AD NO. _____
DTC PROJECT NO. 8-CO-160-UXO-021
REPORT NO. ATC-8807

STANDARDIZED

UXO TECHNOLOGY DEMONSTRATION SITE

OPEN FIELD SCORING RECORD NO. 187

SITE LOCATION:
ABERDEEN PROVING GROUND

DEMONSTRATOR:
GEO-CENTERS, INC.
7 WELLS AVENUE
NEWTON, MA 02459

TECHNOLOGY TYPE/PLATFORM:
STOLS (DUAL MODE EM61/822A MAG)
TOWED ARRAY

PREPARED BY:
U.S. ARMY ABERDEEN TEST CENTER
ABERDEEN PROVING GROUND, MD 21005-5059

JUNE 2004

Prepared for:
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MD 21010-5401

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14. ABSTRACT
This scoring record documents the efforts of GEO-CENTERS, Inc., to detect and discriminate inter unexploded ordnance (UXO) utilizing the APG Standardized UXO Technology Demonstration Site Open Field. The scoring record was coordinated by Larry Overbay and the by the Standardized UXO Technology Demonstration Site Scoring Committee. Organizations on the committee include the U.S. Army Corps of Engineers, the Environmental Security Technology Certification Program, the Strategic Environmental Research and Development Program, the Institute for Defense Analysis, the U.S. Army Environmental Center, and the U.S. Army Aberdeen Test Center.

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SECTION 1. GENERAL INFORMATION

1.1 BACKGROUND

Technologies under development for the detection and discrimination of unexploded ordnance (UXO) require testing so that their performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland and U.S. Army Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multi-agency program spearheaded by the U.S. Army Environmental Center (AEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

1.2 SCORING OBJECTIVES

The objective in the Standardized UXO Technology Demonstration Site Program is to evaluate the detection and discrimination capabilities of a given technology under various field and soil conditions. Inert munitions and clutter items are positioned in various orientations and depths in the ground.

The evaluation objectives are as follows:

a. To determine detection and discrimination effectiveness under realistic scenarios that vary targets, geology, clutter, topography, and vegetation.

b. To determine cost, time, and manpower requirements to operate the technology.

c. To determine demonstrator's ability to analyze survey data in a timely manner and provide prioritized "Target Lists" with associated confidence levels.

d. To provide independent site management to enable the collection of high quality, ground-truth, geo-referenced data for post-demonstration analysis.

1.2.1 Scoring Methodology

a. The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver-operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to

emplaced clutter items, measuring the probability of false positive (P_{fp}), and those that do not correspond to any known item, termed background alarms.

b. The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the open field RESPONSE STAGE, the demonstrator provides the scoring committee with the field location and signal strength of all anomalies that the demonstrator has deemed sufficient to warrant further investigation and/or processing as potential emplaced ordnance items. This list is generated with minimal processing and will only include signals that are above the system noise level.

c. The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such and to reject clutter. For the same field locations as in the RESPONSE STAGE anomaly list, the DISCRIMINATION STAGE list contains the output of the algorithms applied in the discrimination-stage processing. This list is prioritized based on the demonstrator's determination that an anomaly location is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For digital signal processing, priority ranking is based on algorithm output. For other discrimination approaches, priority ranking is based on human (subjective) judgment. The demonstrator also specifies the threshold in the prioritized ranking that provides optimum performance termed the Discrimination Stage Threshold (i.e. that is expected to retain all detected ordnance and reject the maximum amount of clutter).

d. The demonstrator is also scored on EFFICIENCY and REJECTION RATIO, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from non-ordnance items. EFFICIENCY measures the fraction of detected ordnance retained after discrimination, while the REJECTION RATIO measures the fraction of false alarms rejected. Both measures are defined relative to the entire response stage anomaly list, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

e. Based on configuration of the ground truth at the standardized sites and the defined scoring methodology, there exists the possibility of having anomalies within overlapping halos and/or multiple anomalies within halos. In these cases, the following scoring logic is implemented:

(1) In situations where multiple anomalies exist within a single R_{halo}, the anomaly with the strongest response or highest ranking will be assigned to that particular ground truth item.

(2) For overlapping R_{halo} situations, ordnance has precedence over clutter. The Anomaly with the strongest response or highest ranking that is closest to the center of a particular ground truth item gets assigned to that item. Remaining anomalies are retained until all matching is complete.

(3) Anomalies located within any R_{halo} that do not get associated with a particular ground truth item are thrown out and are not considered in the analysis.

f. All scoring factors are generated utilizing the Standardized UXO Probability and Plot Program, version 3.1.1.

1.2.2 Scoring Factors

Factors to be measured and evaluated as part of this demonstration include:

a. Response Stage ROC curves:

(1) Probability of Detection (P_d^{res}).

(2) Probability of False Positive (P_{fp}^{res}).

(3) Background Alarm Rate (BAR^{res}) or Probability of Background Alarm (P_{BA}^{res}).

b. Discrimination Stage ROC curves:

(1) Probability of Detection (P_d^{disc}).

(2) Probability of False Positive (P_{fp}^{disc}).

(3) Background Alarm Rate (BAR^{disc}) or Probability of Background Alarm (P_{BA}^{disc}).

c. Metrics:

(1) Efficiency (E).

(2) False Positive Rejection Rate (R_{fp}).

(3) Background Alarm Rejection Rate (R_{BA}).

d. Other:

(1) Probability of Detection by Size and Depth.

(2) Classification by type (i.e., 20-, 40-, 105-mm, etc.).

(3) Location accuracy.

(4) Equipment setup, calibration time and corresponding man-hour requirements.

(5) Survey time and corresponding man-hour requirements.

(6) Reacquisition/resurvey time and man-hour requirements (if any).

(7) Downtime due to system malfunctions and maintenance requirements.

1.3 STANDARD AND NONSTANDARD INERT ORDNANCE TARGETS

The standard and nonstandard ordnance items emplaced in the test areas are listed in Table 1. Standardized targets are members of a set of specific ordnance items that have identical properties to all other items in the set (caliber, configuration, size, weight, aspect ratio, material, filler, magnetic remanence, and nomenclature). Nonstandard targets are inert ordnance items having properties that differ from those in the set of standardized targets.

TABLE 1. INERT ORDNANCE TARGETS

Standard Type	Nonstandard (NS)
20-mm Projectile M55	20-mm Projectile M55
	20-mm Projectile M97
40-mm Grenades M385	40-mm Grenades M385
40-mm Projectile MKII Bodies	40-mm Projectile M813
BDU-28 Submunition	
BLU-26 Submunition	
M42 Submunition	
57-mm Projectile APC M86	
60-mm Mortar M49A3	60-mm Mortar (JPG)
	60-mm Mortar M49
2.75-inch Rocket M230	2.75-inch Rocket M230
	2.75-inch Rocket XM229
MK 118 ROCKEYE	
81-mm Mortar M374	81-mm Mortar (JPG)
	81-mm Mortar M374
105-mm Heat Rounds M456	
105-mm Projectile M60	105-mm Projectile M60
155-mm Projectile M483A1	155-mm Projectile M483A
	500-lb Bomb

JPG = Jefferson Proving Ground

SECTION 2. DEMONSTRATION

2.1 DEMONSTRATOR INFORMATION

2.1.1 Demonstrator Point of Contact (POC) and Address

GEO-CENTERS, Inc.
7 Wells Ave.
Newton, MA 02459

2.1.2 System Description (provided by demonstrator)

a. The simultaneous electromagnetic (EM) and magnetometry system (multisensor Surface Towed Ordnance Location System (STOLS)) is a towed vehicular array developed by GEO-CENTERS and Corps of Engineers - Huntsville Center (CEHNC) with funding from ESTCP under project UX-0208 (fig. 1). The system simultaneously collects both total field magnometry (Mag) data and EM61 data on a single towed platform. GEO-CENTERS' existing STOLS was used as a host system; the STOLS custom-fabricated aluminum dune buggy with a low magnetic self-signature, Mags, differential Global Positioning System (GPS), sensors, computers, and tractor-trailer for transportation were reused. The new simultaneous EM and magnetometry system augments STOLS with interleaved sampling electronics that allow EM61 coils to be physically located on the same platform as the Mags without corrupting the Mag data. The electronics monitor the rising edge of the 75-Hz transmit pulse from the EM61, waits 8 ms for the pulse to die down, sample the Mags for 5 ms, and then wait for the next transmit pulse and repeat the cycle. Data acquired at McKinley Test Range (Redstone Arsenal, Huntsville) show that Mag data quality, with the EM system switched on, is commensurate with Mag data quality when the EM system is switched off. Mag, EM61, and GPS data are acquired in a single file.

b. Along with new interleaved sampling electronics is a new, proof-of-concept, non-metallic tow platform to host both the EM61 coils and the Mags in a low-noise environment. Constructed almost entirely from fiberglass, the only metallic components on the platform are the axles, the hub, and a small number of aluminum pop rivets. The wheels are composite. Even the tires have had the metal beads removed. Total metallic mass has been reduced by over 99 percent by weight as compared to the original aluminum STOLS tow platform. Certain key structural locations have been reinforced with marine-grade plywood. The proof-of-concept platform was fielded successfully for a prove-out at McKinley Test Range. However, it should be noted that the platform was designed to fit into the existing budget for the ESTCP project, not for commercial surveys; it has no suspension, is speed-limited, and may not survive a fielding over rugged terrain without sustaining structural damage.

