AD NO. _____
DTC PROJECT NO. 8-CO-160-UXO-021
REPORT NO. ATC-8902

# STANDARDIZED

# UXO TECHNOLOGY DEMONSTRATION SITE

## OPEN FIELD SCORING RECORD NO. 135

SITE LOCATION:
U.S. ARMY YUMA PROVING GROUND

DEMONSTRATOR:
U.S. ARMY CORPS OF ENGINEERS
ENGINEERING RESEARCH AND
DEVELOPMENT CENTER
3909 HALLS FERRY ROAD
VICKSBURG, MS 39180-6199

TECHNOLOGY TYPE/PLATFORM:
GEM-3/PUSHCART

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

DECEMBER 2004

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

U.S. ARMY DEVELOPMENTAL TEST COMMAND
ABERDEEN PROVING GROUND, MD 21005-5055

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Overbay, Larry
The Standardized UXO Technology Demonstration Site Scoring Committee

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Commander
U.S. Army Aberdeen Test Center
ATTN: CSTE-STC-ATC-SL-F
Aberdeen Proving Ground, MD 21005-5059

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Commander
U.S. Army Environmental Center
ATTN: SFIM-AEC-PCT
Aberdeen Proving Ground, MD 21005-5401

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This scoring record documents the efforts of U.S. Army Corps of Engineers, Engineering Research and Development Center (ERDC) to detect and discriminate inert unexploded ordnance (UXO) utilizing the APG Standardized UXO Technology Demonstration Site Open Field. The scoring record was coordinated by Larry Overbay and 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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**Authors:**

Larry Overbay Jr.
Military Environmental Technology Demonstration Center (METDC)
U.S Army Aberdeen Test Center (ATC)
U.S. Army Aberdeen Proving Ground (APG)

Robert Archiable
EC 111, Limited Liability Company (LLC)
U.S. Army Yuma Proving Ground (YPG)

Christina McClung
Aberdeen Test and Support Services (ATSS)
Sverdrup Technology, Inc.
U.S. Army Aberdeen Proving Ground (APG)

**Contributor:**

George Robitaille
U.S. Army Environmental Center (AEC)
U.S. Army Aberdeen Proving Ground (APG)




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## TABLE OF CONTENTS

## SECTION 4. TECHNICAL PERFORMANCE RESULTS



## SECTION 5. ON-SITE LABOR COSTS

## SECTION 6. COMPARISON OF RESULTS TO BLIND GRID DEMONSTRATION



## SECTION 7. APPENDIXES

# 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 high-explosive, antitank (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

POC: Mr. Jose Llopis
(601) 634-3164

Address: U.S. Army Corps of Engineers Engineering Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

#### 2.1.2 System Description (provided by demonstrator)

The GEM-3 system is able to collect multiple channels of complex frequency domain electromagnetic interference (EMI) data over a wide range of audio frequencies (30°Hz to 48 kHz). The system is a wheeled pushcart with a 96-cm sensor head, a mounted electronics console, a user interface, and a real-time kinematic (RTK) Global Positioning System (GPS) (fig. 1). The sensor head consists of three coils. The primary transmitter coil is the outer coil in the sensor head. The receiver coil is the inner coil in the sensor head. The bucking transmitter coil is the middle coil in the sensor head. The current in the bucking coil flows in the opposite direction of the current in the primary transmitter coil. This suppresses the dipole moment on the receiver coil that is directly from the primary transmitter coil. The electronics console contains the multifrequency current waveform generator, the analog-to-digital converter receiver electronics, the digital signal processor, and the power management module. The user interface utilizes a personal digital assistant (PDA). The PDA is used for data logging and allows for real-time control of the system. The PDA also allows for real-time display of the data collected. The RTK GPS will require a base station to be set up at a suitable reference point for radio communication with the mobile unit on the GEM-3 system. The GEM-3 system's acquisition of multifrequency data allows for performing what Geophex Ltd., the developer of the system, calls electromagnetic induction spectroscopy (EMIS) on buried objects. EMIS provides a method to discriminate UXO targets from natural and man-made clutter objects by means of their unique, complex (in-phase and quadrature) frequency responses.

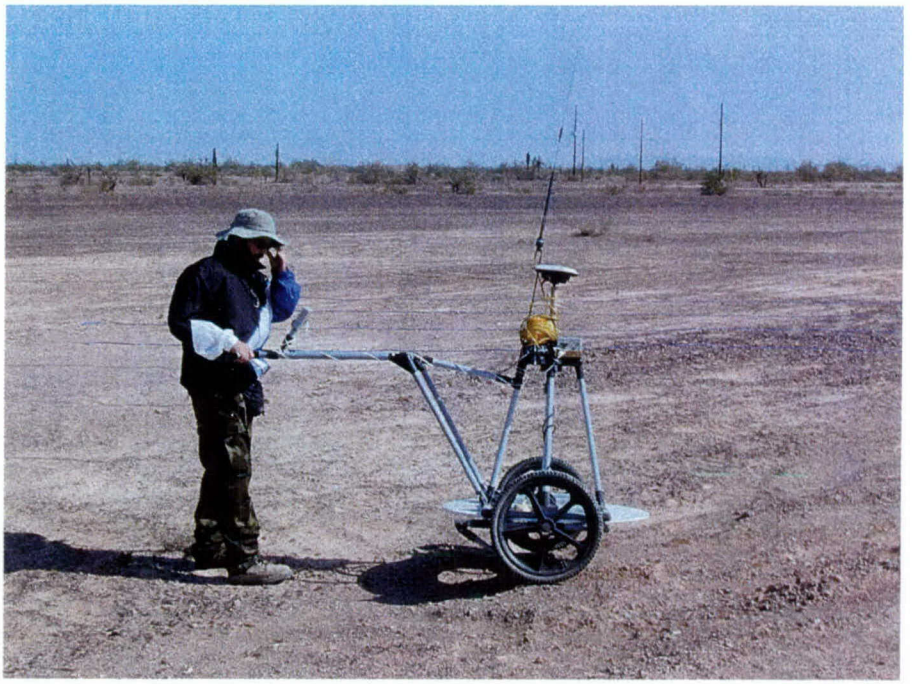

Figure 1. Demonstrator's system, GEM-3 pushcart.

### 2.1.3 Data Processing Description (provided by demonstrator)

The GEM-3 data acquired at the test site will be processed using a combination of ERDC-developed programs and Geosoft's Oasis Montaj. First, basic data corrections such as background subtraction and time-synchronization between the sensor data and GPS data will be performed. The raw data, after these basic corrections, will be submitted in Geosoft XYZ format. Two Response Stage submissions will be made within 30 days. One will be based on a threshold applied to the total magnitude of the sensor inphase and quadrature response for all frequencies. The second will be based on interactive histogram analysis of the data. Data from each of these detection schemes will be used by the target discrimination algorithm to generate separate Discrimination Stage submissions. The discrimination algorithm compares sensor data collected near each detected anomaly with calibration data acquired over the target types of interest at the beginning of the data collection.

One of ERDC's primary objectives for this data acquisition is to obtain high quality data to further our modeling and analysis research. Therefore, ERDC plans to make further data submissions using other detection and discrimination algorithms on this same dataset, alone and in combination with data from other sensors.

### 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. These submitted data are not included in this report in order to protect ground truth information.

### 2.1.5 Demonstrator Quality Assurance (QA) and Quality Control (QC) (provided by demonstrator)

The operators will perform three levels of quality control (QC) checks: the first day of the project, the beginning of the day, and whenever there is an equipment change (i.e. batteries, data dump, etc.). On the first day of the project, the operators will lay out a 10-meter long line oriented North to South with a ferrite bar at the center. This line will be well marked and used each time we test the instrument and positioning are tested. The operators will test for instrument response over the ferrite bar, as well as conduct a position check and a latency check. The operators will walk the line slowly in two directions and then back the pushcart up until it is centered on the ferrite bar. This will set the location of the ferrite bar as well as the instrument response, which will be referenced every time the operators check the equipment.

Each morning the operators will perform functional equipment checks. The operators will visually inspect all equipment for damage. They will then power up the equipment. The operators will perform static and instrument response tests to ensure that the data is stable when the instrument is in a static position over a marked location. These tests will be performed after the instrument has had sufficient time to warm up.

Quality assurance (QA) will be the responsibility of the project lead; he will ensure that test data will be inspected and recorded each day using a known target (e.g. ferrite bar) with the GEM-3 sensors, and using a reference position with the RTK GPS. Geo-referenced data sets will be inspected at the end of the day for GEM-3 data quality and navigation integrity (reasonableness criteria).

Data analysis will be performed each day. This analysis will include inspection of the data for inconsistencies (bad data and errors) and to verify RTK GPS data show good coverage and limited dropouts. If the data show the sensor or electronics are not taking acceptable data or the RTK GPS dropouts are too numerous/large for data analysis or good coverage, that section will be flagged for a resurvey.

### 2.1.6 Additional Records

The following record(s) by this vendor can be accessed via Microsoft Word files at www.uxotestsites.org. The Blind Grid counterpart to this report is Scoring Record #134.

## 2.2 YPG SITE INFORMATION

### 2.2.1 Location

YPG is located adjacent to the Colorado River in the Sonoran Desert. The UXO Standardized Test Site is located south of Pole Line Road and east of the Countermine Testing and Training Range. The Open Field range, Calibration Grid, Blind Grid, Mogul area, and Desert Extreme area comprise the 350- by 500 meter general test site area. The open field site is the largest of the test sites and measures approximately 200 by 350 meters. To the east of the open field range are the calibration and blind test grids that measure 30 by 40 meters and 40 by 40 meters, respectively. South of the Open Field is the 135- by 80-meter Mogul area consisting of a sequence of man-made depressions. The Desert Extreme area is located southeast of the open field site and has dimensions of 50 by 100 meters. The Desert Extreme area, covered with desert-type vegetation, is used to test the performance of different sensor platforms in a more severe desert conditions/environment.

### 2.2.2 Soil Type

Soil samples were collected at the YPG UXO Standardized Test Site by ERDC to characterize the shallow subsurface (<3 meters). Both surface grab samples and continuous soil borings were acquired. The soils were subjected to several laboratory analyses, including sieve/hydrometer, water content, magnetic susceptibility, dielectric permittivity, X-ray diffraction, and visual description.

There are two soil complexes present within the site, Riverbend-Carrizo and Cristobal-Gunsight. The Riverbend-Carrizo complex is comprised of mixed stream alluvium, whereas the Cristobal-Gunsight complex is derived from fan alluvium. The Cristobal-Gunsight complex covers the majority of the site. Most of the soil samples were classified as either a sandy loam or loamy sand, with most samples containing gravel-size particles. All samples had a measured water content less than 7 percent, except for two that contained 11-percent moisture. The majority of soil samples had water content between 1 to 2-percent. Samples containing more than 3 percent were generally deeper than 1 meter.

An X-ray diffraction analysis on four soil samples indicated a basic mineralogy of quartz, calcite, mica, feldspar, magnetite, and some clay. The presence of magnetite imparted a moderate magnetic susceptibility, with volume susceptibilities generally greater than 100 by 10-5 SI.

For more details concerning the soil properties at the YPG 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 YPG is included in Table 2.

**TABLE 2. TEST SITE AREAS**

| Area | Description |
|---|---|
| Calibration Grid | Contains the 15 standard ordnance items buried in six positions at various angles and depths to allow demonstrator equipment calibration. |
| Blind Grid | Contains 400 grid cells in a 0.16-hectare (0.39-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, including vegetation. The center of each grid cell contains ordnance, clutter, or nothing. |



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## SECTION 3. FIELD DATA

### 3.1 DATE OF FIELD ACTIVITIES (7-10, 12-17, 19-20, and 30 May 2003)

### 3.2 AREAS TESTED/NUMBER OF HOURS

Areas tested and 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 | 6.00 |
| Open Field | 92.95 |

### 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, 2003 | Average Temperature, °F | Total Daily Precipitation, in. |
|---|---|---|
| May 7 | 72.1 | 0.00 |
| May 8 | 70.7 | 0.00 |
| May 9 | 68.2 | 0.00 |
| May 10 | N/A | N/A |
| May 12 | 87.4 | 0.00 |
| May 13 | N/A | N/A |
| May 14 | 88.9 | 0.00 |
| May 15 | 78.3 | 0.00 |
| May 16 | 91.3 | 0.00 |
| May 17 | N/A | N/A |
| May 19 | 93.2 | 0.00 |
| May 20 | N/A | N/A |
| May 30 | N/A | N/A |

### 3.3.2 Field Conditions

ERDC surveyed the Open Field area with the GEM-3 pushcart 7-10, 12-17, 19-20, and 30 May 2003 with field conditions remaining dry.

