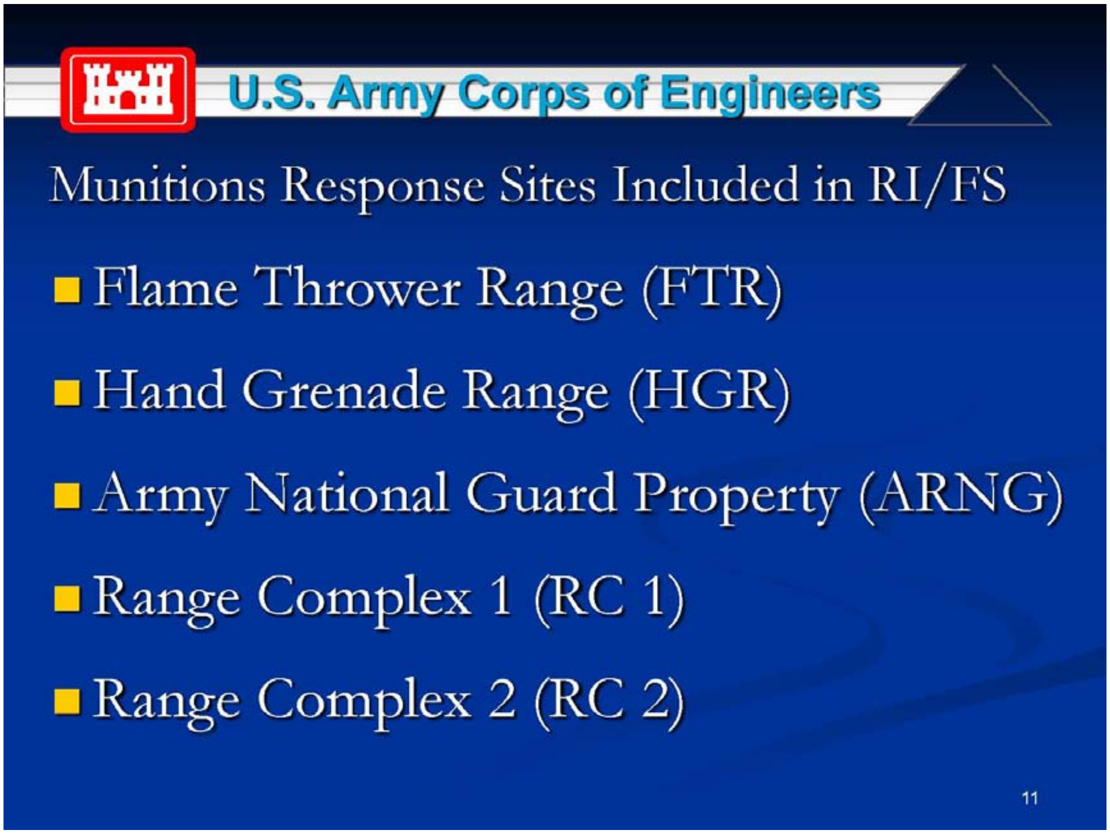

U.S. Army Corps of Engineers
TPP Meeting Objectives
Solicit input from Project Stakeholders
Attain concurrence on the data quality objectives (DQOs) for the project
Attain concurrence on the technical approach for the RI for each Munitions Response Sites (MRSs)
6

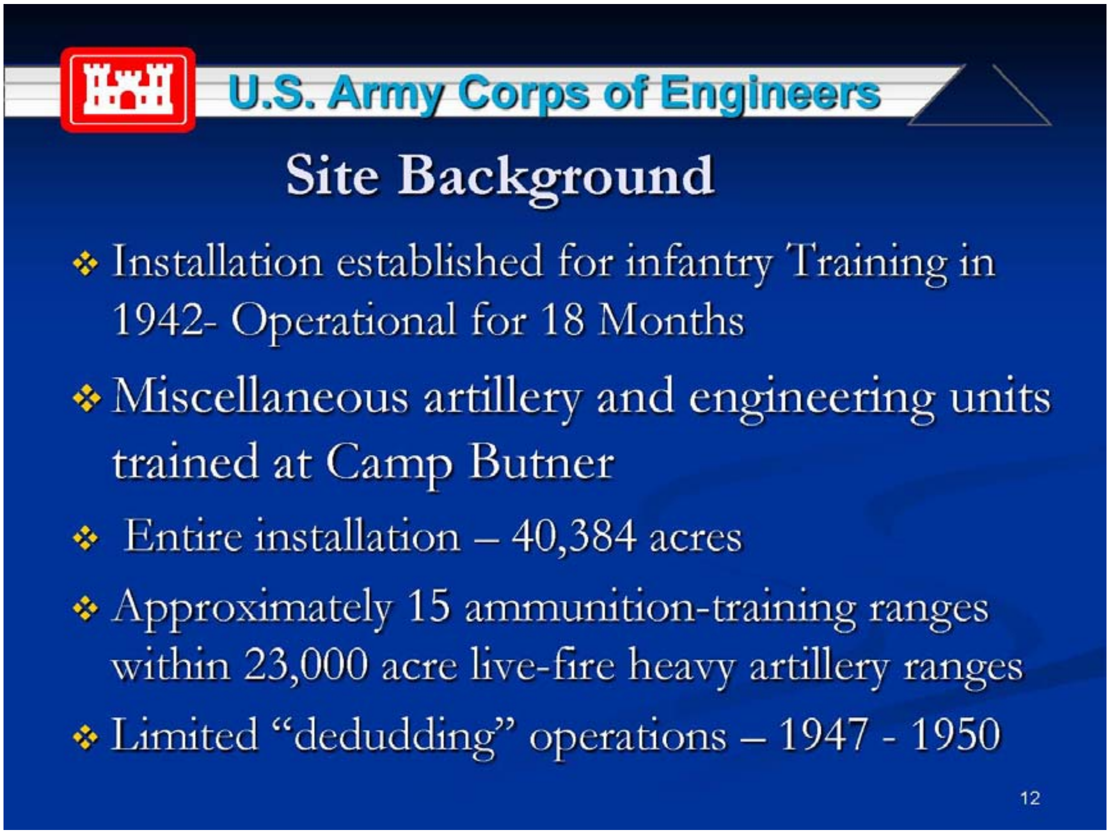

U.S. Army Corps of Engineers
TPP Process Overview
Four Phases
1. Describe the current conditions of the sites (i.e., Conceptual Site Model)
2. Determine data needs (i.e., through review of existing documents - What don't we know)
3. Present and discuss data collection options to fill data needs
4. Finalize data collection program for incorporation into site specific work plan
7

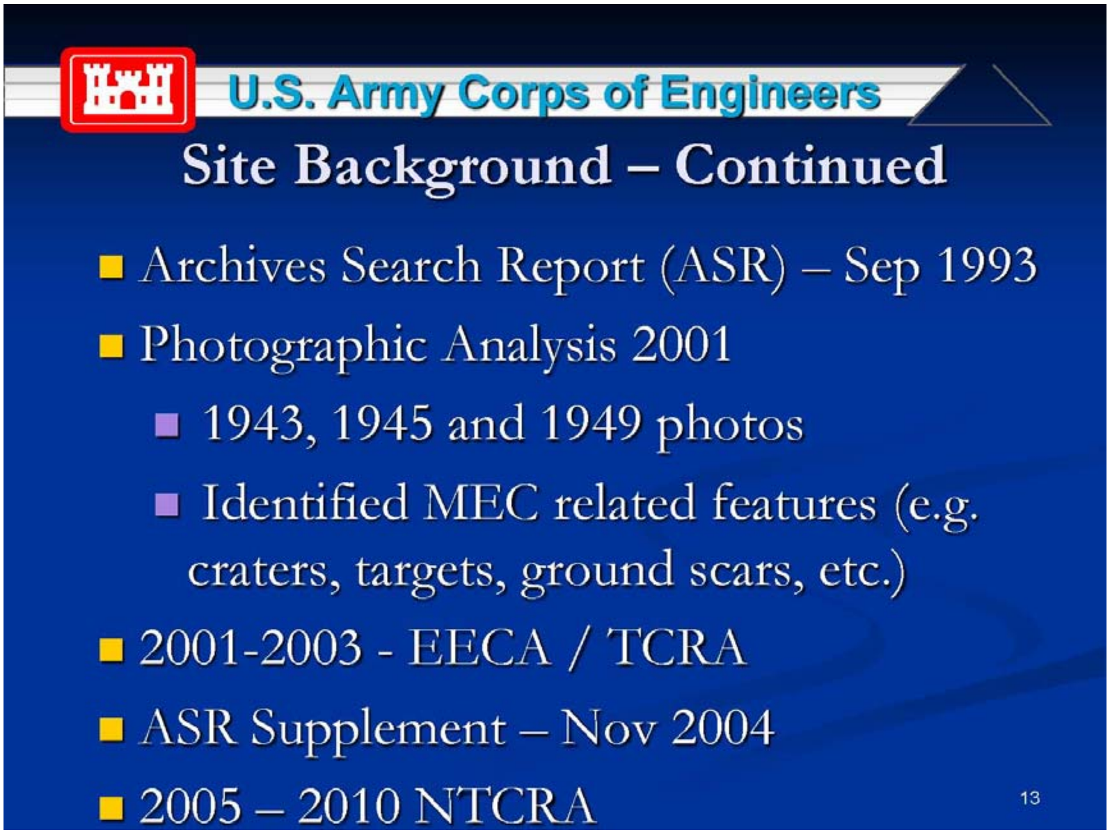

U.S. Army Corps of Engineers
Key Products from TPP
Understanding of:
Current site conditions (i.e., CSM)
Data needs for each MRS
Site Specific Data Quality Objectives (DQOs)
Concurrence on the technical approach / path forward to meet the project objectives
Understanding of Stakeholder concerns
8

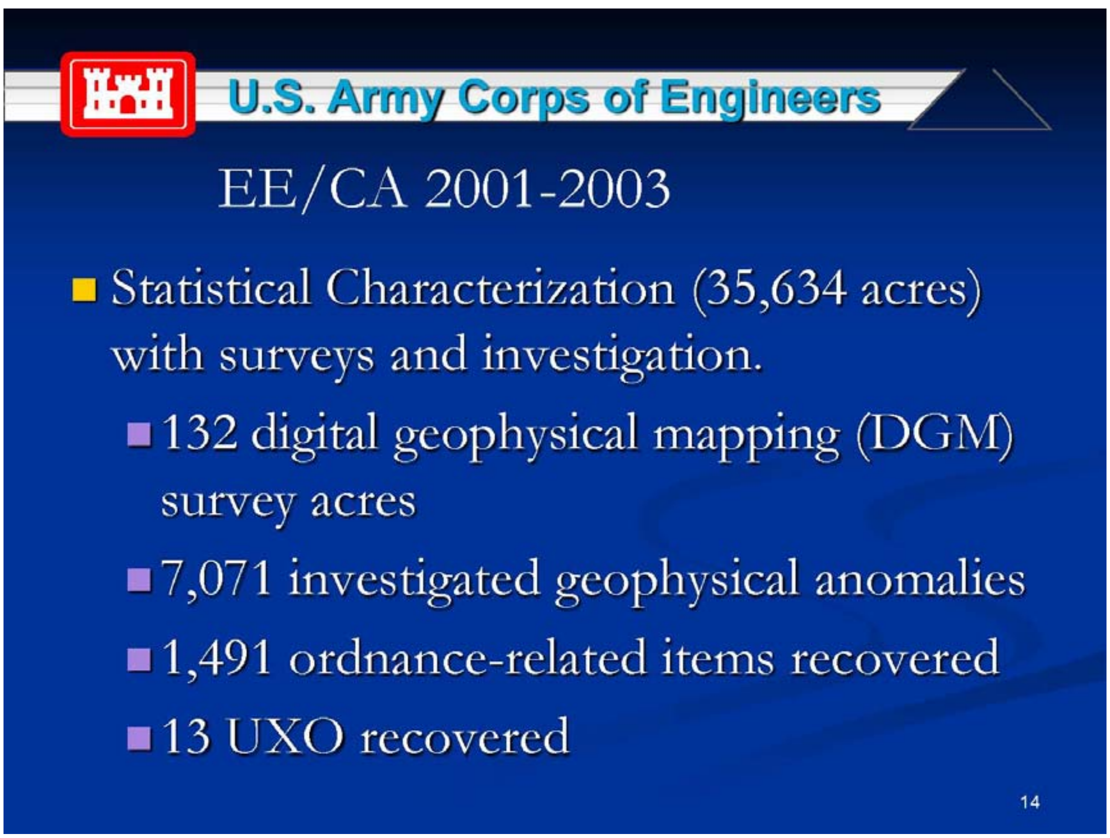

U.S. Army Corps of Engineers
Remedial Investigation (RI) Purpose
❖ Determine the nature and extent of MEC and MC across a site
❖ Determine potential risks to human health and/or the environment
9

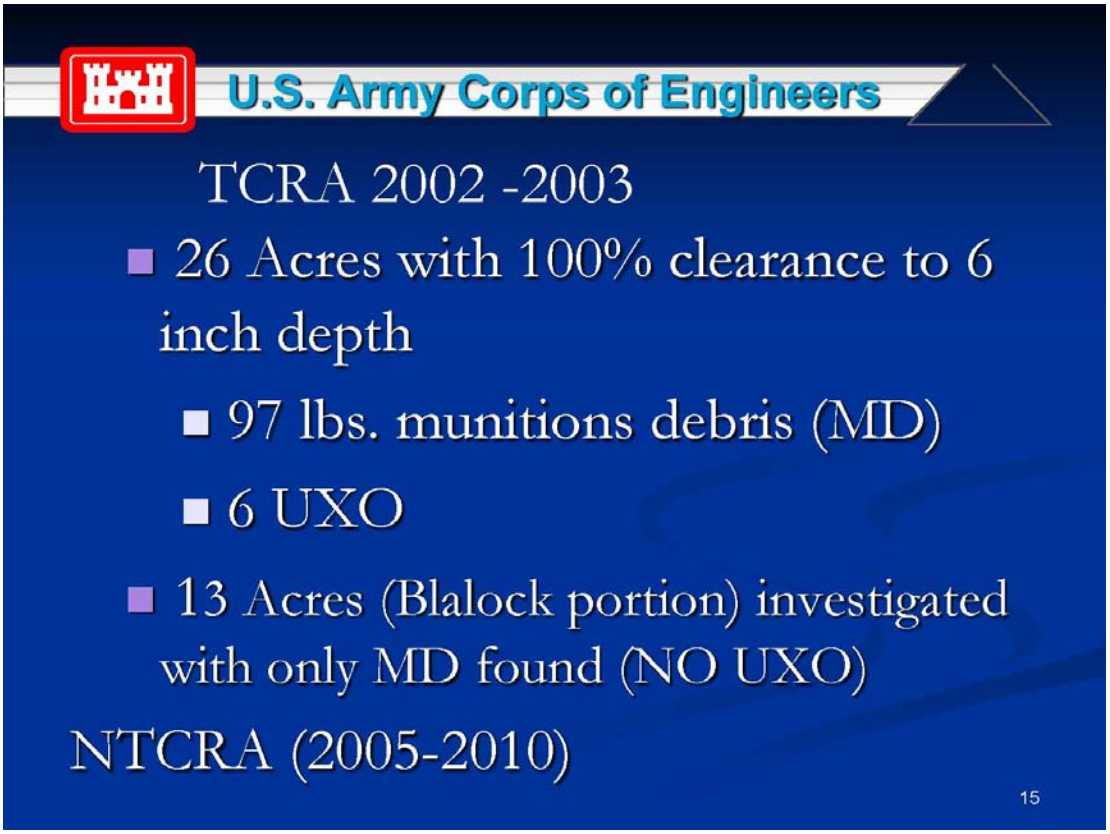

U.S. Army Corps of Engineers
Feasibility Study (FS) Purpose
❖ Mechanism for the development, screening, and detailed evaluation of alternative munitions response options that will result in timely and appropriate decisions for protecting human health, safety, and the environment.
10

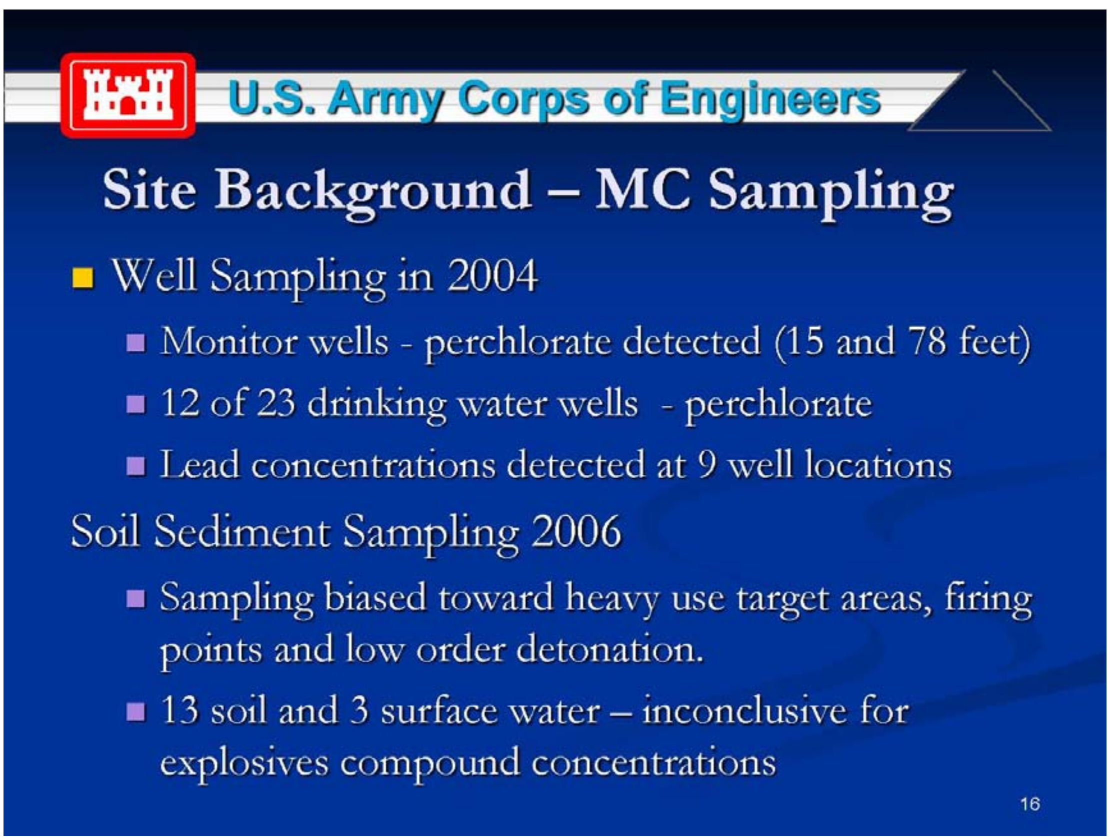

U.S. Army Corps of Engineers
Munitions Response Sites Included in RI/FS
Flame Thrower Range (FTR)
Hand Grenade Range (HGR)
Army National Guard Property (ARNG)
Range Complex 1 (RC 1)
Range Complex 2 (RC 2)
11


U.S. Army Corps of Engineers
Site Background
Installation established for infantry Training in 1942- Operational for 18 Months
Miscellaneous artillery and engineering units trained at Camp Butner
Entire installation – 40,384 acres
Approximately 15 ammunition-training ranges within 23,000 acre live-fire heavy artillery ranges
Limited "dedudding" operations – 1947 - 1950
12


U.S. Army Corps of Engineers
Site Background – Continued
Archives Search Report (ASR) – Sep 1993
Photographic Analysis 2001
1943, 1945 and 1949 photos
Identified MEC related features (e.g. craters, targets, ground scars, etc.)
2001-2003 - EECA / TCRA
ASR Supplement – Nov 2004
2005 – 2010 NTCRA
13


U.S. Army Corps of Engineers
EE/CA 2001-2003
Statistical Characterization (35,634 acres) with surveys and investigation.
132 digital geophysical mapping (DGM) survey acres
7,071 investigated geophysical anomalies
1,491 ordnance-related items recovered
13 UXO recovered
14


U.S. Army Corps of Engineers
TCRA 2002 -2003
26 Acres with 100% clearance to 6 inch depth
97 lbs. munitions debris (MD)
6 UXO
13 Acres (Blalock portion) investigated with only MD found (NO UXO)
NTCRA (2005-2010)
15


U.S. Army Corps of Engineers
Site Background – MC Sampling
Well Sampling in 2004
Monitor wells - perchlorate detected (15 and 78 feet)
12 of 23 drinking water wells - perchlorate
Lead concentrations detected at 9 well locations
Soil Sediment Sampling 2006
Sampling biased toward heavy use target areas, firing points and low order detonation.
13 soil and 3 surface water – inconclusive for explosives compound concentrations
16

U.S. Army Corps of Engineers

Site Background – Continued

- ASR Supplement – November 2004
  - Gas Chamber (No MEC)
  - HGR
  - FTR
  - RC 1 (impact area, small arms ranges, 37mm, mortar ranges)
  - RC 2 (impact area, small arms ranges, mock village)
  - ARNG (area within RC 1)
-

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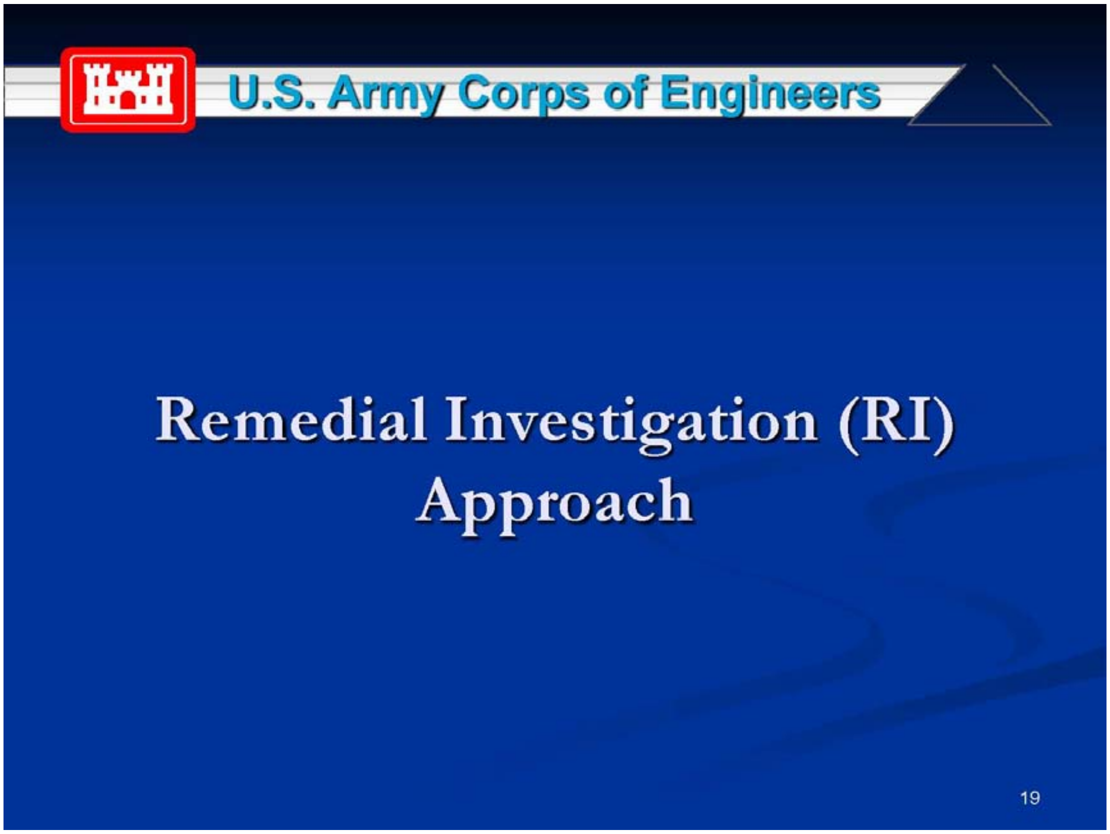
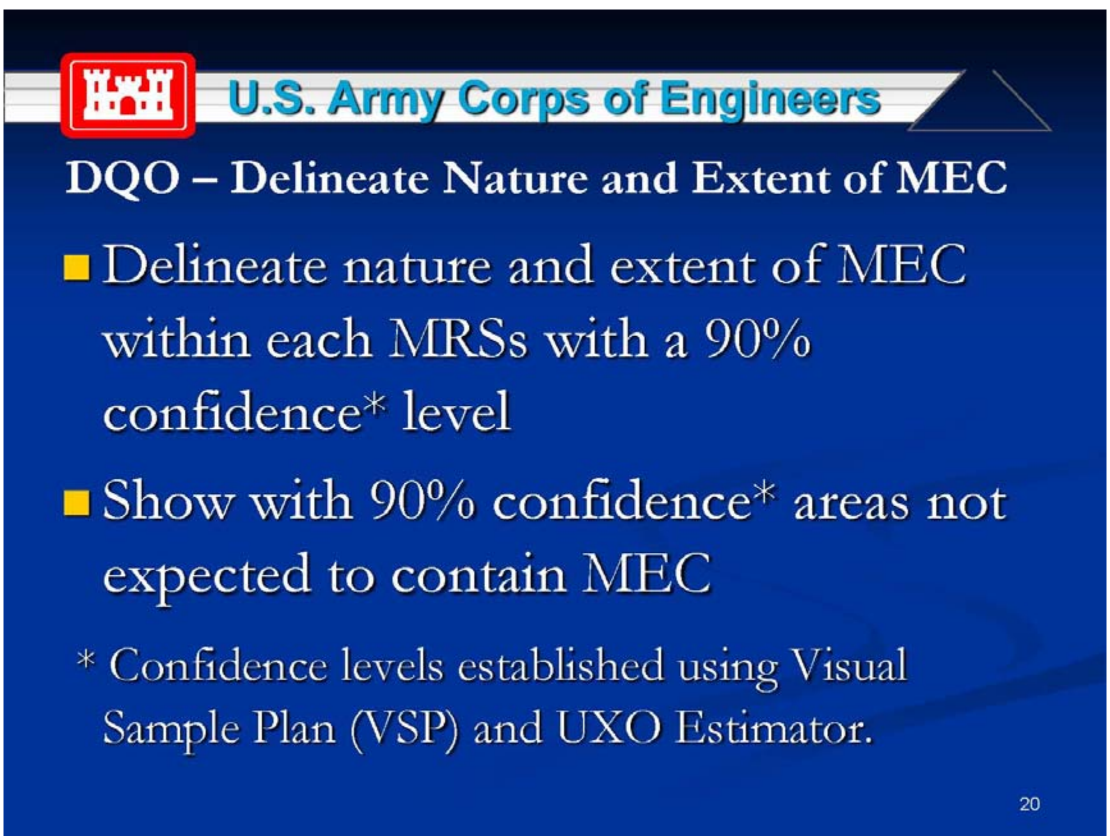
U.S. Army Corps of Engineers

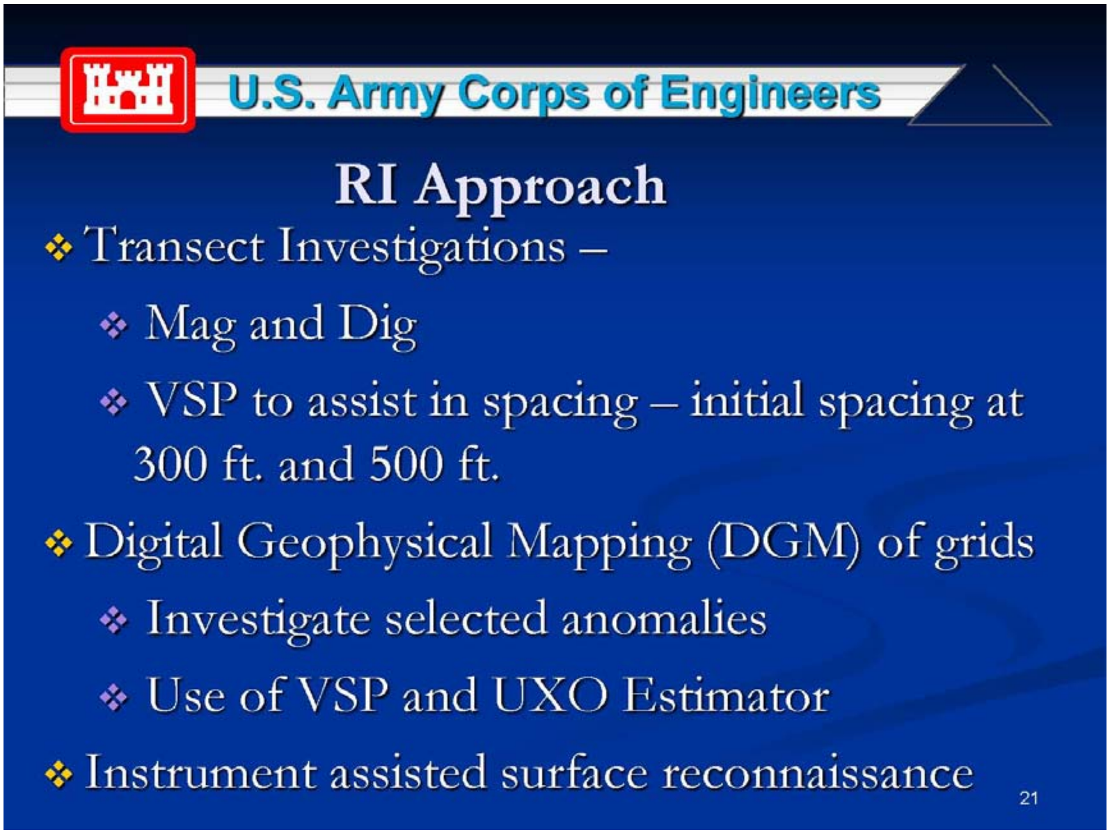
Site Background – Continued

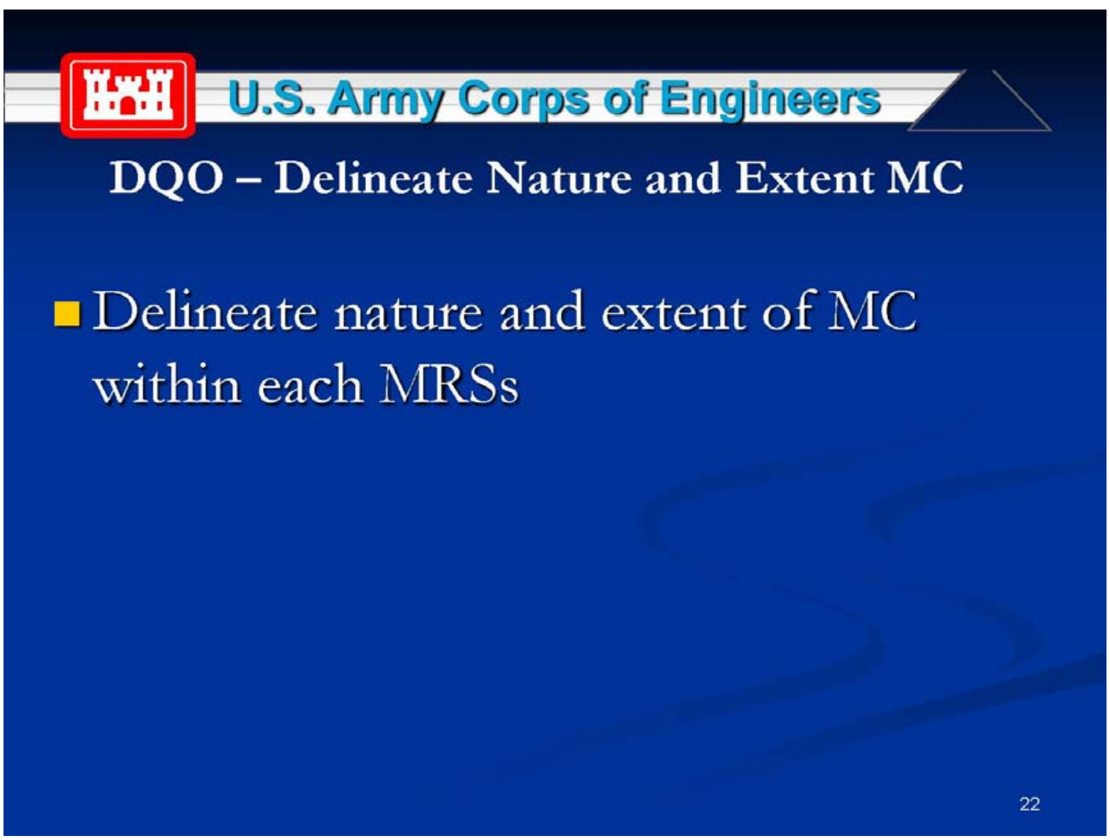
- A significant amount of data exists through prior efforts to characterize:
  - FTR
  - HGR
  - Portions of RC 1
  - Portions of RC 2
- ARNG site not included with the scope of the previous work

18


U.S. Army Corps of Engineers
Remedial Investigation (RI)
Approach
19


U.S. Army Corps of Engineers
DQO – Delineate Nature and Extent of MEC
Delineate nature and extent of MEC within each MRSs with a 90% confidence* level
Show with 90% confidence* areas not expected to contain MEC
* Confidence levels established using Visual Sample Plan (VSP) and UXO Estimator.
20


U.S. Army Corps of Engineers
RI Approach
Transect Investigations –
Mag and Dig
VSP to assist in spacing – initial spacing at 300 ft. and 500 ft.
Digital Geophysical Mapping (DGM) of grids
Investigate selected anomalies
Use of VSP and UXO Estimator
Instrument assisted surface reconnaissance
21


U.S. Army Corps of Engineers
DQO – Delineate Nature and Extent MC
Delineate nature and extent of MC within each MRSs
22

U.S. Army Corps of Engineers

RI Approach

- Soil sampling – compare to site-specific background concentrations and EPA RSLs
- Groundwater sample from existing wells (to establish background perchlorate and lead concentrations - wells outside site boundaries)

23

U.S. Army Corps of Engineers

RI Approach – Continued

- Sediment and surface water sampling to characterize local drainage.
- Further investigate previous detections

24

U.S. Army Corps of Engineers

DQO – Assess Risk to Human Health & Env

- MC Risks - compare maximum MC concentrations to the most stringent of USEPA RSLs and NCDENR human health screening criteria to identify chemicals of potential concern (COPCs)
- Identified COPCs will be evaluated further in the Human Health Risk Assessment (HHRA) process

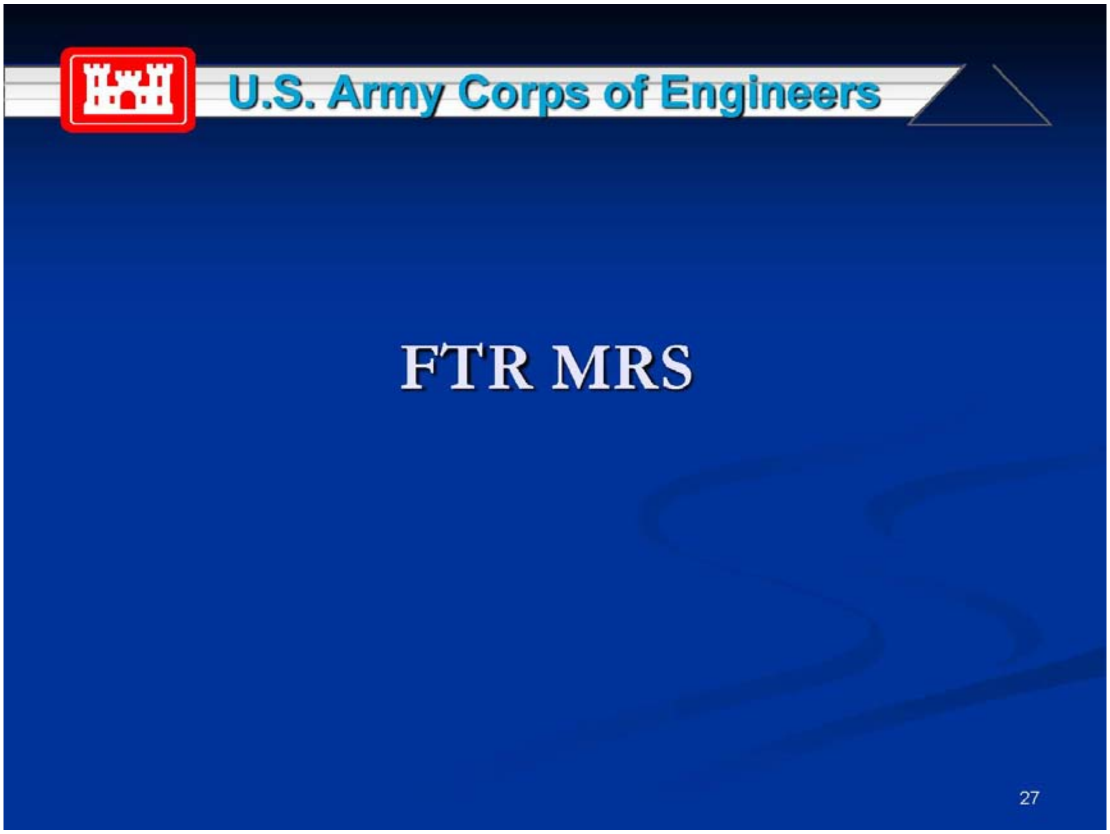
25

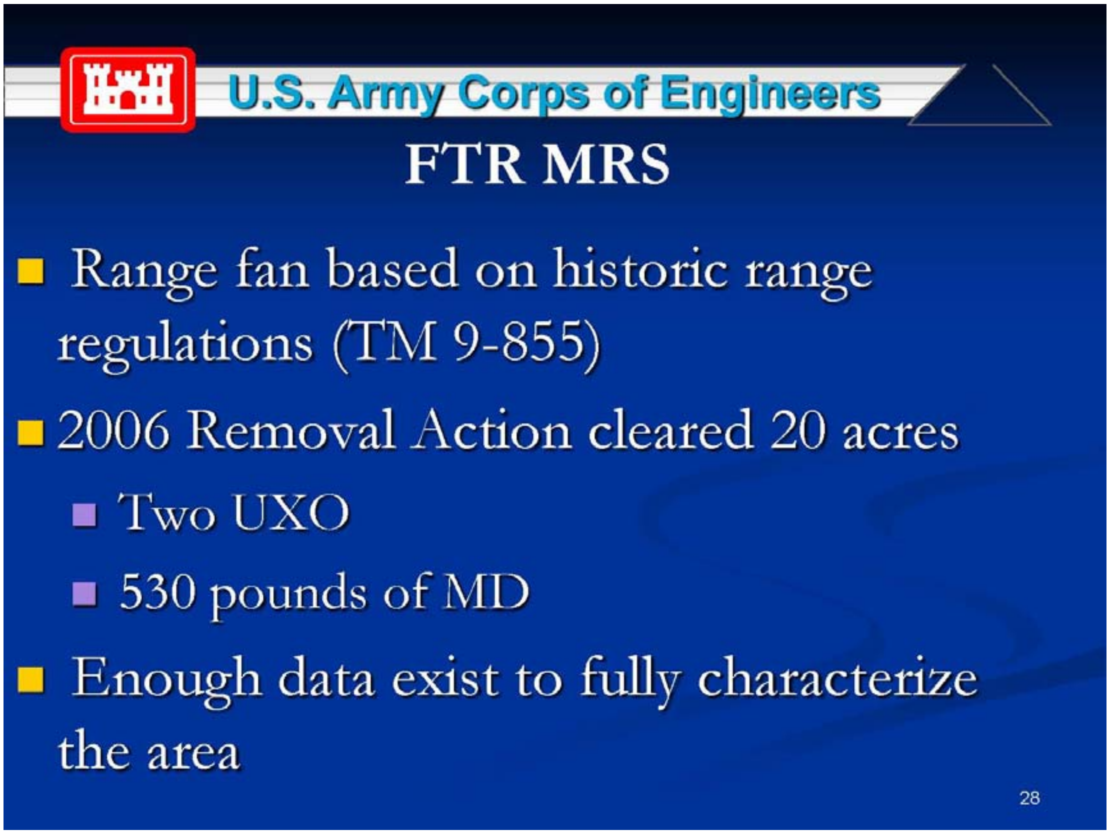
U.S. Army Corps of Engineers

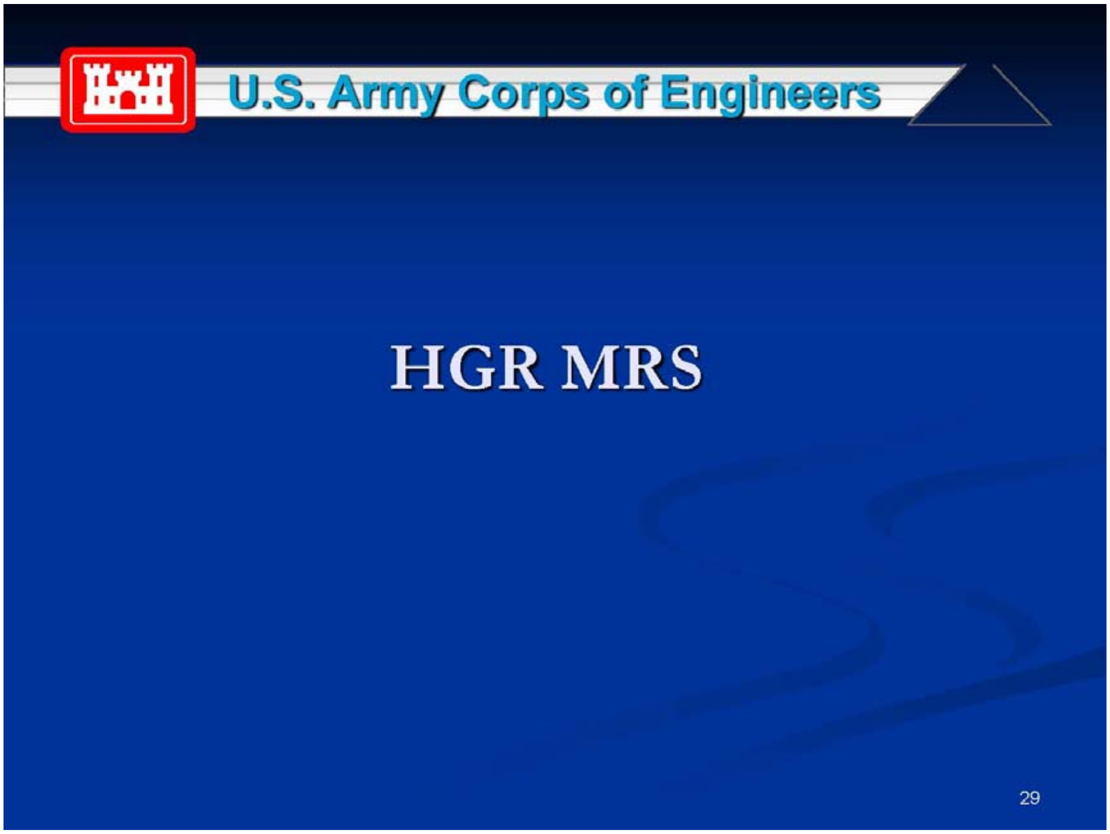
DQO – Assess Risk to Human Health & Env

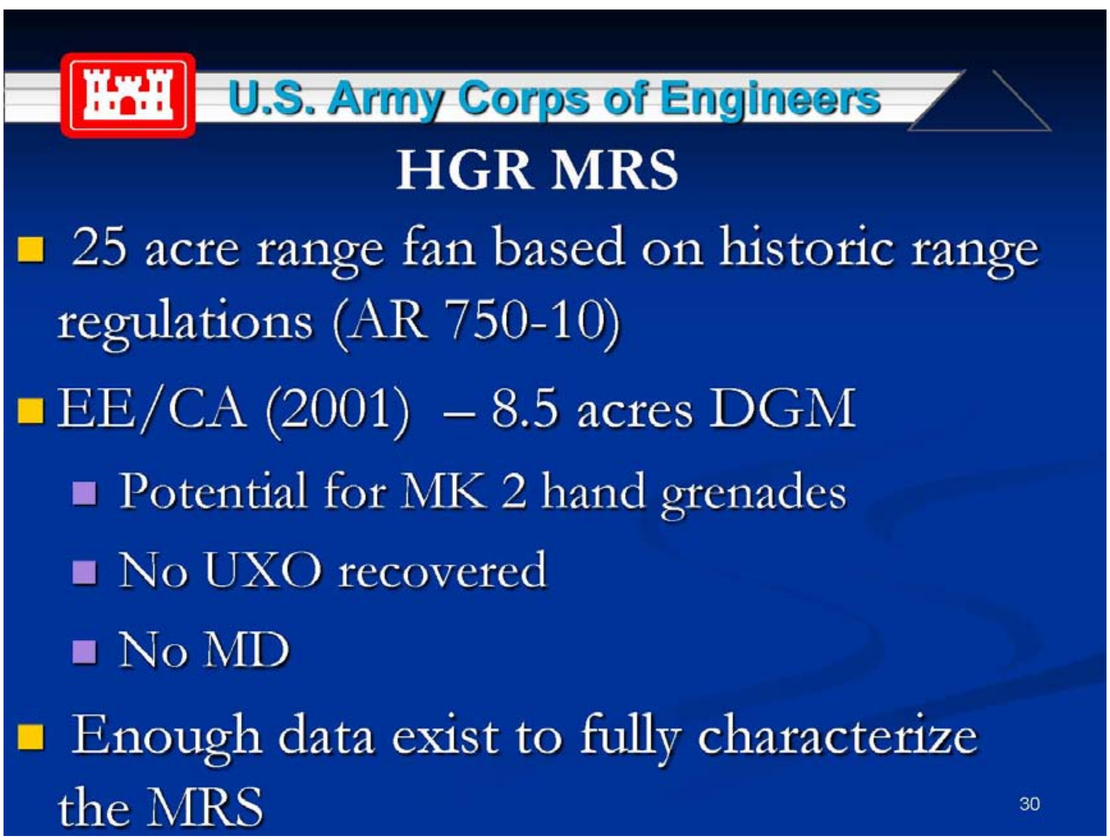
- Explosives Safety Hazard – Assess using MEC Hazard Assessment (MEC HA)

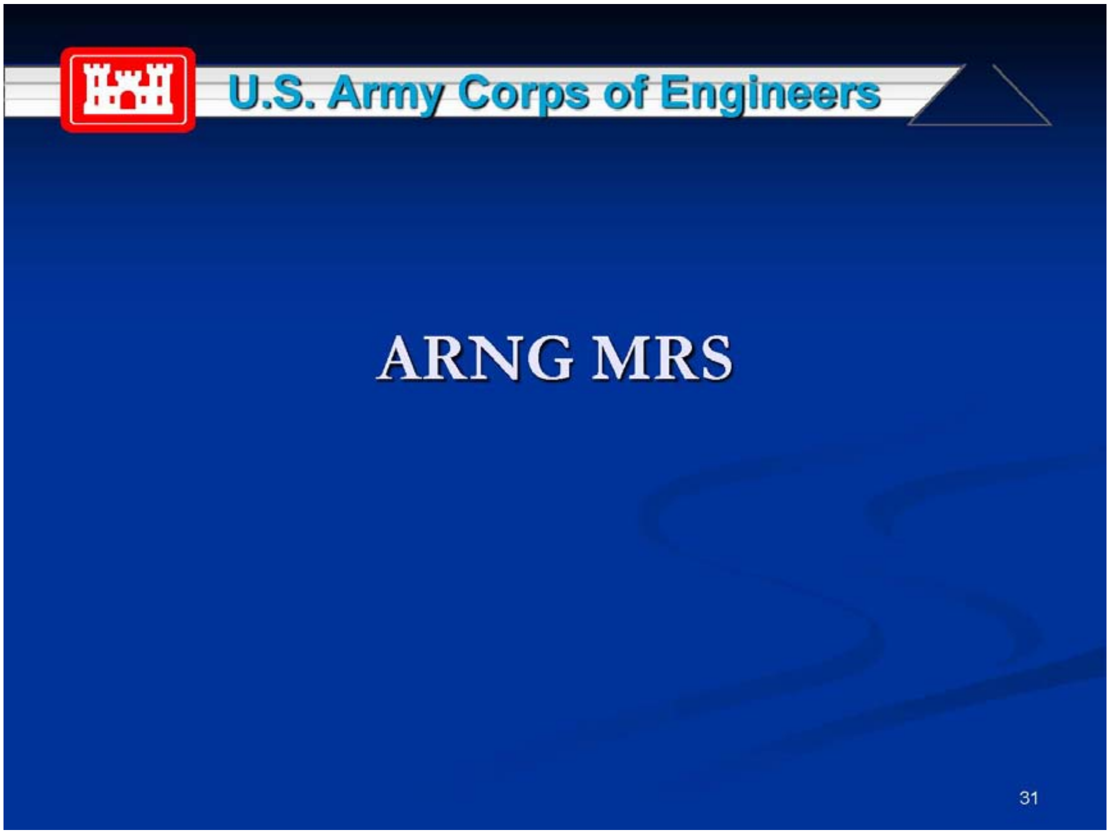
26

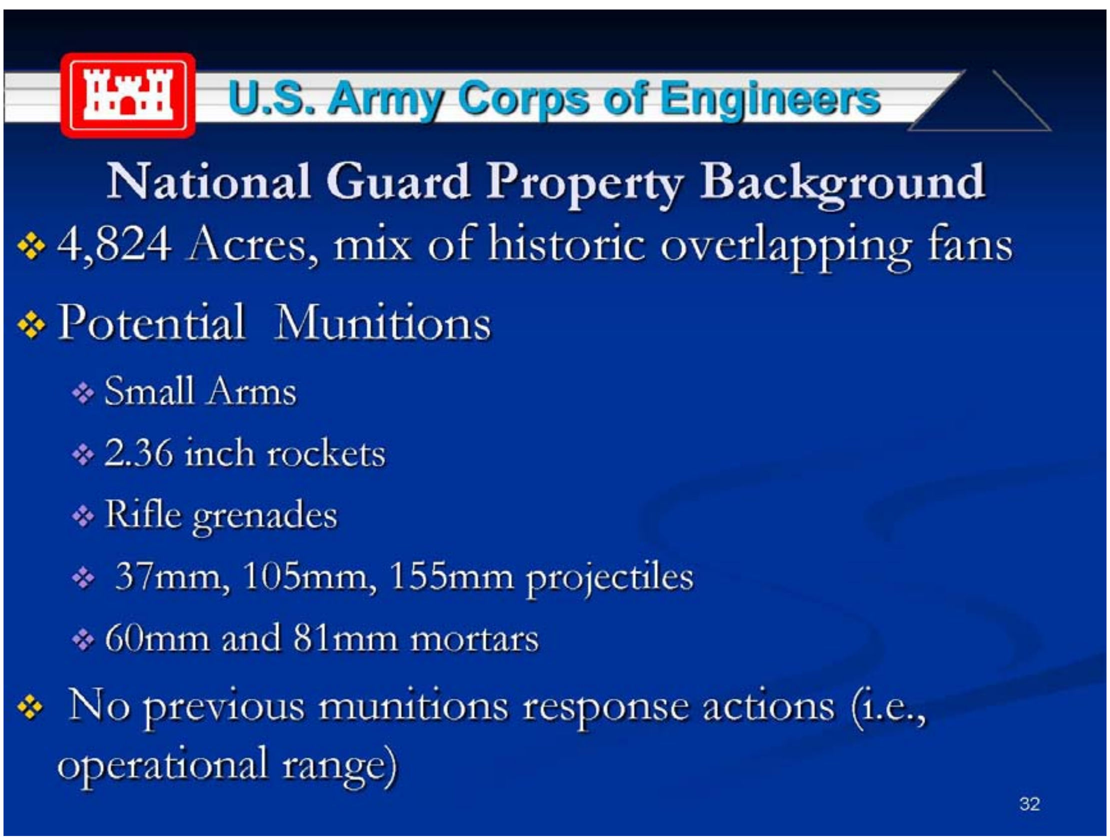

U.S. Army Corps of Engineers
FTR MRS
27


U.S. Army Corps of Engineers
FTR MRS
Range fan based on historic range regulations (TM 9-855)
2006 Removal Action cleared 20 acres
Two UXO
530 pounds of MD
Enough data exist to fully characterize the area
28


U.S. Army Corps of Engineers
HGR MRS
29


U.S. Army Corps of Engineers
HGR MRS
25 acre range fan based on historic range regulations (AR 750-10)
EE/CA (2001) – 8.5 acres DGM
Potential for MK 2 hand grenades
No UXO recovered
No MD
Enough data exist to fully characterize the MRS
30

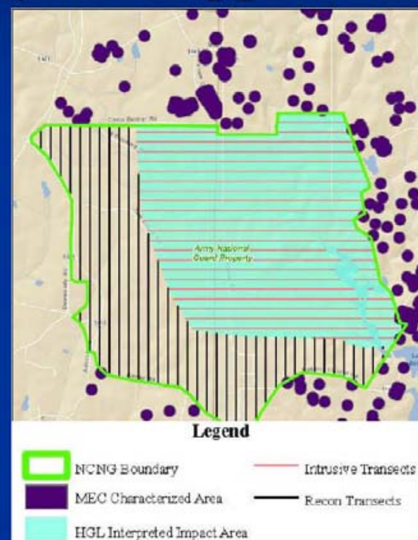

U.S. Army Corps of Engineers
ARNG MRS
31


U.S. Army Corps of Engineers
National Guard Property Background
4,824 Acres, mix of historic overlapping fans
Potential Munitions
Small Arms
2.36 inch rockets
Rifle grenades
37mm, 105mm, 155mm projectiles
60mm and 81mm mortars
No previous munitions response actions (i.e., operational range)
32

U.S. Army Corps of Engineers

National Guard Property – RI Approach

- Transect Approach
  - 300 ft and 500 ft. Spacing
  - Mag and Dig investigations
- DGM grids / Intrusive
  - Placed based upon transects
- Surface reconnaissance to confirm areas not suspected of containing MEC