Figure 1. Demonstrator's system.

c. Five Geometrics 822A Mags, updating and outputting at 75 Hz, are deployed at 1/2-meter spacing. The Mags are 3 meters behind the tow vehicle. Three 1/2-meter Geonics EM61 coils (upper and lower), internally updating at 75 Hz and outputting at 10 Hz, are deployed in a master/slave configuration on the rear of the platform, 2.5 meters behind the Mags, also at 1/2-meter spacing. The centerline of the middle three Mags is coincident with the center line of the three EM61 coils. Both the Mags and the lower EM61 coils are mounted on pivots so they can swing up if they encounter an obstacle while moving forward.

2.1.3 Data Processing Description (provided by demonstrator)

Custom, Unix-based data processing software is used to process the file containing the Mag, EM61, and GPS data. The GPS updates are first automatically examined, and any jumps that could not occur at a nominal vehicle speed are flagged, allowing the operator to manually correct them. Sensor heading is calculated using smoothed position updates.

Mag and EM61 data are then processed separately, as they require different corrections. For the Mag data, the reference Mag recording the ambient variations of the Earth's magnetic field is time-correlated, then subtracted off. The data are then directionally divided into passes acquired in uniform directions (that is, north-going, south-going, west-going, and east-going, or whatever set of directions were used for the survey site). For each major direction, an independent set of sensor offsets is calculated and applied to that set to background-level the

sensors and remove streaks in the image. A site-wide offset may also be applied if the reference Mag is over geology with a background different than that of the survey site.

EM61 background is not directionally dependent, but EM61 data are background-leveled individually by file to account for drift that may occur file-to-file.

Once the background-leveling corrections have been determined, data are processed as follows. Adjacent 1-Hz GPS updates are used to position the sensor array at the beginning and at the end of each second. From there, each sensor on the array can be positioned at each of its updates. An array is set up by the data processing software at a 10-cm cell spacing, and each sensor update is positioned into the appropriate cell in the array. A nearest-neighbor-inverse-distance-squared interpolation is used to fill in the intersensor spacing regardless of the direction of travel. The interpolated image is then displayed on the screen for analysis.

Analysis of the Mag is performed using a nonlinear least squares match to a model of a point dipole with adjustable angles. Outputs from the model are object location, depth, magnetic moment, angle of incidence, and angle of orientation. On the basis of magnetic moment, an estimate is made of object size. For objects that do not resemble point dipoles because they are either too weak or too spatially extended, the object's location can be pinpointed using the mouse. An optional comment field may be added to each target.

Simultaneous viewing and analysis of the simultaneously collected Mag and EM data is obtained by running two linked copies of the data processing software. Once linked, panning, zooming and scrolling in one set of data automatically pans, zooms, and scrolls in the other set, and drawing a region of interest in one set of data automatically draws the same region in the other set.

Data output is available in a variety of formats, including raw, corrected (navigation corrected and background-leveled), and interpolated.

2.1.4 Data Submission Format

Data were submitted for scoring in accordance with data submission protocols outlined in the Standardized UXO Technology Demonstration Site Handbook (app E, ref 1). The submitted data are not included in this report in order to protect ground truth information.

2.1.5 Demonstrator Quality Assurance and Quality Control (provided by demonstrator)

a. The following quality control (QC) steps are taken:

(1) Coordinates of the control monument over which to set up the base GPS station are obtained before deploying to the survey site. These coordinates are obtained in both latitude and longitude (WGS84), as well as the rectangular coordinate system used for final data submission (preferably UTM WGS84 meters), so verification that coordinates can be correctly converted between these two coordinate systems is obtained.

(2) The system is set up using checklists for the vehicle and platform, GPS, and diurnal variation stations.

(3) GPS data, Mag data, and EM61 data are all numerically displayed in a Windows program on the data acquisition computer. These numbers are all visually inspected prior to survey data acquisition, and at the beginning and end of each survey line.

(4) The six-line test required by CEHNC is performed.

b. The following quality assurance steps are taken:

(1) Data are processed and imaged in the field, immediately after survey operations, to ensure that the data are of nominal quality.

(2) Any available control points, such as grid corner coordinates, are overlaid to ensure that the GPS was properly set up and that there are no coordinate offsets.

(3) Reference data are displayed to ensure that there are no unphysical spikes or dropouts.

(4) During processing, GPS data are viewed and corrected if necessary.

(5) Mag data are reference-corrected.

(6) Mag data are background-leveled using a correction specific to the direction of travel.

(7) EM61 data are background-leveled individually for each data file to mitigate the effects of drift.

(8) After data are converted to the desired data output format (e.g., ASCII, comma-delimited .dat files), these files are read back in to the Unix-based data processing software, processed, and viewed.

2.1.6 Additional Records

The following record of this demonstrator's field activities can be accessed via the Internet as PDF files at www.uxotestsites.org.

Geo-Centers Blind Grid Scoring Record No. 40, dated November 2003. Record is published.

2.2 ABERDEEN PROVING GROUND SITE INFORMATION

2.2.1 Location

The APG Standardized Test Site is located within a secured range area of the Aberdeen Area of APG. The Aberdeen Area of APG is located approximately 30 miles northeast of Baltimore at the northern end of the Chesapeake Bay. The Standardized Test Site encompasses 17 acres of upland and lowland flats, woods and wetlands.

2.2.2 Soil Type

a. According to the soils survey conducted for the entire area of APG in 1998, the test site consists primarily of Elkton Series type soil (ref 2). The Elkton Series consist of very deep, slowly permeable, poorly drained soils. These soils formed in silty aeolin sediments and the underlying loamy alluvial and marine sediments. They are on upland and lowland flats and in depressions of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 2 percent.

b. ERDC conducted a site-specific analysis in May of 2002 (ref 3). The results basically matched the soil survey mentioned above. Seventy percent of the samples taken were classified as silty loam. The majority (77 percent) of the soil samples had a measured water content between 15- and 30-percent with the water content decreasing slightly with depth.

c. For more details concerning the soil properties at the APG test site, go to www.uxotestsites.org on the web to view the entire soils description report.

2.2.3 Test Areas

A description of the test site areas at APG is included in Table 2.

TABLE 2. TEST SITE AREAS

Area	Description
Calibration Grid	Contains 14 standard ordnance items buried in six positions at various angles and depths to allow demonstrator to calibrate their equipment.
Blind Test Grid	Contains 400 grid cells in a 0.2-hectare (0.5 acre) site. The center of each grid cell contains ordnance, clutter or nothing.
Open Field	A 4-hectare (10-acre) site containing open areas, dips, ruts and obstructions that challenge platform systems or hand held detectors. The challenges include a gravel road, wet areas and trees. The vegetation height varies from 15 to 25 cm.

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SECTION 3. FIELD DATA

3.1 DATE OF FIELD ACTIVITIES (7 through 11 October 2002)

3.2 AREAS TESTED/NUMBER OF HOURS

Areas tested and the total number of hours operated at each site are summarized in Table 3.