### 3.3.3 Soil Moisture

Five soil probes were placed at various locations of the site to capture soil moisture data: dry, desert extreme, 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 moisture 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. The three-person crew took 5 hours and 30 minutes to perform the initial setup and mobilization. There was 46 minutes of daily equipment preparation and end of day equipment break down lasted 1-hour and 25 minutes.

### 3.4.2 Calibration

ERDC spent 6 hours in the calibration lanes. In addition, ERDC spent 1-hour and 5 minutes in the calibration test pit. No calibrating activities were conducted while in the Open Field area.

### 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 lunch/breaks. 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 included. Breaks and lunches are not included either.

**3.4.3.1 Equipment/data checks, maintenance.** Equipment/data checks and maintenance activities accounted for 10 hours and 37 minutes of site usage time. These activities included changing out batteries and routine data checks to ensure data were being properly recorded/collected.

**3.4.3.2 Equipment failure or repair.** Three minor equipment failures occurred while surveying in the Open Field area. A brief infield computer communication malfunction occurred and the changing of the infield computers was completed. The GPS was down for a few minutes but was restored and a wheel axel broke which was repaired on the sensor. The total time for the failures was 3 hours and 5 minutes.

**3.4.3.3 Weather.** No delays occurred due to weather.

### 3.4.4 Data Collection

ERDC spent 55 hours and 15 minutes collecting data in the Open Field area. This time excludes break/lunches and downtimes described in section 3.4.3.

### 3.4.5 Demobilization

ERDC went on to survey the entire YPG Site. Therefore, actual demobilization did not occur until 30 May 2003. On that day, 46 minutes were spent demobilizing all of the equipment.

## 3.5 PROCESSING TIME

ERDC submitted the raw data from demonstration activities on a date when required by the test director. The scoring submission data were also provided within the required 30-day timeframe.

## 3.6 DEMONSTRATOR'S FIELD PERSONNEL

| | |
|---|---|
| Field Manager: | Ryan North |
| Field Engineers: | Eric Smith |
| | Stephen Billings |
| Quality Assurance: | Don Yule |

## 3.7 DEMONSTRATOR'S FIELD SURVEYING METHOD

ERDC started surveying the Open Field area in the northeast portion and generally in the east/west direction. One lane was surveyed and then the demonstrator returned to the beginning of the next lane, until completion. Lanes were laid out in approximately 50 meter intervals, where appropriate.

## 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.



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## SECTION 4. TECHNICAL PERFORMANCE RESULTS

### 4.1 ROC CURVES USING ALL ORDNANCE CATEGORIES

Figure 2 shows the probability of detection for the response stage ($P_d^{res}$) and the discrimination stage ($P_d^{disc}$) versus their respective $P_{fp}$. Figure 3 shows both probabilities plotted against their respective BAR. Both figures use a horizontal line to illustrate the performance of the demonstrator at the demonstrator's recommended discrimination stage threshold level, which defines the subset of targets the demonstrator would recommend digging based on discrimination. Note that all points have been rounded to protect the ground truth.

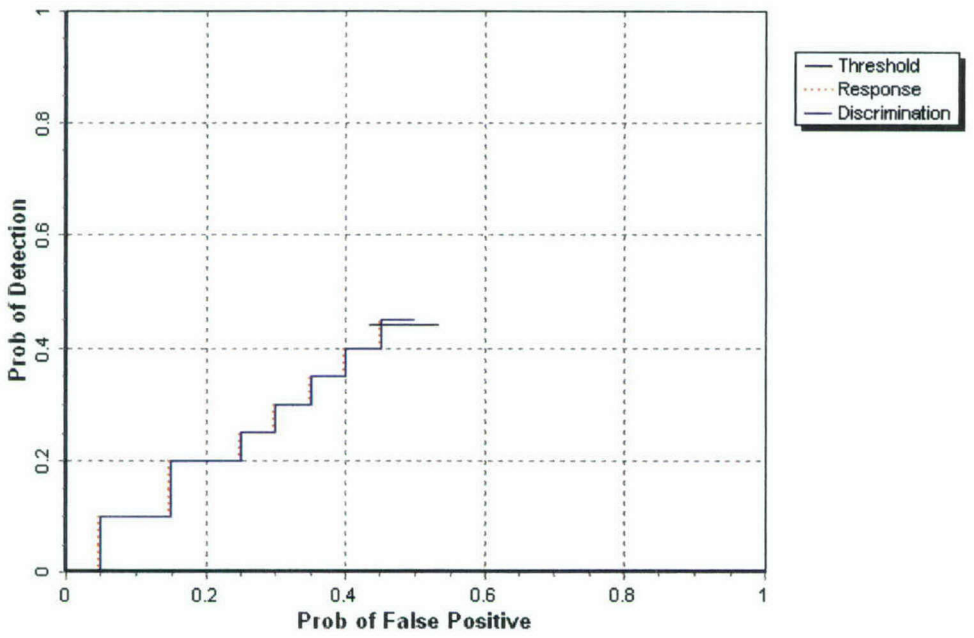


Figure 2. GEM-3 pushcart open field $P_d^{res}$ and $P_d^{disc}$ versus their respective over all ordnance categories combined.

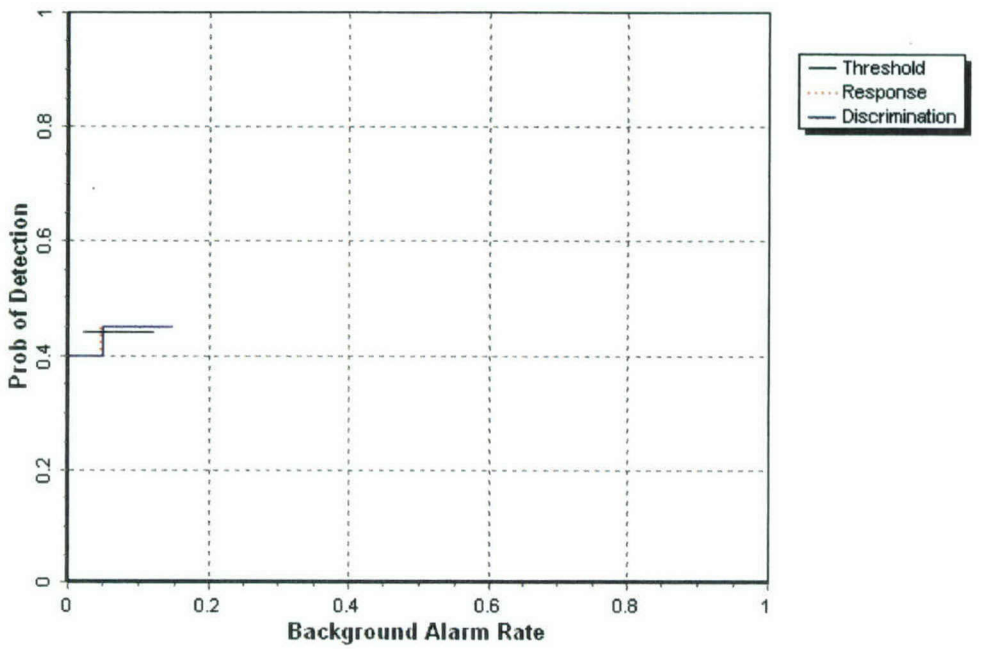


Figure 3. GEM-3 pushcart open field $P_d^{res}$ and $P_d^{disc}$ versus their respective BAR over all ordnance categories combined.

## 4.2 ROC CURVES USING ORDNANCE LARGER THAN 20 MM

Figure 4 shows the probability of detection for the response stage ($P_d^{res}$) and the discrimination stage ($P_d^{disc}$) versus their respective $P_{fp}$ when only targets larger than 20 mm are scored. Figure 5 shows both probabilities plotted against their respective BAR. Both figures use a horizontal line to illustrate the performance of the demonstrator at the demonstrator's recommended discrimination stage threshold level, which defines the subset of targets the demonstrator would recommend digging based on discrimination. Note that all points have been rounded to protect the ground truth.

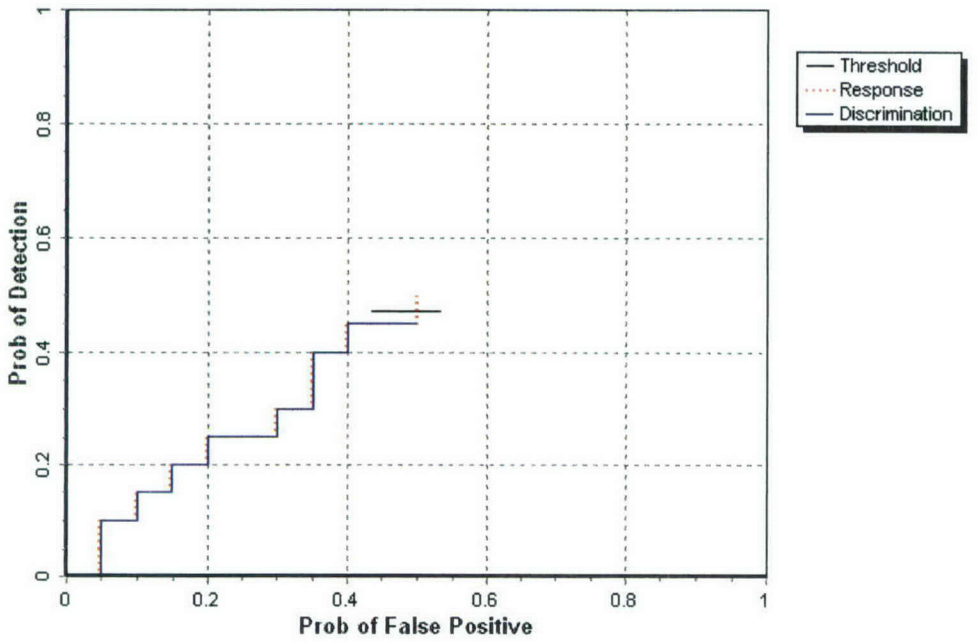


Figure 4. GEM-3 pushcart open field $P_d^{res}$ and $P_d^{disc}$ versus their respective $P_{fp}$ for all ordnance larger than 20 mm.

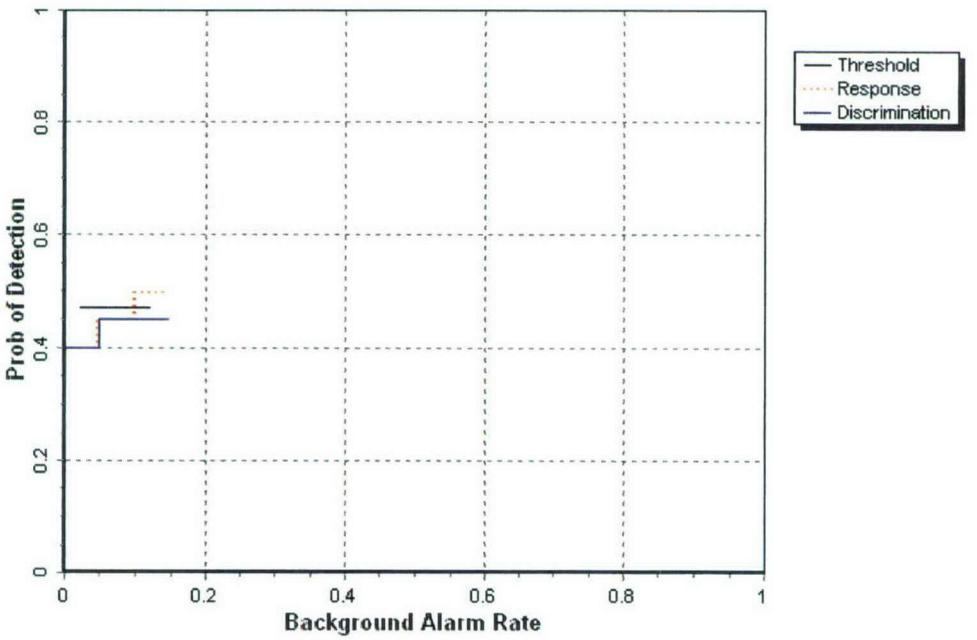


Figure 5. GEM-3 pushcart open field $P_d^{res}$ and $P_d^{disc}$ versus their respective $BAR^{res}$ for all ordnance larger than 20 mm.