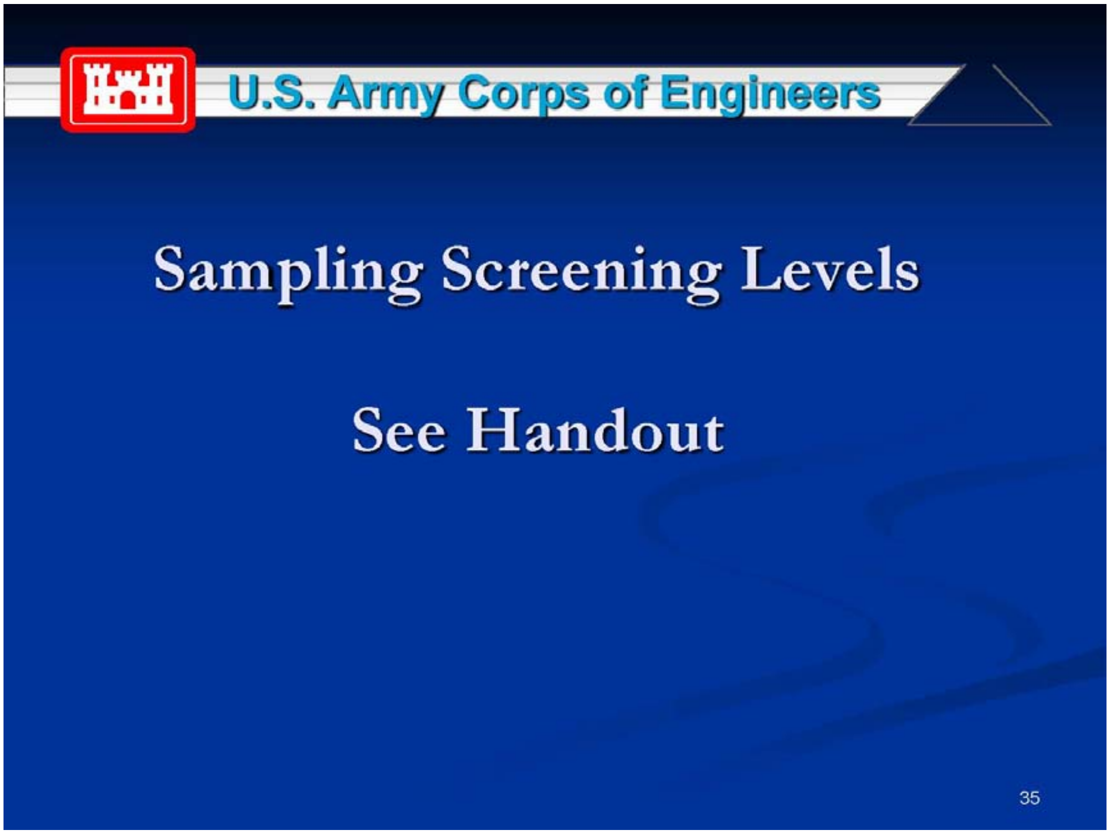


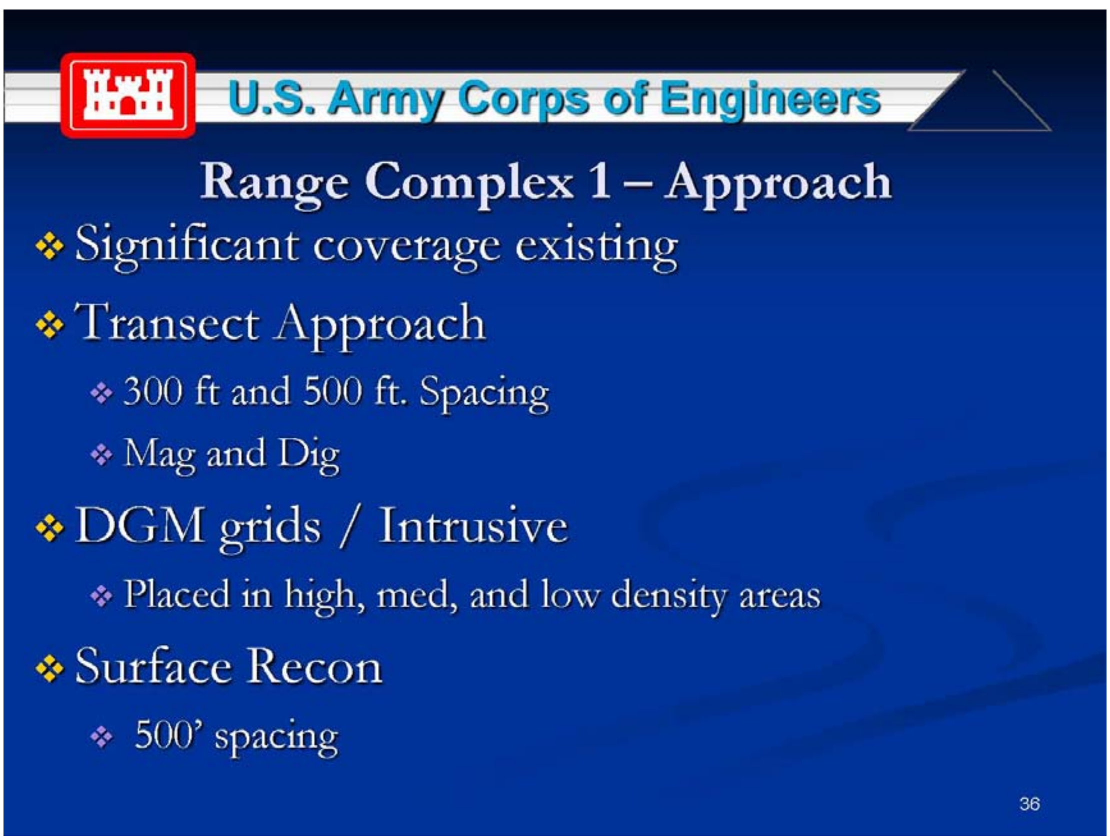
33

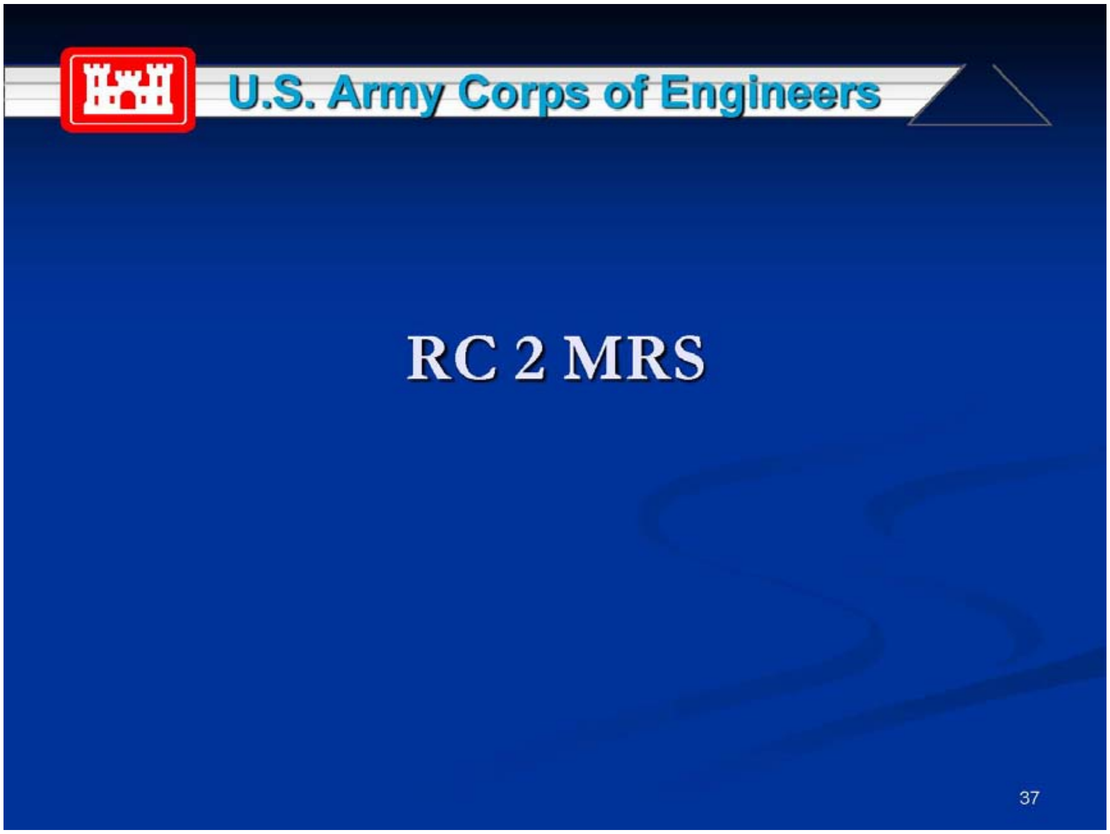
U.S. Army Corps of Engineers

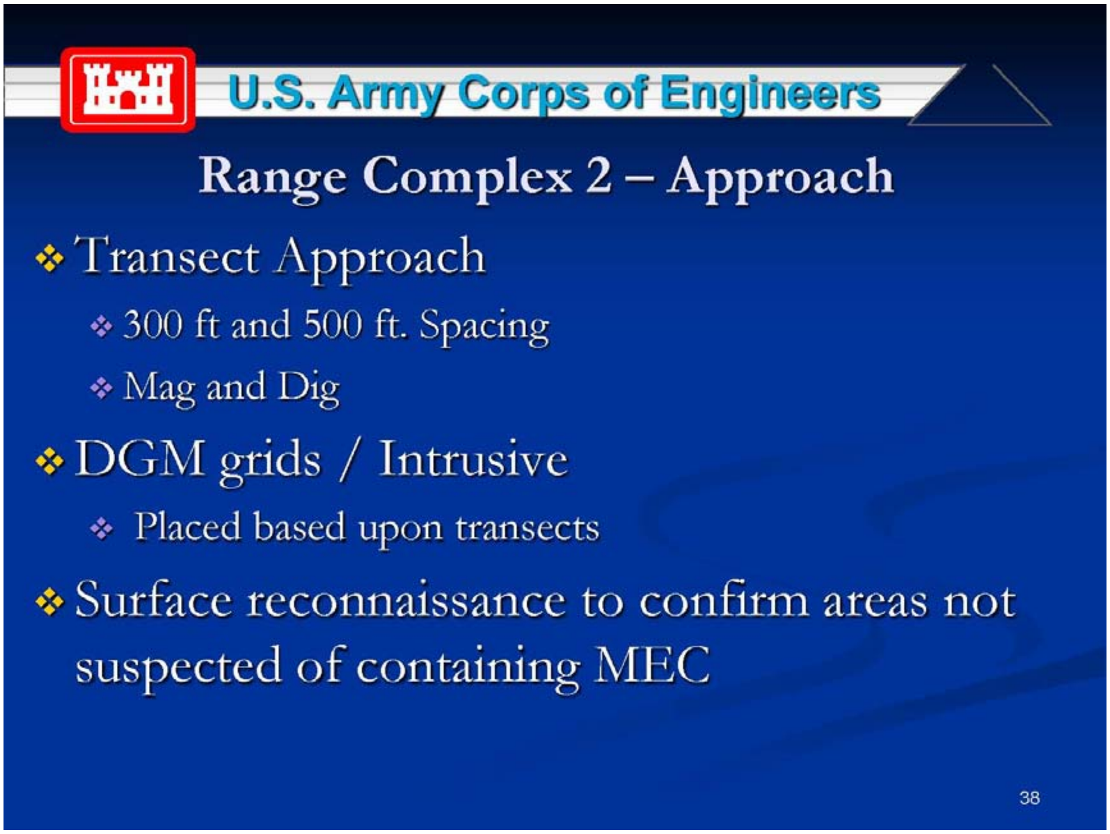
RC 1 MRS

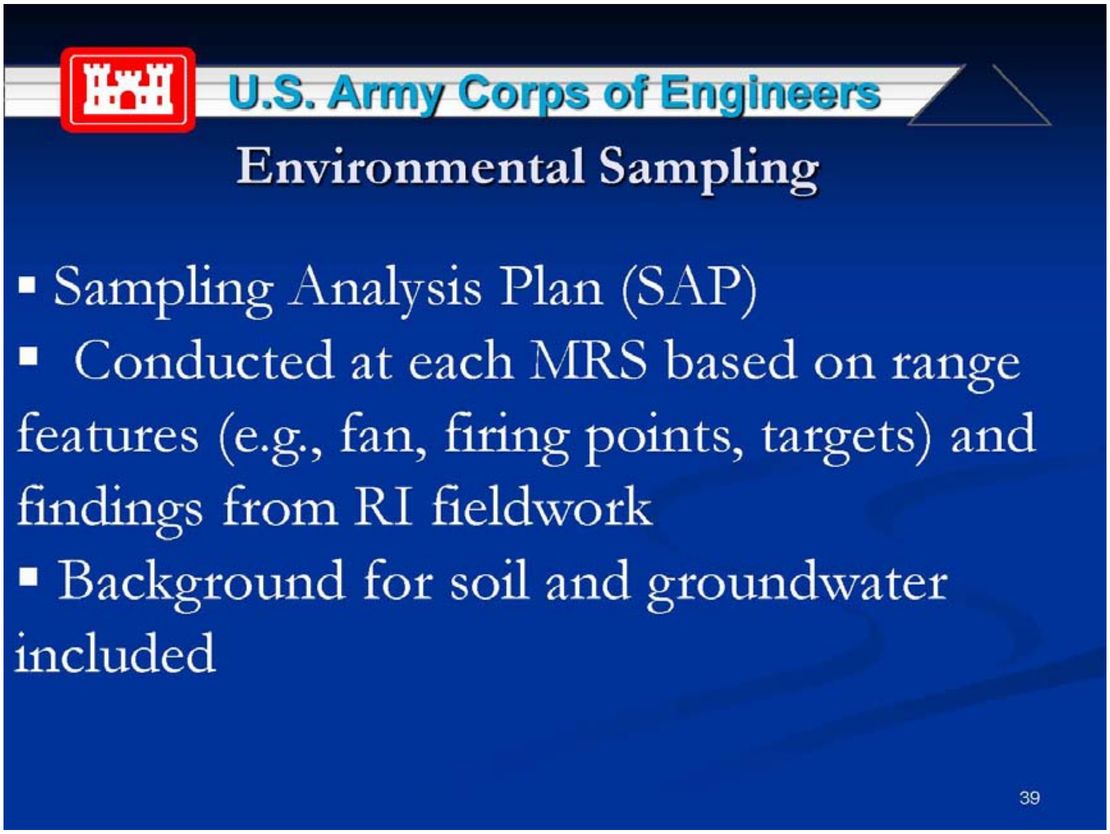
34

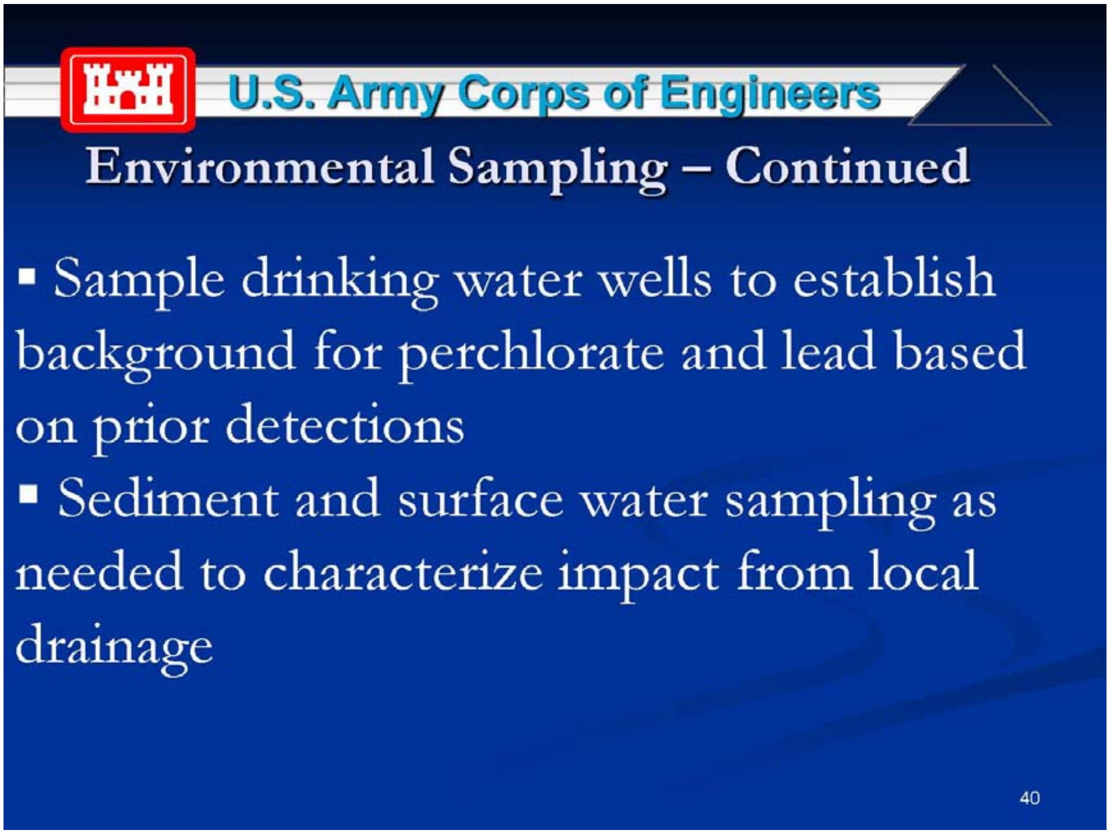

U.S. Army Corps of Engineers
Sampling Screening Levels
See Handout
35


U.S. Army Corps of Engineers
Range Complex 1 – Approach
Significant coverage existing
Transect Approach
300 ft and 500 ft. Spacing
Mag and Dig
DGM grids / Intrusive
Placed in high, med, and low density areas
Surface Recon
500' spacing
36


U.S. Army Corps of Engineers
RC 2 MRS
37


U.S. Army Corps of Engineers
Range Complex 2 – Approach
Transect Approach
300 ft and 500 ft. Spacing
Mag and Dig
DGM grids / Intrusive
Placed based upon transects
Surface reconnaissance to confirm areas not suspected of containing MEC
38


U.S. Army Corps of Engineers
Environmental Sampling
▪ Sampling Analysis Plan (SAP)
▪ Conducted at each MRS based on range features (e.g., fan, firing points, targets) and findings from RI fieldwork
▪ Background for soil and groundwater included
39


U.S. Army Corps of Engineers
Environmental Sampling – Continued
▪ Sample drinking water wells to establish background for perchlorate and lead based on prior detections
▪ Sediment and surface water sampling as needed to characterize impact from local drainage
40

U.S. Army Corps of Engineers

Key Reports / Documents

- Work Plan
- Explosives Siting Plan (ESP)
- RI Report
- FS Report
- Proposed Plans (PPs)
- Decision Documents(DDs)
- Public Involvement Plan (PIP)

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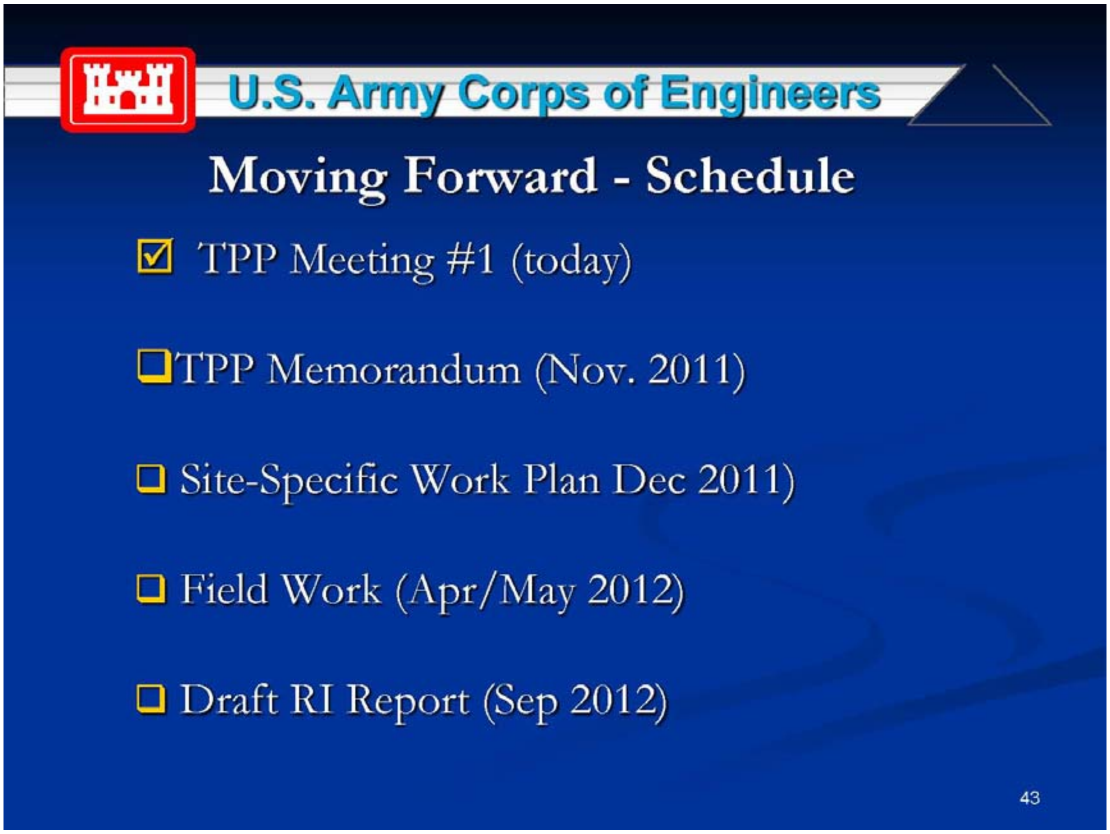
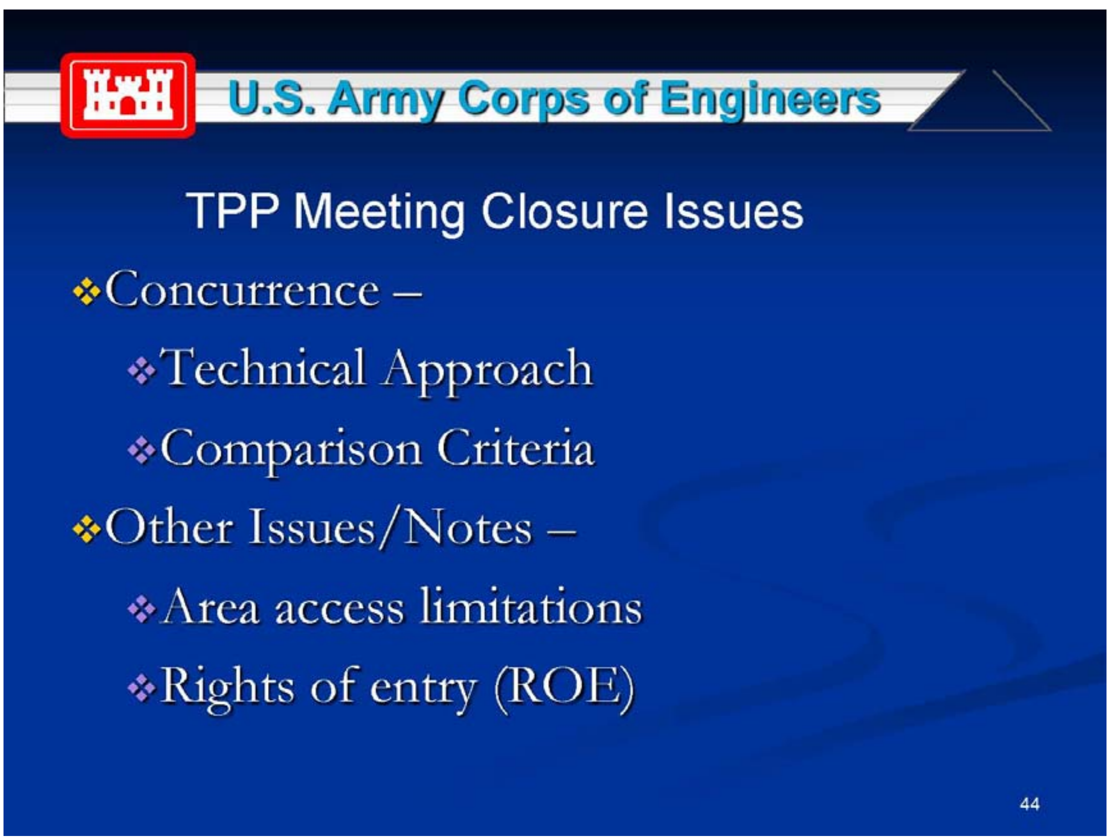
U.S. Army Corps of Engineers

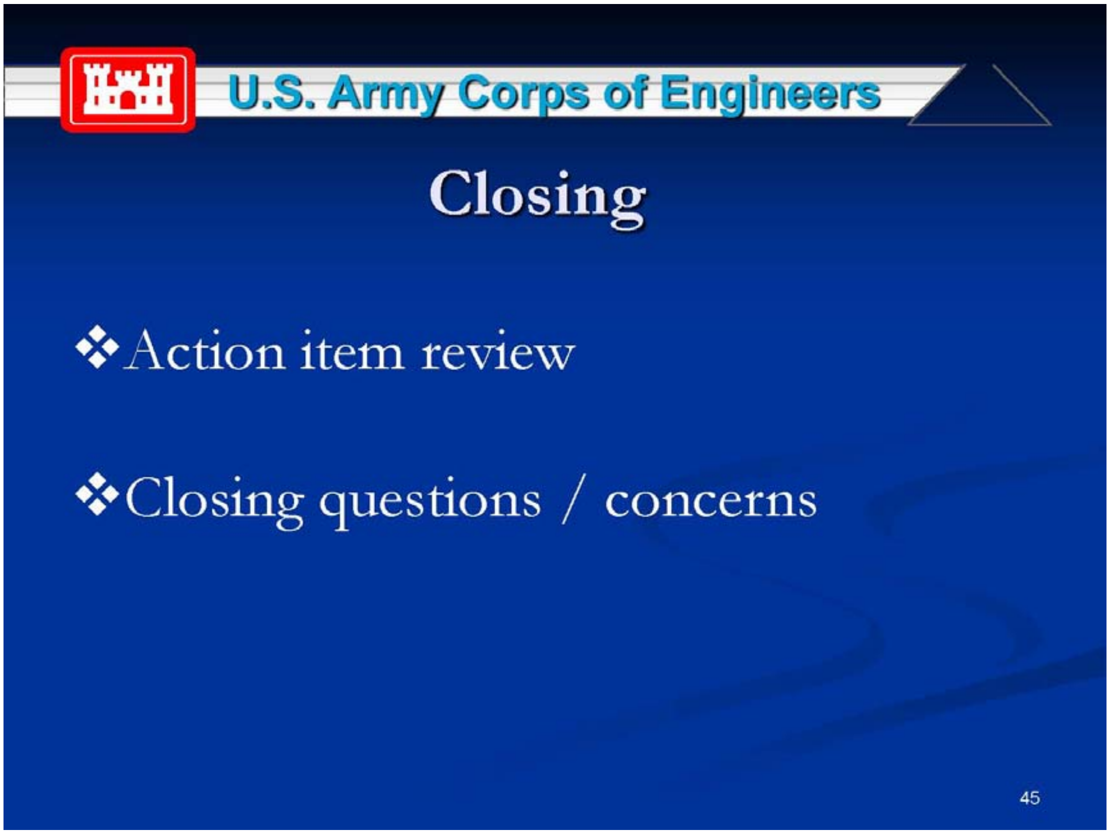
Community Relations Support

- Two (2) public meetings anticipated
  - 1st - Planning phase
  - 2nd - In support of the Proposed Plan
- Five (5) RAB meetings anticipated
- Community relations support outlined in Public Involvement Plan (PIP)
- Administrative Record (AR) will be updated with final documents

42


U.S. Army Corps of Engineers
Moving Forward - Schedule
☑ TPP Meeting #1 (today)
❑ TPP Memorandum (Nov. 2011)
❑ Site-Specific Work Plan Dec 2011)
❑ Field Work (Apr/May 2012)
❑ Draft RI Report (Sep 2012)
43


U.S. Army Corps of Engineers
TPP Meeting Closure Issues
Concurrence –
Technical Approach
Comparison Criteria
Other Issues/Notes –
Area access limitations
Rights of entry (ROE)
44


U.S. Army Corps of Engineers
Closing
❖Action item review
❖Closing questions / concerns
45

APPENDIX I

STANDARD OPERATING PROCEDURES

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TABLE OF CONTENTS

1.0 SOP 2.01 SAMPLING EQUIPMENT CLEANING AND DECONTAMINATION

HGL HydroGeoLogic, Inc — Exceeding Expectations

STANDARD OPERATING PROCEDURE

Sampling Equipment Cleaning and Decontamination	**SOP No.: 2.01** **SOP Category: HTRW** **Revision No.: 1** **Date: December 2010**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe decontamination methods and related issues involving the physical process of removing chemical and radioactive contaminants from sampling equipment.

2.0 SCOPE AND APPLICATIONS

This procedure is specifically applicable to decontaminating the surfaces of sampling equipment that come in direct contact with actual samples during sample collection and processing. This SOP describes the procedures to be followed to achieve effective decontamination as follows: (1) remove contaminants from contaminated surfaces, (2) minimize the spread of contamination to uncontaminated surfaces, (3) avoid any cross-contamination of samples, and (4) minimize personnel exposures. The intent is to accomplish the required level of decontamination while minimizing the generation of additional solid and liquid waste.

Other decontamination procedures may apply to a specific project; refer to the work plan for project-specific decontamination methods and schedules.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Site Health and Safety Plan. Procedures for packaging and disposing of all waste generated during field activities will be described in the project-specific work plan.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 DEFINITIONS

Deionized Water: Tap water treated by passing through a standard deionizing resin column. The deionized water should contain no heavy metals or other inorganic compounds (in other words, compounds at or above analytical detection limits) as defined by a standard inductively coupled argon plasma spectrophotometer scan.

Equipment: Those items (variously referred to as "field equipment" or "sampling equipment") necessary to conduct sampling activities, but that do not directly contact the samples.

Laboratory Detergent: A standard brand of phosphate-free laboratory detergent, such as Liquinox®, or the equivalent.

Organic-Free Water: Tap water treated with activated carbon and deionizing units or water from a Milli-Q® system (or equivalent). This water should not contain pesticides, herbicides, extractable organic compounds, and less than 50 micrograms per liter of purgeable organic compounds as measured by a low-level gas chromatography/mass spectrometry scan. Organic-free water should be stored only in glass or Teflon® containers and dispensed from only glass, Teflon, or stainless steel containers.

Sampling Devices: Utensils and other implements that come into direct contact with samples during their collection and processing.

Solvent: Substance capable of dissolving other substances. Pesticide-grade isopropanol is the most common solvent used to decontaminate equipment. Using any other solvent must be justified and approved by the responsible project personnel and documented on the Daily Field Report forms or in the field logbooks.

Tap Water: Water from a tested and approved water system.

5.0 PROCEDURES

5.1 GENERAL

Decontamination of sampling devices will be performed in a designated decontamination area, removed from any sampling location. This designated area must also be in a location free of direct exposure to airborne and radiological surface contaminants, and downwind of the location where clean field equipment, clean sample devices, and sample containers are stored.

As a minimum, nitrile or equivalent gloves will be worn while decontaminating equipment. Safety glasses or goggles, uncoated Tyvek® coveralls, laboratory coat, or splash apron will be worn if justified by the contaminant concentration and potential adverse effects. If cleaning with steam or high-temperature water, a face shield, heavy-duty polyvinyl chloride (PVC) or equivalent gloves, coated Tyvek or equivalent coveralls will be worn. Ground-fault circuit interrupters will be used to supply power to any portable electrical equipment in the equipment decontamination area. Solvent rinsing will be conducted in an open, well-ventilated area or under a fume hood. No eating, smoking, drinking, chewing, or hand-to-mouth contact will be permitted during

Sampling Equipment Cleaning and Decontamination	**SOP No.: 2.01** **SOP Category: HTRW** **Revision No.: 1** **Date: December 2010**

decontamination activities. A 15-minute eyewash will be available within 100 feet if corrosive (concentrated acids or bases) decontamination fluids are used.

- Contaminated or dirty sampling devices/equipment should not be stored with clean (decontaminated) sampling devices/equipment.
- Clean, decontaminated sampling devices should be segregated from all other equipment and supplies.
- Paint or any other coatings must be removed from any part of a sampling device that may either contact a sample or may otherwise affect sample integrity. After such coatings are removed, the sampling device will then require decontamination by the appropriate method.
- The brushes used to clean sampling devices must not be of the wire-wrapped type.
- For any of the specific decontamination methods that may be used, the substitution of higher-grade water is permitted (for example, using organic-free water in place of deionized water). However, it must be noted that deionized water and organic-free water are less effective than tap water in rinsing away the detergent during the initial rinse.
- Decontaminated sampling devices and all filled and empty sample containers will be stored in locations that are protected from exposure to any contaminant.
- The method for decontaminating sampling devices and the exterior of sample containers that have been exposed to radioactive material is based on the material contaminated, the sample medium, the radiation levels, and the specific radionuclides to be removed.
- The release of decontaminated sampling devices and sample containers for unrestricted use is based on site-specific criteria. These site-specific criteria should be detailed in the project-specific work plan.
- Rags used during decontamination activities may become a hazardous waste and require segregation. Refer to the project work plans for hazardous waste disposal requirements.

5.2 DECONTAMINATION SCHEDULES

- Sampling devices must be decontaminated before being used in the field to prevent potential contamination of a sample.
- Sampling devices must be decontaminated between samples to prevent cross-contamination.
- Sampling devices must be decontaminated at the close of the sampling event before being taken off site.

- An acceptable alternative to cleaning and decontaminating sampling devices is using items cleaned or sterilized by the manufacturer that are discarded after use. Care must be exercised to ensure such previously cleaned or sterilized items do not retain residues of chemical or radioactive sterilizing agents that might interfere with analytical techniques.
- Whenever visible dirt, droplets of liquid, stains, or other extraneous materials are detected on the exterior of a sample container, the exterior surfaces must be decontaminated. This step should be performed before the container is placed in a sample cooler or shipping container.
- For sample containers used in controlled access areas, a more rigorous cleaning and/or radiation monitoring may be required before removal from the site. Refer to the project-specific work plan for details.

5.3 DECONTAMINATION METHODS

The following decontamination methods are examples of some of those most commonly used in field investigations. Note that the decontamination methods described in this section are for guidance only; the field operations manager will adjust decontamination practices to fit the sampling situation and applicable requirements.

- The exterior of sample containers This decontamination will be performed at the sample location before the sample container is placed in the sample cooler or shipping container as follows:
  - The exterior surfaces of the sample container must be wiped with disposable rags/toweling, or rinsed with deionized water.
  - If rinsing with deionized water, the exterior of the sample container must be wiped dry with disposable rags/toweling, or allowed to air dry.
  - All visible dirt, droplets of liquid, or other extraneous materials must be removed.
  - For containers used in controlled-access areas or where the sample media are difficult to remove (for example, sludge), a more rigorous cleaning and/or radiation monitoring may be required. Refer to the project-specific work plan for details.
- Decontaminating stainless steel, Teflon, or metal sampling devices used to collect samples for trace organic compounds and/or metals analyses:
  - Clean with a tap water and laboratory detergent solution. Use phosphate-free detergent, such as Liquinox or equivalent. Use a brush to remove particulate matter and surface film.
  - Rinse thoroughly with organic-free water.

- Rinse twice with solvent (pesticide-grade isopropanol).
- Allow to air dry for 24 hours, if possible.
- If it is not possible to air dry for 24 hours, then rinse twice with organic-free water and allow to air dry as long as possible.
- Wrap sampling devices with aluminum foil (with shiny side facing outward).

Note: When a sampling device is used to collect samples that contain oil, grease, or other hard-to-remove materials, it may be necessary to rinse the device several times with an approved solvent (one that meets the requirements of the work plan) before initiating decontamination. In extreme cases, it may be necessary to steam clean, brush, or sandblast the sampling device before using this decontamination method. If the sampling device cannot be adequately cleaned using the above means, it must be discarded.

- Decontaminating glass sampling devices used for the collection of samples for trace organic compounds and/or metals analyses
  - Wash thoroughly with laboratory detergent and hot water using a brush to remove any particulate matter or surface film.
  - Rinse thoroughly with hot tap water.
  - Rinse thoroughly with tap water.
  - Rinse twice with solvent and allow to air dry for at least 24 hours, if possible.
  - Wrap with aluminum foil (shiny side facing outward) to prevent contamination during storage and/or transport to the field.

Note: When a sampling device is used to collect samples that contain oil, grease, or other hard-to-remove materials, it may be necessary to rinse the device several times with an approved solvent (one that meets the requirements of the work plan) before initiating decontamination. In extreme cases, it may be necessary to steam clean, brush, or sandblast the sampling device before using this decontamination method. If the sampling device cannot be adequately cleaned using the above means, it must be discarded.

5.4 QUALITY CONTROL

The quality of the deionized and organic-free water used may be monitored by collecting samples in standard precleaned sample containers and submitting them to the laboratory for a standard inductively coupled plasma scan. Organic-free water should be submitted for low-level pesticide, herbicide, extractable, or purgeable compounds analyses, as appropriate.

The effectiveness of the decontamination procedures is monitored by submitting samples of rinse water to the laboratory for low-level analyses of the parameters of interest. An attempt should be made to select different sampling devices each time devices are decontaminated to ensure a representative sampling of all devices is obtained over the length of the project. Note on the Daily Field Report Form or in the field logbooks the devices being used for the rinsate samples.

6.0 RECORDS

Documentation generated as a result of this procedure is collected and maintained in accordance with requirements specified in the work plan.

Sampling Equipment Cleaning and Decontamination	**SOP No.: 2.01** **SOP Category: HTRW** **Revision No.: 1** **Date: December 2010**

ATTACHMENTS

Below is Attachment 1, Field Checklist

ATTACHMENT 1
FIELD CHECKLIST

________ Daily Field Report Forms or Field Logbooks
________ Safety Glasses or Monogoggles
________ Black, Indelible Pen
________ Decontamination Equipment
________ Work Plan
________ Appropriate Containers for Waste and Equipment
________ Gloves
________ Safety Shoes
________ Plastic Sheeting
________ Health and Safety Plan
________ Monitoring Instruments

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2.0 SOP 2.03 HAND-OPERATED AUGER SOIL SAMPLING

STANDARD OPERATING PROCEDURE

Hand-Operated Auger Soil Sampling	**SOP No.: 2.03** **SOP Category: HTRW** **Revision No.: 0** **Date: December 2010**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the standard method and equipment used to collect soil samples at the surface or in shallow excavations using a hand auger.

2.0 SCOPE AND APPLICATION

This procedure yields a disturbed sample and applies to a wide variety of soil types including sands, clays, and silts. A hand auger is a small, lightweight metal auger. Diameters typically range between 1 and 4 inches. The use of an auger is of limited value in rocky soil. This procedure is not appropriate for collecting samples at a discrete depth, but may be used to collect samples at an approximate depth.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 EQUIPMENT

The equipment required may include hand-operated, spiral-type, ship-type, open-tubular, orchard-barrel, open-spiral, closed-spiral, post-hole, clamshell, or Iwan augers. Augers typically are used with 3- to 4-foot-long metal extension rods and T-handles. The use of stainless steel augers is preferred. Augers plated with chrome or coated with other materials, except Teflon®, must not be used.

Sampling tools and equipment should be protected from contamination sources before sampling and decontaminated before and between sampling locations, as specified in SOP 2.01: *Sampling Equipment Cleaning and Decontamination.*

Hand-Operated Auger Soil Sampling	**SOP No.: 2.03** **SOP Category: HTRW** **Revision No.: 0** **Date: December 2010**

5.0 PROCEDURES

1. Don clean gloves. Using a decontaminated stainless steel spoon or other approved utensil, remove surface vegetation and debris from the immediate area around the marked sampling point.
2. Use plastic sheeting around work area, as necessary, to prevent equipment from coming in contact with potentially contaminated surfaces.
3. Record the appropriate information and observations about the sample location in the field logbook.
4. Assemble decontaminated auger, extension, and T-handle, if necessary, and advance the auger into the soil to the desired depth.
5. Withdraw the auger from the soil.
6. If a sample is not being collected, remove the soil from the auger and repeat Steps 4 and 5. If a sample is to be collected in the next boring, replace the auger bucket with a decontaminated bucket and repeat Steps 2 through 4.
7. Perform any field monitoring required in the health and safety plan.

If collecting samples for analyses other than volatile organic compound (VOC) analyses, refer to Steps 8 and 9.

8. Using a decontaminated stainless steel spoon, spatula, or disposable scoop, remove soil from the auger and place in a stainless steel bowl on a polyethylene sheet or a glass tray. Discard the top 2 or 3 inches of soil in the auger. Mix or composite soil as directed by the work plan. Using a decontaminated spoon or other approved utensil, remove any large rocks or other organic material (worms, grass, leaves, roots, etc.).
9. Using a decontaminated stainless steel spoon, spatula, or disposable scoop, as appropriate, place soil samples in compatible containers. Place samples in containers defined according to analytical needs specified in the work plan, label samples, and then (when appropriate) pack on ice as soon as possible. Skip to Step 11.

If collecting samples for VOC analysis, refer to Step 10.

10. Remove hand auger from boring. Fit a slide-hammer to the top of the appropriate number of extension rods to reach the total depth of the hole. Attach an impact sampler to the bottom of the extension rod(s) and drive the impact sampler into the soil to a depth of at least 6 inches. Remove the sampler from the borehole and immediately drive an Encore® sampler into the soil in the sampler, then remove the Encore sampler and immediately cap the sample. Collect as many Encore samples

Hand-Operated Auger Soil Sampling	**SOP No.: 2.03** **SOP Category: HTRW** **Revision No.: 0** **Date: December 2010**

as required by the work plan, label samples, and then (when appropriate) pack in ice as soon as possible

11. Package, label, and prepare samples for shipment in accordance with procedures listed in the work plan.
12. If changes in lithology are observed, consult the work plan.

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3.0 SOP 2.04 SOIL SAMPLE COMPOSITING

HGL HydroGeoLogic, Inc Exceeding Expectations

STANDARD OPERATING PROCEDURE

Soil Sample Compositing	**SOP No.: 2.04** **SOP Category: HTRW** **Revision No.: 02** **Date: April 15, 2009**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to outline methods that may be used for field compositing soil samples before they are submitted to an analytical laboratory.

2.0 SCOPE

This procedure applies to compositing soil. This procedure does not apply to sample collection, but rather to combining samples in preparation for submittal for testing. Samples for volatile organic compound analyses must NOT be composited.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 PROCEDURES

Solid material that is to be sampled must be mixed as thoroughly as possible before transferring to the sample container. Anomalous or suspected highly contaminated samples will be brought to the attention of the field manager.

- Solid material that is composited must meet the following requirements:
  - uniform collection techniques must be used to retrieve sample aliquots;
  - samples must be of equal or known proportion, and;
  - the material must be well mixed.
- The most common method of mixing (compositing) is referred to as quartering. The material in the pan is divided into quarters. Each quarter is mixed, and then all quarters are mixed into the center of the pan. This procedure is repeated

Soil Sample Compositing	**SOP No.: 2.04** **SOP Category: HTRW** **Revision No.: 0** **Date: December 2010**

several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion and occasionally turning the material over. Samples are homogenized before placing in containers, except for volatile organic analyses.

- Sampling tools, instruments, and equipment are protected from contamination sources before use and decontaminated after use as specified in SOP 2.01: *Sampling Equipment Cleaning and Decontamination*.
- Composite samples will be packaged, labeled, and prepared for shipment in accordance with the work plan.
- The field logbook will be completed in accordance with procedures detailed in SOP 4.02: *Documentation – Field Logbook Entries*.

5.0 RECORDS

Documentation generated as a result of this procedure is collected and maintained in accordance with requirements specified in the work plan.

- Document all field activities on a daily field activity report in accordance with procedures listed in SOP 4.01: *Documentation – Daily Field Activity Reports*.
- Complete the field logbook in accordance with procedures listed in SOP 4.02: *Documentation – Field Logbook Entries*.

4.0 SOP 2.13 SURFACE AND SHALLOW DEPTH SOIL SAMPLING

STANDARD OPERATING PROCEDURE

Surface and Shallow Depth Soil Sampling	**SOP No.: 2.13** **SOP Category: HTRW** **Revision No.: 0** **Date: December 2010**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the equipment and operations used for sampling surface and shallow depth soils. This procedure outlines the methods for soil sampling with routine field operations on environmental projects. Site-specific deviations from the methods presented herein must be approved by the assigned project manager and the HydroGeoLogic, Inc. (HGL) Quality Assurance/Quality Control Manager.

2.0 SCOPE AND APPLICATIONS

The objective of surface and shallow depth soil sampling is to ascertain the nature and extent of soil contamination at a site. The data can be used to identify contaminant sources, evaluate potential threats to human health or the environment, to evaluate potential exposure pathways, or to calculate environmental risks. For the purposes of this SOP, soil is defined as all unconsolidated materials above bedrock; surface soils are those that occur 0 to 6 inches below ground surface; and shallow depth soils are soils located above the bedrock surface and from 6 inches to 2 feet below ground surface.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Site Health and Safety Plan. Procedures for packaging and disposing of all waste generated during field activities will be described in the project-specific work plan.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 PROCEDURES

4.1 SAMPLING EQUIPMENT

Typically equipment required for surface and shallow depth soil sampling equipment should be specified in the project field sampling plan or work plan. Equipment includes the following:

Surface and Shallow Depth Soil Sampling	SOP No.: 2.13 SOP Category: HTRW Revision No.: 0 Date: December 2010

- stainless steel mixing bowl
- stainless steel trowels or spoons
- stainless steel hand auger
- stainless steel core sampler that uses stainless steel or Lexan® liners (optional)
- stainless steel shovel
- appropriate sample containers

4.2 DECONTAMINATION

Before initial use, and after each subsequent use, all nondedicated sampling equipment must be decontaminated using the procedures outlined in HGL SOP 2.01, *Sampling Equipment Cleaning and Decontamination.*

4.3 SAMPLING LOCATION/SITE SELECTION

Follow the sample design criteria outlined in the project plan for each sampling event. Relocate the sample sites when conditions dictate, such as when natural or artificial obstructions are present at the proposed sample location (such as boulders or asphalt). Document the actual sample locations on a topographic map or site sketch and photograph all sample locations.

4.4 SAMPLING APPROACHES

It is important to select an appropriate sampling approach for accurate characterization of site conditions. Before commencing any soil sampling program, it is necessary to establish appropriate measurement and system data quality objectives. Refer to the U.S. Environmental Protection Agency (EPA) Soil Sampling Quality Assurance User's Guide (EPA, 1989) for guidance in establishing data quality objectives, statistical sampling methodologies, and protocols for each of the sampling approaches. Each approach is defined below.

4.4.1 Judgmental or Biased Sampling

Judgmental or biased sampling is used primarily for documenting an observed release to a groundwater, surface water, air, or soil exposure pathway. This form of sampling is based on the subjective selection of sampling locations where contamination is most likely to be found. Locations are selected using pertinent historical site information and on-site investigation results.

There is no randomization associated with this sampling approach because samples are primarily collected at areas of suspected highest contaminant concentrations. Any statistical calculations based on the results of this sampling technique will be biased.

4.4.2 Random Sampling

Random sampling, used for the characterization of a heterogeneous non-stratified waste, involves arbitrary collection of samples within a defined area. This method is most effective and accurate if the chemical heterogeneity of the waste remains constant from batch to batch. The easiest method for random sampling is to divide the area for sampling into an imaginary grid, assign a series of numbers to the units of the grid, and select the numbers or units to be sampled through the use of a random-numbers table, an example of which can be found in the text of any basic statistics book. Note that haphazardly selecting sample numbers or units is not a suitable substitute for a randomly selected sample. Refer to Attachment 1, Figure 1, for the random sampling approach.

4.4.3 Stratified Random Sampling

Stratified random sampling, used for the characterization of a heterogeneous stratified waste, involves arbitrary collection of samples within a defined area and strata. This method is most effective and accurate if the chemical heterogeneity of the waste remains constant from batch to batch. The easiest method for stratified random sampling is to divide the area for sampling into an imaginary grid, assign a series of numbers to the units of the grid, and select the numbers or units to be sampled through the use of a random-numbers table, an example of which can be found in the text of any basic statistics book. A random sample is then collected from each stratum at the selected numbers or units on the grid. Note that haphazardly selecting sample numbers or units is not a suitable substitute for a randomly selected sample. Refer to Attachment 2.13-1, Figure 1, for the random sampling approach. Attachment 1, Figure 2, illustrates a stratified random sampling approach.

4.4.4 Systematic Grid Sampling

Systematic grid sampling involves dividing the area of concern into smaller sampling areas using a square or triangular grid. Samples are then collected from the intersection of the grid lines or "nodes." Grid placement should be selected by using an initial random point. The distance between nodes depends on the size of the site or area of concern and the number of samples to be collected. Generally, a larger distance is used for a large area of concern. Refer to Attachment 1, Figure 3, for the systematic grid sampling approach.

4.4.5 Systematic Random Sampling

Systematic random sampling involves dividing the area of concern into smaller sampling areas. Samples are collected within each individual grid cell using random selection procedures. Attachment 1, Figure 4, illustrates a systematic random sampling approach.

4.4.6 Search Sampling

Search sampling utilizes a systematic grid or systematic random sampling approach to define areas where contaminants exceed cleanup criteria. The distance between the grid lines and number of

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samples to be collected depend on the acceptable level of error (that is, the chance of missing a hot spot). This sampling approach requires that assumptions be made regarding the size, shape, and depth of hot spots. Attachment 1, Figure 5, illustrates a search sampling approach.

4.4.7 Transect Sampling

Transect sampling involves establishing one or more transect lines, parallel or non-parallel, across the area of concern. If the lines are parallel, this sampling approach is similar to systematic grid sampling. The advantage of transect sampling over systematic grid sampling is the relative ease of establishing and relocating transect lines versus an entire grid. Samples are collected at regular intervals along the transect line at the surface and/or at a specified depth(s). The distance between the sample locations is determined by the length of the line and the number of samples to be collected. Refer to Attachment 1, Figure 6, for the transect sampling approach.

4.5 GENERAL

All boreholes and pits will be filled in with the material removed during sampling unless otherwise specified in the project plan. Where a vegetative turf has been established, fill in with native soil or potting soil and replace the turf if practical in all holes or trenches when sampling is completed.

4.5.1 Homogenizing Samples

Homogenizing is the mixing of a sample to provide a uniform distribution of the contaminants. Proper homogenization ensures that the containerized samples are representative of the total soil sample collected. All samples to be composited or split should be homogenized after all aliquots have been combined. **Do not homogenize (mix or stir) samples for volatile compound analysis.**

4.5.2 Compositing Samples

Compositing is the process of physically combining and homogenizing several individual soil aliquots of the same volume or weight. Compositing samples provide an average concentration of contaminants over a certain number of sampling points. Refer to HGL SOP 2.04 *Soil Sample Compositing*.

4.5.3 Splitting Samples

Splitting samples is performed when multiple portions of the same samples must be analyzed separately. After preparation, fill the sample containers for the same analyses one after another in a consistent manner (parent sample for volatile organic compounds [VOCs], then split samples for VOCs; parent sample for semivolatile organic compounds [SVOCs], then split sample for SVOCs, and so forth).

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4.6 SURFACE SOIL SAMPLING

Perform the following steps for surface soil sampling:

- Before sampling, remove leaves, grass, and surface debris from the area using a decontaminated stainless steel trowel of disposable sampling spoon.
- Label the lid of the sample container with an indelible pen or affix the sample label to the side of the jar. Tape over the label to seal out dirt and water before filling the container with soil.
- Collect surface soil samples with a decontaminated stainless steel trowel, spoon, or hand auger and transfer them to a decontaminated stainless steel bowl for homogenizing. If VOC analyses are to be conducted, fill the appropriate VOC sample containers and then proceed to transfer the appropriate aliquot of soil to the decontaminated stainless steel bowl for homogenizing.
- Collect samples in the order of volatilization sensitivity. The most common collection order is as follows:
  - VOC
  - purgeable organic carbon
  - purgeable organic halogens
  - total organic halogens
  - total organic carbon
  - extractable organics
  - total metals
  - phenols
  - cyanide
  - radionuclides
- Immediately transfer the sample into a container appropriate to the analysis being performed.
- Place the samples in a cooler with ice. The temperature in the cooler must be maintained at approximately 4 degrees Celsius (•C) (if appropriate for analyses) for transport to an analytical laboratory.
- Place all excess soil sample media in the soil boring or pit and fill it to grade with native soil or potting soil.
- Decontaminate all sampling equipment (HGL SOP 2.01, *Sampling Equipment Cleaning and Decontamination*).

4.7 SURFACE SOIL SAMPLING (COMPOSITE SAMPLES ONLY)

Perform the following steps for surface soil (composite) sampling:

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- Before sampling, remove leaves, grass, and surface debris from the area using a decontaminated stainless steel trowel.
- Collect surface soil aliquots with a decontaminated stainless steel spoon, trowel, or hand auger and add to a stainless steel bowl and homogenize. Before homogenizing, remove an aliquot for VOC analysis (if appropriate) and then homogenize in accordance with HGL SOP 2.04 *Soil Sample Compositing*.
- Label the sample container and ice to 4 •C. Complete the chain of custody record and pack in the sample cooler.
- Decontaminate all nondedicated sampling equipment (HGL SOP 2.01, *Sampling Equipment Cleaning and Decontamination*).

4.8 SHALLOW DEPTH SOIL SAMPLING

Perform the following steps to collect shallow depth soil samples:

- Use a decontaminated stainless steel shovel to remove the top layer of soil and leaves, grass, and surface debris.
- Excavate soil to the pre-determined sampling depth by using a decontaminated hand auger. Periodically remove the cuttings from the auger.
- When the proper sample depth is reached, remove the hand auger and all cuttings from the hole.
- Lower the decontaminated core sampler or hand auger to the bottom of the hole. When using a core sampler, it must contain a decontaminated liner appropriate for the constituents to be analyzed.
- Mark the sample interval on the hammer stem or auger.
- Operate the slide hammer on the core sampler to drive the sampler head into the soil, or advance the auger until it is flush with the interval mark at ground level.
- Record weight of hammer, length of slide, blow counts, and geologic soil data for all samples collected with a core sampler in the field logbook as outlined in HGL SOP 4.07, *Field Logbook Use and Maintenance*. This information may also be entered on Attachment 2, Surface/Shallow Soil Sampling Log.
- When the core sampler liner or auger has been advanced to the total depth of the required sample, remove it from the bottom of the hole.
- Immediately remove the liner from the core sampler and transfer the sample into a container or stainless steel bowl for compositing and homogenizing as specified in the project-specific field sampling plan appropriate to the analysis being performed using a stainless steel spoon or trowel. Before compositing and homogenizing, fill the appropriate

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aliquot for VOC analysis (if conducted) and then composite and homogenize in accordance with HGL SOP *Soil Sample Compositing*.

- Label the sample container and preserve it on ice to 4 •C. Complete the chain of custody record and pack in the sample cooler.
- Decontaminate all sampling nondedicated equipment (HGL SOP 2.01, *Sampling Equipment Cleaning and Decontamination*).

4.9 ABANDONMENT PROCEDURES

Abandon boreholes and fill to grade with the material removed for sampling or clean fill.

5.0 DOCUMENTATION

Record applicable sampling information in the field logbook as outlined in HGL SOP 4.07, *Field Logbook Use and Maintenance*. This information can also be entered on Attachment 2, Surface/Shallow Soil Sampling Log.

