Final Technical Memorandum

Summary Report for Non-Instrusive Geophysical Investigation Turkey Road Landfill (Formerly Site 2)

Naval Weapons Station Yorktown
Yorktown, Virginia

NAVFAC
Naval Facilities Engineering Command
NAVFAC MID-ATLANTIC

Prepared for

Department of the Navy

Naval Facilities Engineering Command Mid-Atlantic Division

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CH2MHILL

Summary Report for Non-Intrusive Geophysical Investigation—Turkey Road Landfill (Formerly Site 2), Naval Weapons Station Yorktown

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Introduction

This Technical Memorandum (TM) documents a non-intrusive geophysical survey conducted to identify the lateral extent of buried material in the southern portion of the Turkey Road Landfill (formerly, Environmental Restoration Program [ERP] - Site 2) located on the Naval Weapons Station (WPNSTA) Yorktown. The TM reports the operational and investigational history of the site, summarizes the objectives of the current preliminary investigation, describes the field activities performed, and presents conclusions based on the survey findings. The data gathered during this investigation will be used during munitions response activities at a later date.

Site History

Turkey Road Landfill is a 5-acre landfill located east of Turkey Road and adjacent to a wetland area of the Southern Branch of Felgates Creek and two unnamed tributaries that border the landfill (**Figure 1**). Operations at the landfill reportedly began in the 1940s and ceased in 1981. Wastes disposed in this landfill reportedly included mercury and carbon-zinc batteries, tree stumps and limbs, construction rubble, missile hardware (e.g., wings, fins, power packs), electrical devices, and unidentified drums and tanks. An estimated 240 tons of waste were disposed during the period of use. Waste material was primarily located along the tributaries to the Southern Branch of Felgates Creek. Key documents and milestones in the site's history are summarized in **Table 1**.

TABLE 1
Key Documents

Document Title/ Milestone	Author/Date	AR Document Number
Round One Remedial Investigation Report for Sites 1-9, 11, 12, 16-19, and 21	Baker and Weston, 1993	00313
Action Memorandum and Engineering Evaluation/ Cost Analysis (EE/CA)	Baker, 1994	00615
Closeout Report, Sites 2 and 9 and Site Screening Area 4, Mine Casing and Debris Removal Action	IT Corporation, 1995	00646
Round Two Remedial Investigation Report for Sites 2, 8, 18, and Site Screening Area 14, Naval Weapons Station Yorktown, Yorktown, Virginia	Baker, 2004	01548
Work Plan for the Pre-Removal Characterization of Soil, Site 2, Site 8, and SSA 14	Baker, 2005	01687

Based on the unacceptable risks from soils and waste as reported in the Round One Remedial Investigation (RI) Report (Baker and Weston, 1993), a removal action was conducted in 1994 in which 676 tons of non-ordnance waste and soils were removed. During the removal, approximately 4,327 ordnance items also were removed from Sites 2, 9, and Site Screening Area (SSA) 4 (the Closeout Report [IT Corporation, 1995] did not distinguish between sites but reported the majority of ordnance came from Site 2). All ordnance items were either certified inert by the unexploded ordnance (UXO) superintendent, were transferred to the Naval Explosives Development Engineering Department (NEDED) laboratory onsite and verified as inert, or were transferred offsite by the Station Explosive Ordnance Disposal (EOD) staff for final disposition.

Based on the results of the Round One RI and Construction Closeout Report, additional data were required to determine the extent of several chemical compounds. However, in June 2005, during the additional investigation, an ordnance item was discovered that could not be determined inert in the field. The EOD, Mobile Unit Two, Detachment Yorktown provided emergency response. Because the item potentially exceeded the Yorktown EOD range capability, Naval Surface Warfare Center (NSWC) Indian Head Detachment Yorktown identified the item as a training round for the Bullpup A (AGM-12A). The item was identified as being in fairly good shape, and a marking on its side indicated that it was filled with concrete. The marking further indicated that it weighed 247 pounds and contained 107.1 pounds of filler. The item was drilled and tested by NSWC Indian Head Detachment Yorktown and determined to be inert. Because of the identification of the potential ordnance item, the site was designated as a Munitions Response Site (MRS) and would no longer be identified as ERP - Site 2.

Once identified as an MRS, a munitions response site prioritization protocol (MRSPP) scoring (**Attachment 1**) was completed for the site and a public announcement regarding its availability was published in local newspapers in May 2008. In April 2010, an Explosives Safety Submission Determination Request was submitted (**Attachment 2**) and approved (**Attachment 3**) for conducting the geophysical survey of the southern portion of the MRS.

Investigation Approach

As part of the Preliminary Site Investigation (SI) for the MRS a magnetometer investigation was conducted to ascertain the extent of buried ferrous metal in an area consisting of approximately three vegetated acres in the southern part of the Turkey Road Landfill (**Figure 2**). The primary objective of the investigation was to determine the southern boundary of the landfill. Details concerning the equipment, approach, methods, operational procedures, and quality control methods to be implemented during the geophysical investigation were outlined in the geophysical investigation plan (GIP) which was part of the Technical Memorandum Work Plan (CH2M HILL, 2010). The information and general tasks needed to support the investigation were identified as:

- Emergency response contacts and procedures for notifying the nearest EOD, the Naval Facilities Engineering Command (NAVFAC) Remedial Project Manager (RPM), and appropriate base contacts.
- Site access for geophysical subcontractor personnel and equipment (including Hazards of Electromagnetic Radiation to Ordnance [HERO] approval of digital geophysical mapping [DGM] equipment) through the NAVFAC RPM and Yorktown base support.
- Clearing and grubbing of approximately 5,200 linear feet by 5-foot wide transect paths for traversing the site with the geophysical equipment, conducted with approval by the base Natural Resources Office and under the supervision of an UXO Technician implementing munitions and explosives of concern (MEC) avoidance techniques.
- Conducting a geophysical survey to delineate the limits of the landfill with the support of a UXO Technician implementing MEC avoidance techniques. High accuracy position equipment not being required for this task, the positional data were allowed some error, as defined in the GIP.

Field Activities

In support of the Preliminary SI for the MRS, NAEVA Geophysics, Inc., of Charlottesville, Virginia was contracted by CH2M HILL to conduct DGM of the southern portion of the site. Field activities were completed on April 13, 2010 and are detailed in the geophysical investigation report supplied by NAEVA (**Appendix A**).

Prior to geophysical mapping, 5-foot wide transects were cleared of vegetation and marked with wooden stakes as visual aids for walking the transects and positioning the data. Data was then collected using a Geometrics G-858 magnetometer along each of the transects. Use of a global positioning system (GPS) or robotic total system (RTS) was not feasible due to the forested canopy. Therefore, the data were collected by the magnetometer at a constant rate, which meant local positions could be calculated when the magnetometer operator walked at a constant pace between the stakes. The data positions were subsequently converted to North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) Zone 18N coordinates; the data collected were reviewed by the field team and then sent to NAEVA's office for preprocessing and processing using Geosoft Oasis Montaj software. A map overlain with the processed transect data is provided as **Figure 3**, and a

map showing interpolation of data between these transects is shown in **Figure 4**. These survey results provide the approximate locations of buried ferrous metal. These anomalies are not necessarily MEC or munitions-related. Additional investigation would be necessary to identify the exact locations of individual anomalies to perform excavation and visual inspection of items to determine if they are MEC or munitions-related.

Quality Control

To establish confidence in the data reliability, quality control (QC) tests were conducted throughout the project. Tests were conducted prior to, during, and after all data collection sessions, and were reviewed by a qualified geophysicist. All QC tests for the G-858 magnetometer were conducted after a minimum 20 minute warm-up period for the electronics. QC tests performed included Static Background and Static Spike Tests, Cable Shake Tests, Personnel Tests, Azimuthal Tests, Octant Tests, and Repeat Data Tests. These tests all provided results within acceptable limits (**Appendix A**), though some positioning error was introduced because a GPS or RTS could not be utilized and position calculations relied upon the assumption of a constant walking speed maintained by the magnetometer operator.

Additionally, two "blind" QC seeds (locations unknown to NAEVA personnel) were placed in the investigation area as an additional QC indicator to ensure adequate detection of a known anomaly. One seed item, designated QC1, was located approximately 1.5 meters (m) from the center of the anomaly presumably associated with the seed. The second seed item, QC2, was approximately 5 m from the center of its presumed anomaly (**Figure 5**). However, given that the magnetometer was accurate only within 1-3 m, the 5 m maximum error was considered acceptable. The overall accuracy of the data was suggested as a range of 1-7 m of error.

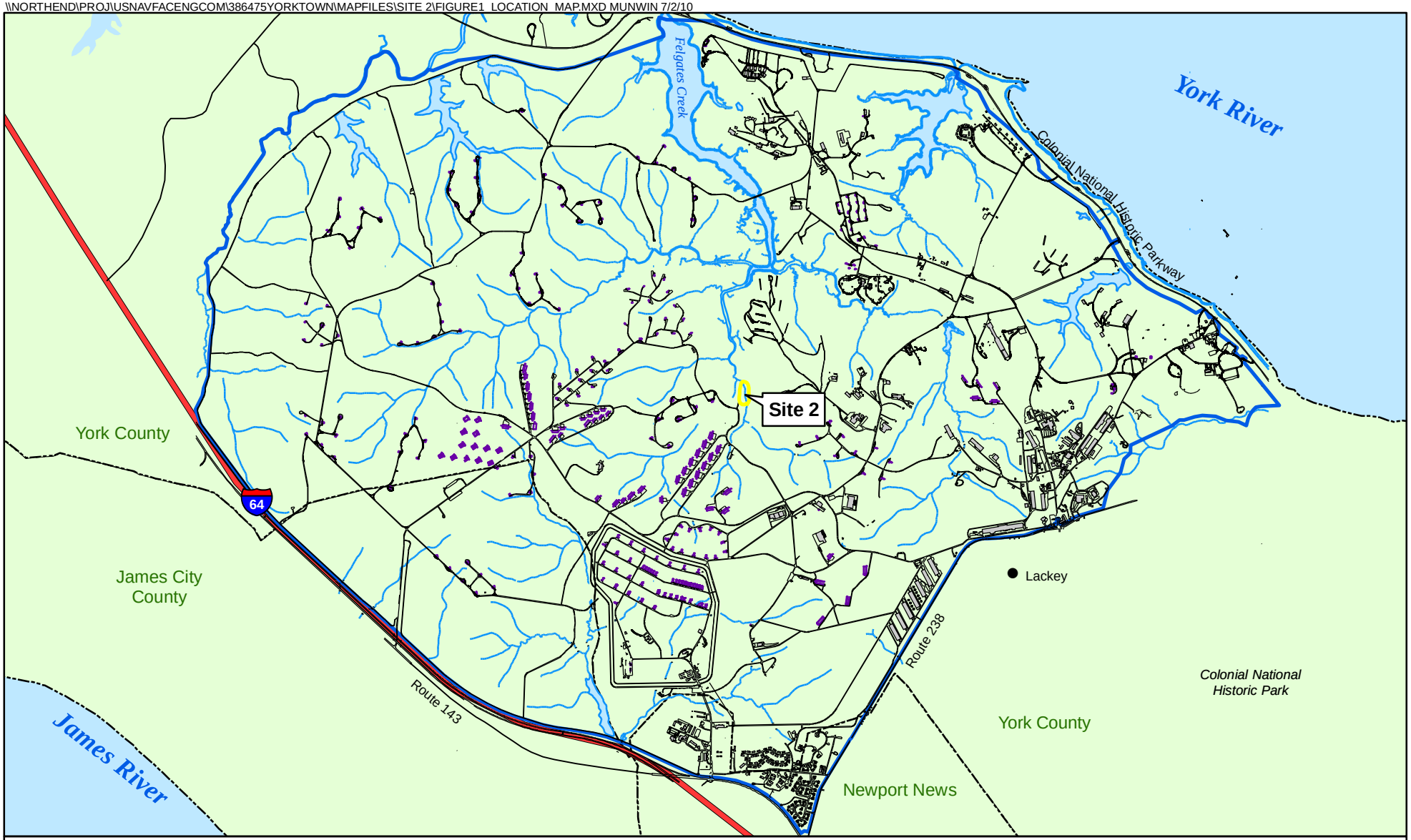
Conclusions

The following key findings were drawn from analysis of data collected during the geophysical investigation:

- The data collected using the G-858 confirmed and supported the results of the EM31 survey performed as part of the Round I RI (Baker and Weston, 1993). There is no identifiable southern boundary of the site. The data supports the conclusion that debris and waste was likely pushed out toward the wetlands surrounding the site (to the west, north, and east) and filled into low lying areas. This can be seen in the southeastern portion of the DGM results (**Figure 4**).
- A removal action was completed in 1994 at Site 2 to remove surface and near surface debris and waste. However, this removal action only removed the surface and near surface waste from designated areas at the site. Based upon the results of the DGM data collected and visual observations while in the field, metallic debris is still located at the site. Site photographs taken during the DGM survey further support this conclusion (**Appendix B**).

Figures

\\NORTHEND\PROJ\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\SITE 2\FIGURE1_LOCATION_MAP.MXD MUNWIN 7/2/10



Legend

- Estimated Site Boundary
- Buildings and Structures
- Yorktown Naval Weapons Station Base Boundary
- Interstate 64
- Magazines
- County Lines

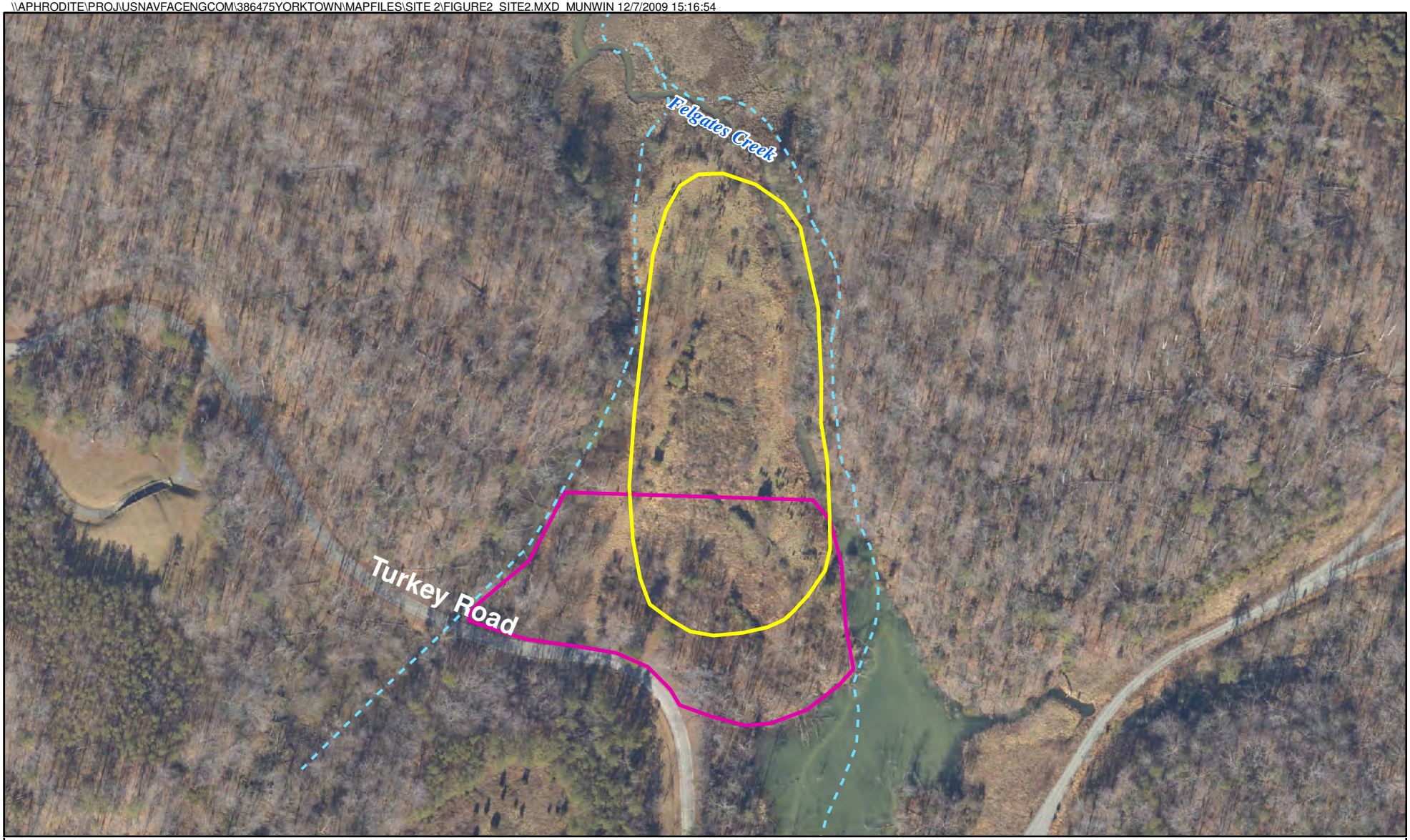
N

0 2,000 4,000 Feet

Figure 1
WPNSTA Yorktown Location Map
Site 2 Site Investigation Summary Report
Naval Weapons Station Yorktown
Yorktown, Virginia