TABLE 3. AREAS TESTED AND NUMBER OF HOURS

Area	Number of Hours
Calibration Lanes	5.17
Blind Grid	11.25
Open Field	17.33

3.3 TEST CONDITIONS

3.3.1 Weather Conditions

An ATC weather station located approximately 2 miles west of the test site was used to record average temperature and precipitation on an hourly basis for each day of operation. The temperatures listed in Table 4 represent the average temperature during field operations from 0700 through 1700 hours while the precipitation data represents a daily total amount of rainfall. Hourly weather logs used to generate this summary are provided in Appendix B.

TABLE 4. TEMPERATURE/PRECIPITATION DATA SUMMARY

Date, 02	Average Temperature, ^{o}F	Total Daily Precipitation, in.
October 7	72.6	0
October 8	57.6	0
October 9	58.9	0
October 10	63.5	0.61
October 11	64.9	2.59

3.3.2 Field Conditions

Geo-Center surveyed the open field on October 9th and 10th. The field was dry on the 9 October but became muddy on 10 October due to rain.

3.3.3 Soil Moisture

Five soil probes were placed at various locations of the site to capture soil moisture data: wet, wooded, and open areas, the calibration lanes, and the blind grid/moguls. Measurements were collected in percent moisture and were taken twice daily (morning and afternoon) from five different soil layers (0 to 6 in., 6 to 12 in., 12 to 24 in., 24 to 36 in. and 36 to 48 in.) from each probe. Soil measurement logs are included in Appendix C.

3.4 FIELD ACTIVITIES

3.4.1 Setup/Mobilization

These activities included initial mobilization and daily equipment preparation and breakdown. A crew of from 2 people took 1 hour and 50 minutes to perform the initial setup and mobilization. Daily equipment preparation took 2 hours and 23 minutes while end of day equipment breakdown took 1 hour and 5 minutes. Daily start/stop activities totaled 1 hour and 40 minutes for the open field.

3.4.2 Calibration

The demonstrator spent 5 hours and 6 minutes in the calibration lanes on October 7 and 8 2002 using the towed multi-sensor (STOLS). No other calibration activities were conducted while operating in the open field.

3.4.3 Downtime Occasions

Occasions of downtime are grouped into five categories: equipment/data checks or equipment maintenance, equipment failure and repair, weather, Demonstration Site issues, or breaks/lunch. All downtime is included for the purposes of calculating labor costs (section 5) except for downtime due to Demonstration Site issues. Demonstration Site issues, while noted in the Daily Log, are considered non-chargeable downtime for the purposes of calculating labor costs and are not discussed. Breaks and lunches are not discussed either.

3.4.3.1 Equipment/data checks, maintenance. Equipment/data checks and maintenance activities accounted for 13 hours and 3 minutes of site usage time. These activities included changing out batteries and routine data checks to ensure that data were being properly recorded/collected

3.4.3.2 Equipment failure or repair. GEO-CENTERS had no equipment failure while surveying the open field.

3.4.3.3 Weather. No weather delays occurred while in the open field.

3.4.4 Data Collection

The demonstrator spent 9 hours and 8 minutes collecting data in the open field. This time excludes break/lunches and downtimes described in section 3.4.3.

3.4.5 Demobilization

A crew of two people took 2 hours to break down and pack up equipment for demobilization.

3.5 PROCESSING TIME

GEO-CENTERS submitted the raw data from demonstration activities on the last day of the demonstration, as required. The scoring submission data were also provided within the required 30-day time frame.

3.6 DEMONSTRATOR'S FIELD PERSONNEL

Supervisor: Allan Crandall
Data Analyst: Rob Siegel

3.7 DEMONSTRATOR'S FIELD SURVEYING METHOD

GEO-CENTERS began surveying in the northeast corner of the field and continued in a north/south direction. GEO-CENTERS placed two straight lines of flags on the ground separated approximately 5 meters apart in width and approximately 75 meters in length. The tow vehicle was driven between these flags in an effort not to miss any part of the surveying areas.

3.8 SUMMARY OF DAILY LOGS

Daily logs capture all field activities during this demonstration and are located in Appendix D. Activities pertinent to this specific demonstration are indicated in highlighted text.

The only other issue besides those mentioned in section 3.4 was that GEO-CENTERS requested to drive wooden stakes into the ground in the open field to layout measuring tapes and mark grids. This request was denied to protect the integrity of the site. GEO-CENTERS did use cones and non-intrusive anchoring points as stakes to layout their measuring tapes and mark grids. The use of these is noted in Appendix D.

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SECTION 4. TECHNICAL PERFORMANCE RESULTS

4.1 ROC CURVES USING ALL ORDNANCE COMBINED

It must be noted that ESTCP project UX-0208 did not include any algorithm development work for discriminating UXO from non-UXO. The project did not fund development of discrimination capability and GEO-CENTERS does not claim to currently have such capability at this time. As such, discrimination stage results usually included in the standardized scoring records will not be included in this record.

The data submitted by GEO-CENTERS consisted of a combined response stage data set from the EM and Mag sensor. The combined EM/MAG response stage data resulted from the Mag and EM data being visually fused and using human judgement to determine whether or not there was an object in the grid square. Due to the subjective nature of visually selecting targets, true signal responses do not exist. Therefore, true ROC curves could not be generated from the provided data set.

4.2 ROC CURVES USING ORDNANCE LARGER THAN 20 MM

As described in Section 4.1 above, true ROC curves could not be generated from the provided data set.

4.3 PERFORMANCE SUMMARIES

It must be noted that ESTCP project UX-0208 did not include any algorithm development work for discriminating UXO from non-UXO. The project did not fund development of discrimination capability and GEO-CENTERS does not claim to currently have such capability at this time. As such, discrimination stage results usually included in the standardized scoring records will not be included in this record.

The data submitted by GEO-CENTERS consisted of a combined response stage data set from the EM and Mag sensor. The combined EM/MAG response stage data resulted from the Mag and EM data being visually fused and using human judgement to determine whether or not there was an object in the grid square. Due to the subjective nature of visually selecting targets, true signal responses do not exist. Therefore, the data set provided was considered a dig list in which all identified items were considered anomalies.

Results for the Open field test broken out by size, depth and nonstandard ordnance are presented in Table 5. (For cost results, see section 5.) Results by size and depth include both standard and nonstandard ordnance. The results by size show how well the demonstrator did at detecting/discriminating ordnance of a certain caliber range. (See app A for size definitions.) The results are relative to the number of ordnance items emplaced. Depth is measured from the closest point of anomaly to the ground surface.

TABLE 5. SUMMARY OF OPEN FIELD RESULTS FOR STOLS

				By Size			By Depth, m		
Metric	**Overall**	**Standard**	**Non-Standard**	**Small**	**Medium**	**Large**	**< 0.3**	**0.3 to <1**	**>= 1**
COMBINED EM/MAG RESPONSE STAGE									
P_d	0.60	0.65	0.55	0.50	0.65	0.85	0.65	0.60	0.60
P_{fp}	0.50	-	-	-	-	-	0.40	0.55	0.80
P_{ba}	0.30	-	-	-	-	-	-	-	-

Response Stage Noise Level: -41.54
Note: The response stage noise level was provided by the demonstrator.

4.4 EFFICIENCY, REJECTION RATES, AND TYPE CLASSIFICATION

Discrimination data was not required for this particular demonstration. Therefore, no results will be presented for this section.

4.5 LOCATION ACCURACY

Discrimination data was not required for this particular demonstration. Therefore, no results will be presented for this section.

TABLE 6. MEAN LOCATION ERROR AND STANDARD DEVIATION (M)

No data available.

SECTION 5. ON-SITE LABOR COSTS

A standardized estimate for labor costs associated with this effort was calculated as follows: the first person at the test site was designated "supervisor", the second person was designated "data analyst", and the third and following personnel were considered "field support". Standardized hourly labor rates were charged by title: supervisor at $95.00/hour, data analyst at $57.00/hour, and field support at $28.50/hour.

Government representatives monitored on-site activity. All on site activities were grouped into one of ten categories: initial setup/mobilization, daily setup/stop, calibration, collecting data, downtime due to break/lunch, downtime due to equipment failure, downtime due to equipment/data checks or maintenance, downtime due to weather, downtime due to demonstration site issue, or demobilization. See Appendix D for the daily activity log. See section 3.4 for a summary of field activities.

The standardized cost estimate associated with the labor needed to perform the field activities is presented in Table 7. Note that calibration time includes time spent in the Calibration Lanes as well as field calibrations. "Site survey time" includes daily setup/stop time, collecting data, breaks/lunch, downtime due to equipment/data checks or maintenance, downtime due to failure, and downtime due to weather.