## 4.3 PERFORMANCE SUMMARIES

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 geometric center of anomalies.

The RESPONSE STAGE results are derived from the list of anomalies above the demonstrator-provided noise level. The results for the DISCRIMINATION STAGE are derived from the demonstrator's recommended threshold for optimizing UXO field cleanup by minimizing false digs and maximizing ordnance recovery. The lower 90 percent confidence limit on probability of detection and $P_{fp}$ was calculated assuming that the number of detections and false positives are binomially distributed random variables. All results in Table 5 have been rounded to protect the ground truth. However, lower confidence limits were calculated using actual results.

**TABLE 5. SUMMARY OF OPEN FIELD RESULTS FOR THE GEM-3**

| | | | | By Size | | | By Depth, m | | |
|---|---|---|---|---|---|---|---|---|---|
| **Metric** | **Overall** | **Standard** | **Non-Standard** | **Small** | **Medium** | **Large** | **< 0.3** | **0.3 to <1** | **>= 1** |
| **RESPONSE STAGE** | | | | | | | | | |
| $P_d$ | 0.45 | 0.45 | 0.55 | 0.35 | 0.60 | 0.65 | 0.50 | 0.50 | 0.05 |
| $P_d$ Low 90% Conf | 0.44 | 0.39 | 0.48 | 0.31 | 0.52 | 0.60 | 0.46 | 0.46 | 0.03 |
| $P_{fp}$ | 0.50 | - | - | - | - | - | 0.55 | 0.50 | 0.00 |
| $P_{fp}$ Low 90% Conf | 0.50 | - | - | - | - | - | 0.51 | 0.47 | 0.00 |
| BAR | 0.15 | - | - | - | - | - | - | - | - |
| **DISCRIMINATION STAGE** | | | | | | | | | |
| $P_d$ | 0.45 | 0.40 | 0.50 | 0.30 | 0.55 | 0.65 | 0.45 | 0.50 | 0.05 |
| $P_d$ Low 90% Conf | 0.41 | 0.37 | 0.44 | 0.27 | 0.50 | 0.57 | 0.43 | 0.44 | 0.03 |
| $P_{fp}$ | 0.50 | - | - | - | - | - | 0.50 | 0.45 | 0.00 |
| $P_{fp}$ Low 90% Conf | 0.47 | - | - | - | - | - | 0.48 | 0.42 | 0.00 |
| BAR | 0.05 | - | - | - | - | - | - | - | - |

Response Stage Noise Level: 49.00
Recommended Discrimination Stage Threshold: 70.00

Note: The recommended discrimination stage threshold values are provided by the demonstrator.

## 4.4 EFFICIENCY, REJECTION RATES, AND TYPE CLASSIFICATION

Efficiency and rejection rates are calculated to quantify the discrimination ability at specific points of interest on the ROC curve: (1) at the point where no decrease in $P_d$ is suffered (i.e., the efficiency is by definition equal to one) and (2) at the operator selected threshold. These values are reported in Table 6.

**TABLE 6. EFFICIENCY AND REJECTION RATES FOR THE GEM-3**

| | Efficiency (E) | False Positive Rejection Rate | Background Alarm Rejection Rate |
|---|---|---|---|
| At Operating Point | 0.94 | 0.07 | 0.50 |
| With No Loss of $P_d$ | 1.00 | 0.02 | 1.00 |

At the demonstrator's recommended setting, the ordnance items that were detected and correctly discriminated were further scored on whether their correct type could be identified (table 7). Correct type examples include "20-mm projectile, 105-mm Projectile, and 2.75-inch Rocket". A list of the standard type declaration required for each ordnance item was provided to demonstrators prior to testing. For example, the standard type for the three example items are 20mmP, 105H, and 2.75in, respectively.

**TABLE 7. CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS UXO**

| Size | % Correct |
|---|---|
| Small | 0.00 |
| Medium | 0.00 |
| Large | 0.00 |
| Overall | 0.00 |

Note: The demonstrator did not attempt to identify ordnance type.

## 4.5 LOCATION ACCURACY

The mean and standard deviations of location accuracy are presented in Table 8 for each of the three dimensions of location. Location accuracy was calculated for those ordnance items correctly identified in the discrimination stage. Note that depth is measured from the closest point of the ordnance to the surface.

**TABLE 8. MEAN LOCATION ACCURACY AND STANDARD DEVIATION FOR THE GEM-3**

| | Mean, m | Standard Deviation, m |
|---|---|---|
| Northing | -0.01 | 0.19 |
| Easting | 0.01 | 0.18 |
| Depth | 0.05 | 0.27 |

## 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 9. 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 9. ON-SITE LABOR COSTS

| | No. People | Hourly Wage | Hours | Cost |
|---|---|---|---|---|
| **INITIAL SETUP** | | | | |
| Supervisor | 1 | $95.00 | 5.5 | $522.50 |
| Data Analyst | 1 | 57.00 | 5.5 | 313.50 |
| Field Support | 2 | 28.50 | 5.5 | 313.50 |
| Subtotal | | | | **$1,149.50** |
| **CALIBRATION** | | | | |
| Supervisor | 1 | $95.00 | 7.08 | $672.60 |
| Data Analyst | 1 | 57.00 | 7.08 | 403.56 |
| Field Support | 2 | 28.50 | 7.08 | 403.56 |
| Subtotal | | | | **$1,479.72** |
| **SITE SURVEY** | | | | |
| Supervisor | 1 | $95.00 | 92.95 | $8830.25 |
| Data Analyst | 1 | 57.00 | 92.95 | 5298.15 |
| Field Support | 2 | 28.50 | 92.95 | 5298.15 |
| Subtotal | | | | **$19,426.55** |

See notes at end of table.

**TABLE 9 (CONT'D)**

| | No. People | Hourly Wage | Hours | Cost |
|---|---|---|---|---|
| **DEMOBILIZATION** | | | | |
| Supervisor | 1 | $95.00 | 0.76 | $72.20 |
| Data Analyst | 1 | 57.00 | 0.76 | 43.32 |
| Field Support | 2 | 28.50 | 0.76 | 43.32 |
| Subtotal | | | | **$158.84** |
| **Total** | | | | **$22,214.61** |

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 BLIND GRID DEMONSTRATION

### 6.1 SUMMARY OF RESULTS FROM BLIND GRID DEMONSTRATION

Table 10 shows the results from Blind Grid survey conducted prior to surveying the open field during the same site visit in May of 2003. For more details on the Blind Grid survey results reference section 2.1.6.

**TABLE 10. SUMMARY OF BLIND GRID RESULTS FOR THE GEM-3**

| Metric | Overall | Standard | Nonstandard | By Size | | | By Depth, m | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Small | Medium | Large | < 0.3 | 0.3 to <1 | >= 1 |
| **RESPONSE STAGE** | | | | | | | | | |
| $P_d$ | 0.45 | 0.45 | 0.50 | 0.30 | 0.50 | 0.80 | 0.50 | 0.50 | 0.00 |
| $P_d$ Low 90% Conf | 0.38 | 0.34 | 0.35 | 0.20 | 0.37 | 0.58 | 0.40 | 0.35 | 0.00 |
| $P_{fp}$ | 0.80 | - | - | - | - | - | 0.85 | 0.65 | 0.00 |
| $P_{fp}$ Low 90% Conf | 0.74 | - | - | - | - | - | 0.79 | 0.50 | - |
| $P_{ba}$ | 0.05 | - | - | - | - | - | - | - | - |
| **DISCRIMINATION STAGE** | | | | | | | | | |
| $P_d$ | 0.45 | 0.40 | 0.50 | 0.25 | 0.50 | 0.80 | 0.45 | 0.50 | 0.00 |
| $P_d$ Low 90% Conf | 0.35 | 0.30 | 0.35 | 0.15 | 0.37 | 0.58 | 0.36 | 0.35 | 0.00 |
| $P_{fp}$ | 0.75 | - | - | - | - | - | 0.80 | 0.55 | 0.00 |
| $P_{fp}$ Low 90% Conf | 0.68 | - | - | - | - | - | 0.72 | 0.43 | - |
| $P_{ba}$ | 0.00 | - | - | - | - | - | - | - | - |

### 6.2 COMPARISON OF ROC CURVES USING ALL ORDNANCE CATEGORIES

Figure 6 shows $P_d^{res}$ versus the respective $P_{fp}$ over all ordnance categories. Figure 7 shows $P_d^{disc}$ versus their respective $P_{fp}$ over all ordnance categories. Figure 7 uses horizontal lines to illustrate the performance of the demonstrator at the recommended discrimination threshold levels, defining the subset of targets the demonstrator would recommend digging based on discrimination.

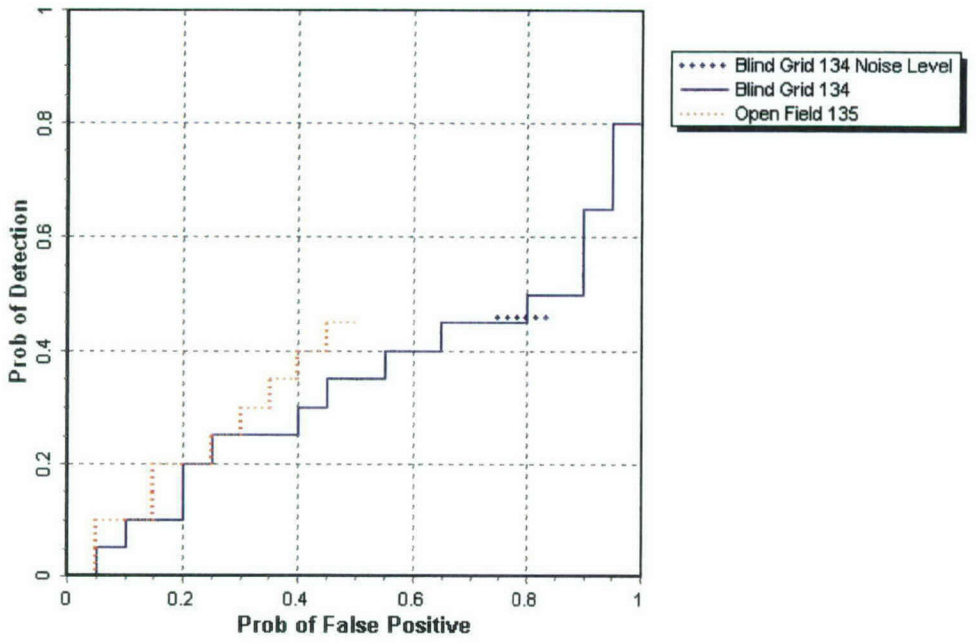


Figure 6. GEM-3 pushcart $P_d^{res}$ stages versus the respective $P_{fp}$ over all ordnance categories combined.