The project manager or an approved designee shall check all field sheets and field logbooks used to record information during sampling for completeness and accuracy. Any discrepancies will be noted, and the documents will be returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating the "checked by" and "date" blanks on the field sheets and at the applicable places in the logbook.

6.0 REFERENCES

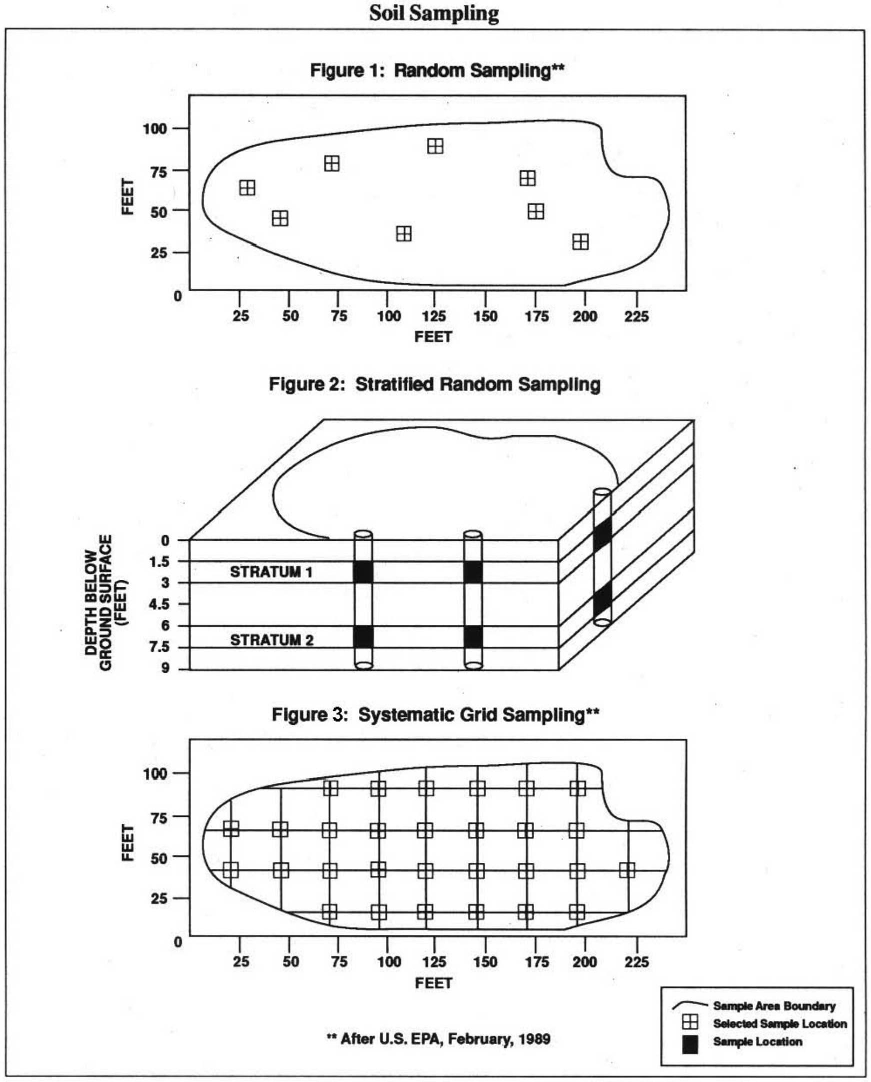
U.S. Environmental Protection Agency. 1989. "Soil Sampling Quality Assurance User's Guide." EPA/600/8-89/046, Washington, DC.

ATTACHMENTS

Attachment 1	Figures for Different Forms of Grid Sampling
Attachment 2	Surface/Shallow Soil Sampling Log

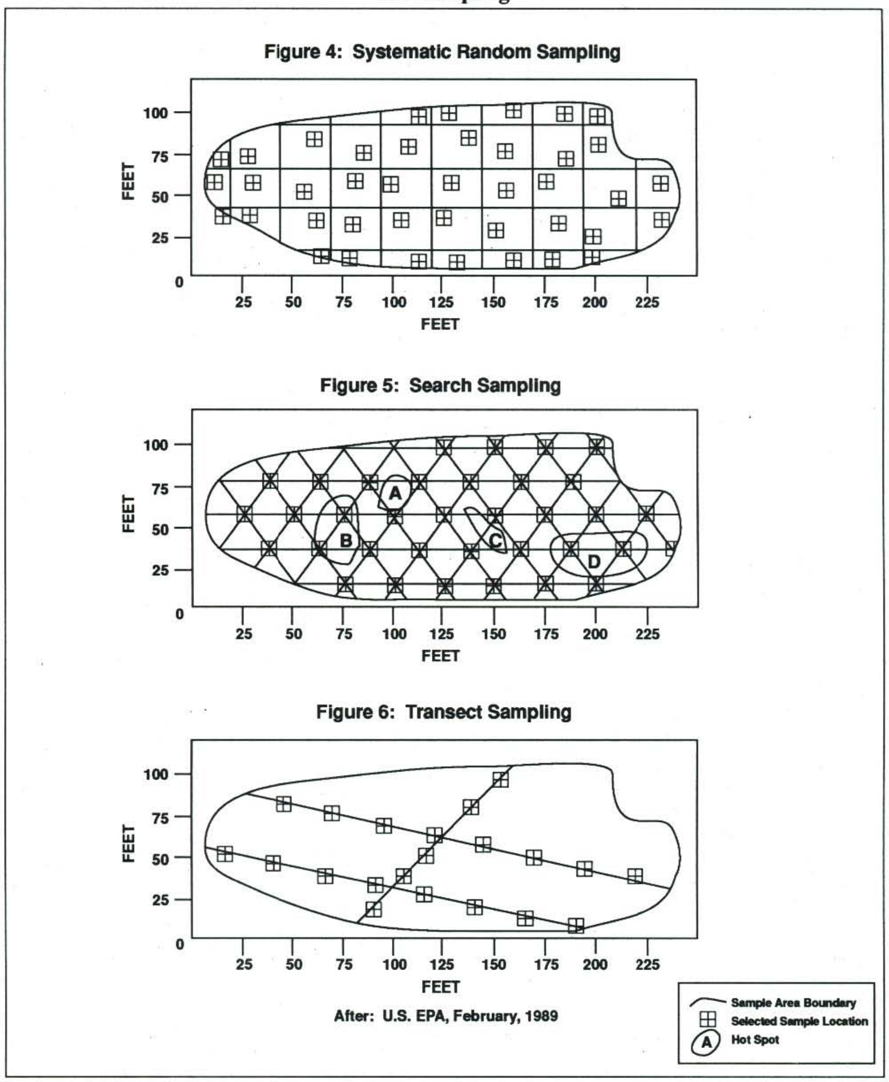
ATTACHMENT 1
Figures for Different Forms of Grid Sampling

Soil Sampling



ATTACHMENT 1 (Continued)
Figures for Different Forms of Grid Sampling

Soil Sampling



ATTACHMENT 2
Surface/Shallow Soil Sampling Log

HGL HydroGeoLogic, Inc Exceeding Expectations	**Surface and Shallow Soil Sampling Log**	Records Management Data
Project Number	Project Name	Page ____ of ____

General Info			
	Location		
	Surface Elevation ft.	Date Started	Date Completed
	Field Investigator		C of Cr
	Sampling Excavation Method	Sampling Method	
	Depth of Excavation ft.	Depth Water First Encountered ft.	Backfill Material

Sampling Info	**Sample Number**	**Depth (ft)**	**Lithologic Description**[1]	**Sample Container**	**Analyses Requested**

Plan View		**Legend**
		Soil Sampling Location

Recorded By:	Date	Checked By:	Date:

[1] Include such data as OVM, pH, blow counts, or other physical reading observations.

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5.0 SOP 2.14 GEOLOGIC BOREHOLE LOGGING

STANDARD OPERATING PROCEDURE

Geologic Borehole Logging	SOP No.: 2.14 SOP Category: HTRW Revision No.: 0 Date: December 2010

1.0 PURPOSE

This Standard Operating Procedure (SOP) defines the methodology for conducting lithologic logging of core, cuttings, split-spoon samples, and subsurface samples collected during field operations at sites where environmental investigations are performed by HGL.

2.0 SCOPE AND APPLICATIONS

The installation of monitoring wells, piezometers, and boreholes is a standard practice at many sites requiring environmental investigations. Following the guidelines presented in this SOP will help ensure that pertinent data is collected so that all borehole logs made while installing these devices at a site can be standardized to create a consistent, uniform database from which interpretive conclusions can be made with minimal decision error. A borehole log provides lithologic descriptions to characterize the physical subsurface and the geologic and hydrologic processes operating at the site. A properly prepared borehole log serves as an essential tool for evaluating and correlating these processes.

This SOP provides guidance for routine field operations on environmental projects, and was derived from *A Compendium of Superfund Field Operations Methods*, U.S. Environmental Protection Agency (EPA/540/P-87/001 [OSWER Directive 9355.0-14]); U.S. Geologic Survey standards; and other industry standards. Site-specific deviations from the methods presented herein must be approved by the Project Manager and HGL Quality Assurance Officer, and detailed in the Field Sampling Plan or Work Plan for the project.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Site Health and Safety Plan. Procedures for packaging and disposing of all waste generated during field activities will be described in the project-specific work plan.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

Geologic Borehole Logging	SOP No.: 2.14 SOP Category: HTRW Revision No.: 0 Date: December 2010

4.0 PROCEDURES

4.1 INTRODUCTION

Boreholes should be logged by a trained geologist, or other earth scientist under the supervision of a geologist. Large-scale inferences such as vertical and horizontal extent of strata, facies changes, attitude of bedding or layering, structural features (faults, folds, fractures, dikes, etc.), location of the water table, lithologic characterizations, and the extent of subsurface contamination are made from small-scale observations recorded on the borehole log. These observations include bedding, grain size, degree of sorting, shape of grains, color, hardness, organic vapor levels, and other observable physical characteristics including visible evidence of contamination.

Logging should document both general and specific lithologic information about the borehole. In all cases, the lithologic log should be identified with the following:

- Specific site number;
- well/boring number;
- Drilling method;
- Location;
- Date of drilling;
- Individual logger (geologist);
- Drilling contractor;
- Significant organic vapor reading;
- Visible evidence of contamination, such as staining or odor;
- Depth to water first encountered:
- Final depth of water level;
- Well/boring elevation (if data is available);
- Total depth in feet;
- Graphic log, and;
- Lithologic description.

Lithologic descriptions for unconsolidated materials often use the Unified Soil Classification System (USCS) or standard geologic field description methods (Compton, 1962). Descriptions of bedrock should follow applicable U.S. Geologic Survey standards.

Lithologic descriptions of unconsolidated material should contain the following characteristics when possible:

- Soil or formation name;
- Gradation degree of sorting;
- Principal constituent;

Geologic Borehole Logging	SOP No.: 2.14 SOP Category: HTRW Revision No.: 0 Date: December 2010

- Specific descriptors for principal constituents (for example, plasticity, grain size, and shape);
- Firmness/hardness;
- Minor constituents;
- Moisture content;
- Color;
- Particle morphology; and
- Other descriptors (such as, visual evidence of contamination, specific monitoring equipment readings including photoionization detector [PID]/organic vapor analyzer [OVA] readings).

4.2 CLASSIFICATION SYSTEM

The following subsections describe in detail the parameters and descriptive terminology used to classify each sample for the bore log.

4.2.1 Soil or Formation Name

The soil or formation name will include the major constituent(s) and may be preceded by a single-word modifier indicating the subordinate constituent. Percentages of each constituent will be used to classify the material without actually recording constituent percentage. The textural terms used to classify a soil are shown in Attachment 1, Triangular Diagram Showing Percentage of Sand, Silt, and Clay in Each Textural Class.

4.2.2 Gradation (Degree of Sorting)

Size sorting describes the extent to which grain size is uniform. The comparison chart listed in Attachment 2, "Comparison Chart for Estimating Degree of Sorting," will be used to describe soils being logged from a borehole.

4.2.3 Principal Constituent

Principal constituents recorded during borehole logging include an identification of the following unconsolidated material types:

- Clay;
- Sand;
- Cobbles;
- Silt;

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- Gravel; and
- Boulders.

If known, an identification of the potential source of the material should be made (such as, alluvium, colluvium, artificial fill, or residual material).

4.2.4 Principal Constituent Descriptors

Additional descriptors for the principal material constituents may be added to the log in order to further delineate or accurately record subtle changes in the lithologic structure. Modifiers such as grain size, shape, and plasticity of materials (high, medium, and low plasticity). (Note: Plasticity is the property of permanently changing shape without movement on any visible fractures.)

4.2.5 Consistency/Density/Rock Hardness

The characteristics of unconsolidated material are often determined by the Standard Penetration Test (SPT). The SPT involves driving a split-spoon sampler into the material by dropping a 140 pound weight from a height of 30 inches. The resistance of the material is reported in the number of blows of the weight required to drive the spoon one foot and translates into the following descriptors:

Number of Blows/Foot	Cohesive Consistency (Clay)
0-2	Very soft
2-4	Soft
4-8	Medium
8-15	Stiff
15-30	Very stiff
30+	Hard
Number of Blows/Foot	**Cohesive Consistency (Gravel)**
0-4	Very loose
4-10	Loose
10-30	Medium dense
30-50	Dense
50+	Very Dense
Number of Blows/Foot	**Rock Hardness**
<20	Weathered
20-30	Firm
30-50	Medium Hard
50-80	Hard
80+	Very Hard

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4.2.6 Minor Constituents

Constituents not previously described in the principal constituent description may be described as a percentage or by weight. Typically, modifiers for minor constituents conform to the following standards:

- No modifier < 5 percent
- Slightly 5 to12 percent
- Moderately (add '-y' or '-ey' such as silty clay) 12 to 40 percent
- Very 40 to 50%

4.2.7 Moisture Content

The terms used to describe the relative moisture content of a field soil sample are:

- Dry - The sample is completely without moisture. Dry, silty sands, for example, will produce suspended particles when dropped by hand.
- Damp - Samples containing a very slight amount of water.
- Moist - Soils in this range are near the maximum water content for their maximum compactibility or density. Moist soils will form a ball when compressed in the hand.
- Wet - The soil samples are wet enough to produce free water upon shaking but still contain unoccupied air voids. Fine-grained soils close to the liquid limit would be termed wet.
- Saturated - Soils with no air voids. Samples placed in sample jars or bags will probably have standing water after a short period of time.

4.2.8 Color

The color of soil and associated materials will be recorded on the borehole log. Color descriptors should include but are not limited to the following descriptors: black, grey-black, brown, olive, mottled, streaked, etc. Color charts should be used to provide general logging guidance but specific use is not necessary for adequately describing lithology.

4.2.9 Particle Morphology

The key elements of particle morphology are roundness and sphericity. Roundness is a measure of the curvature of grain corners. Sphericity is a measure of how equal the three axial lengths (x, y, z) of an object are. Determination of both properties is facilitated by the use of a hand lens. Estimate grain roundness and sphericity by using the American Geologic Institute (AGI) Data Sheet (Attachment 4).

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4.2.10 Other Descriptors

Field screening data collected during the drilling process may help further characterize site conditions during subsurface investigations. Readings from on-site monitoring equipment such as PIDs, OVAs and Oxygen/Explosimeters should be recorded at each sample interval. Other useful information includes the organic content and the presence or absence of waste material in samples.

4.2.11 Particle Size Distribution

An estimate of particle sorting by grain size is often useful for borehole logging purposes. Precise estimates of percent composition of the sample is not necessary.

USCS Grain Size Categories

Exact Size Limits	Approximate Inch Equivalents	Name of Loose Aggregate
>256 mm	>10 in.	Boulder gravel
64 – 256 mm	2.5 – 10 in.	Cobble gravel
32 – 64 mm	1.2 – 2.5 in.	Very coarse pebble gravel
16 – 32 mm	0.6 – 1.2 in.	Coarse pebble gravel
8 – 16 mm	0.3 – 0.6 in.	Medium pebble gravel
4 – 8 mm	0.15 – 0.3 in.	Fine pebble gravel
2 – 4 mm	0.08 – 0.15 in.	Granule (or very fine pebble) gravel
1 – 2 mm	0.04 – 0.08 in.	Very coarse sand
1/2 – 1 mm	0.02 – 0.04 in.	Coarse sand
1/4 – 1/2 mm	0.01 – 0.02 in.	Medium sand
1/8 – 1/4 mm	0.005 – 0.01 in.	Fine sand
1/16 – 1/8 mm	0.002 – 0.005 in.	Very fine sand
1/256 – 1/16 mm	0.00015 – 0.002 in.	Silt
<1/256 mm	<0.00015 in.	Clay (clay-size materials)

mm = millimeters
Source: Wentworth Scale; Compton 1962

The Comparison Chart for Estimating Percentage Composition (Attachment 3) can be used to estimate the percentage of various grain sizes present in a sample. However, visual estimates usually provide sufficient information for characterizing site lithology.

4.3 BOREHOLE LOGS

Record data collected during exploratory boring soil logging in the field logbook and on Attachment 5, Borehole Log. Use this log on all applicable field drilling and subsurface sampling operations.

Geologic correlation and aquifer properties prediction are dependent on good exploratory boring sample descriptions. Rotary drilling with fluids is generally unacceptable since the drilling fluids may potentially contaminate the aquifer under investigation. High quality borehole data are

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generally acquired with a split-spoon or pitcher core barrel. This method of sampling provides detailed logging. The lithofacies interpreted from cuttings logs may lack the accuracy necessary for detailed correlation. Where possible, techniques such as geophysical borehole logging will be used to supplement cuttings descriptions. Note on the log any geologic description determined from borehole cuttings. The cuttings are often mixed over the entire length of the boring.

In bedrock formations, cuttings may be acquired from a reverse circulation, air rotary or from a dual wall rotary boring. These cuttings do not provide information on the in situ properties of the materials, but do provide adequate sample description information.

In summary, close sample spacing or continuous sampling in a boring provide the best material for descriptive geology. Use traditional geologic terminology and supplement with the USCS descriptive system when appropriate. Provide sufficient data on layering and other sedimentary structures and undisturbed textures. Sample numbers, depths, and analytes should be included in each description. The applicable field methods described by Compton (1962) and AGI (1982) are recommended. These methods are fully referenced in Section 5.0.

4.4 REVIEW

Personnel conducting borehole logging of soil will record field data on Attachment 5, Borehole Log, and will record a chronological summary in the project log book. The applicable methods outlined in this procedure shall be used to record the data on this Attachment. The personnel conducting these operations will sign and date the "logged by" and "date" blanks on Attachment 5, Borehole Log.

The Project Manager or designee shall check all field generated data and Attachment 5, Borehole Log, for completeness and accuracy. Any discrepancies will be noted and the Attachments will be returned to the originator for correction. The reviewer will acknowledge that corrections have been incorporated by signing and dating the "reviewed by" and "date" blanks on Attachment 5, Borehole Log.

5.0 REFERENCES

American Geological Institute, 1982. "AGI Data Sheets." Falls Church, Virginia.

ASTM International, 1984. ASTM D1586, Description and Identification of Soils, Visual-Manual Procedure" in the Annual Book of ASTM Standards. V.04.08

Compton, Robert R., 1962. *Manual of Field Geology*. John Wiley and Sons, Inc. New York, New York.

Munsell, 1988. Munsell Soil Color Charts. Macbeth Division, Kollmorgen Instruments Corporation, Baltimore, Maryland.

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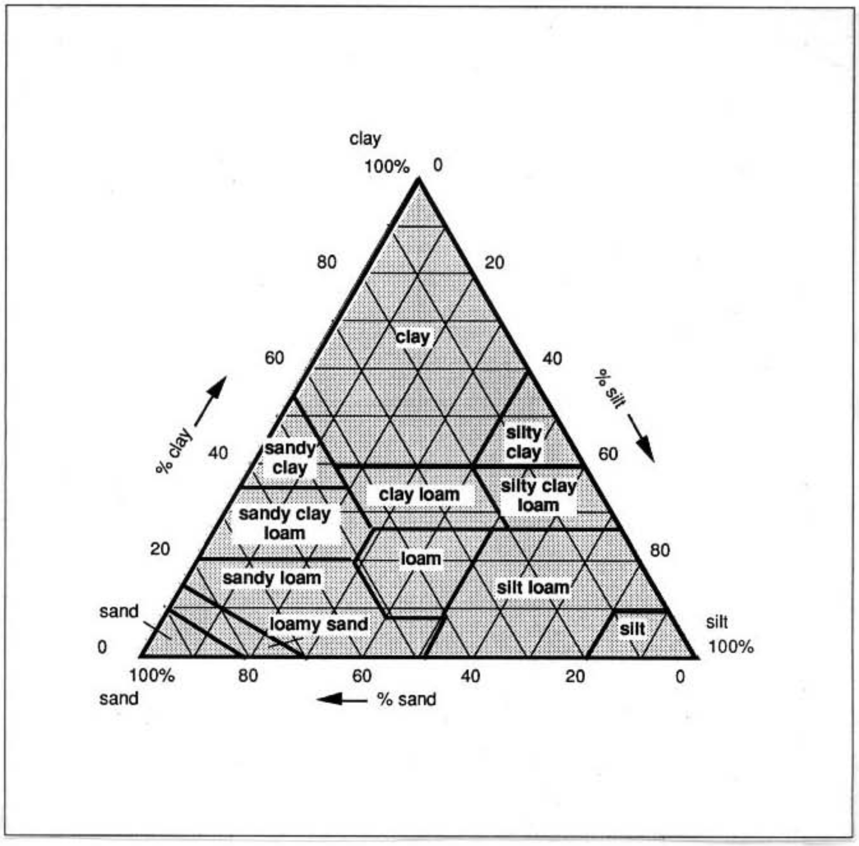
6.0 ATTACHMENTS

Attachment 1	Triangular Diagram Showing Percentage of Sand, Silt and Clay in Each Textural Class
Attachment 2	Comparison Chart for Estimating Degree of Sorting
Attachment 3	Comparison Chart for Estimating Percentage Composition
Attachment 4	Comparison Chart for Estimating Roundness and Sphericity
Attachment 5	Borehole Log

Geologic Borehole Logging	SOP No.: 2.14 SOP Category: HTRW Revision No.: 0 Date: December 2010

ATTACHMENT 1
Triangular Diagram Showing Percentage of Sand, Silt and Clay in Each Textural Class



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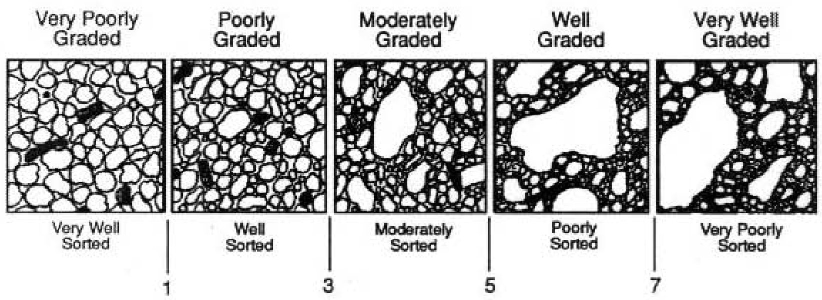
ATTACHMENT 2
Comparison Chart for Estimating Degree of Sorting



Terms for degrees of sorting. The numbers indicate the number of size-classes included by the bulk (80 percent) of the material. The drawings represent sandstones as seen with a hand lens. Silt and clay-size materials are shown diagrammatically by the fine stipple.

Reference: Compton, R.R. 1962. *Manual of Geology.* John Wiley & Sons, Inc. New York, N p. 214

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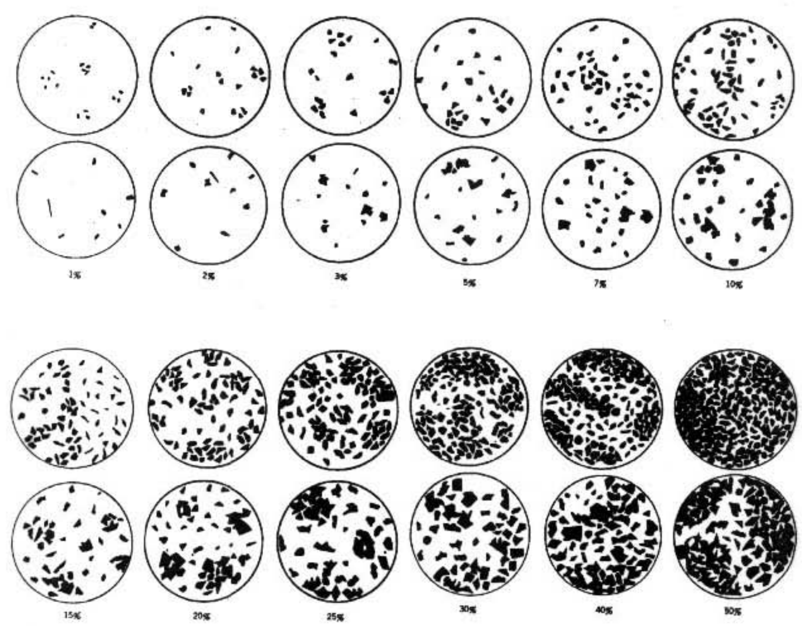
ATTACHMENT 3
Comparison Chart for Estimating Percentage Composition



Reference: Compton, R.R. 1962. *Manual of Geology*. John Wiley & Sons, Inc. New York, NY p. 332-333

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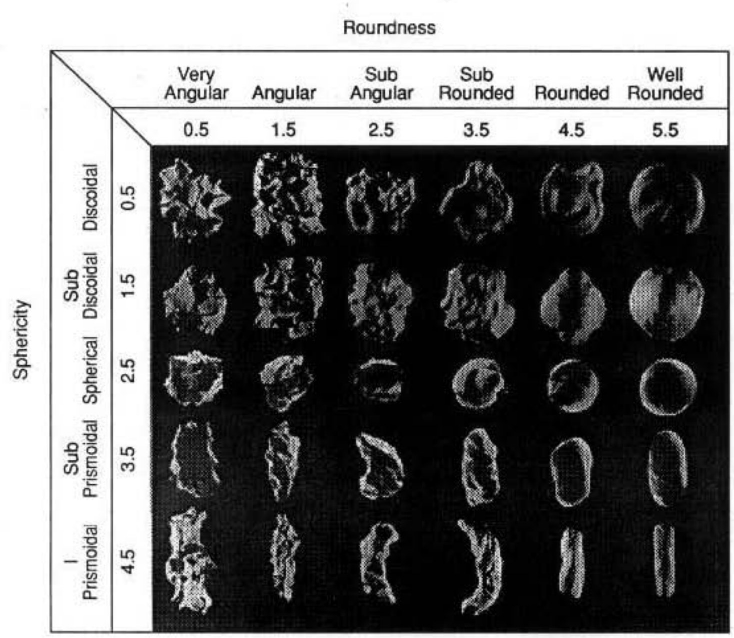
ATTACHMENT 4
Comparison Chart for Estimating Roundness and Sphericity



Reference:American Geological Institute. 1982. "AGI Data Sheet 18.1" in *AGI Data Sheets*. Fall Church, VA

Geologic Borehole Logging	**SOP No.: 2.14** **SOP Category: HTRW** **Revision No.: 0** **Date: December 2010**

ATTACHMENT 5
Borehole Log

HTRW DRILLING LOG		HOLE NO.
1. COMPANY NAME	2. DRILLING SUBCONTRACTOR	SHEET OF SHEETS
3. PROJECT	4. LOCATION	
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION	
	9. SURFACE ELEVATION	
	10. DATE STARTED	11. DATE COMPLETED
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES			
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR		

ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE f	BLOW COUNTS g	REMARKS h

DRILLOG2.CDR HydroGeoLogic, Inc. 01/14/97

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Geologic Borehole Logging	**SOP No.: 2.14** **SOP Category: HTRW** **Revision No.: 0** **Date: December 2010**

HTRW DRILLING LOG							HOLE NO.
PROJECT			INSPECTOR				SHEET OF SHEETS
ELEV a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE f	BLOW COUNTS g	REMARKS h

DRILLOG2.CDR HydroGeoLogic, Inc. 01/14/97

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6.0 SOP 4.07 FIELD LOGBOOK USE AND MAINTENANCE

STANDARD OPERATING PROCEDURE

Field Logbook Use and Maintenance	SOP No.: 4.07 SOP Category: HTRW Revision No.: 1 Date: December 2010

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the methods for use and maintenance of field logbooks. This procedure outlines methods, lists examples for proper data entry into a field logbook, and provides the standardized HydroGeoLogic, Inc. (HGL) format.

2.0 SCOPE AND APPLICATIONS

This procedure provides guidance for routine field operations on environmental projects. Site-specific deviations from the methods presented herein must be approved by the assigned HGL project manager and the HGL project quality assurance/quality control officer. Consult the project-specific planning documents for other documentation requirements that apply to the project.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and documented in the planning documents. Deviations from requirements will be sufficiently documented to re-create the modified process.

All field personnel who travel to a site to conduct work related to environmental projects are responsible for documenting field investigation activities in project field logbooks in a legible manner and maintaining field logbooks over the course of the project in accordance with this SOP. Daily logs will be kept during field activities by the HGL field team leader, or approved designee, to provide daily records of significant events, observations, and measurements taken in the field.

The project manager or an approved designee is responsible for checking the field logbooks and verifying that they have been completed in accordance with this SOP.

Field Logbook Use and Maintenance	**SOP No.: 4.07** **SOP Category: HTRW** **Revision No.: 0** **Date: December 2010**

4.0 PROCEDURE

4.1 INTRODUCTION

Field logbooks provide a means for recording observations and activities at a site. Field logbooks are intended to provide sufficient data and observation notes to enable participants to reconstruct events that occurred while performing field activities and to refresh the memory of field personnel when writing reports or giving testimony during legal proceedings. As such, all entries will be as factual, detailed, and as descriptive as possible so that a particular situation can be reconstructed without reliance on the collector's memory. Field logbooks are not intended to be used as the sole source of project or sampling information. A sufficient number of logbooks will be assigned to a project to ensure that each field team has a logbook at all times.

4.2 FIELD LOGBOOK IDENTIFICATION

Field logbooks shall be bound books with consecutively numbered pages. Logbooks will be permanently assigned to field personnel for the duration of a project, or sampling event. When not in use, the field logbooks are to be stored in site project files. If site activities stop for an extended period of time (2 weeks or more), field logbooks will be stored in the project files in the appropriate HGL office.

The cover of each logbook will contain the following information:

- Organization to which the book is assigned (HGL)
- Project number (if different than site number)
- Book number
- Site name

4.3 LOGBOOK ENTRY PROCEDURES

Every field team will have a logbook, and each field activity will be recorded in the logbook by a designated field team member to provide daily records of significant events, observations, and measurements during field operations. Beginning on the first blank page and extending through as many pages as necessary, the following list provides examples of useful and pertinent information that may be recorded (optional).

- Serial numbers and model numbers for equipment that will be used for the project duration
- Formulas, constants, and example calculations
- Useful telephone numbers

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- County, state, and site address

Entries into the logbook may contain a variety of information. At a minimum, logbook entries must include the following information at the beginning of each day:

- Date
- Site name, site location, and project number
- Start time
- Weather
- All field personnel and subcontractors present and directly involved
- Level of personal protective equipment being used on the site
- Equipment used and calibration procedures followed
- Any field calculations

In addition, information recorded in the field logbook during the day will include, but is not limited to, the following:

- Sample description including sample numbers, time, depth, volume, containers, preservative, and media sampled
- Information on field quality control samples (e.g., duplicates)
- Sample courier airbill numbers and associated chains-of-custody
- Observations about site and samples (odors, appearances, etc.)
- Information about any activities, extraneous to sampling activities, that may affect the integrity of the samples
- Any public involvement, visitors, or press interest, comments, or questions; as well as times present at site
- Equipment used on site including time and date of calibration along with calibration gas/fluid lot numbers and expiration dates
- Background levels of each instrument and possible background interferences
- Instrument readings for the borehole, cuttings, or samples in the breathing zone and from the specified depth of the borehole, etc.
- Field parameters (pH, specific conductivity, etc.)
- Unusual observances, irregularities, or problems noted on site or with instrumentation used

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- Maps or photographs acquired or taken at the sampling site, including photograph numbers and descriptions
- A description of the investigation-derived waste (IDW) generated, the quantity generated, and the manner of IDW storage employed
- A photograph log that lists subject and persons, distance to subject, person taking photograph, distance, direction, time, photograph number, and noteworthy items for each photograph
- Forms numbers and any information contained therein used during sampling (Note that a form does not take the place of the field logbook.)

All logbook entries will be made in indelible black or blue ink. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark and initialed and dated by the originator. Entries will be organized into easily understandable tables if possible. A sample format is shown in Attachment 1.

All logbook pages will be initialed and dated at the top of each page. Times will be recorded next to each entry. No pages or spaces will be left blank. If the last entry for a day is not at the end of a page, a diagonal line will be drawn through the remaining space and the line will be initialed and dated.

Logbooks can become contaminated when used in the field. Every effort should be made by the field team to avoid contaminating the logbook. Logbooks can be kept in seal-top poly bags or temporary plastic covers may be used.

4.4 REVIEW

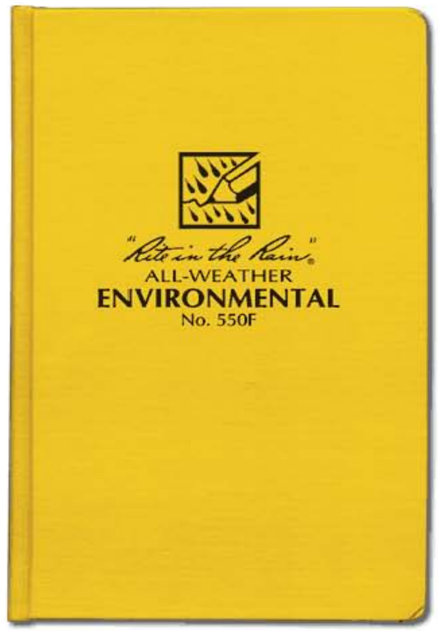
The assigned project leader or an approved designee will check field logbooks for completeness and accuracy on an appropriate site specific schedule determined by the project leader. Any discrepancies in these documents will be noted and returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating the applicable reviewed documents.

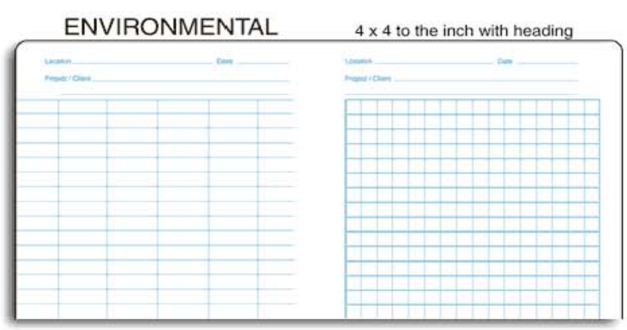
5.0 ATTACHMENTS

Attachment 1 Example Field Logbook

Field Logbook Use and Maintenance	SOP No.: 4.07 SOP Category: HTRW Revision No.: 0 Date: December 2010

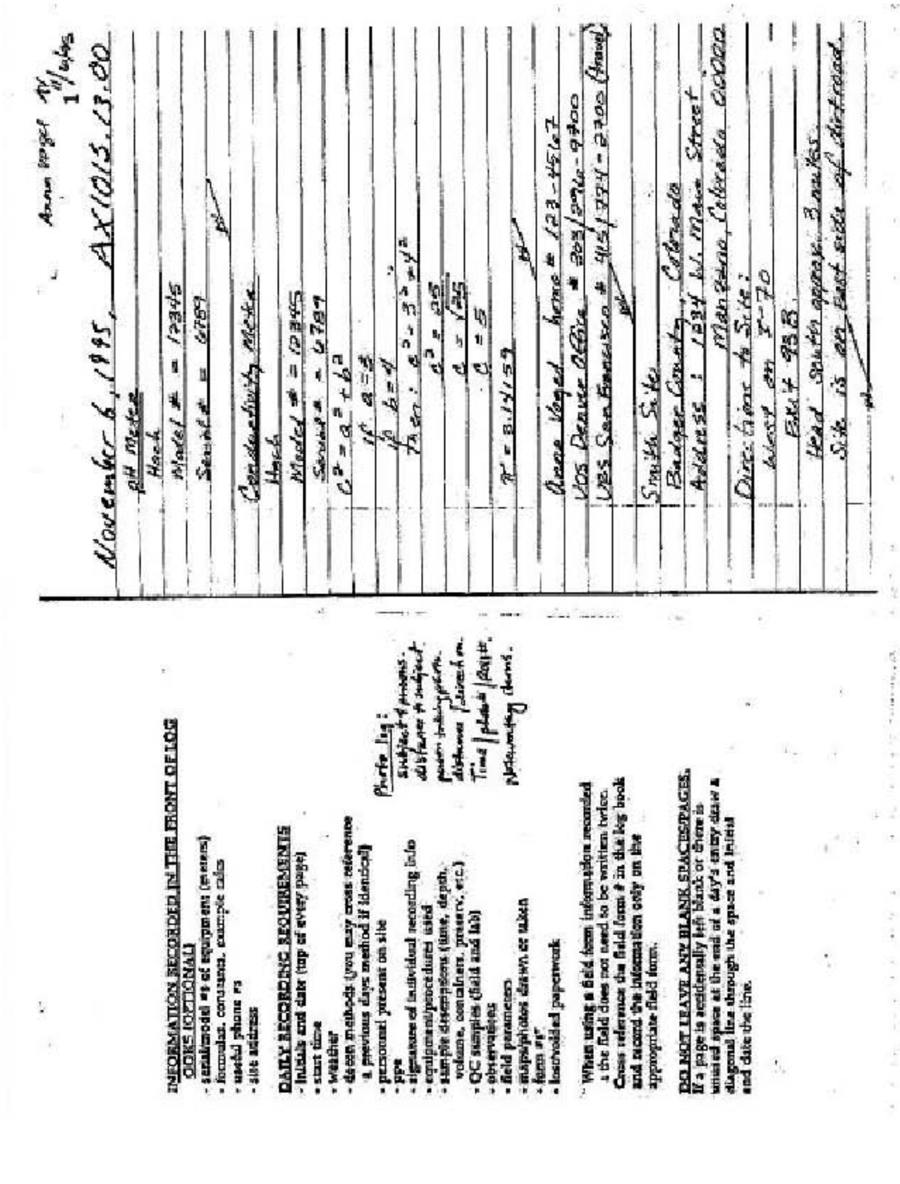
ATTACHMENT 1
Example Field Logbook





Field Logbook Use and Maintenance	SOP No.: 4.07 SOP Category: HTRW Revision No.: 0 Date: December 2010

ATTACHMENT 1 (continued)
Example Field Logbook



INFORMATION RECORDED IN THE FRONT OF LOG BOOKS (OPTIONAL)
- serial/model #s of equipment (meters)
- formulas, constants, example calcs
- useful phone #s
- site address

DAILY RECORDING REQUIREMENTS
- Initials and date (top of every page)
- start time
- weather
- decon methods (you may cross reference a previous days method if identical)
- personnel present on site
- ppe
- signatures of individual recording info
- equipment/procedures used
- sample descriptions (time, depth, volume, containers, preserv, etc.)
- QC samples (field and lab)
- observations
- field parameters
- maps/photos drawn or taken
- form #s"
- lost/voided paperwork

Photo log:
Subject of photo.
distance to subject.
person taking photo.
distance/direction.
Time/photo #/Roll #.
Noteworthy items.

When using a field form information recorded a the field does not need to be written twice. Cross reference the field form # in the log book and record the information only on the appropriate field form.

DO NOT LEAVE ANY BLANK SPACES/PAGES. If a page is accidentally left blank or there is unused space at the end of a day's entry draw a diagonal line through the space and initial and date the line.

Anna Vogel AV 11/6/95
November 6, 1995, AX1015.13.00
pH Meter
Hach
Model # = 12345
Serial # = 6789
Conductivity Meter
Hach
Model # = 12345
Serial # = 6789
$c^2 = a^2 + b^2$
if $a = 3$
if $b = 4$
Then: $c^2 = 3^2 + 4^2$
$c^2 = 25$
$c = \sqrt{25}$
$c = 5$
$\pi = 3.14159$
Anne Vogel home # 123-4567
VOS Denver Office # 303/296-9700
UBS San Francisco # 415/774-2700 (travel)
Smith Site
Badger County, Colorado
Address: 1234 W. Main Street
Manzano, Colorado 00000
Directions to Site:
West on I-70
Exit 93B
Head South approx. 3 miles
Site is on East side of dirt road.

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7.0 SOP 15.00 EXPLOSIVES ACCOUNTABILITY AND MANAGEMENT

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide the basic guidelines for HydroGeoLogic, Inc. (HGL) employees responsible for the accountability and management of explosive materials used on HGL munitions response (MR) project sites. This SOP addresses acquisition, receipt, issue, inventory, storage, safeguarding, security, and transportation of explosive materials.

2.0 SCOPE AND APPLICATION

This SOP applies to all HGL employees who have been granted "Responsible Person" or "Employer Possessor" status by the U.S. Department of Justice Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), Federal Explosive Licensing Center (FELC) and are assigned to any of the positions of responsibility described in Section 6.1. Additionally, this SOP will be used as a baseline guidance document when developing site specific explosive management plans.

3.0 GENERAL REQUIREMENTS

All explosive management and operations will be performed in a manner that is consistent with the U.S. Code of Federal Regulations (CFR) 27, Part 555, Commerce of Explosives (ATF Federal Explosive Laws and Regulations, ATF Publication 5400.7, November 2007) and this SOP. Site-specific procedures for explosive management will be described in the project-specific work plan.

Personnel who use this procedure must provide written documentation to the Senior UXO Operations Manager or UXO Safety Manager that they have read and understand this SOP by completing the Acknowledgement Sheet (Attachment 1). This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project Senior UXO Operation Manager and UXO Safety Manager, and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 DEFINITIONS AND ABBREVIATION

4.1 DEFINITIONS

ATF Responsible Person: An HGL employee who has the power to direct the management and policies pertaining to explosive materials.

ATF Employee Possessor: An HGL employee who has been granted physical access to explosive materials purchased for use on an HGL project site.

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Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

Explosive materials: Explosives, blasting agents, and detonators.

Unexploded Ordnance (UXO)-Qualified Personnel: Personnel who meet the training requirements established by the Department of Defense Explosive Safety Board (DDESB) for UXO Technician and Personnel and have performed successfully in military Explosives Ordnance Disposal (EOD) positions or are qualified to perform in the following Service Contract Act contractor positions: UXO Technician I, UXO Technician II, UXO Technician III, and UXO Safety Officer (UXOSO), UXO Quality Control Specialist (UXOQCS), and Senior UXO Supervisor (SUXOS).

4.2 ABBREVIATIONS

ATF	U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives
CFR	Code of Federal Regulations
DDESB	Department of Defense Explosive Safety Board
DOD	Department of Defense
DOT	Department of Transportation
EM	Engineering Manual
EP	Engineering Pamphlet
ESP	Explosives Site Plan
ESS	Explosives Safety Submission
FELC	Federal Explosive Licensing Center
HE	high-explosive
HGL	HydroGeoLogic, Inc.
IME	Institute of Makers of Explosives
MEC	munitions and explosives of concern
MR	munitions response
MRT	Munitions Response Team
PM	project manager
QDR	quantity distance requirement
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
TP	Technical Paper
USACE	U.S. Army Corps of Engineers
BDC	U.S. Bomb Data Center
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

5.0 EXPLOSIVE ACCOUNTABILITY AND MANAGEMENT PROCEDURES

5.1 GENERAL

This section outlines the procedures that will be followed by HGL employees for maintaining proper accountability and management of explosives materials purchase, stored and used on HGL project sites. These procedures were developed using the references list in Section 8.0.

5.2 EXPLOSIVE LICENSE

HGL holds an ATF Type 20–Manufacturer of Explosives License to purchase and use explosives (Attachment 2) HGL project sites. The original license is posted at the HGL Munitions Response Team office headquartered in Albuquerque, New Mexico. A copy of this permit will be posted at each HGL project site where explosive materials are stored and used, and will be available for Federal State, or local inspections.

5.3 ACQUISITION OF EXPLOSIVE MATERIALS

All acquisitions of explosive materials will be recorded on the day of acquisition, manufacture and receipt using the Manufacturer of Explosive Record of Acquisition (Attachment 3) in accordance with 27 CFR §555.123(b) and the procedures set forth by this SOP. Explosive material acquisition sources will be coordinated in accordance with Section 5.3.3.

5.3.1 Binary Explosives

When binary explosive materials are mixed together into a single solution and held for storage, this is considered "manufacturing explosives". This action will be recorded as an "acquisition" within 24 hour on a separate record following the procedures outlined in Section 5.4.

EXCEPTION: Per 27 CFR §555.123(d)(3) a licensed manufactures is exempt from recordkeeping requirements if the explosive materials are manufactured (mixing binary explosives) for their own use and used within a 24 hour period at the demolition shot site.

5.3.2 Description of Estimated Quantities

When required, each project site's Site Manager/SUXOS will order and stock an initial quantity of commercial explosives for counter and venting charges, and initiating explosives for disposal and demilitarization operations. Based on usage and demand, the quantity in stock may increase, but at no time will storage quantities exceed net explosive weight (NEW) which has been approved by the DDESB per the site's Explosive Safety Submission (ESS) or Explosive Site Plan (ESP).

5.3.3 Acquisition Source

HGL will only purchase explosives from ATF-licensed explosive dealers who will deliver the material to the project site. The Site Manager/SUXOS will coordinate with the Munitions Response Safety and Quality Manager to ensure that:

- All explosive materials acquisition sources are identified,
- Purchase orders are submitted, and
- A list of site personnel authorized to purchase and receive explosives is provided to all acquisition sources, and delivery arrangements are established.

5.4 INITIAL RECEIPT OF EXPLOSIVE MATERIALS

Upon the day of receipt of explosive materials at a project site the type, quantity, and lot number of each explosive item will be checked against the explosive delivery manifest and recorded on the Manufacturer of Explosives Record of Acquisition and the Magazine Data Card—Daily Summary of Magazine Transactions. These records will be completed with the following information:

- **Manufacturer of Explosives Record of Acquisition** (Attachment 3):
  - Site name and location
  - Site supervisor name and position
  - Date of manufacture or other acquisition (The date of manufacture applies when combining/mixing binary explosives, the date of other acquisition applies for when any high explosive material is received)
  - Manufacturer's marks or identification (lot number)
  - Quantity (applicable quantity units, such as pounds of explosives, number of detonators, etc.)
  - Name, brand name or description (blasting caps, Nonel®, detonation cord, perforator, etc).

- **Magazine Data Card—Daily Summary of Magazine Transactions** (Attachment 4) must include:
  - Nomenclature/brand name of manufacturer
  - Lot number/manufacturer's mark
  - Hazard class/division
  - Site name
  - Grid number or latitude and longitude coordinates of the explosive storage magazine location
  - Contract number
  - Date of magazine transaction (receipt, issue or inventory, etc.)
  - Quantity received (amount of explosive material stock received during an explosive acquisition from a dealer or the amount of unused explosives returned to stock from a previous issue)

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- Quantity issued (amount of explosive material removed from magazine inventory for use in the field)
- Current balance
- Signatures (individuals conducting issue, receipt or inventory of explosive materials)

A copy of the original receipt documents and an inventory will be maintained on site by the Site Manager/SUXOS. The Magazine Data Card–Daily Summary of Magazine Transactions (Attachment 4) will remain in the magazine with the explosive materials and will be annotated and updated upon each issue, receipt, and weekly/yearly inventory. No entry is required for any day on which no explosives are placed into or removed from the magazine.

5.4.1 Explosive Materials Accounting

All receipts, issues, turn-ins, and inventories of explosives will be properly documented and verified through physical count by the SUXOS and confirmed by the UXOQCS using the Magazine Data Card–Daily Summary of Magazine Transactions (Attachment 4) and the Explosive Usage Record/Bill of Lading (Attachment 5).

5.4.2 Request for Explosives

The SUXOS will review all requests for explosives from the individual operating sites; only the sufficient amount of explosives for the day's operations will be issued. Explosive issues will be recorded using the Explosive Usage Record/Bill of Lading and deducted from the Magazine Data Card–Daily Summary of Magazine Transactions, and then annotated in the UXO Team Leader's daily field log. This procedure will ensure that the issued explosives are accounted for while they are in the possession of individual users. The end user of explosives shall certify on the Explosive Usage Record/Bill of Lading that the explosives were used for their intended purpose. Entries made on the Explosive Usage Record/Bill of Ladings and Magazine Data Card–Daily Summary of Magazine Transactions will be verified through physical count by the demolition team leader when drawing or turning in the explosives, and will be verified for accuracy by the UXOQCS or the UXOSO.

5.4.3 Reconciling Receipt Records

The SUXOS will reconcile the delivery shipping documentation with the requested amounts ordered and received. Any shortages or overages will be reported to the project PM, who will contact the explosive materials distributor and reconcile any differences.

At the end of each disposal operation, the UXOQCS or the UXOSO and the demolition team leader will reconcile the entries on the Explosive Usage Record/Bill of Lading with the Daily Summary of Magazine Transactions and will turn these records over to the SUXOS. A record of MEC items destroyed will be recorded using the MEC Accountability Log (Attachment 6) and the associated explosives consumed will be kept in the SUXOS daily log.

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5.5 STORAGE

5.5.1 Establishment of Explosive Storage Magazines

The establishment of explosive storage magazines at an MR project location will be in accordance with 27 CFR, Subpart K−Storage and the DDESB-approved ESS/ESP. All explosive materials that are not in use will be properly stored and secured in appropriate ATF Type 2 portable outdoor storage magazines with the appropriate Department of Transportation (DOT) hazard class/division signs, fire symbols and emergency notification information clearly posted. Explosive materials stored on DoD facilities will comply with the local DoD components explosive safety, security and siting requirements. When site security conditions necessitate additional safeguarding of explosive materials, the explosive storage area will be fenced using a minimum 8-foot high fence with a lockable gate.

HGL will comply with all ATF, Federal, DoD, State and local storage and compatibility criteria and procedures when siting explosives storage magazines, which includes locating, installing, and maintaining the magazine(s) to comply with the magazine criteria and quantity distance requirements (QDR) established in 27 CFR, Subpart K−Storage and DoD Ammunition and Explosives Safety Standards, DoD 6055.9-M, Volume 3.

5.5.2 Physical Security of Explosive Materials

Strict physical security and safeguarding of explosive materials will be strictly maintained at all times on HGL MR project sites where explosive material are used and stored. The Site Manager, SUXOS and UXOQCS will enforce access, control and transportation security of all explosives materials used on site. Explosive storage magazines will be placed in secure locations in accordance with 27 CFR §555.207 and §555.208, ATF Safety and Security Information for Federal Explosives Licensees and Permittees, ATF Publication 5400.15 and DoD Ammunition and Explosives Safety Standards, DOD 6055.9-M.

5.5.3 Required Notifications

The following notifications are required when an explosive storage magazine is moved from one location to a new location and explosive materials are stored at an HGL project site location. The Site Manager/SUXOS will:

1. Notify the nearest ATF field office and provide the following information:
    - HGL project location
    - Licensed premise, HGL Albuquerque Office telephone number and address
    - Explosive license number
    - Explosive storage magazine address/location (latitude/longitude coordinates)
    - Magazine identification number
    - Emergency contact name, address and telephone number.

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2. Per 27 CFR §555.21(f) notify the local fire authorities orally before the end of the day and within 48 hours from the time which storage of explosive materials began and provide the following information:
   - Type(s) of explosive materials
   - Magazine capacity (NEW amount)
   - Location of each storage site where explosive materials are stored
3. Notify the HGL Senior UXO Operations Manager and Munitions Response Safety and Quality Manager via email or orally upon establishment of explosive storage magazines on an HGL project site.

5.5.3.1 Access and Control

A key-control system will be established by the Site Manager/SUXOS. Keys to explosive storage magazines and trucks loaded with explosives will be issued only to authorized personnel who have been granted access by the Senior UXO Operations Manager. Keys not in use will be kept secure in an unmarked area located separately from other keys at the premises. Procedures for magazine key control, access restriction, and accountability are provided in HGL SOP 15.02–Explosives Storage Inspection and Security.

Only those HGL employees who are listed as "cleared" on the current HGL Notice of Clearance issued by the FELC, and on the HGL Authorized Agent list will be permitted to purchase and receive explosive materials.

5.6 TRANSPORTATION

Transportation of explosive materials will comply with all DOT 49 CFR, Parts 171-173, 383 and 397, State and local regulations. Even though permits are not required for the transportation of the small quantities of explosives used on-site, but off of public transportation routes, however the most expeditious route will be selected and used at all times when transporting explosive materials. Procedures for transporting explosives to disposal locations and transportation vehicle requirements are described below.

5.6.1 Procedures for Transportation from Storage to Disposal Location

When transportation of explosive materials requires travel on public highways and transportation routes, the SUXOS and UXOSO will coordinate together to provide the explosive driver with a safe transportation route plan. Every effort will be made to take a route with the least public exposure. For transportation of demolition explosive materials, HGL will comply with the following:

- Initiating explosives, such as blasting caps, will remain separated from other explosives at all times. Blasting caps may be transported in the same vehicle as long as they are in a separate container conforming to the Institute of Makers of Explosives (IME) 122 box and secured away from other explosive items.

- An IME 122 box will be used to transport blasting caps, and the high explosives will be placed in an ATF Type 3 Day-Box. The two containers will be placed in the bed of a vehicle, blocked and braced separately using sand bags or other suitable means to keep the containers from shifting. If the load in being transported in an open vehicle, the load will be covered with a tarp.
- Compatibility requirements will always be observed.
- Only UXO-qualified personnel who have been "cleared" by the ATF will have access and authority to issue explosive materials. The receiving party shall sign the receipt documents for accountability.
- Vehicle operators transporting explosives will be a UXO-qualified HGL employee, ATF "Cleared", and possess a valid state driver's license, and a commercial Class-C driver's license with a hazardous material (HAZMAT) endorsement when transporting hazardous material on public roads.
- Vehicle operators will comply with posted speed limits but will not exceed a safe and reasonable speed for road/field conditions. Vehicles transporting explosives off-road will not exceed 25 mph.
- Personnel will not ride in the cargo compartment of a vehicle transporting explosives.