CH2MHILL

\\APHRODITE\PROJ\USNAVFACENGCOM\386475YORKTOWN\MAPFILES\SITE 2\FIGURE2_SITE2.MXD MUNWIN 12/7/2009 15:16:54



LEGEND

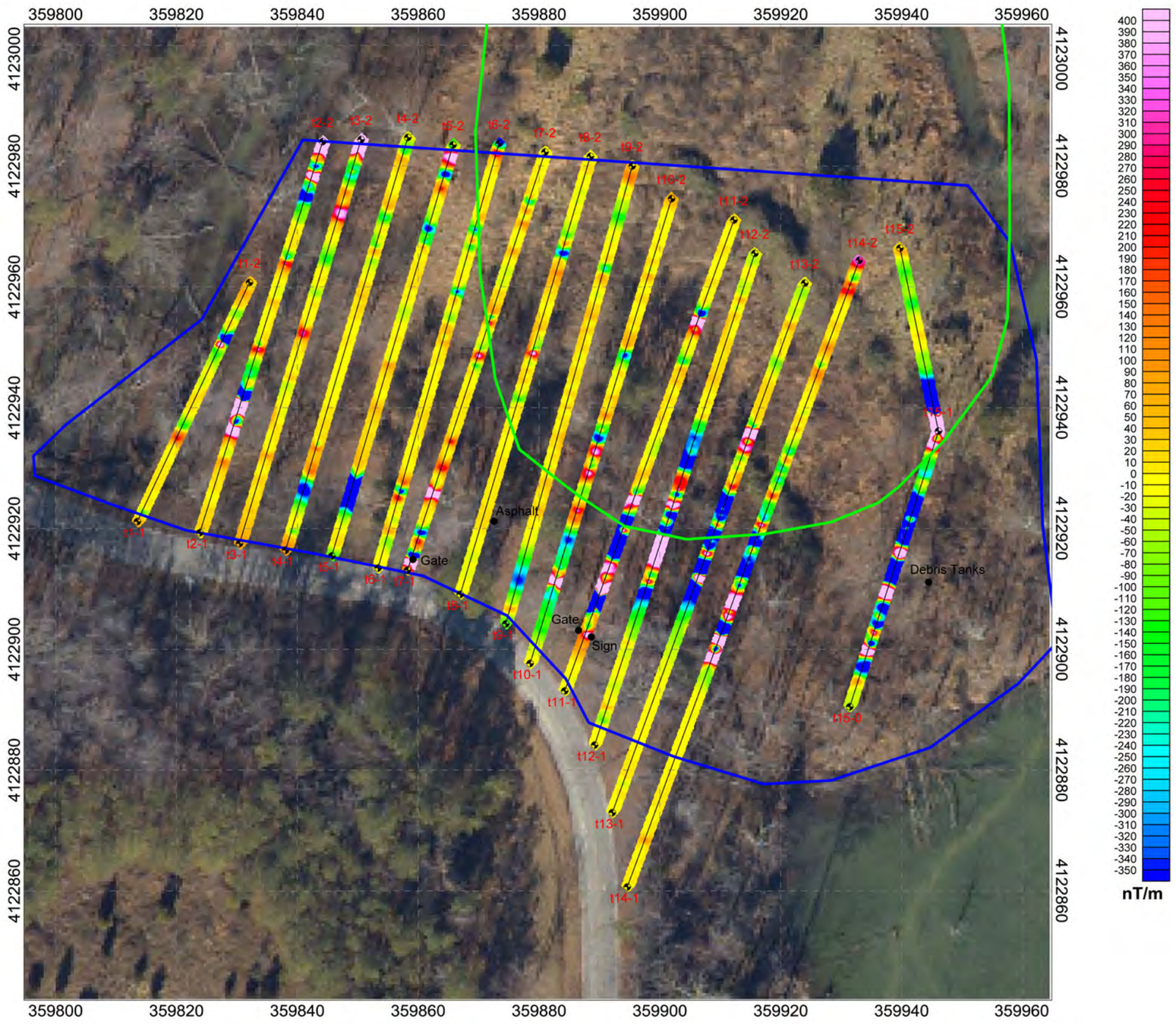
- Site Boundary
- Magnetometer Investigation Area (2.96 acres)
- Tributary

N
W E
S

0 100 200
Feet

Figure 2
Site 2 - Turkey Road Landfill
WPNSTA Yorktown
Yorktown, Virginia

CH2MHILL



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THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys

Legend

- Transect
- Transect End Point
- Culture
- Site Boundary
- Magnetometer Investigation Area

Scale 1:750

10 0 10 20 30 40

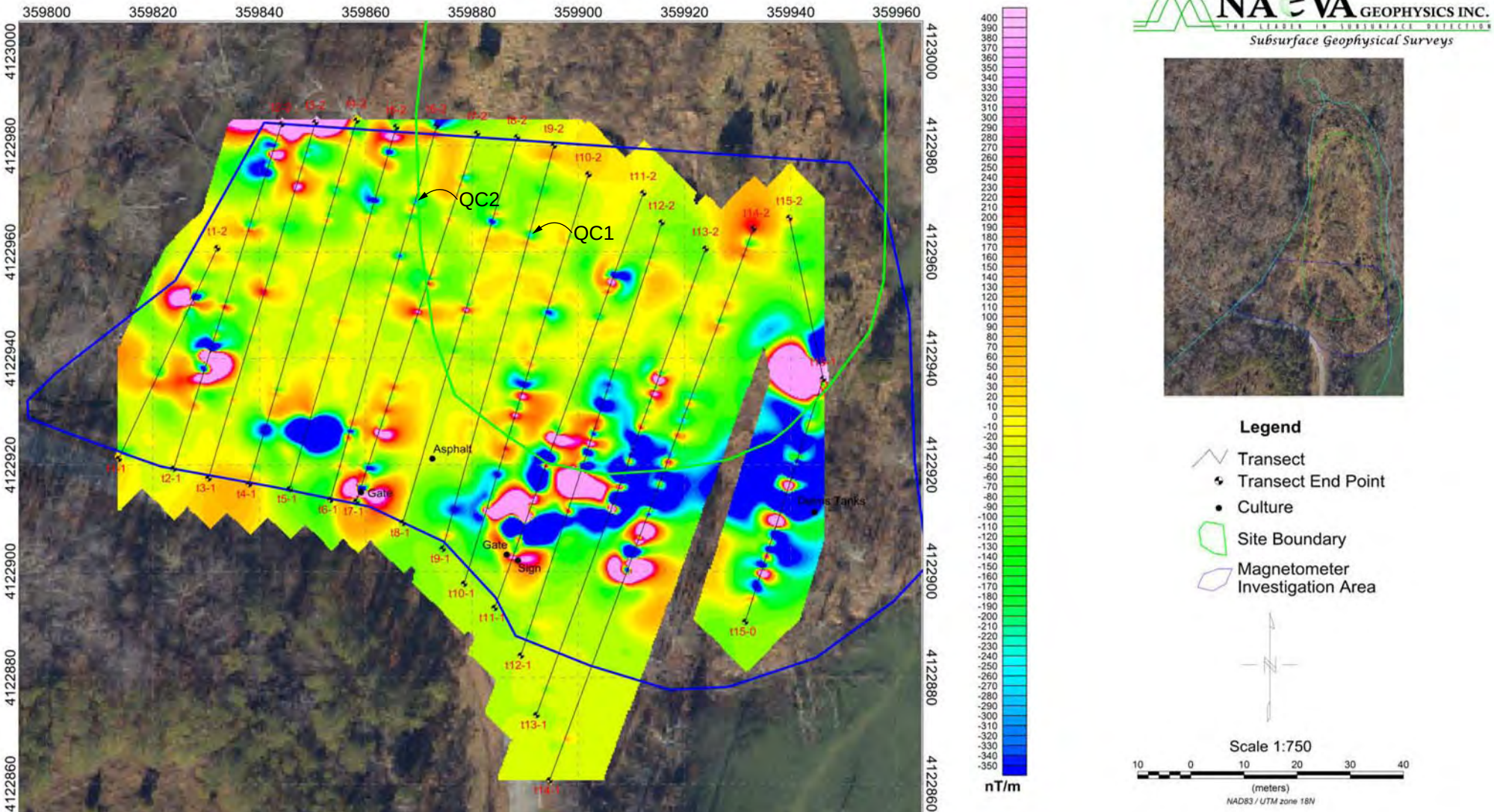
(meters)

NAD83 / UTM zone 18N

NOTE: DATE OF SURVEY 4/13/2010

FIGURE 3
Site 2 -Turkey Road Landfill DGM Transects
WPNSTA Yorktown
Yorktown, Virginia

CH2MHILL



NOTE: DATE OF SURVEY 4/13/2010

FIGURE 4
Site 2 -Turkey Road Landfill DGM Results
WPNSTA Yorktown
Yorktown, Virginia

CH2MHILL

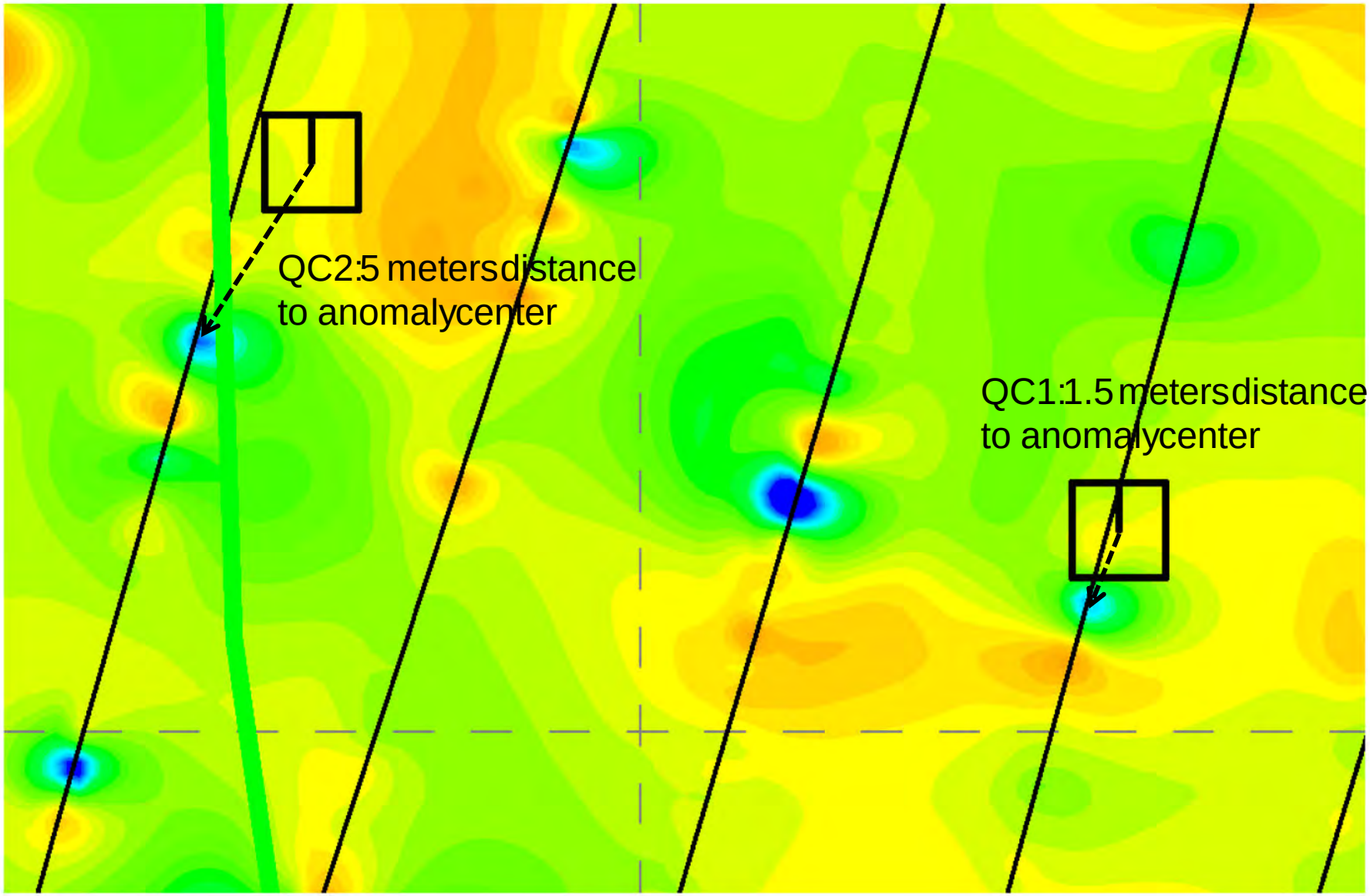


FIGURE 5
Site 2 - Turkey Road Landfill QC Seeds
WPNSTA Yorktown
Yorktown, Virginia

Appendix A
NAEVA Report

NAEVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys

GPR
MAGNETICS
ELECTROMAGNETICS
SEISMICS
RESISTIVITY
UTILITY LOCATION
UXO DETECTION
BOREHOLE CAMERA
STAFF SUPPORT

GEOPHYSICAL INVESTIGATION REPORT

Naval Weapons Station Yorktown
Munitions Response Site 2 – Turkey Road Landfill
Williamsburg, Virginia

Task Order CTO-0122

Date of Investigation:

April 13, 2010

Final Submittal
June 01, 2010

PREPARED FOR

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1.0 INTRODUCTION

NAEVA Geophysics, Inc. (NAEVA) was contracted by CH2M HILL to conduct Digital Geophysical Mapping (DGM) in support of a Preliminary Site Investigation (SI) for Munitions Response Site (MRS) 2, Turkey Road Landfill. The area of concern encompasses approximately 5 acres, located in a forested area within Naval Weapons Station Yorktown, Williamsburg, Virginia. Field operations were conducted on April 13, 2010.

1.1 BACKGROUND AND OBJECTIVES

MRS 2 is a 5-acre disposal area located east of Turkey Road in a wetland area adjacent to the southern branch of Felgates Creek. Operations at the disposal area reportedly began in the 1940s and ceased in 1981. An estimated 240 tons of waste were disposed during the period of use. Hard waste material (mine casings) was primarily located along the tributaries to the southern branch of Felgates Creek. During the Round I Remedial Investigation (RI) in 1993, a geophysical investigation was performed using a Geonics EM31 terrain conductivity meter to attempt to delineate the southern boundary of the waste. The results of the EM31 surveys were inconclusive and could not distinctly identify a southern waste boundary.

A removal of the hard waste material was conducted during the summer of 1994. The main objectives of the removal action were to removal surface and near surface wastes from the designated areas at the Turkey Road Landfill and to restore the site to pre-removal action conditions.

During field investigations in June 2005 to determine the extent of contamination from polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), cadmium, and mercury in subsurface soil at the site, ordnance munitions item was discovered. Because of the discovery of the item, the site was designated as an MRS.

The goal of this DGM survey was to support the previous RI EM31 survey in attempting to identify the southern boundary of the MRS 2 Turkey Road Landfill. The Area of Investigation (AOI) for the DGM survey was approximately 3 acres in the southern portion MRS 2.

1.2 SCOPE OF WORK

Geophysical surveys were conducted along cleared transects within the AOI. A Geometrics G-858 magnetometer was used to collect data along transects spaced approximately 10 meters apart. Quality control measures outlined in the Geophysical Investigation Plan (GIP) (CH2M HILL, 2010) were followed during the field survey, and are documented in the accompanying data CD. All production data was processed, interpreted, and delivered to the CH2M HILL Project Geophysicist on the schedule and in the formats specified in the DGM Scope of Work (SOW).

1.3 SITE LOCATION AND DESCRIPTION

Naval Weapons Station (WPNSTA) Yorktown is a 10,624-acre installation located on the Virginia Peninsula in York and James City Counties and the City of Newport News (**Figure 1**). WPNSTA Yorktown is bounded on the northwest by WPNSTA Yorktown Cheatham Annex and the King's Creek Commerce Center, on the northeast by the York River and the Colonial National Historic Parkway, on the southwest by Route 143 and Interstate 64, and on the southeast by Route 238 and the town of Lackey. MRS 2 is a 5-acre disposal area located east of Turkey Road in a wetland area adjacent to the southern branch of Felgates Creek **(Figure 2)**.

2.0 EQUIPMENT

The instruments used for the geophysical investigation included a Geometrics G-858 cesium vapor magnetometer and a Geometrics G-856 proton precession magnetometer, operated by NAEVA Geophysics geophysicists.

The G-858 was operated in vertical gradient mode (two vertically-separated sensors operating simultaneously), eliminating the necessity for a magnetics base station. Ferrous material typically manifests a remnant magnetic field that varies in orientation from that of the Earth's magnetic field. The summation of the remnant field to the Earth's field results in distortions in the overall field. These local, high frequency (short wavelength) anomalies in the Earth's magnetic field can therefore be interpreted as caused by ferrous material. G-858 data were collected at a rate of 10 readings per second.

Although not a necessity, a stationary Geometrics G-856 Proton Precession magnetometer was utilized as a base station to monitor for changes in the Earth's magnetic field strength in case one of the sensors in the G-858 malfunctioned during the course of the survey (in which case the total field data could be used from a single sensor with correction from the base station sensor). Diurnal variations are expected in the magnetic field, and typically are measured in tens of nanoTeslas, with gradual drift observed. In the event of a solar flare more drastic, rapid changes may be observed in the field, which could result in spikes in background being mistaken for subsurface anomalies. No spikes indicative of solar activity are present in the base magnetometer data for the survey.

3.0 METHODOLOGY

3.1 GEOPHYSICAL SURVEY ACTIVITIES

Prior to NAEVA's arrival, transect lines were cleared of vegetation and wooden stakes installed along the center of the cleared swaths. A single line of data was collected along these transect lines.

3.1.1 Data Positioning

Due to the canopy obstructing a clear view of the sky, the use of a Global Positioning System (GPS) was not possible, nor was a Robotic Total Station (RTS) feasible due to numerous obstructions to line-of-sight, the "Zig-Zag" nature of the transects, and narrow corridors of cleared vegetation.

Since G-858 data were recorded at a constant rate of 10 readings per second, the operator maintained a constant walking pace between stakes so the data would be properly positioned using fiducial marks placed within the data. Local coordinates were transformed to UTM coordinates using provided coordinates for each stake. Local distances along each transect were calculated to position the raw data, which was converted to North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM) Zone 18N coordinates.

3.2 DATA PROCESSING AND INTERPRETATION

3.2.1 Data Storage and Initial Editing

Magnetics data were stored on the G-858 instrument console and then transferred to a laptop computer for processing through MagMap 2000 version 4.88.

Initial data processing was performed by the field team, which included reviewing data for integrity and repeatability, and positioning the data based on the local distance from the first stake on each transect.

G-858 data were emailed to NAEVA's Charlottesville, Virginia office for further processing using Geosoft Oasis Montaj software version 7.1.1.

3.2.2 Preprocessing

Converted raw data files were imported into Geosoft's Oasis Montaj to perform the following:

- Review and finalize all QC tests (cable shake, personnel, static and dynamic response, etc) prior to processing of the DGM data
- Conversion of local coordinates to NAD83 UTM Zone 18N coordinates by performing a 2-channel table lookup between local and UTM coordinates and linear interpolation of the data between each set of stakes
- Evaluate data density
- Apply default lag correction
- Generate preliminary contour map(s) from gridded data
- Generate preliminary original vs. repeat profiles by dataset
- Generate formatted ASCII files containing preprocessed data by transect

3.2.3 Final Processing

After completion of preprocessing, the data were further evaluated and processed to generate final processed data files. Final processing steps included:

- Evaluation and refinement of normalization corrections
- Evaluation and refinement of lag
- Additional digital filtering and enhancement, as necessary
- Generation of formatted ASCII files containing processed data
- Generation of final maps showing contoured gridded data and culture (**Figure 3**)

3.2.4 Analysis and Target Selection

No individual targets were selected since the objective was to identify the southern boundary of the landfill.

All raw, preprocessed, and processed data have been submitted to CH2M HILL's project geophysicist and can be found on the enclosed CD (see Contents of CD).

4.0 RESULTS

4.1 SUMMARY OF WORK PERFORMED

DGM of the Naval Weapons Station Yorktown MRS 2 Turkey Road Landfill site took place on April 13, 2010. The survey consisted of traversing 15 cleared transects that were space approximately 10 meters apart (**Figure 4**). DGM was completed in one working day.

4.2 MOBILIZATION AND SITE SETUP

Prior to mobilization an Activity Hazard Analysis (AHA) and Standard Operating Procedures (SOPs) were provided to CH2M HILL. NAEVA also provided records that all personnel had current 8-hour and/or 40-hour OSHA HAZWOPER training.

NAEVA mobilized one field crew to Williamsburg, Virginia on April 12, 2010. DGM began at the site on April 13, 2010 and was completed the same day. CH2M HILL provided an Unexploded Ordnance (UXO) Technician during all field activities for the purpose of implementing UXO avoidance techniques. A site-specific health and safety brief was given by the CH2M HILL site manager prior to the start of work. No equipment was staged on site.

