DATA ITEM DESCRIPTION

Title: Geophysical Investigation Plan

Number: FPRI-005-05 **Approval Date:** 20031201
AMSC Number: **Limitation:**
DTIC Applicable: No **GIDEP Applicable:** No
Office of Primary Responsibility: CEHNC-ED-CS-G
Applicable Forms: Attachment A – Field Data Sheet, Attachment B – Quality Control Frequency & Acceptance Criteria Chart, Attachment C – Geophysical Dig Sheet and Target History, Attachment D – Example Geophysical Map Deliverable Format
Use/Relationship: The Geophysical Investigation Plan will be used to provide details of the approach, methods, and operational procedures to be employed in performing geophysical investigations for Military Munitions Response Program (MMRP) removal/remedial actions. This Data Item Description contains instructions for preparing work plan chapters and data requirements when addressing geophysical investigations for MMRP removal/remedial actions. Additional references include EM 1110-1-4009. Geophysical Investigations for Buried MunitionsOrdnance and Explosives Digital Geophysical Mapping Guidance- Operational Procedures and Quality Control Manual (DGM QC Manual).

Requirements:

1. Munitions and Explosives of Concern (MEC) Safety. During all initial fieldwork and all intrusive activities, the geophysical crew shall be accompanied by a UXO Technician II. Prior to the survey crew entering an area potentially containing MEC, the UXO Technician II shall conduct visualsurveys for surface MEC and a magnetometer or electromagnetic survey of each intrusive activity site to ensure the site is anomaly free prior to the crew setting monuments or driving stakes. The UXO Technician II will not be required on a full time basis for non-intrusive activities.

2. Personnel Qualifications. All geophysical investigations shall be managed by a qualified geophysicist meeting the qualification requirements listed in Section C of the Basic Contract.

3. Geophysical Investigation Plan Outline. The contractor shall prepare a geophysical investigation plan in accordance with the following outline:

3.1 Site Description.

a. Geophysical Data Quality Objectives. Define target objectives and Site Specific Project constraints. Refer to FPRI-005-05A for Geophysical Prove-out (GPO) requirements.

b. Specific area(s) to be investigated, including a Survey Mission Plan Map

c. Past, current and future use

d. Anticipated MEC type, composition and quantity

e. Depth anticipated

f. Digital topographic maps

g. Vegetation (digital air photos if available)

h. Geologic conditions (including bedrock type, mineralization and depth)

i. Soil conditions - including soil type/composition, typical moisture content, and thickness. Include Soil Conservation Service (SCS) map if available.

Geophysical conditions, including background geophysical gradients, regional magnetic field intensity, inclination, declination, local variation.

l. Site utilities

m. Man-made features potentially affecting geophysical investigations

n. Site-specific dynamic events such as tides, unusually strong winds, or other unusual factors affecting site operations

o. Overall site accessibility and impediments

p. Potential worker hazards

3.2 Geophysical Investigation.

a. Survey type – fixed pattern, transect, meandering path, hybrid

b. Equipment
- Survey platforms
- Detectors
- Sampling rates
- Navigation and mapping system (Note- If GPS systems are used, correlate satellite availability with work/rest periods)
- Data processing system

c. Procedures. Refer to Attachment A for Field Data Sheet format that is required for each area surveyed

d. Personnel – Identify responsible geophysicist and project team members with designated responsibilities and requirements

e. Data spatial density (define data in-line spacing and lane width)

3.3 Instrument Standardization. Refer to Attachment B for minimum test frequency requirements and acceptance criteria.

3.4 Data Processing, Corrections and Analysis. Detail initial field processing, standard data analysis methods, advanced data analysis techniques that may be required by certain project specific conditions, anomaly selection and decision criteria.

