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FINAL WORK PLAN FOR PRE-DESIGN INVESTIGATION AT SITE 11 NSWC INDIAN HEAD MD

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Final
Work Plan for Pre-Design Investigation at Site 11

Naval Support Facility, Indian Head

Naval Facilities Engineering Command
NAVFAC WASHINGTON

Prepared for

Department of the Navy
Naval Facilities Engineering Command Washington

Contract No N62470-02-D-3052
CTO-0051

October 2006

Prepared by

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October 9, 2006

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Subject: Navy CLEAN III Program
Contract N62470-02-D-3052
Contract Task Order 0051
Final Work Plan for Pre-Design Investigation at Site 11
Naval Support Facility, Indian Head, Indian Head, MD

Dear Joe:

CH2M HILL is pleased to submit two hard copies and one pdf CD of the above-referenced document. Copies of the document have also been distributed as shown below.

If you have any questions regarding this deliverable, please call me at (703) 471-1441.

Sincerely,

CH2M HILL

Gunarti H. Coghlan
Project Manager

WDC\Cover letter for Final Site 11 Pre-Design Investigation.doc
Cc: Shawn Jorgensen/NSF-IH (2 hard copies, 10 CDs)
Curtis DeTore/MDE (1 hard copy, 1 CD)
Dennis Orenshaw/USEPA (1 hard copy, 1 CD)
George Latulippe/TTNUS (1 CD)
CH2M HILL (3 hard copies, 1 CD)

Work Plan for Pre-Design Investigation at Site 11 NSF-IH, Indian Head, MD

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DATE:	October 9. 2006

1.0 Introduction

This Work Plan presents the proposed approach for excavating test pits and for sampling surface and subsurface soil at Site 11- Caffee Road Landfill at the Naval Support Facility, Indian Head (NSF-IH), Indian Head, Maryland.

This Work Plan supplements and references the following documents:

- CH2M HILL, 2004. *Final Remedial Investigation Report, Sites 11, 13, 17, 21, and 25, Indian Head Division-NSWC, Indian Head, Maryland* (herein referred to as remedial investigation [RI] report).
- CH2M HILL, 2005. *Draft Site 11 Feasibility Study, Naval Support Facility, Indian Head, Indian Head Maryland.*
- Tetra Tech NUS Inc., 2004. *Master Plans for Installation Restoration Program Environmental Investigations, Naval District Washington, Indian Head, Indian Head, Maryland* (herein referred to as Master Plans).

For ease of reading, the following terms will be used in this work plan: The area proposed for a landfill cover system in the feasibility study report is herein referred to as "proposed cover area." The areas proposed for pre-design investigation to the north and east of the proposed cover area are herein referred to as the "investigation area." Figure 1 shows the investigation area.

2.0 Rationale for the Pre-Design Investigation

As part of the feasibility study conducted for Site 11 (CH2M HILL, 2005), two cover alternatives were evaluated for the footprint of the landfill area in Area A: a soil cover and a RCRA C cap. Both alternatives included placing materials excavated from the surrounding area beneath the landfill cover. The limits of excavation in the surrounding areas of the landfill were approximated based on the presence of suspected waste materials (wood, trash, building debris, metal, industrial sand, etc.), as delineated from borings and observations during the RI , which was conducted in 2000 (CH2M HILL, 2004).

During a site visit with the Navy on February 2, 2006, CH2M HILL observed that the area north of the landfill area might be natural ground because there were no apparent indications of fill or waste placement. Following the site visit, CH2M HILL was tasked with reviewing all available data and developing an investigation plan. A technical memorandum was prepared (CH2M HILL, 2006) that summarized the results of the review and provided a recommended investigation approach. The information was presented to the Indian Head Installation Restoration Team (IHIRT) during the March 2006 partnering meeting, and a recommendation was made for further investigation, either during the design or construction phase of the project, to determine if this area and the area to the east actually contain waste materials requiring excavation and consolidation under the landfill cover. In summary, the areas north and east of the area proposed for cover were recommended for further investigation.

The area to the north of the proposed soil cover area consists of two hillside areas separated by a swale containing a road used to access the landfill and environs. The waste limit area to the west of the swale was investigated by advancing one boring (IS11SB12). This boring indicated the presence of plant debris and leaves at the surface and native soil at a depth of 2 feet. There was no other indication of waste in the boring. No debris or signs of waste fill were noted within the entire area. The waste limit area to the east of the swale was investigated by advancing two borings (IS11SB08 and IS11SB09). Wood debris was noted in the upper portion of IS11SB08, but no other waste constituents were noted. Boring IS11SB09 indicated the presence of metal and debris at the surface and native soil below. During the February 2006 site visit it was noted that the area was heavily vegetated and no surface debris was observed except for a short piece of an old telephone pole.

The area to the east of the proposed soil cover area consists of an apparent fill area between the landfill and a storage area to the east. It was investigated by advancing two borings (IS11SB01 and IS11SB27). Boring IS11SB01, taken near the southwestern corner of the area, indicated the presence of fill to an approximate depth of 6 feet, with wood debris present at 4 feet. Boring IS11SB27, located in the northeastern portion of the area, indicated the presence of about 4 feet of clay/sand fill with wood particles present at about 2 feet. No other waste constituents were noted.

This work plan is a result of the discussion that took place during the March IHIRT partnering 2006 meeting. Key points for the plan from that meeting are as follows:

- Conduct the investigation in two phases. Phase 1 will consist of a geophysical survey and Phase 2 will consist of excavating test pits and installing soil borings for surface and subsurface soil sampling.

- Perform geophysical survey in the north and east areas using electromagnetic conductivity (EM), ground penetrating radar (GPR), and ground resistivity to identify subsurface anomalies, which may indicate previous disturbances and waste placement.
- Locate some test pits in areas where anomalies are identified by the geophysical survey. Test pits are recommended instead of borings because pits and trenches provide a better indication of waste limits and the true nature of wood, rocks, etc., which may or may not be waste.
- Locate some test pits, as deemed necessary, to determine the limits of identified waste or in otherwise suspect areas, such as: (1) eastern area, where fill (waste or otherwise) is known to exist, (2) areas where the nature of wood particles in previous borings must be confirmed, and (3) additional areas, especially areas along the perimeter of the proposed soil cover where drainage ditches and structures are proposed.
- Collect surface and subsurface soil samples from the soil borings and analyze them for the full suite of parameters. According to Maryland Department of the Environment's (MDE) solid waste regulation, Code of Maryland Regulation 26.04, the excavated material can only be consolidated under an impermeable cap. Thus, if the selected remedy for Area A is a soil cover, then the excavated material will have to be disposed offsite. The IHIRT reached a consensus for collection and analyses of soil samples for risk screening.
- Perform human health and ecological risk screenings based on the analytical results for use in making risk management decisions for possible excavation.

3.0 Phase 1 – Geophysical Survey

CH2M HILL's subcontractor, Earth Resources Technology (ERT) of Columbia, Maryland conducted a geophysical survey from May 8 to May 11, 2006 and on May 18, 2006. Several geophysical tools (Geometrics G-858 Magnetometer, a Geonics EM31, and a GSSI SIR-3000 GPR) were used to locate subsurface anomalies associated with site-related solid waste disposal practices within the investigation area. Detailed geophysical survey results are presented in Attachment A.

The Geometrics G-858 magnetometer detects ferrous metals, while the Geonics EM31 detects changes in ground conductivity as well as the presence of ferrous and non-ferrous metals, although it is not as sensitive as the magnetometer. In general, the magnetic anomaly and terrain conductivity maps were used to identify approximate waste boundaries and to select confirmatory test pit locations. The GPR employs radio frequencies to collect images of the subsurface in the form of profiles, and was used to further characterize the subsurface anomalies identified in the EM31 and magnetometer surveys. However, the GPR data were not useful because of the high amounts of distortion observed, possibly associated with non-homogeneous fill materials. Attachment A provides the geophysical survey report from ERT.

4.0 Phase 2 - Test Pits and Soil Sampling

4.1 Objectives

The objectives for Phase 2 investigation are:

- Conduct test pit excavation to confirm the lateral and vertical extents of waste to the north and east of the proposed cover area for use in the feasibility study and subsequent design of a cover system.
- Collect and analyze surface and subsurface soil samples from the test pits to assess the environmental impact of soil to human and ecological receptors.

Initially, the soil samples were to be collected from soil borings. Because the test pits can provide a larger area for sampling than the 3-inch inner diameter direct-push technology sampler, a decision was made to collect the samples directly from the test pits. Using this technique would also result in cost savings.

4.2 Scope of Work

4.2.1 Field Activities

Field activities to be conducted include the following:

- Munitions and explosives of concern (MEC) clearance and avoidance
- Mobilization/demobilization
- Test pit excavation
- Surface and subsurface soil sampling
- Survey test pit and soil sample locations
- Decontamination of sampling equipment
- Field documentation
- Investigation-derived waste (IDW) management

These are discussed in detail below.

MEC Clearance and Avoidance

An explosive safety submission (ESS) will be prepared for approval by the Naval Ordnance Safety and Security Activity (NOSSA) before field activities begin. The Department of Defense Explosive Safety Board (DDESB) will review the ESS only if NOSSA concludes that it is necessary. The ESS is, therefore, an integral part of this work plan because it will provide the detailed processes for MEC handling and management, if encountered.

MEC avoidance and clearance will be performed, as specified in the ESS, before initiating and during intrusive activities because of observations of MEC at the site. CH2M HILL will provide MEC clearance and avoidance for excavation and sampling of test pits. All field personnel will follow the procedures outlined in the ESS.

Mobilization/Demobilization

The Navy will verify the accessibility of the site, and CH2M HILL will perform utility clearance before any fieldwork or other potentially disruptive and/or intrusive action begins. Mobilization includes those activities required for general site mobilization, including coordination with the Navy and site orientation for field staff. CH2M HILL's field personnel and subcontractors will review the project documents, including CH2M HILL's *Addendum to the Health and Safety Plan* (2006) (Attachment B) and the ESS. Demobilization will consist of following proper decontamination procedures for personnel and equipment. Each test pit will be backfilled with excavated soil and the site will be left in the condition it was prior to mobilization.