4.3 DGM SURVEY RESULTS

A total of 0.29 acres were mapped at MRS 2 Turkey Road Landfill. No targets were selected since the objective for the survey was to find the southern edge of the landfill. Transects 1 through 11 were relatively clear of anomalies with some small individual features. At the northern end of Transects 2, 3, 5 and 6, there were anomalies detected. There is a linear trend of anomalies toward the southern end of Transects 4 through 7. However, the majority of the

detected anomalies were found near the center of Transects 11 -15. Cultural objects noted on the site were a couple of gates, a sign, and asphalt.

4.4 DATA PROCESSING AND INTERPRETATION

All data were processed as described in Section 3.2. All recorded culture information is noted and identified on the transect block map (**Figure 3**). Final data delivery reports list down-line data density statistics, lag, and gridding parameters used in processing each transect block.

5.0 QUALITY CONTROL

To establish confidence in the data reliability, QC tests were conducted throughout the project. Tests were conducted prior to, during, and after all data collection sessions. All QC tests for the G-858 magnetometer were conducted after a minimum 20 minute warm-up period for the electronics. Graphical displays of QC data are included in the Appendix.

5.1 QC TEST DESCRIPTIONS AND ACCEPTANCE CRITERIA

The following QC procedures were performed and documented during the data collection process and reviewed by a qualified geophysicist on a daily basis.

Static Background and Static Spike: Static tests were performed by positioning the survey equipment in an area free of metallic response and collecting data for a 3-minute period. During this time, the instrument was held in a fixed position (**Figure 5**). A static test is the primary measurement of instrument functionality and for the G-858 magnetometer this test consists of one minute without a spike, one minute with a spike (a known metallic item placed on the ground), and then one minute without a spike. The purpose of the static test is to determine whether unusual levels of instrument or ambient noise exist. An acceptance criterion of ± 20% of the spike response after background correction was used. The static background and static spike tests were conducted at the beginning and end of the surveying day.

Cable Shake Test: On a daily basis, the instrument connections were checked for their response to vibrations in the cables. The response was observed in the field for immediate corrective action, and later transmitted back to a processor, analyzed, and checked for spikes in the data that can possibly create false anomalies. The cable shake test was conducted at the beginning of the survey operation.

Personnel Test: This test checks the response of instruments to personnel and their clothing/proximity to the system. On a daily basis, the instrument was checked for its response to the personnel operating the system. The response was observed in the field for immediate corrective action and later transmitted back to a processor, and analyzed and checked for spikes in

the data that can possibly create false anomalies. The personnel test was conducted at the beginning of the survey operation.

Azimuthal Test: This test was conducted at the beginning of the day to ensure that the system's sensors were oriented in such a way that they minimize data drop-outs and maximize instrument response.

Octant Test (Heading Error Test): The test was conducted at the beginning of the day. The results of the test were used to adjust the data during data processing. Eight lines of magnetic data were collected, passing over the same central point. The difference in the response over the central point documents heading effects.

Repeat Data: This test is performed to verify repeatability of the data and was performed at the end of each transect block. At least 2% of the survey lines were repeated and evaluated for consistency. Because small deviations in line path can affect the instrument response the profiles were evaluated qualitatively.

5.2 QC TEST RESULTS

QC data were evaluated using Geosoft's QA/QC software. Static, cable shake, and personnel test profiles were plotted. The following provides a summary of the QC results:

1. **Static Background / Spike Test:** All static and spike tests were within acceptance criteria; stable, repeatable, and without spikes.
2. **Cable Shake Test:** No spikes were observed in any of the tests.
3. **Personnel Test:** No deviation from background response was observed.
4. **Azimuthal Test:** Based on the results of the test, no drop outs occurred, the systems sensor orientation was accepted.
5. **Octant Test (Heading Error Test):** Based on the results, no heading correction needed to be applied
6. **Repeat Data:** Repeat lines generally showed good repeatability. Small discrepancies in repeat lines were attributed to line path deviation.

6.0 CONCLUSIONS

The purpose of this investigation was to define the southern boundary of MRS 2 Turkey Road Landfill. Based on the results (Section 4.3) of the survey, this objective was not achieved. There is metallic debris buried throughout the AOI; however the data is not representative of a typical landfill. With a typical landfill there are either trench-like anomalous features or a large anomalous area surrounded by "background" data. The only area that slightly represents the latter scenario is on the eastern side of the AOI, transects 10 through 15. Based on the site history

the landfill (high anomalous response) should extend into the AOI and then have a defined edge/boundary. However, this anomalous area is confined within the AOI. Further investigation would be required on the southeastern side of the AOI to fully evaluate the extent of debris in that area.

7.0 REFERENCES

CH2M HILL. 2010. *Final Geophysical Investigation Plan, Munitions Response Site 2, Turkey Landfill, Naval Weapons Station Yorktown, Yorktown, Virginia.* April.

FIGURES

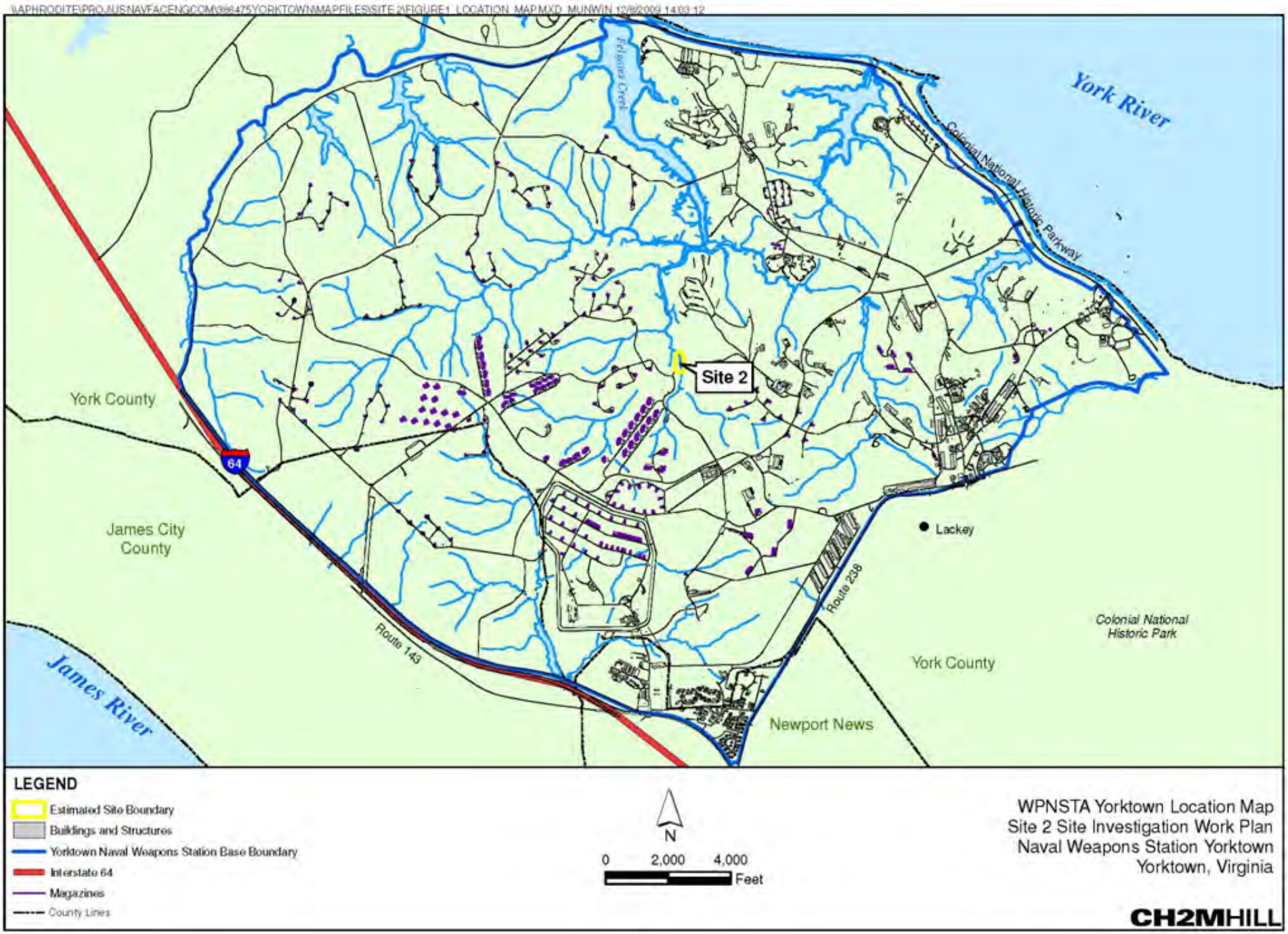

Figure 1: Site Location Map

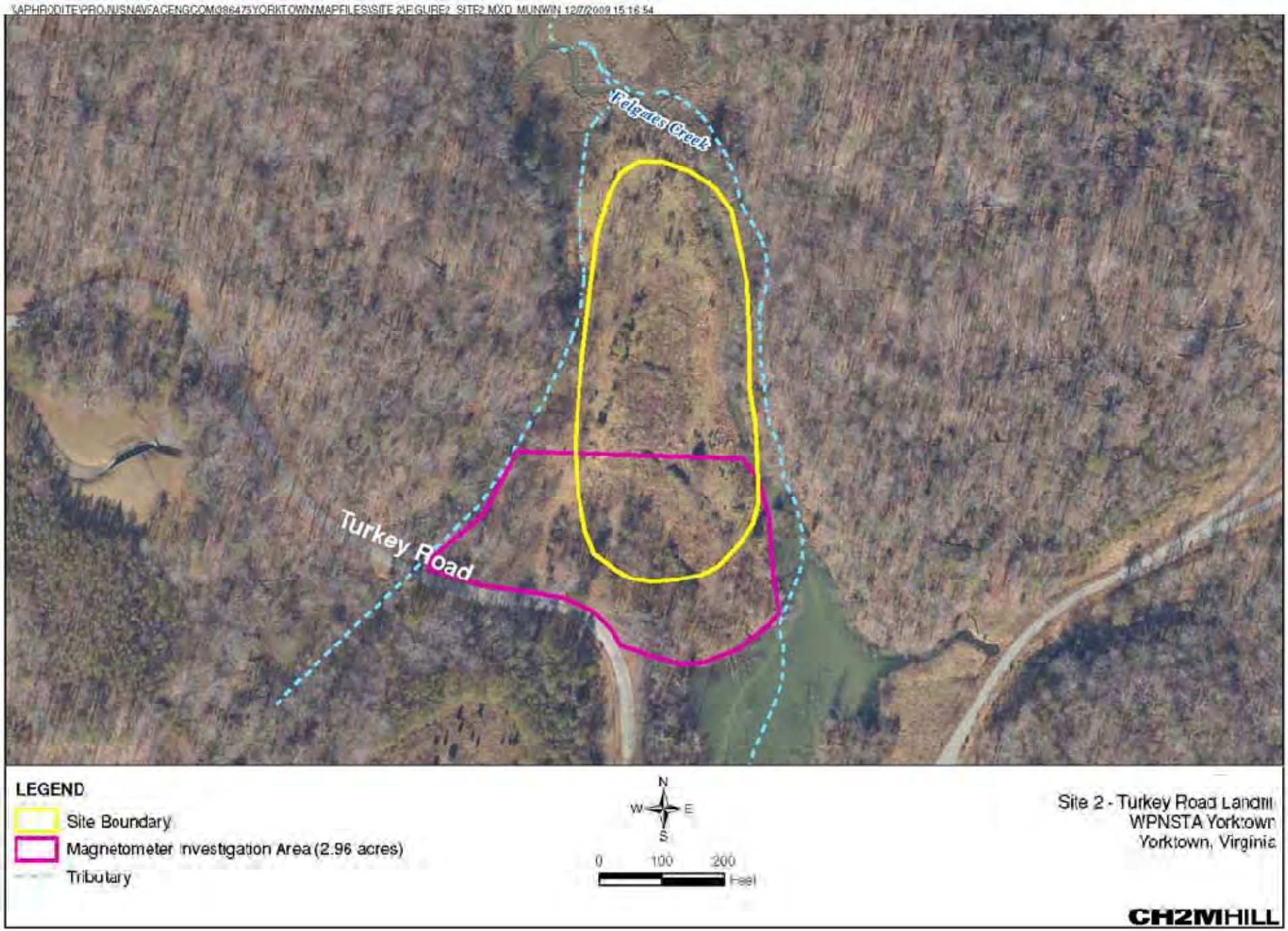

Figure 2: MRS 2 - Turkey Road Landfill Map

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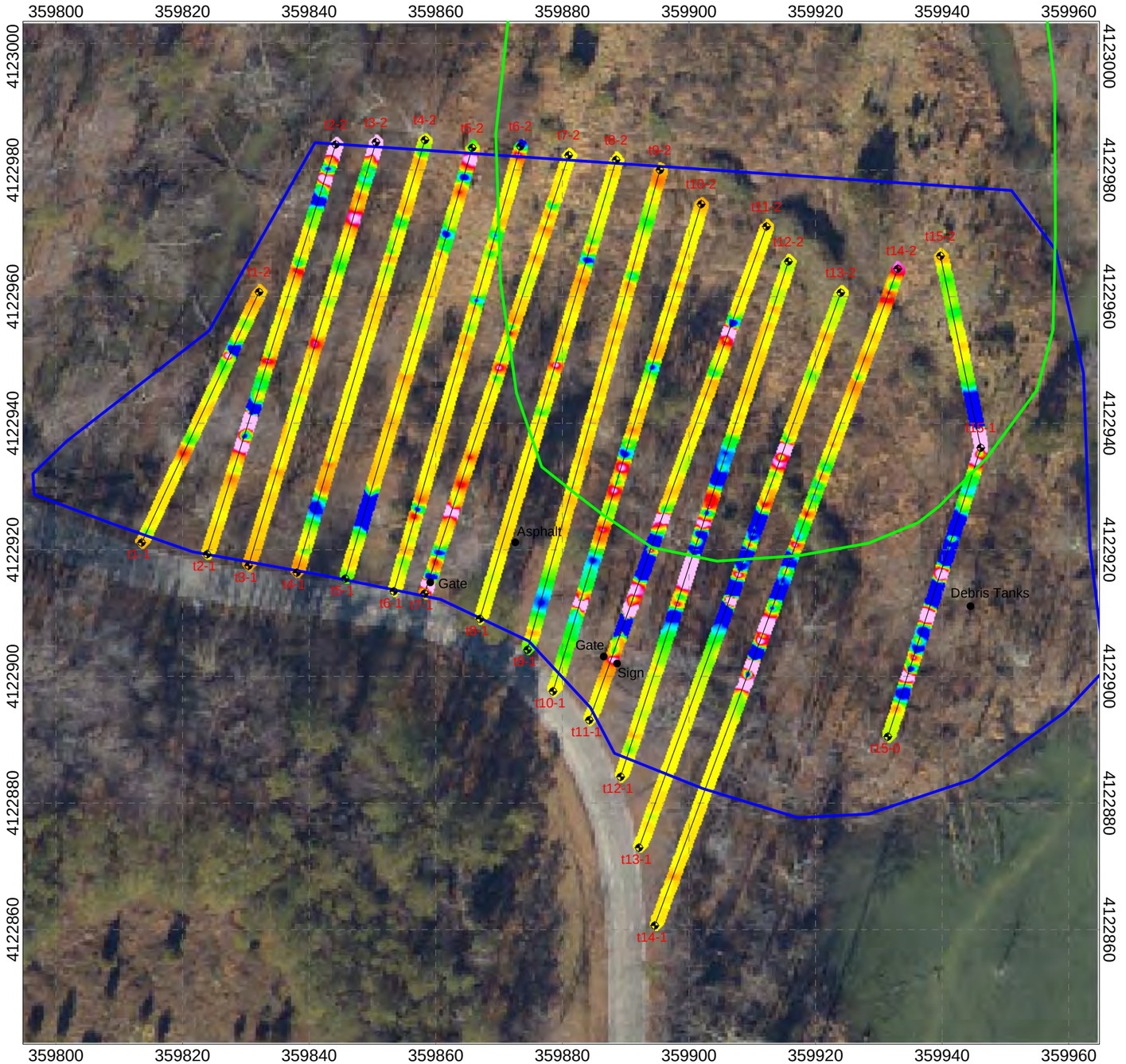
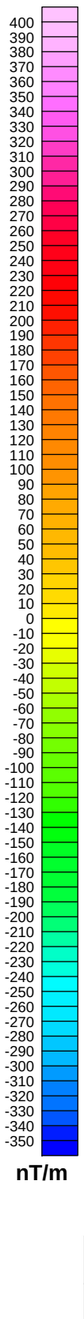
Subsurface Geophysical Surveys





Legend

- Transect
- Transect End Point
- Culture
- Site Boundary
- Magnetometer Investigation Area

Scale 1:750

10 0 10 20 30 40

(meters)

NAD83 / UTM zone 18N

Figure 3

CH2M HILL

G-858 Magnetometer Vertical Gradient
CTO-0122 - Turkey Road Landfill
NWS Yorktown, Virginia