TABLE 7. ON-SITE LABOR COSTS

	No. People	Hourly Wage	Hours	Cost
INITIAL SETUP				
Supervisor	1	$95.00	1.83	173.85
Data Analyst	1	57.00	1.83	104.31
Field Support	0	28.50	1.83	0
SubTotal				**$278.16**
CALIBRATION				
Supervisor	1	$95.00	5.17	491.15
Data Analyst	1	57.00	5.17	294.69
Field Support	0	28.50	5.17	0
SubTotal				**$785.84**
SITE SURVEY				
Supervisor	1	$95.00	17.33	1646.35
Data Analyst	1	57.00	17.33	987.81
Field Support	0	28.50	17.33	0
SubTotal				**$2634.16**

See notes at end of table.

TABLE 7 (CONT'D)

	No. People	Hourly Wage	Hours	Cost
DEMOBILIZATION				
Supervisor	1	$95.00	2.00	190.00
Data Analyst	1	57.00	2.00	114.00
Field Support	0	28.50	2.00	0
SubTotal				**$304.00**
TOTAL				**$4002.16**

Notes: Calibration time includes time spent in the Calibration Lanes as well as calibration before each data run.

Site Survey time includes daily setup/stop time, collecting data, breaks/lunch, downtime due to system maintenance, failure, and weather.

SECTION 6. COMPARISON OF RESULTS TO DATE

No comparisons to date.

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SECTION 7. APPENDIXES

APPENDIX A. TERMS AND DEFINITIONS

GENERAL DEFINITIONS

Anomaly: Location of a system response deemed to warrant further investigation by the demonstrator for consideration as an emplaced ordnance item.

Detection: An anomaly location that is within R_{halo} of an emplaced ordnance item.

Emplaced Ordnance: An ordnance item buried by the government at a specified location in the test site.

Emplaced Clutter: A clutter item (i.e., non-ordnance item) buried by the government at a specified location in the test site.

R_{halo}: A pre-determined radius about the periphery of an emplaced item (clutter or ordnance) within which a location identified by the demonstrator as being of interest is considered to be a response from that item. For the purpose of this program, a circular halo 0.5 meters in radius will be placed around the center of the object for all clutter and ordnance items less than 0.6 meters in length. When ordnance items are longer than 0.6 meters, the halo becomes an ellipse where the minor axis remains 1 meter and the major axis is equal to the projected length of the ordnance onto the ground plane plus 1 meter.

Small Ordnance: Caliber of ordnance less than or equal to 40 mm (includes 20-mm projectile, 40-mm projectile, submunitions BLU-26, BLU-63, and M42).

Medium Ordnance: Caliber of ordnance greater than 40 mm and less than or equal to 81 mm (includes 57-mm projectile, 60-mm mortar, 2.75-inch Rocket, MK118 Rockeye, 81-mm mortar).

Large Ordnance: Caliber of ordnance greater than 81 mm (includes 105-mm HEAT, 105-mm projectile, 155-mm projectile, 500-lb bomb).

Shallow: Items buried less than 0.3 meter below ground surface.

Medium: Items buried greater than or equal to 0.3 meter and less than 1 meter below ground surface.

Deep: Items buried greater than or equal to 1 meter below ground surface.

Response Stage Noise Level: The level that represents the point below which anomalies are not considered detectable. Demonstrators are required to provide the recommended noise level for the Blind Grid test area.

Discrimination Stage Threshold: The demonstrator selects the threshold level that they believe provides optimum performance of the system by retaining all detectable ordnance and rejecting the maximum amount of clutter. This level defines the subset of anomalies the demonstrator would recommend digging based on discrimination.

Binomially Distributed Random Variable: A random variable of the type which has only two possible outcomes, say success and failure, is repeated for n independent trials with the probability p of success and the probability 1-p of failure being the same for each trial. The number of successes x observed in the n trials is an estimate of p and is considered to be a binomially distributed random variable.

RESPONSE AND DISCRIMINATION STAGE DATA

The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver-operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of false positive (P_{fp}) and those that do not correspond to any known item, termed background alarms.

The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the RESPONSE STAGE, the demonstrator provides the scoring committee with the location and signal strength of all anomalies that the demonstrator has deemed sufficient to warrant further investigation and/or processing as potential emplaced ordnance items. This list is generated with minimal processing (e.g., this list will include all signals above the system noise threshold). As such, it represents the most inclusive list of anomalies.

The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such, and to reject clutter. For the same locations as in the RESPONSE STAGE anomaly list, the DISCRIMINATION STAGE list contains the output of the algorithms applied in the discrimination-stage processing. This list is prioritized based on the demonstrator's determination that an anomaly location is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For electronic signal processing, priority ranking is based on algorithm output. For other systems, priority ranking is based on human judgment. The demonstrator also selects the threshold that the demonstrator believes will provide "optimum" system performance (i.e., that retains all the detected ordnance and rejects the maximum amount of clutter).

Note: The two lists provided by the demonstrator contain identical numbers of potential target locations. They differ only in the priority ranking of the declarations.

RESPONSE STAGE DEFINITIONS

Response Stage Probability of Detection (P_d^{res}): P_d^{res} = (No. of response-stage detections)/ (No. of emplaced ordnance in the test site).

Response Stage False Positive (fp^{res}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Response Stage Probability of False Positive (P_{fp}^{res}): P_{fp}^{res} = (No. of response-stage false positives)/(No. of emplaced clutter items).

Response Stage Background Alarm: An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Response Stage Probability of Background Alarm (P_{ba}^{res}): Blind Grid only: P_{ba}^{res} = (No. of response-stage background alarms)/(No. of empty grid locations).

Response Stage Background Alarm Rate (BAR^{res}): Open Field only: BAR^{res} = (No. of response-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{res}, P_{fp}^{res}, P_{ba}^{res}, and BAR^{res} are functions of t^{res}, the threshold applied to the response-stage signal strength. These quantities can, therefore, be written as $P_d^{res}(t^{res})$, $P_{fp}^{res}(t^{res})$, $P_{ba}^{res}(t^{res})$, and $BAR^{res}(t^{res})$.

DISCRIMINATION STAGE DEFINITIONS

Discrimination: The application of a signal processing algorithm or human judgment to response-stage data that discriminates ordnance from clutter. Discrimination should identify anomalies that the demonstrator has high confidence correspond to ordnance, as well as those that the demonstrator has high confidence correspond to nonordnance or background returns. The former should be ranked with highest priority and the latter with lowest.

Discrimination Stage Probability of Detection (P_d^{disc}): P_d^{disc} = (No. of discrimination-stage detections)/(No. of emplaced ordnance in the test site).

Discrimination Stage False Positive (fp^{disc}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Discrimination Stage Probability of False Positive (P_{fp}^{disc}): P_{fp}^{disc} = (No. of discrimination stage false positives)/(No. of emplaced clutter items).

Discrimination Stage Background Alarm: An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Discrimination Stage Probability of Background Alarm (P_{ba}^{disc}): P_{ba}^{disc} = (No. of discrimination-stage background alarms)/(No. of empty grid locations).

Discrimination Stage Background Alarm Rate (BAR^{disc}): BAR^{disc} = (No. of discrimination-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{disc}, P_{fp}^{disc}, P_{ba}^{disc}, and BAR^{disc} are functions of t^{disc}, the threshold applied to the discrimination-stage signal strength. These quantities can, therefore, be written as $P_d^{disc}(t^{disc})$, $P_{fp}^{disc}(t^{disc})$, $P_{ba}^{disc}(t^{disc})$, and $BAR^{disc}(t^{disc})$.

RECEIVER-OPERATING CHARACERISTIC (ROC) CURVES

ROC curves at both the response and discrimination stages can be constructed based on the above definitions. The ROC curves plot the relationship between P_d versus P_{fp} and P_d versus BAR or P_{ba} as the threshold applied to the signal strength is varied from its minimum (t_{min}) to its maximum (t_{max}) value.[1] Figure A-1 shows how P_d versus P_{fp} and P_d versus BAR are combined into ROC curves. Note that the "res" and "disc" superscripts have been suppressed from all the variables for clarity.

