

**APPENDIX B**

**EQUIPMENT FIELD TEST LETTER REPORT**

**Geophysical Equipment Evaluation Letter Report  
Phase II Engineering Evaluation/Cost Analysis  
Former Waikoloa Maneuver Area and Nansay Sites  
Island of Hawai'i, Hawai'i**

In November 2000, a geophysical equipment evaluation plot was prepared for the Phase II Former Waikoloa Maneuver Area and Nansay Sites Engineering Evaluation/Cost Analysis (EE/CA) field investigation. A request was granted by the Parker Ranch for use of an area south of Holoholoku Pu'u for a test plot. The test plot was used to bury representative inert ordnance and explosives (OE) targets to evaluate the performance capabilities and limitations of the geophysical and position locating equipment to be used for the geophysical mapping phase of the EE/CA.

The area utilized for the test plot is approximately 3 miles southeast of the town of Waimea, at 413,092 feet north and 1,592,885 feet east, in the Hawaiian State Plane Grid Coordinate System, Zone 1, North American Datum 83 (NAD83).

Equipment tests conducted during the Phase I Former Waikoloa Maneuver Area EE/CA (1997) clearly demonstrated that magnetic methods were not suitable for detection of explosive ordnance-sized objects in the iron-rich volcanic soils of the Hawaiian Islands. Accordingly, the Geonics EM-61 was selected for use during the EE/CA field investigations. At the current time, no other electromagnetic (EM) systems are available that can provide detection and productivity capabilities equal to that of the EM-61.

The EM-61s were deployed in a ganged array of paired systems tied to a common clock. Transmitter moments are not field adjustable with these systems and the systems were configured using the standard survey parameters provided by the instrument manufacturer. Detector standoff height was 16 inches. Given the variability of the ground surface caused by both vegetation and native rock, lower standoffs could not be practically maintained during data collection.

The EM-61s deployed by the geophysical services subcontractor (Zonge Research and Engineering [Zonge]) were 1 meter by 0.5 meter coils comprising a lower coincident transmitter/receiver coil and an upper receiver coil spaced 16 inches higher than the lower receiver. The position of the arrays was tracked using real-time kinematic (RTK) global positioning systems (GPS) that yield decimeter precision. Three such arrays were fielded; each was evaluated at the test plot prior to deployment for field mapping. The results of these tests are summarized below and depicted on the attached figures.

Prior to burying the inert ordnance items, background EM measurements were obtained over a 100-foot by 300-foot grid laid out using survey tapes, stakes, and rock to mark fiducial references. The background data were captured using a Geonics EM-63 metal detector (Figure 1). This system records transient decays of secondary signals at multiple time gates, whereas the EM-61 records only a single gate. An EM-61 equivalent response is obtained by summing the responses over four gates. The EM-63 was used to take advantage of the temporary availability of the system to acquire data for future use and evaluation of the system. At present, the system availability is limited and its performance advantages are not yet fully established.

EM data were collected with the EM-63 using the same standoff heights as used with the EM-61. Data stations were continuously sampled over time and positions were interpolated from the established fiducial references. Line spacing for the background survey was nominally three feet. The recorded data were downloaded and referenced to the test grid coordinates. The equivalent EM response is presented in the attached figures.

After the background data had been collected, the inert ordnance items were buried. Targets and respective locations are shown in Table 1. The layout of the completed test plot is shown in Figure 2. Construction of the evaluation plot was completed on 22 November 2000. The geophysical mapping arrays to be used for the Phase II EE/CA were deployed in mid-January 2001. In the interim, test data over the buried targets were collected with three additional systems: a standard 1-meter x 1-meter loop EM-61, a hand-held (HH) EM-61 (EM-61HH), and a Geophex GEM-3. These instruments are not evaluated here, as the data was obtained during a "window of opportunity" for future evaluation and comparison of the respective systems. The data have previously been provided to Mr. Bob Selfridge (U.S. Army Engineering and Support Center, Huntsville [CEHNC]) for his use.

Geophysical data were collected over the test plot by Zonge on January 23-24 (Team 1) (Figure 3), January 29-30 (Team 2) (Figure 4), and February 5 (Team 3) (Figure 5). These data were separately processed by Zonge and Earth Tech, Inc., (Earth Tech) to determine the detection performance and limitations of the arrays. Plots of these data are attached and discussed below. The EM-61HH was not used for geophysical mapping due to poor quality of the data collected over the test plot (Figure 6). The EM-61HH data contained amplitude steps as a function of battery power. Consequently, the EM-61HH was used only to recover anomaly locations during reacquisition and as a safety measure during OE sampling; it was not used to define what was, or was not, an anomaly to be investigated.

Each of the arrays detected most of the buried OE items and metallic scrap placed in the evaluation plot. All were unable to detect essentially the same targets, specifically 81-millimeter (mm) mortar rockets (partial rockets - the nose/fuzes were not present) at deeper depths (24 and 36 inches bgs [below ground surface]). The systems were also unable to detect hand grenades at depths greater than 6 inches bgs. Additionally, the response to geology (i.e., subcrops of iron-rich basalt) is in many cases indistinguishable from that caused by some of the buried OE items. This may result in a relatively high false alarm (i.e., false positive) rate.

It may be possible to reduce the false positive target picks as more ground-truthing data are made available, as well as through manipulation and filtering of the geophysical data. Linear geologic trends may be visually identified in the data and target picks can be scrutinized for preferential anomaly shapes (e.g., conical versus truncated highs). Efforts to continually reduce false alarms will be an on-going exercise throughout the EE/CA field activities.

**Table 1. Seeded Target Positions and EM-61 Target Detection Capability**

Zonge Survey of Target Position		Description	Depth (inches bgs)	Target Detected		
Easting	Northing			Team 1	Team 2	Team 3
1592904.41	413101.66	Whisker	Surface	Yes	Yes	Yes
1592920.64	413137.54	105mm projectile	24	Yes	Yes	Yes
1592911.80	413170.84	105mm projectile	35	Yes	Yes	Yes
1592956.04	413126.26	60mm mortar	12	Yes	Yes	No
1592959.22	413171.74	105mm projectile	46	Yes	Yes	Yes
1592958.41	413211.91	60mm mortar	24	Yes	Yes	No
1592985.93	413136.02	60mm mortar	18	Yes	No	No
1592999.54	413130.63	Whisker	Surface	Yes	Yes	Yes
1593004.60	413154.59	81mm mortar	36	No	No	No
1592995.39	413187.34	81mm mortar	24	No	No	No
1592989.70	413211.91	81mm mortar	18	Yes	Yes	Yes
1592974.53	413227.84	Whisker	Surface	No	Yes	No
1593019.98	413210.26	81mm mortar	18	Yes	Yes	Yes
1593029.73	413177.50	81mm mortar	18	Yes	Yes	Yes
1593068.43	413162.63	Mk2 hand grenade	3	Yes	No	Yes
1593063.34	413181.28	Mk2 hand grenade	6	Yes	No	Yes
1593058.19	413200.97	Mk2 hand grenade	18	No	No	No
1593053.39	413219.97	Mk2 hand grenade	12	No	No	No
1593048.43	413239.95	Mk2 hand grenade	9	No	No	No
1593070.23	413256.37	Whisker	Surface	Yes	Yes	Yes
1593085.11	413231.95	2.36-inch rocket	12	Yes	Yes	No
1593094.48	413160.88	Whisker	Surface	Yes	Yes	Yes
1593140.30	413188.50	105mm projectile	6	Yes	Yes	Yes
1593137.14	413233.08	Wire	3	Yes	Yes	Yes
1593153.29	413217.44	Mk2 hand grenade	15	Yes	Yes	No
1593173.30	413202.04	Horseshoe	3	Yes	Yes	Yes
1593157.75	413249.04	Spike	3	Yes	Yes	Yes
1593167.18	413287.15	Whisker	Surface	No	Yes	Yes
1593191.46	413189.83	Whisker	Surface	No	Yes	Yes

bgs = below ground surface

Figure 1.  
Former Waikoloa Maneuver Area and Nansay Sites  
Equipment Evaluation Plot - Background Data  
Equivalent EM Response

Contour interval = 2 millivolts  
Scale: 1 inch = 40 feet

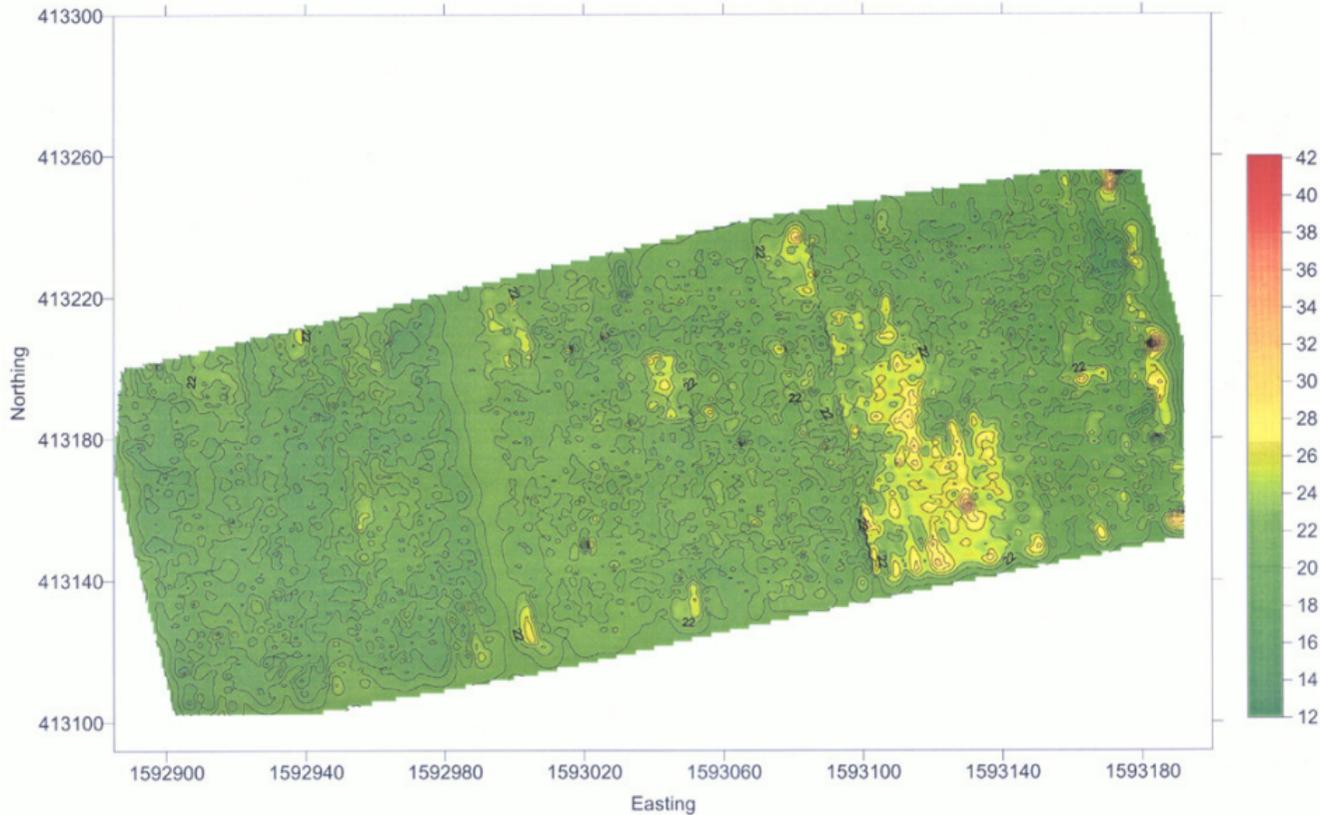


Figure 2.  
 Former Waikoloa Maneuver Area and Nansay Sites  
 Geophysical Equipment Test Plot  
 As Built  
 Scale: 1 inch = 40 feet

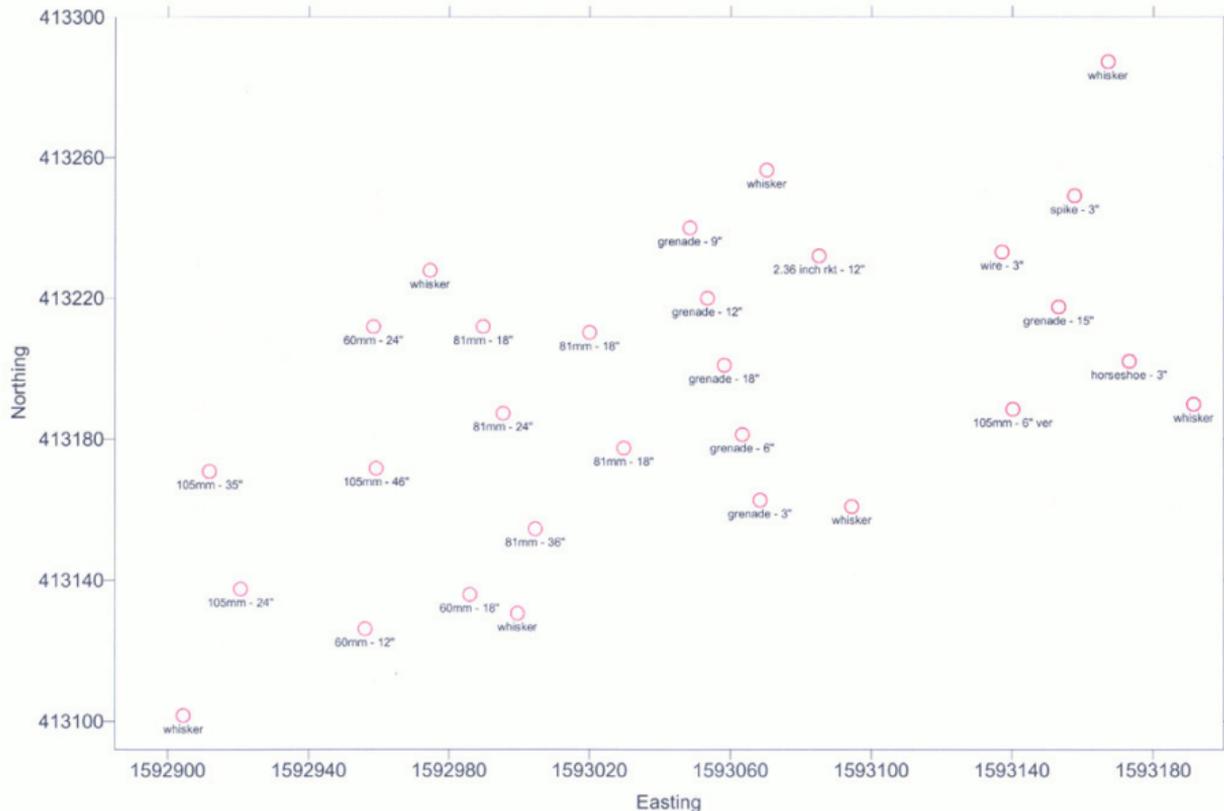








Figure 6.  
Former Waikoloa Maneuver Area and Nansay Sites  
Equipment Evaluation Plot  
EM-61 HH

Scale: 1 inch = 40 feet