Test Pit Excavation

Erosion and sediment controls are not anticipated for these activities and, therefore, are not considered in this work plan. Seven test pits (IS11TP01 through IS11TP07) are proposed for excavation to determine the lateral and vertical extents of waste at the locations shown on Figure 1. The proposed locations of the test pits are based on the results of the geophysical survey. These locations may change in the field based on site conditions with regards to MEC. Three test pits (IS11TP01, IS11TP02, and IS11TP07) are collocated with subsurface anomalies identified from the geophysical survey. The remaining test pits (IS11TP03 through IS11TP06) are placed to provide sufficient coverage within the investigation area for determining the extent of waste for the remedial design.

The width of the test pits will be approximately 2 feet, which is also the width of the excavator bucket. Test pits IS11TP01 and IS11TP02 will be advanced horizontally from the edge of the proposed cover area to the approximate boundary between Area A and Area B (approximately 75 feet in length). The length of test pits IS11TP03 through IS11TP06 will be determined based the native soil contact. The length of test pit IS11TP07 will be determined based on the wetland contact, because excavation in the wetland area is considered costly and time-consuming.

CH2M HILL field personnel will log soil, material and/or waste encountered in each test pit as well as pit depth. The desired depth of excavation will be to the top of native soil, which is estimated to be 6 feet below ground surface (bgs) based on lithologic cross sections (CH2M HILL, 2005). NSF-IH personnel will photograph the test pits, excavator, and sampling devices. Upon completion of sampling, the test pit will be abandoned by backfilling the hole with the soil removed from it.

Surface and Subsurface Soil Sampling

The test pit will be excavated with an excavator to the top of native soil. The test pit will be examined by CH2M HILL for the presence of MEC in accordance with the ESS. Upon approval by the MEC Team, up to two surface soil samples will be scooped from a depth interval of 0 to 6 inches bgs from the sides of the test pit. For health and safety reasons and to prevent human entry into the test pits, up to two subsurface soil samples will be collected from the bucket of the excavator. Subsurface samples will be collected from depths in which solid waste is visually identified or where observations indicate possible impact to the soil, such as soil staining. If no indication of solid waste or impact is observed, the sample will be collected from the mid-point of the test pit or immediately above the groundwater table, if it is encountered. For each test pit, the first pair of the surface and subsurface soil samples will be collected from the starting point of the test pit at the edge the proposed soil cover. The locations of the second pair of the surface and subsurface soil samples will be selected in the field based on the observation of the potential waste contact.

Except for volatile organic compound (VOC) samples, which will be collected with Encore® samplers, disposable trowels will be used to collect soil samples for all other parameters directly from the ground surface and from the bucket of the excavator. The samples will be placed in a stainless steel mixing bowl and homogenized. The samples will then be transferred to laboratory-supplied containers, which will be labeled appropriately, then placed in a cooler with ice and stored at 4°C. The samples will be shipped in the sample coolers by overnight courier under executed chain-of-custody to an offsite laboratory.

For all sampling performed, the appropriate number of field quality assurance/quality control (QA/QC) samples, including field blanks, equipment blanks, and duplicates, will be analyzed in addition to laboratory QA/QC samples, including matrix spike/matrix spike duplicate (MS/MSD) samples. All samples will be analyzed at an offsite laboratory for target compound list (TCL) VOCs, TCL semivolatile organic compounds (SVOCs), TCL pesticides, polychlorinated biphenyls (PCBs), target analyte list (TAL) metals with cyanide, explosives (nitoaromatics/nitramines plus pentaerytharitol, tetranitrate, nitrocellulose, nitroglycerine, nitroguanadine), perchlorate, and total organic carbon (TOC). Samples will be analyzed on a 28-day standard turnaround time.

Table 1 presents the sample media, number of samples, and analyses requirements for this investigation. Table 2 presents the sample identifications and sample analytical requirement. Table 3 presents the frequency at which field QA/QC samples will be collected. Tables 4 and 5 list the sample containers, preservatives, and holding times required for the intended analyses for solid and aqueous samples, respectively. Samples will be labeled, handled, documented, packaged, and shipped as detailed in the Master Plans (Tetra Tech NUS, 2004). The sample identification system will follow the sample identification protocol previously used at NSF-IH.

Survey Test Pit and Soil Sample Locations

Following sampling, the four corners of each test pit will be flagged and surveyed using a portable global positioning system (GPS) unit. Surface soil samples locations will also be surveyed with the GPS. Horizontal locations will be measured to the nearest 1 foot with the GPS. Vertical elevation data will not be collected. A Trimble Pro-XL GIS-grade GPS receiver, in conjunction with a Pro-Beacon navigation beacon receiver, will be used. The navigation beacon receiver enables the reception of the U.S. Coast Guard broadcast of differential corrections and allows the GPS receiver to generate corrected positions in real time. Horizontal locations will be referenced to the 1983 North American datum (NAD83).

Decontamination of Sampling Equipment

All non-dedicated sampling equipment will be decontaminated before beginning sampling activities and after each use. Decontamination procedures are presented in the standard operating procedures (SOPs) provided in the Master Plans.

Field Documentation

Sampling and field information will be documented in a field log book.

IDW Management

Handling and disposal of IDW will be performed in accordance with the Master Plans. A minimal amount of IDW will be generated during this investigation. Paper towels used to wipe down equipment, personal protective equipment, and disposable trowels used during sampling will be disposed in the facility dumpsters. Excess soil remaining after collection of samples will be returned to the test pit, except for MEC, which will be handled in accordance with the ESS.

4.3 Data Evaluation and Reporting

The laboratory analytical results will be validated by an independent third party and will be used to perform human health and ecological risk screening. The results of these risk screenings in conjunction with the test pit lithological results will be used to decide if excavation and offsite disposal of soil north and east of the proposed cover area is warranted.

Human Health Risk Screening

A human health risk-based screening will be conducted for the surface soil and subsurface soil to identify the potential for adverse effects to human receptors. The maximum detected concentrations will be compared to the residential soil risk-based concentrations (RBC) from the current U.S. Environmental Protection Agency (EPA) Region III RBC table. RBCs based on noncarcinogenic effects will be divided by 10 (to adjust to a Hazard Index of 0.1) to account for exposure to multiple constituents. RBCs associated with carcinogenic effects are based on an excess lifetime cancer risk of 10^{-6}, and will not be adjusted from the values in the RBC table. If the maximum detected concentration exceeds the RBC, the site-related concentrations will be compared with background concentrations identified in the *Background Soil Investigation Report for Indian Head and Stump Neck Annex* (Tetra Tech NUS, Inc., 2002).

If maximum detected concentrations exceed the screening levels, and site-related concentrations are above 95 percent upper tolerance limit (95% UTL), the investigation area will be considered to warrant further consideration of potential human health risk, and the next step for addressing the site will be discussed among the IHIRT.

Ecological Risk Screening

An ecological risk screening will be conducted for the surface soil to assess whether site conditions create the potential for adverse effects to ecological receptors. The investigation area will be evaluated for viable habitat to ecological receptors and chemical concentrations. Potential chemical transport pathways will also be identified to ascertain whether chemicals could be transported to viable habitats at offsite locations. Concurrently, chemical concentrations measured in the soil samples will be compared to applicable ecological risk-based screening criteria (e.g., EPA Region III ecological screening values).

No further ecological evaluation will be recommended if onsite chemical concentrations are at or below screening toxicity values. Chemical concentrations exceeding screening toxicity values will also be compared to background concentrations. If the investigation area chemical concentrations exceed these background concentrations, the IHIRT will discuss the next steps to be taken.

Reporting

A technical memorandum will be prepared to document the background, objectives, field activities, and the results of the investigation. It will also provide a recommended management decision, such as no further action or excavation/removal and offsite disposal of soil.

4.4 Data Quality Objectives

Data quality objectives (DQOs) are pre-established goals that help monitor and assess the progress of the project. They provide the benchmarks against which the quality of fieldwork and the quality of resulting analytical data are evaluated. DQOs specify the data type, quality, quantity, and how data are used to support project decisions. Data gathered during the pre-design investigation will be used to delineate the extent of waste excavation. Consequently, the quality and quantity of the data must be sufficient to compare analytical data with appropriate screening levels.

The investigation-specific DQOs included in this Work Plan were developed following the seven-step process outlined in EPA's Office of Environmental Information *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4,* EPA/240/B-06/001 (EPA, 2006). This site-specific DQO is summarized below.

Step 1: State the Problem

Existing information on potential human health and ecological risks, and on the lateral and vertical extents of waste are uncertain to the north and east of the proposed cover area. While existing soil data may indicate a potentially unacceptable human health risk for the site as a whole, the existing data are primarily representing the proposed cover area and the area to the west.

Step 2: Identify the Goals of the Study

Primary Questions:

- What are the potential human and ecological risks related to chemical constituents in the investigative area soil?
- Are there any wastes associated with past site disposal activities present in the investigative area?
- Are the data collected, in conjunction with data already collected, adequate to support a risk management decision about whether a removal action will be needed?

Secondary Questions (necessary environmental data to resolve the primary questions):

- What are the spatial distributions and average concentrations of VOCs, SVOCs, pesticides/PCBs, metals and cyanide, explosives, and perchlorate in surface and subsurface soil for constituents exceeding screening thresholds and/or facility-wide background concentrations?
- What additional data (e.g., TOC) are necessary to interpret the chemical soil data for ecological risk?
- What are the lateral and vertical extents of waste?

Step 3: Identify Information Inputs

Current information about the site, which includes the investigation area, consists of information collected during the RI in 2000. Human health and ecological risk assessments were performed for the site during the RI and risks were identified. The applicability of the risk assessment data to conditions in the investigation area is uncertain because the area is outside the footprint of the landfill. Analytical data collected during this investigation will be compared against screening thresholds and/or background concentrations. Sample locations, media, and analytical parameters will be selected such that the presence or absence of the constituents of concern related to previous site activities area can be confirmed.