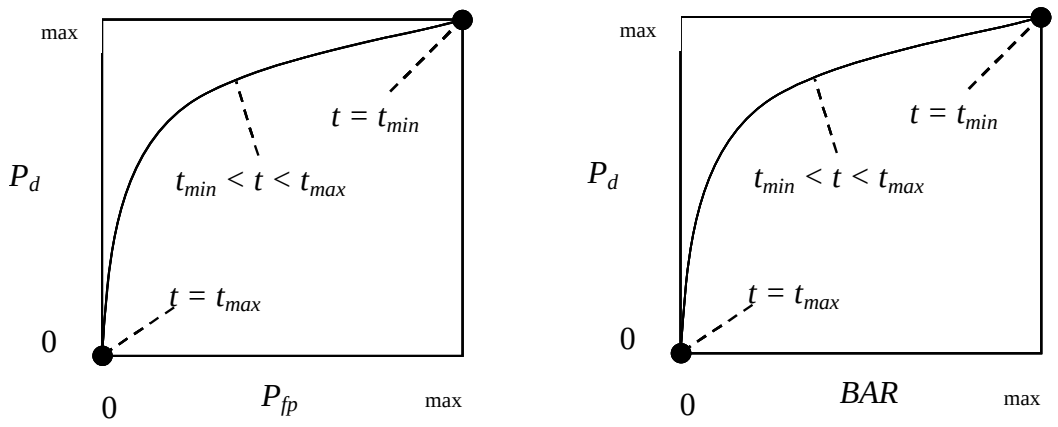

Figure A-1. ROC curves for open-field testing. Each curve applies to both the response and discrimination stages.

[1]Strictly speaking, ROC curves plot the P_d versus P_{ba} over a predetermined and fixed number of detection opportunities (some of the opportunities are located over ordnance and others are located over clutter or blank spots). In an open field scenario, each system suppresses its signal strength reports until some bare-minimum signal response is received by the system. Consequently, the open field ROC curves do not have information from low signal-output locations, and, furthermore, different contractors report their signals over a different set of locations on the ground. These ROC curves are thus not true to the strict definition of ROC curves as defined in textbooks on detection theory. Note, however, that the ROC curves obtained in the Blind Grid test sites are true ROC curves.

METRICS TO CHARACTERIZE THE DISCRIMINATION STAGE

The demonstrator is also scored on efficiency and rejection ratio, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from nonordnance items. The efficiency measures the amount of detected ordnance retained by the discrimination, while the rejection ratio measures the fraction of false alarms rejected. Both measures are defined relative to the entire response list, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

Efficiency (E): $E = P_d^{disc}(t^{disc})/P_d^{res}(t_{min}^{res})$: measures (at a threshold of interest), the degree to which the maximum theoretical detection performance of the sensor system (as determined by the response stage t_{min}) is preserved after application of discrimination techniques. Efficiency is a number between 0 and 1. An efficiency of 1 implies that all of the ordnance initially detected in the response stage was retained at the specified threshold in the discrimination stage, t^{disc}.

False Positive Rejection Rate (R_{fp}): $R_{fp} = 1 - [P_{fp}^{disc}(t^{disc})/P_{fp}^{res}(t_{min}^{res})]$: measures (at a threshold of interest), the degree to which the sensor system's false positive performance is improved over the maximum false positive performance (as determined by the response stage t_{min}). The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all emplaced clutter initially detected in the response stage were correctly rejected at the specified threshold in the discrimination stage.

Background Alarm Rejection Rate (R_{ba}):

Blind Grid: $R_{ba} = 1 - [P_{ba}^{disc}(t^{disc})/P_{ba}^{res}(t_{min}^{res})]$
Open Field: $R_{ba} = 1 - [BAR^{disc}(t^{disc})/BAR^{res}(t_{min}^{res})])$

Measures the degree to which the discrimination stage correctly rejects background alarms initially detected in the response stage. The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all background alarms initially detected in the response stage were rejected at the specified threshold in the discrimination stage.

CHI-SQUARE COMPARISON EXPLANATION:

The Chi-square test for differences in probabilities (or 2 x 2 contingency table) is used to analyze two samples drawn from two different populations to see if both populations have the same or different proportions of elements in a certain category. More specifically, two random samples are drawn, one from each population, to test the null hypothesis that the probability of event A (some specified event) is the same for both populations (ref 4).

A 2 x 2 contingency table is used in the Standardized UXO Technology Demonstration Site Program to determine if there is reason to believe that the proportion of ordnance correctly detected/discriminated by demonstrator X's system is significantly degraded by the more challenging terrain feature introduced. The test statistic of the 2 x 2 contingency table is the Chi-square distribution with one degree of freedom. Since an association between the more challenging terrain feature and relatively degraded performance is sought, a one-sided test is performed. A significance level of 0.05 is chosen which sets a critical decision limit of 2.71 from the Chi-square distribution with one degree of freedom. It is a critical decision limit because if the test statistic calculated from the data exceeds this value, the two proportions tested will be considered significantly different. If the test statistic calculated from the data is less than this value, the two proportions tested will be considered not significantly different.

An exception must be applied when either a 0 or 100 percent success rate occurs in the sample data. The Chi-square test cannot be used in these instances. Instead, Fischer's test is used and the critical decision limit for one-sided tests is the chosen significance level, which in this case is 0.05. With Fischer's test, if the test statistic is less than the critical value, the proportions are considered to be significantly different.

Standardized UXO Technology Demonstration Site examples, where blind grid results are compared to those from the open field and open field results are compared to those from one of the scenarios, follow. It should be noted that a significant result does not prove a cause and effect relationship exists between the two populations of interest; however, it does serve as a tool to indicate that one data set has experienced a degradation in system performance at a large enough level than can be accounted for merely by chance or random variation. Note also that a result that is not significant indicates that there is not enough evidence to declare that anything more than chance or random variation within the same population is at work between the two data sets being compared.

Demonstrator X achieves the following overall results after surveying each of the three progressively more difficult areas using the same system (results indicate the number of ordnance detected divided by the number of ordnance emplaced):

	Blind Grid	Open Field	Moguls
P_d^{res}	100/100 = 1.0	8/10 = .80	20/33 = .61
P_d^{disc}	80/100 = 0.80	6/10 = .60	8/33 = .24

P_d^{res}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the response stage, all 100 ordnance out of 100 emplaced ordnance items were detected in the blind grid while 8 ordnance out of 10 emplaced were detected in the open field. Fischer's test must be used since a 100 percent success rate occurs in the data. Fischer's test uses the four input values to calculate a test statistic of 0.0075 that is compared against the critical value of 0.05. Since the test statistic is less than the critical value, the smaller response stage detection rate (0.80) is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists

between the change in survey area and degradation in performance, it does indicate that the detection ability of demonstrator X's system seems to have been degraded in the open field relative to results from the blind grid using the same system.

P_d^{disc}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the discrimination stage, 80 out of 100 emplaced ordnance items were correctly discriminated as ordnance in blind grid testing while 6 ordnance out of 10 emplaced were correctly discriminated as such in open field testing. Those four values are used to calculate a test statistic of 1.12. Since the test statistic is less than the critical value of 2.71, the two discrimination stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{res}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the response stage, 8 out of 10 and 20 out of 33 are used to calculate a test statistic of 0.56. Since the test statistic is less than the critical value of 2.71, the two response stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{disc}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the discrimination stage, 6 out of 10 and 8 out of 33 are used to calculate a test statistic of 2.98. Since the test statistic is greater than the critical value of 2.71, the smaller discrimination stage detection rate is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the ability of demonstrator X to correctly discriminate seems to have been degraded by the mogul terrain relative to results from the flat open field using the same system.