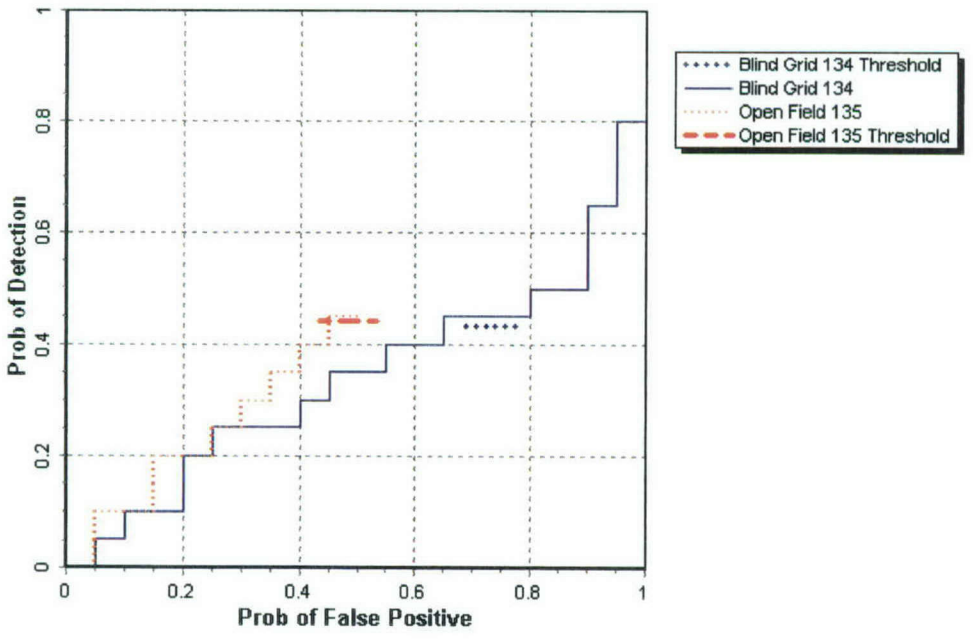


Figure 7. GEM-3 pushcart $P_d^{disc}$ versus the respective $P_{fp}$ over all ordnance categories combined.

## 6.3 COMPARISON OF ROC CURVES USING ORDNANCE LARGER THAN 20 MM

Figure 8 shows the $P_d^{res}$ versus the respective probability of $P_{fp}$ over ordnance larger than 20 mm. Figure 9 shows $P_d^{disc}$ versus the respective $P_{fp}$ over ordnance larger than 20 mm. Figure 9 uses horizontal lines to illustrate the performance of the demonstrator at the recommended discrimination threshold levels, defining the subset of targets the demonstrator would recommend digging based on discrimination.

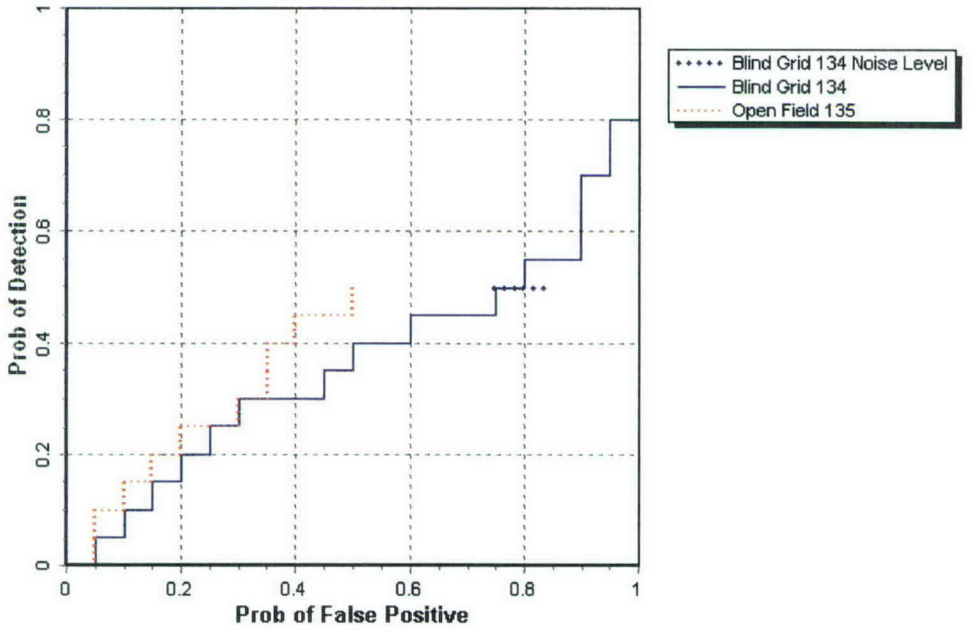


Figure 8. GEM-3 pushcart $P_d^{res}$ versus the respective $P_{fp}$ for ordnance larger than 20 mm.

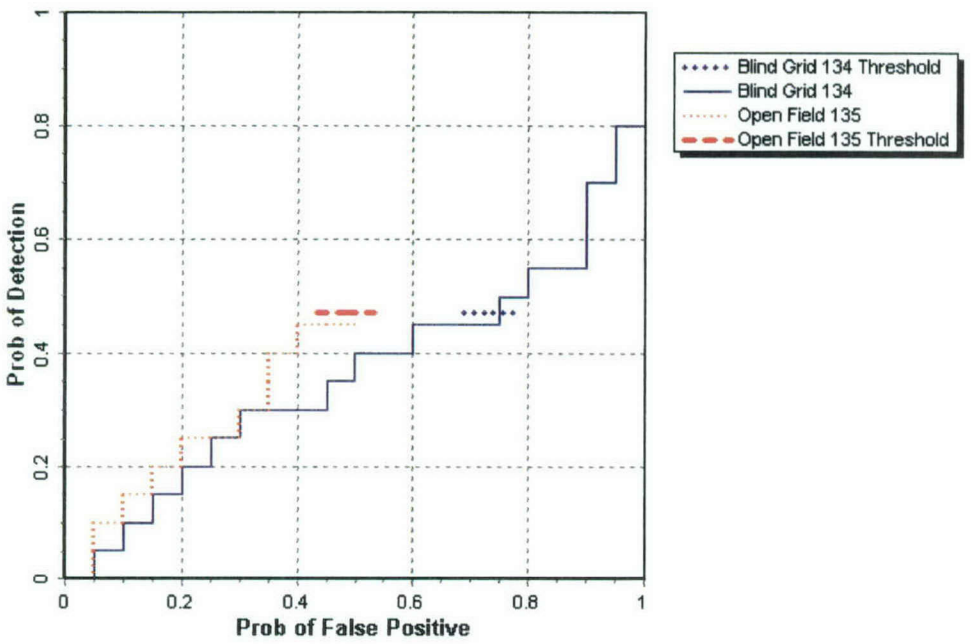


Figure 9. GEM-3 pushcart $P_d^{disc}$ versus the respective $P_{fp}$ for ordnance larger than 20 mm.

## 6.4 STATISTICAL COMPARISONS

Statistical Chi-square significance tests were used to compare results between the Blind Grid and Open Field scenarios. The intent of the comparison is to determine if the feature introduced in each scenario has a degrading effect on the performance of the sensor system. However, any modifications in the UXO sensor system during the test, like changes in the processing or changes in the selection of the operating threshold, will also contribute to performance differences.

The Chi-square test for comparison between ratios was used at a significance level of 0.05 to compare Blind Grid to Open Field with regard to $P_d^{res}$, $P_d^{disc}$, $P_{fp}^{res}$ and $P_{fp}^{disc}$, Efficiency and Rejection Rate. These results are presented in Table 11. A detailed explanation and example of the Chi-square application is located in Appendix A.

**TABLE 11. CHI-SQUARE RESULTS - BLIND GRID VERSUS OPEN FIELD**

| Metric | Small | Medium | Large | Overall |
|---|---|---|---|---|
| $P_d^{res}$ | Not Significant | Not Significant | Not Significant | Not Significant |
| $P_d^{disc}$ | Not Significant | Not Significant | Not Significant | Not Significant |
| $P_{fp}^{res}$ | Not Significant | Not Significant | Not Significant | Significant |
| $P_{fp}^{disc}$ | - | - | - | Significant |
| Efficiency | - | | | Significant |
| Rejection rate | - | - | - | Significant |



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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 non-ordnance 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.

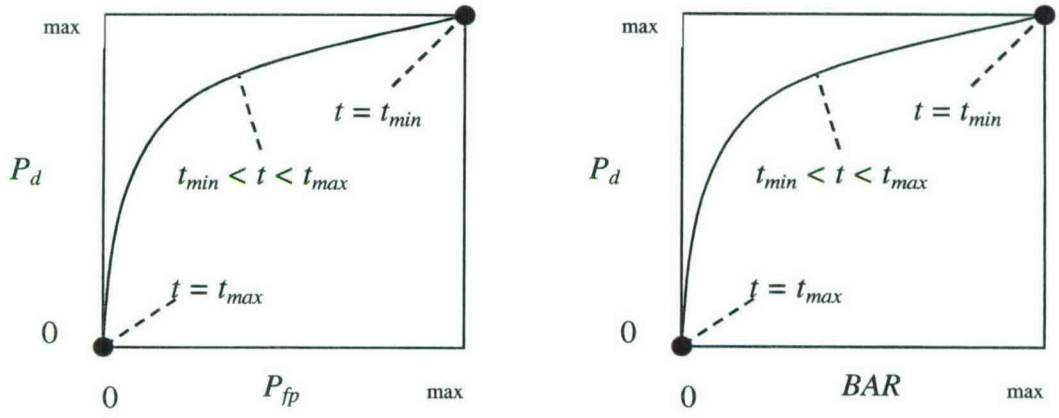


Figure A-1. ROC curves for open-field testing. Each curve applies to both the response and discrimination stages.

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[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 non-ordnance 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, pages 144 through 151).

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

| Weather Data from Yuma Proving Ground | | | | |
|---|---|---|---|---|
| Date | Time, EDST | Average Temperature, °F | RH, % | Precipitation, in. |
| 5/7/2003 | 01:00 | 66.1 | 33 | 0.00 |
| 5/7/2003 | 02:00 | 64.8 | 35 | 0.00 |
| 5/7/2003 | 03:00 | 63.2 | 36 | 0.00 |
| 5/7/2003 | 04:00 | 62.0 | 37 | 0.00 |
| 5/7/2003 | 05:00 | 61.2 | 37 | 0.00 |
| 5/7/2003 | 06:00 | 60.2 | 38 | 0.00 |
| 5/7/2003 | 07:00 | 62.1 | 37 | 0.00 |
| 5/7/2003 | 08:00 | 63.4 | 38 | 0.00 |
| 5/7/2003 | 09:00 | 66.0 | 36 | 0.00 |
| 5/7/2003 | 10:00 | 69.2 | 33 | 0.00 |
| 5/7/2003 | 11:00 | 72.1 | 30 | 0.00 |
| 5/7/2003 | 12:00 | 74.6 | 26 | 0.00 |
| 5/7/2003 | 13:00 | 76.5 | 25 | 0.00 |
| 5/7/2003 | 14:00 | 77.4 | 24 | 0.00 |
| 5/7/2003 | 15:00 | 77.4 | 23 | 0.00 |
| 5/7/2003 | 16:00 | 77.9 | 23 | 0.00 |
| 5/7/2003 | 17:00 | 76.6 | 25 | 0.00 |
| 5/7/2003 | 18:00 | 74.7 | 26 | 0.00 |
| 5/7/2003 | 19:00 | 71.8 | 33 | 0.00 |
| 5/7/2003 | 20:00 | 69.5 | 36 | 0.00 |
| 5/7/2003 | 21:00 | 67.8 | 40 | 0.00 |
| 5/7/2003 | 22:00 | 65.8 | 45 | 0.00 |
| 5/7/2003 | 23:00 | 64.9 | 46 | 0.00 |
| 5/7/2003 | 24:00 | 63.8 | 47 | 0.00 |
| 5/8/2003 | 01:00 | 62.6 | 47 | 0.00 |
| 5/8/2003 | 02:00 | 61.8 | 45 | 0.00 |
| 5/8/2003 | 03:00 | 59.7 | 45 | 0.00 |
| 5/8/2003 | 04:00 | 58.0 | 48 | 0.00 |
| 5/8/2003 | 05:00 | 56.8 | 53 | 0.00 |
| 5/8/2003 | 06:00 | 55.5 | 56 | 0.00 |
| 5/8/2003 | 07:00 | 57.5 | 53 | 0.00 |
| 5/8/2003 | 08:00 | 60.5 | 47 | 0.00 |
| 5/8/2003 | 09:00 | 65.1 | 40 | 0.00 |
| 5/8/2003 | 10:00 | 67.3 | 36 | 0.00 |
| 5/8/2003 | 11:00 | 71.1 | 30 | 0.00 |
| 5/8/2003 | 12:00 | 72.9 | 29 | 0.00 |
| 5/8/2003 | 13:00 | 74.4 | 27 | 0.00 |
| 5/8/2003 | 14:00 | 76.4 | 24 | 0.00 |
| 5/8/2003 | 15:00 | 77.2 | 23 | 0.00 |
| 5/8/2003 | 16:00 | 78.1 | 22 | 0.00 |
| 5/8/2003 | 17:00 | 77.3 | 24 | 0.00 |
| 5/8/2003 | 18:00 | 76.2 | 22 | 0.00 |
| 5/8/2003 | 19:00 | 73.5 | 22 | 0.00 |