Furthermore, the extent of waste to the north and east of the proposed cover area was based on information from three RI soil borings (IS11SB12, IS11SB08, and IS11SB09) to the north and two RI soil borings (IS11SB01 and IS11SB27) to the east . These borings indicated the presence of plant debris, leaves, and wood debris. The test pits will be used to ascertain the subsurface lithology in the investigation area and to delineate the lateral and vertical extents of waste, if present. Based on the observations of the RI soil borings and for the purpose of this investigation, waste is defined as material that is associated with the past site disposal activities, such as metallic debris, ash, treated wood, and plastic.

Step 4: Define the Boundaries of the Study

- The proposed test pit and soil sampling locations are to the north and east of the proposed cover area (Figure 1). The investigation area loops around the northern and eastern edges of the proposed cover area; the width varies from about 25 feet to 100 feet from the edge of the proposed cover area. The investigation area is bounded to the east by the western edge of Area B, which has different historical uses and contaminant sources from Area A, based on information in the RI report. Historical records indicate that Area B was never used as a disposal area. Therefore, investigative activities will not encroach into Area B.
- Sampling depth for surface soil will be from 0 to 6 inches bgs.
- Sampling depth for subsurface soil is anticipated to be between 4 and 6 feet bgs or at depths where waste is identified or suspected based on visual observations.
- Test pits will extend laterally about 25 feet to 75 feet from the edge of the proposed cover area.
- Test pits will be excavated up to a maximum depth of about 6 feet bgs.
- Chemical constituents of interest in surface soil and subsurface soil are the full suite of parameters.

Step 5: Develop the Analytic Approach

The rules for determining concentrations to be used for analysis are different for the human health and ecological risk screenings; they are outlined in Section 4.3. Following the collection of information during the investigation, the following decisions will be made:

1. Human health and ecological risk screening will be performed on the surface and subsurface soil data. If risk drivers are not identified for human and ecological receptors it will be assumed that there are no site-related constituents.
2. If only human health or ecological risk drivers are identified, the average concentrations of the constituents exceeding screening criteria will be compared to their respective 95% UTL background concentrations, if available, and documented in the *Background Soil Investigation Report.*

- If the average concentrations are lower than the 95% UTL background concentration, they will be eliminated from further consideration.
- If the average concentrations are higher than the 95% UTL background concentration, they will be evaluated for removal.

3. If both human health and ecological risk drivers are identified, the same decision logic outlined in Decision 2 will apply.
4. If risk drivers are not identified for human and/or ecological receptors and waste is not observed, the investigation area will not be excavated.
5. If risk drivers are identified for human and/or ecological receptors, but are less than background concentration, and waste is not observed, the investigation area will not be excavated.
6. If risk drivers are identified for human and/or ecological receptors and are greater than background concentration, and waste is not observed, the investigation area will be excavated.
7. If risk drivers are identified for human and/or ecological receptors and are greater than background concentration, and waste is observed, the investigation area will be excavated.
8. If risk drivers are identified for human and/or ecological receptors, but are less than background concentration, and waste is observed, the investigation area will be excavated.
9. Identify and recommend the extent of excavation within the investigation area based on human health and/or ecological risks and risk management decisions. Test pit logs will be used to determine the lateral and vertical extents of the excavation.

Figure 2 summarizes the decision making logic used in this investigation.

Step 6: Specify Performance or Acceptance Criteria

Decision errors will be minimized by biased sampling and risk screening. Sampling and measurement errors in the analytical data may cause over- or underestimation of risk and subsequently lead to no further action when further action is warranted or, conversely, lead to a removal action in an area where no unacceptable risk exists. The risk screening will screen for chemicals of potential concern (COPCs) using maximum concentrations.

QA/QC samples will be used to verify the accuracy and precision of the data generated during the investigation. When data are suspect because a QC sample is outside of a laboratory's established control limits, the data user will be notified through the laboratory's case narrative and the data validator's report. Data validation is an important step in determining how the data can be used by the risk assessors and for risk screening. All data used for risk screening will be validated following *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* (EPA, 1993) and the *Region III Modifications to National Functional Guidelines for Organic Data Review Multi-media, Multi-concentration,* (OLM01.0-OLM01.9) (EPA, 1994).

Step 7: Develop the Plan for Obtaining Data

This additional investigation is part of an overall phased approach to data collection designed to ensure that all appropriate data are collected for a management decision by the IHIRT. The sampling, analysis, and evaluation presented in this plan are part of the optimization process. The analytical results will be the primary basis for project decisions as defined in Step 5; therefore, the analysis of samples will require high-level QC at the laboratory.

4.5 Standard Operating Procedures

Fieldwork will follow the SOPs provided in the Master Plans and will be consistent with the work performed during the RI.

4.6 Health and Safety

Health and safety procedures will follow those described in the Master Plans, the CH2M HILL *Master Health and Safety Plan*, and the addendum to the *Master Health and Safety Plan* for the Site 11 Pre-Design Investigation.

4.7 Schedule

Fieldwork will commence following the approval of the ESS, which is anticipated to be in September or October 2006. Field activities are expected to last for 2weeks; hence, should be completed by the end of October to mid-November.

5.0 Additional References

CH2M HILL. 2002. *Master Health and Safety Plan.*

CH2M HILL. 2006. Final IHIRT Partnering Meeting Minutes. March.

U.S. Environmental Protection Agency (EPA). 1993. *Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses.*

EPA. 1994. *Region III Modifications to National Functional Guidelines for Organic Data Review Multi-media, Multi-concentration, (OLM01.0-OLM01.9).*

EPA. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process,* EPA QA/G-4, EPA/240/B-06/001. February.

Tetra Tech NUS Inc. 2002. *Background Soil Investigation Report for Indian Head and Stump Neck Annex, Naval Surface Warfare Center, Indian Head, Maryland.*

TABLE 1
Sampling and Analysis Summary
Work Plan for Pre-Design Investigation at Site 11, NSF-IH, Indian Head, Maryland

Media	Number of Samples	Analysis	Procedures
Surface Soil	14	Volatile Organic Compounds, Semi-volatile Organic Compounds, Selective Ion Monitoring Polycyclic Aromatic Hydrocarbons, Pesticides / Polychlorinated Biphenyls, Metals and Cyanide, Explosives and Pentaerythritol Tetranitrate, Nitrocellulose, Nitroglycerine, Nitroguanidine, Perchlorate, and Total Organic Carbon	Obtain surface soil samples with a disposable hand trowel
Subsurface Soil	14	Volatile Organic Compounds, Semi-volatile Organic Compounds, Selective Ion Monitoring Polycyclic Aromatic Hydrocarbons, Pesticides / Polychlorinated Biphenyls, Metals and Cyanide, Explosives and Pentaerythritol Tetranitrate, Nitrocellulose, Nitroglycerine, Nitroguanidine, Perchlorate, and Total Organic Carbon	Obtain soil from excavations with a disposable hand trowel

TABLE 2

Sample Analytical Requirement

Work Plan for Pre-Design Investigation at Site 11, NSF-IH, Indian Head, Maryland

Station ID	Sample ID	Sampling Depth Interval (feet bgs)	Sample Media	TCL VOCs	TCL SVOCs	SIM PAH	TCL Pest/PCBs	TAL Metals / Cyanide	Explosives, PETN, and NQ	Nitrocellulose	Nitroglycerine	Perchlorate	TOC
IS11TP01	IS11TP01ASS0001	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP01ASBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP01BSS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP01BSBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
IS11TP02	IS11TP02ASS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP02ASBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP02BSS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP01BSBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
IS11TP03	IS11TP05SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP05SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP06SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP06SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
IS11TP04	IS11TP07SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP07SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP08SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP08SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
IS11TP05	IS11TP09SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP09SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP10SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP10SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
IS11TP06	IS11TP11SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP11SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP12SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP12SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
IS11TP07	IS11TP13SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP13SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP14SS000.5	0 - 6 inches	Surface Soil	X	X	X	X	X	X	X	X	X	X
	IS11TP14SBXXXX	TBD	Subsurface Soil	X	X	X	X	X	X	X	X	X	X

Notes:

I - NSF, Indian Head
S11 - Site 11
TP01 - Test Pit Location 1
A - Collected from the starting point of the test pit
B - Collected from the end point of the test pit
SS - Surface soil
SB - Subsurface soil
XXXX - Depth range for subsurface soil sample (in feet; rounded to the nearest foot)

Examples:

IS11TP01ASS0001 — Surface soil sample collected from from NSF-IH Site 11 at the starting point of Test Pit Location 1 from 0 ft to 1 ft below ground surface (6 inches were rounded to 1 foot)

IS11TP01BSB0205 — Subsurface soil sample collected from from NSF-IH Site 11 at the end point of Test Pit Location 1 from 2 ft to 5 ft below ground surface (6 inches were rounded to 1 foot)

TABLE 3
Summary of Samples to be Submitted for Analysis
Work Plan for Pre-Design Investigation at Site 11, NSF-IH, Indian Head, Maryland

Matrix	Laboratory Parameter (Method)	Samples (solid)	Field Duplicates (solid)1	Field Blanks (aq)[2]	Equipment Blanks (aq)[3]	Trip Blanks (aq)[6]	MS/ MSDs (solid)[4]	Solids Total[5]	Aqueous Total[7]
Surface and Subsurface Soil	TCL Volatiles by EPA CLP OLM04	28	3	1	3	3	2/2	31	7
Surface and Subsurface Soil	TCL Semivolatiles by EPA CLP OLM04	28	3	1	3		2/2	31	4
Surface and Subsurface Soil	SIM PAH by SW-846 8270	28	3	1	3		2/2	33	4
Surface and Subsurface Soil	TCL Pesticides/PCBs by EPA CLP OLM04	28	3	1	3		2/2	33	4
Surface and Subsurface Soil	TAL Metals/Cyanide by EPA CLP ILM04	28	3	1	3		2/2	33	4
Surface and Subsurface Soil	Explosives, PETN, and NQ by SW-846 8330	28	3	1	3		2/2	33	4
Surface and Subsurface Soil	Nitrocellulose by IAAP	28	3	1	3		2/2	33	4
Surface and Subsurface Soil	Nitroglycerine by SW-846 8332	28	3	1	3		2/2	33	4
Surface and Subsurface Soil	Perchlorate by SW-846 6850	28	3	1	3		2/2	33	4
Surface and Subsurface Soil	TOC by Lloyd Kahn	28	3	1	3		2/2	33	4
Surface and Subsurface Soil	TCL Volatiles by EPA CLP OLM04	28	3	1	3		2/2	33	4

1. Field Duplicates are collected at a rate of 1 per 10 samples per matrix.
2. Field Blanks are collected at a rate of 1 per sampling event per week.
3. Equipment Blanks are collected at a rate of 1 per day per matrix where equipment is decontaminated (i.e., if dedicated disposable equipment is not used). One per event if disposable equipment is used.
4. Matrix Spikes/Matrix Spike Duplicates (MS/MSDs) are collected at a frequency of 1 per 20 for soil samples. MS/MSDs represent samples for which extra volume must be collected for the laboratory to perform required QC analyses. Triple the normal volumes will be collected for all analyses.
5. Solids total consists of the samples and their field duplicates.
6. Trip Blanks are collected at a rate of 1 per cooler containing volatiles samples.
7. Aqueous total consists of Field Blanks, Equipment Blanks, and Trip Blanks only.