(Page A-8 Blank)

APPENDIX B. DAILY WEATHER LOGS

TABLE B-1. WEATHER LOG

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, in. Hg	Precipitation, in.
7-Oct-2002	2:00	66.3	66.7	65.8	83	30.00	0.00
7-Oct-2002	3:00	66.4	66.7	66.0	84	29.99	0.00
7-Oct-2002	4:00	66.1	66.5	65.7	86	29.96	0.00
7-Oct-2002	5:00	66.1	66.6	65.6	88	29.94	0.00
7-Oct-2002	6:00	66.6	67.1	66.1	89	29.93	0.00
7-Oct-2002	7:00	66.8	67.2	66.0	91	29.93	0.00
7-Oct-2002	8:00	67.1	69.3	65.9	92	29.92	0.00
7-Oct-2002	9:00	69.8	70.4	68.9	83	29.92	0.00
7-Oct-2002	10:00	71.3	72.6	70.0	79	29.92	0.00
7-Oct-2002	11:00	73.6	75.1	72.1	72	29.92	0.00
7-Oct-2002	12:00	74.6	76.4	72.9	63	29.92	0.00
7-Oct-2002	13:00	77.0	78.0	75.3	50	29.91	0.00
7-Oct-2002	14:00	77.4	78.3	76.1	46	29.90	0.00
7-Oct-2002	15:00	75.5	76.7	74.0	47	29.90	0.00
7-Oct-2002	16:00	73.4	74.4	72.4	48	29.91	0.00
7-Oct-2002	17:00	73.0	73.9	72.3	50	29.92	0.00
7-Oct-2002	18:00	71.5	72.8	70.2	48	29.94	0.00
7-Oct-2002	19:00	68.3	70.5	66.0	48	29.97	0.00
7-Oct-2002	20:00	64.1	66.0	62.2	49	30.00	0.00
7-Oct-2002	21:00	61.1	62.7	59.5	51	30.02	0.00
7-Oct-2002	22:00	56.7	59.8	54.9	63	30.04	0.00
7-Oct-2002	23:00	55.9	56.8	54.0	64	30.05	0.00
7-Oct-2002	23:59	56.2	57.7	53.2	61	30.05	0.00
8-Oct-2002	1:00	56.9	57.8	56.3	58	30.07	0.00
8-Oct-2002	2:00	55.8	56.6	54.8	59	30.09	0.00
8-Oct-2002	3:00	54.4	55.0	53.8	61	30.11	0.00
8-Oct-2002	4:00	52.7	54.0	51.7	64	30.12	0.00
8-Oct-2002	5:00	51.4	52.7	49.3	63	30.13	0.00
8-Oct-2002	6:00	48.9	50.2	48.1	69	30.15	0.00
8-Oct-2002	7:00	48.3	49.7	47.4	70	30.17	0.00
8-Oct-2002	8:00	49.9	50.8	49.2	64	30.20	0.00
8-Oct-2002	9:00	52.3	53.9	50.3	60	30.22	0.00
8-Oct-2002	10:00	55.1	56.4	53.5	56	30.25	0.00
8-Oct-2002	11:00	56.9	57.8	56.2	55	30.25	0.00
8-Oct-2002	12:00	58.8	60.7	57.2	48	30.25	0.00
8-Oct-2002	13:00	60.7	62.0	58.6	41	30.24	0.00
8-Oct-2002	14:00	61.7	62.9	60.8	40	30.22	0.00
8-Oct-2002	15:00	62.3	63.6	61.2	40	30.21	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, in. Hg	Precipitation, in.
8-Oct-2002	16:00	63.4	63.9	62.7	38	30.19	0.00
8-Oct-2002	17:00	63.9	64.6	63.1	39	30.19	0.00
8-Oct-2002	18:00	62.6	64.1	60.3	44	30.18	0.00
8-Oct-2002	19:00	58.4	60.9	54.3	54	30.18	0.00
8-Oct-2002	20:00	54.4	55.5	51.5	66	30.20	0.00
8-Oct-2002	21:00	50.7	51.7	50.0	80	30.21	0.00
8-Oct-2002	22:00	48.9	50.4	48.0	85	30.22	0.00
8-Oct-2002	23:00	47.3	48.1	46.2	89	30.22	0.00
8-Oct-2002	23:59	47.5	48.9	46.4	88	30.22	0.00
9-Oct-2002	1:00	48.7	49.2	47.9	86	30.22	0.00
9-Oct-2002	2:00	48.3	48.9	47.6	89	30.22	0.00
9-Oct-2002	3:00	48.1	49.4	47.4	90	30.22	0.00
9-Oct-2002	4:00	49.5	50.3	48.3	89	30.21	0.00
9-Oct-2002	5:00	47.9	49.8	46.0	94	30.21	0.00
9-Oct-2002	6:00	46.1	46.8	45.6	97	30.21	0.00
9-Oct-2002	7:00	47.4	49.8	46.2	97	30.23	0.00
9-Oct-2002	8:00	51.8	53.2	49.6	90	30.24	0.00
9-Oct-2002	9:00	54.5	55.9	52.7	88	30.25	0.00
9-Oct-2002	10:00	56.1	57.3	55.1	83	30.25	0.00
9-Oct-2002	11:00	58.6	60.2	57.1	77	30.25	0.00
9-Oct-2002	12:00	60.5	61.0	59.8	74	30.24	0.00
9-Oct-2002	13:00	62.1	63.4	60.9	73	30.23	0.00
9-Oct-2002	14:00	63.5	64.4	62.8	73	30.22	0.00
9-Oct-2002	15:00	64.4	65.0	63.9	74	30.20	0.00
9-Oct-2002	16:00	64.4	64.7	64.0	77	30.20	0.00
9-Oct-2002	17:00	64.7	65.1	64.3	78	30.19	0.00
9-Oct-2002	18:00	63.5	64.5	63.1	84	30.19	0.00
9-Oct-2002	19:00	63.2	63.9	62.4	89	30.19	0.00
9-Oct-2002	20:00	62.0	62.7	61.4	95	30.19	0.00
9-Oct-2002	21:00	61.5	61.9	61.3	95	30.19	0.00
9-Oct-2002	22:00	61.7	62.1	61.3	96	30.20	0.00
9-Oct-2002	23:00	62.0	62.3	61.5	97	30.20	0.00
9-Oct-2002	23:59	62.2	62.6	61.6	97	30.19	0.00
10-Oct-2002	1:00	61.8	62.2	61.5	97	30.19	0.00
10-Oct-2002	2:00	61.6	62.2	61.0	97	30.20	0.00
10-Oct-2002	3:00	61.0	61.4	60.7	98	30.19	0.00
10-Oct-2002	4:00	60.9	61.4	60.5	99	30.17	0.00
10-Oct-2002	5:00	61.0	61.6	60.5	98	30.17	0.00
10-Oct-2002	6:00	61.4	61.8	61.0	98	30.19	0.00
10-Oct-2002	7:00	61.5	62.1	60.9	98	30.19	0.00
10-Oct-2002	8:00	62.0	62.3	61.6	99	30.20	0.00

TABLE B-1 (CONT'D)

DCP 7 Data from Phillips Airfield							
Date	Time, EDST	Average Temperature, °F	Maximum Temperature, °F	Minimum Temperature, °F	RH, %	Station Pressure, in. Hg	Precipitation, in.
10-Oct-2002	9:00	62.2	62.6	61.7	99	30.21	0.00
10-Oct-2002	10:00	62.5	62.9	62.1	100	30.22	0.00
10-Oct-2002	11:00	63.0	63.4	62.3	100	30.22	0.00
10-Oct-2002	12:00	63.3	63.9	62.9	100	30.22	0.00
10-Oct-2002	13:00	64.0	64.6	63.4	100	30.21	0.11
10-Oct-2002	14:00	64.7	65.3	64.1	99	30.19	0.06
10-Oct-2002	15:00	64.8	65.3	64.5	98	30.18	0.07
10-Oct-2002	16:00	65.0	65.6	64.6	98	30.17	0.03
10-Oct-2002	17:00	65.2	65.7	64.7	97	30.16	0.01
10-Oct-2002	18:00	65.1	65.4	64.8	97	30.17	0.00
10-Oct-2002	19:00	65.1	65.4	64.7	97	30.17	0.02
10-Oct-2002	20:00	64.7	65.2	64.3	98	30.17	0.05
10-Oct-2002	21:00	64.4	64.9	63.9	98	30.17	0.02
10-Oct-2002	22:00	64.1	64.4	63.9	99	30.16	0.02
10-Oct-2002	23:00	64.0	64.4	63.8	99	30.16	0.12
10-Oct-2002	23:59	63.8	64.1	63.4	99	30.15	0.10
11-Oct-2002	1:00	63.6	64.0	63.3	99	30.14	0.13
11-Oct-2002	2:00	63.7	64.1	63.4	99	30.13	0.17
11-Oct-2002	3:00	63.7	64.0	63.4	99	30.11	0.11
11-Oct-2002	4:00	63.8	64.1	63.4	99	30.10	0.23
11-Oct-2002	5:00	64.0	64.5	63.6	100	30.09	0.13
11-Oct-2002	6:00	64.4	65.1	64.0	100	30.09	0.07
11-Oct-2002	7:00	64.8	65.7	63.9	100	30.09	0.31
11-Oct-2002	8:00	64.0	64.5	63.8	100	30.09	0.25
11-Oct-2002	9:00	64.3	65.2	63.9	100	30.10	0.31
11-Oct-2002	10:00	63.6	65.1	62.8	100	30.10	0.41
11-Oct-2002	11:00	63.3	63.6	63.0	100	30.10	0.16
11-Oct-2002	12:00	63.8	64.1	63.3	100	30.10	0.09
11-Oct-2002	13:00	64.1	64.5	63.6	100	30.09	0.04
11-Oct-2002	14:00	64.9	65.8	64.1	100	30.07	0.05
11-Oct-2002	15:00	66.2	67.2	65.2	100	30.05	0.01
11-Oct-2002	16:00	67.2	67.9	66.6	100	30.03	0.00
11-Oct-2002	17:00	67.2	67.7	66.7	100	30.03	0.00
11-Oct-2002	18:00	67.0	67.7	66.6	100	30.03	0.00
11-Oct-2002	19:00	66.9	67.3	66.5	100	30.03	0.00
11-Oct-2002	20:00	67.8	68.4	67.0	100	30.03	0.01
11-Oct-2002	21:00	68.2	68.5	67.7	100	30.04	0.01
11-Oct-2002	22:00	67.9	68.2	67.6	100	30.04	0.00
11-Oct-2002	23:00	67.5	68.2	66.6	99	30.04	0.09
11-Oct-2002	23:59	66.7	67.1	66.3	98	30.03	0.01
							3.20