5.6.2 Explosive Transportation Vehicle Requirements

Explosives will be transported in closed vehicles whenever possible. The load shall be blocked, braced and covered with a fire-resistant tarpaulin or stored in an appropriate shipping container (if not in an enclosed vehicle). Minimum requirements for vehicles transporting explosives are listed below:

- The HGL employee assigned to operate the motor vehicle transporting explosive material will be qualified in accordance with DOT 49 CFR Parts 387 and 391 and will possess a valid commercial driver's license with a hazardous material.
- Inspected using the Motor Vehicle Inspection-Hazardous Material, HGL MR Form 15.06 (Attachment 7);
- Properly placarded on all sides and at each end per DOT 49 CFR;
- Equipped with a first aid kit, two 10-BC fire extinguishers, and a means of communication with the UXOSO;
- The engine will be shut off when loading or unloading explosives;
- The wheels will be chocked during loading and unloading to prevent movement;

- At no time will any bare explosive come into contact with spark-producing metal. Vehicle cargo beds will have wooden or plastic liners, dunnage, or sand bags to protect the explosive materials from coming into contact with the metal bed and fittings;
- Explosives may be transported in vehicles with plastic bed liners if the explosives are in an authorized original shipping container.

5.7 RECEIPT PROCEDURES AND AUTHORIZED ACCESS

The SUXOS will ensure strict accountability and control of all explosive materials from the time of initial receipt until expenditure, or returned to an authorized explosive dealer, or relieved of accountability by and authorized agent

5.7.1 Authorized Access

Only HGL UXO-qualified employees who have undergone a successful ATF background check in accordance with 18 U.S.C. §843(h), 27 CFR §555.33 and §555.45(c)] will authorized to have direct physical access to purposes of purchase, store and transport explosive materials on HGL project sites. Every HGL employee who is required to handle, transport or store explosives must clearly understand their responsibilities for properly safeguarding and securing explosive materials.

HGL is required to provide explosives distributors with documentation of individuals authorized to request and receive explosives. The primary individual authorized with direct accountability to receive and issue explosives for all HGL project sites will be the SUXOS. In the event the SUXOS is not available, the SUXOS will designate in writing the individual(s) authorized to receive, transport, and use explosives at the MR site. In most cases either the UXO Technician III Demolition Team Leader or the UXOQCS will be the alternate authorized individual. The SUXOS and UXO Demolition Team Leader performing demolition will sign and date the Explosives Usage Report (Attachment 5) certifying that the explosives were used for their intended purpose. Certifications will be archived and kept on site along with other explosive records.

5.7.1.1 <u>ATF Responsible Person</u>

HGL employees with "Responsible Person" status are authorized to direct the management of HGL's explosive accountability and management program. These positions are the Chief Operating Officer, Senior UXO Operations Officer, and UXO Safety Manager.

Employees designated to fill an ATF "Responsible Person" position must complete and submit an ATF E-Form 5400.28—Employee Possessor Questionnaire and FD-258 Fingerprint Identification Card accompanied by a 2-inch by 2-inch photograph to the HGL Munitions Response Team (MRT) UXO Safety Manager and receive a favorable background check from the ATF before fulfilling this position.

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5.7.1.2 ATF Employee Possessor

HGL employees who have submitted an Employee Possessor Questionnaire (ATF E-Form 5400.28) and subsequently "cleared" by the ATF FELC are authorized direct physical access to explosive materials, including explosive storage magazines. "Cleared" status allows these individuals to perform demolition team responsibilities or other associated field functions involving handling explosive materials as outlined by this SOP.

5.7.1.3 Non-Cleared ATF Employee Possessor

UXO-qualified personnel assigned to an explosive operation that are not "cleared" as ATF Employee Possessor's will not have direct physical access to explosive materials and will be under the direct control and supervision of an HGL employee who is a "cleared" ATF Responsive Person or Employee Possessor as indicated on the HGL ATF FELC Notice of Clearance.

5.7.2 Procedures for Reconciling Inventory Discrepancies

If a discrepancy exists between inventoried and on-hand quantities of explosive materials, a review of the Magazine Data Card—Daily Summary of Magazine Transactions and the Explosive Usage Record/Bill of Lading will be completed by the SUXOS and UXOQCS to verify the accuracy of the inventory records. If the records review does not reconcile the discrepancy:

- The SUXOS will immediately report the discrepancy to the PM and the UXO Safety Manager.
- The appropriate government representative will be notified for when the project is under government contract. For example, a USACE project, the Ordnance and Explosive Safety Specialist or the Contracting Officer will be notified.
- The PM will immediately initiate an investigation to determine the cause of the discrepancy.
- Discrepancies that cannot be reconciled within a 24-hour period will be reported in accordance with 27 CFR §555.30 and Section 5.0 and detailed in Section 5.8 below.

5.8 INVENTORY

5.8.1 Special Inventories

A true and accurate physical inventory of all explosive materials on hand at HGL project sites will be conducted by the SUXOS and the UXOQCS, or the UXOSO when the SUXOS or UXOQCS is not available. Special inventories are required under the following conditions:

- On initial physical receipt of explosive materials at a project site;

- When permanently changing location of the premises to another project site;
- When project field operations are temporarily suspended;
- When project field operations resume;
- Annually during July of each year;
- When required by the ATF or an HGL "Responsible Person".

The purpose of these inventories will be properly annotated on the Magazine Data Card-Daily Transaction Record. For example, the annual inventory will be annotated as "Annual Inventory", and a project field season completion will be annotated as "Field Season Suspended". Each special inventory will be prepared in duplicate; the original will be submitted to the UXO Safety Manager for forwarding to the ATF regional office located in Albuquerque, NM.

5.8.2 Weekly Inventories

A true and accurate physical inventory of all explosive materials stored at HGL project sites will be conducted once every 7 days by the SUXOS and the UXOQCS, or the UXOSO when the SUXOS or UXOQCS is not available. The results of this inventory will be appropriately recorded on the Magazine Data Card—Daily Summary of Magazine Transactions form by writing in "Weekly Inventory" through both the "Quantity Received" blocks. Complete inventories will also be conducted after any issues/turn-ins of demolition material. Inventory procedures and controls are described in the following subsections.

5.9 REPORTING LOSS OR THEFT OF EXPLOSIVE MATERIALS

If it is confirmed that MEC or explosive materials are missing, the SUXOS will immediately notify the PM and each agency identified below in the following order:

1. Local law enforcement authorities;
2. Local ATF office;
3. Senior UXO Operations or UXO Safety Managers;
4. Local government client representative when required; and the
5. ATF U.S. Bomb Data Center (BDC). Notification must be within 24 hours of discovery, reported loss or theft of explosives telephonically using ATF E-Form 5400.5, Report of Loss or Theft—Explosive Material and the following emergency contact information:

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Emergency Contact Information

Location	Telephone Number	Hours
ATF BDC	1 (800)-461-8841	Mon-Fri, 8:00am – 5:00pm est.
	1 (888) 283-2662	After hours
	1 (866) 927-4570 (fax)	
HGL Albuquerque Office		
Senior UXO Operations Manager	(505) 341-2010	Mon-Fri, 7:30am – 4:30pm mst.
	(360) 631-6056	After hours
UXO Safety Manager	(505) 280-2036	After hours

If the MR project is under contract to the USACE, the USACE Contracting Officer shall be notified by the PM immediately by telephone, and in writing within 24 hours of the discovery.

Once of all required notifications are made, the completed Report of Theft or Loss–Explosive Material (ATF E-From 5400.5) will be faxed to the USBDC, (toll free) 1-866-927-4570. This form can be downloaded from https://sharepoint.hgl.com (HGL Portal Home > Document Center > Munitions Response > UXO Personnel > 01 - Forms > Explosive Management.

Additional reporting procedures are provided in ATF Safety and Security Information for Federal Explosive Licensees and Permittees, ATF Publication 5400.15 at https://sharepoint.hgl.com (HGL Portal Home > Document Center > Munitions Response > ATF Publications, Munitions Response folder.

WARNING: Failure to report the theft or loss of any explosive materials missing from stock within 24 hours of discovery to the appropriate federal and local authorities is a felony offense.

5.10 RETURNING UNEXPENDED EXPLOSIVES

Explosives that were issued for use but were not expended will be returned to the magazines at the completion of explosive demolition operations for that day (classified as "turn-ins", refer to Section 5.4.1). The demolition team leader will return the unused explosives to the storage magazine and record the transaction on the Explosive Usage Record/Bill of Lading and Daily Summary of Magazine Transactions.

5.11 DISPOSAL OF REMAINING EXPLOSIVES

ATF requires accurate accounting of all explosive materials purchased and used; therefore when work is completed or temporarily suspended at a project site all unused explosives will be either:

- Disposed of by detonation,

- Returned to the ATF licensed dealer where the explosive materials were originally purchased from, or
- Properly stored in accordance with 27 CFR § 555, the work plan and the ESS or ESP.

5.12 DISASTER PREPAREDNESS

Many natural disasters such as flood, forest fire, hurricane, or tornado occur with little or no warning; therefore it is critical to anticipate and prepare for response actions. When a natural disaster threatens HGL personnel at MR project sites, the Site Manager, SUXOS, UXOQCS, and UXOSO will ensure all necessary precautions are taken to ensure the safety of site personnel, and secure explosive materials from potential loss. The following preliminary measures will be taken to prepare for a pending natural disaster:

4. Develop a contingency plan for immediately relocating explosive materials to a compliant explosives magazine storage in an area less susceptible to weather-related damage if at all possible.

5. Notify the nearest ATF field office and provide the following information:
   - HGL project location
   - Licensed premise, HGL Albuquerque Office telephone number and address
   - Explosive license number
   - Explosive storage magazine address/location (latitude/longitude coordinates)
   - Magazine identification number
   - Emergency contact name, address and telephone number.

6. In an emergency, the local ATF Field Supervisor may verbally authorize HGL to immediately move stored explosive materials to compliant magazine storage in an alternate location.

7. Ensure the back-up copies of critical records are collected and maintained in an off-site location when a significant risk or disaster is predicted for the project area.

8. In the event explosives are missing or stolen, make the required notifications immediately in accordance with Section 5.8 of this SOP. If the missing explosives are found, or stolen explosives are recovered and returned, notify the USBDC at 1-800-461-8841, and any investigating agency personnel, of all recovered explosives. The USBDC is responsible for tracking all stolen, lost, and recovered explosives. Prompt reporting of the recovery of explosives previously reported as missing or stolen saves valuable investigative time and resources.

9. If damaged explosive materials are an immediate threat to public safety, contact local law enforcement authorities and the ATF 24-hour hotline (800-800-3855). ATF hotline

personnel will notify the appropriate ATF Field Division, who will coordinate ATF's field response.

10. If the damaged explosive materials are not an immediate threat to public safety, contact the manufacturer for instructions on the appropriate means of destruction. Contact the local ATF office for any additional guidance.

11. If ATF required records have been damaged, lost or destroyed, explosive materials will be immediately inventoried and an effort made to reconstruct any records destroyed, lost, or rendered illegible. Additionally, the acquisition source/explosive dealer will be contacted to obtain copies of recent sales and acquisition records. Contact the local ATF office for assistance or further information.

6.0 QUALITY CONTROL

6.1 RESPONSIBILITIES

Proper and careful execution of explosive accountability and management is critical to the success and safety of all explosive operations involving HGL employees, the public and properties. Primary responsibility, accountability, and use of the explosives will rest with each MR project site's assigned SUXOS or the Senior UXO Technician when a SUXOS is not assigned. This section outlines the responsibility of those employees who have direct administrative and operational management responsibility on HGL projects involving the security, storage, transportation and use of explosive materials.

Since HGL could be engaged in multiple MR projects at a given time, the explosive accountability and management positions lines of authority and responsibility are outlined below:

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HGL
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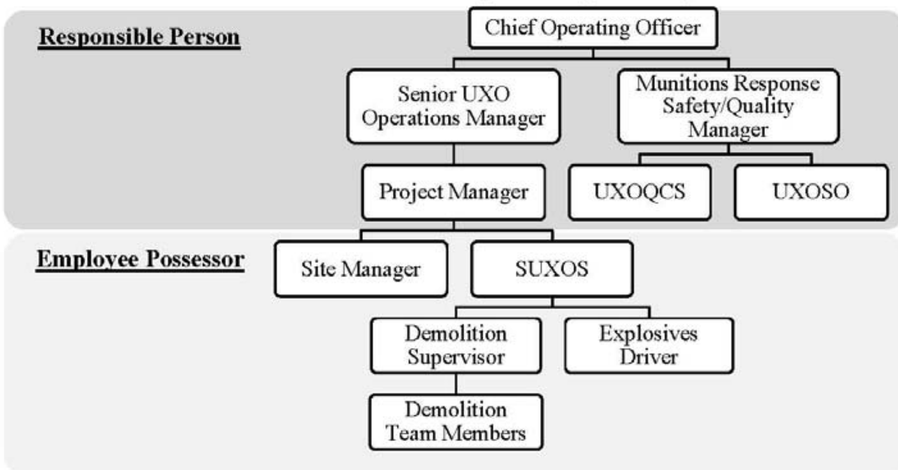
Position Lines of Authority and Responsibility



6.1.1 Chief Operating Officer

Chief Operating Officer is responsible for ensuring this policy and all other HGL SOPs involving explosive operations and transportation are in compliance with all Federal, DoD, state and local regulations.

6.1.2 Senior UXO Operations Manager

The Senior UXO Operations Manager is responsible for implementing and executing the HGL Explosive Management Policy and providing direct administrative, operational, quality control, safety and security oversight on all munitions projects and explosive operations. The Senior UXO Operations Manager will coordinate all explosives logistical requirement through the Munitions Response Safety and Quality Manager.

6.1.3 Munitions Response Safety Manager

The Munitions Response Safety Manager is responsible for explosive accountability, safety and security oversight on all MR projects and communicates directly with the Senior UXO Operations Manager on all matters concerning explosive logistic, safety and security. The Munitions Response Safety Manager is responsible for ensuring that all explosive operations procedures are being performed in accordance with this directive, applicable regulations, and all associated SOPs. The Munitions Response Safety Manager has the authority to stop any

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explosive operation deemed unsafe, and will not allow operations to resume until the unsafe condition is corrected.

6.1.4 Munitions Response Quality Manager

The Munitions Response Quality Manager (QM) is responsible for the administrative quality control of the Explosive Accountability and Management Program and providing administrative and security quality control oversight on all MR projects. The Munitions Response QM will liaise directly with the Senior UXO Operations Manager on all matters concerning quality of the explosive management program. Additionally, to ensure compliance with this directive, site specific explosive operation SOPs, work plans, and Federal, DoD, state, and local regulations the Munitions Response QM is responsible for providing quality control oversight on all projects involving explosive operations, inventories, and stock cards

6.1.5 Project Managers

PMs are responsible for ensuring all munitions projects under their direction are conducted in compliance with this directive and the associated work plan. The PM will provide direct oversight of all field activities involving explosive operations.

6.1.6 Site Managers

Site Managers are directly responsible to the PM for executing the MR work plan as directed. The Site Manager will exercise direct administrative control over field activities involving explosive operations and transportation.

6.1.7 SUXOS

The SUXOS is directly responsible for safe execution of all field activities involving explosive operations. All explosive operations will be carried out under the direct supervision of the SUXOS and in compliance with this directive, the work plan and the applicable DDESB-approved ESP/ESS. The SUXOS will act as the single point of contact for receipt and release of explosive materials to an authorized ATF licensed dealer or agent, including safeguarding and the security of explosive material purchased and stored on the project site. The SUXOS will coordinate all explosive materials logistical support through the HGL Senior Operations Manager and Munitions Response Safety and Quality Manager.

6.1.8 UXOSO

The UXOSO provides direct explosive safety and security oversight on the MR project site to which assigned. The UXOSO will communicate directly with the UXO Safety Manager, or, if not readily available, the Senior UXO Operations Manager on all matters concerning explosive safety and security. The UXOSO is responsible for ensuring all explosive safety procedures and regulations are being performed in accordance with this directive, associated site SOPs, the work plan and the Accident Prevention Plan (APP) and/or Site Specific Safety and Health Plan

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(SSHP). The UXOSO has the authority to stop any explosive operation deemed unsafe and will not resume operations until the unsafe condition is corrected.

6.1.9 UXOQCS

UXOQCS are directly responsible for maintaining explosive management quality control on the MR project assigned. The UXOQCS will liaise directly with the Site Managers and SUXOS concerning proper administration of the explosive management program. Additionally, the UXOQCS is responsible for the overall quality control of all site explosive operations procedures, inventories, stock cards and compliance with this directive, SOPs, the work plan and all Federal, DoD, state and local regulations.

6.1.10 Demolition Supervisor

The Demolition Supervisor (DS) unless otherwise directed will be the SUXOS. The DS is responsible for planning, directing and executing the project site explosive demolition operation for the destruction or demilitarization of MEC, and for ensuring positive control, security of the explosive material and the safe conduct of explosive demolition operations. The SUXOS may delegate the DS responsibilities to a UXO Technician III qualified person.

6.1.11 Explosives Driver

All HGL employees assigned the responsibility for transporting explosive materials (explosives driver) on HGL project sites will possess a valid DOT commercial driver's license with a hazardous materials endorsement in accordance with CFR 49 Parts 383 and 397. Explosives drivers are responsible for ensuring compliance with all federal, state, local and HGL requirements when operating explosive laden vehicles.

6.1.12 Demolition Team Members

Demolition Team members will not have direct access to explosive materials or explosive magazine storage and will be under the direct supervision of either the SUXOS or Demolition Team Leader at all times during explosive demolition operations.

7.0 SECURITY

Before establishing explosive storage magazines or operations on an HGL project site, an explosive security survey will be conducted jointly by the SUXOS and UXOQCS in accordance with HGL SOP 15.02, Explosive Storage Inspection and Security. The inspection, identification of any discrepancies and their disposition will be documented in the SUXOS daily log and the quality control report.

The local law enforcement or security agency closest to the project site will be notified when explosive materials are stored in magazines on-site. As an added security measure, the local law enforcement or security agency will be notified of the project site business hours.

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8.0 RECORDS

Original copies of all explosive material purchases, receipts, issuance, inventories and usage transaction records will be maintained on-site by the SUXOS in accordance with 27 CFR §555.13, and will be available for inspection by authorized agencies. Explosive items will be tracked by their respective manufacturers marks of identification or lot number until the items are expended or transferred to government control, or are returned to the original ATF licensed explosives dealer. Upon completion of project field operations all original explosive records will be sent to the HGL MRT Office, Albuquerque, New Mexico, Attention UXO Safety Manager for archiving throughout the life of HGL's explosive license. Documentation generated as a result of this procedure will be collected and maintained utilizing the following forms:

- Employee Possessor Questionnaire, ATF E-Form 5400.28
- Report of Theft or Loss – Explosive Material, ATF E-Form 5400.5
- Fingerprint Identification Card, FD-258 Form
- Daily Summary of Magazine Transactions, HGL MR Form 15.02
- Manufacturer of Explosives Record of Acquisition, HGL MR Form 15.03
- Munitions and Explosive of Concern Accountability Record, HGL MR Form 15.04
- Explosive Usage Record/Bill of Lading, HGL MR Form 15.05
- Motor Vehicle Inspection-Hazardous Materials, HGL MR Form 15.06

Each special inventory record original will be submitted to the ATF regional office in accordance with 27 CFR §555.123(a)(4).

9.0 REFERENCES

Department of Defense Manual 4145.26-M, 2008, DoD Contractor's Safety Manual for Ammunition and Explosives, March.

Department of Defense Manual 6055.9-M, 2010, DoD Ammunition and Explosives Safety Standards, February.

Department of Defense Explosive Safety Board Technical Paper 18, 2004, Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel, December.

Department of Justice, 27 CFR, Part 555—Commerce of Explosives, 2007, (Bureau of Alcohol, Tobacco, Firearms and Explosives, ATF Publication 5400.7, ATF Federal Explosives Laws and Regulations), November.

Department of Transportation (DOT), 49 CFR Parts 100-199.

U.S. Army Corps of Engineers, Engineer Manual 385-1-97, 2008, Explosives Safety and Health Requirements Manual, September.

U.S. Army Corps of Engineers, Engineer Manual 1110-1-4009, 2007, Military Munitions Response Actions, June.

STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

U.S. Army Corps of Engineers, Engineer Pamphlet 1110-1-18, 2006, Engineer Pamphlet, Ordnance and Explosives Response, April.

U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives ATF Publication 5400.15, 2007, ATF Safety and Security Information For Federal Explosives Licensees and Permittees, March.

10.0 ATTACHMENTS

Attachment 1	Standard Operating Procedure Acknowledgment Form
Attachment 2	HGL Type 20-Manufacturer of Explosives License
Attachment 3	Manufacturer of Explosives Record of Acquisition
Attachment 4	Magazine Data Card—Daily Summary of Magazine Transactions
Attachment 5	Explosive Usage Record/Bill of Lading
Attachment 6	Munitions and Explosive of Concern Accountability Record
Attachment 7	Motor Vehicle Inspection-Hazardous Materials

STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

Attachment 1

STANDARD OPERATING PROCEDURE ACKNOWLEDGEMENT

I have read, understand and agree to abide by the provisions as detailed in this standard operating procedure (SOP) prepared by HGL. By signing below, I certify that I have had the opportunity to read and ask questions about this SOP, and that I understand the procedures, equipment and restrictions, and agree to abide by them. Failure to comply with this SOP may lead to disciplinary action and/or my dismissal from the work site and termination of employment.

Prior to the commencement of any work task associated with this SOP, the SUXSO or UXOQCS assigned to the project will discuss additional procedures to be implemented, or any other site-specific conditions that may arise. All on-site personnel of HydroGeoLogic, Inc. must sign this Acknowledgment Form before performing the task covered by these SOPs.

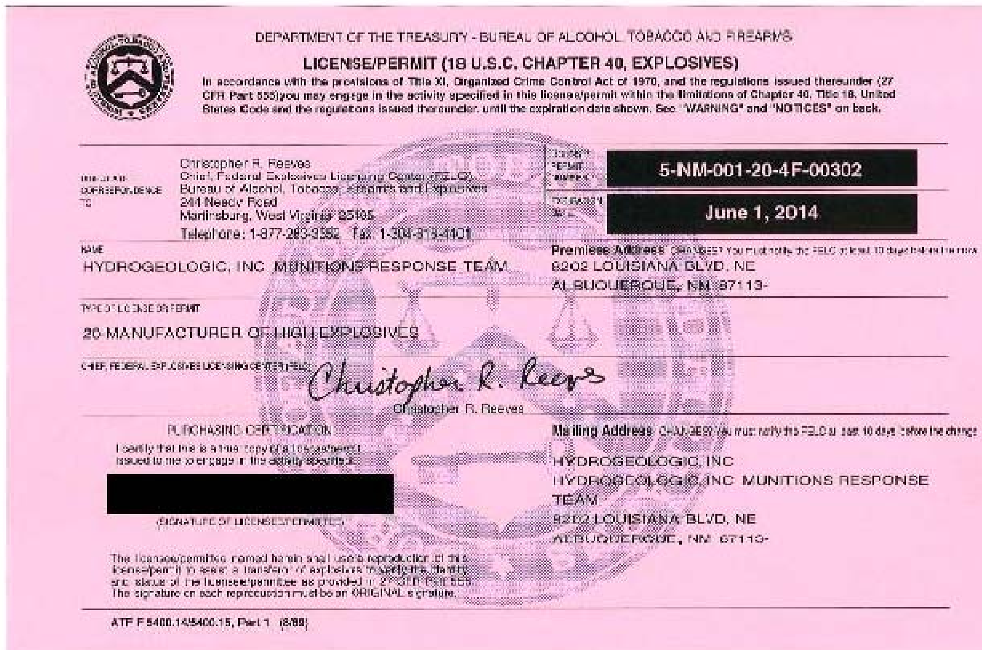
Print Name	Signature	Date

STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 02** **Date: May 31, 2011**

Attachment 2

TYPE 20—MANUFACUTURER OF HIGH EXPLOSIVE LICENSE



DEPARTMENT OF THE TREASURY - BUREAU OF ALCOHOL TOBACCO AND FIREARMS

LICENSE/PERMIT (18 U.S.C. CHAPTER 40, EXPLOSIVES)

In accordance with the provisions of Title XI, Organized Crime Control Act of 1970, and the regulations issued thereunder (27 CFR Part 555)you may engage in the activity specified in this license/permit within the limitations of Chapter 40, Title 18, United States Code and the regulations issued thereunder, until the expiration date shown. See "WARNING" and "NOTICES" on back.

Christopher R. Reeves
Chief, Federal Explosives Licensing Center (FELC)
Bureau of Alcohol, Tobacco, Firearms and Explosives
244 Needy Road
Martinsburg, West Virginia 25405
Telephone: 1-877-283-3352 Fax: 1-304-616-4401

5-NM-001-20-4F-00302

June 1, 2014

NAME
HYDROGEOLOGIC, INC MUNITIONS RESPONSE TEAM

Premises Address
8202 LOUISIANA BLVD. NE
ALBUQUERQUE, NM 87113-

TYPE OF LICENSE OR PERMIT
20-MANUFACTURER OF HIGH EXPLOSIVES

CHIEF, FEDERAL EXPLOSIVES LICENSING CENTER (FELC)
Christopher R. Reeves
Christopher R. Reeves

PURCHASING CERTIFICATION
I certify that this is a true copy of a license/permit issued to me to engage in the activity specified.

[redacted]

(SIGNATURE OF LICENSEE/PERMITTEE)

Mailing Address
HYDROGEOLOGIC, INC
HYDROGEOLOGIC,INC MUNITIONS RESPONSE TEAM
8202 LOUISIANA BLVD. NE
ALBUQUERQUE, NM 87113-

The licensee/permittee named herein shall use a reproduction of this license/permit to assist a transferor of explosives to verify the identity and status of the licensee/permittee as provided in 27 CFR Part 555. The signature on each reproduction must be an ORIGINAL signature.

ATF F 5400.14/5400.15, Part 1 (8/88)

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STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

Attachment 3

Manufacturer of Explosives Record of Acquisition

Site Name/Location:				Supervisor Name and Position
Date of Manufacture or other Acquisition	**Lot Number or Manufacturer's Marks of Identification**	**Nomenclature/ Description**	**Quantity Acquired**	**Name, Address and License or Permit Number of Distributor**

HGL MR Form 15.03 (Revised May 2011)

STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

Attachment 4

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Magazine Data Card—
Daily Summary of Magazine Transactions

Nomenclature/Brand Name of Manufacturer:	Lot No./Manufacturer Mark:	Hazard Class/Division:
Site Name:	Grid No./Lat/Long Coord:	Contract No.:

Date	Quantity Received	Quantity Issued	Current Balance	Signatures Conducted or Issued by:	Signatures Conducted or Received by:

HGL MR Form 15.02 (Revised May 2011)

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STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

Attachment 5

Explosive Usage Record/Bill of Lading

Demolition Team Number:	**Date:**	**Project Name**
Team Leader:	**Work Area/Grid Number:**	**Location Name:**

Explosives Issue:

Nomenclature/Brand Name	Quantity	Lot Number / Manufacturer's Marks	Checked by (Initials)

Demolition Team Leader Signature:	**Explosive Driver Signature** (required when transporting explosives by vehicle):

Explosives Expended:

Nomenclature/Brand Name	Quantity	Lot Number	Checked by (Initials)

Explosives Returned:

Nomenclature/Brand Name	Quantity	Lot Number	Checked by (Initials)

Explosive Driver Signature (required when transporting explosives by vehicle):

Demolition Team Leader Signature:	**SUXOS/UXOQCS Signature:**

1. The signatures in each section of this record indicate the items listed in that section were in fact issued, expended, or returned to storage and that the explosive quantities listed were verified by a true and accurate physical count.
2. This form will serve as a bill of lading when explosives listed herein are picked up, delivered and transported by vehicle on public transportation routes.

HGL MR 15.05 (Nov 2011)

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Explosives Accountability and Management	**SOP No.: 15.00** **SOP Category: MMRP** **Revision No.: 03** **Date: November 2011**

Attachment 6

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Munitions and Explosives of Concern/Unexploded Ordnance Accountability Record

Site Location:						
Contract Number:				Delivery/Task Order Number:		
Grid Coordinates	Anomaly No.	Identification	Date Located	Date Disposed	Method of Disposal	Comments

Reviewed and Accepted (print name)	Senior UXO Supervisor Signature	Date

HGL MR Form 15.04 (Nov 2010)

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STANDARD OPERATING PROCEDURE

Explosives Accountability and Management	SOP No.: 15.00 SOP Category: MMRP Revision No.: 03 Date: November 2011

Attachment 7

HGL HydroGeoLogic, Inc. MUNITIONS RESPONSE TEAM

Motor Vehicle Inspection–Hazardous Materials

Section 1 - Documentation

A. Instructions:

1. This form applies to all vehicles which must be marked and placarded in accordance with DOT Title 49 CFR.
2. This form is required to be completed in conjunction with the Vehicle Inspection Checklist HGL Form 15.23.

a. Company/organization:	
b. Date of inspection:	
c. Time of inspection:	
d. Location of inspection:	
e. Operator name:	
f. Operators license number:	

g. Medical examination current:	☐ Yes	☐ No (check the appropriate box)
h. Valid CDL with HazMat endorsement:	☐ Yes	☐ No (check the appropriate box)
i. Route plan:	☐ Yes	☐ No (check the appropriate box)
j. Hazardous Materials Compliance Handbook in vehicle:	☐ Yes	☐ No (check the appropriate box)
k. Vehicle Inspection Checklist HGL Form 15.23 completed:	☐ Yes	☐ No (check the appropriate box)

Section 2 – Mechanical Inspection *(place X in applicable box)*

A. Item inspected *(If rejected, describe reason in block 3)*:

	SAT	UNSAT		SAT	UNSAT
1. Horn operative			10. Exhaust system		
2. Steering system			11. Brake system		
3. Windshield/wipers			12. Suspension		
4. Mirrors			13. Coupling devices (when applicable)		
5. Warning signals			14. Cargo space		
6. Spare fuses			15. Tires, wheels and rims		
7. Electrical wiring			16. Tailgate and doors		
8. Lights and reflectors			17. Tarpaulin		
9. Fuel system			18. Other (specify		

B. Inspection result *(If rejected provide reason in block 3)*: **Accepted** ☐ **Rejected** ☐

C. Remarks:

D. Inspector signature (origin):	E. Driver signature (origin):
F. Inspector signature (destination):	G. Driver signature (destination):

HGL MR Form 15.06 (Jul 2010)

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8.0 SOP 15.01 EXPLOSIVE DEMOLITION OPERATIONS

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

STANDARD OPERATING PROCEDURE

Explosive Demolition Operations	**SOP No.: 15.01** **SOP Category: MMRP** **Revision No.:** **Date: December 2011**

1.0 PURPOSE

This standard operating procedure (SOP) establishes the overall safe practices and procedures for conducting explosive demolition operations (demolition operations) on HydroGeoLogic, Inc. (HGL) projects involving military munitions response program (MMRP) actions.

2.0 SCOPE

This SOP applies to all HGL employees assigned to perform explosive demolition operation on HGL project sites. All HGL employees who are tasked with performing munitions and explosives of concern (MEC)-related activities will be qualified in accordance with the Department of Defense Explosive Safety Board (DDESB) Technical Paper (TP) 18 and the requirements specified by HGL SOP 15.00, Section 5.0. This SOP also applies to all instances when public safety may be affected by site conditions. This SOP will be used in conjunction with approved work plans and the HGL SOPs cited in Section 9.0 of this SOP.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All explosive activities will be conducted in conformance with the Explosive Safety Submission (ESS)/Explosives Site Plan (ESP) and Site Safety and Health Plan (SSHP) and HGL SOP 15.00. Procedures for packaging and disposing of all munitions waste generated during field activities will be described in the project-specific work plan and processed in accordance HGL SOP 15.00 Material Potentially Presenting an Explosive Hazard (MPPEH) Inspection and Processing.

Personnel who use this procedure must document evidence to the site manager/Senior Unexploded Ordnance Supervisor and the Unexploded Ordnance Quality Control Specialist (UXOQCS) that they have read and understand this procedure by completing the SOP acknowledgement form, Attachment 1. This documentation will be retained in the project file.

Any deviations from the procedures specified in this SOP will be approved by the HGL Senior UXO Operation Manager and UXO Safety Manager before implementing. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 DEFINITIONS AND ABBREVIATION

4.1 DEFINITIONS

Exclusion Zone (EZ): A safety zone established around a MEC work area. Only project personnel and authorized, escorted visitors are allowed within the EZ. Examples of EZs are

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Explosive Demolition Operations	**SOP No.: 15.01** **SOP Category: MMRP** **Revision No.:** **Date: December 2011**

safety zones around MEC intrusive activities and safety zones where MEC is intentionally detonated. For recovered chemical warfare muntions project sites, it is the area within the No Significant Effects (NOSE) zone.

Minimum Separation Distance (MSD): – The minimum safe distance for non-essential personnel to be present during unexploded ordnance (UXO) operations. Generally, the maximum fragmentation distance-horizontal (MFD-H) is to be used for all UXO items as the MSD for all non-essential personnel for both intentional and unintentional detonations. The MSD during demolition operations includes the area from the planned detonation site and the MFD-H for the MEC item(s) and donor explosives being detonated.

Material documented as safe (MDAS): MPPEH that has been assessed and documented as not presenting and explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered MPPEH.

Material documented as an explosive hazard (MDEH): (Formerly referred to as material documented as hazardous, or MDAH). MPPEH that cannot be documented as MDAS, that has been assessed and documented as to the maximum explosive hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH. (The MDEH characterization addresses only the explosives safety status of the material.)

Material Potentially Presenting an Explosive Hazard (MPPEH): Material potentially containing explosives or munitions (for example, munitions containers and packaging material; munitions debris (MD) remaining after munitions use, demilitarization, or disposal; and range-related debris) (RD); or material potentially containing a high enough concentration of explosives that the material presents and explosive hazard.

Military Munitions: All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense (DoD), the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives; pyrotechnics; chemical and riot control agents; smokes; and incendiaries, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, except that the term does include non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) have been completed [10 U.S.C. 2710(e)(3)(A)].

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Munition with the Greatest Fragmentation Distance (MGFD). The munition with the greatest fragment distance that is reasonably expected (based on research or characterization) to be encountered in any particular area.

Munitions and Explosives of Concern (MEC): This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (1) UXO, as defined in 10 U.S.C. 101(e)(5)(A) through (C); (2) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (3) Munitions constituents (such as TNT and RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions Debris (MD): Remnants of munitions (for example, fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal. Inert munitions-related material recovered during an MEC removal.

Unexploded Ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. For the purpose of this project, the definition of UXO is limited to items larger than 50-caliber.

UXO-Qualified Personnel: Personnel who meet the training requirements for UXO Technician and Personnel and have performed successfully in military Explosives Ordnance Disposal (EOD) positions or are qualified to perform in the following service contract act contractor positions: UXO Technician I, UXO Technician II, UXO Technician III, and UXO Safety Officer (UXOSO), UXO Quality Control Specialist (UXOQCS), and Senior UXO Supervisor (SUXOS).

4.2 ABBREVIATIONS

ATF	U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives
DDESB	Department of Defense Explosive Safety Board
DMM	discarded military munitions
DoD	Department of Defense
DS	Demolition Supervisor
EM	Engineering Manual
ESP	Explosive Site Plan
ESS	Explosives Safety Submission
EZ	exclusion zone
HE	high-explosive
HFD-H	hazardous fragmentation distance-horizontal
HGL	HydroGeoLogic, Inc.

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MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MDEH	material documented as an explosive hazard
MEC	munitions and explosives of concern
MGFD	munition with the greatest fragmentation distance
MPPEH	munitions potentially presenting an explosive hazard
MSD	minimum safe distance
PPE	personnel protective equipment
PWP	plasticized white phosphorus
RD	range-related debris
RP	red phosphorus
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
TP	Technical Paper
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
WP	white phosphorus

5.0 PROCEDURES

This section deals with the administrative, training, and logistical aspects of conducting explosives demolition.

5.1 DEMOLITION TEAM PERSONNEL

All employees are required to meet the minimum requirements listed in this procedure, but may request a variance if these procedures are unsafe, or are not compatible with contract or site-specific requirements. Permission to vary from this procedure must be obtained from the Project Manager and the HGL UXO Safety Manager. All employees are encouraged to submit comments and/or recommendations to improve this procedure.

All personnel engaged in demolition operations must be thoroughly trained in explosive safety and demolition procedures, be capable of recognizing hazardous situations, and be able to take prompt corrective action. All UXO demolition team personnel must meet the minimum requirements specified by DDESB TP 18 and HGL SOP 15.00, Section 5.7.1 to perform tasks covered by this SOP. Demolition operations will not be conducted without client authorization, approved plans/SOPs, qualified and trained UXO Technicians, and proper demolition and safety equipment is available.

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5.2 DEMOLITION TEAM ASSIGNMENTS AND RESPONSIBILITIES

HGL demolition operations require specific organizational roles and personnel assignments, specifically:

1. **SUXOS (Demolition Supervisor):**
   a. The SUXOS will normally perform the responsibilities of the Demolition Supervisor (Demo Supervisor), but may delegate this responsibility to a UXO Technician III level qualified individual.
   b. Responsible for planning, directing, and executing all demolition operations.
   c. When employing the services of a "certified blaster" from a licensed explosive dealer, ensure that only UXO Technicians are allowed to place donor charges next to MEC/UXO.
   d. Will maintain explosive accountability and security of all explosive materials issued for use during execution of demolition operations.
   e. Will maintain positive communications at all times with the Demolition Team and the UXOSO.
   f. Will inspect the dentonation site after each explosive detonation or any misfire and ensure no one is allowed within the MSD from the detonatin site until the area is declared safe.

2. **UXOSO** will ensure:
   a. All demolition operations are performed safely and in accordance with the approved site-specific plans (ESP or ESS) and this SOP.
   b. Reliable primary and secondary communications are established before commencing demolition operations.
   c. In collaboration with the SUXOS that all roadways and access points to the MSD area is secure and all personnel are evacuated and not allowed with the MSD from the detonation site before initiating any explosive charges.
   d. The detonation site is inspected after each explosive detonation or misfire. No one will be allowed within the MSD until the area is declared safe.

3. **Demolition Team** will consist of a minimum of three personnel or as required by the approved work plan:
   a. Demo Supervisor.
   b. A UXO Technician II or above to assist the DS during demolition operations.
   c. A UXO Technican I or above.

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5.3 REFERENCE DOCUMENTS

Before commencing demolition operations the SUXOS and UXOSO will read and have a good working knowledge of the following documents, as well as ensuring these approved documents and publications are on-site during all Demolition operations:

1. U.S. Army, Technical Manual 60A-1-1-31, General Information on Explosive Ordnance Disposal Procedure
2. DDESB-approved ESP or ESS
3. SSHP
4. Work Plan or Technical Management Plan

5.4 COORDINATION AND NOTIFICATIONS

A coordination meeting will be conducted by the SUXOS to establish roles and responsibilities before demolition operations begin. The meeting will address specific elements of planning and organizational responsibilities and will include, but not be limited to, the following topics:

1. Who is assigned ultimate responsibility for demolition operations
2. Demolition team assignments and responsibilities
3. Primary and secondary communications
4. On remote sites verification of reliable communications
5. Explosive handling, storage, and transportation
6. Required support services, fire, medical, security, etc.
7. Emergency procedures
8. Notification process
9. Maintaining and controlling exclusion zones:
   a. Safety guard positions
   b. Road barricades
   c. Exclusion zone clearance prior initiation of demolition shot
   d. Demolition team rally point
   e. Post operation "all clear" procedures
10. Community impact

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5.4.1 Public Meeting

A public meeting will be held prior to demolition operations being conducted when Demolition operations potentially impact the local civilian community. The HGL project manager, site manager or Senior UXO Supervisor (SUXOS will conduct a briefing outlining the scheduled operation. Topics will include:

1. Daily hours of operation
2. Requirements for evacuation of occupied residences and road closures
3. Exclusion zones/MSD boundaries
4. Community impact

5.4.2 Notifications

The SUXOS will ensure the agencies responsible for emergency response are notified as far in advance as possible that disposal activities will be taking place. The notifications should address scheduling, evacuations, road closures, EZs, and any other required support. As a minimum, the following agencies should be notified and be prepared to respond, as applicable:

1. Public utility companies (electric, gas and water)
2. Paramedic/Emergency Medical Technician Squad, (as applicable)
3. Local fire department
4. Local law enforcement/police department
5. Security agency

5.4.3 Public Utility Services

When there is a potential for demolition operations to impact public utilities, the SUXOS will notify the appropriate utility company official. When situations mandate the demolition of a MEC hazard near public utilities, precautions will be taken to prevent damage or disruption of these services, either by using protective measures (engineering controls) or by relocating the MEC hazard to a safe distance when the SUXOS and UXOSO have jointly determined the MEC hazard is *acceptable- to-move.*

5.5 EXCLUSION ZONES, EVACUATIONS, AND ROAD CLOSURES

The exclusion zone for all demolition operations will be based on the munition with the greatest fragmentation distance (MGFD) as identified in the project work plan and/or ESP/ESS. Before initiating explosive demolition operations to demilitarize, destroy or dispose of MEC hazards, all personnel will be evacuated to a safe location beyond the MSD as determined by DDESB TP 16

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calculation methodologies. When a single MEC item undergoes explosive demolition, the hazardous fragment distance-horizontal (HFD-H) for that munition will be observed.

Every attempt will be made to post the necessary warnings and safety controls prior to explosive operation. In some cases posters or flyers or may be suitable, however, positive site control must be maintained at all times during any explosive operation. Posters or flyers will identify the location of operations, time operations commence and cease, contact person for verifying if area is safe for passage. To ensure the highest degree of public safety is maintained barricades will be placed at residential streets and roads access points with the appropriate number of safety guards posted at key locations to prevent access to the EZ prior to conducting explosive operations.

Once demolition operations are in progress the public and other non-essential personnel will not be allowed into the EZ under any circumstances. Re-entry into the EZ will be granted only under the following conditions:

1. Essential personnel have been granted an "all-clear" by the SUXOS.
2. The UXO Safety Officer (UXOSO) has completed a post-detonation assessment of the EZ and determined the area safe to access.

5.6 TWO-PERSON RULE

The Two-Person Rule is a safety concept that requires two knowledgeable individuals to perform potentially hazardous operations. These individuals must be trained and be capable of recognizing safety hazards and improper procedures. The Two-Person Rule will apply whenever explosives are handled or transported during demolition operations. No one will handle or assemble explosives alone.

5.7 DEMOLITION OPERATIONS BRIEF

Before beginning any explosive operations, all personnel assigned to or working with disposal teams will attend a demolition operation briefing. The purpose of the briefing will be to review MEC explosive demolition and emergency response procedures. Using attachments 1, 2, 3, 4, 5, 6, and 7 the following topics will be covered during the briefing, but are not limited to:

1. Review of the Accident Prevention Plan (APP)/SSHP
2. Review of this SOP
3. Review of demolition firing systems and components
4. Review of disposal charge placement
5. Review of explosives transportation
6. Site munitions brief

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7. Type and condition of MEC
8. Emergency response equipment
9. Emergency procedures
10. Two-person rule
11. Team assignments

5.8 EQUIPMENT, MATERIAL AND VEHICLE REQUIREMENTS

The DS will be responsible for ensuring that all required equipment and materials are available. The checklists in the attachments to this procedure will be used to ensure and document equipment and material availability. As a minimum, the following will be checked prior to commencing each disposal operation:

1. Demolition equipment (Attachment 3)
2. Safety Equipment (Attachment 4)
3. Explosive vehicles (HGL SOP 15.02, Section 5.6.2)
4. Range vehicle
5. Safety vehicle(s)
6. Designated personnel accountability and assembly location/rally point

5.9 COMMUNICATIONS

Primary communications will be accomplished through the use of field handheld portable radios. The contact information for emergency services, including telephone numbers for the project personnel, is provided in the APP/SSHP. Secondary communication will be via cellular telephones, with the phone numbers for the HGL key personnel posted in the APP. The explosive demolition team SUXOS, UXOSO and DS cellular numbers will be recorded on Attachment 1.

Radio communication between the demolition team and site management team will be maintained at all times. In a location where cellular telephone service is restricted, air horns will be used for communicating as a backup emergency notification system. The following air horn signals will be used to communicate with personnel if the radio is not operable:

1. One Long Blast — Evacuate Area
2. Two Short Blasts — All Clear
3. Three Short Blasts — Emergency Help Required

The location of assembly points, emergency evacuation points, and evacuation routes will be discussed during the demolition operation planning meeting. Throughout the operation, emergency and range vehicles will be positioned to allow the most expedient evacuation means in case an emergency evaluation of the site is necessary.

5.10 EXPLOSIVE VEHICLE TRANSPORTATION

Vehicles that are used to transport explosive materials will comply with the regulations specified by the Department of Transportation, Code of Federal Regulations, Title 49, Parts 171, 173 and 177 and HGL SOP 15.00, Section 5.5.

5.11 WEATHER AND ENVIRONMENTAL CONSIDERATIONS

Before beginning Demolition operations the SUXOS will obtain a local weather report. Demolition operations will not be conducted when electrical storms are within 10 miles of the site operations, when visibility restricts positive control of the exclusion zone, or when weather conditions impact safety.

5.12 EMERGENCY MEDICAL SUPPORT

The telephone number of the responding medical facility will be prominently posted at the site office. Emergency medical personnel will be notified of the location and duration of demolition operations each day. At least two UXO personnel on each demolition team will be trained in first aid and CPR. A first-aid kit, portable eyewash, and bloodborne pathogen kit will be on site at all times. The first-aid kit will contain dressings capable of treating traumatic injuries that could result from an explosion.

5.13 FIRE PREVENTION PLAN

The telephone number of the nearest fire department is posted in the work plan/APP. The fire department will be notified of the location and duration of demolition operations each day. Fire extinguishers and shovels will be on site to fight small fires. Personnel must evacuate the area if the fire approaches munitions or explosives. Do not fight grass fires in areas where there may be munitions or kick-outs.

5.14 PERSONAL PROTECTIVE EQUIPMENT

Demolition operations will normally be conducted in Level "D" personal protective equipment (PPE). This will consist of cotton, Gortex or other non-static producing clothing and foul weather gear, gloves, safety glasses and composite or steel-toed boots. The UXOSO will ensure that the proper PPE is procured, issued, and utilized by project personnel and that daily checks are performed to ensure continued availability and use.

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5.15 EXPLOSIVE OPERATIONS

Only HGL UXO–qualified personnel will be allowed to conduct demolition operations on HGL munitions response project sites to demilitarize or destroy MEC/UXO using open detonation methods. The following general safety guidelines that will be followed at all times during all Demolition operations:

1. MEC items found requiring demolition that is deemed *unacceptable-to-move* by the SUXOS and UXOSO will be blown-in-place.
2. MEC items will only be deemed *acceptable-to-move* by the SUXOS and UXOSO jointly.
3. MEC items that are *acceptable-to-move* by the SUXOS and UXOSO may be moved to a single item location in within the munitions response site for destruction when approved in accordance with the ESS or ESP.
4. MPPEH/MDEH items will be perforated to facilitate 100 percent inspection of all surfaces.
5. Demolition operations will not be conducted without proper authorization.
6. This SOP will be used as guidance for demolition procedures.
7. Engineering control using sandbag mitigation will be employed to reduce blast and fragment hazards.

5.15.1 Engineering Controls

Engineering controls will be employed in accordance with the DDESB-approved ESP for this project.

5.15.2 Initiation sequence

The SUXOS or DS will ensure that the following actions are completed before initiating any demolition shot:

1. Ensure all required notifications have been made.
2. Set up EZ and post guards at the barricades.
3. Visually inspect EZ and surrounding area for unauthorized personnel.
4. Announce on the handheld/mobile radio that air-horn demolition warnings will follow.

5. **Five-minute warning**. The DS will give the five-minute warning on the radio, followed by a 15-second series of long blasts on the air or vehicle horn, or siren befor the demolition shot(s).
6. **One-minute warning**. The DS will give the one-minute warning on the radio, followed by a 15-second series of short blasts on the air or vehicle horn, or siren before to the demolition shot(s).
7. Before initiating the demolition shot the SUXOS/DS will give three, loud "*Fire in the Hole!*" warnings and then give the "fire" command on the radio.
8. When the area has been cleared (post-blast), the SUXOS will sound a prolonged blast on the air-horn.
9. The SUXOS/DS will announce on the radio that Demolition operations have ceased.

5.15.3 Initiation Systems

The following applies to the initiation systems used in explosives operations:

1. The primary firing system will use the Remote Firing Device with Nonel®.
2. The alternate primary firing system will use the Remote Firing Device with electric blasting caps.
3. The secondary system will use the Scorpion Electronic Blasting Machine with electric or Nonel® initiation.
4. In areas of high electromagnetic radiation, or a high fire index, a Nonel® system should be used.

5.15.4 Blow in Place (BIP) Operations

MEC that is discovered and jointly deemed *unacceptable-to-move* by the SUXOS and UXOSO will be blown in place (BIP). The SUXOS will notify the client when a MEC item is deemed as *unacceptable-to-move* and will be BIP. MEC items that are *acceptable-to-move* may be relocated within the site investigation area away from residences and public buildings as necessary. The following verifications must be completed before a MEC item is BIP:

1. Authorization has been granted by the client to conduct the disposal operation.
2. An appropriate EZ for the MEC encountered has been established and evacuation of the area has been confirmed.
3. When applicable, the appropriate engineering controls are in place for the reduction of the fragmentation hazard.

4. Emergency support services have been notified and are standing by in position:
5. Emergency services (when required)
6. Fire department
7. Law enforcement.
8. Every effort has been made to establish the firing point in a location where the SUXOS and the UXOSO can visually observe the entire EZ.
9. All BIP operations will be fired by positive control methods; Nonel® or direct command remote control firing device initiation to maintain positive control up to the point of detonation.

5.15.5 Phosphorus Munitions

When munitions containing Plasticized White Phosphorus (PWP), Red Phosphorus (RP) or White Phosphorus (WP) fillers are encountered, the following procedures will be observed in conjunction with HGL SOP 15.08 Phosphorus Munitions:

1. Protective clothing, to include helmets with full-face shields, a welder's apron, and gloves will be worn when handling suspected Phosphorus munitions.
2. Ensure medical support personnel know they are supporting Phosphorus munitions demolition operations and have first-aid treatment materials on hand (copper sulfate or other suitable material).
3. If an accident occurs in the field, irrigate Phosphorus wounds with water, pick out visible pieces of Phosphorus (with knife or tweezers), and apply saline soaked dressing. Keep dressing wet until arrival of medical personnel.
4. Ensure an ample supply of water and sand are readily available when handling suspected Phosphorus-filled munitions.
5. Phosphorus munitions will be counter-charged bottom centerline (CCBC) to disperse the Phosphorus in the air for complete combustion.
6. Care must be taken when returning to the disposal site after detonation of Phosphorus muntions to ensure that all Phosphorus was consumed.
7. Do not approach the area until all smoke has cleared and the SUXOS has declared the area safe.
8. Do not conduct phosphorus filled munitions handling or demolition operations when the ambient temperature is above 95°F.

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5.15.6 MPPEH

All potential munitions-related items are considered to be MPPEH until they have undergone a 100 percent inspection by a UXO Technician II and a 100 percent re-inspection by a UXO Technician III. If an item is determined to contain high explosives (HE) or energetic material, it will be classified as MEC and then categorized as either UXO, or as DMM, or as MC as defined in Section 4.1 above. Items determined to contain HE or energetic material, or cannot be 100 percent visually inspected will be designated as material documented as an explosive hazard (MDEH) in accordance with DoD 4140.62. MDEH will be treated as Hazards Class/Division 1.1 material and until it has undergone the proper treatment process specified by the work plan and the DDESB-approved ESP/ESS. MDEH will not be commingled with any other material until it has undergone the required treatment process and a second 100 percent UXO Technician II and a 100 percent re-inspection by a UXO Technician III and met the designation requirement of MDAS.

Upon completion of the demolition shot UXO Technicians will conduct a thorough inspection of the surrounding area. All MD will be picked up and inspected to determine its designation as either MDEH or MDAS before final disposition is accomplished in accordance with the DDESB-approved ESS/ESP and HGL SOP 15.03.

6.0 SAFETY

The SUXOS and UXOSO are responsible for ensuring all demolition operations on HGL MR project sites are conducted in the safest possible manner for protection of project personnel, the public, and project equipment assets. The SUXOS and the UXOSO are responsible for ensuring Attachments 2, 4, and 5 of this SOP are briefed and acknowledged by all demolition team members before the execution of any explosive operation.

7.0 RECORDKEEPING

The SUXOS and DS will use the forms and checklists identified by this SOP and HGL SOP 15.00, Explosive Accountability and Management for all HGL demolition operations. The following checklists will be used to ensure all demolition operations personnel assignments and functions, and explosive expeditures are properly documented and recorded:

1. Disposal Operations Checklist (Attachment 2)
2. Post Demolition Opereations Checklist (Attachment 8)

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7.1.1 Required Documents

In conjunction with this SOP, the following documents are required to be on site during disposal operations:

1. Approved Work Plan
2. Approved site safety and health plan
3. Approved ESP or ESS
4. Range certification (when applicable)
5. HGL SOP 15.00 Explosives Accountability and Management Program
6. HGL SOP 15.02 Explosives Storage Inspection and Security
7. HGL SOP 15.03 Material Potentially Presenting and Explosive Hazard Inspection, Management and Processing
8. HGL SOP 15.03 Phosphorus Munitions Safe Practices

8.0 REFERENCES

Code of Federal Regulations, Tile 27, Part 555—Commerce of Explosives, 2007, Bureau of Alcohol, Tobacco, Firearms and Explosives, ATF Publication 5400.7, ATF Federal Explosives Laws and Regulations, November.

Code of Federal Regulation, Title 49 Parts 171, 173 and 177, U.S. Department of Transportation, Other Regulations Relating to Transportation.

Department of Defense Explosive Safety Board Technical Paper 18, 2004, Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel, December.

Department of Defense Manual 6055.9-M, 2010, DoD Ammunition and Explosives Safety Standards, February.

Department of Defense Instruction 4140.62, 2008, DoD Ammunition and Explosives Safety Standards, November.

U.S. Army, Technical Manual 60A-1-1-31, 2008, General Information on Explosive Ordnance Disposal Procedure, October.

U.S. Army Corps of Engineers, Engineer Manual 385-1-97, 2008, Explosives Safety and Health Requirements Manual, September.

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U.S. Army Corps of Engineers, Engineer Regulation 385-1-95, 2007, Safety and Health Requirements Munitions and Explosives of Concern Operations, March.

HydroGeoLogic, Inc., HGL MMRP SOP 15.00, Revision 2, 2011, Explosives Accountability and Management Program, June.

HydroGeoLogic, Inc., HGL MMRP SOP 15.02, 2011, Explosives Storage Inspection and Security, June.

HydroGeoLogic, Inc., HGL MMRP SOP 15.03, 2011, Material Potentially Presenting and Explosive Hazard Inspection, Management and Processing, April.

HydroGeoLogic, Inc., HGL MMRP SOP 15.08, 2011, Phosphorus-filled Munitions Safe Practices, November.