TCL = Target Compound List; TAL = Target Analyte List; CLP = Contract Laboratory Program
SW-846 = Test Methods for Evaluating Solid Waste; PETN = Pentaerythritol Tetranitrate
NQ = Nitroguanidine; IAAP = Iowa Army Ammunition Plant
Aq – aqueous sample

TABLE 4
Summary of Required Containers, Preservatives, and Holding Times for Solid Samples
Work Plan for Pre-Design Investigation at Site 11, NSF-IH, Indian Head, Maryland

Parameter	Container Type per Sample	Preservation	Holding Time	Notes
TCL Volatiles by EPA CLP OLM04	3 X 5g EnCores	Cool to 4°C	48 hours to extraction; 14 days to analyze	
TCL Semivolatiles by EPA CLP OLM04	1 X 8oz CWM	Cool to 4°C	7 days to extraction; 40 days to analyze	
SIM PAH by SW-846 8270	1 X 8oz CWM	Cool to 4°C	7 days to extraction; 40 days to analyze	
TCL Pesticides/PCBs by EPA CLP OLM04	1 X 8oz CWM	Cool to 4°C	7 days to extraction; 40 days to analyze	
TAL Metals/Cyanide by EPA CLP ILM04	1 X 8oz CWM	Cool to 4°C	6 months; 28 days for Hg; 14 days for CN^-	
Explosives and PETN by SW-846 8330	1 X 4oz AWM	Cool to 4°C	7 days to extraction; 40 days to analyze	
Nitrocellulose by USATHAMA	1 X 4oz AWM	Cool to 4°C	7 days to extraction; 40 days to analyze	
Nitroglycerine by SW-846 8332	1 X 4oz AWM	Cool to 4°C	7 days to extraction; 40 days to analyze	
Nitroguanidine by IAPP	1 X 4oz AWM	Cool to 4°C	7 days to extraction; 40 days to analyze	
Perchlorate by SW-846 6850	1 X 4oz AWM	Cool to 4°C	7 days to extraction; 40 days to analyze	
TOC by Lloyd Kahn	1 X 4oz AWM	Cool to 4°C	ASAP	

CWM – clear wide mouth

AWM – amber wide mouth

TABLE 5
Summary of Required Containers, Preservatives, and Holding Times for Liquid Samples (Quality Control Blanks)
Work Plan for Pre-Design Investigation at Site 11, NSF-IH, Indian Head, Maryland

Parameter	Container Type per Sample	Preservation	Holding Time	Notes
TCL Volatiles by EPA CLP OLM04	3 X 40mL VOA vial	HCL to pH < 2; Cool to 4°C	14 days	
TCL Semivolatiles by EPA CLP OLM04	1 X 1L Amber	Cool to 4°C	7 days to extraction; 40 days to analyze	
SIM PAH by SW-846 8270	1 X 1L Amber	Cool to 4°C	7 days to extraction; 40 days to analyze	
TCL Pesticides/PCBs by EPA CLP OLM04	1 X 1L Amber	Cool to 4°C	7 days to extraction; 40 days to analyze	
TAL Metals/Cyanide by EPA CLP ILM04	1 X 1L HDPE	HNO_3 to pH < 2; Cool to 4°C	6 months; 28 days for Hg; 14 days for CN^-	
Explosives and PETN by SW-846 8330	1 X 1L Amber	Cool to 4°C	7 days to extraction; 40 days to analyze	
Nitrocellulose by USATHAMA	1 X 1L Amber	Cool to 4°C	7 days to extraction; 40 days to analyze	
Nitroglycerine by SW-846 8332	1 X 1L Amber	Cool to 4°C	7 days to extraction; 40 days to analyze	
Nitroguanidine by IAPP	1 X 1L Amber	Cool to 4°C	7 days to extraction; 40 days to analyze	
Perchlorate by SW-846 6850	1 X 1L Amber	Cool to 4°C	7 days to extraction; 40 days to analyze	
TOC by SW-846 9060	4 X 40mL Amber vial	H_2SO_4 to pH < 2; Cool to 4°C	ASAP	

File Path: v:\18gis\indianhead\figures\site11_pre-design_investigation.apr

LEGEND

- Proposed Test Pit
  Dotted line indicates that the length of the pit will be determined in the field based on the native soil content.
- Soil Boring
- Stream
- Approximate Site Boundary
- Approximate Boundary between Area A and Area B
- Buildings
- Demolished Buildings
- Approximate Extent of Solid Waste (Based on RI, CH2M Hill, 2004)
- Pre-design Investigation Area
- Wooded Area
- Roads
- Approximate Limit of Cover System
- Topographic Contours (5 foot Intervals)
- Topographic Index Contours (1 foot Intervals)
- Wetland Area

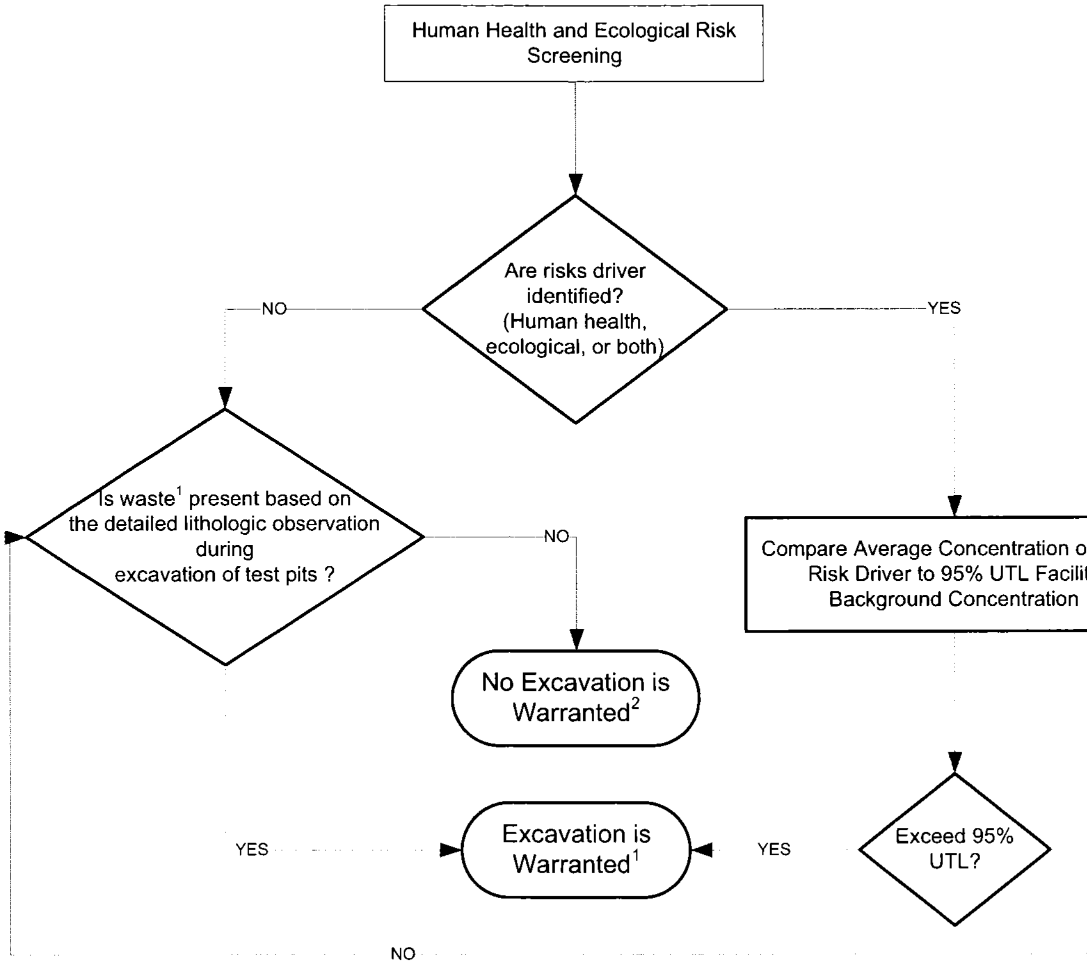
N

0 100 200 Feet

Notes: Locations of IS11TP01, IS11TP02, and IS11TP07 coincide with subsurface anomalies identified during the geophysical survey conducted in May 2006.

Figure 1
Area of Investigation and Location of Proposed Test Pits
Pre-Design Investigation at Site 11
NSF-IH, Indian Head, Maryland

CH2MHILL



NOTES:
UTL – Upper Tolerant Limit
1 – Waste is defined as material that is associated with past site disposal activities.
2 - Extent Of Excavation Will Be Determined Based On Observation Of Waste In The Test Pits.

FIGURE 2
Decision Flowchart for Excavation
Work Plan for Pre-Design Investigation at Site 11
NSF-IH, Indian Head, Maryland

Attachment A
Geophysical Survey Report

Earth Resources Technology, Inc.

June 13, 2006

Gunarti Coughlan
CH2M Hill
13921 Park Center Road
Suite 600
Herndon, VA 20171

RE: Results of Geophysical Surveys, Site 11, Caffee Road Landfill, Indian Head Navy Base, Indian Head, Maryland

Dear Ms. Coughlan:

This report discusses geophysical investigations carried out by Earth Resources Technology, Inc., at Caffee Road Landfill, Indian Head Navy Base, Indian Head, Maryland, for CH2M Hill, on May 8, 9, 10, and 18, 2006.