Date of Survey: 04/13/2010

Figure 4: Data Collection of Cleared Transect

Figure 5: Collection of Static Test

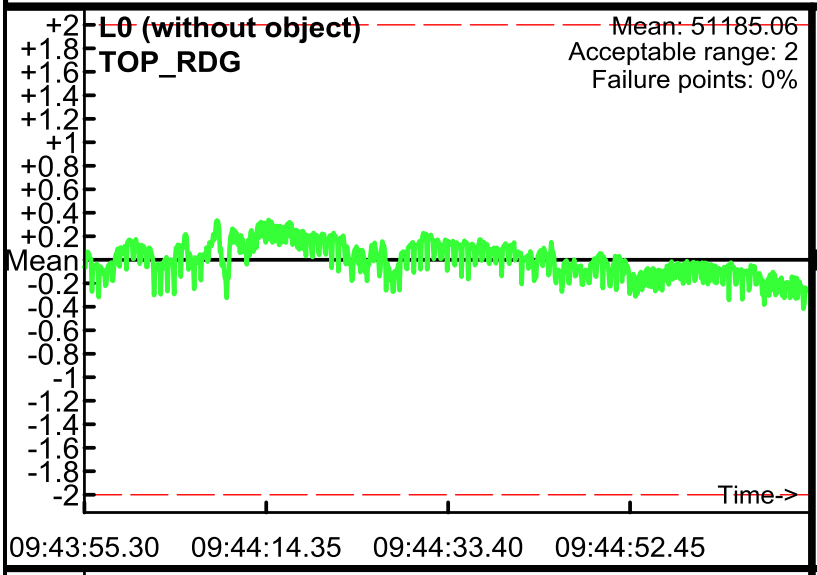
APPENDIX & CD

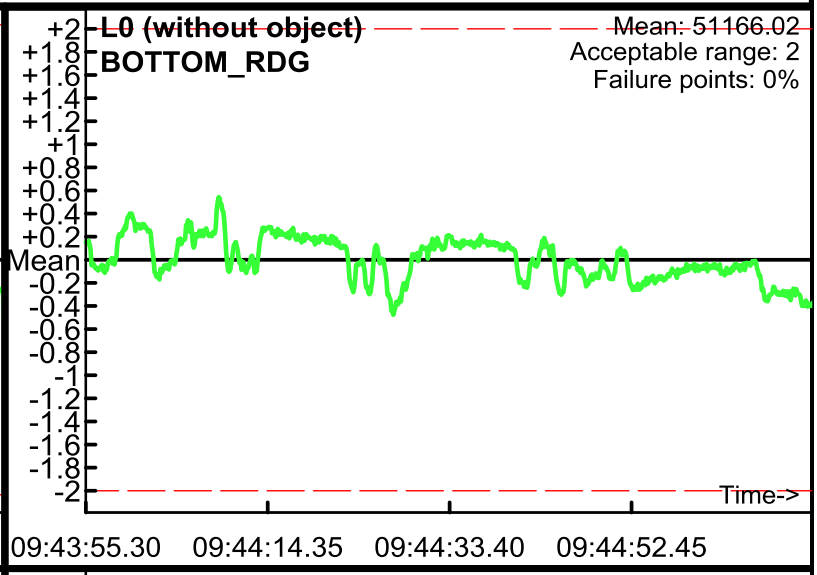
Static Calibration Test

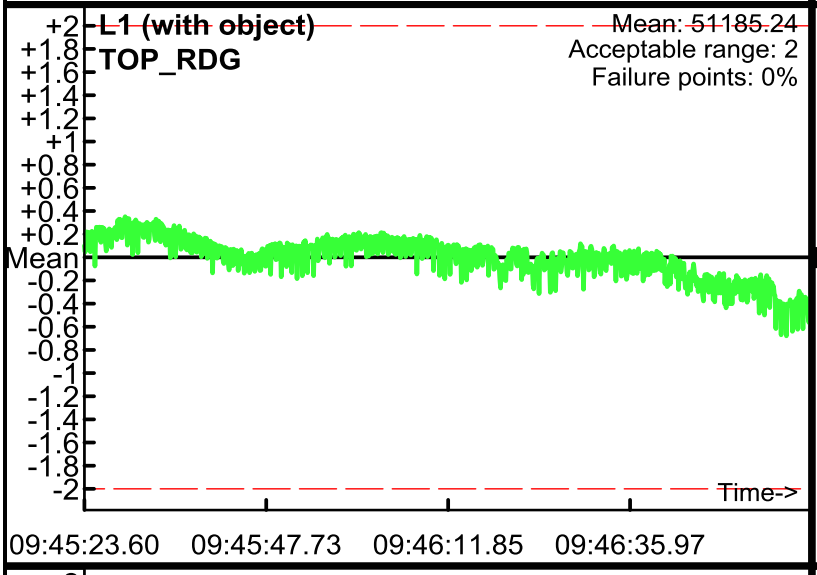
Project: CTO-0122, NWS Yorktown
Equipment: Magnetometers
Grid/Location: n/a

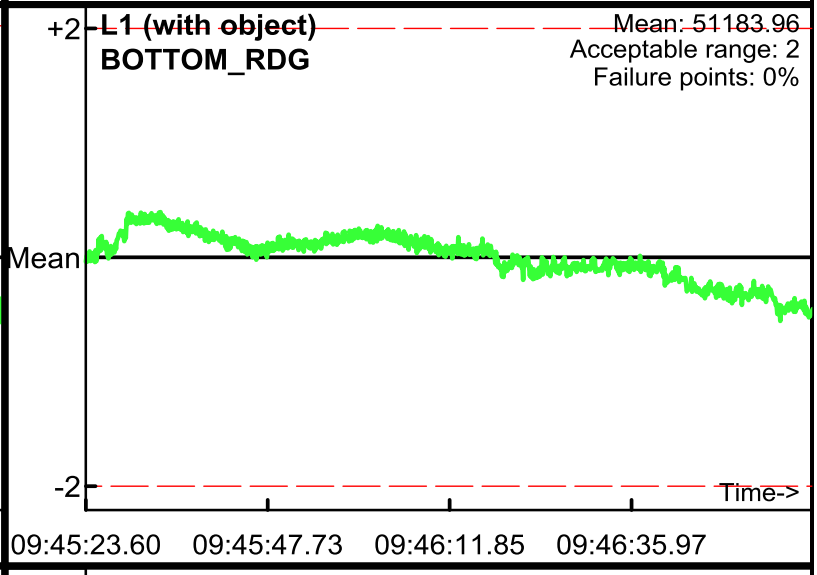
Outside range
Acceptable limits

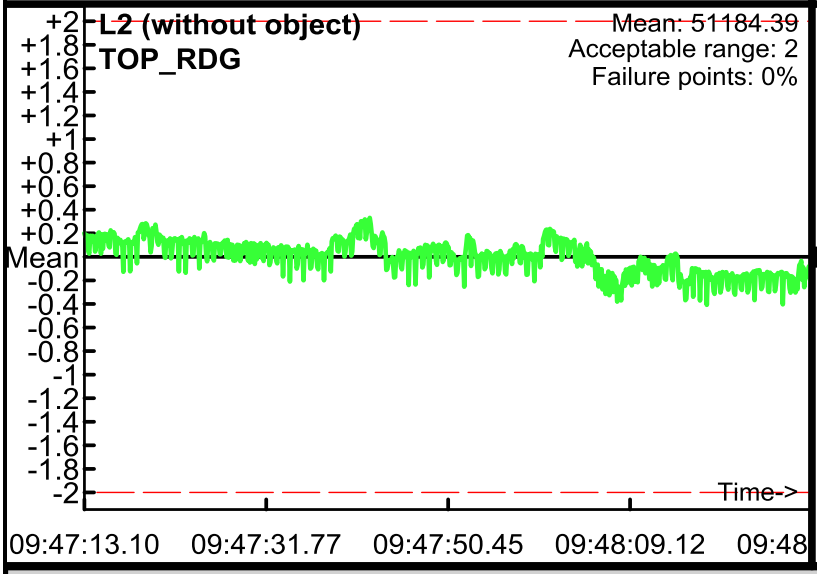
AM test
Operator: NAEVA
Date: 4/13/2010

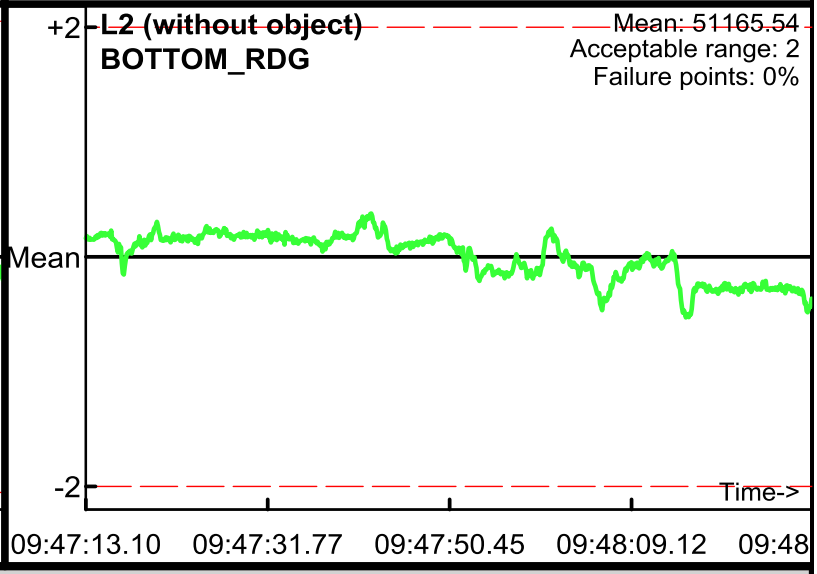












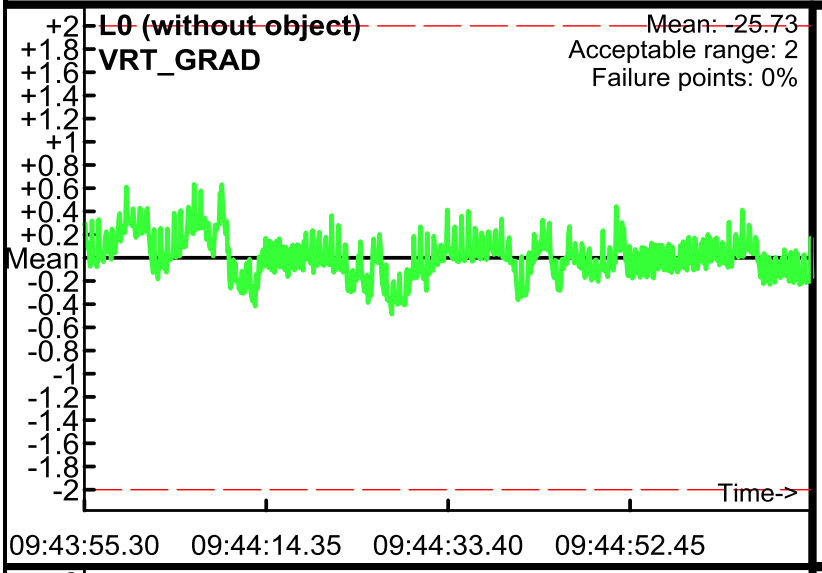
Database: q:\virginia office\ch2m hill\naval weapons station yorktown\CTO_0122\Data\Geosoft\QC_Tests\Static.g
Line Name: L0 L1 L2

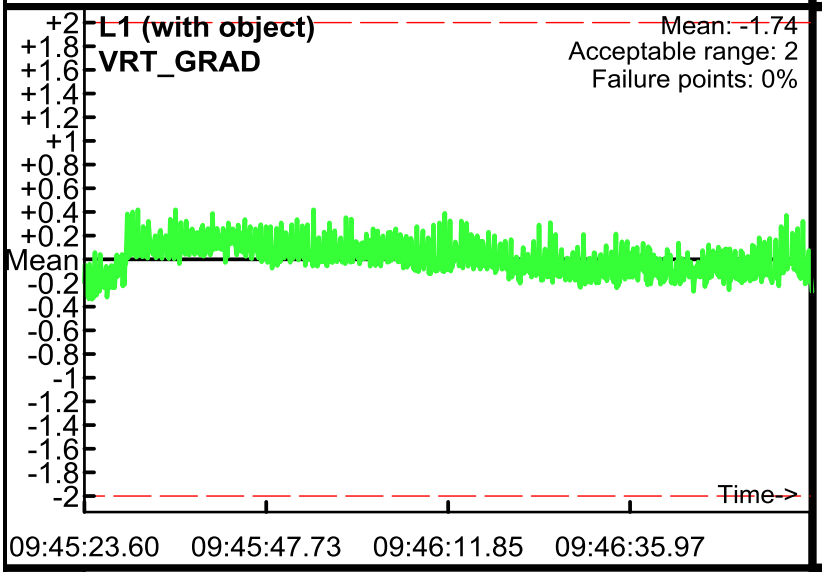
Static Calibration Test

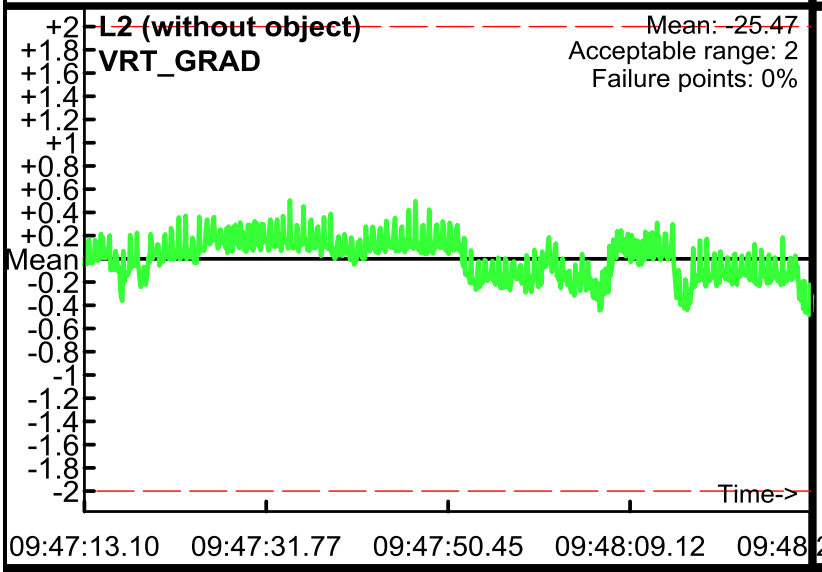
Project: CTO-0122, NWS Yorktown
Equipment: Magnetometers
Grid/Location: n/a

Outside range
Acceptable limits

AM test
Operator: NAEVA
Date: 4/13/2010





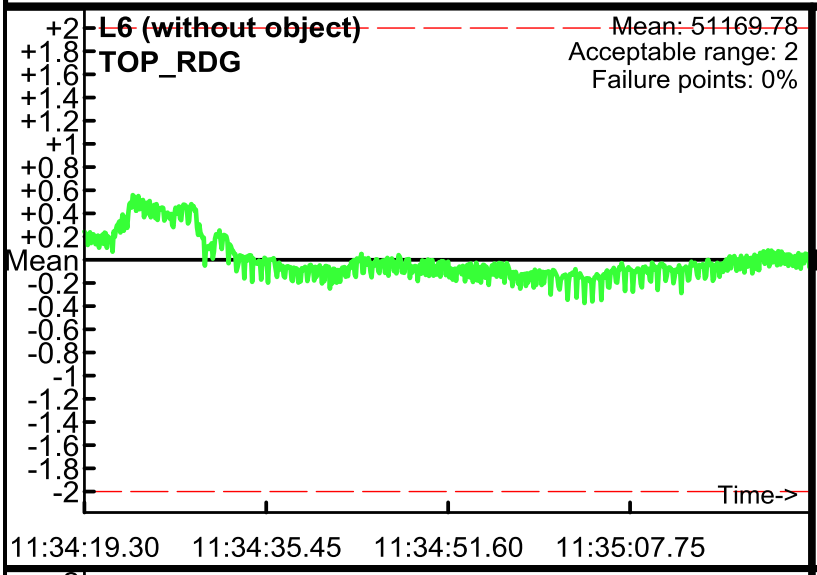


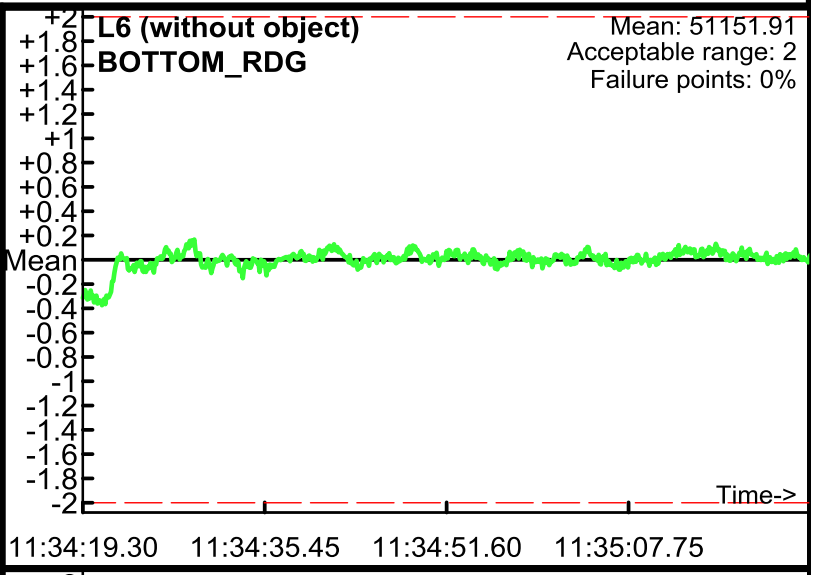
Static Calibration Test

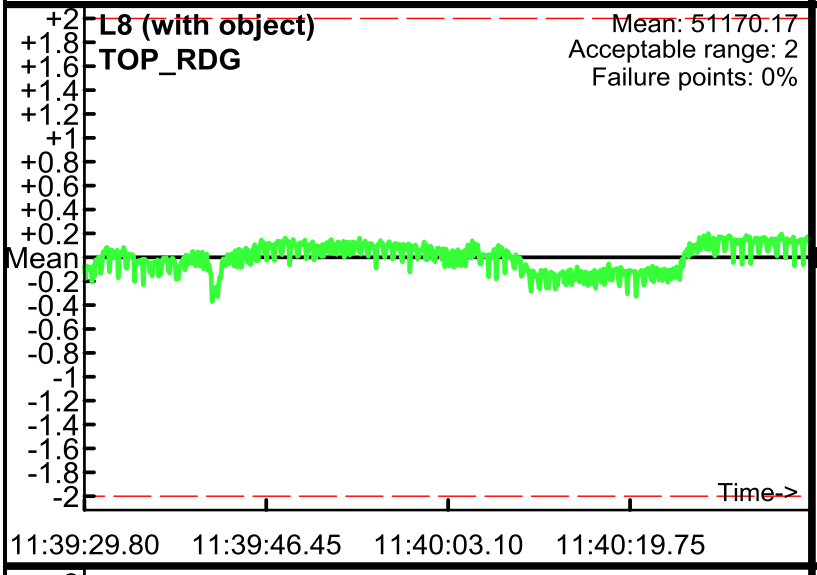
Project: CTO-0122, NWS Yorktown
Equipment: Magnetometers
Grid/Location: n/a