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APPENDIX C. SOIL MOISTURE

UXO SOIL MOISTURE PROBES DATA
10/23/2002

Rec#: 36

1. Item ID (Vender) GEO CENTER 2. Date: 10/08/2002

3. Start Time: 758 4. Stop Time 815

5. Data Collectors Name C. WATSON

---------- REPEAT SECTION ----------

	Morning % Moisture		Afternoon % Moisture	
Wet Area	Time:	815	Time:	0
1		17.3		0.0
2		20.3		0.0
3		19.6		0.0
4		34.8		0.0
5		52.4		0.0
Tree Area	Time:	807	Time:	0
1		11.1		0.0
2		12.3		0.0
3		14.8		0.0
4		4.7		0.0
5		0.4		0.0
Other Area	Time:	758	Time:	0
1		14.5		0.0
2		8.8		0.0
3		0.3		0.0
4		26.8		0.0
5		9.9		0.0

UXO SOIL MOISTURE PROBES DATA

Rec#: 39

1. Item ID (Vender) GEO CENTER 2. Date: 10/09/2002

3. Start Time: 749 4. Stop Time 1357

5. Data Collectors Name C. WATSON

---------- REPEAT SECTION ----------

	Morning % Moisture		Afternoon % Moisture	
Wet Area	Time:	804	Time:	1357
1		16.8		16.5
2		20.5		20.0
3		18.6		18.4
4		4.5		4.5
5		4.6		4.6
Tree Area	Time:	757	Time:	1348
1		11.4		10.8
2		11.1		11.1
3		14.8		14.8
4		4.5		4.8
5		0.4		0.5
Other Area	Time:	749	Time:	1339
1		13.7		13.7
2		8.8		10.0
3		0.3		0.5
4		26.8		26.4
5		9.6		9.9

UXO SOIL MOISTURE PROBES DATA

Rec#: 40

1. Item ID (Vender) GEO CENTER 2. Date: 10/10/2002

3. Start Time: 733 4. Stop Time 1415

5. Data Collectors Name C. WATSON

---------- REPEAT SECTION ----------

	Morning % Moisture		Afternoon % Moisture	
Wet Area	Time:	800	Time:	1415
1		17.6		25.9
2		20.3		19.1
3		18.6		18.9
4		33.2		33.2
5		48.9		48.1
Tree Area	Time:	733	Time:	1408
1		10.8		36.1
2		10.8		64.8
3		14.2		25.4
4		4.8		5.9
5		0.5		4.6
Other Area	Time:	745	Time:	1400
1		15.4		27.6
2		9.4		13.1
3		0.3		0.3
4		26.2		26.1
5		9.9		9.6

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Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021007	2	NA	1400	1425	25	INITIAL SET-UP	EQUIPMENT SET UP/ START OF TEST OPERATIONS	OTHER	NA	NA	NA	NA
20021007	2	NA	1425	1500	35	INITIAL SET-UP	GPS BASE STATION SET UP	OTHER	NA	NA	NA	NA
20021007	2	NA	1500	1520	20	INITIAL SET-UP	SET UP MAGNETOMETER TO THE GPS	OTHER	NA	NA	NA	NA
20021007	2	CALIBRATION LANES	1520	1550	30	INITIAL SET UP	PREPARE FOR THE FIRST RUN	PIN FLAGS	FLAGS	NA	NA	NA
20021007	2	CALIBRATION LANES	1550	1625	35	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	CLEAR/UNLIMITED	DRY
20021007	2	CALIBRATION LANES	1625	1630	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	EQUIPMENT CHECK	OTHER	NA	NA	NA	NA
20021007	2	CALIBRATION LANES	1630	1642	12	CALIBRATION	MAPPING 4 CORNERS OF CALIBRATION GRID USING GPS	OTHER	NA	NA	NA	NA
20021007	2	CALIBRATION LANES	1642	1655	13	CALIBRATION	COIL MAPPING FROM THE TOW VEHICLE USING GPS	OTHER	NA	NA	NA	NA
20021007	2	CALIBRATION LANES	1655	1700	5	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	CLEAR/UNLIMITED	DRY
20021007	2	CALIBRATION LANES	1700	1715	15	DAILY START, STOP	END OF DAILY OPERATIONS / EQUIPMENT BREAKDOWN	OTHER	NA	NA	NA	NA
20021008	2	CALIBRATION LANES	700	755	55	DAILY START, STOP	START OF DAILY OPERATIONS / EQUIPMENT PRERPARATIONS	OTHER	NA	NA	NA	NA

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021008	2	CALIBRATION LANES	755	810	15	DOWNTIME DUE TO EQUIP MAINT/CHECK	ADDED 4 GALLONS OF REGULAR UNLEADED GASOLINE TO TOW VEHICLE	OTHER	NA	NA	NA	NA
20021008	2	CALIBRATION LANES	810	840	30	DOWNTIME DUE TO EQUIP MAINT/CHECK		PIN FLAGS	NA	NA	NA	NA
20021008	2	BLIND TEST GRID	840	910	30	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	CLEAR/UNLIMITED	DRY
20021008	2	BLIND TEST GRID	910	920	10	Collecting Data	MAPPING 4 CORNERS OF THE BLIND GRID USING GPS	GPS	NA	NA	NA	nNA
20021008	2	BLIND TEST GRID	920	935	15	DOWNTIME DUE TO EQUIP MAINT/CHECK		OTHER	NA	NA	NA	NA
20021008	2	BLIND TEST GRID	935	1110	95	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHECKING DATA FROM THE DATA DUMP / EQUIPMENT CHECK	OTHER	NA	NA	NA	NA
20021008	2	BLIND TEST GRID	1110	1120	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHECKING EM61 ELECTRONICS SYSTEM / EQUIPMENT CHECK	OTHER	NA	NA	NA	NA
20021008	2	BLIND TEST GRID	1120	1300	100	DOWNTIME DUE TO EQUIP MAINT/CHECK	REPLACED LAP-TOP IN THE TOW VEHICLE / EQUIPMENT CHECK	OTHER	NA	NA	NA	NA