I. Purpose and Scope of Investigation

The purpose of the geophysical investigations was to characterize the subsurface in an area approximately 500 feet long by 250 feet wide on the banks of the Mattawoman River. Data gathered from the subsurface investigation will be used to guide Geoprobe operations to follow.

The geophysical instruments used to characterize the site were a Geometrics G-858 Magnetometer, a Geonics EM31, and a GSSI SIR-3000 Ground Penetrating Radar (GPR). The magnetometer detects ferrous metals. The EM31 detects changes in ground conductivity as well as the presence of ferrous and non-ferrous metals, although it is not as sensitive as the magnetometer. Results from these two instruments are displayed as contour maps of the site. The GPR collects images of the subsurface in the form of profiles that can be interpreted individually.

II. Field Methods and Equipment

Survey Grid

A 240' x 520' grid was laid out in the field on the first day of the survey, with an arbitrary baseline (Y=200') trending approximately east-west along the length of the site. The X-axis increases to the east, and the Y-axis increases to the north. Grid marks were placed every 10 feet on the ground, and orange pin flags with grid coordinates were placed at many locations in order to facilitate mapping and surveying. The grid was subsequently expanded to the west 50 feet on the last day of the survey. When the grid was expanded, a large amount of metallic debris was moved from the surface into two piles at the edges of the grid (labeled "metal debris" on Plots 1 and 2). The grid can be divided into three general areas for reference: The *western area* includes the parts of the grid to the west of the road, or from X=50' to X=280'; the *central area* includes the parts of the grid from the road to X=550'; the *eastern area* includes the parts of the grid from X=550' to the east and south of the baseline.

Utility Locating

The RadioDetection model RD433HCTx-2 unit was used to locate utilities at the site. The device can locate electrical lines passively and can locate other utilities by direct connection. An electric line (obvious as a partially exposed pair of PVC pipes connecting a telephone pole to an electrical building) was located and marked with pin flags with the letter "E" on them. A water line was located and marked with pin flags with the letter "W" on them.

Magnetic Survey

A Geometrics Portable Cesium Magnetometer, Model G-858, was used for the magnetic survey. Using self-oscillating split-beam Cesium vapor (non-radioactive Cs-133), this magnetometer measures the earth's total geomagnetic field (magnetic flux density) at a particular location in units of nannoteslas (nT) with an accuracy of ±1.0 nT. It collects a maximum of 10 magnetic readings per second. The total field consists of three components: the main field of the earth, the external field caused by the sun and moon, and local variations caused by objects at the site. The main field and external field remain relatively constant over the period of time of a field investigation. Local variations are attributable to anomalies near the surface such as buried ferrous metal objects or above-ground objects containing ferrous metal. Magnetic data were collected along and between grid lines in the field with 5' separation between transects.

The magnetic survey was conducted on two separate days. On May 9, data were acquired over the entire grid from X=100' to the east. On May 18, the grid was expanded to the west and magnetic data were acquired over the expanded western area. The data acquired in the western area on May 9 are not shown in this report, because it is very similar to that acquired on May 18.

Electromagnetic Survey

The Geonics EM31 was used for the electromagnetic survey. The EM31 measures the changes in the ground conductivity using a patented electromagnetic inductive technique that makes the measurements without electrodes or ground contact. The EM31 has two analog meters that display the quadrature-phase (conductivity) and in-phase components of the electromagnetic field. The unit of conductivity used is millisiemens per meter (mS/m). Conductivity changes are used to infer geological variations, or groundwater contamination. In-phase measurements are the ratio of the induced secondary magnetic field to the primary magnetic field in parts per thousand (ppt). The in-phase component is especially useful for searching for buried metal drums, pipes, and other ferrous and non-ferrous metallic debris. The effective depth of exploration of the equipment is about 20 feet.

Electromagnetic data were collected along grid lines with 10' separation between readings, forming a uniform grid. The spatial resolution of this data is much less than that of the magnetometer.

Different orientations of the transmitter and receiver on the EM31 can produce different readings at the same points. For this reason, the survey area was covered with the instrument at two orthogonal orientations, with the receiver pointing north and pointing east. On May 9, the data were acquired over the entire grid from X=100' to the east, with the receiver pointing east. On May 18, the data were reacquired in the expanded western area with the receiver pointing north and pointing east, and in the central area with the receiver pointing north. There was no time to reacquire the data in the eastern area with the receiver pointing north because the grid had been destroyed or covered by heavy equipment activities.

Ground Penetrating Radar Survey

The SIR-3000 Ground Penetrating Radar unit, manufactured by Geophysical Survey Systems, Inc. (GSSI), was used to conduct the GPR survey. The device radiates a polarized electromagnetic wave from a transmitter antenna into the earth and receives at a receiving antenna the reflection of the wave from subsurface interfaces at which changes in the electrical properties (dielectric permittivity and electrical conductivity) of the subsurface materials occur. Dielectric permittivity controls wave speed; and conductivity determines the signal attenuation. Radar reflections occur when the radio waves encounter a change in the velocity or attenuation. The greater the change in properties the more signal is reflected. These properties may be controlled by water in the material, hence by the porosity and quantity of dissolved solids in the water. Also, metallic objects usually exhibit strong subsurface reflection character due to their high electrical impedance or contrast versus surrounding soil or fill. Depth of penetration of the radar signal is inversely proportional to the conductivity of the soil. As a result, electrically resistive earth materials such as coarse-grained, unsaturated sediments allow a deeper radar penetration than the conductive finer-grained soils such as clay and silt. Similarly, reinforced concrete and shallow groundwater are conductive and thus attenuate the radar signals. The 400 MHz antenna was used for this survey. The odometer was set up such that 10 radar readings would be acquired every foot. The average velocity of the radar is estimated around 0.1 m (0.328 ft) per nanosecond (ns). The time range selected was 80 ns and such a time range would allow a theoretical penetration depth of about 13 feet. The GPR data were recorded digitally in a portable computer for instant display and subsequent processing.

The collection of the GPR data was performed by pulling the antenna along grid lines in both the X and Y directions over areas where terrain and vegetation permitted it. Due to an unexpected equipment malfunction, the data acquired on May 10 over most of the site and the data acquired on May 18 in the expanded part of the western area have slightly different acquisition parameters (gains and filters). This accounts for the different appearance on Plot 3 of profiles collected between X=50' and X=100' on May 18 from those collected elsewhere on May 10.

III. Data Reduction and Processing

Magnetic Data Processing

Data from the G-858 were downloaded to a laptop using MagMap2000 software where they were spatially corrected (to fit site features) and exported to Surfer format. Dropouts, or zero readings, are caused by magnetic field lines passing through the sensor at angles outside of its cone of sensitivity, and these were removed using MagMap2000. Griding of the data was accomplished using the method of kriging.

Electromagnetic Data Processing

The data were downloaded from the EM31 Datalogger to a PC where they were placed directly into a Surfer data sheet. The data were gridded using the method of kriging.

Ground Penetrating Radar Data Processing

The data were collected onto a flash card in the SIR-3000 unit and downloaded to a PC. The data were time-zero corrected and gains were applied to all files using Radan software distributed by GSSI. All files were converted to bitmaps using Rad2bmp, also distributed by GSSI. The bitmaps were converted to GIF files using Adobe Photoshop in order to save memory. The GIF files were imported into Surfer for final display.

The vertical axis of GPR profiles is in time, rather than depth. Because a radar wave must travel from the transmitter through the subsurface medium to the target and back through the medium to the receiver, it is said to have a "two-way travel time." The units are nanoseconds (ns). The data were collected such that the records are 80 ns long, which was subsequently cropped to 40 ns after the "time-zero" correction was applied. However, nannoseconds are often not a useful unit for presentation of the data, so a conversion is made to depth by using an assumed velocity of 0.1 m/ns, which is an average for earth materials. All vertical axes have been converted from time to depth in feet, but one must remember that these depths are not precise, and may be over- or underestimates, particularly at depth.

IV. Results and Interpretation

Results from the magnetic survey are displayed in Plot 1, which includes the magnetic contour map, a post map showing the locations of data points, and GOES satellite data supporting the validity of the data. The magnetic contour map is displayed at a 500 nT contour interval. Readings above background (approximately 52,000 nT) are shown as shades of red, while readings below background are shown as shades of blue. It shows many anomalies. The varying intensity of the magnetic field in all three areas (western, central, and eastern) is most likely caused by buried metallic debris, and indicates that it is buried beneath most of the site. A dashed green line indicates the approximate extent of this "landfill material." The magnetic anomalies north of the dashed green line in the western and central areas are all most likely caused by surface objects such as the containter, telephone poles, guy wires, fire hydrants, etc. One anomaly in particular, located about 15 feet to the east of the culvert, is a magnetic dipole, and GPR data, discussed below, gives some indication of the object's properties. Scattered anomalies occur throughout the eastern area. The most intense anomaly in the eastern area is a dipole (high next to low) centered at coordinates [585,85].

Results from the EM31 survey are displayed in Plot 2, which includes contour maps of both quadrature and inphase readings with the receiver pointed both north and east. The quadrature (conductivity) contour maps are displayed at a 10 mS/m contour interval. The inphase contour maps are displayed at a 5 ppt contour interval. There are differences between the data acquired with the receiver pointed north versus that acquired with the receiver pointed east, but the general pattern of both quadrature and inphase anomalies is essentially the same as that observed on the magnetic contour map in Plot 1. The electrical utility shows up particularly well on the inphase maps.

Representative GPR profiles and a map showing their locations are shown in Plot 3. Profiles **A-A'** through **K-K'** are from the western area, profiles **L-L'** through **V-V'** are from the central area, and profiles **W-W'** through **Z-Z'** are from the eastern area. Stations on parallel profiles are aligned with each other for ease of comparison.

In the western area, all profiles show some degree of "saturation" with chaotic reflectors. Profile **D-D'** shows a good example of isolated chaotic reflectors. Profiles **H-H'** and **I-I'** (as well as adjacent, parallel profiles not displayed) show a fairly clear edge to the chaotic reflections that correlates approximately with the edge of the landfill material identified from the magnetic data and shown in Plot 1. Other scattered strong or chaotic reflectors are present on other profiles.