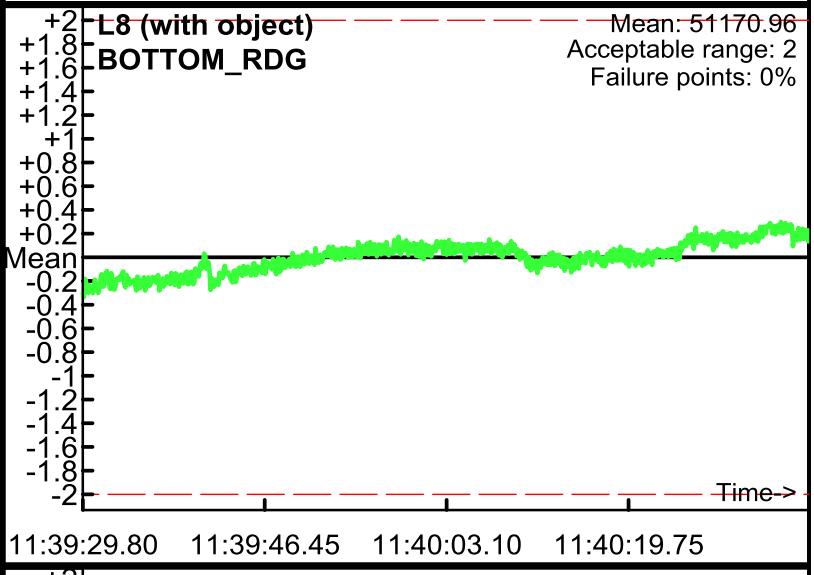
Outside range
Acceptable limits

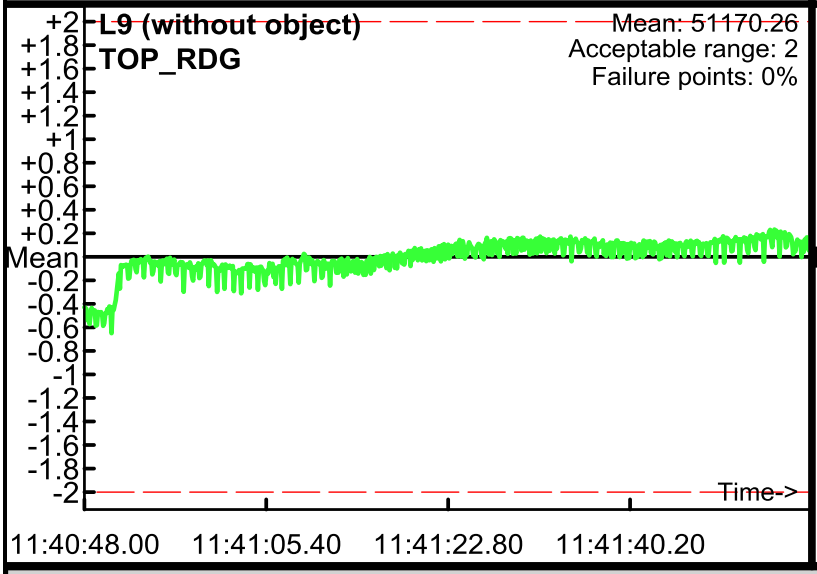
PM test
Operator: NAEVA
Date: 4/13/2010

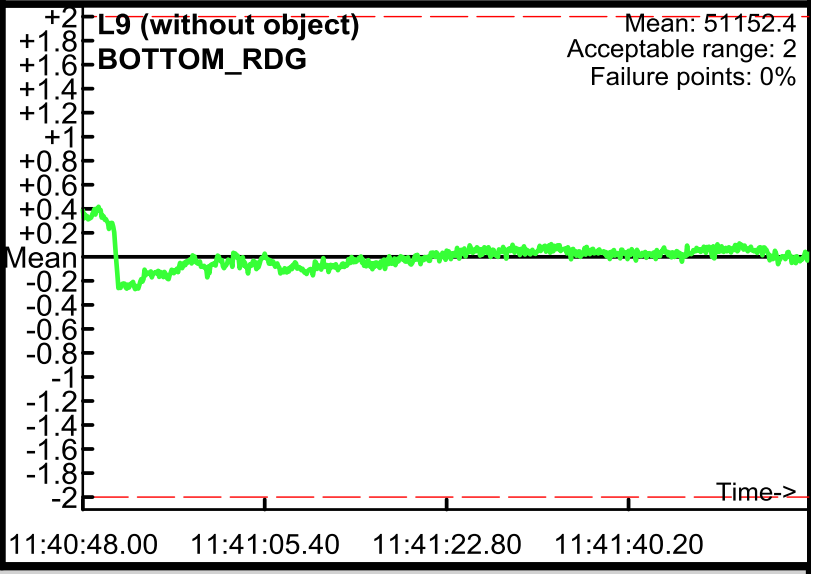












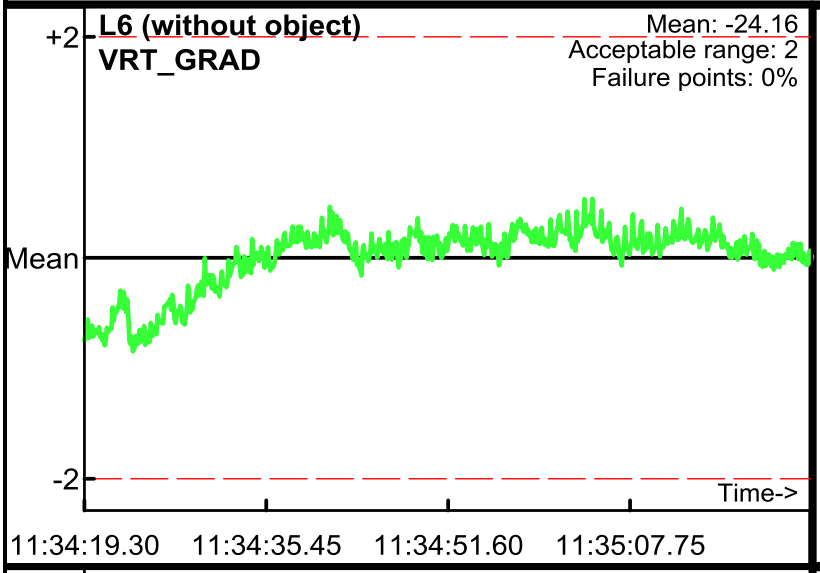
Database: q:\virginia office\ch2m hill\naval weapons station yorktown\CTO_0122\Data\Geosoft\QC_Tests\Static.g
Line Name: L6 L8 L9

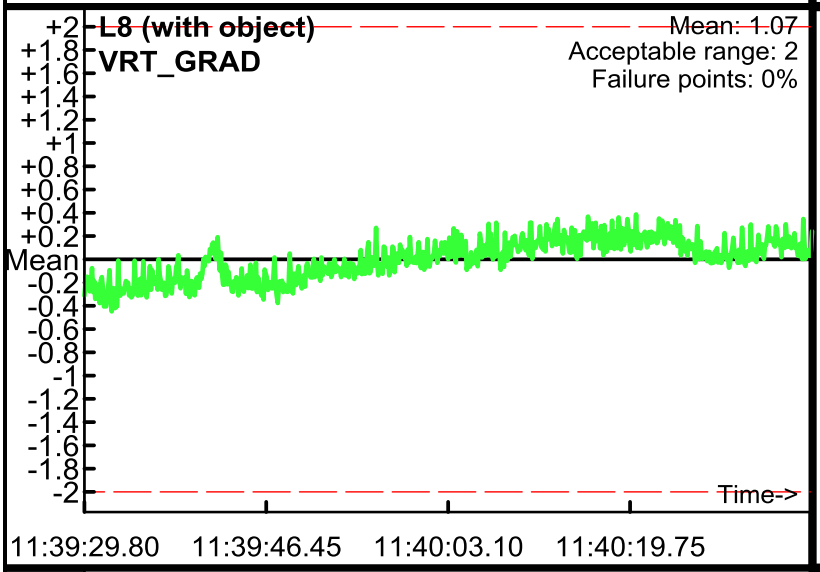
Static Calibration Test

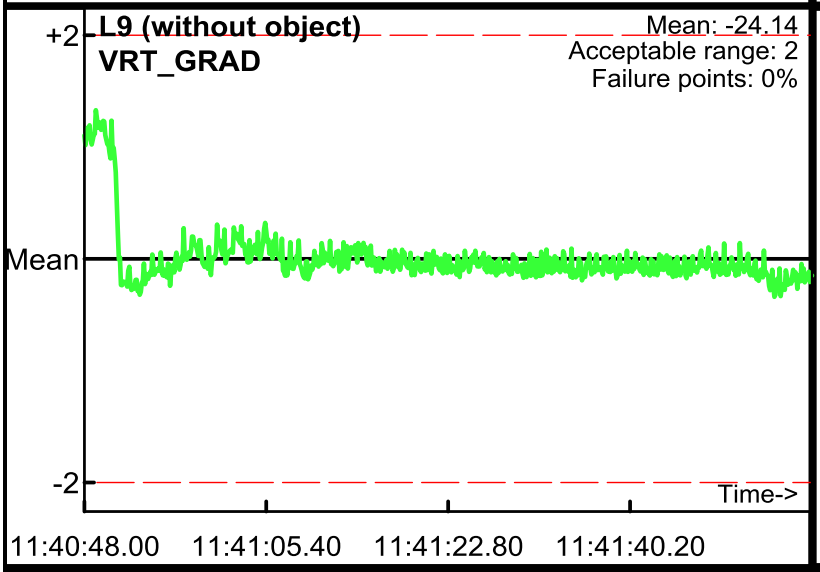
Project: CTO-0122, NWS Yorktown
Equipment: Magnetometers
Grid/Location: n/a

Outside range
Acceptable limits

PM test
Operator: NAEVA
Date: 4/13/2010





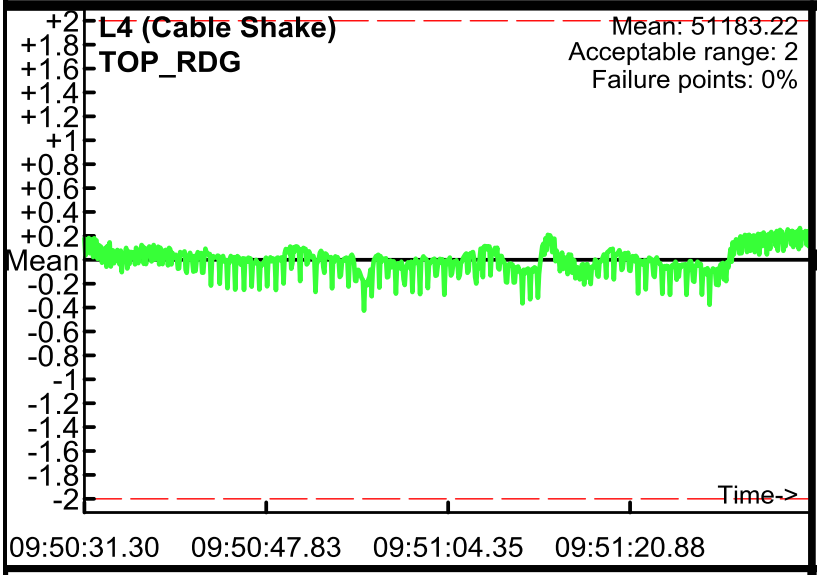


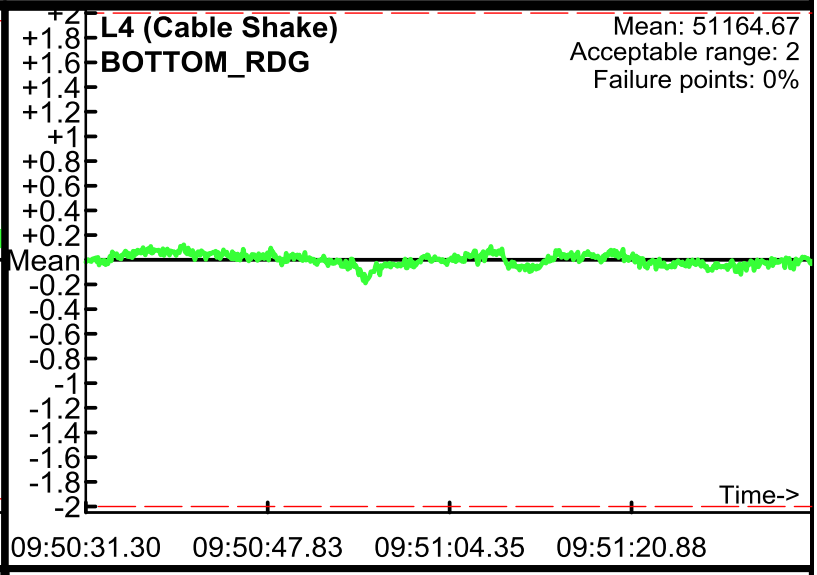
Cable Shake and Personnel Tests

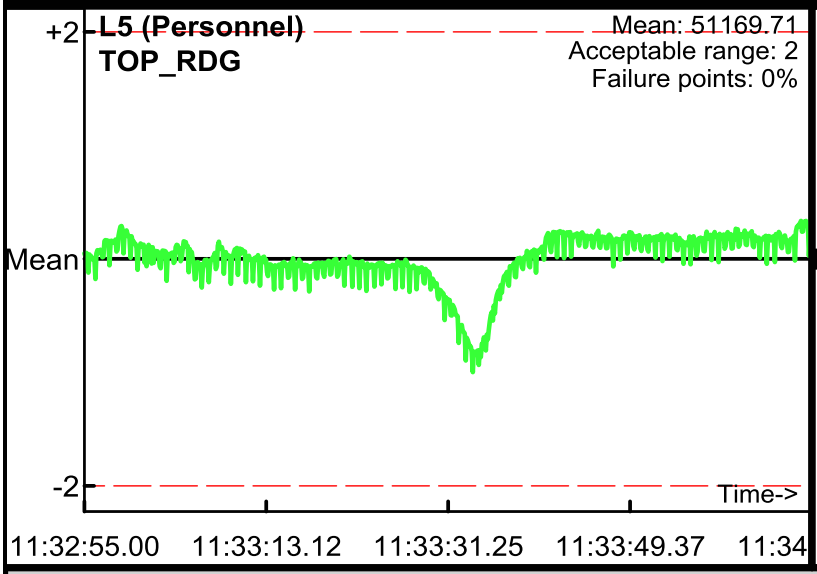
Project: CTO-0122, NWS Yorktown
Equipment: Magnetometers
Grid/Location: n/a

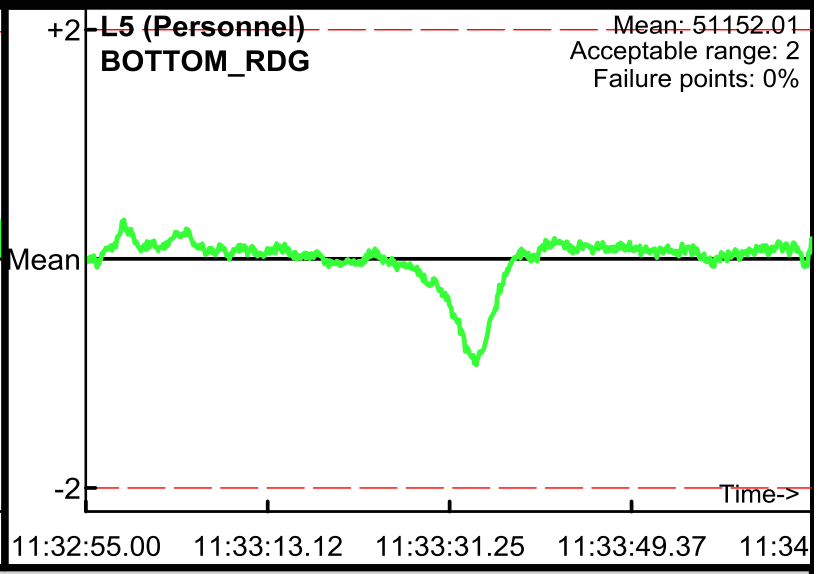
Outside range
Acceptable limits

AM test
Operator: NAEVA
Date: 4/13/2010









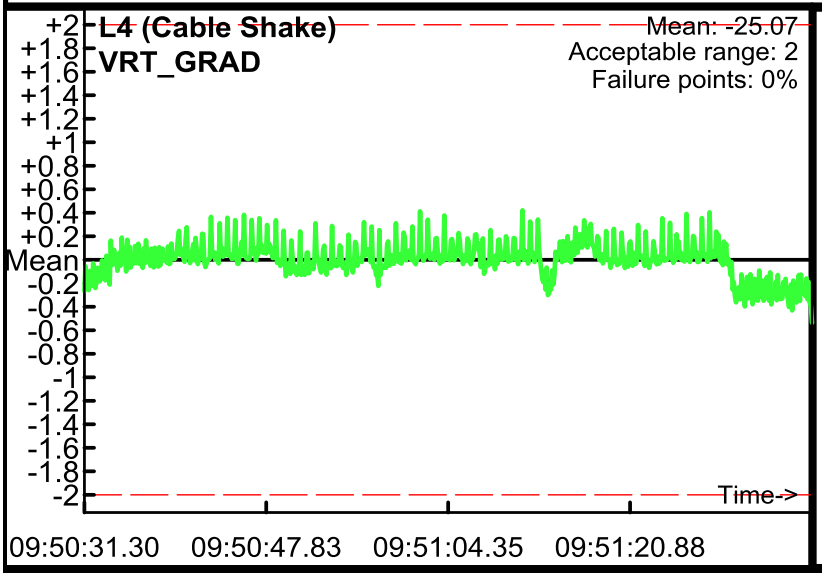
Database: q:\virginia office\ch2m hill\naval weapons station yorktown\CTO_0122\Data\Geosoft\QC_Tests\Static.g
Line Name: L4 L5 L5