9.0 ATTACHMENTS

Attachment 1	Supervisor/Workers Statements
Attachment 2	Demolition Operations Checklist
Attachment 3	Demolition Equipment Checklist
Attachment 4	Safety Equipment Checklist
Attachment 5	General Safety Precautions
Attachment 6	Explosive Systems Configuration
Attachment 7	Rothenbuhler Engineering 1670 Remote Firing Device Procedures
Attachment 8	Post Demolition Operations Checklist
Attachment 9	Three Phase Quality Control Checklist Explosive Demolition Operations (Demolition operations) (HGL SOP 15.01)

ATTACHMENT 1

SUPERVISOR'S STATEMENT

I have read and understand this SOP. To the best of my knowledge, the activities described in this SOP can be done in a safe, healthful, and environmentally sound manner. I have made sure that all persons assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure that the SOP contains current procedures. If a change to the SOP is necessary, I will ensure that the process is stopped until the SOP is revised and approved. Changes will require the submission of a Field Change Request (FCR) or Design Change Notice (DCN) by the HGL project team and receipt of Naval RPM approval prior to implementation. If unexpected safety, health, or environmental hazards are found, I will make sure the process is stopped until the hazards have been eliminated.

Senior UXO Supervisor　　　　　　　　Date

WORKER'S STATEMENT

I have read this SOP and I have received adequate training to perform the procedures addressed in the SOP. If I identify a hazard not addressed in the SOP, or encounter an operation I cannot perform in accordance with the SOP, I will stop the process and notify my immediate supervisor.

Worker's Name	Date	Supervisor's Name	Date

ATTACHMENT 2
DEMOLITION OPERATIONS CHECKLIST

FUNCTION CHECK	DATE/TIME	INITIALS
1.0 SENIOR UXO SUPERVISOR:		
1. Assign Demolition Team:		
a. SUXOS: ______________________________		
b. Demolition Supervisor: ______________________________		
c. Demo Team Assistant: ______________________________		
d. Demo Team Member: ______________________________		
e. Demo Team Member: ______________________________		
f. UXOSO: ______________________________		
1) Safety Position #1: ______________________________		
2) Safety Position #2: ______________________________		
3) Safety Position #3: ______________________________		
4) Safety Position #4: ______________________________		
g. Other: ______________________________		
2. Communications:		
a. Radio call signs / cellular numbers:		
1) SUXOS: ________________ /____________________		
2) DS: ________________ /____________________		
3) UXOSO: ________________ /____________________		
4) Safety Position-1: ______________ /________________		
5) Safety Position-2: ______________ /________________		
6) Safety Position-3: ______________ /________________		
7) Safety Position-4: ______________ /________________		
3. Brief Demolition Team:		
a. Review emergency procedures.		
b. Discuss MEC/MC/UXO to be disposed.		
c. Describe Disposal procedures.		
4. Inspect Range/Exclusion zone upon completion of operations.		
2.0 DEMOLITION SUPERVISOR		
1. Verify roads are closed.		
2. Verify exclusion zone boundaries in place.		
3. Complete health and safety and equipment checklists.		
4. Ensure command center has completed the verification		

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ATTACHMENT 2 DEMOLITION OPERATIONS CHECKLIST		
FUNCTION CHECK	**DATE/TIME**	**INITIALS**
checklist: a. Responsible activity. b. Medical Facility. c. Fire Department. d. Security/Police Department.		
5. Disposal Supervisor tailgate safety brief: a. Designate emergency vehicles. b. Designate emergency evacuation route. c. Review emergency response procedures.		
6. Verify daily equipment inspection.		
7. Verify detonators are separated from explosives.		
8. Verify area has been evacuated.		
9. Notify command center operations are commencing.		
10. Start disposal activities.		
11. UXOSO ensures detonation site insected after designated wait time.		
12. Collect all metal fragments for later disposal.		
13. QC check performed.		
14. Stop disposal activities.		
15. QA check (if required).		
16. HGL notification upon completion of demolition operations: a. Notify Client: ______________________________ b. Responsible Activity : ______________________________ c. Medical Facility: ______________________________ d. Fire Department: ______________________________ e. Local Police/Security: ______________________________ f. Public Utilitiy Company: ______________________________		
17. Complete HGLForm 15.04 MEC/UXO Accountability Log.		
18. Demobilize (when applicable)		
19. Complete Post Demolitoin Operation Checklist, Attachment 8.		
Demolition supervisor signature:	**Date:**	

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ATTACHMENT 3
DEMOLITION EQUIPMENT CHECKLIST

Equipment	Quantity	Comments
Explosive Vehicle(s)		
Personnel Vehicle(s)		
Camcorder/Digital Camera		
Air Horn		
Handheld Radios		
Electronic Firing Device		
Radio Controlled Firing Device		
Ruler, 24-inch		
Shovel, round point, long handle		
Blasting Machine		
Duct tape		
Plastic tape		
Measuring tape, 50- or 100-meter		
Toolbox, general hand tools		
Galvanometer		
Firing Wire		
Demolition Kit		
Knife		
Magnetometer		

3.0 CHECKLIST VERIFICATION

Disposal Supervisor Signature:	Date:

ATTACHMENT 4
SAFETY EQUIPMENT CHECKLIST

1.0 EQUIPMENT	QUANTITY	COMMENTS
Air Horn, emergency		
Burn Blanket		
Burn Kit		
Emergency Eye Wash		
Fire Blanket		
Fire Extinguisher, 10-pound ABC		
Bloodborne Pathogen Kit		
First Aid Kit		
Leather gloves		
Goggles		
Face Shield(s)		
Welder's Gloves		
Welder's Apron(s)		
Rain Suit(s)		
Safety Vest(s)		
Stretcher		
Water, 5-gal bottle (emergency shower)		
Water, drinking – 1 liter per person		
Other:		
Other:		

2.0 CHECKLIST VERIFICATION	
Disposal Supervisor Signature:	**Date:**

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HGL HydroGeoLogic, Inc

ATTACHMENT 5
GENERAL SAFETY PRECAUTIONS

1. Carry blasting caps in approved containers and keep them out of direct sun. Keep the caps located at least 25 feet from other explosives until they are needed for priming.
2. Do not work with electric blasting caps or other electro-explosive devices while wearing clothing prone to producing static electricity such as nylon, silk, synthetic hair, etc.
3. Do not use explosives or accessory equipment that is obviously deteriorated or damaged. They may cause premature detonation or fail completely.
4. Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling.
5. Use only standard blasting caps of at least the equivalent of a commercial No. 8 blasting cap.
6. Use electric blasting caps of the same manufacturer for each demolition shot involving more than one cap.
7. Do not use improvised methods for initiating blasting caps.
8. Do not bury blasting caps. Use detonating cord to transmit the explosive wave from the blasting caps, on the surface, to a buried/tamped explosive charge. Buried blasting caps are subject to unobserved pressures and movement, which could lead to premature firing or misfires.
9. Test electric-blasting caps for continuity at least 50 feet from any other explosives prior to connecting them to the firing circuit. Upon completion of testing, the lead wires will be shunted by twisting the bare ends of the wires together. The wires will remain shunted until ready to be connected to the firing circuit.
10. In the event of a misfire when disposing of explosives by detonation, do not approach the disposal site for at least 30 minutes after the expected detonation time, when firing electrically. When conducting non-electric procedures, the wait time will be at least one hour from the expected time of detonation.
11. Items with lugs, strong backs, tail-booms, base plates, etc., should be oriented away from personnel locations.
12. Consideration should be given to tamping the UXO to control fragments, if the situation warrants. Fragments will be minimized not only to protect personnel but also property, such as buildings, trees, etc.
13. Avoid inhaling the smoke, dust, or fumes of burning pyrotechnic or incendiary materials. The smoke, dust and fumes from many of these materials are irritating and/or toxic if inhaled.
14. Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.
15. Anticipate a high order detonation when burning pyrotechnic or incendiary-loaded MEC. Safety measures for personnel and property must be based upon this possibility.
16. Inert munitions will not be disposed of, or sold for scrap, until the internal fillers have been exposed and unconfined. Heat generated during a reclamation operation can cause the inert filler, moisture, or air to expand and burst the sealed casings. Venting or exposure may be accomplished in any way necessary to preclude rupture due to pressure from being confined. All requirements of the UXO Procedure for the Management and Disposition of Material Potentially Presenting an Explosive

Hazard (MPPEH) will be met prior to releasing any inert munitions material.

17. Maintain minimum safe distances between electromagnetic-radiating sources and electro-explosive devices (IAW EODB/TM-TO 60A-1-1-12).
18. Do not conduct blasting or Demolition operations during an electrical, dust, sand, or snowstorm severe enough to produce atmospheric static electrical charges, or when such a storm is nearby (within 10 miles). Under such conditions, all operations will be suspended or terminated, cap and lead wires shunted, and personnel removed from the demolition area. Demolition operations will also be terminated if visibility becomes less than 600 feet.
19. Loose initiating explosives: lead azide, mercury fulminate, lead styphnate, and tetracene. These explosives manifest extreme sensitivity to friction, heat, and impact. Extra precautions are required when handling these types of explosives. Keep initiating explosives in a water-wet condition at all times until ready for final preparation for detonation. Sensitivity of these explosives is greatly increased when dry.
20. Exercise extreme care when handling and preparing high explosives for detonation. They are subject to detonation by heat, shock, or friction.
21. Do not pack bomb fuze wells with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.
22. Photo flash bombs must be handled with the same care as black powder-filled munitions.
23. MEC containing white phosphorus will not be detonated into the ground. White phosphorus munitions will be counter-charged on the bottom centerline (CCBC) when possible.
24. A search of the detonation site, after the demolition operation, will be conducted to assure complete disposal was accomplished.
25. Do not abandon any explosives.
26. Do not leave explosives, empty cartridges, boxes, liners or other materials used in the packing of explosives lying around where children, unauthorized persons or livestock can get at them.
27. Do not allow any wood, paper or other materials used in packing explosives to be burned in a stove, fireplace, or other confined space, or be re-used for any other purpose. Such materials will be destroyed by burning at an isolated location out of doors, with no one allowed within 100 feet of the burning operation.
28. Do not fight fires involving explosive material. Evacuate all personnel to a safe location and secure the area.
29. Know and observe federal, state, and local laws/regulations that apply to the transportation, storage, and use of explosives.
30. Do not permit metal, except approved metal truck bodies, to contact explosive containers.
31. Do not transport metal, flammable, or corrosive substances with explosives.
32. Do not allow smoking, or the presence of unauthorized personnel, in vehicles transporting explosives.
33. Carefully load and unload explosives from vehicles. Never throw or drop explosives from the vehicle.
34. Assure the load is blocked and braced to prevent it from movement and displacement.
35. Do not drive vehicles containing explosives over public highways until all permits and certifications

have been obtained from the state enforcement agencies.

36. All routes must be approved in writing prior to transporting explosive materials over public highways.
37. Licensed commercial carriers will conduct the shipment of explosive materials over public highways unless HGL UXO personnel have been specifically licensed and certified to make the shipment.
38. Never leave a vehicle that is loaded with explosives unattended.
39. Do not store blasting caps, detonators, or other items containing initiating explosives in the same box, container, or magazine with other explosives.
40. Store explosive materials in military or BATF-approved magazines only. Ensure the magazines used for the storage comply with quantity distance requirements, for the class of explosive material they contain. Reference documents include: Explosives Law and Regulation, BATF P 5400.7, and 49 CFR.
41. Do not store spark-producing metal/tools in an explosive magazine.
42. Do not permit smoking, matches, or any source of fire or flame within 100 feet of an explosive magazine.
43. Do not allow leaves, grass, brush, or debris to accumulate within 50 feet of an explosive magazine.
44. Do not permit the discharge of firearms within 300 feet of an explosive magazine.
45. Do not use any alkaline material such as lye, washing soda, or soap to remove TNT exudate. Alkaline materials will react with TNT to render it more sensitive.
46. Do not permit smoking, matches, or other sources of fire or flame within 100 feet of an area in which explosives are being handled.
47. Do not expose explosives or devices containing explosive to prolonged exposure to direct sun light. Such exposure can increase sensitivity and deterioration.
48. Ensure all unused explosives are returned to their proper containers and the container closed after use.
49. Do not carry explosives or explosive components in pockets or on the body.
50. Do not insert anything but time fuse or detonating cord into the open end of a blasting cap.
51. Do not strike, tamper with, or attempt to remove or investigate the contents of an electric/non-electric blasting cap, detonator, or other explosive initiating device. A detonation may occur.
52. Do not pull on the electrical lead wires of electric blasting caps, detonators, or their electro-explosive devices. A detonation may occur.
53. Do not attempt to remove an unfired or misfired primer or blasting cap from a base coupling. There is a high risk of an explosion.
54. Do not allow unauthorized or unnecessary personnel to be present when explosives are being handled.
55. Always point the explosive end of blasting caps, detonators, and other explosive devices away from the body.
56. Do not use pull rings or safety pins to lift or handle explosive devices.

ATTACHMENT 6
EXPLOSIVE SYSTEMS CONFIGURATION

1.0 REMOTE FIRING DEVICE

1. Perform system pre-operational test and set up using the Rothenbuhler Operator's Manual. Remove key from controller unit until ready to fire.
2. Place the remote near the detonation site with the antenna in the vertical position. If using electric caps the remote should be within 100 feet of the shot. Use the unit blast shield, sandbags, or natural cover to protect the remote.
3. Ensure the remote indicates a READY condition for the selected initiation method (green READY LED on steady, red ARMED LED off).
4. If using Nonel®/shocktube, connect the shock tube to the igniter tip. The tube should be wrapped around through holes in the tip's molded casing to keep it from falling out. Prime the shot and return to the safe area.
5. If using electric caps, cut off a length of firing wire that will reach between the remote and the charges (100 feet or less).
6. Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
7. Test each electric blasting cap 50 feet downwind of other explosives with a galvanometer.
8. Place blasting caps in a hole, behind a barricade, or under a sandbag before removing the shunt and testing for continuity.
9. Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
10. Secure the leg wires to prevent the cap from moving during the test.
11. Use only a special silver-chloride dry cell battery in the testing galvanometer. Other type batteries may provide sufficient voltage to fire the blasting cap.
12. Upon completion of testing, re-shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
13. For dual priming connect blasting caps in a parallel circuit to the extension wires.
14. Test the circuit with the galvanometer, and then connect extension wires to the remote.
15. Retrieve caps from barricade, prime shot, and return to safe area.
16. Retrieve caps from barricade, prime shot, and return to safe area.

2.0 FIRING THE REMOTE FIRING DEVICE

1. The SUXOS will verify that the exclusion zone is clear and barricades are in place.
2. The SUXOS will give a "five-minute warning" blast on either the air/vehicle horn, vehicle horn, or siren, and on the and radio.

3. The SUXOS will give a "one-minute warning" blast on either the air/vehicle horn, or siren, and on the radio.
4. Install the key and engage the "POWER" switch on the controller to the right until the BATTERY LED illuminates.
5. Momentarily depress the controller STATUS button. The yellow TRANSMIT LED will flash for approximately one second. At the end of this time a green READY LED will come on steady, indicating that the remote is on and in the standby mode. The steady green LED also indicates the remote is within range of the controller.
6. Push the ARM/DISARM switch to the left and hold for one second. The red ARMED LED will flash for approximately 18 seconds and then come on steady. The remote is now armed.
7. UXO Demolition Supervisor gives three loud "Fire-in-the-Hole" warnings.
8. SUXOS gives fire command on the radio.
9. SUXOS gives permission to fire the shot.
10. Lift the safety cover on the FIRE switch and push the FIRE switch forward.

3.0 PREPARATION OF THE SCORPION ELECTRONIC BLASTING MACHINE

1. Perform pre-operational check as per instructions on blasting machine.
2. Lay out firing wire or Nonel®/shocktube.
3. Conduct a continuity check of the firing wire with a galvanometer. Shunt the free ends of the wire to prevent an electric charge from building up in the firing wire.
4. Test each blasting cap with a galvanometer 50 feet away from other explosives.
5. Place blasting caps in a hole, behind a barricade, or under a sandbag before removing the shunt and testing for continuity.
6. Fully extend the leg wires and ensure the cap is pointing away from the person conducting the continuity test.
7. Secure the leg wires to prevent the cap from moving during the test.
8. Use only a special silver-chloride dry cell battery in the testing galvanometer. Other type batteries may provide sufficient voltage to fire the blasting cap.
9. Upon completion of testing, re-shunt the leg wires. The wires will remain shunted until ready to connect to the firing circuit.
10. For dual priming, connect blasting caps in a parallel circuit to the firing wire.
11. Retrieve caps from barricade, prime shot, and return to safe area.

4.0 FIRING THE SCORPION ELECTRONIC BLASTING MACHINE

1. The SUXOS will verify that the exclusion zone is clear and barricades are in place.
2. The SUXOS will give a "one-minute warning" blast on either the air or vehicle horn, or siren, and on the radio.
3. The SUXOS will give a "one-minute warning" blast on either the air or vehicle horn, or siren,

and on the radio .

4. If firing electric check firing wire with a galvanometer.
5. Connect the firing leads to the terminal posts of the blasting machine.
6. For Nonel®/shocktube, plug in the shock tube adapter and attach Nonel®/shocktube.
7. UXO Demolition Supervisor gives three loud "Fire-in-the-Hole!" warnings.
8. SUXOS gives fire command on the radio.
9. SUXOS gives permission to fire the shot.
10. Degrees and hold CHARGE button (keep depressed throughout sequence).
11. Press DETONATE button when green ready light comes on. For non-electric shots, hold DETONATE button down for one second and release.

5.0 MISFIRE PROCEDURES FOR THE REMOTE FIRING DEVICE

1. Make three successive attempts to fire.
2. Turn off the controller and remove the key.
3. Wait 30 minutes from the last initiation attempt.
4. After the wait time has elapsed, the Demolition Supervisor and a safety observer will proceed down range to inspect the firing system.
5. If Nonel®/shocktube was used, do not remove the caps from the charge. Disconnect Nonel®/shocktube from the igniter tip on the remote. Place a new, primed explosive charge next to the misfired charge.
6. If electric caps were used, remove the old blasting caps from charge and disconnect from extension wires. Shunt cap leg wires.
7. If detonating cord was used, cut detonating cord between cap and charge, and disconnect cap from extension wires. Shunt cap leg wires.
8. Set up new firing system.

6.0 MISFIRE PROCEDURES FOR THE SCORPION ELECTRONIC BLASTING MACHINE

1. Make three successive attempts to fire.
2. If using firing wire and still unsuccessful, disconnect wires and check continuity.
3. If continuity is good, reconnect to blasting machine and make three more attempts to fire.
4. If still unsuccessful, check connections of firing wires to terminals and make three more attempts to fire.
5. Change blasting machine after third unsuccessful attempt.
6. If unsuccessful with new blasting machine, disconnect and shunt firing leads.
7. If using Nonel®/shocktube, disconnect from blasting machine.
8. Wait 30 minutes from the last initiation attempt.

9. After the wait time has elapsed, the Demolition Supervisor and a safety observer will proceed down range to inspect the firing system.
10. If electric caps were used, remove old blasting caps from charge and disconnect from firing wire. Shunt cap leg wires.
11. If detonating cord was used, cut detonating cord between cap and charge and disconnect cap from fire wire. Shunt cap leg wires.
12. If Nonel®/shocktube was used, do not remove the caps from the charge. Place a new, primed explosive charge next to the misfired charge (FM-5-250).
13. Set up new firing system.

7.0 SHOCK TUBE FIRING SYSTEMS

Shock tube is a thin plastic tube of extruded polymer with a layer of special explosive dust deposited on its interior surface. The special explosive dust propagates a detonation wave, which is normally contained within the plastic tubing. Shock tube offers the instantaneous action of electric initiation without the risk of accidental initiation of the blasting cap by radio transmitters in the area or by static electricity discharge. The shock tube medium is extremely reliable.

7.1 SHOCK TUBE SPLICING

The high reliability of shock tube blasting is due to the fact that all of the components are sealed and, unlike standard non-electric priming components, cannot be easily degraded by moisture. Cutting the shock tube makes the open end vulnerable to moisture. Care should be taken to keep moisture from the cut end of the shock tube. Use the following procedures to cut and splice shock tube.

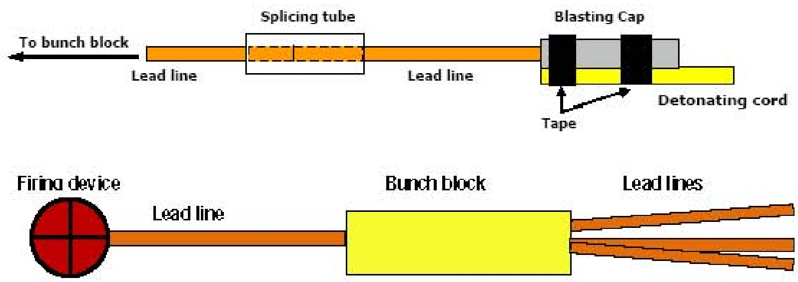
1. Use a sharp knife or razor blade to squarely cut (90 degree angle) approximately 18 inches from a new roll or the cut-off end of a partial roll.
2. Loosely tie the two shock tube ends to be spliced together in a SQUARE KNOT. Leave at least 2 inches free at the end of each shock tube beyond the knot.
3. Pull the shock tube lightly to tighten the knot, but not so tight as to significantly deform the shock tube in the knot.
4. Use only the splicing tubes provided to make splices. Taping the two cut ends of shock tube together does not make a reliable splice.
5. Push one of the free shock tubes, to be spliced, firmly into one of the pre-cut splicing tubes at last 1/4 inch.
6. Push the other shock tube end firmly into the other end of the splicing tube at least 1/4 inch. Attempt to push the two ends up against each other or get as close as possible.
7. Secure splice with electrician's tape.
8. Each additional splice in shock tube reduces the reliability of the priming system. Minimize the number of splices in a shock tube line to as few as possible.
9. Spool out the desired length of shock tube and cut off squarely with a sharp knife or razor blade.

10. Secure the shock tube remaining on the spool by tying a tight overhand knot in the loose end.
11. Protect the open end of the shock tube by sealing it with the end caps provided or with electrician's tape.
12. Attach an initiator to the free end of the shock tube that is spliced into the blasting cap. If a separate blasting cap or detonating cord is used to actuate the shock tube, tie a tight overhand knot in this end

8.0 SHOCK TUBE SET-UP

1. Lay out required length of shock tube (trunk line) from demo area back to the firing point.
2. Attach an EZTL 30 bunch block (or equivalent) using the supplied splicing tube to the lead line at demo site. Secure the bunch block or immobilize with sandbags. Run additional lead line(s) from bunch block to OE (See Figure 1).
3. Attach only a maximum of six additional leads per bunch block. Use additional bunch blocks, if necessary.

FIGURE 1 – SHOCK TUBE SETUPS



9.0 DONOR EXPLOSIVES

The primary donor explosives used for MEC disposal will be the 1-pound pentolite booster, plastic explosives, jet perforators, or binary explosives.

9.1 ONE-POUND PENTOLITE BOOSTER

1. Insert 80 grain detonating cord into the detonator well. Insert all the way through and back through other hole and tie an overhand knot to secure it.
2. When using more than one booster, insert detonating cord through each of the boosters' detonator wells and secure to keep them from sliding along the detonating cord.

9.2 PLASTIC EXPLOSIVES

Set up with blasting cap(s) or detonating cord lead(s) as per EODB 60A-1-1-31. Position plastic explosives on MEC.

9.3 JET PERFORATOR

1. Use the detonating cord clip provided to secure detonating cord to the Jet Perforator.

2. Place the Jet Perforator on the MEC item using tape or other suitable methods to prevent it from moving.
3. For tamped shots, use a box or other suitable material to provide soil from getting between the perforator and MEC item.

9.4 BINARY EXPLOSIVES

Binary explosives are two-part explosives that are not classified as an explosive until mixed. These can be procured in various configurations to include plastic tube containers and pliable packs in varying sizes depending on the required application. The binary should not be mixed until ready for use. After mixing it can be primed as a cap sensitive explosive using Nonel®/shocktube, detonating cord, or electric or non-electric blasting caps. Use as any high explosive with a velocity of detonation around 20,000 feet per second.

9.5 POST-DEMOLITION PROCEDURES

1. Wait the designated wait times specified by the SOP. A minimum 5 minutes after single shots or after a series of shot that can be counted. A minimum of 30 minutes after multiple shots that could not be counted.
2. The Demolition Supervisor and one other UXO technician will return to the detonation site and check the results of the shot. If the procedure was successful the Demolition Supervisor will call in additional personnel to clean up the site. UXO personnel will conduct a visual sweep of the detonation site and the immediate area to gather fragments and explosive residue, if present.
3. Explosive residue will be collected and detonated.
4. Metal fragments will be examined to ensure complete consumption of explosive material.
5. Intact MEC items that failed to detonate will be disposed of.
6. After area is swept and cleared the Demolition Supervisor will notify the SUXOS and the "all clear' will be given.

ATTACHMENT 7

ROTHENBUHLER ENGINEERING 1670
REMOTE FIRING DEVICE (RFD)
PROCEDURES

SAFETY WARNINGS

1) Always follow your local safety regulations. This manual and its procedures are secondary to governmental regulations, local regulations or company safety regulations and procedures. The operation procedures in this manual are only suggestions and should be checked against the above safety regulations and procedures. Company training should include the proper use of this machine and only trained personnel should use it.

2) Never rely on this equipment or any equipment totally for your safety. All mechanical and electronic equipment can fail. Always have a safety procedure that will protect you and minimize hazards of such failure.

3) High power radio transmissions can cause electric blasting caps to detonate. Keep the high powered Controller 25 or more feet (8 meters) from electric detonators.

4) The Shock Tube Initiator on the Remote Unit can develop up to 3,000 Volts. Do not touch this tip or tip jacks while arming or firing the unit.

5) Do not connect electric detonator wires or shock tube to the Remote Unit unless the green READY light is on, the red ARMED light is off, and the battery light is on steady.

6) Do not use the system if any of the units show damage to the point that failure is suspected. Thoroughly test the system prior to use.

7) Never approach the Remote Unit if it is attached to live explosives unless you have a confirmed READY status back to the Controller AND you have waited at least 2 minutes for the automatic disarm AND you have followed proper safety wait times.

8) It is MANDATORY that the Protective Cover is installed on the Charge Connector of the Remote unit at all times unless charging. There is the potential presence of voltage on some of the pins of the Charge Connector. For models produced after March 2009 (Serial Numbers 371+), the maximum current available from any pin is limited to 14.3 milliamperes.

3. PREOPERATIONAL PROCEDURES

3.1. PHYSICAL INSPECTION

3.1.1. Inspect all components for physical damage.

3.1.2. Remove the antenna dust caps and ensure the antenna jacks on the Controller Unit and Remote Unit are not damaged. Ensure they are clean and dry. Replace the antenna dust caps.

3.1.3. Ensure that the Remote and Controller Unit antennas are clean and free of damage. Ensure the electrical contacts are clean and dry.

3.1.4. Examine the shock tube igniter jacks on the left sides of the Remote Units. The jacks should be clean and dry.

3.1.5. Examine the Remote Unit's shock tube igniter tips. They should be clean and dry. If more than 200 shots have accumulated on either tip, replacement is recommended to ensure reliable shot initiation.

3.1.6. Press the two electric detonator binding posts located on the left sides of the Remote Units. Ensure they compress and return to their normal position (Dual Output Model only).

3.1.7. Ensure the key receptacles on the Controller Unit and Remote Units are clean and dry. Ensure they operate smoothly and show no signs of physical damage.

3.2. CHARGING THE BATTERIES

3.2.1. Ensure all units are turned off (The Remote Unit will not charge unless deactivated).

3.2.2. Ensure the ambient air temperature is between 32 and 86 °F (0 to 30 °C). When the ambient temperature is above 80 °F (27 °C), best results are obtained when the Remote lids are opened and air is allowed to circulate over the Remote display panels.

3.2.3. Remove the protective covers on the charge connectors. Line the key on the charger adapter plugs with the slot on the top of charge connectors mounted on each unit. Insert the plugs and turn clockwise until locked in place.

WARNING It is MANDATORY that the Protective Cover is installed on the Charge Connector of the Remote unit at all times unless charging. There is the potential presence of voltage on some of the pins of the Charge Connector. For models produced after March 2009 (Serial Numbers 371+), the maximum current available from any pin is limited to 14.3 milliamperes.

3.2.4. Insert the supplied charger adapters into suitable power outlets (100-240 VAC, 50/60 Hz).

3.2.5. As the units begin charging, the green SLOW lights will come on briefly, then the red FAST lights will blink for about 5 seconds and come on steady. The red FAST lights indicate the units are fast charging. Table 3-1 shows the charge indicator modes.

3.2.6. When charging is complete, the FAST lights will turn off, and the green SLOW lights will come on steady. Typical recharge time is 3-4 hours. For maximum battery life, avoid leaving the charger connected for more than 24 hours when possible.

Light	Blink Mode	Indicates
FAST	On steady	Fast Charging
FAST	Blinks at startup	Pre-testing
FAST	Blinks continuous	Battery Error
SLOW	On steady	Charge Complete
SLOW	Blinks continuous	Pack Temperature Range Exceeded

Table 3-1 RFD Charge Indicator Modes

3.2.7. When charging is complete, disconnect the charge adapters and reinstall the covers on the charge connectors.

WARNING It is MANDATORY that the Protective Cover is installed on the Charge Connector of the Remote unit at all times unless charging. There is the potential presence of voltage on some of the pins of the Charge Connector. For models produced after March 2009 (Serial Numbers 371+), the maximum current available from any pin is limited to 14.3 milliamperes.

3.3. BATTERY USAGE AND TESTING

3.3.1. To check the Controller's battery level, activate the unit by pressing the ON switch. The battery level will be shown as a percentage of full charge.

Figure 3-1 Controller Battery Level

Figure 3-2 Remote Battery Voltage

3.3.2. To test the Remote's battery voltage, turn the unit on and the hold the PRESS TO TEST switch for 10 seconds. A fully charged battery will stabilize with a reading of 13.5 V or more. The Remote Unit should be charged when the battery is less than 12.0 V. At 11.7 V, the yellow POWER light will flash to show the battery is too low.

3.3.3. When freshly charged, the Remote Units will run for up to 16 hours at an ambient temperature of 68 °F or 20 °C. Allow for reduced run times for hot or cold temperatures, or when the Safety Poll® mode of operation is used (Safety Poll® mode is explained in Section 5.1). Each unit can be fired approximately 100 times before recharging is required. Allow 15 minutes less run time, for each firing event.

3.3.4. When freshly charged, the Controller Unit will run in standby for up to 12 hours at an ambient temperature of 68 °F or 20°C. Allow for reduced run times for hot or cold temperatures, or when the Safety Poll® mode of operation is used (Safety Poll® mode is explained in Section 5.1).

3.3.5. The batteries will self-discharge at a rate of approximately 1% per day. This rate will increase as the temperature increases.

3.3.6. The RFD battery cells are reasonably resistant to developing a memory. For best results, allow the RFD to become mostly discharged before recharging, and allow the unit to fully charge without interruption.

3.3.7. The RFD's internal battery packs can be recharged up to 500 times before replacement is required. A decrease in run time may be noticed at the end of the battery pack's life cycle.

Return the RFD to an authorized service shop for replacement when required, or change your packs during the recommended 2-year servicing. Do not attempt field replacement.

3.3.8. Always turn the units off when not in use to conserve the battery charge.

3.3.9. The battery meter test switch can be pushed to check the battery level even if the power switch is in the off position. If the accessories bag in the lid gets excessively stuffed with tips or other items the possibility exists that the battery test button could be held down and consequently drain the battery.

3.4. TESTING THE RFD

3.4.1. This test procedure must be conducted in an area that is at least 100 feet from the nearest electric detonators or wires connected to electric detonators.

3.4.2. All RFD system components are described in detail in Section 2.

3.4.3. Ensure all units are sufficiently charged according to procedures 3.2 and 3.3.

3.4.4. Position the Controller and Remote Units at least 5 feet (1.5 meters) apart, in a position where all units can be observed while testing.

3.4.5. Install the antennas on the Remote and Controller Units.

3.4.6. On the Remotes, insert the enable keys and turn the POWER switches to the ON positions. Observe that the READY, ARMED, and POWER lights blink briefly on power up. The yellow light next to the ENABLE KEY should blink continuously to show the key is installed. The POWER light should remain on steady.

3.4.7. On the Remote Units, place the SELECT switch to the SHOCK TUBE position (Dual Output Model only). Observe the green SHOCK TUBE READY lights are on, and the red ARMED lights are out. Install a shock tube tip into the jacks located on the side of each Remote Unit.

3.4.8. On the Controller Unit, insert the Controller's key and press the ON switch. Observe the yellow POWER and KEY lights are on steady.

3.4.9. On the Controller, press the STATUS switch. After a short time the green READY lights for the Remote Units that were previously prepared for use, will come on steady to show they are disarmed and communicating two-way. The select lights will automatically be turned on for Remote Units that answered back to the Status request if the Auto Select option is enabled.

3.4.10. If Auto Select option is not enabled, on the Controller, press the SELECT switches to select the Remote Units to be tested. The yellow SELECT lights for the selected units will turn on.

3.4.11. On the Controller, press the ARM switch. The ARMED lights for the selected Remote Units will blink for up to 15 seconds and come on steady.

3.4.12. On the Remote Units, the red ARMED lights will come on steady. The system is armed.

3.4.13. On the Controller, before 2 minutes have elapsed, press the DISARM switch. All Remotes will disarm within 3 seconds.

3.4.14. Re-arm the Controller Unit and wait 2 minutes. After the 2 minutes, all Remotes will return to the disarmed state. The red ARMED lights will go out, and the green READY lights will come on steady.

3.4.15. Re-arm the Controller Unit, and before the two minutes have expired, press both FIRE switches together and hold for ½ second. You should notice that all Remote Units developed sparks at the shock tube tip electrodes. All units subsequently return to the disarmed state.

Note: 3.4.16 through 3.4.19 applies to the Dual Output Model only.

3.4.16. On the Remote Units, place the SELECT switches to the ELECTRIC DETONATOR position and observe the green ELECTRIC DETONATOR READY lights are on, and the ARMED lights are out.

3.4.17. On the Remotes, depress the two spring loaded binding posts and insert the leads of the test lamps.

3.4.18. Repeat procedures 3.4.11 through 3.4.14. The test lamps should remain extinguished through out this portion of the procedure.

3.4.19. Re-arm the Controller Unit, and before the two minutes have expired, press both FIRE switches together and hold for ½ second. You should notice that all test lamps light briefly. All units subsequently return to the disarmed state.

3.4.20. If any units did not work as described in this section, return to a service shop for repair. Never use a unit that is damaged or suspected of being damaged.

3.4.21. Turn off all units. Restore antennas, tips, and test lamps as required. The system is now operationally ready for use.

4. RFD OPERATIONAL PROCEDURES

4.1. SETTING UP THE RFD

WARNING It is MANDATORY that the Protective Cover is installed on the Charge Connector of the Remote unit at all times unless charging. There is the potential presence of voltage on some of the pins of the Charge Connector. For models produced after March 2009 (Serial Numbers 371+), the maximum current available from any pin is limited to 14.3 milliamperes."

4.1.1. Select the number of Remotes required for the operation. Ensure all units are sufficiently charged and tested according to Chapter 3.

Figure 4-1 Installing the Controller Antenna

4.1.2. Ensure the Controller Unit key is removed. Position the Controller Unit at the intended firing position and install the antenna.

4.1.3. To place the RFD in Safety Poll® mode, press and hold the STATUS switch while also pressing the ON switch (Details of Safety Poll® mode in Section 5.1).

4.1.4. Select a position for the first Remote Unit close to the blast area, but far enough to ensure the Remote is safe from direct air blasts and falling rocks.

Figure 4-2 Remote Antenna Installation

4.1.5. Install the antenna on the Remote Unit. Ensure the antenna is free of obstruction.

Figure 4-3 Activating the Remote Unit

4.1.6. Turn the POWER switch to the ON position. Observe the yellow POWER light is on and not flashing. Ensure the battery voltage is above 12.0V.

4.1.7. For underground operation, ensure the green RECEIVE light is on steady to indicate the Remote is in receiving range of the leaky feeder radio signal.

4.1.8. For surface operation, the green RECEIVE light suggests there may be an interfering radio signal or noise present. The RECEIVE light is similar to breaking squelch on a handheld radio and does not necessarily indicate operation is degraded.

Figure 4-4 Select the Initiator

4.1.9. Place the SELECT switch to the desired initiation method (Dual Output Model only). Verify the green READY light is on, while the red ARMED light remains off.

4.1.10. If using non-electric shock tube, install the tube into the RFD Tip, and install the tip into the jacks on the left side of the Remote as described in Section 2.8.

4.1.11. If using electric detonators, install the two-wire firing cable into the spring loaded binding posts located on the left side of the Remote Unit (Dual Output Model only).

4.1.12. Install the enable key into the Remote Unit and observe the yellow light next to the ENABLE KEY begins flashing. If the Controller is in Safety Poll® mode, this light will turn on steady within 15 seconds to show that full 2-way communications are working.

4.1.13. Close the lid on the Remote for protection. Repeat Sections 4.1.4 to 4.1.13 for the remaining Remote Units to be used in the operation.

4.2. FIRING THE RFD

Figure 4-5 Activating the Controller Unit

4.2.1. Activate the Controller Unit on pressing the ON switch. Observe the yellow POWER light is on. The Controller should be recharged when the BATTERY indicator reads 20% or less.

Figure 4-6 Inserting the Controller KEY

4.2.2. When the area is clear and all shots are prepared, insert the key into the Controller Unit as shown in Figure 4-6. The yellow KEY light will turn on.

Figure 4-7 Select the Remote Units

4.2.3. Press the SELECT switches to select the Remote Units to be fired. The yellow SELECT lights will illuminate as the corresponding Remotes are selected.

Figure 4-8 Perform a STATUS check

4.2.4. Press the STATUS switch and observe the green READY lights will light for each selected Remote Unit that is operational and within range.

Figure 4-9 Observing the STATUS check results

4.2.5. Shown in Figure 4-9 are the results of our STATUS check for Unit #3. The steady green READY light indicates Unit #3 is disarmed. The steady yellow BATTERY light indicates Unit #3's battery is not low.

Figure 4-10 Arm the SELECTED Remote Units

4.2.6. Wait for the appropriate warning sirens. About 30 seconds from firing, press and hold the ARM switch for ½ second. The red ARMED lights will blink for up to 15 seconds and come on steady.

4.2.7. For systems configured in 1-way mode: If any of the ARMED lights continue to blink, those units are not within 2-way range and confirmation cannot be received. The Remote(s) may or may not fire depending on range, local interference, and the Controller radio's power setting.

4.2.8. For systems configured for 2-way only mode, units that are not within 2-way range will not be armed.

Figure 4-11 Firing the ARMED and SELECTED Remote Units

4.2.9. When ready to fire, press the two FIRE switches together at the same time and hold for ½ Second as shown in Figure 4-11. Shot initiation should be detected.

Figure 4-12 Verify the green READY Lights are on steady

4.2.10. After a short time, the green READY lights should be on steady to show that each Remote Unit has fired and is now disarmed as shown in Figure 4-12. Any lights that continue to blink indicate the Controller did not receive a confirming message and a manual STATUS check is required to ensure all units are disarmed.

Figure 4-13 Manually checking STATUS

4.2.11. To manually check status, press the STATUS switch at any time. The updated status of the SELECTED Remotes will be reported on the faceplate enunciator panel. You may alternately press DISARM and STATUS until all Remotes have reported they are confirmed READY.

Figure 4-14 Turn the Controller Unit OFF

4.2.12. With all deployed Remote Units having reported steady READY status, deactivate the Controller by pressing the OFF switch.

Figure 4-15 Remove the Controller's Key

4.2.13. Remove the Controller Unit's key.

4.2.14. Wait an additional 2 minutes, and following standard safety procedures, you may approach and retrieve the Remote Units.

4.2.15. Turn OFF the Remote Units. Remove and store the enable keys, antennas, and shock tube tips.

4.2.16. Inspect all units for physical damage. Close the lids and restore dust caps.

ATTACHMENT 8

POST DEMOLITON OPERATION CHECKLIST

I. Project Information

Site Name: ____________________ Date: __________

Site Location: ____________________ Grid Number: __________

Demolition Team Leader: ____________________

II. Explosive and MEC/UXO Accountability (Donor explosives)	Yes	No
(a) All unused explosive materials returned to magazine and properly stored?		
(b) Explosive Usage Record (HGL Form 15.05) completed and submitted to SUXOS?		
(c) All destroyed/demiled MPPEH, MEC and UXO accounted for and verified by SUXOS?		
(d) MEC/UXO Accountability Record (HGL Form 15.04) completed and filed?		
(e) Magazine Data Card–Daily Summary of Magazine Transaction (HGL Form 15.02) completed?		
(f) Magazine locked and secured (two-locks)?		
(g) Detonator box locked and secured (two-locks)?		
(h) Magazine fence gate locked and secured?		
(i) Magazine keys returned and properly secured?		

III. Remarks

IV. Approval (signature)

Demolition Supervisor:	**Senior UXO Supervisor:**

HGL—Standard Operating Procedure

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ATTACHMENT 9
Three Phase Quality Control Checklist
Demolition operations (HGL SOP 15.01)

Team:	**Location:**	**Date:**

Personnel Present:

Phase of Inspection (Circle): *PREPARATORY (P); INITIAL (I); FOLLOW-UP (F)*

CHECKLIST

Item	**Reference**	**Inspection Point**	**Yes**	**No**	**N/A**	**Comments**
1.	DDESB TP 18	All demolition team members meet the UXO-qualified personnel requirements				*(P)*
2.	Work Plans, ESP or ESS	Have all demolition team members reviewed the current work plan, ESP or ESS? *Check Dates/Record of training.*				*(P)*
3.	SOP 15.01 Sec 5.1	Do the provisions of SOP 15.01 meet procedural and safety requirements for performing demolition operations for all personnel selected to participate in the procedures meet the requirements specified in Para. 5.1?				*(P), (I), (F)*
4.	SOP 15.01 Sec 5.2	Was the **Coordination Meeting** held prior to commencing Demolition operations?				*(P)*
5.	SOP 15.01 Sec 5.4.1	Was a **Public Meeting** held prior to commencing Demolition operations?				*(P)*
6.	SOP 15.01 Sec 5.4.2	Has the SUXOS completed the mandatory notifications in advance of the conduct of Demolition operations (i.e. *Medical, Fire, Security)*				*(P),(I),(F)*
7.	SOP 15.01 Sec 5.5	Has the Explosive Safety Quantity Distance arc for the largest munition that will be detonated been used to calculate the EZ prior to the conduct of Demolition operations?				*(P),(I),(F)*
8.	SOP 15.01 Sec 5.5	Are proper visitor access and control procedures known and followed?				*(P),(I),(F)*
9.	SOP 15.01 Sec 5.5	Does the integrity of the EZ remain intact until Demolition operations are complete?				*(P), (I), (F)*
10.	SOP 15.01 Sec 5.1, 5.2	Are appropriate personnel requirements met/achieved for the proper conduct of Demolition operations?				*(P), (I), (F)*
11.	SOP 15.01 Sec 5.6	Is the two man rule concept religiously followed whenever explosives are transported or handled during explosive operations?				*(P), (I), (F)*
12.	SOP 15.01 Sec 5.7	Does a demolition procedures review occur prior to the conduct of Demolition operations in accordance with the requirements of SOP 15.01?				*(P), (I), (F)*
13.	SOP 15.01 Sec 5.8 ATT 1, ATT 2	Is all the equipment/ and materials required for Demolition operations available and checked prior to operation conduct in accordance with the provisions of SOP 15.01?				*(P), (I), (F)*
14.	TMP, SOP 15.01 Sec 5.1.2	Is a current copy of SOP 15.01, Project TMP, Explosive Safety Submission, Range Certification (when applicable) and EOD Publications (minimum TM 60A-1-1-31) available to the Team when conducting Demolition operations? *Check dates.*				*(P),(I),(F)*
15.	SOP 15.01 Sec 5.3	Have sufficient communications been established to enable team/field personnel to communicate with the Site Field Office and emergency response agencies prior to the conduct of operations?				*(P), (I), (F)*

16.	SOP 15.01 Sec 5.9	Has a backup emergency communication system (air horns) been established in accordance with SOP 15.01 in the event that radios are inoperative in the EZ?				*(P), (I), (F)*
17.	SOP 15.01 Sec 5.8, 5.10, ATT 2 ATT 5	Are there sufficient range vehicles available, with appropriate safety devices installed, to transport and support Explosive Demolition Operation Personnel?				*(P), (I), (F)*
18.	SOP 15.01 Sec 5.8	Are all vehicle safety requirements of SOP 15.01 known and strictly observed?				*(P), (I), (F)*
19.	SOP 15.01 Sec 5.11	Does the SUXOS obtain a weather report prior to the conduct of Demolition operations?				*(P), (I), (F)*
20.	SOP 15.01 Sec 5.11	Are Demolition operations denied or cancelled when electrical storms are within 5 miles of the disposal site or when other severe weather conditions exist that would have a negative impact on safety?				*(P), (I), (F)*
21.	SOP 15.01 Sec 5.12	Are emergency medical support administrative, notification, training, and equipment requirements observed for Demolition operations in accordance with SOP 15.01?				*(P), (I), (F)*
22.	SOP 15.01 Sec 5.13	Are fire support administrative, notification, training, and equipment requirements observed for Demolition operations in accordance with SOP 15.01?				*(P), (I), (F)*
23.	SOP 15.01 Sec 5.14	Are the PPE items required for Demolition operations present and serviceable in accordance with SOP 15.01?				*(P), (I), (F)*
24.	SOP 15.01 Sec 5.1, 5.2	Are Demolition operations only performed by qualified UXO Personnel following the requirements specified in SOP 15.01?				*(P), (I), (F)*
25.	SOP 15.01 Sec 5.15.1	Are engineering control specifications available and employed when it becomes necessary to reduce detonation effects?				*(P), (I), (F)*
26.	SOP 15.01 Sec 5.13	Does the SUXOS or Demolition Supervisor take the appropriate actions as specified in SOP 15.01 prior to initiating a demolition shot?				*(I), (F)*
27.	SOP 15.01 Sec 5.15.2	Are explosive initiation systems chosen in accordance with SOP 15.01 provisions?				*(I), (F)*
28.	SOP 15.01 Sec 7.4	Are only Blow-in-Place (BIP) operations performed for MEC/MPPEH determined to be unsafe to move in accordance with the provisions of SOP 15.01?				*(I), (F)*
29.	SOP 15.01 Sec 7.5	Is the appropriate disposal procedures followed for munitions containing Phosphorus-filled in accordance with the provisions of SOP 15.01?				*(I), (F)*
30.	Phosphorus-filled munitions SOP 15.01 Sec 7.6	Following the performance of disposal operations does an inspection occur for MPPEH and is MPPEH inspected, collected, and certified in accordance with TMP requirements?				*(I), (F)*
31.	SOP 15.01 Sec 9.0 and ATT 8	Are Disposal Operations Checklists and Explosive Disposal Logs prepared and completed in accordance with this SOP 15.00 and SOP 15.01 Attachments 4 and 8?				*(I), (F)*

PUNCH LIST ITEMS	
No.	

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Conducted by: ______________________ Acknowledged by: ________________________

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9.0 SOP 15.02 EXPLOSIVE STORAGE INSPECTION AND SECURITY

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

STANDARD OPERATING PROCEDURE

Explosives Storage Inspections and Security	**SOP No.: 15.02** **SOP Category: MMRP** **Revision No.:** **Date: June 2011**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide HydroGeoLogic, Inc. (HGL) employees with the basic guidelines and procedures for performing explosive storage inspections and security for magazines sited during Military Munitions Response Program (MMRP) projects. This SOP will be employed in conjunction with HGL SOP 15.00 *Explosives Accountability and Management.*

2.0 SCOPE AND APPLICATION

This procedure applies to all HGL employees who have been granted "Responsible Persons" and "Employee Possessor" status by the Bureau of Alcohol Tobacco, Firearms and Explosives (ATF) under the HGL Munitions Response Team (MRT) Type 20-Manufacturer of Explosives License and are tasked with performing explosive storage inspections, operations and security of magazines located on HGL project premises. These procedures apply to the inspection and security of all HGL explosive storage magazines during mobilization and demobilization, active site operations, and during periods when site operations are inactive, but explosives are still stored on the premises.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the approved explosive safety submission (ESS) or the explosive site plan (ESP) and site safety and health plan (SSHP). Procedures for packaging and disposing of waste generated during field activities will be described in the project-specific work plan.

Personnel who use this procedure must provide documented evidence to the Senior Unexploded Ordnance Supervisor (SUXOS) and Unexploded Ordnance Quality Control Specialist (UXOQCS) that they have read and understand this procedure by completing the SOP Acknowledgement Form, Attachment 1. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

STANDARD OPERATING PROCEDURE

Explosives Storage Inspections and Security	SOP No.: 15.02 SOP Category: MMRP Revision No.: Date: June 2011

4.0 DEFINITIONS AND ABBREVIATION

4.1 DEFINITIONS

ATF Responsible Person: Responsible persons are the corporate officer and managers who have the authority to direct the management and policies as they pertain to explosive materials.

ATF Employee Possessor: An individual who is required by law to submit their personal information to the ATF to undergo a background check for a responsible person or a employee possessor position; to restrict the availability of explosives to authorized persons only; and to reduce the risk of prohibited persons acquiring explosive materials [18 U.S.C. 843(h), 27 CFR 555.33, 555.45(c)].

UXO-Qualified Personnel: Personnel who meet the training requirements for UXO Technician and/or have performed successfully in military Explosive Ordnance Disposal (EOD) positions or are qualified to perform in the following Service Contract Act contractor positions: UXO Technician II, UXO Technician III, and UXO Safety Officer (UXOSO), UXOQCS, and SUXOS. Refer to Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18 for detailed information for approved contract titles and qualifications.

4.2 ABBREVIATIONS

ATF	U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives
DDESB	Department of Defense Explosive Safety Board
DoD	Department of Defense
EM	Engineering Manual
ESP	Explosive Site Plan
ESS	Explosives Safety Submission
HE	high-explosive
HGL	HydroGeoLogic, Inc.
PES	potential explosive site
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
TP	Technical Paper
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

STANDARD OPERATING PROCEDURE

Explosives Storage Inspections and Security	**SOP No.: 15.02** **SOP Category: MMRP** **Revision No.:** **Date: June 2011**

5.0 PROCEDURES

Only HGL employees who are cleared by the ATF as either a Responsible Person or Employee Possessor and are listed on the HGL Explosive License–Notice of Clearance will be authorized access to explosive materials and storage magazines.

The SUXOS and the UXOQCS will be responsible for the explosive storage magazine inspections and security. The SUXOS and UXOQCS will perform all inspections with another UXO-qualified individual who should not be the same person on subsequent inspections. When the UXOQCS is not dual-hatted as the UXOSO, the UXOSO may serve as the third UXO-qualified individual.

5.1 INSPECTIONS

5.1.1 Project Start-up and Routine Inspections

Prior to establishing explosive magazine storage and receiving explosive materials following mobilization to a project site, a joint explosive security survey inspection will be conducted by the SUXOS and UXOQCS using the checklist provided as Attachment 2. The result of this survey will be documented using Attachment 2 and in the daily report prepared by the SUXOS.

Weekly inspections will commence immediately upon acquisition of explosive materials following mobilization to the site. The inspection does not have to coincide with the explosive materials inventory. The weekly inspection is necessary to determine if there has been an attempted or unauthorized entry into the magazine(s), or unauthorized removal of the magazine contents. The Explosive Storage Magazine Inspection Checklist, Attachment 3 will be used for conducting and documenting weekly explosive storage inspections. Upon completion of this inspection, the checklist will be signed by the individual conducting the inspection. The SUXOS will also sign the inspection checklist upon completion of their review of this form. This report will be maintained with the project site files. This inspection includes, but is not limited to the following:

- Explosive storage magazine(s) grounding systems
- Placards and signage
- Fire hazards
- Posting of fire/chemical hazards and safety information
- Explosive compatibility
- Net Explosive Weight limits
- Explosive material container labeling and packing
- Housekeeping
- Explosive storage magazine integrity

- Fencing security
- Evidence of forced entry, sabotage, tampering or vandalism
- Vegetation
- Magazine lock and key accountability
- Abnormal odors and temperatures
- Emergency point of contact information displayed

5.1.2 Grounding Inspection

A local qualified electrician will be contracted to perform grounding installation meeting the lightening protection system criteria of the National Electrical Code (NEC), National Fire Protection Association (NFPA) 780 as directed by DoD Manual 6055.09-M DoD Ammunition and Explosives Safety Standards, Volume 2, Enclosure 4. In the unlikely event that a qualified electrician is not available, the explosive storage magazine will be installed by a knowledgeable HGL employee.

5.1.3 Visual Inspection

A visual inspection of the explosive storage magazines, installation, and grounding shall be conducted in accordance with DoD Manual 6055.09-M, DoD Ammunition and Explosives Safety Standards Volume 2, Enclosure 4,.

5.1.4 Explosive Inspection and Inventories

An inventory of the explosive storage magazine containing explosive materials will be conducted every 7 days and documented in accordance with HGL SOP 15.00 *Explosive Accountability and Management*. The inventory will be performed by the SUXOS and the UXOQCS together, with another UXO-qualified individual who should not be the same person on the subsequent inspections as follows:

- Perform explosive material issue and returns from the SUXOS and UXOQCS or other designated UXO-qualified personnel.
- Confirm a current Manufacture of Explosives Record of Acquisition is maintained in the project field office.
- Confirm the Magazine Data Card—Daily Summary of Transactions is being maintained with the explosive material and a duplicate copy is being maintained in the project field office.
- Inventory, issue and receipt transactions are accurately annotated and reflect the most current transactions.
- Commercial donor explosives received and stored in the magazine are accounted for from the date of receipt to the date of destruction or to the date of transfer.

STANDARD OPERATING PROCEDURE

Explosives Storage Inspections and Security	**SOP No.: 15.02** **SOP Category: MMRP** **Revision No.:** **Date: June 2011**

5.2 EXPLOSIVE STORAGE MAGAZINES

An appropriate number of explosive storage magazines required for the proper storage and security of explosive materials and their locations will be sited in accordance with all applicable DoD Explosive Safety Board (DDESB), ATF, federal, state and local laws and regulations. All high explosive materials will:

- Be appropriately stored in accordance with DoD Manual 6055.09-M DoD Ammunition and Explosives Safety Standards Volumes 2 and 3, ATF Publication 5400.7 ATF Federal Explosives Law and Regulations, Subpart K, and U.S. Army Corps of Engineering (USACE) Engineer Manual 385-1-97, Explosive Safety and Health Requirements Manual, Section I.2.N, and properly secured in approved ATF Type 2 outdoor portable explosive storage magazine(s); and
- Comply with the explosive quantity distances per the site-specific DDESB approved ESS or ESP.

