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Validation Plan for the ESTCP Wide Area Assessment Pilot Program Demonstration at Pueblo Precision Bombing Range #2, CO

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14. ABSTRACT

In response to a recent Defense Science Board Task Force report and Congressional interest, the Environmental Security Technology Certification Program designed a Wide Area Assessment Pilot Program that consisted of demonstrations at three sites to validate the application of a number of recently developed and validated technologies as a comprehensive approach to Wide Area Assessment of sites potentially contaminated with unexploded munitions. One of these sites was the former Pueblo Precision Bombing Range #2 in Otero County, CO. Geophysical data from airborne sensors, helicopter magnetometer arrays, and ground arrays were collected in the Fall of 2005. The final phase of the demonstration is a field validation of the results obtained from the geophysical surveys. This phase will consist of ground reconnaissance on selected areas and features of the demonstration site, additional ground-based geophysical measurements if required, and intrusive investigation of a number of the anomalies identified by the geophysical surveys. This report details the plan for the validation efforts.

15. SUBJECT TERMS
Wide area assessment; Airborne magnetometry; Orthophotography; Unexploded ordnance (UXO); LiDAR

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Contents

Figures

Tables

List of Acronyms

ASR	Archive Search Report
CSM	Conceptual Site Model
DoD	Department of Defense
DSB	Defense Science Board
ESTCP	Environmental Security Technology Certification Program
FUDS	Formerly Used Defense Sites
GIS	Geographic Information System
HSI	Hyperspectral Imaging
LiDAR	Light Detection and Ranging
MRA	Munitions Response Area
MRS	Munitions Response Site
OB/OD	Open Burning/Open Detonation
SAR	Synthetic Aperture Radar
UXO	Unexploded Ordnance
VSP	Visual Sample Plan
WAA	Wide Area Assessment

Validation Plan for the ESTCP Wide Area Assessment Pilot Program Demonstration at Pueblo Precision Bombing Range #2, CO

1. Introduction

1.1 Background

Unexploded ordnance (UXO) contamination is a high-priority problem for the Department of Defense (DoD). Approximately 1,400 DoD sites, comprising about 10 million acres, are suspected of containing UXO. A typical site is thousands of acres; many exceed 10,000 acres. Remediation of such large areas would cost tens of billions of dollars. However, according to some estimates, no more than 20 percent of those 10 million suspected acres are actually contaminated with UXO. Thus, finding a technology or combination of technologies to accurately delineate the contaminated areas on each site would significantly reduce the actual area that would require a site investigation and response, allowing limited cleanup resources to be used more effectively.

The Defense Science Board (DSB) Task Force on Unexploded Ordnance issued a series of recommendations about this problem in their December 2003 report [1]. Recommendation 1 was "Institute a national area assessment of the identified 10 million acres [of land involved]." They elaborate on this recommendation saying "The Task Force envisions an intensive five-year campaign to assess all 10 million acres with the goal of delineating where the UXO are and where they are not. This campaign would use the full range of techniques and instruments including the helicopter-borne sensor where applicable."

The Environmental Security Technology Certification Program (ESTCP) is charged with promoting innovative, cost-effective environmental technologies by demonstrating and validating those technologies. In response to the DSB Task Force report and recent Congressional interest, ESTCP designed a Wide Area Assessment Pilot Program that consisted of demonstrations at three sites to validate the application of a number of recently developed and validated technologies as a comprehensive approach to Wide Area Assessment.

1.2 Objective of the Demonstration

The purpose of this pilot program is to demonstrate and evaluate the use of technologies suitable for wide area assessment (WAA) of suspected munitions contaminated sites to do the following:

- Demonstrate the effectiveness of a range of investigation technologies, used singly or together, in supporting decisions to be made concerning large range areas. The role of those technologies includes:

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- Identification of areas of concentrated munitions use: Identify munitions response sites (MRSs), such as target areas, OB/OD areas, and burial pits that are the result ofmilitary activities (whether documented or undocumented) that could reasonably be expected to result in the release of munitions and explosives of concern (MEC) to the environment.[†]
- Characterization of site conditions for future work: Provide information about the MRS conditions to support future investigation, prioritization and cost estimation tasks.
- Investigation of areas outside the MRSs: Provide information to support regulatory decisions regarding the portions of the munitions response areas (MRAs) outside of the MRSs, including decisions as to requirements for further investigation, institutional controls, or no further action.

- Understand the effects of site specific factors such as terrain, vegetation and ordnance type that will affect applicability and limitations of the technologies.

1.3 Validation Objectives

As mentioned above, the Wide Area Assessment Pilot Program consisted of a number of technologies, each of which could contribute to the overall goals of the demonstration. These technologies can be thought of in a layered fashion. The top layer consists of the various sensors deployed from (relatively) high-flying fixed- or rotary-wing aircraft. These will be referred to as "high-airborne" technologies. These sensors include Light Detection and Ranging (LiDAR) sensors for measuring variation in surface elevation, orthorectified photography and hyperspectral imaging (HSI) for detection of surface reflectivity variations either across the entire visible portion of the spectrum or within narrow wavelength bands, and synthetic aperture radar (SAR) for detection of variation in reflectivity and polarization in the radar bands. All of these sensors are designed to detect anomalies that can be referred to as "ordnance-related features." These are features such as target rings, craters, and possibly surface metal that can be associated with the presence of UXO.