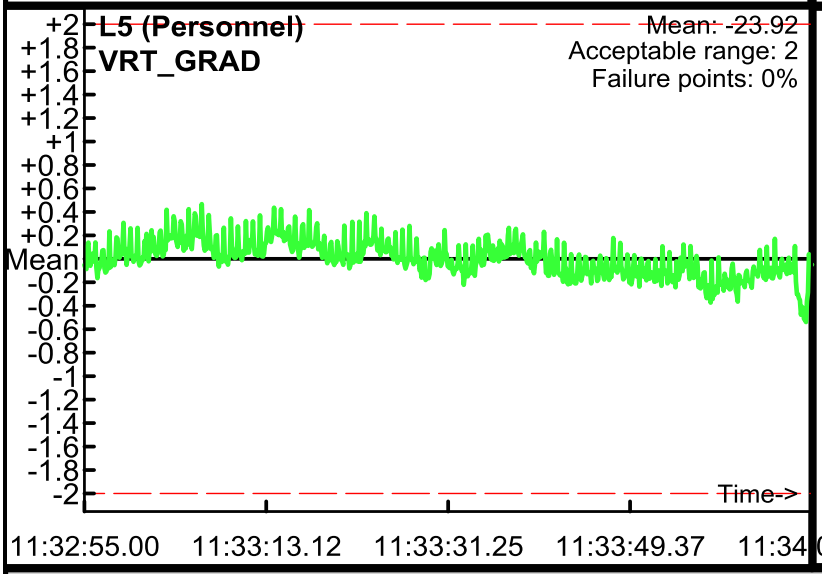
Cable Shake and Personnel Tests

Project: CTO-0122, NWS Yorktown
Equipment: Magnetometers
Grid/Location: n/a

Outside range
Acceptable limits

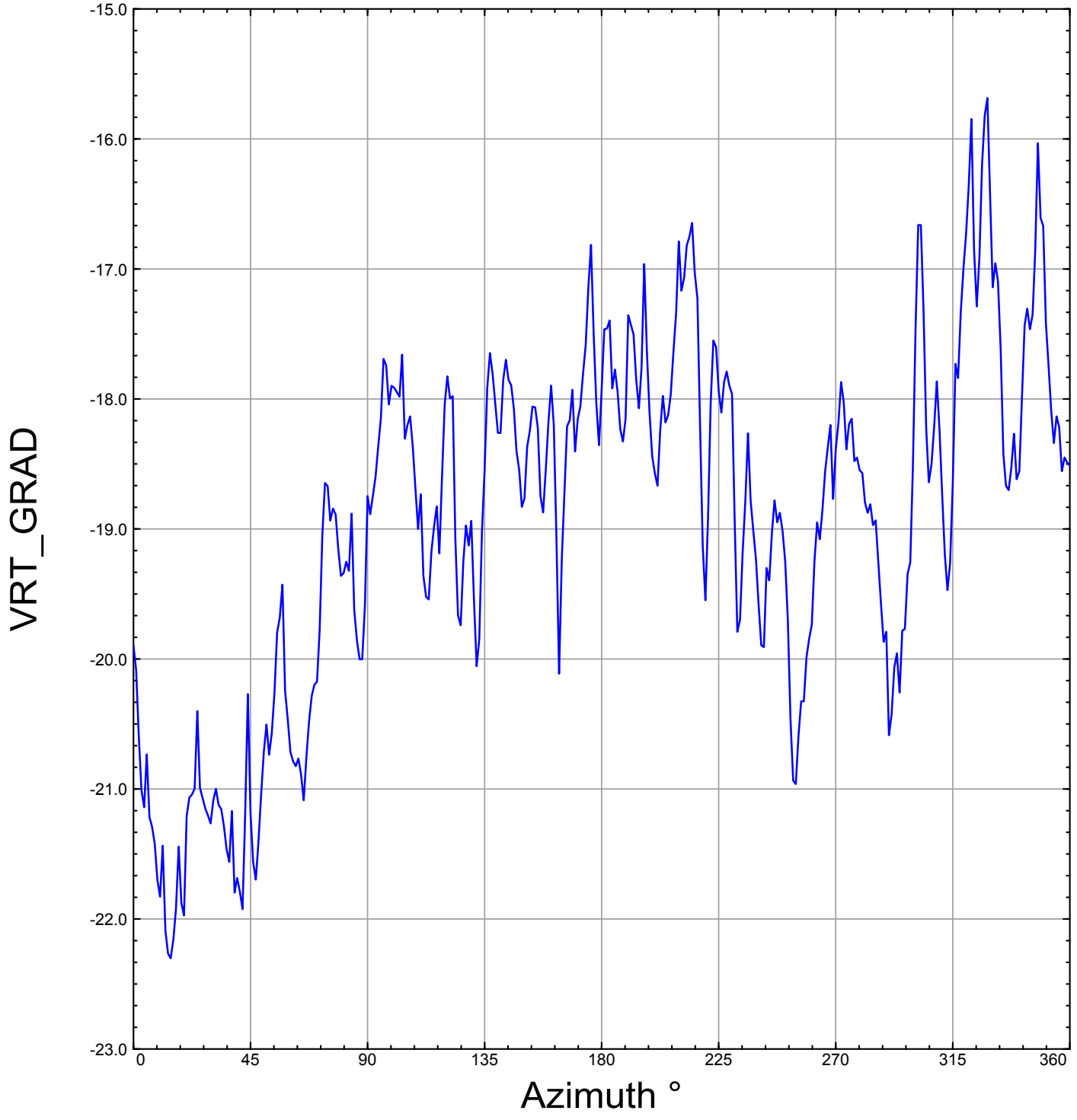
AM test
Operator: NAEVA
Date: 4/13/2010





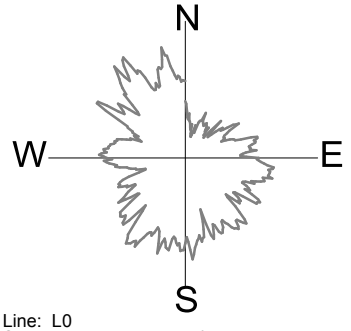
Database: q:\virginia office\ch2m hill\naval weapons station yorktown\CTO_0122\Data\Geosoft\QC_Tests\Static.g
Line Name: L4 L5 L5

MAP
Azimuth Test



LEGEND

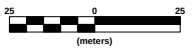
Polar Plot



Line: L0
Sensor head angle: 0.0 °

Amplitude offset exceeds tolerance.

Map Scale: Scale 1:2500

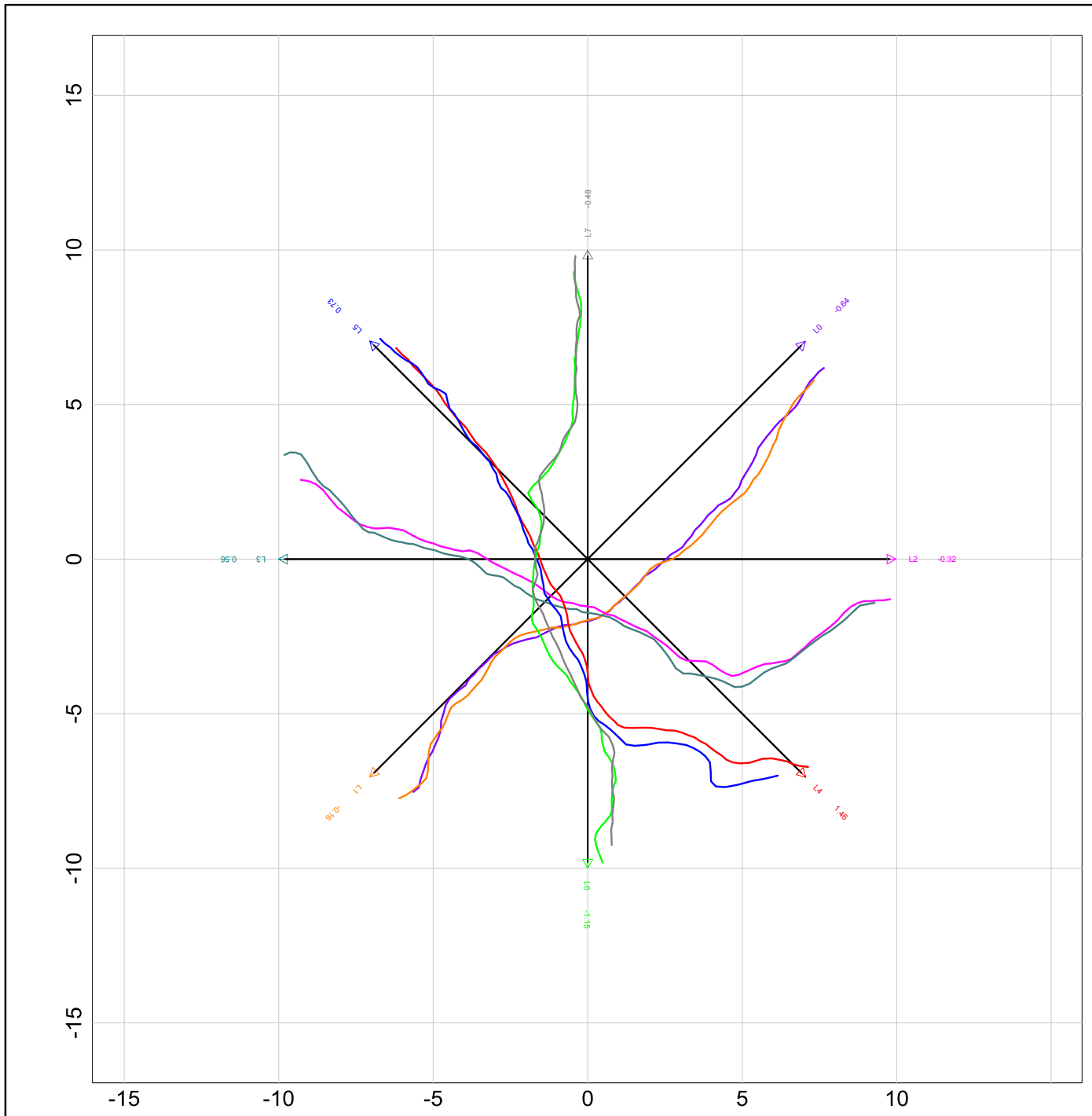


Grid North: 0°0'0"
Mag North: -10°38'24"

Client: CH2M HILL	
Project: CTO-0122, NWS Yorktown	
Contractor: NAEVA Geophysics Inc.	
Created by: A. Paski	**Verified by:**
Date: 2010/04/13	**File: Azimuth_Heading**
Page number:	**Approved:**

NAEVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys

database: q:\virginia office\ch2m hill\naval weapons station yorktown\CTO_0122\Data\Geosoft\QC_Tests\Azmith.gdb Channel: VRT_GRAD



MAP
Octant Test

LEGEND

Amplitudes exceeding tolerance are flagged in red

- Line 0 - SW --> NE
- Line 1 - NE --> SW
- Line 2 - W --> E
- Line 3 - E --> W
- Line 4 - NW --> SE
- Line 5 - SE --> NW
- Line 6 - N --> S
- Line 7 - S --> N

Map Scale: 2.5 0 2.5 (feet)

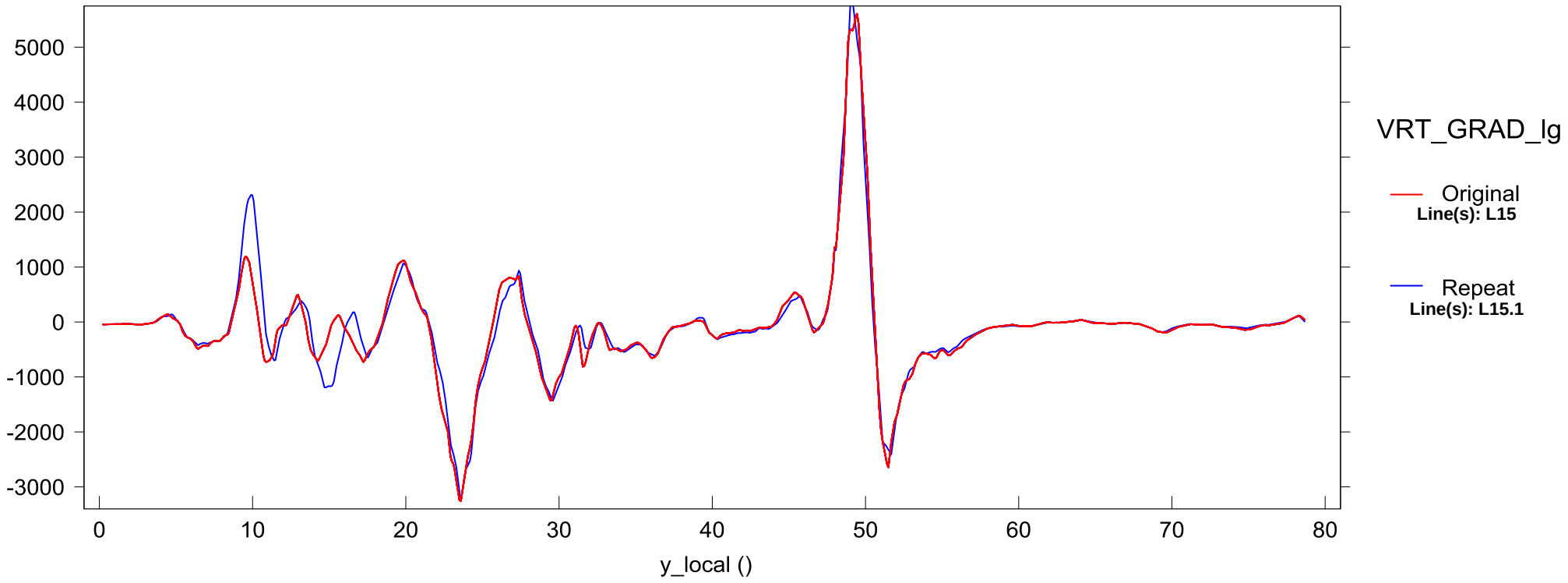
N

Grid North: 0°0'0"
Mag North: -10°38'24"

Client: CH2M HILL	
Project: CTO-0122, NWS Yorktown	
Contractor: NAEVA Geophysics Inc.	
Created by: A. Paski	Verified by:
Date: 2010/04/13	File: Octant
Page number:	Approved:

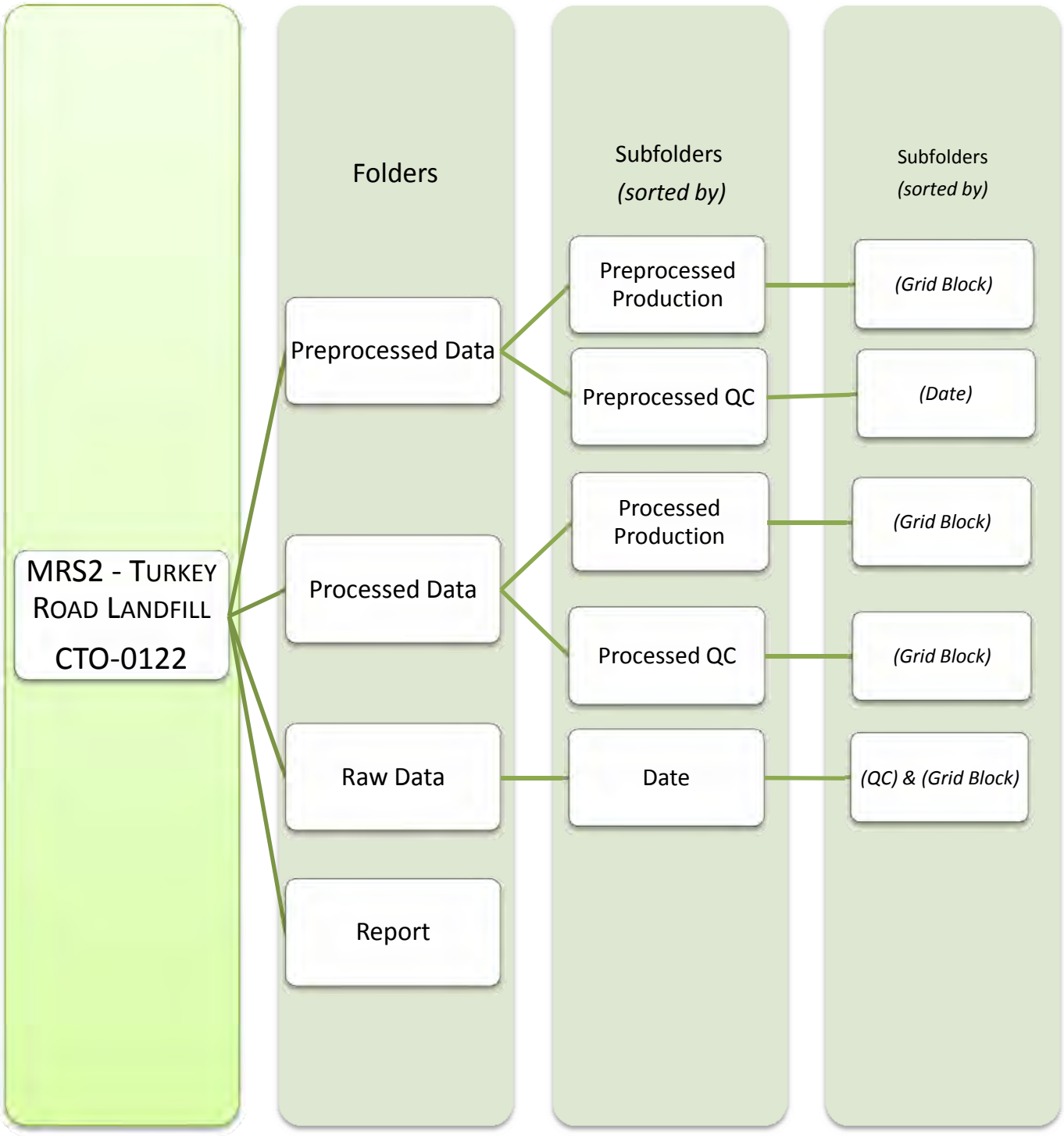
NAEVA GEOPHYSICS INC.
THE LEADER IN SUBSURFACE DETECTION
Subsurface Geophysical Surveys

CTO-0122 Repeat Line 15
G-858 Magnetometer Vertical Gradient



Database: CTO_0122_Transects_Repeat.gdb

CONTENTS OF CD



Appendix B
Debris Photo Summary

Attachment 1

Table A
MRS Background Information

DIRECTIONS: Record the background information below for the MRS to be evaluated. Much of this information is available from Service and DoD databases. If the MRS is located on a FUDS property, the suitable FUDS property information should be substituted. In the **MRS Summary**, briefly describe the UXO, DMM, or MC that are known or suspected to be present, the exposure setting (the MRS's physical environment), any other incidental nonmunitions-related contaminants (e.g., benzene, trichloroethylene) found at the MRS, and any potentially exposed human and ecological receptors. If possible, include a map of the MRS.

Munitions Response Site Name: Site2, Turkey Road Landfill

Component: U.S. Navy

Installation/Property Name: Naval Weapons Station-Yorktown

Location (City, County, State): Yorktown, Virginia

Site Name/Project Name (Project No.): _____

Date Information Entered/Updated: _____

Point of Contact (Name/Phone): _____

Project Phase (check only one):

☐ PA	☐ SI	☐ RI	☐ FS	☐ RD
☐ RA-C	☐ RIP	☐ RA-O	☐ RC	☐ LTM

Media Evaluated (check all that apply):

☐ Groundwater	☐ Sediment (human receptor)
☐ Surface soil	☐ Surface Water (ecological receptor)
☐ Sediment (ecological receptor)	☐ Surface Water (human receptor)

MRS Summary:

MRS Description: Describe the munitions-related activities that occurred at the installation, the dates of operation, and the UXO, DMM, or MC known or suspected to be present. When possible, identify munitions, CWM, and MC by type:
Dumping ground for inert ordnance items. In use from the 1940s until 1981. The concern is that live ordnance may have been inadvertently discarded.

Description of Pathways for Human and Ecological Receptors: _____

Description of Receptors (Human and Ecological): _____

Table 1

EHE Module: Munitions Type Data Element Table

DIRECTIONS: Below are 11 classifications of munitions and their descriptions. Circle the scores that correspond with **all** the munitions types known or suspected to be present at the MRS.

Note: The terms *practice munitions, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Sensitive	◆ UXO that are considered most likely to function upon any interaction with exposed persons (e.g., submunitions, 40mm high-explosive [HE] grenades, white phosphorus [WP] munitions, high-explosive antitank [HEAT] munitions, and practice munitions with sensitive fuzes, but excluding all other practice munitions). ◆ Hand grenades containing energetic filler. ◆ Bulk primary explosives, or mixtures of these with environmental media, such that the mixture poses an explosive hazard.	30
High explosive (used or damaged)	◆ UXO containing a high-explosive filler (e.g., RDX, Composition B), that are not considered "sensitive." ◆ DMM containing a high-explosive filler that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	25
Pyrotechnic (used or damaged)	◆ UXO containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades). ◆ DMM containing a pyrotechnic filler other than white phosphorus (e.g., flares, signals, simulators, smoke grenades) that have: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	20
High explosive (unused)	◆ DMM containing a high-explosive filler that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	~~5~~
Propellant	◆ UXO containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor) that are: ▪ Damaged by burning or detonation ▪ Deteriorated to the point of instability.	15
Bulk secondary high explosives, pyrotechnics, or propellant	◆ DMM containing mostly single-, double-, or triple-based propellant, or composite propellants (e.g., a rocket motor). ◆ DMM that are bulk secondary high explosives, pyrotechnic compositions, or propellant (not contained in a munition), or mixtures of these with environmental media such that the mixture poses an explosive hazard.	10
Pyrotechnic (not used or damaged)	◆ DMM containing a pyrotechnic filler (i.e., red phosphorus), other than white phosphorus filler, that: ▪ Have not been damaged by burning or detonation ▪ Are not deteriorated to the point of instability.	10
Practice	◆ UXO that are practice munitions that are not associated with a sensitive fuze. ◆ DMM that are practice munitions that are not associated with a sensitive fuze and that have not: ▪ Been damaged by burning or detonation ▪ Deteriorated to the point of instability.	5
Riot control	◆ UXO or DMM containing a riot control agent filler (e.g., tear gas).	3
Small arms	◆ Used munitions or DMM that are categorized as small arms ammunition. (Physical evidence or historical evidence that no other types of munitions [e.g., grenades, subcaliber training rockets, demolition charges] were used or are present on the MRS is required for selection of this category.)	2
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
MUNITIONS TYPE	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	15

DIRECTIONS: Document any MRS-specific data used in selecting the ***Munitions Type*** classifications in the space provided.