5.3 SECURITY LOCKS

High security padlocks will be used to secure explosive materials in accordance with CFR Subpart K, §555.208, The SUXOS and UXOQCS shall maintain positive control of all keys and the explosive storage area entry gate. Accountability for all explosive magazine storage keys will be registered using the HGL Key Control Register and Inventory Log (Attachment 3).

5.4 PLACARDS AND SIGNAGE

Placards and signs will be placed on the doors of the magazines that indicate the Explosive Hazard Class and Division of the explosive materials stored in the magazine (Class 1, Division 1 for high explosives). An *"EMPTY"* placard/sign will be placed on the magazine when the magazine is empty of explosive materials and not in use. Additionally, a sign showing the HGL project personnel emergency point of contact information will be prominently displayed in an accessible location at the explosive storage area.

5.5 NOTIFICATIONS

Upon establishment of explosive storage magazines on HGL project sites the appropriate notifications will be made as required by HGL SOP 15.00 *Explosives Accountability and Management*.

6.0 QUALITY CONTROL

The HGL Senior UXO Operation Manager is responsible for ensuring that this SOP is reviewed annually for completeness and accuracy, and that appropriate safety measures are addressed. The

STANDARD OPERATING PROCEDURE

Explosives Storage Inspections and Security	**SOP No.: 15.02** **SOP Category: MMRP** **Revision No.:** **Date: June 2011**

HGL UXO Safety Manager is responsible for the maintenance, management and annual review of this SOP for procedural, quality control and safety issues. All questions, comments or recommendations regarding this SOP should be directed to the UXO Safety Manager.

Project Managers and supervisors are responsible for ensuring all site personnel read, understand, and follow this SOP. If any discrepancies are found with procedural steps or safety issues pertaining to this, it will be brought to the attention of the responsible supervisor for corrective action.

6.1 TRAINING REQUIREMENTS

All personnel assigned the responsibility for explosive storage magazine and security will receive training on the requirements of this SOP. The training will be conducted by the SUXOS or their designee. This training will be documented using the HGL Training Attendance Log and in the SUXOS daily report.

7.0 SAFETY

If an explosive safety situation is encountered during any phase of work the SUXOS and UXOSO, and the project manager will be immediately notified. The following explosive safety precautions and protocols will be followed:

- Never open a metal container inside or within 50 feet of the explosive storage magazine or explosives.
- Open all containers of explosives with non-sparking tools, except metal slitters, which may be used on fiberboard containers.
- Do not permit matches, lighters or any other spark-producing devices inside or in the proximity of an explosive storage area, explosive storage magazine or potential explosive site (PES).
- No smoking is allowed within 50 feet of the explosive storage area or a PES.
- Ensure cleanliness of magazines. Magazines will be kept clean, dry and free of trash at all times. Magazine floors will be swept regularly. All cleaning gear used to maintain cleanliness will be non-sparking.
- Clean floors stained with leakage from explosive materials according to the explosive manufactures instructions.
- Keep the area within 25 feet in all direction surrounding the explosive storage magazines clear of rubbish, brush, high grass and trees. Live trees greater than 10 feet tall do not need to be moved.
- Do not allow flammable and volatile materials within 50 feet from the explosive storage area.

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- Observe the two-person rule at all times during inventory, inspection, issue, turn-in and transportation of explosives.

8.0 RECORDS

8.1 GROUNDING INSPECTIONS

Explosive storage magazines grounding test certification documentation will be provided by the certifying individual to the HGL Site Manager/SUXOS upon completion of the test. The documentation will include a statement that the explosive storage magazine(s) complies with the requirements of NFPA 780 before storing explosive materials in the magazine(s).

8.2 SECURITY INSPECTIONS

Original copies of all inspection records will be maintained on-site by the SUXOS, and will be available for inspection by authorized HGL employees. Upon completion of project field operations all original inspection and explosive transaction records will be sent to the HGL MRT Office, Albuquerque, New Mexico, Attention UXO Safety Manager for archiving throughout the life of HGL's explosive license.

8.3 DOCUMENTATION

Documentation generated as a result of this procedure will be collected and maintained utilizing the following forms:

- Magazine Data Card—Daily Summary of Magazine Transactions, HGL MR Form 15.03 (HGL SOP 15.00, *Explosives Accountability and Management*, Attachment 4)
- Explosive Storage Magazine Inspection Checklist HGL MR Form 15.09, Attachment 2
- Training Attendance Log HGL MR Form 15.18
- Key Control Register and Inventory Log HGL MR Form 15.26, Attachment 3
- SUXOS Site Daily Production Report, HGL MR Form 15.27

In the event of that a nonconformance is identified during an inspection, a detailed description of the nonconformance will be provided with recommendations for addressing the nonconformance. All inspections will be recorded using the Explosive Storage Area Inspection Checklist, Attachment 3.

9.0 REFERENCES

Department of Defense Manual 6055.9-M, 2010, DoD Ammunition and Explosives Safety Standards, August.

Department of Defense Explosive Safety Board Technical Paper 18, 2004, Minimum Qualifications for Unexploded Ordnance Technicians and Personnel, December.

U.S. Army Corps of Engineers, Engineer Manual 385-1-97, 2008, Explosives Safety and Health Requirements Manual, September.

U.S. Coder of Federal Regulations, 27 CFR Subpart 555-Commerce of Explosives (Bureau of Alcohol, Tobacco, Firearms and Explosives, ATF Publication 5400.7, 2007, ATF Federal Explosives Laws and Regulations, November).

HydroGeoLogic, Inc., HGL MMRP SOP 15.00, Revision 3, 2011, Explosives Accountability and Management Program, November.

10.0 ATTACHMENTS

Attachment 1	SOP Acknowledgement Form
Attachment 2	Explosive Storage and Security Survey Checklist
Attachment 3	Explosive Storage Magazine Inspection Checklist
Attachment 3	Key Control Register and Inventory Log HGL MR Form 15.26

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Attachment 1

STANDARD OPERATING PROCEDURE ACKNOWLEDGEMENT

I have read, understand and agree to abide by the provisions as detailed in this standard operating procedure (SOP) prepared by HGL. By signing below, I certify that I have had the opportunity to read and ask questions about this SOP, and that I understand the procedures, equipment and restrictions, and agree to abide by them. Failure to comply with this SOP may lead to disciplinary action and/or my dismissal from the work site and termination of employment.

Prior to the commencement of any work task associated with this SOP, the SUXSO or UXOQCS assigned to the project will discuss additional procedures to be implemented, or any other site-specific conditions that may arise. All on-site personnel of HydroGeoLogic, Inc. must sign this Acknowledgment Form before performing the task covered by these SOPs.

Print Name	Signature	Date

Explosives Storage Inspections and Security	SOP No.: 15.02 SOP Category: MMRP Revision No.: Date: June 2011

Attachment 2

Explosive Storage and Security Survey Checklist

Project Site: ______________________ **Survey Date** ______________

Contract No: ______________________ **Conducted by:** ______________

1. Publications	YES	NO	NA	COMMENTS
a. ATF Federal Explosives Law & Regulations, 27 CFR Part 555—Commerce of Explosives (ATF P 5400.7, Nov 2007).				
b. HGL SOP 15.00 Explosives Accountability and Management.				
c. HGL SOP 15.02 Explosives Storage, Inspection and Security.				
2. Explosives Storage	**YES**	**NO**	**NA**	**COMMENTS**
a. Proper explosives storage magazines, Type 2 conforming to ATF standard.				
b. Placards. Each magazine properly placarded with DOT Hazard Class/Division symbol.				
c. Explosive compatibility groups separated into the appropriate Hazard Class/Division.				
d. Physical Security survey conducted and documented.				
e. Locks met ATF standards.				
f. Key control system established and functional.				
g. Lightning Protection.				
1) Magazine constructed of minimum 3/16 inch metal.				
2) Magazine grounded.				
3) Magazine located 6.5 feet from nearest fence.				
4) BRAC, DoD, IRP, FUDS and active installation standards met.				
h. Has the local ATF field office been notified of the explosive storage site location?				
i. Fire Protection.				
1) Minimum size/type fire extinguisher located within 30 feet of storage magazine.				
2) Proper fire division symbol at entrance to storage site.				
3) Fire fighting control plan established & posted.				
4) Area surrounding magazine free of rubbish, brush, dry grass, trees for a minimum of 25 foot.				
5) Magazine location site meets IBD/PTR distances.				

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6) Adequate earth cover used to meet inhabited building and public transportation route distances.				
7) Was the local fire safety authorities notified orally before the end of the day and in writing 48 hours from the time explosive storage began?				
3. Explosives Accountability & Management	**YES**	**NO**	**NA**	**COMMENTS**
a. Explosive accountability and management responsibilities and organization established.				
b. Explosive material purchase/receipt signature authority on hand.				
c. Accountability and tracking records established.				
d. MEC final disposition accountability tracking records established.				
e. Procedures for addressing lost, missing, or stolen items in place.				
f. Disaster preparedness plan in place.				
g. Receipt procedures accounting for each item of explosives properly documented on site.				
h. Individuals authorized to receive issue and transport identified and granted explosive access by the ATF FELC.				
4. Explosives Transportation	**YES**	**NO**	**NA**	**COMMENTS**
a. Hazardous waste manifest on hand and maintained.				
b. Explosives Transport Vehicle.				
1) Vehicle inspection checklist on hand.				
2) Proper DOT placards, lettering, and/numbering on hand.				
3) Operators licensed (CDL with Hazardous Material endorsement).				
4) First aid kit on board vehicle.				
5) Minimum of two methods of communications.				
6) Blasting caps box on hand.				
7) Day box on hand.				

Accountable Personnel Position	**Name**	**Signature**
UXOSO/SSO:	______________	______________
UXOQCS:	______________	______________
Site Manager/SUXOS:	______________	______________

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Explosives Storage Inspections and Security	SOP No.: 15.02 SOP Category: MMRP Revision No.: Date: June 2011

Attachment 3

HGL HydroGeoLogic, Inc

Explosive Storage Magazine Inspection Checklist

Site (name, city and state):		
Inspection by:	**Signature:**	**Date:**
Reviewed by Senior UXO Supervisor:	**Signature:**	**Date:**

INSPECTION ITEM	Yes	No	Discrepancies must be explained in this column
1. Are explosive storage magazines grounding systems in place, and properly grounded and bonded?	☐	☐	
2. Are the proper hazard class/division and fire symbols placards posted and in good condition?	☐	☐	
3. Are any fire hazards (flammable/volatile materials) visible within 50 feet of the magazine?	☐	☐	
4. Are no-smoking signs posted?	☐	☐	
5. Are there any unusual odors present?	☐	☐	
6. Are Net Explosive Weigh limits exceeded?	☐	☐	
7. Are detonators segregated from high explosives and stored properly?	☐	☐	
8. Are ventilation ports clear?	☐	☐	
9. Are explosive material containers properly packed, marked and stowed in the magazine?	☐	☐	
10. Are all magazines clean and dry, and good housekeeping being followed and maintained?	☐	☐	
11. Are containers properly stowed away from the magazine walls?	☐	☐	
12. Are magazines and fence gates in good repair, locked and secured?	☐	☐	
13. Are there any indications of vandalism/tampering with the magazines, fence or locks?	☐	☐	
14. Is the area around the magazine cleared of vegetation not less than 25feet in all directions?	☐	☐	
15. Are all magazines locks and key accounted for and recorded on the Key Control Register and Inventory?	☐	☐	
16. Is the emergency point of contact information prominently displayed in an accessible location?	☐	☐	

HGL MR Form 15.09 (Dec 2010)

Explosives Storage Inspections and Security	**SOP No.: 15.02** **SOP Category: MMRP** **Revision No.:** **Date: June 2011**

Attachment 4

HGL HydroGeoLogic, Inc

Key Control Register and Inventory Log

SITE NAME/LOCATION	PERIOD COVERED FROM: TO:

KEY CONTROL NUMBER(S)
(Insert serial number or other identifying number from key)

1.	11.	21.	31.
2.	12.	22.	32..
3.	13.	23.	33.
4.	14.	24.	34.
5.	15.	25.	35.
6.	16.	26.	36.
7.	17.	27.	37.
8.	18.	28.	38.
9.	19.	29.	39.
10.	20.	30.	40.

KEY ISSUE AND TURN IN

KEY NUMBER	ISSUED (Date/Time)	ISSUE BY (Printed Name/Signature)	ISSUED TO (Printed Name/Signature)	TURNED IN (Date/Time)	RECEIVED BY (Printed Name/Signature)

HGL MR Form 15.26 (Sep 06)

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10.0 SOP 15.03 MPPEH MANAGEMENT AND PROCESSING

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

STANDARD OPERATING PROCEDURE

Material Potentially Presenting an Explosive Hazard Inspection, Management and Processing	**SOP No.: 15.03** **SOP Category: MMRP** **Revision No.:** **Date: April 2011**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish the overall practices for inspecting, processing, security, safeguarding and managing material potentially presenting and explosive hazard (MPPEH) during munitions response activities.

2.0 SCOPE AND APPLICATION

This SOP applies to all HGL employees who are involved in the inspection process for certifying MPPEH as either material documented as safe (MDAS) or as material documented as an explosive hazard (MDEH) and before transfer within or release from Department of Defense (DoD) control. All HGL employees who are tasked with performing these procedures will be qualified in accordance with the Department of Defense Safety Board (DDESB) Technical Paper 18 and Department of Defense Instruction (DoDI) 4140.62.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Explosive Safety Submission (ESS)/Explosives Site Plan (ESP) and Site Safety and Health Plan (SSHP). Procedures for packaging and disposing of all waste generated during field activities will be described in the project-specific work plan.

Personnel who use this procedure must document evidence to the site manager/Senior Unexploded Ordnance Supervisor and the Unexploded Ordnance Quality Control Specialist (UXOQCS) that they have read and understand this procedure by completing the SOP acknowledgement form, Attachment 1. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 DEFINITIONS AND ABREVIATIONS

4.1 DEFINITIONS

Exclusion Zone (EZ): A safety zone established around a MEC work area. Only project personnel and authorized, escorted visitors are allowed within the EZ. Examples of EZs are safety zones around MEC intrusive activities and safety zones where MEC is intentionally detonated. For RCWM project sites, it is the area within the No Significant Effects (NOSE) zone.

STANDARD OPERATING PROCEDURE

Material Potentially Presenting an Explosive Hazard Inspection, Management and Processing	**SOP No.: 15.03** **SOP Category: MMRP** **Revision No.:** **Date: April 2011**

Fuzes: (1) A device with explosive components designed to initiate a train of fire or detonation in a munition. (2) A non explosive device designed to initiate an explosion a munition. Devices that initiate the detonation sequence in munitions. Fuzes are typically associated with munitions (for example, mortars and bombs), but they are occasionally found separately. They may contain a charge large enough to cause injury. Magnetic and proximity fuzes are the most sensitive and, depending on other factors (for example, fuze location and arming), greatly influence the likelihood of detonation.

Minimum Separation Distance (MSD) – The minimum safe distance for non-essential personnel to be present during unexploded ordnance (UXO) operations. Generally speaking, the maximum horizontal fragmentation distance is to be used for all UXO items as the MSD for all non-essential personnel for both intentional and unintentional detonations.

Material documented as safe (MDAS): MPPEH that has been assessed and documented as not presenting and explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered MPPEH.

Material documented as an explosive hazard (MDEH): (Formerly referred to as material documented as hazardous, or MDAH). MPPEH that cannot be documented as MDAS, that has been assessed and documented as to the maximum explosive hazards the material is known or suspected to present, and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH. (The MDEH characterization addresses only the explosives safety status of the material.)

Material Potentially Presenting an Explosive Hazard (MPPEH): Material potentially containing explosives or munitions (for example, munitions containers and packaging material; munitions debris (MD) remaining after munitions use, demilitarization, or disposal; and range-related debris) (RD); or material potentially containing a high enough concentration of explosives that the material presents and explosive hazard.

Military Munitions: All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of DoD, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants; explosives; pyrotechnics; chemical and riot control agents; smokes; and incendiaries, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, except that the term does include non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) have been completed [10 U.S.C. 2710(e)(3)(A)].

Military Munitions Response Program (MMRP): The MMRP addresses the potential explosives safety, health, and environmental issues caused by past DoD munitions related activities. MMRP is a relatively new (2002) element of the Secretary of Defense's Defense Environmental Restoration Program. The program addresses the potential explosives safety hazards presented by MEC, which includes UXO, discarded military munitions (DMM), and munitions constituent (MC) concentrations high enough to pose an explosive hazard and potential environmental contamination.

Munitions and Explosives of Concern (MEC): This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) UXO, as defined in 10 U.S.C. 101(e)(5)(A) through (C); (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (C) Munitions constituents (such as TNT and RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions Debris (MD): Remnants of munitions (for example, fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal. Inert munitions-related material recovered during an MEC removal.

Transferred within or released from DoD control. A receiver has acknowledgment of MDEH or MDAS material by signed documentation (DD For, 1348-1A "Issue Release/Receipt Document," or an equivalent document) and has taken physical custody of the MDEH or MDAS from the Department of Defense.

Unexploded Ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. For the purpose of this project, the definition of UXO is limited to items larger than 50-caliber.

UXO-Qualified Personnel: Personnel who meet the training requirements for UXO Technician and Personnel and have performed successfully in military Explosives Ordnance Disposal (EOD) positions or are qualified to perform in the following service contract act contractor positions: UXO Technician I, UXO Technician II, UXO Technician III, and UXO Safety Officer (UXOSO), UXO Quality Control Specialist (UXOQCS), and Senior UXO Supervisor (SUXOS).

4.2 ABBREVIATIONS

DD	Department of Defense form
DDESB	Department of Defense Explosive Safety Board

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DMM	discard military munitions
DoD	Department of Defense
DoDI	Department of Defense Instruction
ESP	Explosive Safety Plan
ESS	Explosive Safety Submission
EZ	exclusion zone
HTRW	hazardous, toxic or radioactive waste
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MDEH	material documented as an explosive hazard
MEC	Munitions and Explosives of Concern
MPPEH	material potentially presenting an explosive hazard
NOSE	No Significant Effects
OESS	Ordnance and Explosives Safety Specialist
PPE	personal protective equipment
RD	range-related debris
SOP	standard operating procedure
SUXOS	Senior Unexploded Ordnance Supervisor
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

5.0 PROCEDURES

5.1 MANAGERS AND SUPERVISORS

Project Managers and field supervisors are responsible for ensuring all site personnel read, understand, and follow this SOP. If any discrepancies are found with procedural steps or safety issues pertaining to this SOP, discrepancies will immediately be brought to the attention of the responsible supervisor for corrective action.

The Senior Unexploded Ordnance Supervisor (SUXOS or senior UXO-qualified individual assigned is responsible for ensuring that all MPPEH activities are conducted in accordance with DoD 6055.09-M, Volume 7, *DoD Ammunition and Explosives Safety Standards: Criteria for Unexploded Ordnance, Munitions Response, Waste Military Munitions, and Material Potentially Presenting an Explosive Hazard,* DoDI 4140.62 Material Potentially Presenting and Explosive Hazard, USACE EM 1110-1-4009, *Military Munitions Response Actions* and EM 385-1-97

Explosives Safety and Health Requirements Manual and all other references shown in Section 8.0 of this SOP.

HGL employees assigned by the field level UXO Technicians will comply with these procedures for processing MPPEH for final disposition. Only UXO-qualified personnel are authorized to perform MPPEH processing.

5.2 UXO TECHNICIAN RESPONSIBILITIES AND PROCEDURES

The objective of the following procedures is to ensure that an inspection of the exterior and interior surfaces of all recovered MPPEH is safely conducted to ensure these items do not present and explosive hazard.

1. Unexploded Ordnance Sweep Personnel (UXOSP) will only mark suspected items and will not be allowed to perform any assessment of a suspect item to determine its status.
2. UXO Technician I can tentatively identify a located item as MPPEH confirmation by a UXO Technician II or III.
3. UXO Technician II will:
   a. Perform a 100 percent inspection of each item as it is recovered and determine the following:
      1. Is the item a UXO, a DMM, munitions debris, or range-related debris?
      2. Does the item contain explosives hazards or other dangerous fillers?
      3. Does the item require detonation?
      4. Does the item require demilitarization or venting to expose dangerous fillers?
      5. Does the item require removal of batteries, mercury seals or switches, the draining of engine fluids, illuminating dials and other visible liquid hazardous, toxic or radiological waste (HTRW) materials?

   b. Segregate material items requiring demilitarization or venting procedures from those items ready for certification.
   c. Items found to contain explosives hazards or other dangerous fillers will be processed in accordance with applicable procedures.
4. UXO Technician III will:
   a. Perform a 100 percent re-inspection of all recovered items to determine if free of explosives hazards or other dangerous fillers and engine fluids, illuminating dials and other visible liquid HTRW materials?

b. Supervise detonation of items found to contain explosive hazards or other dangerous fillers and venting/demil procedures.

c. Supervise the consolidation of MPPEH for containerization and sealing. MD and RD will be segregated.

5. UXO Quality Control Specialist (UXOQCS) will:

a. Conduct daily audits of the procedures used by UXO teams and individuals for processing MPPEH.

b. Perform and document random sampling (by pieces, volume or area) of all MPPEH collected from the various teams to ensure no items with explosive hazards, engine fluids, illuminating dials and other visible liquid HTRW materials are identified as munitions debris or range-related debris as required for completion of Attachment 2, DD Form 1348-1A—Issue Release/Receipt Document.

6. UXO Site Safety Officer (UXOSO) will:

a. Ensure the specific procedures and responsibilities for processing MPPEH for certification as munitions debris or range-related debris specified in the work plan are being followed.

b. Ensure all procedures for processing MPPEH are being performed safely and consistent with applicable regulations.

7. SUXOS will:

NOTE: When a SUXOS is not assigned to a project site where MPPEH is being processed, the UXOSO will be responsible for performing the procedures outlined this section.

a. Be responsible for ensuring work and Quality Control (QC) Plans specify the procedures and responsibilities for processing MPPEH for final disposition as munitions debris or range-related debris.

b. Ensure a Requisition and Turn-in Document DD Form 1348-1A is completed for all munitions debris and range-related debris to be transferred for final disposition.

c. Perform random checks to satisfy that the munitions debris and range-related debris is free from explosive hazards necessary to complete the DD Form 1348-1A.

d. Certify all munitions debris and range-related debris as free of explosive hazards, engine fluids, illuminating dials and other visible liquid HTRW materials.

e. Be responsible for ensuring that inspected debris is secured in a closed, labeled and sealed container and documented as follows:

(1) The container will be closed and clearly labeled on the outside with the following information: The first container will be labeled with a unique identification that will start with either USACE or other applicable DoD component/Installation Name/HGL's Name/0001/Seal's unique identification and continue sequentially.

(2) The container will be closed in such a manner that a seal must be broken in order to open the container. A seal will bear the same unique identification number as the container or the container will be clearly marked with the seal's identification if different from the container.

(3) A documented description of the container will be provided by HGL with the following information for each container; contents, weight of container; location where munitions or range-related debris was obtained; name of contractor, names of certifying and verifying individuals; unique container identification; and seal identification, if required. HGL, in a separate section of the final report, will also provide these documents.

f. Establish a secure location for collection, processing and storage of DMM, MPPEH, MD and RD until transferred off site.

g. Per Attachment 4 ensure:

(1) Exclusion zones are maintained during MPPEH inspection and processing activities.

(2) Adequate warning signs and boundary markers are in place during MPPEH inspection and processing activities.

(3) Storage containers, drums, pallets and tarpaulins are in good repair.

(4) Storage containers and drums are properly labeled and legible.

(5) Un-inspected material is properly segregated from inspected material to prevent comingling.

(6) Storage containers or drums in active use are locked to prevent un-inspected material from being comingled with inspected material until seals are installed.

(7) Demilitarized items are secured.

5.3 MPPEH CERTIFICATION AND VERIFICATION:

MPPEH procedures will be in accordance with DoDI 4140.62 and EM 1110-1-4009. All MPPEH will be assessed and its explosive safety status determined and documented prior to transfer within the DoD or release from DoD control. Prior to release to the public, MPPEH will be documented by authorized and technically qualified personnel as Material Documented as

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Safe after a 100% inspection and an independent 100% re-inspection to determine that it is safe from an explosive perspective. The following certification and verification procedures will be followed for material suspected or determined as MPPEH:

1. The Senior UXO Supervisor will certify that the debris is free of explosives hazards.
2. The USACE Ordnance and Explosive Safety Specialist (OESS) or similarly trained individual will verify that the debris is free of explosive hazards. When an USACE OESS is not assigned a similarly trained UXO-qualified person will perform this step.
3. DD Form 1348-1A—Issue Release/Receipt Document will be used as the certification/verification documentation. The DD Form 1348-1A must clearly show the SUXOS and the USACE OESS or similarly trained UXO-qualified individual:
   a. Typed or printed or typed name
   b. Organization
   c. Signature
   d. HGL Albuquerque office addresses and telephone number.
   e. HGL unique identification number for each container
   f. Container seal number.
   g. Basic material content (Type of metal, such as steel or mixed), block 17.
   h. Estimated weight, block 20.
   i. Origin of where munitions debris or range-related debris was obtained, site name, city and state.
4. The following certification/verification will be entered on each DD Form 1348-1A (refer to example, Attachment 2) for MD or RD transferred within or release from DoD control and will be signed by the SUXOS and the USACE OESS if present or a similarly trained UXO-qualified individual if the OESS is not on site/assigned. <u>This statement will be used on any ranges where range related-debris is be processed along with MD:</u>

   "This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluids, illuminating dials and other visible liquid HTRW materials."
5. The following certification/verification will be entered on each DD Form 1348-1A (refer to example, Attachment 3) for turnover of MD and will be signed by the SUXOS and the USACE OESS if present or a similarly trained individual if the OESS is not on site on properties <u>where only munitions debris is being processed:</u>

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"This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials."

5.4 MAINTAINING CHAIN OF CUSTODY AND FINAL DISPOSITION

HGL in coordination with the appropriate DoD agency will arrange for maintaining the chain of custody and final disposition of the certified and verified materials. The certified and verified material will only be released to an organization that will:

1. Upon receiving the unopened labeled containers each with its unique identified and unbroken seal ensuring a continued chain of custody, and after reviewing and concurring with all the provided supporting documentation, sign for having received and agreeing with the provided documentation that the sealed containers contained no explosive hazards when received. This will be signed on company letterhead and will state that the contents of the sealed containers will not be sold, traded or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content.
2. Send notification and supporting documentation to the sealed container-generating contractor documenting the sealed containers have been smelted and are now only identifiable by their basic content.
3. This document will be incorporated into the final report as documentation for supporting the final disposition of munitions debris and range-related debris. If the chain of custody is broken, the affected MPPEH must undergo a second 100 percent inspection, then 100 percent re-inspection, and be documented to verify its explosives safety status (identified as either munitions debris or range-related debris).
4. MDAS is no longer considered MPPEH as long as the chain of custody remains intact. A legible copy of inspection, re-inspection, and documentation must accompany the material through final disposition and be maintained for a period of 3 years thereafter. This documentation will be maintained as directed in Section 7.0 of this SOP.
5. MDAS being transferred within or released from DoD control will be documented on Inert, Demilitarization and Chain of Custody for Non-Hazardous Ammunition, Explosives and other Dangerous Articles (AEDA) and Range Scrap (Attachment 4).
6. The Project Manager will contact the receiving agent/recycler to obtain MDAS final demilitarization certification documentation.

5.5 MDEH MANAGEMENT

The following procedures must be accomplished before release of MDEH:

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1. Ensure that MDEH is only transferred or released to those entities that:
   a. Have the licenses and permits required to receive, manage, or process the materials.
   b. Have technical experts about the known or suspected explosive hazards associated with the MDEH.
   c. Are qualified to receive, manage, and process MDEH in accordance with DoDI 4140.62.
   d. Have personnel who are:
      (1) Experienced in the management and processing of hazardous materials equivalent to the MDEH.
      (2) Trained and experienced in the identification and safe handling of used and unused military and/or any potential explosive hazards that may be associated with the specific MPPEH.
2. The receiver must be advised of all of the potential hazards associated with the MPPEH and agree to receive and process the material in accordance with (IAW) with DoD Instruction 4140.62.
3. All MPPEH shipments over public transportation routes must comply with DoD guidance that implements hazardous material transportation regulations.
4. Ensure that chain of custody and accountability records are maintained through final disposition of MPPEH. A legible copy of inspection, re-inspection, and documentation must accompany MPPEH through final disposition and be maintained for a period of 3 years thereafter and IAW Section 7.0 of this SOP.

5.6 INSPECTION

An inspection of the MPPEH processing and MD/RD storage area containers will be conducted weekly by the UXOQCS and a periodic spot-check by the SUXOS to ensure the security, integrity and good housekeeping of the storage area is maintained. This inspection will be documented in the project Daily Quality Control Report (DQCR). Attachment 5 will be used to conduct and record this inspection

NOTE **–** It is paramount that these inspections enforce all safeguarding and security control measures required for preventing potential comingling of processed material and ensuring the integrity of this process is properly maintained.

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5.7 PROJECT START-UP AND ROUTINE INSPECTIONS

Prior to the establishment of the MPPEH processing and storage area, a joint inspection will be conducted by the UXOQCS and UXOSO. The inspection, identification of any discrepancies and their disposition will be documented in the project DQCR.

Weekly inspections will commence immediately on acquisition of explosive materials following mobilization to the site. The weekly inspection is necessary to determine if there has been an attempted or unauthorized entry into the container, or unauthorized removal of the contents. MPPEH Processing and Munitions Debris and Range Debris Storage Area Inspection Checklist (Attachment 4) will be used for conducting and documenting weekly storage area inspections. Upon completion of this inspection, the checklist will be signed by the individual conducting the inspection. The SUXOS will also sign the inspection checklist upon completion of their review of this form. This report will be maintained with the project site office files. This inspection includesthe following:

1. Are exclusion zones properly maintained?
2. Are adequate hazard warning signs and boundary markers in place?
3. Are storage containers and drum pallet in fair condition?
4. Are containers properly labeled and labels intact?
5. Are containers seal and locked?
6. Are un-inspected items segregated from inspected items?
7. Are demilitarized items secured?
8. Are any materials missing, evidence of tamping or unauthorized entry?

6.0 QUALITY CONTROL

The HGL Senior UXO Operation Manager is responsible for ensuring this SOP is reviewed annually for completeness, accuracy and safety. The HGL UXO Safety Manager is responsible for the maintenance, management and annual review of this SOP for procedural, quality control and safety issues. All questions, comments or recommendations regarding this SOP should be directed to the UXO Safety Manager.

Project Managers and supervisors are responsible for ensuring all site personnel read, understand, and follow this SOP. If any discrepancies are found with procedural steps or safety issues pertaining to this, it will be brought to the attention of the responsible supervisor for corrective action. When there is the potential to encounter MEC during HTRW-related activities a UXO Team must be assigned to provide anomaly avoidance support.

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All personnel involved in the MPPEH inspection, process and management are responsible for ensuring all safe guards and security control measures are carefully followed to prevent comingling of processed material. Whenever there is any suspicion that comingling has occurred, the SUXOS and the UXOQCS will be notified immediately, and the suspect material will be re-inspected and processed in accordance with this SOP.

6.1 TRAINING

All UXO-qualified personnel will be trained in the recognition and safe handling of used and unused military munitions and specific types of MPPEH in accordance with DoDI 4140.62, Material Potentially Presenting and Explosive Hazard and shall be qualified in accordance with DDESB Technical Paper 18.

7.0 RECORDS

All project personnel are responsible for documenting in detail all reports, logs and certification and inspection forms based on their assigned level of technical responsibility. The following forms will be utilized for documenting the MPPEH inspection, certification, storage and transfer and release of material process.

1. DD Form 1348-1a Issue Release/Receipt Document (Attachments 2 and 3).
2. Inert/Demilitarization/Chain of Custody Certification for Non-Hazardous AEDA and Range Residue Scrap (Attachment 4).
3. MPPEH, MD and RD Processing and Storage Area Inspection Checklists (Attachment 5).

7.1 TRANSFER, RELEASE AND CHAIN OF CUSTODY DOCUMENTS

Prior to the transfer within DoD or release from DoD all accessed and certified materials will be documented as follows:

(1) The UXOQCS will prepare three original copies of:

(a) DD Form 1348-1A Issue Release/Receipt Document (refer to examples, Attachment 2 and 3).

(b) Inert/Demilitarization/Chain of Custody Certification for Non-Hazardous AEDA and Range Residue Scrap.

(c) Ensure signatures are obtained in the appropriate blocks on all documents.

(2) Distribute copies of the DD Form 1348-1A Issue Release/Receipt Document and Inert/Demilitarization/Chain of Custody Certification for Non-Hazardous AEDA and Range and Range Residue Scrap as follows:

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(a) Copy 1—will be issued to the receiver (for example, transporter, demilitarization facility or recycler).

(b) Copy 2—will be issued to by the SUXOS for retention with field files.

(c) Copy 3—will be electronically scanned and submitted with an original copy to the HGL MRT Albuquerque office, attention UXO Safety Manager.

(3) The project manager will:

(a) Follow up with the receiving agent/recycler to obtain final demilitarization certification documents.

(b) Provide copies of the final demilitarization certification documents to the HGL Albuquerque office, attention UXO Safety Manager.

8.0 REFERENCES

HydroGeoLogic, Inc., 2010. Safety and Health Manual, Section—15 Munitions and Explosives of Concern.

U.S. Code of Federal Regulations, Title 27, Part 55, Commerce in Explosives.

U.S. Code of Federal Regulations, Title 29, Part 1910, Occupational Safety and Health Standards.

U.S. Code of Federal Regulations, Title 29, Part 1926, Occupational Safety and Health Standards.

U.S. Code of Federal Regulations, Title 40, Parts 260-299, Protection of the Environment.

U.S. Code of Federal Regulations, Title 49, Parts 100-199, Transportation.

Department of Defense 4145.26-M, 2008. Contractor's Safety Requirements for Ammunition and Explosives, March.

Department of Defense Explosive Safety Board Technical Paper 18, 2004. Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel, December.

Department of Defense Manual 6055.09-M, Volume 7, 2010. DoD Ammunition and Explosives Safety Standards: Criteria for Unexploded Ordnance, Munitions Response, Waste Military Munitions, and Material Potentially Presenting an Explosive Hazard, August.

Department of Defense Manual 4160.21-M-1, 1995. Defense Demilitarization Manual, April.

Department of Defense Instruction 4140.62, 2008. Material Potentially Presenting an Explosive Hazard, November.

U.S. Army Corps of Engineers, 2008. Engineer Manual 385-1-97 Explosives Safety and Health Requirements, September.

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U.S. Army Corps of Engineers, 2007. Engineer Manual 1110-1-4009, Military Munitions Response Actions, June.

9.0 ATTACHMENTS

Attachment 1	Standard Operating Procedure Acknowledgment Form
Attachment 2	DD Form 1348-1A Issue Release/Receipt Document (MD and RD release of transfer)
Attachment 2	DD Form 1348-1A Issue Release/Receipt Document (MD release only)
Attachment 3	Inert/Demilitarization/Chain of Custody Certification for Non-Hazardous AEDA and Range Residue Scrap, HGL MR Form 15.07
Attachment 4	Material Potentially Presenting and Explosive Hazard, Munitions Debris and Range Debris Processing and Storage Area Inspection Checklist, HGL MR Form 15.28

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ATTACHMENT 1
STANDARD OPERATING PROCEDURE ACKNOWLEDGEMENT

SUPERVISOR'S STATEMENT

I have read and understand this SOP. To the best of my knowledge, the activities described in this SOP can be done in a safe, healthful, and environmentally sound manner. I have made sure that all persons assigned to this process are qualified, have read and understand the requirements of this SOP, and have signed the worker's statement for this purpose. I will ensure that the SOP contains current procedures. If a change to the SOP is necessary, I will ensure that the process is stopped until the SOP is revised and approved. Changes will require the submission of a Field Change Request (FCR) or Design Change Notice (DCN) by the HGL project team and receipt of Naval RPM approval prior to implementation. If unexpected safety, health, or environmental hazards are found, I will make sure the process is stopped until the hazards have been eliminated.

Senior UXO Supervisor Date

WORKER'S STATEMENT

I have read this SOP and I have received adequate training to perform the procedures addressed in the SOP. If I identify a hazard not addressed in the SOP, or encounter an operation I cannot perform in accordance with the SOP, I will stop the process and notify my immediate supervisor.

Printed Name	Company	Signature	Date

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ATTACHMENT 2

1 2 3 4 5 6 7 23 24 25 26 27 28 29 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

DOC IDENT | RI FROM | M&S | UNIT ISS | QUANTITY | SER | SUPPLEMENTARY ADDRESS | SIG | FUND | DISTRIBUTION | PROJECT | PRI | REQD DEL DATE | ADV | RI | O/P | COND | MGT | UNIT PRICE: DOLLARS, CTS

1. TOTAL PRICE: DOLLARS, CTS | 2. SHIP FROM | 3. SHIP TO | 4. MARK FOR

5. DOC DATE | 6. NMFC | 7. FRT RATE | 8. TYPE CARGO | 9. PS

10. QTY. REC'D | 11.UP | 12. UNIT WEIGHT | 13. UNIT CUBE | 14. UFC | 15. SL

16. FREIGHT CLASSIFICATION NOMENCLATURE

17. ITEM NOMENCLATURE
Munitions Debris - Steel, Brass and Copper,

18. TY CONT | 19. NO CONT | 20. TOTAL WEIGHT | 21. TOTAL CUBE

22. RECEIVED BY | 23. DATE RECEIVED

24. DOCUMENT NUMBER & SUFFIX (30-44)

NOTICE: This form will used when Munitions Debris (MD) and range debris (RD) are processed together.

"This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluids, illuminating dials and other visible liquid HTRW materials."

25. NATIONAL STOCK NO. & ADD (8-22)

DoD Contractor Title: Senior UXO Supervisor (SUXOS)

Print Name ______________________

Signature: ______________________
Company: HydroGeoLogic, Inc., Munitions Response Team
Address: 8202 Louisiana Blvd NE, Albuquerque, NM 87113
Telephone #:(505) 341-2010

Container No. HGL-00______________________

Seal No: ______________________

26. RIC (4-6) UI (23-24) QTY (25-29) CON CODE (71) DIST (55-56) UP (74-80)

DoD Agency Representative or USACE Ordnance and Explosive Safety Specialist

27. ADDITIONAL DATA

Print Name: ______________________

Origin of the Material: (Site Name/City/State:

____

____

Signature: ______________________

Address: ______________________

Telephone: ______________________

DD FORM 1348-1A, JUL 91 (EG) ISSUE RELEASE/RECEIPT DOCUMENT

PREVIOUS EDITION MAY BE USED

PerFORM (DLA)

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ATTACHMENT 3

DD FORM 1348-1A, JUL 91 (EG) ISSUE RELEASE/RECEIPT DOCUMENT

1 2 3 4 5 6 7 23 24 25 26 27 28 29 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80

DOC IDENT | RI FROM | M&S | UNIT | ISS | QUANTITY | SER | SUPPLEMENTARY ADDRESS | SIG | FUND | DISTRIBUTION | PROJECT | PRI | REQD DEL | DATE | ADV | RI | O/P | COND | MGT

UNIT PRICE: DOLLARS | CTS

1. TOTAL PRICE: DOLLARS | CTS

2. SHIP FROM

3. SHIP TO

4. MARK FOR

5. DOC DATE | 6. NMFC | 7. FRT RATE | 8. TYPE CARGO | 9. PS

10. QTY. REC'D | 11.UP | 12. UNIT WEIGHT | 13. UNIT CUBE | 14. UFC | 15. SL

16. FREIGHT CLASSIFICATION NOMENCLATURE

17. ITEM NOMENCLATURE
Munitions Debris - Steel, Brass and Copper,

18. TY CONT | 19. NO CONT | 20. TOTAL WEIGHT | 21. TOTAL CUBE

22. RECEIVED BY | 23. DATE RECEIVED

24. DOCUMENT NUMBER & SUFFIX (30-44)

25. NATIONAL STOCK NO. & ADD (8-22)

26. RIC (4-6) UI (23-24) QTY (25-29) CON CODE (71) DIST (55-56) UP (74-80)

27. ADDITIONAL DATA

NOTICE: This form will be used for the release of munition debris (MD) ONLY.

"This material does not present an explosive hazard and is consequently safe for release. This certifies and verifies that the material listed has been 100 percent inspected and to the best of my knowledge and belief is inert and/or free of explosives related materials."

DoD Contractor Position Title: Senior UXO Supervisor

Print Name: ______________________________

Signature: ______________________________
Company: HydroGeoLogic, Inc., Munitions Response Team
Address: 8202 Louisiana Blvd NE, Albuquerque, NM 87113

Telephone #: (505) 341-2010

DoD Contractor Position Title: UXO Safety Officer

Print Name: ______________________________

Signature: ______________________________
Company: HydroGeoLogic, Inc., Munitions Response Team
Address: 8202 Louisiana Blvd NE, Albuquerque, NM 87113

Telephone #: (505) 341-2010

Container No. HGL-00________________________

Seal No: ______________________________

Origin of the Material: (Site Name/City/State:

____

____

PREVIOUS EDITION MAY BE USED

PerFORM (DLA)

HGL—Standard Operating Procedure
17

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ATTACHMENT 4

Inert, Demilitarization and Chain of Custody Certification for Non-Hazardous Munitions and Range-related Debris

SECTION 1 — GENERATOR RELEASE

1a. Load number:				
1b. Releasing generator name and mailing address: HydroGeoLogic, Inc. Munitions Response Team 8202 Louisiana Blvd NE, Albuquerque, NM 87107-2105		Telephone number: (505) 341-2010	Site Manager/Senior UXO Supervisor:	
1c. Project site name and location:		Telephone number:	Senior Unexploded Ordnance Supervisor:	
1d. Container Number:	**1e.** Seal Number:	**1f.** Gross weight:	**1g.** Net weight:	**1h.**Tare weight:
1i. Material description:	**1j.** Material type:		**1k.** Units (weight/volume):	

1l. Inert certification:

"I certify and verify that the AEDA residue, range residue and / or explosive contaminated property listed have been 100 percent inspected and to the best of my knowledge and belief is free of AEDA and other dangerous articles."

1m. Project Inspector/Certifier—Unexploded Ordnance Quality Control Specialist (UXOQCS):

Print or type name:	Signature:	Month/Day/Year:

1n. Inspector/Certifier—Project Site Senior Unexploded Ordnance Supervisor (SUXOS):

Print or type name:	Signature:	Month/Day/Year:

1o. Generator Release—I am the Project Site Manager and acknowledge release of this material:

Print or type name:	Signature:	Month/Day/Year:

SECTION 2 — TRANSPORTER

2a. Transporter company name and mailing address:	Telephone Number:	Dispatcher Name:

2b. Transporter Receipt—I acknowledge receipt of this material and have verified that each container is sealed and intact:

Print or type name:	Signature:	Month/Day/Year:

2c. Transporter Release I acknowledge release of this material:

Print or type name:	Signature:	Month/Day/Year:

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Material Potentially Presenting an Explosive Hazard Inspection, Management and Processing	**SOP No.: 15.03** **SOP Category: MMRP** **Revision No.:** **Date: April 2011**

ATTACHEMENT 4 – continued

SECTION 3 — T RANSPORTER

3b. Certified Recycler/Storage Manager –I acknowledge receipt of this material and have verified that each container is seal and intact:

Print or type name:	Signature:	Month/Day/Year:

3c. Certified Demilitarization / Destruction Processor–I acknowledge receipt of this material (when applicable):

Print or type name:	Signature:	Month/Day/Year:

3d. Demilitarization / Destruction Certification:

"I certify that each item or items listed hereon were demilitarized and/or destroyed, so as to no longer resemble AEDA or ordnance beyond the requirement listed in DoD 4160.21-M-1."

3e. Certified Recycler Manager-I acknowledge this material has undergone demilitarization/destruction in accordance with DoD 4160.21-M-1.

Print or type name:	Signature	Month/Day/Year:

4a. Special Instructions.

1. Three copies of this form will be completed and signed with original signature by the generator.
2. The transporter will receive one original copy and complete Section 2, blocks 2a.-2c., affix signature on 3-copies of this document and deliver 1-original copy with the material shipment to the recycler.
3. The recycler upon receipt and completion of Section 3. 3a.-3e. will return the original copy with affixed signatures to the generator address shown in Section 1, block 1b.
4. Attach DD FORM 1348-Issue Release/Transfer Document must remain attached with this document at all times.

4b. Discrepancies.

SECTION 1 — GENERATOR RELEASE (continued)

	Container Numbers:	Seal Numbers:	Net weigh (lb):		Container Numbers:	Seal Numbers:	Net weigh (lb):
1.				16.			
2.				17.			
3.				18.			
4.				19.			
4.				20.			
6.				21.			
7.				22.			
8.				23.			
9.				24.			
10.				25.			
11.				26.			
12.				27.			
13.				28.			
14.				29.			
15.				30.			

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ATTACHMENT 5

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Material Potentially Presenting an Explosive Hazard, Munitions and Range Debris Processing and Storage Area Inspection Checklist

Site (name, city and state):		
Inspection conducted by:	**Signature:**	**Date:**
Reviewed by Senior UXO Supervisor:	**Signature:**	**Date:**

I. INSPECTION ITEM

A. MPPEH and MD Storage Areas	YES	NO	Explain Discrepancies
1. Are exclusion zones maintained during processing?	☐	☐	
2. Are adequate warning signs and boundary markers in place?	☐	☐	
3. Are containers/drums in fair condition?	☐	☐	
4. Are drum pallets in fair condition?	☐	☐	
5. Are containers properly labeled and labels intact?	☐	☐	
6. Are un-inspected items segregated from inspected items to prevent comingling?	☐	☐	
7. Are containers sealed or locked?	☐	☐	
8. Are MDEH items properly segregated and secure?	☐	☐	
9. Are demilitarization items secure?	☐	☐	
10. Is the plastic tarpaulin intact?	☐	☐	
B. RD Storage Area	**YES**	**NO**	**Explain Discrepancies**
1. Are there any pieces or parts of targets missing?	☐	☐	
2. Is there evidence of any disturbance to the pile?	☐	☐	

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11.0 SOP 15.12 MUNITIONS AND EXPLOSIVES OF CONCERN ANOMALY AVOIDANCE SUPPORTPROGRAM

STANDARD OPERATING PROCEDURE

Munitions and Explosives of Concern Anomaly Avoidance Support	**SOP No.: 15.12** **SOP Category: MMRP** **Revision No.: 01** **Date: December 2011**

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the procedures for performing munitions and explosives of concern (MEC) anomaly avoidance support during field operations on environmental projects where there is a potential for encountering MEC hazards.

2.0 SCOPE AND APPLICATIONS

This MEC SOP discusses surface and subsurface anomaly avoidance procedures and techniques to be used while conducting hazardous, toxic, radioactive waste (HTRW)-related activities during investigative, design, and remedial actions. These procedures were developed using the Department of Defense (DoD) Manual 6055.09-M DoD *Ammunition and Explosive Safety Standard*, DoD Explosive Safety Board (DDESB) Technical Paper 18 *Minimum Qualifications for UXO Technicians and Personnel,* United States Army Corps of Engineers (USACE) EM 385-1-97 *Explosives Safety and Health Manual*, USACE EP 75-1-2 *Munitions and Explosives of Concern (MEC) Support During HTRW and Construction Activities*, USACE ER 385-1-92 *Safety and Occupational Health Requirements for HTRW Activities* and USACE ER 385-1-95 *Safety and Health Requirements for MEC Operations*. These procedures will be performed and adhered to by all HGL and subcontractor personnel during HTRW field activities. HGL and its subcontractors will work closely together to ensure a safe working environment and to ensure the equipment, supplies, and other resources needed to provide MEC anomaly avoidance support are present on-site.

No intrusive work will be allowed during investigative phases where physical contact is NOT planned or intended [e.g., Preliminary Assessments/Site Inspections (PA/SI)] or when a determination is made that the probability of encountering MEC is moderate to high (current or previous land use leads to a determination that MEC was employed or disposed of in the parcel of concern [e.g., open burn and open detonation areas, impact areas, maneuver areas, etc.]). Intrusive anomaly investigation and/or MEC removal is not authorized unless stated in the current Performance Work Statement (PWS) or Scope of Work (SOW). If a MEC removal action is authorized at a later date, the policies and procedures for a MEC removal action will be contained in a separate MEC Removal Action Work Plan (WP) and when in support of HTRW remedial action phase (construction) the HGL SOP 15.3 MEC Construction Support Standard Operating Procedure will be implemented.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Site Health and Safety Plan.

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Personnel who use this procedure must provide documented evidence to the Senior Unexploded Ordnance Supervisor (SUXOS) and Unexploded Ordnance Quality Control Specialist (UXOQCS) that they have read and understand this procedure by completing the SOP acknowledgement (Attachment 1). This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 DEFINITIONS AND ABBREVIATONS

4.1 DEFINITIONS

Anomaly Avoidance: Techniques employed on property known or suspected to contain MEC, other munitions that may have experienced abnormal environments (e.g., Discarded Military Munitions (DMM)), Munitions Constituents (MC) in high enough concentrations to pose an explosive hazard, or chemical agent (CA), regardless of configuration, to avoid contact with potential surface or subsurface explosives or CA hazards, to allow entry into the area for the performance of the required operations. Anomaly avoidance techniques are implemented to avoid any potential surface MEC or MPPEH and any subsurface anomalies. Anomaly avoidance techniques are primarily implemented during Hazardous, Toxic, and Radioactive Waste (HTRW) project activities, for example, in support of soil sampling or well installation activities where the specific site of the activity can be moved to another location.

Hazardous, Toxic, and Radioactive Waste Activities (HTRW): HTRW activities include those activities undertaken for the Environmental Protection Agency's (EPA) Superfund Program, the Defense Environmental Restoration Program (DERP), including Formerly Used Defense Sites (FUDS) and Installation Restoration Program (IRP) sites act active DoD facilities, HTRW actions associated with Civil Works projects, and any other mission or non-mission work done for others at HTRW sites. For the purposes of MEC support, HTRW actions during investigative/design phase of a HTRW project on a site with known UXO or unknown fillers requires anomaly avoidance procedures. HTRW activities during the remedial action phase (construction) of a HTRW project on a site with known or UXO with unknown fillers may require either standby support or subsurface removal.

Material Potentially Presenting an Explosives Hazard (MPPEH): Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or final disposition; and range-related debris); or material potentially containing a high enough concentration of explosives that the material presents and explosive hazard.

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Military Munitions: All ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, except that the term does include non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) have been completed [10 U.S.C. 2710(e)(3)(A)].

Munitions and Explosives of Concern (MEC): This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) UXO, as defined in 10 U.S.C. 101(e)(5)(A) through (C); (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2); or (C) Munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

Munitions Constituents (MC): Any materials originating from unexploded ordnance, discarded military munitions, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions. (10 U.S.C. 2710).

Munitions Debris: Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or final disposition. Inert munitions-related material recovered during an MEC removal.

Recovered Chemical Warfare Materiel (RCWM): Non-stockpile CWM that was previously discarded, buried, or fired and discovered either unexpectedly or during planned environmental restoration operations.

Unexploded Ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material; and remain unexploded either by malfunction, design, or any other cause. For the purpose of this project, the definition of UXO is limited to items larger than 50-caliber.

UXO-Qualified Personnel: Personnel who meet the training requirements for UXO Technician and Personnel and have performed successfully in military EOD positions or are qualified to perform in

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the following service contract act contractor positions: UXO Technician II, UXO Technician III, and UXO Safety Officer (UXOSO), UXO Quality Control Specialist (UXOQCS), and Senior UXO Supervisor (SUXOS). Refer to DDESB TP 18 for detailed information for approved contract titles and qualifications.

4.2 ABBREVIATIONS

EPA	Environmental Protection Agency
DDESB	Department of Defense Explosive Safety Board
DoD	Department of Defense
DPT	direct push technology
FSP	Field Sampling Plan
FUDS	Formerly Used Defense Site
GPS	global positioning system
HTRW	hazardous, toxic and radiological waste
IDW	investigated derived waste
IRP	Installation Restoration Program
MC	munitions constituents
MEC	Munitions and Explosives of Concern
PPE	personal protective equipment
SSHP	Site Safety and Health Plan
SOP	standard operating procedure
SSO	site safety officer
SUXSO	Senior Unexploded Ordnance Supervisor
USACE	United State Army Corps of Engineers
UXO	Unexploded Ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
WP	work plan

5.0 PROCEDURES

5.1 UXO TEAM

The senior UXO-qualified person will serve as the UXO Team Leader and has ultimate responsibility for ensuring all MEC anomaly avoidance support activities are performed in accordance with this SOP, the WP and/or the SSHP. The UXO Team Leader will direct all MEC anomaly avoidance support during field operations.

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STEP ONE–The UXO Team will:

A. Review any archival information available on the area where MEC anomaly avoidance is required in an effort to determine the probable of types of MEC that may be encountered and identify specific hazards and precautions.

B. Provide MEC recognition, location, and safety function for the prime contractor during construction support and HTRW activities.

C. Conduct MEC safety briefing for all site personnel and visitors.

D. Conduct a surface access survey to locate all surface and near-surface anomalies.

E. The UXO Technician on the point position will conduct the initial surface sweep.

F. Establish and delineate surface MEC or subsurface anomaly-free ingress/egress lanes and work areas.

G. Reporting of all MEC encountered to the appropriate authority, and coordinate final disposition as directed by the Project Manager.

H. Work closely with the USACE personnel on all MEC-related matters.

I. Document all MEC discoveries following these procedures.

J. Coordinating and reporting MEC discoveries to the appropriate authority.

STEP TWO–Non UXO-qualified personnel responsibilities include:

A. Being trained to recognizing the potential hazards impose by MEC, which are fire, fragmentation and blast overpressure.

B. Remain with the UXO Technician all times unless otherwise cleared to proceed on your own.

C. In the event of an accident, follow the instructions given by the UXO Technician.

D. If you see something suspicious please notify the UXO Technician immediately.

E. Always be careful where you walk and do as the UXO Technician directs.

F. The buddy-system will be observed at all times on the work site.

G. If you see something suspicious notify the UXO Technician immediately.

5.2 ANOMALY AVOIDANCE

A. Anomaly avoidance procedures will be utilized during HTRW-related field investigation activities whenever there is a potential for encountering MEC. These activities include, but are not limited to:

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1. site access and MEC clearance survey;
2. clearing and grubbing;
3. land surveying and mapping;
4. geophysical surveying; and
5. environmental and natural resource assessments:
   (a) surface soil sampling,
   (b) subsurface soil sampling,
   (c) boring and drilling,
   (d) ground water monitoring, and
   (e) test pits and trenches excavations; and

B. Preliminary Assessments (PA) and Site Inspection (SI) on Formerly Used Defense (FUDS) and Base Realignment and Closure Sites (BRAC).