In the central area, a similar pattern of chaotic reflectors correlating with the landfill material identified from the magnetic data is evident. Exceptions occur at the north ends of profiles **R-R'** through **U-U'**, where chaotic reflections occur that do not correspond to any magnetic or EM anomalies on Plots 1 or 2. An important anomaly occurs at the eastern end of profile **O-O'**, about 15 feet to the east of the culvert pipe visible on the profile. This is a strong, clear, hyperbolic reflector at about 2 feet below the ground surface. It correlates with a magnetic dipole, and may represent a buried pipe, drum, or some other cylindrical metallic object.

In the eastern area, most profiles acquired looked similar to profiles **W-W'** through **Y-Y'**, with scattered chaotic reflections. Profile **Z-Z'**, along the eastern margin of the surveyed area, shows what may be the bottom of a fill surface (an area that was excavated to the level of the reflector and then backfilled). Profiles **W-W'** and **Y-Y'** were acquired across the strongest magnetic anomaly, but show nothing that was not observed on other profiles in the eastern area.

V. Summary and Conclusion

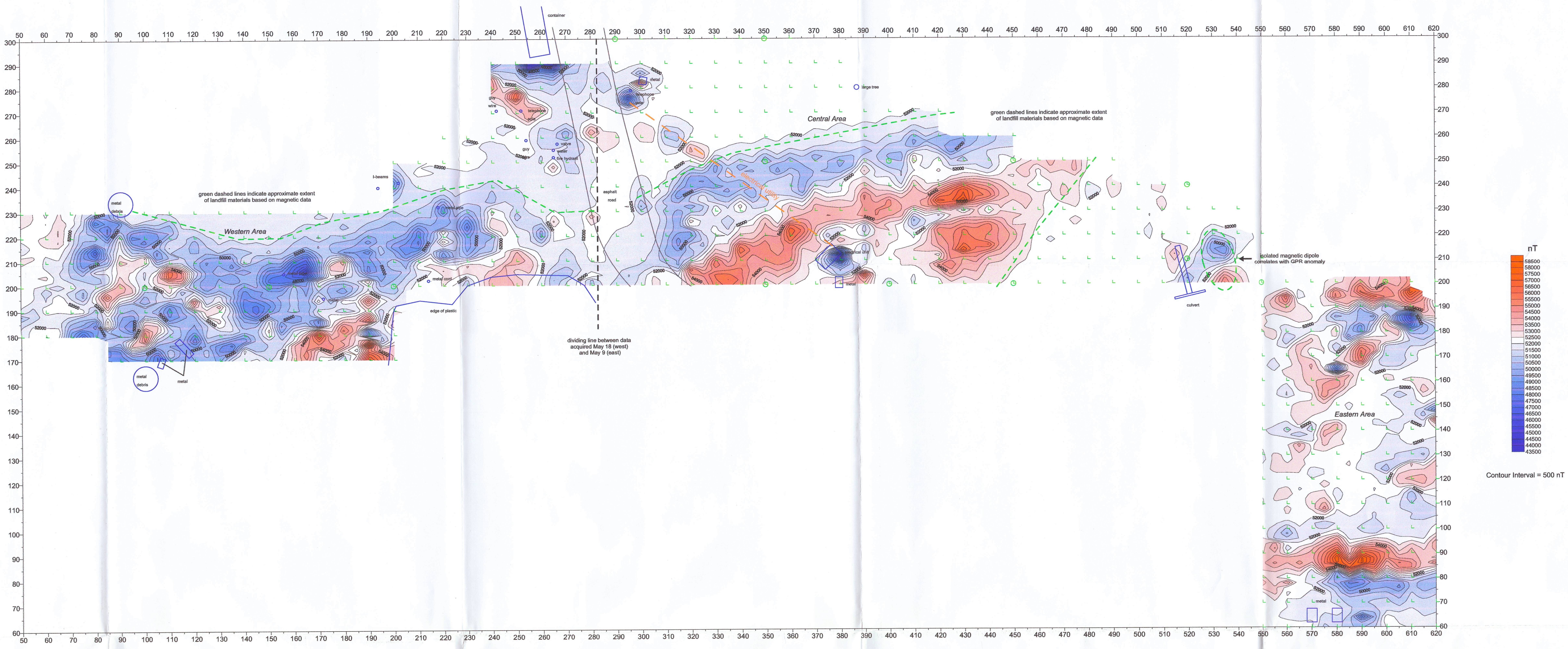
The magnetic and electromagnetic data correlate well with each other and seem to be the best way to delineate the extent of landfill material at this site. The extent of the landfill is delineated on Plot 1, and this interpretation is supported by EM and GPR data. A cylindrical metallic object is buried about 15 feet to the east of the culvert pipe.

The field procedures and interpretative methodologies used in this project are consistent with standard, recognized practices in similar geophysical investigations. The correlation of geophysical responses with probable subsurface features is based on the past result of similar surveys although it is possible that some variation could exist at this site. This warranty is in lieu of all other warranties either implied or expressed. **ERT** assumes no responsibility for interpretations made by others based on work performed by or recommendations made by **ERT.**

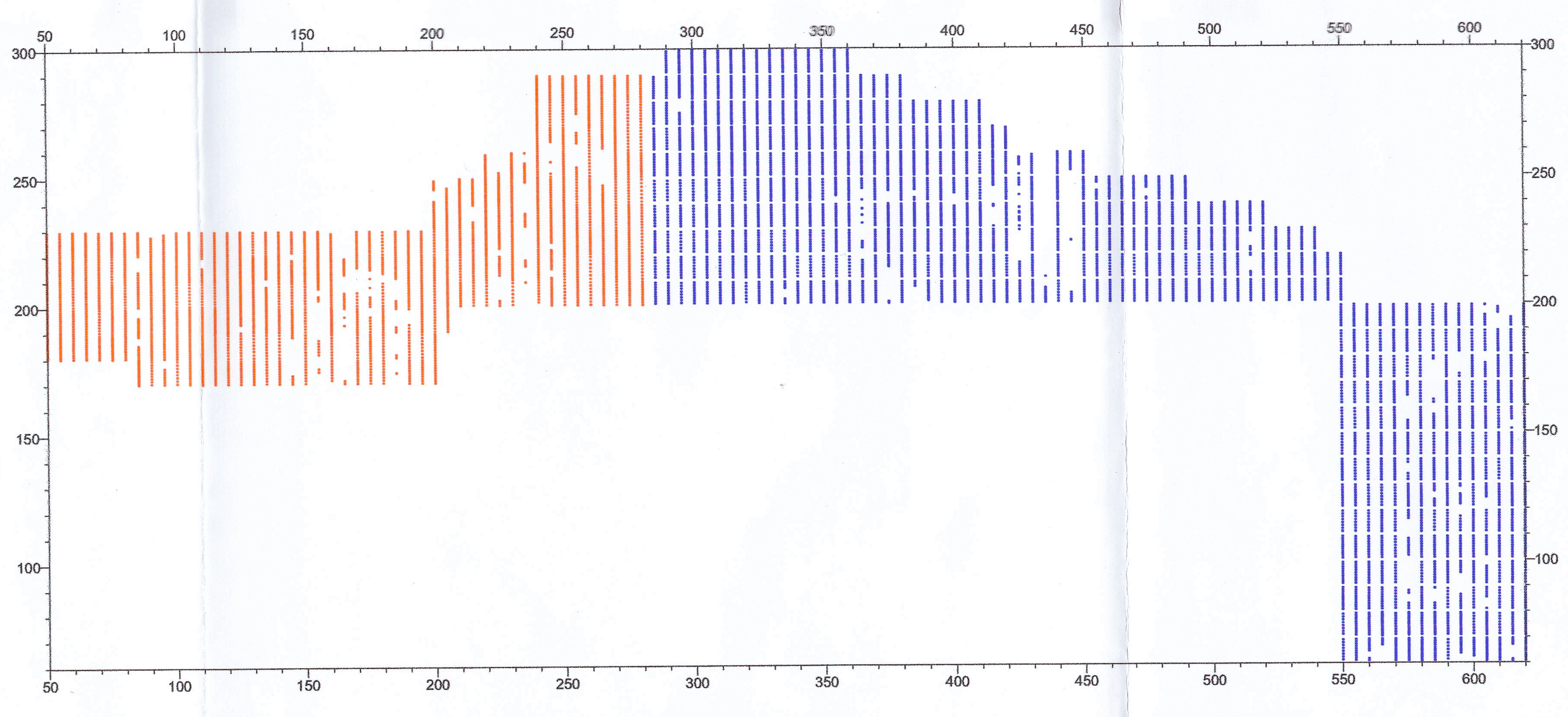
Sincerely,
Earth Resources Technology, Inc.

James L. Stuby, M.S., P.G.
Project Geophysicist

Enclosures: Plots 1-3

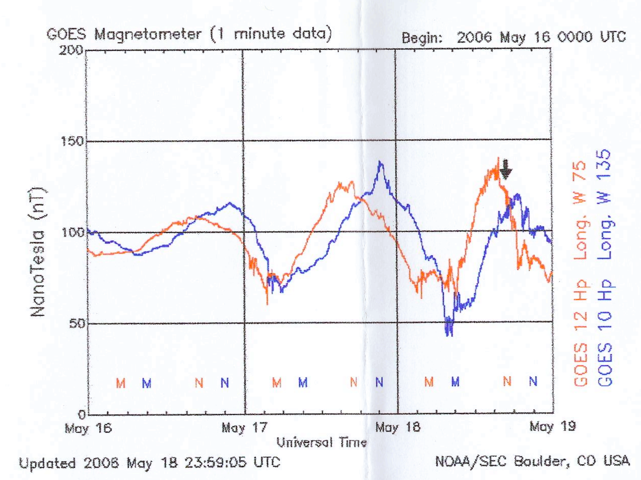


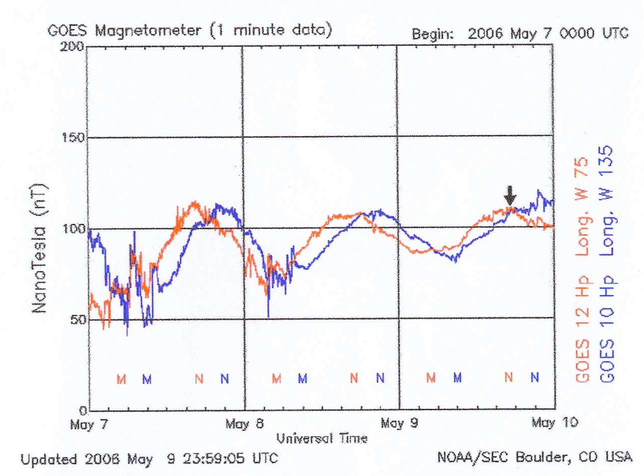
All distances in feet.