a. Initial field processingData file QC review and correction
- Grid name and location
- Line numbers, survey direction, fiducial locations, start and end points
- Removal of data drop-outs, spikes and physical feature interference sources

b. Standard data analysis -Diurnal correction (magnetic data)
- Positional offset correction
- Sensor bias, background leveling and/or standardization adjustment
- Sensor drift removal
- Latency Correction
- Heading error removal (magnetic data)
- Geophysical noise identification and removal (spatial, temporal, motional, terrain induced)
- Gridding method and search criteria
- Contour level selection with background shading and analysis

c. Advanced data processing, digital filtering and enhancement (if applicable)
- Dipole match, or Analytic Signal calculation (magnetic data)
- Adaptive (matched) filtering
- Approximate magnetic volume/mass estimates (magnetic data)
- Approximate depth determination
- Time decay curve analysis (TDEM data)
- Amplitude and Phase response analysis (FDEM)
- Data Fusion
- Digital filtering and Enhancement (low pass, high pass, band pass, Convolution, Correlation, Non-linear, etc…)

d. Anomaly selection and decision criteria

3.5 Dig Sheet Development. Refer to Attachment C for form.

3.6 Anomaly Reacquisition.

3.7 Feed-Back Process (Comparison of dig-sheet predictions with ground-truth excavation results).

3.8 Quality Control.

3.9 Corrective Measures.

3.10 Records Management (Life Cycle Data Management, resource loaded schedule in MicrosoftProject 2000 format, data transfer, and data storage).

3.11 Interim Reporting. (Include frequency of data submittals, dig-sheet and excavation results submittals.)

3.12 Map Format. Refer to Attachment D.

4. Geophysical Investigation Performance Goals.

4.1 Detection of Munitions and Explosives of Concern (MEC) or MC.

a. A simplified expression for maximum depth of detection is calculated as:

Estimated Detection Depth (meters) = 11*diameter (mm) / 1000

b. Minimum ordnance item diameter must be determined on a project-specific basis. The contractor shall detect and remove all metallic items located within the target objective performance box on Figure 1 (blue area).

c. Any unexcavated (missed) item that has an intermediate principal axis diameter that fits withinthe target acceptance box is considered to be a Quality failure. The contractor will, at no expense to the Government, correct the Quality deficiency and re-sweep and perform QC on all affected areas again before re-submitting to the Government for verification and acceptance.

d. If the contractor believes the target objective performance goals cannot be achieved at a particular site, then the contractor shall propose and document alternative goals for the Contracting Officer's consideration. The contractor will not be held liable for technically unachievable goals, as determined during the GPO and initial phase of field work.