## TABLE B-1 (CONT'D)

| Weather Data from Yuma Proving Ground | | | | |
|---|---|---|---|---|
| Date | Time, EDST | Average Temperature, °F | RH, % | Precipitation, in. |
| 5/8/2003 | 20:00 | 69.5 | 29 | 0.00 |
| 5/8/2003 | 21:00 | 67.3 | 28 | 0.00 |
| 5/8/2003 | 22:00 | 64.5 | 32 | 0.00 |
| 5/8/2003 | 23:00 | 62.8 | 32 | 0.00 |
| 5/8/2003 | 24:00 | 60.8 | 38 | 0.00 |
| 5/9/2003 | 01:00 | 58.6 | 43 | 0.00 |
| 5/9/2003 | 02:00 | 57.9 | 45 | 0.00 |
| 5/9/2003 | 03:00 | 56.1 | 49 | 0.00 |
| 5/9/2003 | 04:00 | 54.6 | 52 | 0.00 |
| 5/9/2003 | 05:00 | 55.1 | 52 | 0.00 |
| 5/9/2003 | 06:00 | 55.0 | 51 | 0.00 |
| 5/9/2003 | 07:00 | 56.7 | 49 | 0.00 |
| 5/9/2003 | 08:00 | 59.7 | 45 | 0.00 |
| 5/9/2003 | 09:00 | 62.9 | 39 | 0.00 |
| 5/9/2003 | 10:00 | 65.8 | 33 | 0.00 |
| 5/9/2003 | 11:00 | 67.7 | 29 | 0.00 |
| 5/9/2003 | 12:00 | 69.8 | 26 | 0.00 |
| 5/9/2003 | 13:00 | 71.4 | 22 | 0.00 |
| 5/9/2003 | 14:00 | 72.2 | 17 | 0.00 |
| 5/9/2003 | 15:00 | 73.0 | 18 | 0.00 |
| 5/9/2003 | 16:00 | 75.0 | 16 | 0.00 |
| 5/9/2003 | 17:00 | 76.0 | 14 | 0.00 |
| 5/9/2003 | 18:00 | 75.8 | 12 | 0.00 |
| 5/9/2003 | 19:00 | 73.5 | 20 | 0.00 |
| 5/9/2003 | 20:00 | 71.4 | 20 | 0.00 |
| 5/9/2003 | 21:00 | 68.5 | 22 | 0.00 |
| 5/9/2003 | 22:00 | 66.4 | 24 | 0.00 |
| 5/9/2003 | 23:00 | 65.9 | 23 | 0.00 |
| 5/9/2003 | 24:00 | 63.4 | 27 | 0.00 |
| 5/10/2003 | 01:00 | 60.5 | 34 | 0.00 |
| 5/10/2003 | 02:00 | 59.6 | 39 | 0.00 |
| 5/10/2003 | 03:00 | 56.9 | 42 | 0.00 |
| 5/10/2003 | 04:00 | 54.6 | 44 | 0.00 |
| 5/10/2003 | 05:00 | 53.2 | 43 | 0.00 |
| 5/10/2003 | 06:00 | 51.0 | 44 | 0.00 |
| 5/10/2003 | 07:00 | 58.1 | 32 | 0.00 |
| 5/10/2003 | 08:00 | 64.8 | 31 | 0.00 |
| 5/10/2003 | 09:00 | 68.4 | 25 | 0.00 |
| 5/10/2003 | 10:00 | 72.5 | 20 | 0.00 |
| 5/10/2003 | 11:00 | 76.3 | 15 | 0.00 |
| 5/10/2003 | 12:00 | 77.8 | 12 | 0.00 |
| 5/10/2003 | 13:00 | 79.8 | 13 | 0.00 |
| 5/10/2003 | 14:00 | 81.7 | 12 | 0.00 |
| 5/10/2003 | 15:00 | 81.8 | 12 | 0.00 |
| 5/10/2003 | 16:00 | 83.2 | 10 | 0.00 |

## TABLE B-1 (CONT'D)

| Weather Data from Yuma Proving Ground | | | | |
|---|---|---|---|---|
| Date | Time, EDST | Average Temperature, °F | RH, % | Precipitation, in. |
| 5/10/2003 | 17:00 | 83.3 | 10 | 0.00 |
| 5/10/2003 | 18:00 | 82.7 | 10 | 0.00 |
| 5/10/2003 | 19:00 | 81.6 | 10 | 0.00 |
| 5/10/2003 | 20:00 | 78.1 | 13 | 0.00 |
| 5/10/2003 | 21:00 | 75.4 | 15 | 0.00 |
| 5/10/2003 | 22:00 | 72.8 | 15 | 0.00 |
| 5/10/2003 | 23:00 | 68.9 | 18 | 0.00 |
| 5/10/2003 | 24:00 | 66.1 | 19 | 0.00 |
| 5/12/2003 | 01:00 | 71.2 | 21 | 0.00 |
| 5/12/2003 | 02:00 | 69.7 | 21 | 0.00 |
| 5/12/2003 | 03:00 | 67.2 | 23 | 0.00 |
| 5/12/2003 | 04:00 | 63.2 | 24 | 0.00 |
| 5/12/2003 | 05:00 | 63.4 | 25 | 0.00 |
| 5/12/2003 | 06:00 | 61.7 | 26 | 0.00 |
| 5/12/2003 | 07:00 | 65.9 | 21 | 0.00 |
| 5/12/2003 | 08:00 | 74.7 | 15 | 0.00 |
| 5/12/2003 | 09:00 | 81.7 | 14 | 0.00 |
| 5/12/2003 | 10:00 | 86.5 | 12 | 0.00 |
| 5/12/2003 | 11:00 | 89.3 | 10 | 0.00 |
| 5/12/2003 | 12:00 | 90.8 | 11 | 0.00 |
| 5/12/2003 | 13:00 | 93.0 | 8 | 0.00 |
| 5/12/2003 | 14:00 | 94.3 | 8 | 0.00 |
| 5/12/2003 | 15:00 | 95.7 | 8 | 0.00 |
| 5/12/2003 | 16:00 | 95.0 | 8 | 0.00 |
| 5/12/2003 | 17:00 | 94.7 | 9 | 0.00 |
| 5/12/2003 | 18:00 | 94.7 | 9 | 0.00 |
| 5/12/2003 | 19:00 | 92.2 | 9 | 0.00 |
| 5/12/2003 | 20:00 | 89.5 | 9 | 0.00 |
| 5/12/2003 | 21:00 | 85.3 | 10 | 0.00 |
| 5/12/2003 | 22:00 | 83.4 | 16 | 0.00 |
| 5/12/2003 | 23:00 | 80.4 | 17 | 0.00 |
| 5/12/2003 | 24:00 | 79.1 | 19 | 0.00 |
| 5/14/2003 | 01:00 | 76.0 | 21 | 0.00 |
| 5/14/2003 | 02:00 | 74.1 | 21 | 0.00 |
| 5/14/2003 | 03:00 | 72.4 | 22 | 0.00 |
| 5/14/2003 | 04:00 | 73.2 | 21 | 0.00 |
| 5/14/2003 | 05:00 | 71.8 | 21 | 0.00 |
| 5/14/2003 | 06:00 | 73.4 | 18 | 0.00 |
| 5/14/2003 | 07:00 | 73.2 | 19 | 0.00 |
| 5/14/2003 | 08:00 | 77.0 | 15 | 0.00 |
| 5/14/2003 | 09:00 | 82.6 | 13 | 0.00 |
| 5/14/2003 | 10:00 | 85.0 | 12 | 0.00 |
| 5/14/2003 | 11:00 | 88.9 | 10 | 0.00 |
| 5/14/2003 | 12:00 | 92.4 | 9 | 0.00 |
| 5/14/2003 | 13:00 | 94.8 | 8 | 0.00 |

## TABLE B-1 (CONT'D)

| Weather Data from Yuma Proving Ground | | | | |
|---|---|---|---|---|
| Date | Time, EDST | Average Temperature, °F | RH, % | Precipitation, in. |
| 5/14/2003 | 14:00 | 97.4 | 7 | 0.00 |
| 5/14/2003 | 15:00 | 96.2 | 6 | 0.00 |
| 5/14/2003 | 16:00 | 96.5 | 7 | 0.00 |
| 5/14/2003 | 17:00 | 94.6 | 9 | 0.00 |
| 5/14/2003 | 18:00 | 93.8 | 7 | 0.00 |
| 5/14/2003 | 19:00 | 92.0 | 8 | 0.00 |
| 5/14/2003 | 20:00 | 87.9 | 10 | 0.00 |
| 5/14/2003 | 21:00 | 84.4 | 11 | 0.00 |
| 5/14/2003 | 22:00 | 81.9 | 11 | 0.00 |
| 5/14/2003 | 23:00 | 79.4 | 12 | 0.00 |
| 5/14/2003 | 24:00 | 78.6 | 12 | 0.00 |
| 5/15/2003 | 01:00 | 62.5 | 39 | 0.00 |
| 5/15/2003 | 02:00 | 61.1 | 40 | 0.00 |
| 5/15/2003 | 03:00 | 60.0 | 44 | 0.00 |
| 5/15/2003 | 04:00 | 58.1 | 49 | 0.00 |
| 5/15/2003 | 05:00 | 57.9 | 51 | 0.00 |
| 5/15/2003 | 06:00 | 57.0 | 52 | 0.00 |
| 5/15/2003 | 07:00 | 60.8 | 46 | 0.00 |
| 5/15/2003 | 08:00 | 64.5 | 45 | 0.00 |
| 5/15/2003 | 09:00 | 68.3 | 37 | 0.00 |
| 5/15/2003 | 10:00 | 73.1 | 31 | 0.00 |
| 5/15/2003 | 11:00 | 78.0 | 26 | 0.00 |
| 5/15/2003 | 12:00 | 81.0 | 23 | 0.00 |
| 5/15/2003 | 13:00 | 83.4 | 22 | 0.00 |
| 5/15/2003 | 14:00 | 85.7 | 20 | 0.00 |
| 5/15/2003 | 15:00 | 87.5 | 18 | 0.00 |
| 5/15/2003 | 16:00 | 89.7 | 17 | 0.00 |
| 5/15/2003 | 17:00 | 89.8 | 17 | 0.00 |
| 5/15/2003 | 18:00 | 89.9 | 17 | 0.00 |
| 5/15/2003 | 19:00 | 88.4 | 18 | 0.00 |
| 5/15/2003 | 20:00 | 86.0 | 19 | 0.00 |
| 5/15/2003 | 21:00 | 83.4 | 21 | 0.00 |
| 5/15/2003 | 22:00 | 80.2 | 22 | 0.00 |
| 5/15/2003 | 23:00 | 75.7 | 25 | 0.00 |
| 5/15/2003 | 24:00 | 73.7 | 26 | 0.00 |
| 5/16/2003 | 01:00 | 73.9 | 29 | 0.00 |
| 5/16/2003 | 02:00 | 70.8 | 32 | 0.00 |
| 5/16/2003 | 03:00 | 69.2 | 32 | 0.00 |
| 5/16/2003 | 04:00 | 68.5 | 33 | 0.00 |
| 5/16/2003 | 05:00 | 66.7 | 35 | 0.00 |
| 5/16/2003 | 06:00 | 65.4 | 35 | 0.00 |
| 5/16/2003 | 07:00 | 70.5 | 30 | 0.00 |
| 5/16/2003 | 08:00 | 79.3 | 23 | 0.00 |
| 5/16/2003 | 09:00 | 86.4 | 17 | 0.00 |
| 5/16/2003 | 10:00 | 90.0 | 14 | 0.00 |