This map shows the locations of data points collected with the Geometrics G-858 Magnetometer on May 9 (blue dots) and May 18 (red dots). Gaps in the data set are "drop-outs" caused by the magnetic field vector passing outside the instrument's cone of sensitivity. This phenomenon is generally caused by the presence of strong local magnetic fields such as the metallic debris visible on the surface at this site.

Scale: 1" = 50'





The black arrows on these graphs show the approximate times of the magnetic surveys at this site. The red lines show the magnetic field variation with time as measured by the GOES-12 Satellite, which is in geostationary orbit over the east cost of the United States. The variation over the duration over the surveys is negligible.

These graphs and the following text were downloaded from the following NOAA website:
http://www.sel.noaa.gov/rt_plots/mag_3d.html

"The GOES Hp plot contains the 1-minute averaged parallel component of the magnetic field in nanoTeslas (nT), as measured at GOES-12 (W75) and GOES-10 (W135). The Hp component is perpendicular to the satellite orbit plane and Hp is essentially parallel to Earth's rotation axis. If these data drop to near zero, or less, when the satellite is on the dayside it may be due to a compression of Earth's magnetopause to within geosynchronous orbit, exposing satellites to negative and/or highly variable magnetic fields. On the nightside, a near zero, or less, value of the field indicates strong currents that are often associated with substorms and an intensification of currents in the Earth's geomagnetic tail."

approximate

Earth Resources Technology

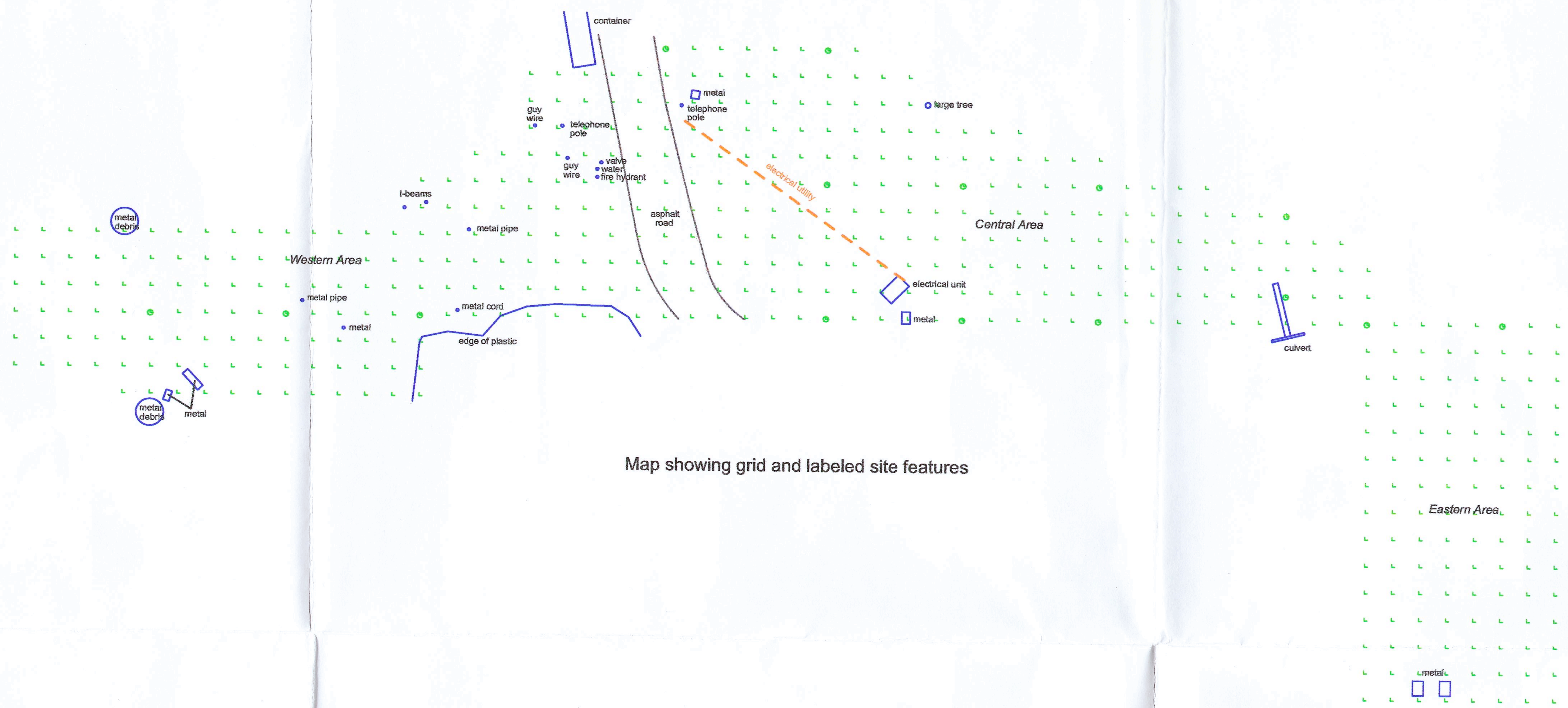
Magnetic Flux Density Contour Map
Site 11 - Caffee Road Landfill
Indian Head Navy Base, Maryland

Prepared for CH2M Hill.