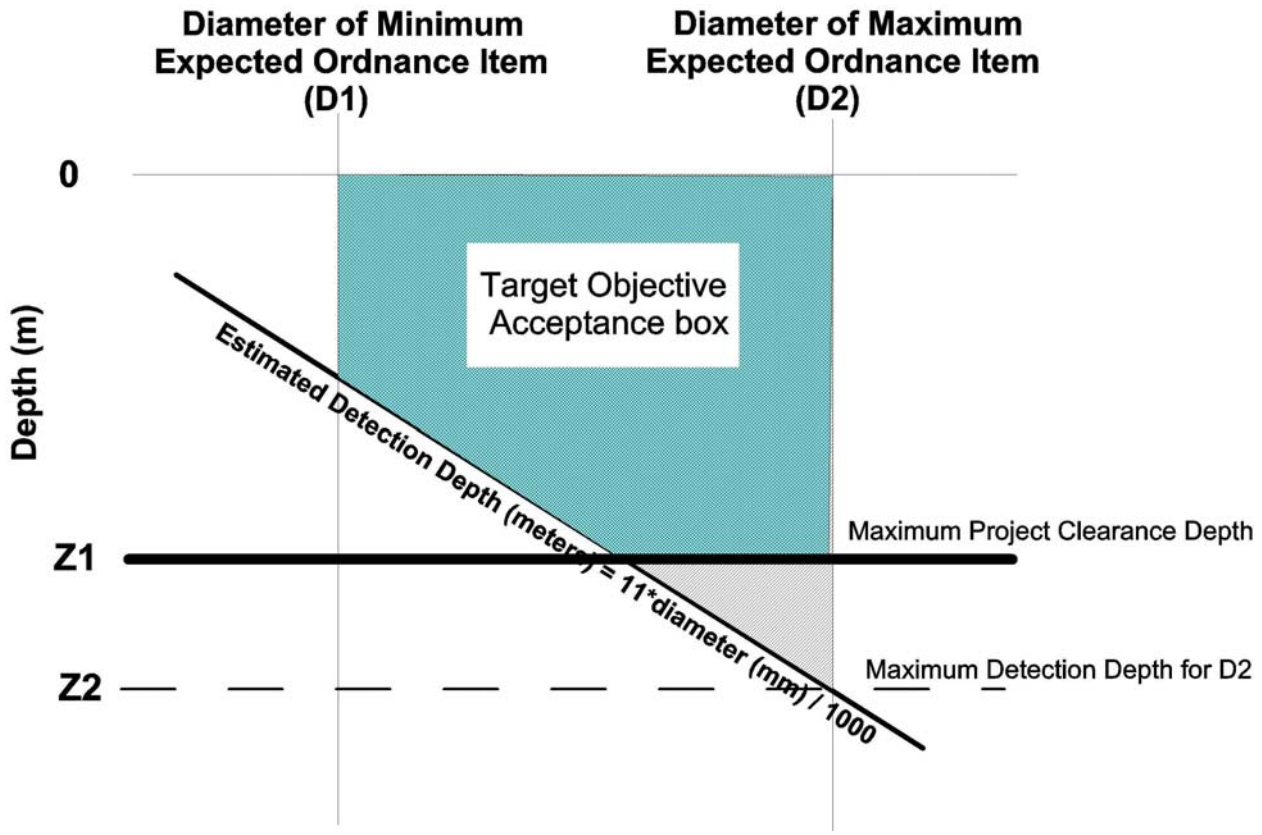

Figure 1 – Geophysical Target Objective Acceptance Box

4.2 Horizontal Accuracy. Horizontally, 95% of all reacquired anomaly locations must lie within a one (1) meter radius of their original surface location as marked on the dig sheet.

4.3 False Positives. If there are more than 15% "false positives" (anomalies reacquired by the Contractor result in no detectable metallic material recovered during excavations, calculated as a running average for the sector), a re-evaluation of the data, detection methods being utilized, and overall project QC shall be performed at no cost to the Government. A written response explaining the reason for the excessive false positive results and a Corrective Action Plan, if appropriate, shall be submitted to the Contracting Officer within 10 days of identification of the situation.

5. Geophysical Mapping Data.

5.1 The Contractor shall correlate all sensor data with navigational data based upon a local “third order” (1:5,000) monument or survey marker. If a suitable point is not available, the Contractor shall have a Professional Land Surveyor (PLS) establish a minimum of two (2) new monuments or survey markers per sector with a minimum of “third order” accuracy. All sensor data shall be preprocessed for sensor offsets, diurnal magnetic variations, latency corrections, drift corrections,etc. and correlated with navigation data. Diurnal magnetic variations measured at a base-station must be collected at a minimum of once per minute. The approved geophysical mapping technologyshall digitally capture the instrument readings into a file coincident with the grid coordinates. All raw and final processed data shall be delivered corrected and processed in ASCII files. Corrections such as for navigation, instrument bias, and diurnal magnetic shift shall be applied. All corrections shall be documented. Geophysically mapped grids shall be exactly coincident with the grid system used by the UXO removal or remedial action contractor and shall use exactly the same datum and coordinate system. However, the geophysical contractor may choose to provide geophysical data files in grids of up to 400 ft. x 400 ft. square. The data shall be presented in delineated fields as x, y, z, v1, v2, etc., where x and y are UTM Grid Plane Coordinates in Easting (meters) and Northing(meters) directions, z (elevation is an optional field in meters), and v1, v2, v3, etc., are theinstrument readings. The last data field should be a time stamp. Each data field shall be separated by a comma or tab. No individual file may be more than 100 megabytes in size and no more than 600,000 lines long. Each grid of data shall be logically and sequentially named so that the file namecan be easily correlated with the grid name used by other project personnel. The formats specified in this paragraph are REQUIRED to be exactly followed, although the Contractor may choose to submitthe data in additional formats as well. No later than 36