## TABLE B-1 (CONT'D)

| Weather Data from Yuma Proving Ground | | | | |
|---|---|---|---|---|
| Date | Time, EDST | Average Temperature, °F | RH, % | Precipitation, in. |
| 5/16/2003 | 11:00 | 92.0 | 14 | 0.00 |
| 5/16/2003 | 12:00 | 94.0 | 13 | 0.00 |
| 5/16/2003 | 13:00 | 95.5 | 12 | 0.00 |
| 5/16/2003 | 14:00 | 97.9 | 11 | 0.00 |
| 5/16/2003 | 15:00 | 98.9 | 11 | 0.00 |
| 5/16/2003 | 16:00 | 99.9 | 11 | 0.00 |
| 5/16/2003 | 17:00 | 99.4 | 12 | 0.00 |
| 5/16/2003 | 18:00 | 99.1 | 10 | 0.00 |
| 5/16/2003 | 19:00 | 97.7 | 11 | 0.00 |
| 5/16/2003 | 20:00 | 93.1 | 12 | 0.00 |
| 5/16/2003 | 21:00 | 87.8 | 14 | 0.00 |
| 5/16/2003 | 22:00 | 86.1 | 16 | 0.00 |
| 5/16/2003 | 23:00 | 83.0 | 18 | 0.00 |
| 5/16/2003 | 24:00 | 80.4 | 19 | 0.00 |
| 5/19/2003 | 01:00 | 79.3 | 19 | 0.00 |
| 5/19/2003 | 02:00 | 77.6 | 19 | 0.00 |
| 5/19/2003 | 03:00 | 75.2 | 20 | 0.00 |
| 5/19/2003 | 04:00 | 73.4 | 21 | 0.00 |
| 5/19/2003 | 05:00 | 71.6 | 24 | 0.00 |
| 5/19/2003 | 06:00 | 68.4 | 25 | 0.00 |
| 5/19/2003 | 07:00 | 74.2 | 23 | 0.00 |
| 5/19/2003 | 08:00 | 80.5 | 25 | 0.00 |
| 5/19/2003 | 09:00 | 84.5 | 24 | 0.00 |
| 5/19/2003 | 10:00 | 89.7 | 14 | 0.00 |
| 5/19/2003 | 11:00 | 94.4 | 11 | 0.00 |
| 5/19/2003 | 12:00 | 97.3 | 10 | 0.00 |
| 5/19/2003 | 13:00 | 99.8 | 8 | 0.00 |
| 5/19/2003 | 14:00 | 101.0 | 8 | 0.00 |
| 5/19/2003 | 15:00 | 101.1 | 8 | 0.00 |
| 5/19/2003 | 16:00 | 101.3 | 7 | 0.00 |
| 5/19/2003 | 17:00 | 101.9 | 7 | 0.00 |
| 5/19/2003 | 18:00 | 101.0 | 7 | 0.00 |
| 5/19/2003 | 19:00 | 99.1 | 8 | 0.00 |
| 5/19/2003 | 20:00 | 95.2 | 9 | 0.00 |
| 5/19/2003 | 21:00 | 91.4 | 11 | 0.00 |
| 5/19/2003 | 22:00 | 88.1 | 11 | 0.00 |
| 5/19/2003 | 23:00 | 83.8 | 13 | 0.00 |
| 5/19/2003 | 24:00 | 81.7 | 15 | 0.00 |
| 6/4/2003 | 01:00 | 81.0 | 19 | 0.00 |
| 6/4/2003 | 02:00 | 80.0 | 22 | 0.00 |
| 6/4/2003 | 03:00 | 78.0 | 22 | 0.00 |
| 6/4/2003 | 04:00 | 75.5 | 28 | 0.00 |
| 6/4/2003 | 05:00 | 75.1 | 32 | 0.00 |
| 6/4/2003 | 06:00 | 74.3 | 34 | 0.00 |
| 6/4/2003 | 07:00 | 77.1 | 32 | 0.00 |

## TABLE B-1 (CONT'D)

| Weather Data from Yuma Proving Ground | | | | |
|---|---|---|---|---|
| Date | Time, EDST | Average Temperature, °F | RH, % | Precipitation, in. |
| 6/4/2003 | 08:00 | 82.1 | 27 | 0.00 |
| 6/4/2003 | 09:00 | 87.3 | 22 | 0.00 |
| 6/4/2003 | 10:00 | 89.9 | 19 | 0.00 |
| 6/4/2003 | 11:00 | 93.9 | 15 | 0.00 |
| 6/4/2003 | 12:00 | 95.8 | 14 | 0.00 |
| 6/4/2003 | 13:00 | 98.5 | 13 | 0.00 |
| 6/4/2003 | 14:00 | 100.8 | 12 | 0.00 |
| 6/4/2003 | 15:00 | 102.5 | 12 | 0.00 |
| 6/4/2003 | 16:00 | 103.5 | 11 | 0.00 |
| 6/4/2003 | 17:00 | 103.4 | 10 | 0.00 |
| 6/4/2003 | 18:00 | 102.5 | 10 | 0.00 |
| 6/4/2003 | 19:00 | 100.0 | 10 | 0.00 |
| 6/4/2003 | 20:00 | 96.6 | 11 | 0.00 |
| 6/4/2003 | 21:00 | 94.1 | 11 | 0.00 |
| 6/4/2003 | 22:00 | 90.9 | 12 | 0.00 |
| 6/4/2003 | 23:00 | 86.7 | 14 | 0.00 |
| 6/4/2003 | 24:00 | 84.1 | 16 | 0.00 |

# APPENDIX C. SOIL MOISTURE

SOIL MOISTURE LOGS (6 through 17, 19 through 22, and 28 through 30 May 2003)

| Date | Time | Calibration Area Readings (%) | | | | | Time | Mogul Area Readings (%) | | | | | Time | Desert Extreme Area Readings (%) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 to 6 in. | 6 to 12 in. | 12 to 24 in. | 24 to 36 in. | 36 to 48 in. | | 0 to 6 in. | 6 to 12 in. | 12 to 24 in. | 24 to 36 in. | 36 to 48 in. | | 0 to 6 in. | 6 to 12 in. | 12 to 24 in. | 24 to 36 in. | 36 to 48 in. |
| 5/6/2003 | 0748 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 0807 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 | 800 | 1.7 | 2.0 | 3.5 | 3.9 | 4.0 |
| | 1237 | 1.8 | 2.2 | 3.6 | 3.6 | 4.0 | 1246 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 1254 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/7/2003 | 0723 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 0740 | 1.6 | 2.0 | 3.6 | 3.9 | 3.9 | 733 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1255 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1310 | 1.6 | 2.0 | 3.5 | 3.9 | 4.0 | 1305 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/8/2003 | 0715 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 0724 | 1.6 | 2.0 | 3.6 | 4.0 | 3.9 | 732 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1243 | 1.8 | 2.2 | 3.7 | 3.6 | 3.9 | 1250 | 1.6 | 2.0 | 3.5 | 4.0 | 4.0 | 1258 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/9/2003 | 0623 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 0638 | 1.6 | 2.0 | 3.5 | 3.9 | 3.9 | 631 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1306 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 1315 | 1.6 | 2.0 | 3.5 | 3.9 | 3.9 | 1324 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/10/2003 | 0618 | 1.8 | 2.2 | 3.7 | 3.6 | 3.9 | 0626 | 1.6 | 2.0 | 3.5 | 3.9 | 4.0 | 634 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1203 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 1212 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 1221 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/12/2003 | 0630 | 1.8 | 2.2 | 3.7 | 3.6 | 3.9 | 0638 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 644 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1256 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 1305 | 1.6 | 2.0 | 3.5 | 3.9 | 4.0 | 1313 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/13/2003 | 0711 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 0719 | 1.7 | 2.0 | 3.6 | 3.9 | 4.0 | 726 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1312 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1323 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 1332 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/14/2003 | 0630 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 0639 | 1.7 | 2.0 | 3.6 | 3.9 | 4.0 | 647 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1302 | 1.8 | 2.2 | 3.7 | 3.6 | 3.9 | 1312 | 1.7 | 2.0 | 3.6 | 4.0 | 4.0 | 1318 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/15/2003 | 0626 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 0640 | 1.7 | 2.0 | 3.6 | 3.9 | 4.0 | 648 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1302 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1310 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 1318 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/16/2003 | 0622 | 1.8 | 2.2 | 3.7 | 3.6 | 3.9 | 0629 | 1.7 | 2.0 | 3.6 | 4.0 | 4.0 | 0637 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1250 | 1.8 | 2.2 | 3.6 | 3.6 | 3.9 | 1258 | 1.6 | 2.0 | 3.5 | 3.9 | 4.0 | 1305 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/17/2003 | 0610 | 1.8 | 2.2 | 3.7 | 3.6 | 3.9 | 0618 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 0626 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1319 | 1.8 | 2.2 | 3.6 | 3.6 | 4.0 | 1327 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 1334 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| 5/19/2003 | 0600 | 1.8 | 2.2 | 3.6 | 3.6 | 4.0 | 0608 | 1.6 | 1.9 | 3.6 | 3.9 | 4.0 | 0615 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| | 1306 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1316 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 1324 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| 5/20/2003 | 0534 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 0542 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 0550 | 1.7 | 2.0 | 3.4 | 3.9 | 4.1 |
| | 1311 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1320 | 1.6 | 2.0 | 3.6 | 3.9 | 4.0 | 1326 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| 5/21/2003 | 0547 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 0555 | 1.6 | 2.0 | 3.6 | 4.0 | 4.1 | 0603 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| | 1301 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1309 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 1316 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| 5/22/2003 | 0535 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 0543 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 0550 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| | 1303 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1311 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 1318 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| 5/28/2003 | 0722 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 0730 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 0743 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| | 1210 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1218 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 1225 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| 5/29/2003 | 0645 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 0653 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 0700 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| | 1222 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1230 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 1237 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| 5/30/2003 | 0600 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 0609 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 0616 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |
| | 1239 | 1.8 | 2.2 | 3.7 | 3.6 | 4.0 | 1248 | 1.6 | 2.0 | 3.6 | 4.0 | 4.0 | 1255 | 1.7 | 2.0 | 3.4 | 4.0 | 4.1 |