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021008	2	BLIND TEST GRID	1300	1310	10	BREAK/LUNCH	LUNCH BREAK	OTHER	NA	NA	NA	NA
20021008	2	BLIND TEST GRID	1310	1315	5	DOWNTIME DUE TO EQUIP MAINT/CHECK		PIN FLAGS	NA	NA	NA	NA
20021008	2	CALIBRATION LANES	1315	1341	26	COLLECTING DATA	COLLECTING DATA USING MAGNETOMETER ONLY / NO EM61 ELEC SYSTEM	OTHER	NA	NA	CLEAR/UNLIMITED	DRY
20021008	2	CALIBRATION LANES	1341	1415	34	DOWNTIME DUE TO EQUIP MAINT/CHECK	DATA CHECK	OTHER	NA	NA	NA	NA
20021008	2	CALIBRATION LANES	1415	1430	15	DOWNTIME DUE TO EQUIP MAINT/CHECK		OTHER	NA	NA	NA	NA
20021008	2	CALIBRATION LANES	1430	1450	20	DAILY START, STOP	END OF DAILY OPERATIONS / EQUIPMENT BREAKDOWN	OTHER	NA	NA	NA	NA
20021009	2	BLIND TEST GRID	700	1047	227	DOWNTIME DUE TO EQUIPMENT FAILURE	WAITING FOR REPLACEMENT PARST TO ARRIVE FROM AIRBORNE	OTHER	NA	NA	NA	NA
20021009	2	BLIND TEST GRID	1047	1132	45	DOWNTIME DUE TO EQUIPMENT FAILURE	REPLACING EM61 ELECTRONICS SYSTEM	OTHER	NA	NA	NA	NA
20021009	2	BLIND TEST GRID	1132	1140	8	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARING FOR THE FIRST RUN OF THE DAY WITH REPLACEMENT PART	OTHER	NA	NA	NA	NA

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021009	2	BLIND TEST GRID	1140	1220	40	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	CLEAR/UNLIMITED	DRY
20021009	2	BLIND TEST GRID	1220	1225	5	DOWNTIME DUE TO EQUIP MAINT/CHECK	DATA CHECK	OTHER	NA	NA	NA	NA
20021009	2	BLIND TEST GRID	1225	1240	15	DOWNTIME DUE TO EQUIP MAINT/CHECK		OTHER	NA	NA	NA	NA
20021009	2	BLIND TEST GRID	1240	1340	60	DOWNTIME DUE TO EQUIP MAINT/CHECK	EQUIPMENT CHECK	OTHER	NA	NA	NA	NA
20021009	2	OPEN FIELD	1340	1350	10	DOWNTIME DUE TO EQUIP MAINT/CHECK		PIN FLAGS	FLAGS	NA	NA	NA
20021009	2	OPEN FIELD	1350	1515	85	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	CLEAR/UNLIMITED	DRY
20021009	2	OPEN FIELD	1515	1525	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	TOW VEHICLE STUCK IN DITCH / NEEDED TO BE TOWED OUT	OTHER	NA	NA	NA	NA
20021009	2	OPEN FIELD	1525	1540	15	DOWNTIME DUE TO EQUIP MAINT/CHECK		OTHER	NA	NA	NOT APPLICABLE	NA
20021009	2	OPEN FIELD	1540	1620	40	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	CLEAR/UNLIMITED	DRY
20021009	2	OPEN FIELD	1620	1635	15	DAILY START, STOP	END OF DAILY OPERATIONS / EQUIPMENT BREAKDOWN	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	700	810	70	DAILY START, STOP	START OF DAILY OPERATIONS / EQUIPMENT SET UP	OTHER	NA	NA	NA	NA

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021010	1	OPEN FIELD	810	820	10	DOWNTIME DUE TO EQUIP MAINT/CHECK	PREPARE FOR FIRST RUN OF THE DAILY OPERATIONS	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	820	1051	151	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1051	1051	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1051	1100	9	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1100	1100	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1100	1101	1	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1101	1101	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1101	1110	9	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1110	1110	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1110	1110	0	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1110	1116	6	DOWNTIME DUE TO EQUIP MAINT/CHECK	DATA CHECK / NO ACTION	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	1116	1116	0	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021010	1	MINE GRID	1116	1117	1	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1117	1121	4	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1121	1121	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1121	1122	1	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1122	1123	1	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1123	1139	16	COLLECTING DATA	FENCE CHALLENGE AREA INCLUDED IN DATA RUN	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1139	1139	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1139	1140	1	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1140	1140	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1140	1141	1	COLLECTING DATA	FENCE CHALLENGE AREA INCLUDED IN THE DATA RUN	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021010	1	OPEN FIELD	1141	1150	9	DOWNTIME DUE TO EQUIP MAINT/CHECK	TOW VEHICLE STUCK IN A DITCH / NEEDED TO BE TOWED OUT	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	1150	1155	5	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1155	1155	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1155	1156	1	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1156	1156	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1156	1203	7	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1203	1203	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1203	1204	1	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1204	1204	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1204	1212	8	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021010	1	OPEN FIELD	1212	1215	3	DOWNTIME DUE TO EQUIP MAINT/CHECK	NOT GETTING A GOOD SATILITE CONNECTION / NO ACTION	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	1215	1236	21	BREAK/LUNCH	LUNCH BREAK	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	1236	1308	32	DOWNTIME DUE TO EQUIP MAINT/CHECK	NOT GETTING A GOOD SATILITE CONNECTION / NO ACTION	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	1308	1312	4	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1312	1313	1	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1313	1313	0	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1313	1314	1	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1314	1320	6	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1320	1320	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN THE OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1320	1320	0	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1320	1321	1	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021010	1	OPEN FIELD	1321	1326	5	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1326	1326	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1326	1326	0	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	MINE GRID	1326	1326	0	COLLECTING DATA	PASSED THRU MINE GRID WHILE IN OPEN FIELD	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1326	1352	26	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1352	1400	8	DOWNTIME DUE TO EQUIP MAINT/CHECK	VEHICLE STUCK IN A DITCH / NEEDED TO BE TOWED OUT	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	1400	1432	32	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1432	1450	18	DOWNTIME DUE TO EQUIP MAINT/CHECK	EQUIPMENT CHECK	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	1450	1602	72	DOWNTIME DUE TO EQUIP MAINT/CHECK	CHARGING THE BATTERY	OTHER	NA	AN	NA	NA
20021010	1	OPEN FIELD	1602	1605	3	DOWNTIME DUE TO EQUIP MAINT/CHECK	DATA CHECK	OTHER	NA	NA	NA	NA
20021010	1	OPEN FIELD	1605	1615	10	DOWNTIME DUE TO EQUIP MAINT/CHECK		OTHER	NA	NA	NA	NA

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area-Tested	Status Start Time	Status Stop Time	Duration min.	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
20021010	1	OPEN FIELD	1615	1715	60	COLLECTING DATA		PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1715	1750	35	COLLECTING DATA	PHONE LINE CHALLENGE AREA INCLUDED IN DATA RUN	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1750	1830	40	COLLECTING DATA	GRAVEL CHALLENGE AREA INCLUDED IN DATA RUN	PIN FLAGS	FLAGS	LINEAR	RAIN/LIMITED	WET
20021010	1	OPEN FIELD	1830	1845	15	DAILY START, STOP	END OF DAILY OPERATIONS / EQUIPMENT BREAKDOWN	OTHER	NA	NA	NA	NA
20021011	2	OPEN FIELD	700	945	165	DOWNTIME DUE TO EQUIP MAINT/CHECK	DATA AND EQUIPMENT CHECK	OTHER	NA	NA	NA	NA
20021011	2	NA	945	1145	120	DEMOBILIZATION	BREAKDOWN OF OPERATIONS	OTHER	NA	NA	NA	NA

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

APPENDIX E. REFERENCES

1. Standardized UXO Technology Demonstration Site Handbook, DTC Project No. 8-CO-160-000-473, Report No. ATC-8349, March 2002.

2. Aberdeen Proving Ground Soil Survey Report, October 1998.

3. Data Summary, UXO Standardized Test Site: APG Soils Description, May 2002.

4. Practical Nonparametric Statistics, W. J. Conover, John Wiley & Sons, 1980, pages 144 through 151.

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APPENDIX F. ABBREVIATIONS

AEC = U.S. Army Environmental Center
APG = Aberdeen Proving Ground
ATC = U.S. Army Aberdeen Test Center
CEHNC = Corps of Engineers - Huntsville Center
EM = electromagnetic
ERDC = U.S. Army Corp of Engineers Engineering Research and Development Center
ESTCP = Environmental Security Technology Certification Program
EQT = Army Environmental Quality Technology Program
GPS = Global Positioning System
HEAT = high-explosive, antitank
Mag = Magnetometry
NS = nonstandard
POC = point of contact
QC = quality control
ROC = receiver-operating characteristic
SERDP = Strategic Environmental Research and Development Program
STOLS = Surface Towed Ordnance Location System
UXO = unexploded ordnance