C. The purpose of MEC anomaly avoidance is to avoid any potential surface and subsurface MEC hazards during these activities. For anomaly avoidance on an HTRW site with potential MEC, HGL will provide an UXO Team consisting of a minimum of two personnel, one of whom must be a UXO Technician II or above.

5.2.1 Site Access and MEC Clearance Surveying

In HTRW areas with known or suspected MEC the UXO Team will:

STEP ONE:

A. Use geophysical instrumentation capable of detecting the smallest known or anticipated MEC will be used to locate anomalies just below the surface that may be encountered through erosion from rain or continual foot or vehicular traffic.

B. The subsurface surveys (to a depth of 4 feet below ground surface [bgs]) need only be conducted when the use of motor vehicles is anticipated.

C. Conduct a geophysical instrument-assisted surface clearance access survey and/or a subsurface survey for anomalies before any activities (e.g., site visits, field investigations or PA/SI) commence, including footpath and/or vehicular traffic routes.

D. The access route both approaching and leaving shall be at least twice as wide as the widest vehicle that will use the route. The route shall be clearly marked with flagging or stakes for future entry control.

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E. If only foot traffic is required, then a surface clearance and access survey (to a depth of 2 feet bgs) will suffice.

F. Non-UXO qualified HTRW field personnel must be escorted by UXO-qualified personnel at all times in areas where there is any potential for encountering MEC hazards until the UXO Team has completed the access surveys and the cleared areas are visibly marked.

G. Non UXO-qualified will follow behind the UXO Technician.

H. If MEC hazards are detected, the UXO Technician will halt the escorted personnel in place, select a course around the hazard, and instruct escorted personnel to follow behind.

I. No personnel will be allowed outside of the surveyed and cleared areas.

STEP ONE:

A. Complete an access survey of an area around the proposed investigation site that is large enough to support all planned operations.

B. The size of the surveyed area will be project-specific and will take into account, for example, maneuverability of required equipment (e.g., drill rigs, excavation equipment, etc.), parking of support vehicles, and establishment of decontamination stations.

C. At a minimum, the surveyed area should have a dimension in all directions equal to twice the length of the longest vehicle or piece of equipment to be brought on-site and clearly delineated with flagging or stakes.

STEP THREE:

A. In the event that anomalies or surface MEC hazards are encountered, they will be marked with flagging and the investigation area will be relocated to avoid contact with the hazards.

B. The UXO team will clearly mark the boundaries of the surveyed area using survey flagging and non-metallic pin flags.

C. The team will establish a system of flagging colors that will distinguish anomalies, surface MEC, and route boundaries from each other as well as from any utility markings used at the site.

D. Attempt to identify the hazard and will inform the appropriate project management personnel. Under no circumstances will the team disturb the hazard in anyway.

E. The UXO Team Leader is responsible as directed by the Project Manager for all coordination with the proper authorities for the final disposition of all MEC hazards.

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5.2.2 Clearing and Grubbing

Initial clearing and grubbing operations may be required for specific projects prior to HTRW field activities. The objective of clearing and grubbing is to allow for unhindered access by the HTRW field teams. In areas with potential MEC hazards, the UXO Team must:

STEP ONE:

A. Conduct an access survey of the routes to and from the proposed clearing and grubbing area. The UXO Team will conduct a geophysical instrument-assisted clearance survey for the entire area to be grubbed to a depth of 4 feet. Once this has been accomplished, the clearing and grubbing operation may commence.

B. A accompany grubbing teams at all times. At least one UXO Technician will accompany every grubbing team of six personnel. For every piece of mechanical grubbing equipment used, one UXO Technician will supervise the use of that equipment at all times.

C. If mechanical grubbing equipment is used, the lowest part of the cutting deck will remain at least 6 inches above ground level to ensure that any possible surface MEC hazard that may have been missed during the surface sweep is not contacted by the cutting blades of the equipment.

STEP TWO:

A. If a potential MEC hazard is encountered, all clearing and grubbing operations will cease. The clearing and grubbing team will immediately notify the accompanying UXO Technician. No further action shall be taken until the UXO Technician has made all notifications and the appropriate safety concerns are addressed, in accordance with the SSHP.

B. Under no circumstances will the team disturb the hazard in anyway. The UXO Team Leader is responsible as directed by the Project Manager for all coordination with the proper authorities for the final disposition of all MEC hazards. After final disposition of the MEC hazard has been completed, clearing and grubbing operations may continue.

C. If the item is not MEC, clearing and grubbing activities may resume with the concurrence of the UXOSO when assigned.

5.2.3 Land Surveying and Mapping

During land surveying activities in areas with potential MEC, the survey team will have a minimum of one UXO Technician II or above assigned to perform MEC anomaly avoidance. The UXO Technician will:

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A. Conduct an access clearance survey of the routes to and from the proposed survey site as well as an area around the site, as described in Section 5.11.2.

B. Visually survey the surface of each proposed survey point for any indication of MEC or MEC-related contamination.

C. Use a Schonstedt GA-52Cx magnetometer (or equivalent) to assess the presence or absence of buried metallic anomalies at the locations where survey points/stakes will be installed. If magnetometer responses indicate a buried metallic anomaly, no survey point/stake will be installed at that specific location. An alternate location will be selected.

D. For location surveying in areas with suspected non-conventional MEC (e.g., micro-gravel mines), GPS will be used for location surveying. Additionally, no intrusive survey markers will be used, only traffic cones and paint will be used to mark locations.

5.2.4 Geophysical Surveying

Geophysical survey methods will consist of several progressive procedures to ensure the safe collection of quality data that can be used to relocate and investigate any anomalies detected. Once an area has been identified and selected for geophysical surveying, UXO sweep personnel will:

STEP ONE:

A. Conduct a geophysical instrument-assisted surface clearance of the area to aid in the location of surface metal that may be obscured by vegetation.

B. The surface clearance will be managed using a search system based on transects. To accomplish this surface clearance, UXO sweep personnel will line up side by side, forming a sweep line, and walk each geophysical survey area in an orderly manner.

C. The geophysical survey area may be divided into grids. An automated line-marking system or physical lines will be used to ensure complete coverage within each geophysical survey area or grid.

D. The geophysical instrument-aided surface clearance will determine the presence or absence of surface MEC and provide increased safety to site personnel.

E. During the surface clearance, surface debris will be removed to support subsequent geophysical mapping. Non-MEC metallic debris, which may interfere with the subsurface geophysical survey, will be removed from the surface of the work area, to the maximum extent possible, and consolidated for later disposition.

STEP TWO:

A. If a potential MEC item is encountered by the geophysical mapping team, all geophysical survey operations will cease.

B. The geophysical survey team will immediately notify the UXO Team Leader.

C. Under no circumstances will the team disturb the item in any way.

D. No further action shall be taken until the UXO Team Leader has made all notifications and the appropriate safety concerns are addressed, in accordance with the SSHP.

E. The UXO Team Leader is responsible as directed by the Project Manager for all coordination with the proper authorities for the final disposition of all MEC hazards.

STEP THREE:

If the item is not MEC, geophysical survey activities may resume with the concurrence of the UXOSO when assigned.

5.2.5 Sampling and Drilling

5.2.5.1 Surface Soil Sampling

The following paragraphs describe anomaly avoidance procedures for surface soil sampling (between 0 and 12 inches bgs) in areas with potential MEC. Soil sampling at depths greater than 12 inches bgs will follow the procedures in Section 5.3.5.2 of this plan. The UXO Team will:

STEP ONE:

A. Conduct a surface clearance and access survey of the routes to and from the proposed investigation site as well as an area around the investigation site, as described in Section 5.11.2.

B. Visually survey the surface of each proposed surface soil sampling site for any indication of MEC or MEC-related contamination.

C. Conduct a survey of the proposed sample locations using hand-held geophysical instruments capable of detecting the smallest known or anticipated MEC to a depth of 2 feet.

STEP TWO:

A. If anomalies are detected at a proposed sampling location or too many anomalies are detected in a general area of interest, the HTRW personnel will select an alternate location for collection of surface soil samples.

B. Any anomalies detected will be prominently marked with survey flagging or non-metallic pin flags for avoidance during HTRW sampling activities.

5.2.5.2 Subsurface Soil Sampling and Monitoring Well Installation

The following paragraphs describe anomaly avoidance procedures for subsurface soil sampling and monitoring well installations in an area with potential MEC. Subsurface soil sampling is defined as the collection of samples below a nominal depth of approximately 12 inches with a split-spoon, Shelby tube, direct push sampler, or bucket auger (i.e., hand auger) soil sampler using drilling techniques. Drilling techniques will also be used to drill larger diameter soil borings (e.g., 4- to 8-inch outer diameter) and install groundwater monitoring wells for HTRW investigations. The UXO Team will:

STEP ONE:

A. Conduct a surface clearance and access survey of the routes to and from the proposed investigation site as well as an area around the investigation site, as described in Section 5.11.2.

B. Complete a hand-held, geophysical instrument-assisted, subsurface survey of the proposed drill-hole location(s) to a depth of 4 feet.

STEP TWO:

A. If an anomaly is detected, sampling personnel will select a new borehole location.
B. Any anomalies detected will be prominently marked with survey flagging or non-metallic pin flags for avoidance.

C. If the subsurface sampling depth is greater than the geophysical instrumentation (e.g. hand-held geophysical instrument) detection capabilities, the UXO Team must incrementally complete the down-hole geophysical survey to undisturbed soil depth as outlined below.

5.2.5.3 Underground Utilities

Utility clearance and/or excavation permits, if required, must be obtained prior to the commencement of any incremental subsurface geophysical survey activities by the UXO Team. The UXO Team Leader is responsible for:

A. Verifying that all necessary excavation permits are on-site prior to commencing operations.

B. Ensuring that the appropriate agencies or companies have marked the location of all subsurface utilities in the investigation areas prior to commencing intrusive work.

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C. High-visibility paint, nonmetallic pin flags, or other appropriate means will be used to visually delineate their approximate subsurface routing. The color shall not conflict with the colors used in MEC avoidance activities.

STEP TWO:

A. In the event subsurface utilities are suspected in an excavation area, the field sampling team must attempt to verify their location.

B. The field sampling team should be aware that not all utility lines will be detectable with geophysical instrument equipment; not all utility lines are constructed of ferrous material.

C. Utility clearance procedures and contact numbers should be listed in the Field Sampling Plan (FSP).

5.2.5.4 Pilot-Hole and Incremental Geophysical Survey for Conventional MEC Clearance

For intrusive sampling (i.e., subsurface sampling and well drilling) in areas with incremental suspected conventional (metallic) MEC, pilot holes and geophysical surveying will be completed. Once an access survey has been completed, the team will install a pilot hole to undisturbed soil depth at each proposed drill-hole location. During installation of the pilot hole, non-essential personnel will:

STEP ONE:

A. Withdraw to a distance of not less than the exclusion zone (EZ) or fragmentation distance of the munition with the greatest fragmentation distance (MGFD) established for the site.

B. The pilot-hole may be installed using manual or mechanical means. During installation of the pilot hole, a geophysical instrument configured for down-hole utilization will be used to inspect for anomalies every 2 feet or unless otherwise specified by the WP or SSHP.

STEP TWO:

A. If an anomaly is detected, the pilot-hole will be backfilled in accordance with project-specific procedures, and HTRW sampling personnel will select a new drill-hole location.

B. Any anomalies detected will be prominently marked on the surface with survey flagging or non-metallic pin flags for avoidance.

STEP THREE:

A. When no anomalies are detected, the pilot hole will be advanced to the maximum reach of the auger or to the maximum depth of the proposed drill hole, whichever is less.

B. The pilot hole will also be inspected upon reaching the final depth, providing a total clearance depth equal to the pilot-hole depth plus 2 feet.

C. If no anomalies are detected to the total depth of the proposed drill hole, the drill rig may be brought on-site and utilized.

STEP FOUR:

A. In cases where the pilot hole does not reach the full depth of the proposed boring (e.g., the proposed depth of the drill hole is more than the maximum depth of the auger or the team cannot penetrate the soils using the auger), the drill rig may be brought on-site and advanced in 2-foot increments beyond the clearance depth of the pilot hole.

B. At the end of each 2-foot increment, the drill rig augers must be withdrawn from the hole so that the UXO Team may screen for anomalies as described previously. As necessary with loose soils, a polyvinyl chloride (PVC) pipe (minimum 3 inches inner diameter) may be inserted to keep the hole open and to allow for incremental geophysical instrument screening.

C. Incremental screening may be discontinued once the drilling has extended to depths greater than the maximum estimated depth of MEC presence (as described in the WP), based upon the maximum depth of fill materials and maximum depth of MEC penetration.

D. All pilot holes will be backfilled in accordance with project-specific procedures.

5.2.5.5 Test Pits for Non-Conventional MEC Clearance

For intrusive sampling (subsurface and well drilling) in areas with suspected non-conventional MEC (e.g., non-metallic micro-gravel mines), MEC avoidance and location clearance activities will also include test pits. The test pits will:

STEP ONE:

Be dug by an armored remote-controlled excavator to undisturbed soil depths as MEC clearance for each intrusive sampling location.

STEP TWO:

A. The procedure for test pit non-conventional MEC clearance will be as follows:

1. A geophysical instrument-assisted subsurface survey of the proposed boring location will be completed to a depth of 4 feet to clear for metallic anomalies. If an anomaly is detected, a new location will be selected.
2. All non-essential personnel will withdraw to a distance not less than the MGFD established for the site.
3. An armored, remote-controlled excavator will be used to excavate a small area around the proposed soil boring down to 2 feet. UXO Technicians will inspect the excavation and excavated soil for non-conventional MEC. This process will continue at 2-foot intervals until undisturbed soil is reached.
4. Once undisturbed soil is reached, the test pit excavation will be stopped. HTRW sampling personnel and equipment may be mobilized to the site, and intrusive soil sampling may begin.

5.2.5.6 <u>Soil Sampling with Direct Push Technology</u>

A. The following paragraphs describe anomaly avoidance procedures for soil sampling and use of direct push technology (DPT) in areas with potential MEC. Soil sampling with DPT typically involves manual or mechanical penetration at the desired location, followed by withdrawal and collection of a soil sample. The UXO Team will:

1. Conduct a surface clearance and access clearance survey of the routes to and from the proposed investigation site as well as an area around the investigation site, as described in Section 5.11.2.
2. Soil sampling and DPT installations will follow the same anomaly-avoidance procedures as described previously for subsurface soil sampling and monitoring well installations (i.e., incremental down-hole geophysical survey for metallic anomalies and remote-dig test pits for non-conventional MEC). However, the actual sampling and geophysical instrument screening will occur through the DPT borehole. Following collection of the soil samples, the sampling location will be backfilled in accordance with project-specific procedures.

5.2.6 Test Pit and Trench Excavating

Test pits and trench excavations may be used to identify and characterize large subsurface HTRW areas of concern. The following paragraphs describe MEC anomaly avoidance procedures for test pit and trench excavations on a HTRW site with potential MEC. The UXO Team will:

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STEP ONE:

A. Conduct a surface clearance and access survey of the routes to and from the proposed investigation site as well as an area around the investigation site, as described in Section 5.11.2.

B. Complete a subsurface geophysical survey of the proposed excavation locations.

STEP TWO:

A. If an anomaly is detected, HTRW sampling personnel will select a new excavation location nearby.

B. Anomalies detected will be prominently marked with survey flagging or non-metallic pin flags for avoidance.

C. Proposed excavation depths greater than the geophysical instrumentation detection capabilities will undergo an incremental geophysical survey as outlined by STEPS THREE, FOUS and FIVE below.

5.2.6.1 Test Pits and Trenches MEC Avoidance

STEP THREE:

A. Once an access survey has been completed, HTRW personnel may begin excavation in 2-foot increments. During excavation, personnel not directly involved in the excavation activities should withdraw to a distance of not less than the fragmentation distance of the MGFD established for the site.

B. At the end of each 2-foot increment, the UXO team will screen for anomalies. If an anomaly is detected, HTRW sampling personnel will modify the excavation locations to avoid the anomaly.

C. Any anomalies detected will be prominently marked on the surface with survey flagging or non-metallic pin flags for avoidance.

STEP FOUR:

A. If a potential MEC hazard is uncovered in an excavation, all operations will cease. The UXO Team will attempt to identify the hazard.

B. The UXO team will address the appropriate safety concerns in accordance the SSHP and Section 5.

C. Under no circumstances will the team disturb the hazard in anyway.

D. After final disposition of the MEC hazard has been completed, the excavation may continue.

STEP FIVE:

A. For test pits and trenches in areas with suspected non-conventional MEC (e.g., non-metallic micro-gravel mines), excavations will be completed using an armored, remote-controlled excavator.

B. The procedures for test pits and trenches in areas with suspected non-conventional MEC will be the same as previously described, except that the excavations will be completed using an armored, remote-controlled excavator, and

C. The UXO team will visually inspect 100 percent of the material excavated, as well as the excavation, for non-conventional MEC.

5.2.6.2 Waste and/or Other Materials Encountered

In the event potentially hazardous waste, debris, or drums are encountered during test pit or trenching operations, excavation activities will cease. The HTRW SSO will:

A. Assess the situation and may direct a change to the personal protective equipment (PPE) for site workers.

B. Notify the appropriate personnel in accordance with the WP or SSHP.

C. Wastes will be handled in accordance with the Derived Waste (IDW) Management, Transportation, and Disposal Plan (IDW Plan).

5.2.7 Groundwater Monitoring

Groundwater monitoring activities include measurement of groundwater elevations, measurement of free product thickness, and collection of analytical samples. Unless a path is clearly marked, the HTRW sampling personnel must be escorted by UXO-qualified personnel, as described in Section 5.11.2, to conduct groundwater monitoring/aquifer characterization activities in areas with potential MEC.

5.2.8 Preliminary Assessment (PA) and Site Inspection (SI)

Whenever HGL employees conduct PA/SI work on in areas where MEC may be encountered UXO-qualified personnel will provide anomaly avoidance measures to prevent non UXO-qualified personnel from coming into contact with an MEC hazard. Specific notification and reporting procedure for MEC hazards encountered on FUDS or BRAC sites are discussed in Section 5.12 of this SOP.

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5.3 MUNITIONS AND EXPLOSIVES OF CONCERN

5.3.1 ENCOUNTER

If MEC/UXO is encountered, the UXO Technician on point will direct the team to stop, point out the hazard and mark the hazard with a high-visibility pin flag, paint, or surveyors tape. The UXO Technician discovering the MEC hazard will inform the UXO Team Leader who then will notify the Site Supervisor of the hazard and its location. The UXO Team Leader shall:

A. Visually examined the MEC hazard for markings and other external features such as shape, size and external fittings.
B. Record the MEC hazard item(s) GPS coordinates in the UXO team logbook.
C. Record the MEC hazard as outlined by Section 7.0.
D. Take a digital photograph of the hazard and record the photo number using the MEC Investigation Field Log Form (HGL MEC Form 15.01) and UXO Team Leader logbook.
E. After notifying the Site Supervisor and all other authorities of the MEC hazard(s), and collecting the necessary data, the team may proceed with their activities.

5.3.2 DISPOSITION

The disposition of MEC hazards will be implemented as specified by the applicable site WP, SSHP or when applicable the Memorandum of Agreement (MOA). The senior UXO-qualified person has the responsibility for coordinating with the proper authorities for the final disposition of all MEC hazard(s) discoveries. Specific procedures for reporting MEC discoveries during a PA/SI are covered by USACE Military Munitions Center of Expertise (MM CX) Interim Guidance Document 06-05.

6.0 QUALITY CONTROL

The HGL Senior UXO Operation Manager is responsible for ensuring this SOP is reviewed annually for completeness, accuracy and safety. The HGL UXO Safety Manager is responsible for the maintenance, management and annual review of this SOP for procedural, quality control and safety issues. All questions, comments or recommendations regarding this SOP should be directed to the UXO Safety Manager.

Project Managers and supervisors are responsible for ensuring all site personnel read, understand, and follow this SOP. If any discrepancies are found with procedural steps or safety issues pertaining to this, it will be brought to the attention of the responsible supervisor for corrective action. Anytime there is a potential for encountering MEC during HTRW related activities a UXO Team will be assigned to provide anomaly avoidance support.

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6.1 AUTHORITY

The senior UXO-qualified person on site has final on-site authority on all munitions and MEC procedures and safety issues. This individual will have direct reporting and communications responsibility with and as direct by the HGL Project Manager with all responsible authorities.

6.2 CERTIFICATIONS

HGL will provide UXO-qualified personnel that meet the certification levels specified by DDESB Technical Paper 18 and USACE EP 75-1-2. The UXO Team will:

A. Consist of a minimum of two personnel for anomaly avoidance, one of whom must be a UXO Technician II or above.
B. Be on-call during all investigative/design HTRW activities where there is a potential for encountering MEC.
C. Conduct access clearance surveying activities:
   1. The second person can be a designated UXO Sweep Person (DDESB TP 18).
   2. UXO Sweep Personnel are required to have undergone site specific training on the potential hazards present.
D. The UXO Team may include additional UXO-qualified personnel depending on project-specific and task-specific conditions and requirements. Additional personnel requirements, including certificates of training and medical monitoring guidelines listed in the Site Safety and Health Plan (SSHP).

6.3 EQUIPMENT

Project equipment for MEC anomaly avoidance and construction support will come from HGL sources, subcontractors, and local vendors offering equipment for lease or purchase. All equipment, regardless of source, will be inspected and function checked to ensure completeness and operational readiness. Any equipment found damaged or defective will be repaired or returned for replacement. All instruments and equipment that require routine maintenance and/or calibration will be inspected initially upon arrival and then periodically as required in the manufacturer's equipment manual. Equipment required for daily usage shall be calibrated twice daily (start and finish). This system of checks ensures that the equipment on-site is functioning properly. If an equipment function check indicates that any piece of equipment is not operating correctly and field repair cannot immediately be accomplished, the equipment will be removed from service until it can be repaired. Alternately, the equipment may be replaced with a like model or an approved substitute. Replacement equipment will meet the same specifications for accuracy and precision as the equipment removed from service.

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6.3.1 Geophysical Equipment

A. The use of geophysical sweep equipment (magnetometers) will depend on the local area of the sweep and the intended work to be conducted in that area. If the area is to be investigated only on foot, it may suffice to conduct only a detector-aided visual search of the area. If vehicular traffic is expected, the site will require a geophysical sweep for shallow subsurface anomalies (to a depth of 4 feet). For the purpose of anomaly avoidance, the following geophysical equipment will be utilized:

1. For a geophysical sweep of an area, either the Schonstedt GA-52Cx or GA-72Cd or the Subsurface ML-1 or ML-1M will be utilized. These units can be expected to detect subsurface ferrous anomalies to a depth of 4 feet.
2. Additionally, the White's Spectrum XLT all-metals detector may be utilized. This unit can be expected to detect subsurface ferrous and non-ferrous anomalies to a depth of 18 to 24 inches.
3. For down-hole surveillance, the Subsurface BHG-1, Schonstedt MG 220/230, MAGEX 120 LW or the MK26 Forrester will be utilized. The down-hole geophysical instrument used will depend on the diameter of the borehole. If direct push technology (DPT) is used, then the MAGEX 120 LW, Subsurface BHG-1 or Schonstedt MG 220/230 w will be used. The MK 26 will not fit inside the typical direct push borehole (e.g., 1 to 1.5 inches outer diameter).

B. Additional equipment items that may be required for marking hazards are:

1. Non-metallic shaft pin flags (as required)
2. Brightly colored surveyors tape (as required)
3. High visibility, biodegradable spray paint (as required)

6.3.2 Equipment Function Checks

A daily equipment function check will be performed on all geophysical instruments and global position systems (GPS). The check will consist of using the geophysical instrument in the demarcated function check area and verifying its response on a known designated target anomaly. A record of the geophysical equipment/serial number function check will be logged using the Instrument Maintenance and Calibration Log (HGL MEC Form 15.16) following each functionality test describing the performance results.

6.4 TRAINING

As part of the anomaly avoidance support process, the senior UXO-qualified person or UXOSO, as assigned will perform project-specific training for all on-site personnel assigned to these activities.

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The purpose of this training is to ensure that all on-site personnel fully understand the operational procedures and methods to be used, including individual duties and responsibilities and all safety and environmental concerns during investigation and excavation activities. Any personnel arriving at the site after this initial training session will have to complete the training before being allowed to work. On-site training will include the following topics:

A. Field equipment operation, including safety precautions and safety equipment, field inspection of equipment, and maintenance procedures that will be used
B. Procedures, guidelines, and requirements in relevant sections of the WP and the SSHP, as they relate to the task being performed
C. Site- and task-specific hazards, including physical, biological and chemical hazards
D. Specific ordnance materials (e.g., MEC, munitions constituents [MC], explosive soil) potentially found on-site and hazards awareness
E. Public relations, including encounters with press and public
F. Environmental concerns and sensitivities, including endangered/threatened species and historic, archaeological, and cultural resources on-site
G. Emergency procedures and contact information

7.0 SAFETY

If MEC is encountered during any phase of work the HGL Project Manager, and when assigned the Site Safety Officer or UXOSO will be immediately notified. In general, the following MEC safety precautions and protocols will be followed:

- Always remain alert at all times for MEC, UXO and related scrap or MPPEH hazards.
- The cardinal principle to be observed involving ordnance, explosives, ammunition, severe fire hazards, or toxic materials is to limit the exposure to a minimum number of personnel, for the minimum amount of time, to a minimum amount of hazardous material consistent with a safe and efficient operation.
- Always assume MEC hazards contain a live charge until determined otherwise.
- Death or injury can occur from MEC/UXO and explosive related accidents.
- The age or condition of a MEC hazard does not decrease the effectiveness. MEC that has been exposed to the elements for an extended period of time becomes more sensitive to shock, movement, and friction because the stabilizing agent in the explosives may be degraded.
- Consider MEC that has been exposed to fire as extremely hazardous. Chemical and physical changes to the contents may have occurred that render it more sensitive than it was in its original state.

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- DO NOT touch, move or jar any ordnance items regardless of the markings or apparent condition. Under no circumstances will any MEC be handled during avoidance activities or moved in an attempt to make a positive identification.
- DO NOT touch, pickup up, kick or move anything that is unfamiliar or unknown.
- DO NOT roll the item over or scrap the item to identify markings.
- DO NOT approach or enter a munitions site if an electrical storm is occurring or approaching. If a storm approaches during site operations, leave the site immediately and seek shelter.
- DO NOT transmit radios or cellular phones in the vicinity of suspect MEC hazards.
- DO Norwalk across an area that the ground surface cannot be seen that has not been cleared of MEC hazards by the UXO Technician.
- DO NOT rely on color codes for positive identification of ordnance items nor their contents.
- DO NOT drive vehicles into a suspected MEC area; use clearly marked lanes.
- DO NOT carry matches, cigarettes, lighters or other flame-producing devices into a MEC site.
- DO Note misled by markings on the MEC item stating "practice bomb," "dummy," or "inert." Practice ordnance can have explosive charges that are used to mark and/or spot the point of impact; or the item could be marked incorrectly.
- The location of any ordnance item found anomaly avoidance activities will be clearly marked so it can be easily located and avoided.
- Follow the procedures of the WP and SSHP; and upon locating any MEC hazards immediately notify the UXO Technician so appropriate measures can be taken.

— WARNING —

REMOVING OR TAKING ANY MUNITIONS, EXPLOSIVE OR UNEXPLODED ORNANCE OR MUNITIONS RELATED DEBRIS FROM THE SITE BY ANY EMPLOYEE IS STRICTLY PROHIBITED,

7.1 DAILY TAILGATE SAFETY MEETING

Prior to entering an area requiring MEC anomaly avoidance, the UXO Team Leader must conduct a safety brief covering emergency procedures, operations, MEC hazards and anomaly avoidance procedures.

8.0 RECORDS

Documentation generated as a result of this procedure is collected and maintained utilizing the following forms:

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- SOP Acknowledgement (Attachment 1)
- HGL MEC Form 15.01 MEC Investigation Field Log (Attachment 2)
- HGL MEC Form 15.16 Instrument Maintenance and Calibration Log (Attachment 3)
- HGL MEC Form 15.19 Daily Tailgate Meeting Log (Attachment 4)

All forms are available on the HGL SharePoint Website, Munitions Response Folder: https://sharepoint.hgl.com/docs/Munitions%20Response/Forms/AllItems.aspx?RootFolder=%2fdocs%2fMunitions%20Response%2fUXO%20Personnel%2f01%20%2d%20Forms&FolderCTID=&View=%7b82CD0347%2dEF52%2d433E%2d9E9C%2d99870ACC8736%7d

9.0 REFERENCES

Department of Defense Manual 6055-09-M, 2010, DoD Ammunitions and Explosives Safety Standards, August;

Department of Defense Explosive Safety Board (DDESB) Technical Paper (TP) 18, 2004, Minimum Qualification for UXO Technicians and Personnel, December;

US Army Corps of Engineers, 2008 Engineer Manual 385-1-97 Explosives Safety and Health Requirements, September;

US Army Corps of Engineers, 2004 Engineer Pamphlet 75-1-2 Munitions and Explosives of Concern Support during Hazardous, Toxic and Radio Active Waste (HTRW) and Construction Activities, August;

US Army Corps of Engineers, 2007, Engineer Regulation 385-1-92 Safety and Occupational Health Requirements for Hazardous, Toxic and Radio Active Waste (HTRW) Activities, May;

US Army Corps of Engineers, 2007, Engineer Regulation 385-1-95 Safety and Health Requirements for Munitions and Explosives of Concern (MEC) Operations, March;

US Army Corps of Engineers, 2006, Memorandum, Procedures for PA/SI Teams that Encounter UXO While Gathering Non-UXO Field Data, Military Munitions Center of Expertise (MM CX) Interim Guidance Document 06-05, March;

HydroGeoLogic, Inc., 2010. Safety and Health Manual, Section 15—Munitions and Explosives of Concern.

HydroGeoLogic, Inc., 2007. Standard Operating Procedure 4.07, Field Logbook Use and Maintenance.

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ATTACHMENT 1

STANDARD OPERATING PROCEDURE ACKNOWLEDGEMENT

I have read, understand and agree to abide by the provisions as detailed in this standard operating procedure (SOP) prepared by HGL. By signing below, I certify that I have had the opportunity to read and ask questions about this SOP, and that I understand the procedures, equipment and restrictions, and agree to abide by them. Failure to comply with this SOP may lead to disciplinary action and/or my dismissal from the work site and termination of employment.

Prior to the commencement of any work task associated with these SOPs, the Senior Unexploded Ordnance Supervisor (SUXOS) or Senior Unexploded Ordnance Technician assigned to the project will discuss additional procedures to be implemented, or any other site-specific conditions that may arise.

Print Name	Signature	Date

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ATTACHMENT 2

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Munitions and Explosives of Concern Investigation Field Log

UXO Technician:		Team:		Date:	
Anomaly ID No.					
Actual Anomaly Coordinates *(Latitude= Longitude=Y)*		X:		Y:	
Object Depth (from center of mass):		Inches			
Object length:		Inches			
Object Diameter/Thickness:		Inches			
Object Weight (Estimated):		Lbs.			
Slope of terrain (Check one box):		☐ <10°	☐ 10° to 30°	☐ >30	
Vegetation cover (Check one box):		☐ Clear	☐ Tundra	☐ Swamp	
Soil type (Check one box):		☐ Sand	☐ Clay	☐ Rock	
Inclination:		☐ 0° ☐ 45°	☐ 90°	☐ 135°	☐ 180°
Orientation:		N-S	NW-SE	E-W	SW-NE
Item Description/Justification/Comments:					

Anomaly type categories (Check Appropriate Box)					
☐ MEC	☐ Abandoned	☐ Scrap	☐ Practice Ordnance	☐ Inert Ordnance	☐ Metal Waste
☐ Other	☐ No Find	☐ No Dig	☐ Rust Layer	☐ Dig Abandoned	☐ Target >4 ft
Was photo taken?	☐ Yes	☐ No	File Name:		
Ordnance Positive Identification (If Known, Record Below and record 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:					
☐ Bomb	☐ Guided Missile	☐ Mortars	☐ Pyrotechnics and Flares		
☐ Cluster/Dispenser	☐ Land Mine	☐ Projectiles	☐ Small Arms		
☐ Grenade	☐ Misc. Explosive Device	☐ Rockets	☐ Underwater Ordnance		
Fuzing Types:					
☐ All-ways Acting	☐ Base Detonating	☐ Influence	☐ Electric	☐ Impact	
☐ Mechanical Time	☐ Mechanical long delay	☐ MT Super-quick	☐ Piezoelectric	☐ Point Detonating (PD)	
☐ Point-initiating, Base-detonating	☐ Powder Train Time Fuze (PTTF)		☐ Pressure	☐ Proximity (VT)	

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HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Munitions and Explosives of Concern Investigation Field Log

Status of MEC:	☐ Armed ☐ Unarmed			
Physical Condition of MEC:	☐ Broken Open ☐ Soil Staining ☐ Filler Visible ☐ Soil Sample Taken			
MEC/MPPEH Disposition:				
Disposition: (Clarify Under Remarks)	☐ Transport	☐ Leave In Place	☐ Other	Date:
Notifications To EOD By:	Signature:			Date
Transported By:	Signature:			Date:
Transferred To:	Signature:			Date:
Storage Location:				
Destroyed By:	Signature			Date:
Remarks:				
SUXOS/UXO Team Leader Signature:		EOD Personnel Signature (when applicable):		

Abandoned—MEC 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.
MEC—Military munitions that may pose unique explosives safety risks, Unexploded ordnance (UXO), Discarded military munitions (DMM), Munitions constituents (e.g., TNT, RDX); present in high enough concentrations to pose an explosive hazard.
MPPEH—Material potentially containing explosives or munitions (e.g., munitions containers and packaging material; munitions documented as an explosive hazard (MDEH) or material document as safe (MDAS) remaining after munitions use, demilitarization, or disposal; and range-related debris) or material potentially containing a high enough concentration of explosives such that the material presents an explosive hazard.
MDEH–Material documented as an explosive hazard that contains an energetic material.
MDAS—Material documented as safe that does not contain an energetic material.

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ATTACHMENT 3

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Equipment/Instrument Calibration/Maintenance Log

Project Location (Name, City and State):		Contract No:
Team Number:	Instrument Description/Type:	Equipment/Instrument Serial Number:

Date	Calibration Standard (example, Test Pit)	Test results (check box) Pass	Fail	Name of Individual	Comments or Observations
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
		☐	☐		
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		☐	☐		
		☐	☐		

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ATTACHMENT 4

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HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

Tailgate Safety Meeting Log

Date:	**Time:**	**Team No:**
Site Name/Location:		**Grid No:**

1. SAFETY TOPICS DISCUSSED:

- ☐ Site Description
- ☐ Site Controls
- ☐ Personal Protective Equipment
- ☐ Emergency Procedures / Equipment
- ☐ Site Evacuation
- ☐ Physical/Biological Hazards
- ☐ Heat or Cold Stress
- ☐ Communication/Radio Procedure
- ☐ Environmental Concerns/Hazards
- ☐ Emergency Procedures/Route
- ☐ First Aid Procedures
- ☐ Injury Reporting
- ☐ Safe Work Practices
- ☐ Other:
- ☐ Other:
- ☐ Other:

2. TASK OPERATION AND REMARKS:

____

____

3. ATTENDEES:

	Print Name	Signature	Company
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			

Meeting Conducted by:	**Signature:**

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12.0 SOP 15.50 ANALOG GEOPHYSICAL MAPPING WITH REAL-TIME INSTRUMENTATION AND ANOMALY WAYPOINT MAPPING

STANDARD OPERATING PROCEDURE (SOP) FOR
ANALOG GEOPHYSICAL MAPPING WITH REAL-TIME INSTRUMENTATION
AND ANOMALY WAYPOINT MAPPING

OBJECTIVE

This Standard Operating Procedure provides guidance and methods for collecting analog geophysical data and applying those data in the preparation of a geophysical anomaly map. Specific performance metrics should be detailed in a project Work Plan.

DEFINITIONS

Real-time: Refers to the manner of data acquisition and use. The geophysical response of the instrumentation is used to immediately identify anomalous areas of interest. No geophysical response is captured.

Analog: The instrument response is analogous (hence "analog") to a geophysical characteristic being interrogated - e.g., the audible tone from a Schonstedt magnetic locator is an analog of the voltage between two ferrite cores in the instrument; this voltage, in turn, is an analog of the differences in the magnetic flux intensity of the Earth's magnetic field at two points above the surface.

Anomaly: An instrument response identified as different from the background response of the system. Anomalies are characteristically associated with objects or features that create a variation in the particular geophysical field tested.

AGM: Analog Geophysical Mapping.

BACKGROUND

Analog geophysical mapping (AGM) surveys are a non-destructive means for detecting and mapping the locations of buried metal objects. Dependent upon the instrumentation used, the survey can detect ferrous (magnetic) and non-ferrous sources (if an electromagnetic or all-metals detector is used). The field procedures are a variant of the "mag and flag" approach commonly used in environmental and UXO investigations. The essential difference is that the AGM survey will result in an anomaly map that can be used for planning subsequent operations.

Typical targets include:

- Underground utilities, product lines, cables and well casings;
- Trench-and-fill, dumping ground, and landfill boundaries; and,
- Buried ordnance.

PERSONNEL

AGM surveys must be conducted by trained personnel to ensure proper design of the survey and interpretation of the data. The task manager must ensure that the equipment is functional and that AGM personnel have been adequately trained to detect and locate anomaly sources in real time. The AGM team will require support from global positioning system (GPS) or robotic total station (RTS) survey specialists and a geographic information system (GIS) manager to facilitate development of the appropriate maps.

The AGM team can be comprised of as few as two people or may include as many as ten to twelve or more. The limiting constraint is the need to ensure each person and geophysical instrument has a minimum 7-foot buffer between the closest other survey team member. This is necessary to assure the instrumentation and audible output do not impair the efforts of adjacent team members by distracting tones and/or the instruments being physically affected by proximal detectors.

For safety reasons, and to facilitate mapping, at least two persons will be deployed for AGM surveys. Mapping personnel should be trained and familiar with the instruments and their operations.

EQUIPMENT AND SUPPLIES

White PI SurfMaster: The White PI SurfMaster is a transient EM metal detector that offers all-metals detection to depths of approximately one foot (0.3 meters). The system is hand-held, readily portable, and has been used for numerous MEC projects to aid in the detection of surficial metallic objects.

Schonstedt GA-52cx Magnetic Locator: The Schonstedt GA-52cx is a hand-held magnetic locator comprised of two fluxgate sensors that are aligned and mounted at a fixed distance apart. When the instrument is passed near ferrous objects, the difference in magnetic flux between the two sensors is registered as changes in an audible tone.

Trimble GeoXH and Zephyr External Antenna: The Trimble GeoExplorer 2008 Series GeoXH is a handheld, state-of-the-art GPS that provides 30 centimeters (cm) accuracy with an internal antenna. The instrument operates using Windows Mobile Version 6 with one gigabyte of onboard storage. When coupled with the Zephyr external L1/L2 GPS antenna on a range pole, the system delivers 10-cm positional accuracy.

The following equipment and supplies will typically be needed to conduct an AGM survey:

- GPS/RTS system;
- Analog geophysical system;
- Battery charger and batteries;
- Extra batteries (if battery powered instruments used);
- User's manuals;
- Measuring tapes (if local grid with fiducial markers is to be used);
- Pocket transit (e.g., Brunton) or hand compass;
- Traffic cones and/or surveyor string and lath;
- Hammer;
- Bound field notebook;
- Miscellaneous supplies (e.g., flash drive, tool kit, voltmeter, flagging, stakes, permanent markers, electrical tape); and,
- First aid kit.

SURVEY TYPE

The AGM surveying will consist of randomized or sub-parallel transects, as specified in the project Work Plan.

Survey speed will be limited such that the mapping progresses at a slow walking pace that can be sustained over the course of the day. Typically, a walking pace of 2.0 to 2.5 feet/second (~0.7

meter/second) will allow all team members to maintain position and achieve an effective sweep over the ground surface with the analog instrument. Do not exceed this rate.

NAVIGATION AND MAPPING SYSTEM

Positional accuracies will be as specified in the project Work Plan and statement of work. GPS or RTS location of an AGM anomaly will be recorded and referenced to the project coordinate system (e.g., in U.S. Survey feet, NAD83). Center the GPS/RTS antenna/reflector over the flagged location and capture the waypoint coordinates. Record the anomaly identifier in the daily logbook. For GPS measurements, be aware that topography that would obscure the sky and degrade satellite coverage (e.g., hills or ravines) may be present; record these occurrences in the daily field logs.

If GPS/RTS coverage is not available and physical fiducials (i.e., footprint/grid coordinates) are used, the anomaly locations will be measured along the southern and western footprint/grid boundaries (footprint/grid origin in southwest corner). Measurements will be accomplished by laying calibrated tapes along the footprint/grid boundaries and stretching a survey tape between opposing boundaries of the footprint/grid. An easting and northing is recorded for each anomaly.

CAPABILITIES AND LIMITATIONS OF THE DETECTION METHOD

EM instruments can detect both ferrous and non-ferrous metals and thus offer a means of ensuring detection of such items. Magnetic locators respond only to ferrous metals. All geophysical methods are limited by size-dependent depth of detection. In general, the larger an item is, the deeper it can be detected. A multiple sourced target (e.g., a disposal pit with several buried MEC/MPPEH items) should produce a greater instrument response and therefore is expected to be detected at greater depths than the individual items separately.

AGM FIELD PROCEDURES

Hand-held EM (e.g., White PI SurfMaster or XLT) and/or magnetic locators (Schonstedt GA-52cx) and a GPS/RTS with 30 cm or better accuracy will be used to conduct the AGM surveys. Each survey will be performed within an established footprint for the transect or grid, with individual lanes delineated within the footprint/grid to assure complete survey coverage. Team members will use metal detectors to sweep the areas of interest identified along each lane, advancing en echelon formation. Lane spacing (width) will be at nominally 4 to 5 feet (as specified in the Work Plan) and typically with a 5-foot fore and aft separation en echelon or line in-trail formation (i.e., staggered distance between personnel), which should suffice to detect MEC of interest within the surveyed footprint/grid, as well as to minimize interference between individual team members. The fore-and-aft separation is determined by a "walk away" test described below. As anomalies are detected, the locations will be pinned with a plastic pin flag. GPS/RTS survey units or tape and compass measurements will be used to record the geographic position (waypoint) of each detected anomaly. The AGM team leader will trail the team to monitor and track the progress of the effort.

The AGM survey steps comprise the following.

1. Ensure all system components are in good repair and that batteries for all electronics in the system have been fully charged.

2. Proceed to assigned survey area.

3. Turn on the instrument to warm up the system's electronics (typically takes 10 to 15 minutes depending on ambient conditions).
4. Perform spot check readings to locate a noise-free background area.
5. Perform nulling procedures.
6. Perform pre-survey equipment operational (QC) tests.
   - Personnel metal interference source check;
   - Static spike test; and,
   - Position reference test (for GPS/RTS).
7. Record episodes of each QC test and footprint/grid survey as separate entries in the team leader's daily logbook.
8. Collect field data.
9. Perform post data collection QC tests.
10. Team leader is to review, sign, and date field logs and documentation before the close of business each survey day.

9.1 Analog Detector Set Up, Initialization, and Survey Checklist

- Assemble unit following instrument instruction manual;
- Power on systems;
- Check/set up survey parameters;
- Check/set up data logging parameters (select sensitivity scale);
- Power on GPS/RTS;
- Check GPS/RTS data stream;
- Perform QC tests (personnel, spike, point position); and,
- Record activities and test results in logbook.

9.2 Field Survey Data Collection

- Establish footprint/grid and survey lanes;
- Record corner coordinates;
- Record footprint/grid lane spacing and length in logbook. Lanes are designated by alpha characters, progressing alphabetically left to right from the southwestern-most corner of the footprint/grid;

- Align team members in appropriate formation (en echelon or in-trail, but not line abreast);
- Stagger the start of each lane in time;
- Proceed down the assigned lane, flagging anomalies as detected;
- Maintain personnel and instrument separations;
- Record waypoint and footprint/grid anomaly identification (grid id. + sequential number for each flagged anomaly. The anomaly identifier is to be noted in logbook as well as recorded in the GPS/RTS waypoint file;
- Recover grid construction materials, as needed; and,
- Record AGM activities in the daily log.

The AGM team leader will oversee the division of the survey area into manageable search lanes, which will allow team members to perform sweeps in a controlled pattern covering the footprint/grid. Wooden stakes will be driven into opposing ends of the survey area boundary at regular intervals and surveyor's string will be strung between opposing stakes to define the search lanes. The footprint/grid corner locations (position coordinates) will be measured and recorded.

AGM personnel will systematically and thoroughly search assigned search lanes using the highest sensitivity setting of the instrument. The operator will slowly move forward along the search lane sweeping the instrument from side to side, keeping the sensor-ground standoff geometry consistent and ensuring the entire width of the search lane is swept. As anomalous areas are encountered, the detector will generate a change in aural tone that is indicative of a buried metallic and/or ferrous object. The operator will further refine the position of an anomalous area by observing the peak aural tones as the instrument is moved over the locations. The operator will place a yellow pin flag in the ground adjacent, but not immediately over, the location at which the instrument response indicates a source center – e.g., EM audio tone is the greatest or magnetic locator "chirp" is highest along intersecting perpendicular sweeps.

The team GPS/RTS specialist will occupy each pinned anomaly locations and measure and record the anomaly coordinates.

Data Downloading

Download the waypoint data to a footprint/grid-specific file. Copy field logbook pages and provide copies of the electronic waypoint data to the GIS/database manager (or the PM, if GIS support is not on site).

Throughout these steps, the AGM team leader will be responsible for recording and maintaining QC documentation and field notes for each step as they occur. The logbook narrative will be sufficient to allow a future reader to reconstruct the particular survey activities, results, and observations. File naming conventions for positional data will be maintained (include date, sequential number for day, transect), and periodic downloads of data will be made as necessary.

9.4 Shutdown Sequence

- Perform QC test;
- Turn GPS/RTS off;
- Turn AGM detectors off;
- Review field logbook to ensure information needed to reconstruct AGM survey events has been recorded; and,
- Sign logbook (team leader).

9.5 DATA

The location of each AGM anomaly will be way-pointed and recorded using a GPS/RTS unit with accuracy sufficient to meet the performance specifications of the project Work Plan. The waypoint data, including position and associated notes, are populated into the project GIS database. The locations are then overlain and posted on a project map, generating a geophysical anomaly map for the AGM search area.

In general, the data are presented as anomaly maps, and will include the following basic map features.

- Title block that includes the site name (grid), location, and date of survey;
- Scale and graphical bar scale;
- North arrow (true or grid);
- Color and/or line and target symbols; and,
- Relevant cultural features if appropriate (e.g., surface ground clutter that may affect data quality).

10.0 AGM Survey Quality Control Tests

Summarized below are QC tests that are required for AGM surveys.

10.1 Personnel Test

This test checks to ensure that operators are not a source of noise. Survey crewmembers will remove, to the maximum extent possible, any metal items on their person (in particular, steel-toed and steel-shanked boots will not be worn).

10.2 Static Background and Spike Tests

These tests check the instrument's background noise level, the instrument's response to a known standard (spike), as well as the return to background level upon removal of the spike. The spike response will be qualitative and subject to the operator's interpretation. However, the response should be loud, distinct, and as "consistent" as possible. This test is performed, at a minimum, at the start and end of each survey day, and in most cases before and after the instrument is turned off/on during the course of the day (e.g., changing batteries) as directed by the Work Plan. As the instruments do not output recordable data, the conduct of the tests will be recorded in a logbook for each instrument.

The tests should be conducted in a noise-free area. Proper operation and function of the instruments to be used will be periodically checked each day and documented in the field notebook and field data sheet.

The completion of each test and the detection results are to be recorded in a logbook assigned to each analog survey instrument. Test results will be recorded by the operator and reviewed and signed by the team leader each day.

10.3 Point Position Test

This test checks the accuracy of the GPS/RTS positioning system. This test is performed, at a minimum, at the start and end of each survey day, or more frequently, as specified by the Work Plan. The project test strip provides a test bed for determining and recording locations to ensure proper function of the GPS/RTS unit(s). The tests are recorded in a daily log assigned to the GPS/RTS instrument.

The positional testing will use a known fixed point (e.g., rebar in the ground whose coordinates have been determined through land surveying). The instrument is placed in a stationary position over the point and the point location is recorded.

10.4 Miscellaneous Good Field Practices and Additional Comments

Miscellaneous good field practices and additional comments are summarized below.

- Given that this instrument detects metal, it is important that the operators be as metal-free as possible. Unless dictated by health and safety concerns, this includes the absence of cell phones.
- Whenever possible, the nulling of the instrument and the performance of QC tests should be conducted at the same location. This is practical for only small survey areas.
- It is important to ensure that any cables (e.g., for EM metal detectors) be firmly secured and not allowed to swing. A swinging cable is a moving piece of metal and a potential source of noise. The excess cable should be at the operator's end of the system and not coiled near the receiver/sensor.
- It is important to note that even though nulling of the instrument will mask out the effects of metal close to the sensors/Tx/Rx coil, one should always try to minimize the amount of this metal.
- If multiple systems are to be operating at the same time, determine a minimum separation distance between instruments by performing a "walk away" test while monitoring the response of the systems. If this distance is greater than the 7-foot minimum, the en echelon stagger is adjusted to ensure the separation is appropriate. Once this distance is identified, maintain the separation to minimize interference between units.

10.5 Documentation

The following activities and guidelines are provided to ensure proper documentation and quality control for the survey.

Prior to field mobilization, a Work Plan will be developed. This document will explain the objective(s) of the survey and state why the method was selected to meet the objective(s). It should outline specific field procedures and protocols, and identify potential problems that may be encountered. In addition, data recording requirements should be included.

All notes will be recorded in a bound and sequentially numbered field notebook using an indelible pen or marker, or recorded using a PC notebook. At the end of each field day, the team leader, crew chief, or responsible geophysicist/PM will sign and date the notebook at the end of the entries for that day. The electronic data (GPS/RTS data) will be downloaded to a computer as well as archived on a second storage medium (e.g., CD or flash card) for backup.

A summary of field and data processing activities will be documented through the following reports.

- Daily AGM Log: This log documents information about the survey and field-crew activities. Information in this log includes date, weather conditions, names of the field crew, instrument name and serial number, pertinent instrument settings, sensor positions (height above ground surface), sketch map of survey area, and filenames of QC test and field data.
- Standardization Report: This report documents both the daily Personnel and Spike tests.
- Positioning Report: This report documents the GPS/RTS results Point Positioning Tests.
- Data Processing Log: This report documents the results of the data processing procedures and includes the information of the initial field processing (GPS/RTS file names, map names for mapping files created by GIS, etc.)

13.0 SOP 6.01.01 DIGITAL GEOPHYSICAL MAPPING USING GEONICS LTD., EM61 MK 2

HGL HydroGeoLogic, Inc MUNITIONS RESPONSE TEAM

STANDARD OPERATING PROCEDURE

Digital Geophysical Mapping Using Geonics, Ltd., EM61-MK2	SOP No.: 6.01.01 SOP Category: Geophysics Revision No.: 0 Date: April 2012

1.0 PURPOSE

This standard operating procedure (SOP) provides information on theory, personnel, equipment, and methodology to conduct a time-domain electromagnetic (TDEM) survey using the Geonics, Ltd., EM61-MK2 metal detector coupled with a positioning system such that a digital record of geophysical responses and coincident position are recorded. Project-specific performance metrics should be outlined in the pertinent Work Plan.

2.0 SCOPE AND APPLICATIONS

The TDEM method is a non-destructive geophysical method commonly used in environmental and munitions response investigations for detecting buried ferrous and non-ferrous metal objects.

Typical targets include:

- Burial pits containing metal materials;
- Buried 55-gallon drums and storage tanks;
- Underground utilities, product lines, cables and well casings;
- Metallic content of trench-and-fill and landfill boundaries; and
- Subsurface munitions.

The TDEM method generates a primary magnetic field by pulsing an electrical current through a transmitter (Tx) coil. This primary magnetic field inductively couples with the ground and illuminates conductive targets or materials. The illuminating field causes eddy currents to flow in proximal metallic objects, resulting in a secondary current. The time decay of this secondary field (the geophysical response), as measured when the transmitter is off, is a function of the material properties of the source (type of metal and its electrical properties, size, shape and orientation), its depth of burial, and the conductive properties of the matrix or soil in which the field is generated. The response is measured through a receiver (Rx) coil, typically at 3 or 4 time gates (windows), and is recorded in units of millivolts (mV). The system response is the cumulative voltage derived from all conductive materials within a sphere illuminated by the primary signal. Consequently, variations ("anomalies") in the measured secondary signal may be caused by individual or multiple objects buried in a variable soil media. Background noise levels are typically a few mV; the response to a metal target can be up to thousands of mV for large objects.

This SOP is specific to use of a Geonics, Ltd., EM61, but may be adapted for use with other TDEM or frequency-domain electromagnetic systems.

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3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Site Health and Safety Plan. Procedures for packaging and disposing of all waste generated during field activities will be described in the project-specific Work Plan.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure as described in Section 5.0. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 DEFINITIONS

GGA NMEA-0183 data string: A commonly used global positioning system (GPS) data string that provides positional information (X, Y and Z). The data string is usually inserted into the recorded field data at one-second intervals. Note that this string does not include information on the precision of position.

GSA NMEA-0183 data string: A commonly used GPS data string that provides information on the signal quality. The GSA string is used only to display Position Dilution of Precision (PDOP) on the data logger and is not used by the DAT61-MK2 program.

Hertz: A measure of frequency with units of cycles per second. A sampling rate of 10 Hz corresponds to the collection of 10 samples per second.

Line-and-fiducial: A method of collecting digital geophysical data relative to a local grid established using survey tapes stretched over the survey area of interest. Data are collected at fixed intervals along the resulting lines and tied to physical markers (fiducials).

Real-time: A reference to data collected and used as the survey progresses rather than processed following completion of the survey episode.

Robotic total station: An electronic survey and navigation method that uses angles and distances from a known fixed point to calculate the position of a reflector target. Data are recorded as the survey progresses. The total station base robotically tracks the position of the target as it moves across the survey area of interest.

Time gate (window): TDEM instruments operate on the principle of measuring the time decay of eddy currents that are generated in a nearby metallic source. The decay is accurately measured over a dynamic range of time. Depending on the specific instrument, a few or tens of time gates are measured, typically covering the range of hundreds of microseconds to tens of milliseconds.