hours after collection, the Contractor shall furnish each day's data to USAESCH, via internet using FTP, E-mail attachment for small files under 5 Mb, digital compact disk (CD) or other approved method, for inspection. Such data is considered to be in draft form. This data shall be corrected for sensor offsets, diurnal variations, latency, heading error, and drift. The Contractor shall also provide a digital planimetric map, in Intergraph .DGN, Surfer .srf, ESRI ArcView or Geosoft format, and coincident with the location of the geophysical survey, so that each day's geophysical data set can be registered within the originalmission plan survey map. Within 10 days after collection, the Contractor shall furnish interim dig sheets for each day's data to USAESCH via email. Within 14 days of completion of survey activity the Contractor shall provide USAESCH all final geophysical maps, dig-sheets and supporting geophysical interpretations. All geophysical data shall be accompanied by a Microsoft Word 6.0 or higher file documenting the field activities associated with the data, and the processing performed.The Government will periodically perform validation checks to assure positional accuracy, proper instrument calibration or other analysis. Draft Data shall be provided within 24 hours of request to the government representative performing QA activities on the project.

5.2 Geophysical Data Analysis, Field Reacquisition, and Reporting. The Contractor shall analyze the geophysical data and provide complete digital "dig-sheets" in Microsoft Excel spreadsheet format utilizing Attachment C. Microsoft Access '97(or higher) database tables that include pre-built queries for the required information are also acceptable.

5.3 Anomaly Reacquisition and Marking. The same contractor that geophysically mapped and analyzed the survey area shall reacquire all geophysical anomalies identified for excavation on the dig sheets using the re-acquisition method tested by the Contractor and approved by CEHNC on the GPO. The Contractor shall flag (PVC flag with the unique identifier number recorded in indelible ink on the flag) the actual field location of each re-acquired anomaly shown on the "dig-sheet" and paint the ground (if feasible and allowable) at the flag location with high-visibility paint. Such reacquisition shall be carried out concurrently with other site activities and shall be completed no later than 14 days after geophysical field investigations are completed. If a longer than 14 day hiatus between the geophysical survey work and re-acquisition is expected, this should be so stated in the resource loaded Project Schedule that is submitted for Government approval. The Contractor shall record and report on all discrepancies between final reacquired mapped locations of anomalies as shown on the dig-sheet, and actual locations of the excavated anomalies. The Contractor shall also report any anomalies that could not be reacquired.

5.4 Anomaly Excavation Reporting. The Contractor shall, in full accordance with the project work plan, excavate the reacquired anomalies in the field. The disposition and final location details of each anomaly shall be recorded on the final dig sheets, which shall be submitted to the USAESCH within 10 days of completed excavations for that individual grid and also submitted in the Site Inspection, Remedial Investigation/Feasibility Study, Engineering Evaluation/Cost Analysis, or Site Specific Final Report.

6. End of DID FPRI-005-05.

DID FPRI-005-05
Attachment B
Field Data Sheet

☐ QC checked by _____ Date: _____

☐ QA checked by _____ Date: _____

Project Name: _____ **Project Location:** _____

Geophysical Contractor: _____ **Design Center POC:** _____

Project Geophysicist: _____ **Site Geophysicist:** _____

Survey Area ID: _____ **Date:** _____ **Field Team:** _____

Survey Type: ☐Grid ☐Meandering Path ☐Transect ☐Other _____

Coordinate System: ☐UTM ☐State Plane NAD _____ ☐Local ☐Other _____ **Unit of Measure:** ☐ meters ☐ feet

Sketch of Survey Area: **Approx. Scale:** _____ **North Arrow:**

_____

Terrain:

☐Level ☐Moderate Slope ☐Steep

☐Rolling ☐Ruts ☐Gullies

☐Rocky ☐Swampy ☐Dangerous

Tree Cover: **Tree Height:** ____

☐None ☐Light ☐Medium ☐Thick

Brush:

☐None ☐Light ☐Medium ☐Thick

Weather:

☐Sunny ☐Cloudy ☐Drizzle

☐Rain ☐Thunderstorms ☐Hail

☐Fog ☐Humid ☐Snow

Grid Corner Coordinates:

	UTM/State Plane	Local
SW	_____, _____	_____, _____
NW	_____, _____	_____, _____
NE	_____, _____	_____, _____
SE	_____, _____	_____, _____

	Start	End	File Name
Battery Voltage:	_____	_____	
Static Background Value:	_____	_____	_____, _____
Static Response Value:	_____	_____	_____, _____

Instrument Clock Drift: _____

Raw Data File Name: _____ **Repeat Data File Name:** _____

Geophysical Instrumentation: _____ **Serial Number:** _____

Base Station: _____ **Serial Number:** _____

Navigation Method: _____ **Serial Number:** _____

Additional Comments:

_____

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Attachment B

Quality Control Frequency & Acceptance Criteria Chart

To facilitate the detection of buried munitions, the U.S. Army Engineering and Support Center, Huntsville (USAESCH) has defined standard equipment tests and data quality. It is imperative to perform and review QC tests before carrying out production geophysical work. This ensures that the geophysical system is functioning properly and optimized for the target objectives.
The most common instruments in use today for metallic munitions detection are magnetometers, and electromagnetic metal detectors. This chart identifies the minimum USAESCH required QC tests and acceptance criteria for these types of instruments.

Test #	Test Description	Acceptance Criteria	Power on	Beginning of	Begi-ning & Day	1st P each o-	1 Lir ft. per Linear Mile `00
1	Equipment Warm-up	Equipment Specific (typically 5 min)	X				
2	Record Sensor Positions	+/- 1 inch (2.54 cm)		X			
3	Personnel Test	EM61 2mV p-p, Mag 3nT p-p		X			
4	Vibration Test (Cable Shake)	Data Profile does not exhibit data spikes		X			
5	Static Background & Static Spike	Background: EM61 2.5 mV p-p, Mag 1nT p-p;			X		
		Spike : +/- 20% of standard item response, after background correction.					
6	Azimuthal Test *	Sensor Orientation that minimizes drop-outs				X	
7	Height Optimization	Maximum S/N ratio that reliably detects smallest target objective.				X	
8	6 Line Test	Repeatability of response amplitude +/-20%, Positional Accuracy +/- 20cm				X	
9	Octant Test (Heading Error Test) *	Document heading error for post-processing correction				X	
10	Repeat Data	Repeatability of response amplitude +/-20%, Positional Accuracy +/- 20cm					X

* Magnetometer Only

Geophysical Dig Sheet and Target History

Page ____ of _____

Reacquisition Geophysical Equipment Used	Component	Serial #	Grid Background Value (mV / nT)	Date	Time

Project Name: ___________________________________

Project Location: ___________________________________

Date: ___________________________________

Coordinate System: ___________________________________

Survey Area ID: ___________________________________

Sector: ________ Grid: ____________

Field Book ID: ___________________________________

Geophysical Contractor: ____

Project Geophysicist: ____

Site Geophysicist: ____

Field Team: ____

COE Design Center POC: ____

COE Project Engineer: ____

COE Geophysicist: ____

	Original Survey						Reacquisition Survey			Dig Results											Post-Dig UXO QC Results			Post-Dig Geophysical QC		
													Offset													
Unique Target ID	Easting Coord. (ft/m)	Northing Coord. (ft/m)	Channel ID (ie-C1 ....C4, top sensor, gradient, etc)	Response Amplitude (units*)	Dig Priority (0 is no dig-known anomaly source,1 is highest dig recommendation, etc..)	Date	Channel ID (ie-C1 or C4, top sensor, gradient)	Response Amplitude (units*)**	Date	Anomaly type ***	Approx. weight (lbs-oz / kg-g)	Comments	Distance (ft / m)	Direction (N, NE, etc.)	Orientation of Nose (Azimuth deg) **	Inclination of Nose (deg) **	Depth to Top of Item (in/cm)	Digital Photo Filename **	Date	Team Leader Initials	Excavation Hole Cleared?	UXO QC Spec. Initials	Date	Agreement between Dig Results & Geophysical Data? (G=good, P=poor, U=unacceptable)	Geophysicist QC Initials	Date

Geophysical Map Example Deliverable Format