(Page C-2 Blank)

| 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/5/2003 | | INTIAL SETUP | 1015 | 1045 | 30 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | HOT | DRY |
| 5/5/2003 | 4 | INTIAL SETUP | 1045 | 1100 | 15 | BREAK/LUNCH | LUNCH | NA | NA | NA | HOT | DRY |
| 5/5/2003 | 4 | INTIAL SETUP | 1100 | 1530 | 270 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | HOT | DRY |
| 5/5/2003 | 4 | INITIAL SETUP | 1530 | 1600 | 30 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | INITIAL SETUP | 0730 | 0815 | 45 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION LANES | 0815 | 0915 | 60 | COLLECTING DATA | RUNNING CAL LANE, BI DIRECTION, NORTH/SOUTH | NA | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION LANES | 0915 | 1030 | 75 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION LANES | 1030 | 1120 | 50 | COLLECTING DATA | RUNNING CAL LANE BI DIRECTION EAST/WEST | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION LANES | 1120 | 1140 | 70 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | NA | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION LANES | 1140 | 1210 | 30 | BREAK/LUNCH | LUNCH | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION LANES | 1210 | 1240 | 30 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | NA | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | BLIND TEST GRID | 1240 | 1355 | 75 | COLLECTING DATA | RUNNING BTG, BIDIRECTION EAST/WEST | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | BLIND TEST GRID | 1355 | 1430 | 35 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION PIT | 1430 | 1450 | 20 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION PIT | 1450 | 1515 | 25 | COLLECTING DATA | COLLECT DATA OVER PIT | GPS | NA | NA | HOT | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/6/2003 | 5 | CALIBRATION PIT | 1515 | 1520 | 5 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHANGE OUT BATTERY | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION PIT | 1520 | 1525 | 5 | COLLECTING DATA | COLLECT DATA OVER PIT | GPS | NA | NA | HOT | DRY |
| 5/6/2003 | 5 | CALIBRATION PIT | 1525 | 1535 | 10 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 0715 | 0855 | 100 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | COOL/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 0855 | 1035 | 100 | COLLECTING DATA | RUNNING OPEN RANGE, GRID A2, BIDIRECTIONAL E/W | GPS | NA | NA | COOL/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1035 | 1115 | 40 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1115 | 1125 | 10 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | GPS | NA | NA | HOT/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1125 | 1300 | 95 | COLLECTING DATA | RUNNING OPEN RANGE, GRID A3, BIDIRECTIONAL E/W | GPS | NA | NA | HOT/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1300 | 1330 | 30 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1330 | 1350 | 20 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1350 | 1400 | 10 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | HOT/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1400 | 1530 | 90 | COLLECTING DATA | RUNNING OPEN RANGE GRID G2, BIDIRECTIONAL E/W | GPS | NA | NA | HOT/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1530 | 1550 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT/WINDY | DRY |
| 5/7/2003 | 4 | OPEN RANGE | 1550 | 1600 | 10 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT/WINDY | DRY |
| 5/8/2003 | 5 | OPEN RANGE | 0700 | 0745 | 45 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | COOL/WINDY | DRY |
| 5/8/2003 | 5 | OPEN RANGE | 0745 | 0950 | 125 | COLLECTING DATA | RUNNING OPEN RANGE, GRID G3,G4, BIDIRECTIONAL E/W | GPS | NA | NA | COOL/WINDY | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/8/2003 | 5 | OPEN RANGE | 0950 | 1020 | 30 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | COOL/WINDY | DRY |
| 5/8/2003 | 5 | BLIND TEST GRID | 1020 | 1130 | 70 | COLLECTING DATA | RUNNING BTG BIDIRECTIONAL NORTH/ SOUTH | GPS | NA | NA | HOT/WINDY | DRY |
| 5/8/2003 | 5 | BLIND TEST GRID | 1130 | 1145 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT/WINDY | DRY |
| 5/8/2003 | 5 | BLIND TEST GRID | 1145 | 1215 | 30 | BREAK/LUNCH | LUNCH | GPS | NA | NA | HOT/WINDY | DRY |
| 5/8/2003 | 5 | OPEN RANGE | 1215 | 1300 | 45 | SET UP/MOBILIZATION | LAYOUT LANES WITH ROPE | NA | NA | NA | HOT/WINDY | DRY |
| 5/8/2003 | 5 | CALIBRATION PIT | 1300 | 1440 | 100 | COLLECTING DATA | COLLECT DATA OVER PIT | GPS | NA | NA | HOT/WINDY | DRY |
| 5/8/2003 | 5 | CALIBRATION PIT | 1440 | 1500 | 20 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT/WINDY | DRY |
| 5/8/2003 | 5 | OPEN RANGE | 1500 | 1550 | 50 | SET UP/MOBILIZATION | LAYOUT LANES WITH ROPE | NA | NA | NA | HOT/WINDY | DRY |
| 5/8/2003 | 5 | OPEN RANGE | 1550 | 1600 | 10 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT/WINDY | DRY |
| 5/9/2003 | 4 | OPEN RANGE | 0645 | 0720 | 35 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | COOL | DRY |
| 5/9/2003 | 4 | OPEN RANGE | 0720 | 0845 | 85 | COLLECTING DATA | RUNNING OPEN RANGE, GRID F2,F3,F4,F5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | COOL/WINDY | DRY |
| 5/9/2003 | 4 | OPEN RANGE | 0845 | 0905 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | COOL/WINDY | DRY |
| 5/9/2003 | 4 | OPEN RANGE | 0905 | 1030 | 85 | COLLECTING DATA | RUNNING OPEN RANGE, GRID F2,F3,F4,F5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | COOL/WINDY | DRY |
| 5/9/2003 | 4 | OPEN RANGE | 1030 | 1100 | 30 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | COOL/WINDY | DRY |
| 5/9/2003 | 4 | OPEN RANGE | 1100 | 1130 | 30 | BREAK/LUNCH | LUNCH | NA | NA | NA | COOL/WINDY | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/9/2003 | 4 | OPEN RANGE | 1130 | 1250 | 80 | COLLECTING DATA | RUNNING OPEN RANGE, GRID F2,F3,F4,F5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT/WINDY | DRY |
| 5/9/2003 | 4 | OPEN RANGE | 1250 | 1300 | 10 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHANGE OUT PROCESSOR UNIT | GPS | NA | NA | HOT/WINDY | DRY |
| 5/9/2003 | 5 | OPEN RANGE | 1300 | 1330 | 30 | COLLECTING DATA | RUNNING OPEN RANGE, GRID F2,F3,F4,F5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT/WINDY | DRY |
| 5/9/2003 | 5 | OPEN RANGE | 1330 | 1430 | 60 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT/WINDY | DRY |
| 5/9/2003 | 5 | OPEN RANGE | 1430 | 1445 | 15 | COLLECTING DATA | RUNNING OPEN RANGE, GRID F2,F3,F4,F5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT/WINDY | DRY |
| 5/9/2003 | 5 | OPEN RANGE | 1445 | 1500 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHANGE OUT BATTERY | GPS | NA | NA | HOT/WINDY | DRY |
| 5/9/2003 | 5 | OPEN RANGE | 1500 | 1520 | 20 | COLLECTING DATA | RUNNING OPEN RANGE, GRID F2,F3,F4,F5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT/WINDY | DRY |
| 5/9/2003 | 5 | OPEN RANGE | 1520 | 1540 | 20 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT/WINDY | DRY |
| 5/10/2003 | 5 | OPEN RANGE | 0630 | 0700 | 30 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | COOL | DRY |
| 5/10/2003 | 5 | OPEN RANGE | 0700 | 0826 | 86 | COLLECTING DATA | RUNNING OPEN RANGE, GRID E2,E3,E4,E5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | COOL | DRY |
| 5/10/2003 | 5 | OPEN RANGE | 0826 | 0828 | 2 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | SWAPPED OUT FIELD COMPUTER | GPS | NA | LINEAR | COOL | DRY |
| 5/10/2003 | 5 | OPEN RANGE | 0828 | 1015 | 107 | COLLECTING DATA | RUNNING OPEN RANGE, GRID E2,E3,E4,E5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/10/2003 | 5 | OPEN RANGE | 1015 | 1040 | 25 | BREAK/LUNCH | LUNCH | NA | NA | NA | HOT | DRY |
| 5/10/2003 | 5 | OPEN RANGE | 1040 | 1100 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/10/2003 | 4 | OPEN RANGE | 1100 | 1243 | 103 | COLLECTING DATA | RUNNING OPENRANGE, GRID E2,E3,E4,E5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/10/2003 | 4 | OPEN RANGE | 1243 | 1246 | 3 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHANGE OUT PROCESSOR UNIT | GPS | NA | NA | HOT | DRY |
| 5/10/2003 | 4 | OPEN RANGE | 1246 | 1340 | 54 | COLLECTING DATA | RUNNING OPEN RANGE, GRID E2,E3,E4,E5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/10/2003 | 4 | OPEN RANGE | 1340 | 1400 | 20 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | GPS | NA | NA | HOT | DRY |
| 5/12/2003 | 5 | OPEN RANGE | 0700 | 0721 | 21 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | GPS | NA | NA | HOT | DRY |
| 5/12/2003 | 5 | OPEN RANGE | 0721 | 0725 | 4 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/12/2003 | 5 | OPEN RANGE | 0725 | 0825 | 60 | COLLECTING DATA | RUNNING OPEN RANGE, GRID E2,E3,E4,E5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/12/2003 | 5 | OPEN RANGE | 0825 | 0935 | 50 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/12/2003 | 5 | OPEN RANGE | 0935 | 1025 | 50 | COLLECTING DATA | RUNNING OPEN RANGE, GRID A4,A5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/12/2003 | 5 | OPEN RANGE | 1025 | 1030 | 5 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/12/2003 | 5 | OPEN RANGE | 1030 | 1325 | 175 | DOWNTIME DUE TO EQUIPMENT FAILURE | WHEEL AXLE BROKE | NA | NA | NA | HOT | DRY |
| 5/12/2003 | 5 | OPEN RANGE | 1325 | 1330 | 5 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/13/2003 | 4 | OPEN RANGE | 1130 | 1215 | 45 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | GPS | NA | NA | HOT | DRY |
| 5/13/2003 | 4 | OPEN RANGE | 1215 | 1300 | 45 | COLLECTING DATA | RUNNING OPEN RANGE, A4,A5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/13/2003 | 4 | OPEN RANGE | 1300 | 1320 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/13/2003 | 4 | OPEN RANGE | 1320 | 1430 | 70 | COLLECTING DATA | RUNNING OPEN RANGE, A4,A5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/13/2003 | 4 | OPEN RANGE | 1430 | 1447 | 17 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |
| 5/13/2003 | 4 | OPEN RANGE | 1447 | 1535 | 48 | COLLECTING DATA | RUNNING OPEN RANGE, A4,A5 BIDIRECTIONAL E/W | NA | NA | LINEAR | HOT | DRY |
| 5/13/2003 | 4 | OPEN RANGE | 1535 | 1545 | 10 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/13/2003 | 4 | OPEN RANGE | 1545 | 1600 | 15 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |
| 5/14/2003 | 5 | OPEN RANGE | 0630 | 0735 | 65 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 0735 | 0739 | 4 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | LINEAR | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 0739 | 0850 | 71 | COLLECTING DATA | RUNNING OPEN RANGE, A4,A5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 0850 | 0920 | 30 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 0920 | 1020 | 60 | COLLECTING DATA | RUNNING OPEN RANGE, D4,D5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 1020 | 1035 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 1035 | 1130 | 55 | BREAK/LUNCH | LUNCH | NA | NA | NA | WARM | HUMID |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/14/2003 | 5 | OPEN RANGE | 1130 | 1325 | 115 | COLLECTING DATA | RUNNING OPEN RANGE, D4,D5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 1325 | 1400 | 35 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 1400 | 1430 | 30 | BREAK/LUNCH | BREAK | NA | NA | NA | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 1430 | 1530 | 120 | COLLECTING DATA | RUNNING OPEN RANGE, D4,D5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | WARM | HUMID |
| 5/14/2003 | 5 | OPEN RANGE | 1530 | 1600 | 30 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | WARM | HUMID |
| 5/15/2003 | 5 | OPEN RANGE | 0645 | 0710 | 25 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | COOL | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 0710 | 0735 | 25 | COLLECTING DATA | RUNNING OPEN RANGE, B2,B3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | COOL | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 0735 | 0742 | 7 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | COOL | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 0742 | 0750 | 8 | COLLECTING DATA | RUNNING OPEN RANGE, B2,B3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | COOL | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 0750 | 0755 | 5 | DOWNTIME DUE TO EQUIPMENT FAILURE | GPS DOWN | GPS | NA | NA | COOL | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 0755 | 0925 | 90 | COLLECTING DATA | RUNNING OPEN RANGE, B2,B3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | COOL | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 0925 | 0945 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | COOL | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 0945 | 1140 | 115 | COLLECTING DATA | RUNNING OPEN RANGE, B2,B3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 1140 | 1150 | 10 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 1150 | 1250 | 60 | BREAK/LUNCH | CHOW | NA | NA | NA | HOT | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/15/2003 | 5 | OPEN RANGE | 1250 | 1255 | 5 | SET UP/MOBILIZATION | SET UP ON C4,C5 | NA | NA | NA | HOT | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 1255 | 1320 | 25 | COLLECTING DATA | RUNNING OPEN RANGE, C4,C5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 1320 | 1325 | 5 | DOWNTIME DUE TO EQUIPMENT FAILURE | COMMUNICATION ERROR INFIELD COMPUTOR | GPS | NA | NA | HOT | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 1325 | 1330 | 5 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHANGE OUT FIELD COMPUTORS | GPS | NA | NA | HOT | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 1330 | 1530 | 120 | COLLECTING DATA | RUNNING OPEN RANGE, C4,C5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/15/2003 | 5 | OPEN RANGE | 1530 | 1600 | 30 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 0640 | 0655 | 15 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | COOL | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 0655 | 0700 | 5 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | COOL | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 0700 | 0825 | 85 | COLLECTING DATA | RUNNING OPEN RANGE, C4,C5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | COOL | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 0825 | 0850 | 25 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | COOL | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 0850 | 0900 | 10 | SET UP/MOBILIZATION | SET UP ON D3 | NA | NA | NA | COOL | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 0900 | 1110 | 130 | COLLECTING DATA | RUNNING OPEN RANGE, D3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 1110 | 1125 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 1125 | 1235 | 70 | BREAK/LUNCH | CHOW | NA | NA | NA | HOT | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 1235 | 1330 | 55 | COLLECTING DATA | RUNNING OPEN RANGE, D3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 1330 | 1410 | 40 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/16/2003 | 4 | OPEN RANGE | 1410 | 1515 | 65 | COLLECTING DATA | RUNNING OPEN RANGE, D3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 1515 | 1530 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/16/2003 | 4 | OPEN RANGE | 1530 | 1600 | 30 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |
| 5/17/2003 | 4 | OPEN RANGE | 0630 | 0715 | 45 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | HOT | DRY |
| 5/17/2003 | 4 | OPEN RANGE | 0715 | 0720 | 5 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/17/2003 | 4 | OPEN RANGE | 0720 | 0825 | 65 | COLLECTING DATA | RUNNING OPEN RANGE, D2 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/17/2003 | 4 | OPEN RANGE | 0825 | 0921 | 56 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/17/2003 | 4 | OPEN RANGE | 0921 | 1040 | 79 | COLLECTING DATA | RUNNING OPEN RANGE, B5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/17/2003 | 4 | OPEN RANGE | 1040 | 1045 | 5 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/17/2003 | 4 | OPEN RANGE | 1045 | 1120 | 35 | BREAK/LUNCH | CHOW | NA | NA | NA | HOT | DRY |
| 5/17/2003 | 3 | OPEN RANGE | 1120 | 1230 | 70 | COLLECTING DATA | RUNNING OPEN RANGE, B5 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/17/2003 | 3 | OPEN RANGE | 1230 | 1245 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/17/2003 | 3 | OPEN RANGE | 1245 | 1335 | 50 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |
| 5/17/2003 | 3 | OPEN RANGE | 1335 | 1400 | 25 | COLLECTING DATA | CONDUCTED EQUIPMENT INTERFERENCE TEST | GPS | NA | NA | HOT | DRY |
| 5/17/2003 | 3 | OPEN RANGE | 1400 | 1430 | 30 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/19/2003 | 4 | OPEN RANGE | 0600 | 0615 | 15 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 0615 | 0620 | 5 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 0620 | 0743 | 83 | COLLECTING DATA | RUNNING OPEN RANGE, B4 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 0743 | 0815 | 32 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | NA | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 0815 | 0930 | 75 | COLLECTING DATA | RUNNING OPEN RANGE, B4 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 0930 | 0945 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | NA | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 0945 | 0950 | 5 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHANGE OUT BATTERY | NA | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 0950 | 0955 | 5 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 0955 | 1005 | 10 | COLLECTING DATA | RUNNING OPEN RANGE, B4 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 1005 | 1010 | 5 | SET UP/MOBILIZATION | SET UP ON GRID C2,C3 | NA | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 1010 | 1024 | 14 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 1024 | 1130 | 66 | COLLECTING DATA | RUNNING OPEN RANGE, C2,C3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 1130 | 1145 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 1145 | 1310 | 85 | BREAK/LUNCH | CHOW/BREAK | NA | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 1310 | 1410 | 60 | COLLECTING DATA | RUNNING OPEN RANGE, C2,C3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/19/2003 | 4 | OPEN RANGE | 1410 | 1420 | 10 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/19/2003 | 4 | OPEN RANGE | 1420 | 1430 | 10 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0530 | 0545 | 15 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0545 | 0549 | 4 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0549 | 0718 | 89 | COLLECTING DATA | RUNNING OPEN RANGE, C2,C3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0718 | 0738 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0738 | 0805 | 27 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0805 | 0847 | 42 | COLLECTING DATA | RUNNING OPEN RANGE, C2,C3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0847 | 0900 | 13 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0900 | 0937 | 37 | COLLECTING DATA | RUNNING OPEN RANGE, C2,C3 BIDIRECTIONAL E/W | GPS | NA | LINEAR | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0937 | 0952 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | OPEN RANGE | 0952 | 1012 | 20 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | YUMA EXTREME | 1012 | 1024 | 12 | SET UP/MOBILIZATION | SET UP IN YUMA EXTREME | NA | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | YUMA EXTREME | 1024 | 1111 | 47 | COLLECTING DATA | RUNNING YUMA EXTREME BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |

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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/20/2003 | 4 | YUMA EXTREME | 1111 | 1130 | 19 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | YUMA EXTREME | 1130 | 1230 | 60 | BREAK/LUNCH | LUNCH | NA | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | YUMA EXTREME | 1230 | 1245 | 15 | SET UP/MOBILIZATION | SETUP | NA | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | YUMA EXTREME | 1245 | 1248 | 3 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | YUMA EXTREME | 1248 | 1255 | 7 | COLLECTING DATA | RUNNING YUMA EXTREME BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/20/2003 | 4 | YUMA EXTREME | 1255 | 1300 | 5 | DOWNTIME DUE TO EQUIPMENT FAILURE | FIELD COMPUTER OVERHEAT/FAILED | NA | NA | NA | HOT | DRY |
| 5/20/2003 | 4 | YUMA EXTREME | 1300 | 1310 | 10 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | YUMA EXTREME | 0530 | 0550 | 20 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | YUMA EXTREME | 0550 | 0600 | 10 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | YUMA EXTREME | 0600 | 0605 | 5 | COLLECTING DATA | RUNNING YUMA EXTREME BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/21/2003 | 3 | YUMA EXTREME | 0605 | 0614 | 9 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | YUMA EXTREME | 0614 | 0750 | 96 | COLLECTING DATA | RUNNING YUMA EXTREME BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/21/2003 | 3 | YUMA EXTREME | 0750 | 0810 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |

| 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/21/2003 | 3 | YUMA EXTREME | 0810 | 0820 | 10 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | YUMA EXTREME | 0820 | 0850 | 30 | COLLECTING DATA | RUNNING YUMA EXTREME BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/21/2003 | 3 | YUMA EXTREME | 0850 | 0920 | 30 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 0920 | 0930 | 10 | SET UP/MOBILIZATION | SET UP IN MOGUL AREA | NA | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 0930 | 1040 | 70 | COLLECTING DATA | RUNNING MOGUL AREA, BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 1040 | 1100 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 1100 | 1158 | 58 | COLLECTING DATA | RUNNING MOGUL AREA, BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 1158 | 1210 | 12 | DOWNTIME DUE TO EQUIPMENT FAILURE | GPS MOUNT BROKE, OPERATOR ERROR | NA | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 1210 | 1230 | 20 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 1230 | 1237 | 7 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 1237 | 1322 | 45 | COLLECTING DATA | RUNNING MOGUL AREA, BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 1322 | 1335 | 13 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |

| 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/21/2003 | 3 | MOGUL AREA | 1335 | 1445 | 70 | COLLECTING DATA | RUNNING MOGUL AREA, BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/21/2003 | 3 | MOGUL AREA | 1445 | 1500 | 15 | SET UP/MOBILIZATION | BREAKING DOWN EQUIPMENT EOD | NA | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 0530 | 0637 | 67 | SET UP/MOBILIZATION | SETTING UP EQUIPMENT | NA | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 0637 | 0642 | 5 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 0642 | 0745 | 63 | COLLECTING DATA | RUNNING YUMA EXTREME BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 0745 | 0800 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 0800 | 0930 | 90 | COLLECTING DATA | RUNNING YUMA EXTREME BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 0930 | 0935 | 5 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | SWAP OUT BATTERIES | NA | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 0935 | 0950 | 15 | COLLECTING DATA | RUNNING YUMA EXTREME BIDIRECTIONAL NORTH/SOUTH | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 0950 | 1005 | 15 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | YUMA EXTREME | 1005 | 1020 | 15 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1020 | 1028 | 8 | SET UP/MOBILIZATION | SET UP OVER CALIBRATION PIT | NA | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1028 | 1030 | 2 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |

| 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 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/22/2003 | 3 | CALIBRATION PIT | 1030 | 1052 | 22 | COLLECTING DATA | RUNNING SIGNITURE DATA ON 40MM MARK II | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1052 | 1105 | 13 | COLLECTING DATA | RUNNING SIGNITURE DATA ON 57MM | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1105 | 1128 | 23 | COLLECTING DATA | RUNNING SIGNITURE DATA ON 60MM | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1128 | 1138 | 10 | BREAK/LUNCH | BREAK | NA | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1138 | 1149 | 11 | DOWNTIME DUE TO EQUIPMENT MAINTENANCE/CHECK | CHECKING/ DOWNLOADING DATA | GPS | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1149 | 1240 | 51 | BREAK/LUNCH | LUNCH | NA | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1240 | 1243 | 3 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1243 | 1255 | 12 | COLLECTING DATA | RUNNING SIGNITURE DATA ON ROCKEYE MK118 | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1255 | 1320 | 25 | COLLECTING DATA | RUNNING SIGNITURE DATA ON 2.75 ROCKET | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1320 | 1347 | 27 | COLLECTING DATA | RUNNING SIGNITURE DATA ON 105 STANDARD | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1347 | 1412 | 25 | COLLECTING DATA | RUNNING SIGNITURE DATA ON 155MM | GPS | NA | LINEAR | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1412 | 1414 | 2 | COLLECTING DATA | EQUIPMENT WAS CALIBRATED USING CAL BALL | GPS | NA | NA | HOT | DRY |
| 5/22/2003 | 3 | CALIBRATION PIT | 1414 | 1500 | 46 | DEMOBILIZATION | END OF TEST | NA | NA | NA | HOT | DRY |

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



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## 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. Yuma Proving Ground Soil Survey Report, May 2003.

5. Practical Nonparametric Statistics, W.J. Conover, John Wiley & Sons, 1980, ages 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 |
| HEAT | = | high-explosive, antitank |
| EMI | = | electromagnetic interference |
| EMIS | = | Electromagnetic Induction Spectroscopy |
| ERDC | = | U.S. Army Corps of Engineers Engineering Research and Development Center |
| ESTCP | = | Environmental Security Technology Certification Program |
| EQT | = | Army Environmental Quality Technology Program |
| GPS | = | Global Positioning System |
| JPG | = | Jefferson Proving Ground |
| PDA | = | personal digital assistant |
| POC | = | point of contact |
| PVC | = | polyvinyl chloride |
| QA | = | quality assurance |
| QC | = | quality control |
| ROC | = | receiver-operating characteristic |
| RTK | = | real time kinematic |
| SERDP | = | Strategic Environmental Research and Development Program |
| UXO | = | unexploded ordnance |
| YPG | = | U.S. Army Yuma Proving Ground |



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