4.2 ABBREVIATIONS

DGM	digital geophysical mapping
DGPS	differential global positioning system
GDP	Geophysical Data Processor
GEO	Geophysical Equipment Operator
GFT	Geophysical Field Technician
GIS	geographic information system
GPS	global positioning system
Hz	hertz
IVS	instrument verification strip
mV	millivolts
PDOP	position dilution of precision
QC	quality control
RTK	real-time kinematic
RTS	robotic total station
Rx	receiver
TDEM	time-domain electromagnetic
Tx	transmitter
UTM	Universal Transverse Mercator

5.0 PERSONNEL

TDEM surveys must be conducted by appropriately trained personnel. Most TDEM surveys will require a geophysicist to direct the survey and, for safety and quality control, at least two persons to deploy with each operational system. To ensure proper survey design and data interpretation, data-collection personnel will be trained and familiar with the specific instruments and their operation, and in particular, an understanding of factors that affect instrument response. Data-processing personnel should have an understanding of the geophysical principles underlying the TDEM method and knowledge of the types of targets sought. In addition, depending on the location of the project, a state-licensed geophysicist may be required to direct the survey and sign off on the final report.

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5.1 ROLES, RESPONSIBILITIES, AND QUALIFICATIONS

Field personnel should meet the following qualifications:

Geophysical Field Technician (GFT) – Aptitude for or experience using electronics, radio and satellite communications, global positioning systems, robotic total station, and map and compass navigation.

Geophysical Equipment Operator (GEO) – All of the attributes of the GFT, plus 1 to 3 years of experience assisting with navigation and tracking, GPS and/or RTS operation, set up, QC testing, and operation of geophysical equipment to collect digital geophysical mapping data.

Site Geophysicist – At least 3 to 5 years of experience in the field collecting, processing, and reporting geophysical survey data and results. The site geophysicist will have an extensive background in geophysical surveys or a degree in geophysics, geology, physics, engineering, or other related field. Experience will include use of the geophysical and positional systems to be deployed and used, as well as all of the attributes and qualifications of the GFT and GEO.

Geophysical Data Processor (GDP) – The GDP will have the same experience and qualifications as the Site Geophysicist. This individual will not be assigned data collection responsibilities. Data processing effort will require 4 to 8 hours per day per data stream generated (each geophysical system deployed in the field generates one data stream). If only one data stream is being generated and the GDP has the appropriate skills, experience, and resources (hardware and software), this person may also act as the project Geo-spatial Information Systems manager.

Project Geophysicist – The project geophysicist is the technical team leader charged with ensuring that the geophysical survey is performed as planned, where planned, as completely as possible, and with the best quality data given site conditions and environmental variables. The project geophysicist will have all of the experience and qualifications of the Site Geophysicists and more than 5 years of experience conducting geophysical surveys, that includes planning, field execution, data processing, and interpretation, reporting, and quality assurance review of field procedures, data processing, and deliverables (for example, anomaly table and anomaly maps).

Quality Control Geophysicist – The QC geophysicist will have the same experience and qualifications as the project geophysicist. To the greatest extent possible, the lines of report and responsibility for quality management should be outside of the chain of command for project operations. Accordingly, the QC geophysicist will be responsible to the Quality Assurance Manager (or Senior Geophysicist).

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These are the staffing requirements for a successful geophysical investigation. For most projects, it is not possible for one individual to perform the roles of more than one of the above positions. If only one geophysical survey system is being deployed, or for small projects, e.g., one requiring less than one week in the field and less than 4 to 5 acres, it may be possible to combine the roles of the project and site geophysicists. The roles of the GDP and QC geophysicist cannot be combined with other project responsibilities without jeopardizing the timeliness of data deliverables and the ultimate project success.

5.2 TRAINING REQUIREMENTS

Before the geophysical survey commences, training sessions will be held for all personnel responsible for geophysical surveying and the downloading and QC of data. The project-specific survey methods, data requirements, and field note protocol will be explained in detail. Training will include an overall discussion of the survey approach and how the data collection and field documentation tasks integrate into the overall program. Training will also include review of the internal QC procedures listed in this SOP. Training should include a hands-on application of the required procedures for collecting, processing, and interpreting a sample dataset. The Project Geophysicist is responsible for conducting this training and any follow up training deemed necessary.

In general training will include the following elements:

- SOP and administrative requirements
- Geophysical survey sampling approach
- Instrument operation
- Field data collection procedures
- Transect deviation documentation training, including use of inclinometer
- Data file management training
- Logbook/note taking

6.0 PROCEDURES

Digital EM data will be collected using the Geonics, Ltd., EM61-MK2 system arrayed with a positioning system. The physical footprint of this system is taken as the outside width of the transceiver antenna, or one (1) meter. The geophysical footprint (sphere of influence) of the system is approximately 1.5 meters as a result of the flux pattern of the transmitted signal. The antenna will be mounted either on a wheeled cart or runnered sled. Instrument sensor standoff height will vary between 0.2 and 0.5 meters above ground surface. Navigation and instrument position within the investigative area will be tracked and recorded using precision surveying systems—state-of-the-art real-time kinematic (RTK) GPS, robotic total station (RTS), or line-and-fiducial method capable of yielding survey accuracy of ± 0.3 meter precision. GPS or RTS data are collected relative to the World Geodetic System datum of 1984 (WGS84) in degrees of latitude and longitude. These data may be output as either geodetic decimal degrees

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or in meters north and east in the Universal Transverse Mercator (UTM) system and may be later referenced to the North American Datum of 1983 (NAD83), in U.S. survey feet, as required by project specifications. Line-and-fiducial positioning is referenced to a local grid that can be subsequently tied to the project datum.

6.1 INSTRUMENTATION

Geonics EM61-MK2: The EM61-MK2 consists of coincident transmitter and receiver loops, in a 1 meter x 0.5 meter rectangular configuration, which may also be ganged together into larger arrays. Actual configurations will depend on site conditions and maximum operating efficiency. The EM61-MK2 nominally transmits at 75 to 150 hertz (Hz), with data captured at up to 16 records per second (16 Hz). Data from three or four time gates are recorded with the coincident receiver loop. Data acquisition and recording will use an Allegro CX, or comparable field computer. The Allegro CX supports real-time graphic display of data for review and QC, data storage via flash card for extended survey time, and serial port input connections for simultaneous collection of both EM and GPS data. Survey speed typically will be constrained to collect data at roughly 0.3-meter (1-foot) intervals or less along each survey line.

GPS Navigation Subsystem: An RTK GPS system (for example a Trimble 5700 base station and rover) consists of two dual-frequency geodetic quality receivers that are in radio communication with each other. The GPS antenna will be mounted on the cart in a position where it does not adversely affect the EM measurements and the data are streamed directly into the data logger used to capture the geophysical data.

RTS Navigation Subsystem: An RTS system (for example a Trimble S6 and rover prism) consists of an optical total station survey instrument at a known point that robotically tracks and calculates the position of a reflector prism. The reflector prism is mounted directly over the center of the geophysical array and geodetic or UTM coordinate position is electronically recorded in a controller/datalogger via radio link with the total station.

6.2 CAPABILITIES AND LIMITATIONS OF THE DETECTION METHOD

EM instruments can detect both ferrous and non-ferrous metals. Geophysical methods require sufficient contrast between the target and field matrix. The detection capability also is limited by the size, orientation, and depth of the target. In general, the larger an item is, the deeper it can be detected. A multiple-source target (such as a disposal pit containing several buried munitions items, steel drums, or other metal debris) should produce a "larger" EM response and therefore is expected to be detected at greater depths than the individual items separately. Actual in situ detection performance will be determined and documented from on-site equipment detection performance evaluation tests.

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6.3 SURVEY TYPE

The DGM surveying will consist of radial, meandering, parallel, and/or contiguous transects of transient EM measurements over the project survey area.

6.3.1 Sampling Rates

The data logger will be configured to collect DGM data at 10 to 16 Hz and interpolated with navigation data collected at 1 Hz.

6.3.2 Data Spatial Density

Survey speed will be constrained to limit inter-data spacing to 0.3 meters or less, as required by the particular project performance specifications. An along-line data spacing interval will be monitored and a frequency calculation will be used to quantify the portion of data for which the spacing performance metric required by the project Work Plan is exceeded. Where the proportion of data spacings exceeds the required metric, data will be re-collected in the affected segments of the transects.

A comfortable walking pace that can be maintained over the course of the day equates to 1.0 to 2.0 meters/second (and will yield a nominal data spacing of 0.20-meter or less). At 10 Hz, a pace of 3.0 meters/second equals 0.3 meter data spacing. This would be a rapid walking pace that would not be sustainable over a prolonged period, but could be achieved using a tow vehicle. This rate should not be exceeded.

6.3.3 Navigation and Mapping System

DGM data will be digitally recorded coincident with positional data. Positional accuracies will be as specified in the project Work Plan and statement of work. The project coordinate system, will be as specified in the project performance metrics, and will be referenced to WGS84 UTM meters, NAD83 feet, or a local grid.

For electronic positioning, the sensors (for example, GPS antenna or RTS reflector) will be in a fixed geometry with the EM receiver. Error introduced by erratic motion of the antenna/reflector is not expected to be larger than 0.3 meters, and can be reduced by use of a sled. Positioning error will be introduced by sloping topography based on the height of the GPS antenna relative to the array. This error will result in anomaly sources being located uphill in the direction of maximum slope from the targeted locations; the offset increases as the slope increases. An additional source of position error is derived from the dimensions of the EM61 coils. Response position is recorded at the coil center; however, sources that may be offset by as much as 0.5 meters will be recorded as being at this center position. The resulting positional error is the cumulative sum of all sources of error, and may be as great as one meter. Topography or vegetation that would obscure the sky and degrade satellite coverage or preclude continuous line-of-sight fixes for RTS targets or line-and-fiducial markers may be present; these occurrences should be recorded in the daily field logs.

For line-and-fiducial positioning, using the wheel-mode or a timing trigger, horizontal map distances will always be less than ground traverse distances. Steep slopes, intervening vegetation or obstacles, and ground irregularity will all add to apparent survey error that must be considered when attempting to tie the local grid to fixed survey points.

6.3.4 Data Processing System

Data will be processed using standard, Microsoft-compatible PC platforms. Processing software will be comprised of downloading routines specific to the geophysical and positional instrumentation deployed, Geosoft Oasis montaj and/or Golden Software SURFER, ESRI ArcGIS, and other off-the-shelf software such as Microsoft Excel, Word, and Access programs.

7.0 EQUIPMENT AND SUPPLIES

The following equipment and supplies will typically be needed to conduct a TDEM survey using the Geonics Limited EM61-MK2. Transect preparation may require other specialized survey equipment:

- EM61-MK2 High-Sensitivity Metal Detector
- Navigation-tracking system
  - Real Time Kinematic GPS system (if GPS navigation is used)
  - Robotic total station (if optical tracking methods are used)
  - Calibrated survey tapes (non-metallic) and compass
  - GPS base station or RTS tripod
  - Antenna or reflector mount;
- User manuals;
- Laptop computer;
- Standardization jig (if not incorporated into cart/sled design);
- Standard targets (pipe nipple, steel sphere or suitable substitute);
- Measuring tapes (if local grid with fiducial markers is used);
- Traffic cones or other fiducial markers;
- Bound field notebook;
- Miscellaneous supplies (e.g., flash drive, tool kit, voltmeter, flagging, stakes, permanent markers, indelible ink pens, electrical tape).

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The components of the EM61-MK2 include:

- Geonics Ltd., EM61-MK2 system (Tx/Rx coils and data logger) or equivalent;
- Wheeled cart or non-conductive sled;
- Console containing transmitter and receiver electronics;
- Power supply (battery and battery chargers);
- Data logger with battery charger (for example, Allegro);
- Extra batteries for the transmitter and data logger;
- Cable to connect transmitter to transceiver (Tx/Rx) coil;
- Pigtail cable to connect bottom and top coils, or shunt to close circuit if top coil not deployed;
- Cable to connect receiver to Allegro data logger; and
- Sled/cart handle or towing assembly.

8.0 EQUIPMENT SET-UP AND INITIALIZATION

Before field work commences each day, a safety and operational briefing will be held and attendance by all digital geophysical mapping (DGM) personnel is mandatory. The topics covered, attendees, and operational plan for the day's work are to be recorded in the team leader's daily logbook. Additionally, the following system checks are required before proceeding to the QC test area or assigned survey grids with geophysical/GPS array.

- Ensure all system components are in good repair and that batteries for all electronics in the system have been fully charged. Chargers should all display a green light.
- Set up/initialize the RTK GPS base station, RTS base station, or local grid.
- Assemble the EM61-MK2 cart according to the operating manual. Typically, both bottom and top coils will be assembled but measurements will be made only through the bottom coil. The upper coil may be used to support the GPS antenna or RTS reflector mount.

8.1 EM61-MK2 SETUP AND INITIALIZATION

Transceiver Set Up

1. Assemble cart or position coils on tow sled;
2. Plug in optical encoder cable if using wheels;
3. Connect long Coil-to-Console cable to lower coil;

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4. Connect cable between upper and lower coils;
5. Secure GPS antenna mount in place on coil(s); and
6. Mount GPS antenna.

<u>Connecting the Electronics Console</u>

1. Mount battery in rack/crate;
2. Connect synchronization cable if using array of two or more systems;
3. Connect Coil-to-Console cable to console;
4. Ensure slaved/master switch is in proper position;
5. Ensure number of desired channels is properly selected;
6. Connect battery power cable;
7. Connect power cable to battery(ies); and
8. Turn on the transmitter to warm up the system electronics (Typically 10 to 30 minutes depending on ambient conditions.)

<u>Data Logger Set Up</u>

1. Interface the EM61-MK2 to the COM1 port on the Allegro data logger;
2. Interface the GPS system to the COM2 port (typically inputting the GGA string at 1 Hertz [Hz]);
3. Set sampling interval (set to 10 to 16 Hz);
4. Set acquisition parameters for 4 time gates (216, 366, 660 and 1266 microseconds);
5. Enable GPS transfer;
6. Check GPS data stream; and
7. Disable Data Output.

9.0 COLLECTING QUALITY CONTROL DATA

9.1 PRE-SURVEY TESTING

The following tests are performed daily, and more often as needed, after the system has been assembled and allowed to warm up for at least 10 to 30 minutes and the background response amplitude is flat (that is, not exhibiting a continual increasing or decreasing response trend). Each test will be recorded as a separate line within the recorded QC datasets (data files).

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- *Personnel Test* – At the start of each survey day, remove, to the maximum extent possible, any metal items on survey crew members (in particular, steel-toed and steel-shanked boots should be avoided). Each member will approach then walk away from the system while the other observes the response. The response should be less than 1 mV. If the level exceeds this value, recheck possessions, remove any possible sources of the noise, and perform the test again. Document performance of test for each survey member in the daily log.
- *Cable Shake Test* – At the start of each day and periodically during the course of the day, grasp each electrical cable and shake it while observing the geophysical response on the data logger. All cables should be checked, and replaced if necessary. Record the results of this test in the daily log, for example "All cables are secure, no excessive noise noted" or "Checked and re-tightened cable at Tx connection, noise eliminated." Increment the dataset line number to capture final shake test data in the mission data file.
- *Static Instrument Response Test* – To prepare a standard target, secure the portable target (e.g., 2-inch diameter pipe nipple, carbon steel solid sphere, or suitable substitute) configured such that it can be placed in a repeatable geometry with EM61 transceiver.

  To calculate a standard response, record static background readings (static background response test) in a test data file for 30 seconds. Using the standard target provided for the EM61, place the target in the jig receptacle and record the instrument response for an additional 30 seconds, without changing any operating settings. After the required time interval, remove the standardization target and record 30 seconds of data in the data file. Repeat the above steps at least 5 times to collect sufficient data to calculate an average "standard response." Review these data and record values for each episode in the daily log. Calculate the difference between target and background response (subtract background from the target response value) and record the "Standard Response" in the daily log. This process does not need to be repeated unless there is a change in instrument components or configuration. The resulting standard response will be used for comparison of daily static instrument response tests.

  For a static instrument response or "Standardization" test, only one iteration is required, unless the system response does not fall within the acceptance criteria specified in the project Work Plan.

  To perform the static instrument response test,

  - Create a new data file and record filename in daily log;
  - Record sufficient data to demonstrate a stable, low-amplitude response;
  - Increment the dataset (data file) line number;

- Record line number in daily log;
- Capture static background response data in data logger for 60 seconds;
- Record average background response for each channel in daily log;
- Place standard target in specified geometry and capture 60 seconds of target response data in data logger;
- Record average target response for each channel in daily log;
- Remove target and capture static background response for 60 seconds;
- Calculate the residual (spike response minus background response) for each channel of data;
- Compare the residual response obtained during the static tests to the "Standard Response" determined for the particular instrument;
- Repeat the steps above for 1 to 3 episodes, as needed;
- Note PASS/FAIL results for the static tests in daily log;
  - PASS if residual response is within acceptance metrics specified in Work Plan; or
  - FAIL if residual response is lower or higher than acceptance range).
- At a minimum, perform and record the static response tests prior to collecting field data and again before powering down (turning equipment OFF).

- *Position Reference, Repeatability and Dynamic Response Repeatability* – The repeatability or positional precision_and the dynamic response repeatability of the geophysical system will be captured during the following tests. Dynamic repeatability tests will be preserved as a separate line number within a QC dataset (data file). Place two target items at known positions and separations along the planned transect line. Flag or stake these to provide "gates" for the geophysical array to transit.

  Place one target, for example a steel-link chain, such that it lies across the path of the transect. Place the second item, for example a solid steel sphere or a pipe nipple, at ground level a measured distance (10 meters) from the first. Mark the locations of both targets with stakes and flagging.

  Record the coordinates (geodetic, UTM or local grid) of the positions of both targets in the logbook.

- *Static Position Reference Test (for electronic positioning)* – Position the array with the GPS antenna or RTS reflector centered over a known position. Continuous positioning data should be collected for 180 epochs (approximately

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180 seconds) in order to assess average error of the GPS unit. Subsequently, a single accuracy point should be collected in order to evaluate instantaneous accuracy of the GPS unit. Using the GPS/RTS controller, note the measured position and record it in the daily log. Compare the data to the known position coordinates. Measurements that vary more than ± 0.3 meters (1-foot) will trigger a review of the positioning system equipment and affected data. Do not proceed with field data collection until any static position reference disparity greater than 0.3 meters have been resolved and corrected.

- *Dynamic Position Repeatability* – Increment the dataset line number and record in daily log. With the data logger recording geophysical response and position, tow the array over both target items, collecting a linear transect of approximately 20 meters of data. Continue to collect data along the transect while turning such that the direction of the array is reversed and the equipment is passed over the targets along a path repeating the initial pass.

  These data cannot be reviewed in real-time with the Allegro data logger; therefore, record the file name and time of reference test in the daily log. The electronic data will be reviewed during data processing. Position repeatability of the targets must be within 1 meter of the initial positions, after the data are corrected for latency offset. Position offsets greater than 1 meter will be resolved prior to further collection of field data.

- *Dynamic Response Repeatability – Compare the* amplitude of the voltage recorded as the system is passed over the targets and the intervening space between them. Dynamic repeatability (measured in mVs) must be such that the second pass over the targets is within 75 percent of that recorded during the first pass, or as specified by the project Work Plan.

  Record the noise regime as recorded by the geophysical system along the transect between the two targets. Peak-to-trough background response in excess of 5 mV or differing from previous tests by more than 1 to 1.5 mV will be reviewed by the project geophysicist to determine causative source.

- *Latency* – Latency tests must be conducted at least once daily; tests will be conducted at greater frequency if there is reason to suspect change in the system (geophysical and positioning equipment) response parameters. To capture the latency response, increment the dataset line number and record value in daily log. Ensure logger is receiving GPS data stream, and start logging field data. Traverse the EM61 over both targets while recording the geophysical and GPS data twice, once in each direction. This check will allow the calculation of the offset between the time the EM sensor passes over the targets and the position at the time the data are captured relative to GPS/RTS clock time.

- *6-Line Test and Latency Test* – To be conducted if positioning data is NOT captured simultaneously with geophysical response in one data logger, for example if GPS or RTS position is captured in a separate data controller/logger. The 6-Line Test will be preserved as a separate data file. Place one target item at a known position along the planned test transect line. Flag and record the coordinates for this position.

The 6-Line Test will be conducted at the initiation of field activities, and will consist of recording six lines of data with and without target item, in varying directions and speeds. This test may be performed along the same line as the "clean line" near the instrument verification strip (IVS).

Place the standard target (for example a solid steel sphere or a pipe nipple) at ground level and mark the location of the target with stakes and flagging. Record the coordinates (geodetic, UTM or local grid) of the positions of both targets in the logbook.

- *Lines 1 and 2:* Before emplacing the target item on the transect line; tow the EM61 along the line twice at a normal pace; once in each direction, while recording the geophysical response and GPS data.
- *Lines 3 and 4:* The target item should be emplaced on the transect line path (as stated above). Tow the EM61 across the target item at a normal pace, while recording the geophysical and GPS data twice; once in each direction.
- *Lines 5 and 6:* With the target items left in place, tow the EM61 along the transect path at a fast pace. The last line should be collected in the opposite direction, at a slow pace. These checks will allow the calculation of the offset between the EM sensor clock and GPS/RTS time.

9.2 COLLECTING QUALITY CONTROL DATA

1. Select "Monitor/Log";
2. System will normalize;
3. Create file;
4. Null response;
5. Collect/record data (press "Go");
6. Perform spot check readings to locate a noise-free background area;
7. Perform and record in daily log pre-survey equipment operational (QC) tests;
   - Shake cables while monitoring response (cable shake test);
   - Perform personnel test to identify excess metal carried on the survey team;

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- Static Position Reference;
- Static Instrument Response;
- Latency check - move array over line target (chain, pipe nipple or rebar) twice, once in each direction over target (latency test) at normal speed;
- 6-line Test, as appropriate;
- Dynamic response and position repeatability tests (may be same as latency test); and
- End logging.

Throughout these steps, the Site Geophysicist will be responsible for recording and maintaining QC documentation and field notes for each step as they occur. File naming conventions will be maintained (include date, sequential number for day, transect), and periodic downloads of data made as necessary.

10.0 FIELD SURVEY DATA COLLECTION

QC tests and survey data are to be collected as separate files. The typical file naming convention uses the date and sequential file alpha-numeric characters. The EM61-MK2 data collection software records default names with each file creation. As example, for data collected on March 16 (0316), the first filename would be "031611A" with the last 3 characters (numeric and alpha) sequential values created automatically by the software. If several units are operational or other types of geophysical data will be collected for the project, then the file name can be edited, e.g., "031611AM" to ensure file names are unique. The second filename would be 031611BM, etc.

1. Create new file;
2. Null response;
3. Begin moving array before pressing "GO" to start logging;
4. Press <GO> to start LOGGING;
5. Check the GPS communications indicator (a string of "1s" will display and an audible "tick" is typically heard from the logger at 1 second intervals - e.g., 1 hertz);
6. Monitor the data logger display frequently to ensure data stream is being captured;
7. Tow array over assigned transect(s);
8. At end of transect, "PAUSE" before stopping;
9. Increment (advance) line number counter and continue as before;

10. Periodically stop, exit, check GPS data stream, then create new file and continue logging;
11. At end of transect surveys, Close data file <END>; and <EXIT> logging. “Exit” logging;
12. Create new file and perform post data collection QC tests (standardization, dynamic position and response tests, and latency);
13. Download data files at end of survey day; and
14. Review, sign, and date field logs and documentation.

Shutdown Sequence

1. Turn GPS rover receiver off;
2. Turn datalogger(s) off;
3. Turn EM61 transceiver(s) off; and
4. Disassemble array/GPS, as necessary.

Downloading Data

The data in the Allegro data logger are recorded on either on the data logger internal memory, or on compact flash drives (if external memory was selected). Data captured on internal memory can be copied to the flash drive after logging is complete. Downloading the recorded data is then a simple matter of transferring (copying) the data from the compact flash drive to the hard drive of the data processing computer.

- Ensure Allegro data logger is OFF;
- Open back panel of logger;
- Eject PCMCIA adaptor with compact flash card;
- Insert adaptor and card in PCM slot (or USB port) of processing computer and copy files from external (mobile) drive to PC; and
- Make a copy of data files and archive in accordance with project Work Plan.

10.1 MISCELLANEOUS GOOD FIELD PRACTICES AND ADDITIONAL COMMENTS

- Given that this instrument is a metal detector, it is important that the operators be as metal-free as possible. Unless dictated by health and safety concerns, this includes the absence of cell phones.
- Whenever possible, the nulling of the instrument and the performance of QC tests should be conducted at the same location. This is practical for only small survey areas.

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- It is important to ensure that cables be firmly secured and not allowed to swing. A swinging cable is a moving piece of metal and a potential source of noise. The excess cable should be at the operator's end of the pushcart, secured using cable ties, and not wound around the GPS antenna.
- If RTK GPS navigation is to be used, the antenna should be mounted as far as possible from the Tx/Rx coil, without creating either a safety hazard or inducing excessive error due to motion of the GPS antenna relative to the TDEM receiver coil. This will minimize the amount of metal close to the Tx coil.
- It is important to note that even though nulling of the instrument will mask out the effects of metal close to the Tx/Rx coil, one should still always try to minimize the amount of this metal. For very high-resolution surveys, the GPS antenna mount should be non-metallic and all excess cable should be placed near the operator's end of the cart.
- If two systems are to be operating at the same time, a minimum of 100 meters should separate them in order to minimize interference between units.

11.0 DATA PROCESSING

The main components of data processing are field editing, preprocessing, processing and target selection, and preparation of deliverables. Field editing of the raw data will include an initial review to check for proper file identification, line number, transect direction, and starting/ending stations. The data will be compared to the field notes to verify the geometry of the survey.

The standard preprocessing to be performed includes a check of the precision of the navigational data (point-precision test), a determination of the comprehensive coverage to identify any data gaps that may require additional surveying, a check of noise levels to ensure they are within acceptable limits, and an identification of anomalous data spikes or dropouts that may be associated with cultural features.

Upon acceptance of the QC tests, further data processing will typically include corrections for navigational errors, timing errors, and instrumental drift (for example,, application of a demedian filter).

DGM data will be processed using multiple response parameters to identify anomalies for potential intrusive activities. A "demedian" filter may be applied to data that exhibits long wave-length variations and response drift. A weighted sum average of all time-gate responses may be calculated for each measurement point. A signal-to-noise parameter will be calculated for each data point. Time decay curves recorded using the multiple time gates of the instrumentation will be analyzed to attempt to improve identification of metallic versus "false positive" responses. Anomaly shape will be reviewed by the processing specialist to remove to the extent practical spurious noise spikes and obvious interference (for example, stationary responses, start/stop anomalies, etc.).

The data will be viewed in profile and fit to a grid and contoured/imaged using appropriate software (e.g., Geosoft Oasis, Golden software Surfer, or equivalent). The use of automatic picking algorithms may be used to select initial targets. Additional targets may be added or removed based on visual inspection. In general, geophysical data presented as gridded contoured maps will include the following basic map features.

- Title block that includes the site name (grid), location, and date of survey;
- Scale and graphical bar scale;
- North arrow (true or grid);
- Contour interval (color scale bar);
- Color and/or line contours and target symbols; and,
- Relevant cultural features such as surface ground clutter that may affect data quality.

The transect track and the locations of the anomalies will be incorporated into the project geographic information system (GIS). Project geophysical staff will screen potential anomalies by comparing locations with field notes to identify those resulting from cultural clutter. Anomalies of interest will be identified and tabulated for the intrusive investigation. A geophysical response map, anomaly map, and an anomaly "dig sheet" will be prepared. These will provide intrusive investigation teams with an image of the data, a unique anomaly identification number, relative anomaly values, and coordinates (latitude/longitude or in northing/easting) for each anomaly. Variations or results not compatible with the standard data analysis or expectations will be reviewed by the Project Geophysicist and the intrusive investigation team leader to determine causative features that may be present.

11.1 DATA PROCESSING

11.1.1 Initial Field Processing

Perform the following procedures:

- Positional offset correction;
- Sensor bias, background leveling, and/or standardization adjustment;
- Sensor drift removal; and
- Latency correction.

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DGM data files will be logged upon receipt in a survey database. For each geophysical file, record the following:

- File Name (incorporates date, sequential file, and time stamp);
- Type of data (QC test type, transect survey);
- Area of Concern or grid; and
- DGM System ID.

11.1.2 Standard Data Analysis

Record and describe all corrections, edits, filtering, or normalization of the data used to identify the location of potential anomalies in the data processing log. Describe any discrepancies in positional accuracy of the data noted during the field review, including steps taken to correct or resolve any QC issues. Compare the landmarks, fiducials, and anomaly locations represented in the processed geophysical data to known geophysically referenced spatial data (GIS base maps). The features of the GIS that are reflected in the geophysical data should be coincident to within 2.5 feet (0.8 meter).

Data collected by different EM systems will be demoded (if necessary) to set background levels for each system to as close as possible to the same datum. In the data processing log, note any sensor biasing, background leveling, or standardization corrections accomplished.

Inspect the noise levels in the data. The signal to noise ratio should allow adequate anomaly resolution. If it can be clearly identified in the field data, remove motion-induced noise from the data, as well as quantifiable transient noise such as transmission bursts, power line noise, or single-point spikes).

Interpolate the DGM response with the GPS position data using Geonics EM61-MK2 software, in accordance with the manufacturer's software manual. Perform the routine latency checks to determine and correct offset between the GPS antenna and geophysical sensor(s) at the instant of data capture. Level the data using a non-linear multi-fiducial median filter (typically 200- to 400- element) that smoothes slowly changing background responses to enhance narrow, closed, "spikes" typical of the response to metallic sources. This same filtering will also serve to correct instrument drift (e.g., calculate the median of 200-fiducials before and after each point and apply it as a "boxcar" filter, subtracting the "median" response value calculated over a defined spatial length from the individual response).

Prepare a posting map that presents measurement stations along the transects and generate EM response profiles of the dataset. Display the data profiles and inspect them to identify any single-point anomalies, steps in response, incoherent signal, or excessive noise. Edit the data as needed and note all such events, as well as the processing used to correct and/or remove these events in a daily data processing log. Data gaps or inexplicable data shortages, if not detected during the field review and scheduled for reacquisition, will be evaluated to identify the root problem and steps needed for resolution.

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Anomaly identification depends on the ambient background or noise response. The manufacturer suggests that instrument "noise" for a well maintained system will be on the order of 1.5 mVs or less. To this must be added the effects of motion-induced noise (bounce and geologic variability) as the system is transited over a transect/traverse in the field. This is a site-specific variable. Anomaly discrimination from the background matrix requires sufficient contrast that the anomalous response be coherent and recognized. A detection "floor," or minimum anomaly amplitude, will be established for each site requiring at least a 1.5 to 1 signal-to-noise ratio.

The identification of metal objects is the primary concern for DGM surveys employing the EM61. Accordingly, it is noted that the decay progression for metal targets across the four time windows offered by the EM61 generally conforms to a geometric progression such that the response of channel 3 is two times that of channel 4; channel 2 is two times that of channel 3; and channel 1 is two times that of channel 2. Decay progressions that do not approximate this form are unlikely to be of interest and will be de-prioritized or deleted from the anomaly lists.

One further consideration is anomaly shape. Abrupt spikes with gradual decay are not representative of true anomaly sources; because of the response parameters of the EM method, an anomaly must have general symmetry.

11.2 RECORDS MANAGEMENT

11.2.1 Daily Log

The geophysical equipment operator, Site Geophysicist, or data processor, as appropriate, will record and document the survey effort in a bound field notebook, on field data sheets (if required by the project Work Plan), and data processing logs. These data should detail pertinent activities, survey line features, and field conditions encountered during the EM survey to create a detailed field log. A field sketch map of surveyed areas will be maintained as the EM data collection progresses. Field maps will note date/time of the survey, area covered, and the location and description of noise sources that may affect data quality. The notes will provide sufficient narrative such that a future reader could reconstruct each day's activities and observations. The logs are to be reviewed and signed daily by the Site Geophysicist. The field log and the field data sheet will document:

- Morning pre-survey checks of instrument and batteries;
- Safety and planning briefing;
- Team designation and members;
- Weather conditions;
- Identification of transects to be surveyed;
- Equipment set-up;
- Definition of data file names;

- Initialization of data logger(s) to record EM response;
- Performance of instrument standardization;
- Any interruptions to data collection or system problems;
- Verification of complete investigation of all segments; and
- Delivery of digital data to the Site Manager (or designee).

At the end of each field day, the Site Geophysicist is responsible for signing/dating the field logs and field data sheet(s).

11.2.2 Daily Deliverables

Deliver draft data to the Customer daily via an FTP site or other approved method. These raw field data shall include:

- Field notes, including sketch map of surveyed area;
- Documentation of QC test results; and
- Raw instrument dump files (GPS and EM data), including static and standardization measurements in binary format.

Data tracking documentation are to be completed for each day. QC documentation and progress to date maps will be submitted via FTP or other approved methods on a weekly basis.

Data and anomaly deliverables will be as specified in the project Work Plan.

11.2.3 Data Archive

The collected digital data will be archived daily by saving it, including processed and raw data files, field notes, photographs, etc., to optical compact disk (CD) or other format media. Archived data are not to be manipulated in any fashion. Files that have been archived must be copied to another media, if any type of manipulation or processing must be performed on the saved data.

12.0 QUALITY CONTROL

The following activities and guidelines are provided to ensure proper documentation and quality control for the survey.

Before field mobilization, a Work Plan will be developed. This document will explain the objective(s) of the survey and state why the method was selected to meet the objective(s). It will outline specific field procedures and protocols, define the performance metrics for the survey, and identify potential problems that may be encountered. In addition, data recording requirements should be included. Field and processing notes will be recorded in a bound and sequentially numbered field notebook using an indelible ink pen or marker. At the end of each field day, the DGM team leader (or responsible geophysicist) will sign and date the notebook at the end of the entries for that day. Digital data will be downloaded to a computer and archived on a second storage medium (e.g., CD or flash drive) for backup.

In general, a summary of field and data processing activities will be documented through the following reports.

- **Daily Geophysical Log:** This log documents information about the survey and field-crew activities. Information will include date, weather conditions, names of the field crew, instrument name and serial number, pertinent instrument settings, sensor positions (coil height, GPS antenna height, and any offset from the center of measurement, if there is one), sketch map of survey area, and filenames of QC test and field data. This log will also document daily Personnel, Cable Shake, Static Background, and Static Spike tests.
- **Static Instrument Response Log:** Records standardization response for each channel and each test.
- **Static Positioning Repeatability Log:** This log documents the results from the Static Reference Positioning tests.
- **Dynamic Response and Position Repeatability Log:** This documents and records the dynamic repeatability test results.
- **Data Processing Log:** This log documents the data processing steps for each data file including the procedures applied and corrections made, as needed.

13.0 REFERENCES

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Geonics Limited, 2005. *Operating Instructions, EM61-MK2 Data Logger System for Field Computer Allegro CX Field PC*, Mississauga, Ontario, Canada.

Yarie, Q., 2001. *Geophysical Investigations with the Geonics EM61-MK2 and EM61, Operational Procedures and Quality Control Recommendations*, Geonics Limited, Mississauga, Ontario, Canada.

ATTACHMENTS

Attachment 1	Positioning using the Trimble 5700 RTK GPS
Attachment 2	Positioning using Differential GPS (DGPS)

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ATTACHMENT 1

POSITIONING USING THE TRIMBLE 5700 RTK GPS

Base Hookup

1. Connect the base antenna to the base GPS receiver (make sure to hook up to the GPS connector, not the radio connector)
2. Connect the large base battery to Port 2, the center connector.
3. Connect the long interface cable labeled 'Trimble Cable, Trimmark 3 Base Interface #7781' to Port 3 on the receiver. Connect the other end to the Trimmark 3 radio.
4. Connect Power, radio antenna cable and base antenna to the radio. A 12V car battery is OK for the base radio.
5. Connect one of the short interface cables labeled 'Trimble Cable, Interface 7 Lemo/DB9F' to Port 1 on the GPS receiver and hook up the other end to the bottom of the data collector.

TSC2 Data Collector and Survey Controller

1. The TSC2 is a Windows touch-screen device and there is a stylus in the TSC2 bag.
2. Turn on the TSC2 by momentarily pressing the Power Switch.
3. Trimble Survey Controller may be already running. If it isn't, press the Trimble Logo to the left of the circular keypad.

Starting the Base

This describes how to start the base using an autonomous position. Note: Don't change the channel on the base radio; it's setup to match the internal radio on the Rover receiver.

1. Select the Survey icon and press Enter.
2. Select Trimble RTK from the Style menu.
3. Then select 'Start Base Receiver'. A screen will appear prompting you for a point name.
4. Click on the arrow on the right side of the box, then on 'Key_In.'
5. On the next screen click on 'Here' at the bottom of the display and hit 'Enter'. This will seed the base station position.
6. Enter an arbitrary point name e.g., T100.

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7. Enter the antenna height.
8. Disconnect the TSC2 cable when prompted. The base should now be transmitting and the radio should now be transmitting – the top right of the display should be flashing.

Testing the Rover

1. Connect GPS antenna to Receiver;
2. Connect Radio antenna to Receiver;
3. Connect one of the short interface cables labeled 'Trimble Cable, Interface 7 Lemo/DB9F' to Port 1 on the GPS receiver in the backpack and hook up the other end to the Trimble Controller (TRC2);
4. Select the Survey Icon, then Trimble RTK (if prompted);
5. Now select Start Survey (Not Start Base);
6. The data collector will turn on the Rover receiver and initialize RTK initialization;
7. Various messages will appear on the bottom of the display such as "Setting Clock", "waiting for Info from the Base";
8. A radio icon should appear and after a short time the display will show "RTK Float" then "Initialization has been gained" and "RTK fixed";
9. If you want to log data, select one of the options from the Survey menu, e.g., "Continuous Topo";
10. Select 'End Survey' to end the test; and
11. Follow directions to power down rover receiver.

Starting the Rover for Data Collection

1. Connect one of the short interface cables 'Trimble Cable, Interface 7 Lemo/DB9F' to Port 3 on the GPS receiver and hook up the other end to the geophysical data logger (e.g., Juniper Systems Allegro or Geometrics Magmapper).
2. Initialize geophysical instruments (see separate checklist).
3. Press green button on Receiver panel; battery, satellite, and radio lights should all illuminate.
4. NMEA GGA, with the quality flag set to RTK, will now be streaming out of Port 3 of the GPS receiver.

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Power and Charging

Make sure you charge all the batteries overnight.

- Trimble Controller (TRC2);
- All internal receiver batteries (2 in each receiver);
- Base station external receiver battery (large battery with handle); and
- Base station radio battery (e.g., 12 volt lead-acid deep-cycle marine battery)

To charge the batteries in the Rover GPS receiver, connect one of the 18-volt power supplies to one of the cables labeled 'Trimble Cable, Power & DB9 Interface (5700, TSC)' and plug that into the center connector of the receiver. Use the other charger and cable to charge the data collector. You can use the external chargers to charge the four spare GPS batteries. The batteries in the GPS receiver are 'hot swappable' the LED on the receiver will show if the batteries are getting low.

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ATTACHMENT 2

POSITIONING USING DIFFERENTIAL GPS (DGPS)

The following are step-by-step instructions for data acquisition with an EM61 geophysical instrument coupled to a RTK GPS. The procedures will be adhered to during data acquisition activities to ensure that the data collected are of sufficient quantity and quality to meet the program objectives. The Project Geophysicist is responsible for ensuring that these guidelines are followed, and that the data acquisition staff is adequately trained to operate the equipment.

Equipment Necessary

- DGPS backpack
- DGPS receiver with PCMCIA card
- DGPS antenna, terminal, antenna cable, and terminal cable
- Two batteries in GPS unit and three extra batteries
- Appropriate battery chargers
- Extra antenna and terminal cable
- Plastic antenna pole
- Power bar and AC-to-DC cigarette lighter adapter
- EM61 coil and "doghouse"
- EM61 backpack with battery
- Black cable, orange computer logging cable
- Two extra batteries
- Data recording device with battery, two extra batteries, and charger
- EM61 PCMCIA card
- One polycorder, orange polycorder cable, and orange polycorder dump cable (backup)
- Plastic watch **synchronized with GPS satellite time to +- 1 second (i.e., to be used as a backup timing device)**
- Field logbook and "write in the rain" pens
- Safety glasses or goggles
- Communication radio
- Personal gear and supplies (**leave metal and/or wallets in the office**).

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The following specific description may be altered depending upon the specific data logging device used, as well as the software version utilized for the EM61.

EM61 Ready

- Take the EM61 coil and backpack out of vehicle and connect via the black cable. Connect the orange cable to the data logger serial port 1 (e.g., Juniper Allegro).
- Turn the on instrument via the switch on the backpack; ensure that zero controls are locked, and that the silver "flip" switch is in standard (STD) mode.
- Have one person set up the "time – synch" object (e.g., Schonstedt) where the survey will begin; the other person should set up the GPS per directions. In addition, ensure who the operator that will carry the EM61 coil has no metal on his/her person.

GPS Ready

- Position the GPS backpack against the EM61 coils so that the antenna is approximately vertical and pointing away from obstructions (includes the vehicle and personnel).
- If you have a problem with satellite acquisition (minimum of five necessary to start), tilt the antenna slightly toward the south.
- Assuming that the antenna/receiver cable is already attached, connect the terminal to the receiver via the gray cable; turn on the instrument with the terminal (on/off button).
- Format the PCMCIA card (**4, 2** quick format = yes, **F1**)
- **CONFIG KEY** (**4, 2,** enter 4-digit identifier CLG1 [Clam Lagoon, geo 1, enter key], **F1** – refer to Attachment 2 for Sector ID representations)
- Survey (**1**)
- Select FWEPPKIS configuration
- Job (**enter** key), **F2,** Name **CLG1*4120*, F1, F1**). *4120 (April 12, file 0.... next file would be file 1, etc.)*
- **F1** (the instrument is logging data, F10 to check on logging status)
- Let the instrument collect data for approximately 5 minutes without movement (you MUST have five or more satellites before beginning the survey).

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EM61 and GPS Go

- Mount equipment (EM61 coil and GPS antenna on one person, EM61 backpack, data recording device, and GPS receiver on the other).
- Turn EM61 data logger (e.g., Juniper Allegro) device on.
- Open **ML61a** on "desktop."
- Select **Survey Setup** (Mode=auto, readings/s=12-15, surv line=0 or n/a, line incr=1 or n/a, sequence=alternate or n/a, direction=north or n/a, start stn=0, stn incr=positive).
- Select **System Setup** (# of EM61s=1, sensor size=0.5 × 1 (1/2 meter) or 1 × 1(full meter), GPS antennae=0.25m (1/2 meter) or 0.5m (full meter), leading em=1, trailing em=1 or n/a, sensor sep=0.0, em61#1 port=com1).
- Select **Logger Setup.**
- Enter correct data and time (as a backup synch field watch with data logger time to +-1 s accuracy.
- Units=meters or n/a, dump port=com1 or n/a, audio=yes or n/a, pause key=any two keys BUT NOT any key, bar scale=compressed or n/a.
- Select **GPS Input** (GPS input=enabled, nmea data=gll, com port=com2, baud rate=9600, parity=no, data bits=8, stop bits=1).
- Select **Logging.**
- Instrument is in *monitoring mode*; check GPS data (# satellites and position, AGPS for autonomous) and EM61 data (coil values, battery); DO NOT NULL without first contacting lead field geophysicist; no nulling should be required.
- Hit F1 key to enter filename and create file (select F3 and enter appropriate filename for geo team, date, sector, and file #). After enter filename then instrument automatically goes to *standby mode*.
- In *standby mode* screen very similar to *monitoring mode* but can enter comments-important (F3), new lines and stations (not applicable), a new scale (F4).
- Hit enter key on data logger to start digitally recording data. Station (# of readings) counter should be increasing rapidly; check that GPS has valid position and # satellites >= 5 to start survey. To enter comment, hit F3 and type in text (11 characters max).
- Wait ~ 30 seconds while standing as still as possible, then commence survey over Schonstedt at least 3 times in opposite directions—go over center of Schonstedt each time. Begin walking to first waypoint—keep distance > 4–5 meters between backpack operator and coil operator.

- To end the survey (or a file), hit the F5 key.
- During the survey, check the GPS logging status as well as the EM61 recording status ~ 15–30 minutes.

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14.0 SOP 2.32 DOMESTIC AND PUBLIC WELL SAMPLING

HGL HydroGeoLogic, Inc Exceeding Expectations

STANDARD OPERATING PROCEDURE

Domestic and Public Well Sampling	SOP No.: 2.32 SOP Category: HTRW Revision No.: 0 Date: December 2010

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the standard method and equipment used to perform sampling of private and public wells that are used for water supply.

2.0 SCOPE AND APPLICATIONS

The general techniques described in this procedure are in general agreement with the procedures outlined in the California Department of Pesticide Regulation, Environmental Hazards Assessment Program SOP Number FSWA001.00 and the Wisconsin Department of Natural Resources Groundwater Sampling Desk Reference, PUBL-DG-037 96, 1996.

This SOP emphasizes the need to care for the property of the owner and obtain the highest quality sample possible given the limitations of sampling wells that are outfitted with water delivery systems that are not designed for such sampling. Some jurisdictions have local regulations or guidelines and training/certification requirements that may differ from those described in this SOP. Before using this SOP, location-specific requirements should be evaluated.

3.0 GENERAL REQUIREMENTS

All work will be performed in a manner that is consistent with Occupational Safety and Health Administration established standards and requirements. Refer to the site- or project-specific health and safety plan for relevant health and safety requirements. All activities will be conducted in conformance with the Site Health and Safety Plan. Procedures for packaging and disposing of all waste generated during field activities will be described in the project-specific work plan.

Personnel who use this procedure must provide documented evidence to the program manager or project manager that they have been trained on the procedure. This documentation will be retained in the project file.

Any deviations from specified requirements will be justified to and authorized by the project manager and/or the relevant program manager and discussed in the approved project plans. Deviations from requirements will be sufficiently documented to re-create the modified process.

4.0 PROCEDURES

4.1 OBTAIN PERMISSION TO SAMPLE WELL

A signed access agreement for permission to sample well must be obtained from the property owner before sampling is conducted. Permission to sample each location will be coordinated with

Domestic and Public Well Sampling	SOP No.: 2.32 SOP Category: HTRW Revision No.: 00 Date: January 2010

the property owner through the Client, the HGL Project Manager, and Field Manager. Only after gaining explicit permission through these sources will the well owner be contacted and the sampling scheduled.

4.2 SAMPLING PREPARATION

Before departing for the field, the field team leader will disseminate information to the field samplers regarding specific well locations on the property, well depths, holding tank volumes, and other pertinent information.

4.3 INITIAL CONTACTS WITH PROPERTY OWNER

Ring the doorbell and identify yourself and your purpose. Offer your identification badge and/or business card to the property owner for inspection. Describe the sampling procedure to the property owner and ask if they have any questions or concerns. It is very important to listen to the owner's concerns and address questions in a professional and courteous manner. If any issues/concerns are encountered that cannot be resolved, sampling personnel should consult the Project Manager before proceeding.

Determine if the sample will be obtained from an indoor or an outdoor source. If the sample is collected from an outdoor source, ask if the owner has a preference for where to direct the purge water. If the information has not already been provided, the property owner should be questioned as to the well depth and holding tank capacity, if known. Additionally, the owner should be asked if they have a water filtration or conditioning unit in their system. If a water filter is connected to the water system, permission should be asked to obtain the sample before the water passes through such systems. If the property owner is not home but has given permission to sample, consult the sampling instructions for the location of the outside spigot.

4.4 PURGING AND SAMPLING

The equipment and supplies necessary to conducted domestic and private well sampling are listed in Attachment 3.

4.4.1 Small Water Supply Systems (private water supply and distribution systems)

Sample private and non-community wells as close to the well pump as possible; preferably before the water passes through any softener, heater, storage or pressure system, or tank. A sample tap is usually located just before the pressure tank. Remove any aerators, filters or other devices from the tap before collecting samples. If aerators are to be removed, wrap the aerator with a nitrile glove to protect the finish before using pliers to remove the fitting. If the sample must be collected from an outside tap, remove any hoses.

Determine the flow rate using a graduated bucket. Record the flow rate. Record oxidation reduction potential (ORP), pH, temperature, turbidity, and dissolved oxygen (DO) at frequent intervals during purging (at least every 5 minutes). Note any unusual odors or coloration in the water. Enter all data on the Field Sampling Data Sheet. Acquire samples and draw a diagram of where the sample was collected.

4.4.2 Sampling Tap Located after the Pressure Tank

If the sampling tap is located after the pressure tank, allow the water to run for at least five minutes and to become cold before collecting samples. This should allow stagnant water to be flushed out of the pressure tank and be replaced by freshly pumped water. For large pressure tanks, a longer period may be necessary. Either calculate the necessary flushing time based on the pressure tank volume and purging flow rate, or allow the pump to cycle at least two or three times and wait until the water is cold before collecting samples. Document that samples were collected after the pressure tanks. Record the purging time and tap location. Determine the flow rate using a graduated bucket and record that rate. Record ORP, pH, temperature, turbidity, DO at frequent intervals during purging and enter the data into the Field Sampling Data Sheet (Attachment 2). Acquire samples and draw a diagram of where the sample was collected.

5.0 DECONTAMINATION

Decontamination of non-dedicated sampling equipment should be conducted in accordance with SOP 2.01 *Cleaning and Decontaminating Sampling Equipment*.

6.0 FIELD QUALITY CONTROL

Quality control (QC) samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field QC samples must be collected and prepared in the same manner as regular investigation samples with regard to sample volume, containers, and preservation. Unless specified otherwise in the Quality Assurance Project Plan for the project, the following QC samples should be collected at the rates specified below. Trip blanks are required for samples being submitted for volatile organic compound (VOC) analysis at a frequency of one set per VOC sample cooler.

- Field duplicate (at least 1 for every 10 samples collected)
- Matrix spike (at least 1 for every 20 samples collected)
- Matrix spike duplicate (at least 1 for every 20 samples collected)
- Equipment blank (only needed if additional non-deposable sampling equipment is used to acquire the samples after the tap, at least 1 for every 20 samples collected or one per day)
- Trip blank (one per sample cooler containing VOC samples)
- Temperature blank (one per sample cooler)

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- Split samples (samples sent to an alternate laboratory. Sample rate to be specified in the project Work Plan)

The equipment blank will be acquired through use of organic-free deionized water poured over or pumped through the non-disposable sampling equipment used for sampling after it has been decontaminated. If tubing is dedicated to the well, the equipment blank will include only the pump in subsequent sampling rounds. Collect equipment blanks after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine precision of the sampling procedure. For this procedure, collect a duplicate for each analyte group in consecutive order (VOC original, VOC duplicate semivolatile organic compound (SVOC) original, SVOC duplicate, etc.).

If split samples are to be collected, collect the split for each analyte group in consecutive order (VOC original, VOC split, etc.). Split sample should be as identical as possible to original sample.

All monitoring instrumentation will be operated in accordance with EPA analytical methods and manufacturer's operating instructions. EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846 with exception of ORP, for which the manufacturer's instructions are to be followed. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. At the end of each day, check calibration to verify that instruments remained in calibration. Temperature measuring equipment, thermometers and thermistors, need not be calibrated at the above frequency. They should be checked for accuracy before field use according to EPA methods and the manufacturer's instructions.

7.0 FIELD LOGBOOK

A field logbook should be maintained in accordance with SOP 4.07 *Use and Maintenance of Field Logbooks*. The following information should be recorded:

- Well identification.
- Well depth, and measurement technique.
- Static water level depth, date, time and measurement technique.
- Presence and thickness of immiscible (nonaqueous phase) liquid layers and detection method.
- Pumping rate, drawdown, indicator parameters values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.
- Well sampling sequence and time of each sample collection.

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- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations during sampling event.
- Name of sample collector(s).
- Weather conditions.
- Quality assurance (QA)/QC data for field instruments.
- Any problems/issues encountered or unusual conditions observed.
- Description of all sampling equipment used, including trade names, model number, diameters, material composition and so forth.

8.0 RECORDS

Complete the Groundwater Field Sampling Data Sheet (measurement times, parameter values, purge volume, water levels, etc.). Record purge information in field logbook.

9.0 QUALITY CONTROL

The project QA Coordinator is responsible for ensuring that all equipment is calibrated daily before use and recording the calibration results on the Calibration Log. The QA Coordinator is responsible for periodically reviewing these results.

10.0 ATTACHMENTS

Attachment 1	Field Sampling Equipment and Supplies
Attachment 2	Groundwater Field Sampling Data Sheet
Attachment 3	Calibration Log

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ATTACHMENT 1
GROUNDWATER FIELD SAMPLING DATA SHEET

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Well No.:		Site:	
Sampler(s):		Project No.:	
Well Depth:		Date:	Time:
DTW (ft):	DTP (ft):	Courier: UPS Hand Other	
MP Ht. Above/Below Ground Surface:		Sampling Method (G=grab, B=bailer, SP=submersible pump	
Condition of Bottom of Well:		Type of Pump:	
Screen Interval (ft):		Weather (sun/clear, overcast/rain, wind direction, ambient temperature):	
Well Diameter (in):			
Placement of Pump (ft):			

TIME	DEPTH TO WATER (FT)	FLOW RATE (GPM)	TOTAL VOLUME (GAL)	PH	TEMP. (°C)	COND. (UMHOS/ CM)	ORP	D.O. (MG/L)	TURB (N.T.U.)	COMMENTS

OBSERVATIONS

Color: Clear Other (describe):
Odor: None Low Medium High Very strong H2S Fuel-like
Notes:
PURGE VOLUME CALCULATIONS For: well casing volume = J $(Rc)^2$ (well depth - static H_2O depth) x (conversion 7.48 gal/ft3)
Signed/Sampler(s):

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ATTACHMENT 2
CALIBRATION LOG

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Project Name: ____________________

Project No. ____________________

Date/Time	Calibrated by	Instrument	Standard/ Manufacturer Lot #	Standard Concentration	Instrument Reading	Comments

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ATTACHMENT 3
EQUIPMENT AND SUPPLIES

Equipment	
Horiba U-22 or YSI-556 water quality analyzer (with flow-thru cell)	Calculator for determining purge volume
Watch with second hand or stopwatch	PID or FID instrument (if appropriate) to detect VOCs for health and safety purposes, and to provide qualitative field evaluations
Camera (and film if not digital)	
Supplies	
Flow measurement supplies (e.g. graduated cylinder, stopwatch)	Trash bags
Plastic sheeting	Sponges
Paper towels	Decontamination supplies
Locking pliers	5-gallon bucket, 2-gallon bucket
Teflon®tape	Coolers
Sample bottles (with labels and/or tags)	Sample preservation supplies
Chain of custody forms	Personal protective equipment (PPE), Nitrile gloves, Tyvek, over boots, etc.
Garden hose or tubing with fitting to discharge water if not sampling in a drain.	Field logbook
Groundwater field sampling data sheet	Site-specific Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP)