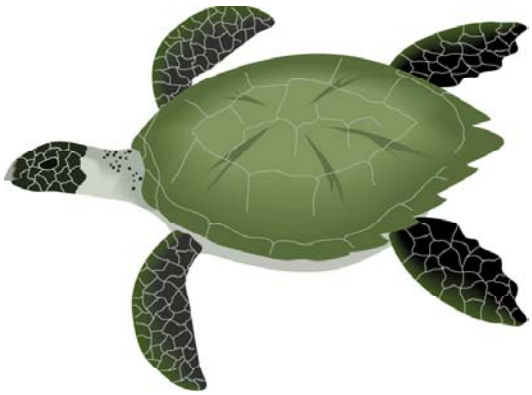
United States Air Force
15th Air Base Wing
Environmental Restoration Program

SITE INSPECTION REPORT
PIER DUMP SITE

Bellows Air Force Station
Oahu, Hawaii



Appendix B

Geophysical Survey Report - Representative Portions of Three Reports for Work Completed on the Pier Dump Site

BREWER
ENVIRONMENTAL
INDUSTRIES, LLC

Mr. Marshall J. Ness
Project Manager
CH2M Hill
1585 Kapiolani Blvd, Suite 1420
Honolulu, Hawaii 96814

July 10, 1998
BES Job No. 5150.01

Subject: Geophysical Survey of Pier Dump Site, Bellows Air Force Station
Contract F41624-97-D-8019 Delivery Order No. 04, Project 146231.01.06
IDIQ Agreement No. 16996, Task Order 02

Dear Mr. Ness,

Brewer Environmental Services (BES) is pleased to present this letter report to CH2M Hill presenting the geophysical survey performed at the Pier Dump Site on Bellows Air Force Station (AFS), Oahu, Hawaii.

1.0 INTRODUCTION/SCOPE

On June 10, 1998, CH2M Hill contacted BES regarding an investigation at the Pier Dump Site on Bellows AFS. Based on historical references, this site is suspected to have been used as a landfill in the past. It is located on the shore of Bellows AFS between Tinker Road and the ocean, near the former fueling pier. The location is at the end of the former runway 3R, approximately 800 feet south of the new guard gate. The suspected landfill is estimated to comprise an area of approximately 300 feet by 110 feet. The depth to groundwater is approximately six to eight feet below grade.

CH2M Hill had decided to use non-intrusive means to gain an overview of the subsurface conditions at the site, to streamline subsequent intrusive means of investigation. BES's part in the project entailed the following scope:

- Research the appropriate geophysical method to detect ferrous metal objects measuring more than 1 foot in diameter and consolidated fill measuring more than three feet in diameter;

it is not expected that the fill material extends into groundwater. Therefore, it was not necessary to define the vertical limits of waste disposal using a GPR survey, and a magnetic survey was performed.

Total field magnetic data are often used to measure the presence of large features such as faults, changes in stratigraphy or the presence of large metallic objects. One limitation of total field data is their susceptibility to time variations of the Earth's magnetic field (diurnal variations). Variations can occur with periods of seconds, minutes, and hours and are caused by the effect of solar wind as it distorts the Earth's magnetosphere. Diurnal variations are not predictable and can exhibit changes as large as 100 gammas (1 gamma = 10^{-5} gauss = 10^{-5} oersted = 10^{-9} tesla). Another source of erroneous data is magnetic storms occurring as often as several times a month.

During the scoping of the project, it was assumed that the survey would extend over an area 200 by 550 feet. The survey was expected to take a minimum of three hours, a time period, during which time variations may affect the Earth's magnetic field causing erroneous data. To correct for time variations, BES opted to collect vertical magnetic gradient data. Gradient data are obtained by using two magnetometers mounted vertically above each other. Both sensors are configured to measure the total magnetic value. During data reduction, the sensor 2 data are subtracted from the sensor 1 data, thus canceling out the time variations in the Earth's magnetic field. Therefore, vertical gradient data are not susceptible to diurnal drift in the magnetic field. They are often used to map the presence of buried anthropogenic features such as drums or metallic debris.

2.2 VERTICAL MAGNETIC GRADIENT SURVEY

BES used a high resolution Geometrics G858 cesium vapor gradiometer to perform the survey at the subject site. The G-858 was equipped with two magnetic field sensors located at the end of an aluminum pole, which positions the sensors approximately four feet ahead of the operator. The aluminum pole "tees" off at the front end to enable vertical mounting of two sensors. The magnetic field sensors are referred to as sensors 1 and 2, with sensor 1 being in the top position and sensor 2 at the bottom. Sensor 2 was located approximately 1.5 feet above ground, and the distance between the two sensors measured two feet and seven inches. Cesium sensors are insensitive to magnetic fields in certain directions. Therefore, the orientation of the two sensors was chosen to achieve the best signal to noise ratio and to eliminate dead zones, based on the dip angle (37°) of the Earth's magnetic

2.3 SURVEY GRID LAYOUT

The survey area measured 300 feet by 110 feet. The long side was directed towards 10 degrees from north, the short side towards 100 degrees from north. The baseline was chosen to be the east boundary of the area, with the survey lines running from east to west (100 degrees from north). The survey line spacing was chosen to be 5 feet, to achieve a survey resolution capable of detecting ferrous iron objects of 1 foot diameter (Figure 1).

The grid was established by using a compass and non-stretch measuring tape. The baseline and end line (west boundary) were marked every 100 feet using wooden stakes with brightly colored surveyor's tape. In addition the lines were marked every five feet using brightly colored spray paint, to establish the start and end points for the individual survey lines. A centerline parallelling the base and end lines was marked using the same method to establish way points in the center of each survey line. All markers were non-magnetic.

The grid was established following a cartesian coordinate system using feet as the dimension. The x-axis is directed roughly north towards 10 degrees from north, the y-axis roughly west towards 280 degrees from north. The point of origin (0,0) is located at the southeast corner of the grid. The northeast corner of the grid has the coordinates (300,0), the northwest corner (300,110), and the southwest corner (0,110). The original grid was extended southward to fully capture an anomaly found at the south boundary, during the first survey. The grid therefore extends to the coordinates (-25,0) and (-25,110) adding five survey lines (Figure 1).

Permanent survey markers (aluminum survey nails with surveying tape) were installed on Tinker Road, to facilitate relocation of the grid in the future. The markers were installed at the coordinates (0,139.8), (300,119.85), and (349.9,110)

2.4 DATA REDUCTION

Upon completion of the survey, the data were downloaded into a PC and archived on diskette. The MAGMAP96 software was then used to edit the data. When the raw data were imported into MAGMAP96 the marker spacing was set to 55 feet, and the line spacing to 5 feet. All survey lines, which required more than one way point marker, were then edited to move the markers into their real position within the coordinate system. The data segment acquired between markers that delimited an obstacle were deleted, since they were acquired while moving off the survey line to avoid the obstacle. The software then interpolated across the

fluctuates around 35,000 gammas, which compares to a typical Earth's magnetic field intensity of approximately 37,000 gammas for Hawaii.

In addition there are also three distinct, linear features showing positive anomalies along their south side and negative anomalies along their north side (Figure 2). The first linear feature runs from (-10,0) to (20,75), the second feature runs from (185,0) to (250,110) with a branch forking off to the southeast at (225,75). The third linear feature extends from (255,0) to (280,50). Localized anomalies are found at (0,100) and at (100,0).

3.3 DATA INTERPRETATION

The strong fluctuations in the magnetic field intensity across the site are higher than usually expected from lithological changes or tectonic features. However, the lithology at the site is composed of Hawaiian basalt covered by carbonate sand. While Hawaiian basalt is rich in ferrous iron causing a strong magnetic signature, carbonate sand exhibits very little magnetism. A strong relief in the lava flows, where the valleys are filled in with carbonate sand, may cause strong magnetic variations. The distinct linear features may represent basalt ledges bordering deep erosional features such as former river beds, now filled in with carbonate sand.

However, the strong fluctuations across the site may also represent an abundance of dumped materials, while the linear features may also represent trenches filled in with refuse.

4.0 RECOMMENDATIONS

BES has located distinct magnetic anomalies at the subject site. BES recommends to employ further means of investigation to examine the nature of the features causing the magnetic anomalies. BES recommends trenching across the linear magnetic anomalies at a 90 degree angle of the feature itself. The trenches should cross the strongest anomalies found along the linear magnetic distortions of the Earth's magnetic field. The recommended trench locations are marked in Figure 2.

BES appreciates the opportunity to assist CH2M Hill in their environmental investigation. If you have any questions, please call Ursula Ginster at 535-6031.