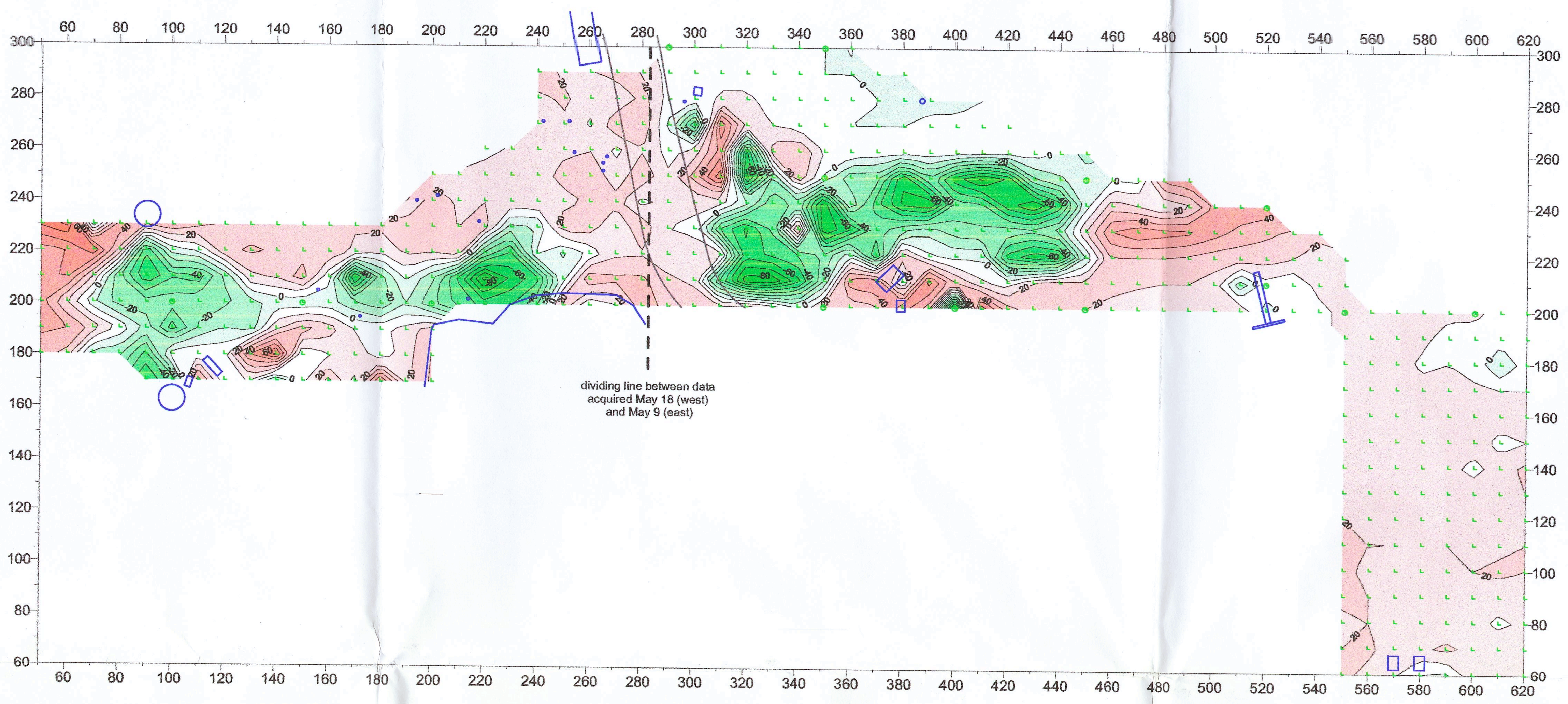
PLOT 1

June 13, 2006

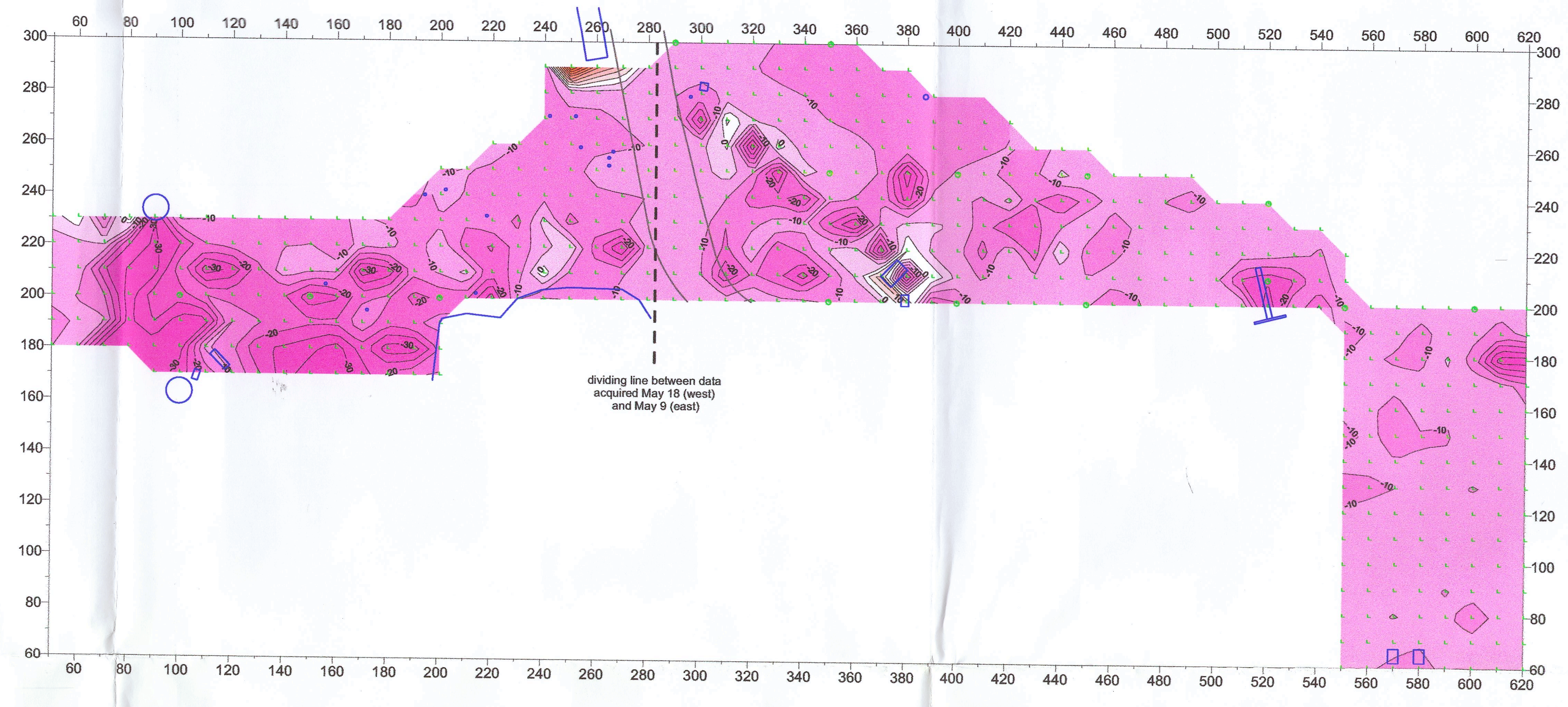
Scale: 1" = 20'



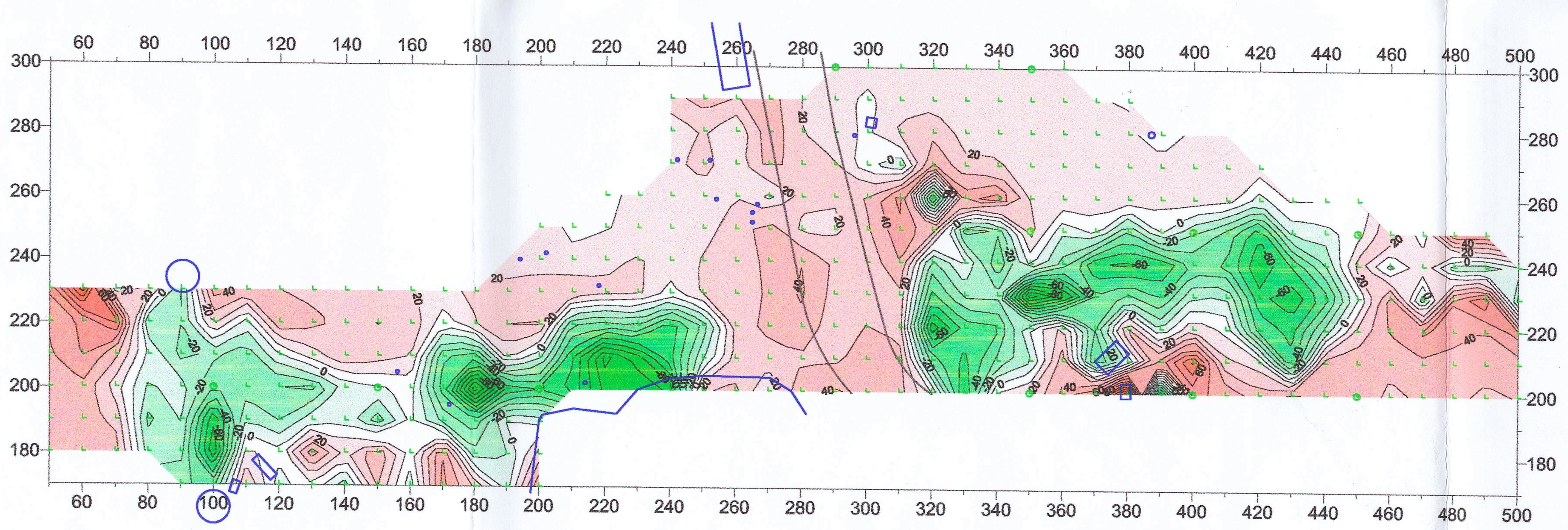
Map showing grid and labeled site features



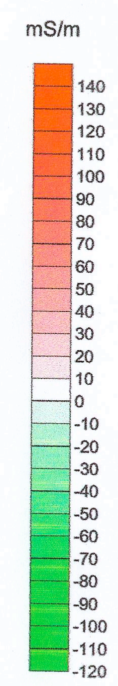
Quadrature Contour Map
Receiver: East



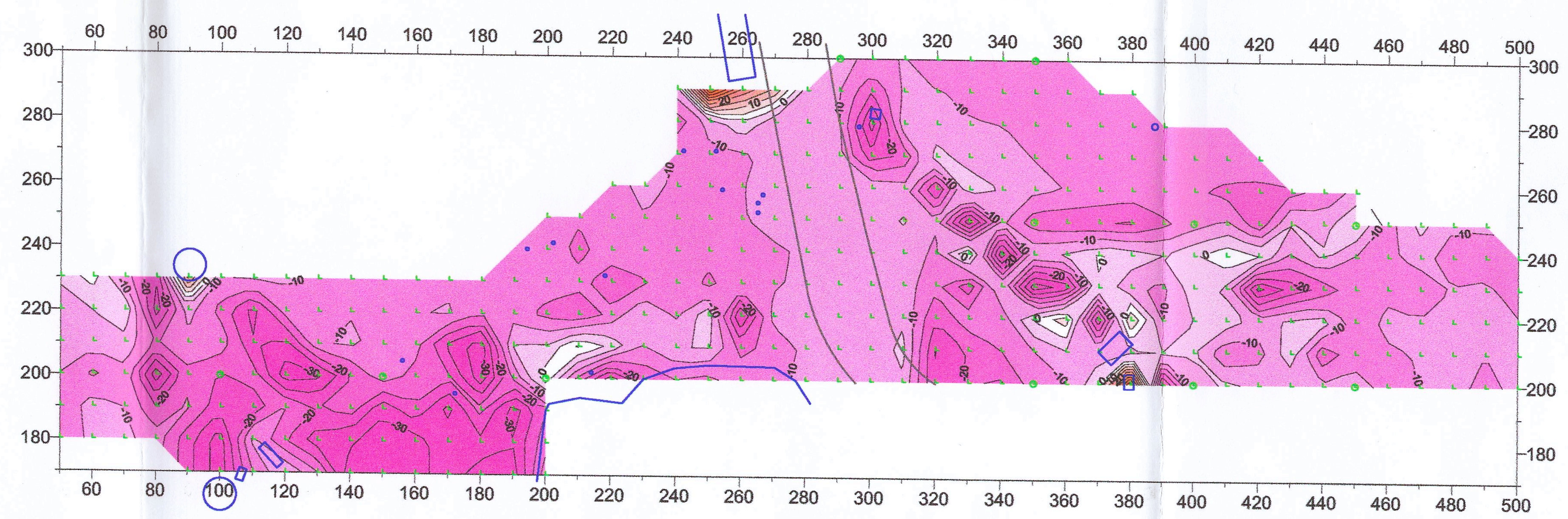
Inphase Contour Map
Receiver: East



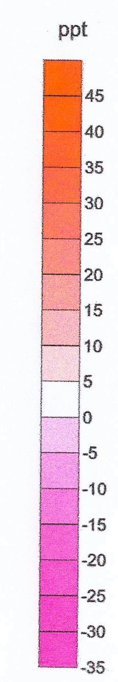
Quadrature Contour Map
Receiver: North
(all acquired May 18)



Contour Interval = 10 mS/m



Inphase Contour Map
Receiver: North
(all acquired May 18)



Contour Interval = 5 ppt

approximate

Earth Resources Technology

Quadrature and Inphase Contour Maps
Site 11 - Caffee Road Landfill
Indian Head Navy Base, Maryland

Prepared for CH2M Hill.

PLOT 2

June 13, 2006

Scale: 1" = 40'

Profiles acquired using GSSI SIR-3000 Ground Penetrating Radar unit with 400 MHz antenna on May 10 and 18, 2006.
All profiles cropped at 40 ns, and converted to depth in feet assuming 0.1 m/ns of two-way travel time, resulting in total depth of 6.56 feet.

Earth Resources Technology

Map of GPR Profile Locations with Representative Profiles
Site 11 - Caffee Road Landfill
Indian Head Navy Base, Maryland
Prepared for CH2M Hill.

PLOT 3

June 13, 2006

Map Scale: 1" = 40'
Profile Horizontal Scale: 1" = 20'
Profile Vertical Scale: 1" = 5'