During debris removal activities conducted in 1994, several hundred inert ordnance items were recovered. No live items were recovered, however there is no documentation describing the procedures to ensure that live ordnance items would not have been inadvertently discarded at the site.

Table 2

EHE Module: Source of Hazard Data Element Table

DIRECTIONS: Below are 11 classifications describing sources of explosive hazards. Circle the scores that correspond with **all** the sources of explosive hazards known or suspected to be present at the MRS.

Note: The terms *former range, practice munitions, small arms range, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Former range	• The MRS is a former military range where munitions (including practice munitions with sensitive fuzes) have been used. Such areas include impact or target areas and associated buffer and safety zones.	10
Former munitions treatment (i.e., OB/OD) unit	• The MRS is a location where UXO or DMM (e.g., munitions, bulk explosives, bulk pyrotechnic, or bulk propellants) were burned or detonated for the purpose of treatment prior to disposal.	8
Former practice munitions range	• The MRS is a former military range on which only practice munitions without sensitive fuzes were used.	6
Former maneuver area	• The MRS is a former maneuver area where no munitions other than flares, simulators, smokes, and blanks were used. There must be evidence that no other munitions were used at the location to place an MRS into this category.	5
Former burial pit or other disposal area	• The MRS is a location where DMM were buried or disposed of (e.g., disposed of into a water body) without prior thermal treatment.	X
Former industrial operating facilities	• The MRS is a location that is a former munitions maintenance, manufacturing, or demilitarization facility.	4
Former firing points	• The MRS is a firing point, where the firing point is delineated as an MRS separate from the rest of a former military range.	4
Former missile or air defense artillery emplacements	• The MRS is a former missile defense or air defense artillery (ADA) emplacement not associated with a military range.	2
Former storage or transfer points	• The MRS is a location where munitions were stored or handled for transfer between different modes of transportation (e.g., rail to truck, truck to weapon system).	2
Former small arms range	• The MRS is a former military range where only small arms ammunition was used. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present to place an MRS into this category.)	1
Evidence of no munitions	• Following investigation of the MRS, there is physical evidence that no UXO or DMM are present, or there is historical evidence indicating that no UXO or DMM are present.	0
SOURCE OF HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Source of Hazard*** classifications in the space provided.

It has been confirmed that inert ordnance items were discarded at this site. There has been no documentation discovered describing the treatment or inspection prior to the items being placed on this site.

Table 3

EHE Module: Location of Munitions Data Element Table

DIRECTIONS: Below are eight classifications of munitions locations and their descriptions. Circle the scores that correspond with **all** the locations where munitions are known or suspected to be present at the MRS.

Note: The terms *confirmed, surface, subsurface, small arms ammunition, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are UXO or DMM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report that an incident or accident that involved UXO or DMM occurred) indicates there are UXO or DMM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS, and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose UXO or DMM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of UXO or DMM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed. ◆ Historical evidence indicates that UXO or DMM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause UXO or DMM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause UXO or DMM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence (e.g., munitions debris such as fragments, penetrators, projectiles, shell casings, links, fins), other than the documented presence of UXO or DMM, indicating that UXO or DMM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that UXO or DMM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that UXO or DMM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the UXO or DMM.	2
Small arms (regardless of location)	◆ The presence of small arms ammunition is confirmed or suspected, regardless of other factors such as geological stability. (There must be evidence that no other types of munitions [e.g., grenades] were used or are present at the MRS to place an MRS into this category.)	1
Evidence of no munitions	◆ Following investigation of the MRS, there is physical evidence that there are no UXO or DMM present, or there is historical evidence indicating that no UXO or DMM are present.	0
LOCATION OF MUNITIONS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	20

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of Munitions*** classifications in the space provided.

This is a wetlands area and any buried DMM would likely surface over time.

Table 4

EHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	• There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	• There is a barrier preventing access to parts of the MRS, but not the entire MRS.	~~8~~
Barrier to MRS access is complete but not monitored	• There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	• There is a barrier preventing access to all parts of the MRS, and there is active, continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	8

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

The site is in a restricted area of the base however it is accessible by foot.

Table 5

EHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	• The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal, or local governments; and land or water bodies managed by other federal agencies. • The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to the control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	• The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD must control access to the MRS 24 hours per day, every day of the calendar year.	X 0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

The site is on DOD property and is likely to remain so.

Table 6

EHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	• There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	• There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	X3
< 100 persons per square mile	• There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

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Table 7

EHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	• There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	X
16 to 25 inhabited structures	• There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	• There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	• There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	• There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	• There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

Table 8

EHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structure classifications at the MRS.

Note: The term *inhabited structure* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	• Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	• There are no known or recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

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Table 9

EHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	• There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	• There are ecological resources present on the MRS.	3
Cultural resources present	• There are cultural resources present on the MRS.	3
No ecological or cultural resources present	• There are no ecological resources or cultural resources present on the MRS.	X 0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Table 10
Determining the EHE Module Rating

DIRECTIONS:

1. From Tables 1–9, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **EHE Module Total** box below.
4. Circle the appropriate range for the **EHE Module Total** below.
5. Circle the **EHE Module Rating** that corresponds to the range selected and record this value in the **EHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
Explosive Hazard Factor Data Elements			
Munitions Type	Table 1	15	20
Source of Hazard	Table 2	5	
Accessibility Factor Data Elements			
Location of Munitions	Table 3	20	28
Ease of Access	Table 4	8	
Status of Property	Table 5	0	
Receptor Factor Data Elements			
Population Density	Table 6	3	13
Population Near Hazard	Table 7	5	
Types of Activities/Structures	Table 8	5	
Ecological and/or Cultural Resources	Table 9	0	
EHE MODULE TOTAL			61

EHE Module Total	EHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected Explosive Hazard
EHE MODULE RATING	D

Table 11

CHE Module: CWM Configuration Data Element Table

DIRECTIONS: Below are seven classifications of CWM configuration and their descriptions. Circle the scores that correspond with **all** the CWM configurations known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
CWM, that are either UXO, or explosively configured damaged DMM	The CWM known or suspected of being present at the MRS are: ◆ CWM that are UXO (i.e., CWM/UXO) ◆ Explosively configured CWM that are DMM (i.e., CWM/DMM) that have been damaged.	30
CWM mixed with UXO	◆ The CWM known or suspected of being present at the MRS are undamaged CWM/DMM or CWM not configured as a munition that are commingled with conventional munitions that are UXO.	25
CWM, explosive configuration that are undamaged DMM	◆ The CWM known or suspected of being present at the MRS are explosively configured CWM/DMM that have not been damaged.	20
CWM/DMM, not explosively configured or CWM, bulk container	The CWM known or suspected of being present at the MRS are: ◆ Nonexplosively configured CWM/DMM either damaged or undamaged ◆ Bulk CWM (e.g., ton container).	15
CAIS K941 and CAIS K942	◆ The CWM/DMM known or suspected of being present at the MRS are CAIS K941-toxic gas set M-1 or CAIS K942-toxic gas set M-2/E11.	12
CAIS (chemical agent identification sets)	◆ CAIS, other than CAIS K941 and K942, are known or suspected of being present at the MRS.	10
Evidence of no CWM	◆ Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	0
CWM CONFIGURATION	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 30).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***CWM Configuration*** classifications in the space provided.

None of the previously discovered inert ordnance items were associated with chemical warfare and nothing in the site history suggest that chemical warfare material was ever present at the site.

Table 12

CHE Module: Sources of CWM Data Element Table

DIRECTIONS: Below are 11 sources of CWM hazards and their descriptions. Review these classifications and circle the scores that correspond with **all** the sources of CWM hazards known or suspected to be present at the MRS.

Note: The terms *CWM/UXO, CWM/DMM, CAIS/DMM, surface, subsurface, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Live-fire involving CWM	• The MRS is a former military range that supported live-fire of explosively configured CWM and the CWM/UXO are known or suspected of being present on the surface or in the subsurface. • The MRS is a former military range that supported live-fire with conventional munitions, and CWM/DMM are on the surface or in the subsurface commingled with conventional munitions that are UXO.	10
Damaged CWM/DMM surface or subsurface	• There are damaged CWM/DMM on the surface or in the subsurface at the MRS.	10
Undamaged CWM/DMM surface	• There are undamaged CWM/DMM on the surface at the MRS.	10
CAIS/DMM surface	• There are CAIS/DMM on the surface.	10
Undamaged CWM/DMM, subsurface	• There are undamaged CWM/DMM in the subsurface at the MRS.	5
CAIS/DMM subsurface	• There are CAIS/DMM in the subsurface at the MRS.	5
Former CA or CWM Production Facilities	• The MRS is a facility that formerly engaged in production of CA or CWM, and CWM/DMM is suspected of being present on the surface or in the subsurface.	3
Former Research, Development, Testing, and Evaluation (RDT&E) facility using CWM	• The MRS is at a facility that formerly was involved in non-live-fire RDT&E activities (including static testing) involving CWM, and there are CWM/DMM suspected of being present on the surface or in the subsurface.	3
Former Training Facility using CWM or CAIS	• The MRS is a location that formerly was involved in training activities involving CWM and/or CAIS (e.g., training in recognition of CWM, decontamination training) and CWM/DMM or CAIS/DMM are suspected of being present on the surface or in the subsurface.	2
Former Storage or Transfer points of CWM	• The MRS is a former storage facility or transfer point (e.g., intermodal transfer) for CWM.	1
Evidence of no CWM	• Following investigation, the physical evidence indicates that CWM are not present at the MRS, or the historical evidence indicates that CWM are not present at the MRS.	X 0
SOURCES OF CWM	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Sources of CWM*** classifications in the space provided.

No known or suspected activities involving chemical warfare material occurred at this site.

Table 13

CHE Module: Location of CWM Data Element Table

DIRECTIONS: Below are seven classifications of CWM locations and their descriptions. Review these locations and circle the scores that correspond with **all** the locations where CWM are known or suspected of being found at the MRS.

Note: The terms *confirmed, surface, subsurface, physical evidence,* and *historical evidence* are defined in Appendix C of the Primer.

Classification	Description	Score
Confirmed surface	◆ Physical evidence indicates that there are CWM on the surface of the MRS. ◆ Historical evidence (i.e., a confirmed report such as an explosive ordnance disposal [EOD], police, or fire department report, that an incident or accident that involved CWM, regardless of configuration, occurred) indicates there are CWM on the surface of the MRS.	25
Confirmed subsurface, active	◆ Physical evidence indicates the presence of CWM in the subsurface of the MRS and the geological conditions at the MRS are likely to cause CWM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose CWM. ◆ Historical evidence indicates that CWM are located in the subsurface of the MRS and the geological conditions at the MRS are likely to cause CWM to be exposed, in the future, by naturally occurring phenomena (e.g., drought, flooding, erosion, frost heave, tidal action), or intrusive activities (e.g., plowing, construction, dredging) at the MRS are likely to expose CWM.	20
Confirmed subsurface, stable	◆ Physical evidence indicates the presence of CWM in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause CWM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause CWM to be exposed. ◆ Historical evidence indicates that CWM are located in the subsurface of the MRS and the geological conditions at the MRS are not likely to cause CWM to be exposed, in the future, by naturally occurring phenomena, or intrusive activities at the MRS are not likely to cause CWM to be exposed.	15
Suspected (physical evidence)	◆ There is physical evidence, other than the documented presence of CWM, indicating that CWM may be present at the MRS.	10
Suspected (historical evidence)	◆ There is historical evidence indicating that CWM may be present at the MRS.	5
Subsurface, physical constraint	◆ There is physical or historical evidence indicating that CWM may be present in the subsurface, but there is a physical constraint (e.g., pavement, water depth over 120 feet) preventing direct access to the CWM.	2
Evidence of no CWM	◆ Following investigation of the MRS, there is physical evidence that there is no CWM present or there is historical evidence indicating that no CWM are present.	X0
LOCATION OF CWM	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 25).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Location of CWM*** classifications in the space provided.

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Table 14

CHE Module: Ease of Access Data Element Table

DIRECTIONS: Below are four classifications of barrier types that can surround an MRS and their descriptions. The barrier type is directly related to the ease of public access to the MRS. Circle the score that corresponds with the ease of access to the MRS.

Note: The term *barrier* is defined in Appendix C of the Primer.

Classification	Description	Score
No barrier	• There is no barrier preventing access to any part of the MRS (i.e., all parts of the MRS are accessible).	10
Barrier to MRS access is incomplete	• There is a barrier preventing access to parts of the MRS, but not the entire MRS.	~~8~~
Barrier to MRS access is complete but not monitored	• There is a barrier preventing access to all parts of the MRS, but there is no surveillance (e.g., by a guard) to ensure that the barrier is effectively preventing access to all parts of the MRS.	5
Barrier to MRS access is complete and monitored	• There is a barrier preventing access to all parts of the MRS, and there is active continual surveillance (e.g., by a guard, video monitoring) to ensure that the barrier is effectively preventing access to all parts of the MRS.	0
EASE OF ACCESS	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 10).	8

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ease of Access*** classification in the space provided.

Table 15

CHE Module: Status of Property Data Element Table

DIRECTIONS: Below are three classifications of the status of a property within the Department of Defense (DoD) and their descriptions. Circle the score that corresponds with the status of property at the MRS.

Classification	Description	Score
Non-DoD control	◆ The MRS is at a location that is no longer owned by, leased to, or otherwise possessed or used by DoD. Examples are privately owned land or water bodies; land or water bodies owned or controlled by state, tribal or local governments; and land or water bodies managed by other federal agencies. ◆ The MRS is at a location that is owned by DoD, but that DoD has leased to another entity and for which DoD does not control access 24 hours per day.	5
Scheduled for transfer from DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD, and DoD plans to transfer that land or water body to control of another entity (e.g., a state, tribal, or local government; a private party; another federal agency) within 3 years from the date the Protocol is applied.	3
DoD control	◆ The MRS is on land or is a water body that is owned, leased, or otherwise possessed by DoD. With respect to property that is leased or otherwise possessed, DoD controls access to the MRS 24 hours per day, every day of the calendar year.	0
STATUS OF PROPERTY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Status of Property*** classification in the space provided.

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Table 16

CHE Module: Population Density Data Element Table

DIRECTIONS: Below are three classifications for population density and their descriptions. Determine the population density per square mile that most closely corresponds with the population of the MRS, including the area within a two-mile radius of the MRS's perimeter. Circle the most appropriate score.

Note: Use the U.S. Census Bureau tract data available to capture the **highest** population density within a two-mile radius of the perimeter of the MRS.

Classification	Description	Score
> 500 persons per square mile	• There are more than 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	5
100–500 persons per square mile	• There are 100 to 500 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	3
< 100 persons per square mile	• There are fewer than 100 persons per square mile in the U.S. Census Bureau tract in which the MRS is located.	1
POPULATION DENSITY	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	3

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Density*** classification in the space provided.

Table 17

CHE Module: Population Near Hazard Data Element Table

DIRECTIONS: Below are six classifications describing the number of inhabited structures near the MRS. The number of inhabited buildings relates to the potential population near the MRS. Determine the number of inhabited structures within two miles of the MRS boundary and circle the score that corresponds with the number of inhabited structures.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
26 or more inhabited structures	• There are 26 or more inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	X
16 to 25 inhabited structures	• There are 16 to 25 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	4
11 to 15 inhabited structures	• There are 11 to 15 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	3
6 to 10 inhabited structures	• There are 6 to 10 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	2
1 to 5 inhabited structures	• There are 1 to 5 inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	1
0 inhabited structures	• There are no inhabited structures located up to 2 miles from the boundary of the MRS, within the boundary of the MRS, or both.	0
POPULATION NEAR HAZARD	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Population Near Hazard*** classification in the space provided.

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Table 18

CHE Module: Types of Activities/Structures Data Element Table

DIRECTIONS: Below are five classifications of activities and/or inhabited structures and their descriptions. Review the types of activities that occur and/or structures that are present within two miles of the MRS and circle the scores that correspond with **all** the activities/structures classifications at the MRS.

Note: The term *inhabited structures* is defined in Appendix C of the Primer.

Classification	Description	Score
Residential, educational, commercial, or subsistence	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with any of the following purposes: residential, educational, child care, critical assets (e.g., hospitals, fire and rescue, police stations, dams), hotels, commercial, shopping centers, playgrounds, community gathering areas, religious sites, or sites used for subsistence hunting, fishing, and gathering.	5
Parks and recreational areas	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with parks, nature preserves, or other recreational uses.	4
Agricultural, forestry	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with agriculture or forestry.	3
Industrial or warehousing	◆ Activities are conducted, or inhabited structures are located up to two miles from the MRS's boundary or within the MRS's boundary, that are associated with industrial activities or warehousing.	2
No known or recurring activities	◆ There are no known of recurring activities occurring up to two miles from the MRS's boundary or within the MRS's boundary.	1
TYPES OF ACTIVITIES/STRUCTURES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	5

DIRECTIONS: Document any MRS-specific data used in selecting the ***Types of Activities/Structures*** classifications in the space provided.

Table 19

CHE Module: Ecological and/or Cultural Resources Data Element Table

DIRECTIONS: Below are four classifications of ecological and/or cultural resources and their descriptions. Review the types of resources present and circle the score that corresponds with the ecological and/or cultural resources present on the MRS.

Note: The terms *ecological resources* and *cultural resources* are defined in Appendix C of the Primer.

Classification	Description	Score
Ecological and cultural resources present	• There are both ecological and cultural resources present on the MRS.	5
Ecological resources present	• There are ecological resources present on the MRS.	3
Cultural resources present	• There are cultural resources present on the MRS.	3
No ecological or cultural resources present	• There are no ecological resources or cultural resources present on the MRS.	X 0
ECOLOGICAL AND/OR CULTURAL RESOURCES	**DIRECTIONS:** Record **the single highest score** from above in the box to the right (maximum score = 5).	0

DIRECTIONS: Document any MRS-specific data used in selecting the ***Ecological and/or Cultural Resources*** classification in the space provided.

Table 20
Determining the CHE Module Rating

DIRECTIONS:

1. From Tables 11–19, record the data element scores in the **Score** boxes to the right.
2. Add the **Score** boxes for each of the three factors and record this number in the **Value** boxes to the right.
3. Add the three **Value** boxes and record this number in the **CHE Module Total** box below.
4. Circle the appropriate range for the **CHE Module Total** below.
5. Circle the **CHE Module Rating** that corresponds to the range selected and record this value in the **CHE Module Rating** box found at the bottom of the table.

Note:
An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more data elements, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

	Source	Score	Value
CWM Hazard Factor Data Elements			
CWM Configuration	Table 11	0	0
Sources of CWM	Table 12	0	
Accessibility Factor Data Elements			
Location of CWM	Table 13	0	8
Ease of Access	Table 14	8	
Status of Property	Table 15	0	
Receptor Factor Data Elements			
Population Density	Table 16	3	13
Population Near Hazard	Table 17	5	
Types of Activities/Structures	Table 18	5	
Ecological and/or Cultural Resources	Table 19	0	
CHE MODULE TOTAL			21

CHE Module Total	CHE Module Rating
92 to 100	A
82 to 91	B
71 to 81	C
60 to 70	D
48 to 59	E
38 to 47	F
less than 38	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected CWM Hazard
CHE MODULE RATING	No Known or Suspected

Table 21

HHE Module: Groundwater Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's groundwater and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional groundwater contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the groundwater, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
Vinyl Chloride	17	1.5	11.33
1,2-Dichloroethene (total)	28	330	0.08
Total Aluminum	16400	36000	0.46
Total Barium	339	7300	0.05
Total Cadmium	2.2	18	0.12
CHF Scale	**CHF Value**	**Sum The Ratios**	~~12.04~~ 35.07
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		M

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the groundwater is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in groundwater has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	(M)
Confined	Information indicates a low potential for contaminant migration from the source via the groundwater to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the groundwater receptors at the MRS.

Classification	Description	Value
Identified	There is a threatened water supply well downgradient of the source and the groundwater is a current source of drinking water or source of water for other beneficial uses such as irrigation/agriculture (equivalent to Class I or IIA aquifer).	H
Potential	There is no threatened water supply well downgradient of the source and the groundwater is currently or potentially usable for drinking water, irrigation, or agriculture (equivalent to Class I, IIA, or IIB aquifer).	M
Limited	There is no potentially threatened water supply well downgradient of the source and the groundwater is not considered a potential source of drinking water and is of limited beneficial use (equivalent to Class IIIA or IIIB aquifer, or where perched aquifer exists only).	(L)
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Groundwater MC Hazard ☐

Table 22

HHE Module: Surface Water – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
2,4,6-Trinitrotoluene	0.14J	18	0.01

CHF Scale	CHF Value	Sum The Ratios	0.01
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	(H)
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L

MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	H

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move	(M)
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L

RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

No Known or Suspected Surface Water (Human Endpoint) MC Hazard ☐

Table 23

HHE Module: Sediment – Human Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with human endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Carbazole	0.3	2400	0.00
Benzo(a)anthracene	1.4	62	0.02
Chrysene	1.4	6200	0.00
Benzo(b)fluoranthene	1.6	62	0.03
Benzo(k)fluoranthene	0.72	620	0.00
CHF Scale	**CHF Value**	**Sum The Ratios**	~~0.05~~ 0.51
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right maximum value = H).		M

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls)	(L)
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	(M)
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

No Known or Suspected Sediment (Human Endpoint) MC Hazard ❑

Table 24

HHE Module: Surface Water – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface water and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface water contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the surface water, select the box at the bottom of the table.

Contaminant	Maximum Concentration (µg/L)	Comparison Value (µg/L)	Ratios
None			

CHF Scale	CHF Value	Sum the Ratios	0
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	DIRECTIONS: Record **the CHF Value** from above in the box to the right (maximum value = H).	

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface water is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface water has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the surface water to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	DIRECTIONS: Record **the single highest value** from above in the box to the right (maximum value = H).	

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface water receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface water to which contamination has moved or can move	H
Potential	Potential for receptors to have access to surface water to which contamination has moved or can move	M
Limited	Little or no potential for receptors to have access to surface water to which contamination has moved or can move.	L
RECEPTOR FACTOR	DIRECTIONS: Record **the single highest value** from above in the box to the right (maximum value = H).	

No Known or Suspected Surface Water (Ecological Endpoint) MC Hazard ☐

Table 25

HHE Module: Sediment – Ecological Endpoint Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's sediment and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional sediment contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard with ecological endpoints present in the sediment, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratios
Silver	24 6	390	0 06

CHF Scale	CHF Value	Sum the Ratios	0.06
CHF > 100	H (High)	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	M (Medium)		
2 > CHF	L (Low)		

CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).	L

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the sediment is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in sediment has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	M
Confined	Information indicates a low potential for contaminant migration from the source via the sediment to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L

MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the sediment receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to sediment to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to sediment to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to sediment to which contamination has moved or can move.	L

RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

No Known or Suspected Sediment (Ecological Endpoint) MC Hazard ☐

Table 26

HHE Module: Surface Soil Data Element Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: Record the **maximum concentrations** of all contaminants in the MRS's surface soil and their **comparison values** (from Appendix B of the Primer) in the table below. Additional contaminants can be recorded on Table 27. Calculate and record the **ratios** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** by adding the contaminant **ratios** together, including any additional surface soil contaminants recorded on Table 27. Based on the **CHF**, use the **CHF Scale** to determine and record the **CHF Value**. If there is no known or suspected MC hazard present in the surface soil, select the box at the bottom of the table.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value (mg/kg)	Ratio
Carbazole	6.6J	2400	0.00
Benzo(a)anthracene	48	62	0.77
Chrysene	50	6200	0.01
Benzo(b)fluoranthene	35	62	0.56
Benzo(k)fluoranthene	33	620	0.05
CHF Scale	**CHF Value**	**Sum the Ratios**	~~1.39~~ 92,10
CHF > 100	**H (High)**	$CHF = \sum \frac{\text{[Maximum Concentration of Contaminant]}}{\text{[Comparison Value for Contaminant]}}$	
100 > CHF > 2	**M (Medium)**		
2 > CHF	**L (Low)**		
CONTAMINANT HAZARD FACTOR	**DIRECTIONS:** Record **the CHF Value** from above in the box to the right (maximum value = H).		M

Migratory Pathway Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil migratory pathway at the MRS.

Classification	Description	Value
Evident	Analytical data or observable evidence indicates that contamination in the surface soil is present at, moving toward, or has moved to a point of exposure.	H
Potential	Contamination in surface soil has moved only slightly beyond the source (i.e., tens of feet), could move but is not moving appreciably, or information is not sufficient to make a determination of Evident or Confined.	(M)
Confined	Information indicates a low potential for contaminant migration from the source via the surface soil to a potential point of exposure (possibly due to the presence of geological structures or physical controls).	L
MIGRATORY PATHWAY FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	M

Receptor Factor

DIRECTIONS: Circle the value that corresponds most closely to the surface soil receptors at the MRS.

Classification	Description	Value
Identified	Identified receptors have access to surface soil to which contamination has moved or can move.	H
Potential	Potential for receptors to have access to surface soil to which contamination has moved or can move.	M
Limited	Little or no potential for receptors to have access to surface soil to which contamination has moved or can move.	(L)
RECEPTOR FACTOR	**DIRECTIONS:** Record **the single highest value** from above in the box to the right (maximum value = H).	L

No Known or Suspected Surface Soil MC Hazard ☐

Table 27

HHE Module: Supplemental Contaminant Hazard Factor Table

Contaminant Hazard Factor (CHF)

DIRECTIONS: **Only use this table if there are more than five contaminants in any given medium present at the MRS.** This is a supplemental table designed to hold information about contaminants that do not fit in the previous tables. Indicate the **media** in which these contaminants are present. Then record all **contaminants**, their **maximum concentrations** and their **comparison values** (from Appendix B of the Primer) in the table below. Calculate and record the **ratio** for each contaminant by dividing the **maximum concentration** by the **comparison value**. Determine the **CHF** for each medium on the appropriate media-specific tables.

Note: Do not add ratios from different media.

Media	Contaminant	Maximum Concentration	Comparison Value	Ratio
Table 21 cont	----	~~6.6J~~	----	----
Groundwater	Total Iron	~~48~~ 94900	11000	8.63
"	Total Manganese	~~50~~ 7550	1700	4.44
* "	Total Thallium	~~35~~ 7.1K	NA	NA
"	Dissolved Barium	~~33~~ 344	7300	0.05
"	Dissolved Iron	92400	11000	8.40
"	Dissolved Manganese	7670	1700	4.51
"	Dissolved Thallium	5.8K	NA	NA
Table 23 cont	----	----	----	----
Sediment	Benzo(a)pyrene	1.3	.91	1.43
"	Indeno(1,2,3-cd)pyrene	0.89	62	0.02
"	Dibenz(a,h)anthracene	0.19J	6.2	0.03
"	Arsenic	21.5	22	0.98
Table 26 cont	----	----	----	----
Surface Soil	Benzo(a)pyrene	40	.91	13.4
"	Indeno(1,2,3-cd)pyrene	28	62	0.45
"	Dibenz(a,h)anthracene	11J	6.2	1.77
"	Dieldrin	0.04P	3.0	0.01
"	Aroclor-1254	6.2	1.1	5.64
"	2,4,6-Trinitrotoluene	0.0017	18	0.00
** "	4-Amino-2,6-Dinitrotoluene	0.00076	(not in Appendix B)	NA
"	Antimony	24.3	31	0.78
"	Cadmium	2460	39	63.08
"	Cobalt	168	1400	0.12
"	Copper	14700	3100	4.74
"	Mercury	16.6	23	0.72
"	Thallium	26.8	NA	NA

* Thallium listed as "NA" in Appendix B of Primer.

** CAS No 19706-51-0 → no matches in Appendix B

Table 28

Determining the HHE Module Rating

DIRECTIONS:

1. Record the letter values (H, M, L) for the **Contaminant Hazard**, **Migration Pathway**, and **Receptor Factors** for the media (from Tables 21–26) in the corresponding boxes below.
2. Record the media's three-letter combinations in the **Three-Letter Combination** boxes below (three-letter combinations are arranged from Hs to Ms to Ls).
3. Using the **HHE Ratings** provided below, determine each media's rating (A–G) and record the letter in the corresponding **Media Rating** box below.

Media (Source)	Contaminant Hazard Factor Value	Migratory Pathway Factor Value	Receptor Factor Value	Three-Letter Combination (Hs-Ms-Ls)	Media Rating (A-G)
Groundwater (Table 21)	M	M	L	MML	E
Surface Water/Human Endpoint (Table 22)	L	H	M	LHM	D
Sediment/Human Endpoint (Table 23)	M	L	M	MLM	E
Surface Water/Ecological Endpoint (Table 24)					
Sediment/Ecological Endpoint (Table 25)	L	M	M	LMM	E
Surface Soil (Table 26)	M	M	L	MML	E

DIRECTIONS (cont.):

4. Select the single highest Media Rating (A is highest; G is lowest) and enter the letter in the **HHE Module Rating** box.

Note:

An alternative module rating may be assigned when a module letter rating is inappropriate. An alternative module rating is used when more information is needed to score one or more media, contamination at an MRS was previously addressed, or there is no reason to suspect contamination was ever present at an MRS.

HHE MODULE RATING	D

HHE Ratings (for reference only)

Combination	Rating
HHH	A
HHM	B
HHL	C
HMM	C
HML	D
MMM	D
HLL	E
MML	E
MLL	F
LLL	G
Alternative Module Ratings	Evaluation Pending
	No Longer Required
	No Known or Suspected MC Hazard

Table 29
MRS Priority

DIRECTIONS: In the chart below, circle the letter **rating** for each module recorded in Table 10 (EHE), Table 20 (CHE), and Table 28 (HHE). Circle the corresponding numerical **priority** for each module. If information to determine the module rating is not available, choose the appropriate alternative module rating. The MRS Priority is the single highest priority; record this relative priority in the **MRS Priority or Alternative MRS Rating** at the bottom of the table.

Note: An MRS assigned Priority 1 has the highest relative priority; an MRS assigned Priority 8 has the lowest relative priority. Only an MRS with CWM known or suspected to be present can be assigned Priority 1; an MRS that has CWM known or suspected to be present cannot be assigned Priority 8.

EHE Rating	Priority	CHE Rating	Priority	HHE Rating	Priority
		A	1		
A	2	B	2	A	2
B	3	C	3	B	3
C	4	D	4	C	4
D	5	E	5	D	5
E	6	F	6	E	6
F	7	G	7	F	7
G	8			G	8
Evaluation Pending		Evaluation Pending		Evaluation Pending	
No Longer Required		No Longer Required		No Longer Required	
No Known or Suspected Explosive Hazard		No Known or Suspected CWM Hazard		No Known or Suspected MC Hazard	
MRS PRIORITY or ALTERNATIVE MRS RATING				5	

Attachment 2

REQUEST FOR AN EXPLOSIVES SAFETY SUBMISSION DETERMINATION

Instructions: Project managers shall complete all blocks in this request and enclose it in a letter or memo, fax it, or attach it to a digitally signed e-mail, and send to either:

NOSSA (N53) 4234 Steve's Way, Ste 121 Indian Head, MD 20640-5058 Fax: 301-744-6749 (DSN 354) E-mail: inhdnossa-ess@navy.mil	COMMARSYSCOM (PM AMMO) 2200 Lester Street Quantico, VA 22134-5010 Fax: 703-432-3160 (DSN 378) E-mail: explosivessafety@usmc.mil

Site name/number, Activity, City, State and ZIP code:	MRS 2, Turkey Road Landfill Naval Weapons Station, Yorktown, Virginia (NWSY)	Date submitted:	01 April, 2010
Project manager: Contact information	Thomas Kowalski Code OPHREV4 NAVFAC MIDLANT 757.445.6618 Tom.Kowalski@navy.mil	EOD/UXO contractor: Contact information	EOD Mobile Unit Two - responding EOD Unit; CH2M HILL - UXO Contractor providing UXO Avoidance

Site history: Briefly describe past MEC or MPPEH use at the site	The Turkey Road Landfill is a 5 acre disposal site located at Naval Weapons Station Yorktown, Yorktown, Virginia used from 1940 until 1981. Various types of waste material was disposed of at this site including inert munitions items.
MEC or MPPEH known or suspected to be present: Quantity, type/nomenclature, and condition	No MEC/MPPEH have been reported as being at this site however in 1994, 4327 inert munitions items were reported to have been recovered during a removal action at three sites aboard NWS Yorktown. The close out report did not distinguish the amount of inert munitions items from each site, but reported the majority of it came from the Turkey Road Landfill site. By today's standards it is likely that some or all of these items would have been classified as MPPEH, requiring formal certification/verification to reclassify as MDAS. It is unknown if any MPPEH remains on or beneath the ground surface.
Work task/project being proposed: Briefly describe proposed work; identify encumbering ESQD arcs	A geophysical survey using a G858 MAGNETOMETER will be conducted on approximately three acres along the southern portion of the site to determine the lateral extent of the buried material. Vegetation removal will be required along the proposed transect lanes prior to the geophysical survey. A UXO Qualified individual will perform a detector-aided visual survey of each transect lane before clearing in that lane begins. Transect lanes will be adjusted, where necessary, to facilitate the clearing activities. Intrusive activities will be limited to driving marking stakes for DGM transect lanes into the ground and emplacing QC seeds. Anomaly avoidance by a UXO Qualified person will be practiced during all intrusive activities. A UXO Qualified person will also provide surface MEC avoidance during all activities on the site. Intentional contact with MEC/MPPEH is prohibited. EOD Mobile Unit Two will be contacted if MEC/MPPEH is encountered. Site activities are encumbered by a nearby IBD arc. The Base ESO (Meg White) has approved performing the work within the IBD.

Likelihood of encountering MEC or MPPEH: Low, medium or high	Low (MEC/anomaly avoidance will be practiced by a UXO Qualified Person at all times)

Attachment 3

DEPARTMENT OF THE NAVY
NAVAL ORDNANCE SAFETY AND SECURITY ACTIVITY
FARRAGUT HALL
3817 STRAUSS AVENUE, SUITE 108
INDIAN HEAD, MD 20640-5151

8020
Ser N539/529
7 Apr 10

From: Commanding Officer, Naval Ordnance Safety and Security Activity
To: Commanding Officer, Naval Facilities Engineering Command, Mid-Atlantic (OPHREV4)

Subj: EXPLOSIVES SAFETY SUBMISSION DETERMINATION REQUEST TO CONDUCT A GEOPHYSICAL SURVEY OF MRS 2 (TURKEY ROAD LANDFILL), NWS YORKTOWN, YORKTOWN, VIRGINIA

Ref: (a) E-mail NAVFAC MIDLANT Mr. T. Kowalski/NOSSA (N539) Mr. D. Murray of 1 Apr 10 (w/encl)
(b) NOSSAINST 8020.15B, Explosives Safety Review, Oversight, and Verification of Munitions Responses, of 26 Jan 09
(c) NAVSEA OP 5, Volume 1, Seventh Revision, Change 8

1. As requested by reference (a), the Naval Ordnance Safety and Security Activity (NOSSA) reviewed the subject Explosives Safety Submission (ESS) Determination Request in accordance with references (b) and (c). Based on the information provided, NOSSA has determined that an ESS is not required to conduct a geophysical survey of Munitions Response Site (MRS) 2, also known as the Turkey Road Landfill, on Naval Weapons Station Yorktown, Yorktown, Virginia.

2. As outlined in your request, we understand that the likelihood of encountering Munitions and Explosives of Concern (MEC) and/or Material Potentially Presenting an Explosive Hazard (MPPEH) during the proposed project has been determined to be low and that the following conditions apply:

a. An Unexploded Ordnance (UXO)-qualified technician using a magnetometer will conduct a geophysical survey of approximately three acres along the southern portion of the site in order to determine the lateral extent of buried material. Prior to this survey the UXO-qualified technician will conduct a detector-aided visual sweep of the site, mark transect lanes with stakes, and emplace quality control seeds in the ground. Once these preparatory actions are completed vegetation will be removed from that portion of the site to be surveyed.

b. Anomaly avoidance techniques described in references (b) and (c) will be employed during all intrusive activities. At no time will intentional physical contact be made with any MEC or MPPEH items.

c. Authorization is granted to conduct work within K18 intraline (IL) separation distance from existing potential explosion sites (PESs), as necessary. However, work schedules shall be coordinated to ensure the proposed project and operations at any PES at less than IL distance do not occur simultaneously.

3. If surface MEC or MPPEH is discovered on the site while employing anomaly avoidance techniques, the item will be avoided and its location and description will be reported to the cognizant Explosive Safety Officer and the Navy Project Manager. An emergency response from the cognizant Explosive Ordnance Disposal detachment will be requested, if necessary.

4. The NOSSA point of contact for this ESS determination is Mr. Douglas Murray, who can be contacted at DSN 354-5630 or commercial at 301-744-5630.

TAMMY K. SCHIRF
By direction

Copy to:
CNO (N411C2; N453; N453C)
NAVFAC HQ (ENV3)
WPNSTA YORKTOWN ESO (N05PN)
NOSSA ESSOLANT (N5L)