The next layer is a helicopter-borne magnetometer array. This technology is designed to detect subsurface ferrous metal directly. The magnetometer data can be analyzed to extract either distributions of magnetic anomalies which can be used to locate and bound targets, aim points, and OB/OD sites or individual anomaly parameters (location, depth, rough size, etc.) that can be used in conjunction with target remediation to validate the results of the magnetometer survey.

The final layer of the demonstration is a ground survey of portions of the demonstration site using a vehicular-towed array of magnetometers. These ground surveys will be deployed in two modes. The first use will be in conjunction with statistical transect planning with the goal of defining target locations and bounds. This is a technique that might be employed in a wide area

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[†] The WAA Pilot Program is not designed to search for MEC items randomly lost or abandoned during training activities.

assessment of some sites. Additional ground surveys were conducted to validate the results of the airborne layers. These validation surveys consisted of 100% coverage of selected areas with emphasis on portions of the sites that had been declared to be outside a target by the statistical analysis methods or the airborne systems.

The final phase of the demonstration is a field validation of the results obtained from the geophysical surveys. This phase will consist of ground reconnaissance on selected areas and features of the demonstration site, additional ground-based geophysical measurements if required, and intrusive investigation of a number of the anomalies identified by the geophysical surveys. In the layer terminology used above, each successive layer provides unique information as well as providing validation for the preceding layers. The final validation of the performance of the various layers will come from this validation effort.

2. Summary of Geophysical Measurements

2.1 Test Site History/Characteristics

The former Pueblo Precision Bombing and Pattern Gunnery Range #2 consists of a total of 67,769 acres and is located approximately 20 miles south of La Junta, Colorado, in Otero County, Figure 1. The closest community is La Junta, a rural town with a population of about 7,637.

The MRA was used by local populations for cattle grazing until the War Department assumed control of the lands to construct the Pueblo Precision Bombing and Pattern Gunnery Range #2 (1942 to 1946). Currently, the lands within the study area are primarily Federal lands that are managed by the U.S. Forest Service as the Comanche National Grasslands, with portions leased to private owners or owned by the State of Colorado. There is some private ownership of parcels in the middle of the study area. All privately owned lands within the study area are used for cattle grazing.

The general recreational use of the site is very broad and encompasses hiking, camping, and use by all-terrain vehicles. The entire site is also used for cattle grazing, which may require well drilling and pipe laying to supply water to the cattle, as well as fences.

At least three residences with farm buildings are located within the boundaries of the bombing range. Several water tanks and wells used to water the cattle are identified in the maps from the ASR. This may well have changed in the 10 years since the ASR was written. Additional wells and tanks may be present, and some of those mapped may have been closed.

General access to the site is provided by all-weather gravel roads. Specific access to most of the individual targets is provided by dirt roads that require use of a 4-wheel-drive vehicle during dry weather and are impassible during wet weather.

During active operations the ranges were under the Western Flying Training Command, supporting Pueblo Army Air Field as part of the Second Air Force. A variety of activities took place in the 67,769-acre range that encompasses the Pueblo PBR #2. The training ranges consisted of a bombing camp with two runways and nine precision bombing targets, along with an air-to-ground pattern gunnery range. A map of the Wide Area Assessment Demonstration Area is shown in Figure 2 with the known and suspected targets indicated. In March 1943, E-1 sonic bomb scoring targets were installed at five of the Pueblo PBR #2 targets. In December 1944 crews also constructed a skip and a submarine target for the 471st Combat Crew Training School. The training documents indicate that the ranges were heavily used.

During flight training, aviators used M-38A2 100-pound practice bombs as part of the May 1943 Second Air Force training requirement. From 28 August to 1 October 1945, the intended training also included rocket firing, ground gunnery (50 caliber), aerial gunnery, and dive bombing, with each pilot firing 30 rockets and dropping 20 bombs. The training requirements

(May 1943 Second Air Force) were First Phase 148 bombs, Second Phase 155, Third Phase 154. In January 1944, crews completed 672 high-altitude bombing releases during training. In March 1944, the 491st Bomb Group completed 1,449 high-altitude bombing releases. In 1944, Chinese B-25 Mitchell Bomber students practiced firing 75mm cannons using the M72 shot, armor-piercing projectile.

In August 1946 Tibbits Contractors Inc. conducted a surface clearance in the MRA and issued a Certificate of Clearance (COC). It is not known how much of the range was cleared under this contract, nor is the location of the clearance indicated. However, it is probably reasonable to assume that the clearance was done on the established bombing targets, probably including those in the study area (Bomb Targets 3 and 4). During the surface-only clearance, incendiary bombs (4-pound AN-M50A1 magnesium-type incendiary bomb), M38A2 practice bombs, and AN-M30 general-purpose (GP) high explosive bombs were identified. The COC stated that the land was surface cleared and free from explosives for the land use of cattle grazing. Also in 1946, the Department of the Interior (DOI) cleared a 1,400-acre portion of the MRA, which again was not identified, except that the ASR noted that the clearance results indicated it was not part of the bombing targets. A COC was not issued for the DOI effort.

The following are munitions that have been found on Pueblo PBR #2 MRA and were included in the ASR:

- Bomb, General Purpose (GP), 100-pound, AN-M30 and AN-M30-A1
- Bomb, Practice, 100-pound, M38A2
- Bomb, Practice, 100-pound, Mk 15 Mod 3
- Bomb, Incendiary, 4-pound, AN-M50A1
- Shot, Armor-Piercing (AP), M72 (75mm)
- Small Arms Ammunition, Caliber 50

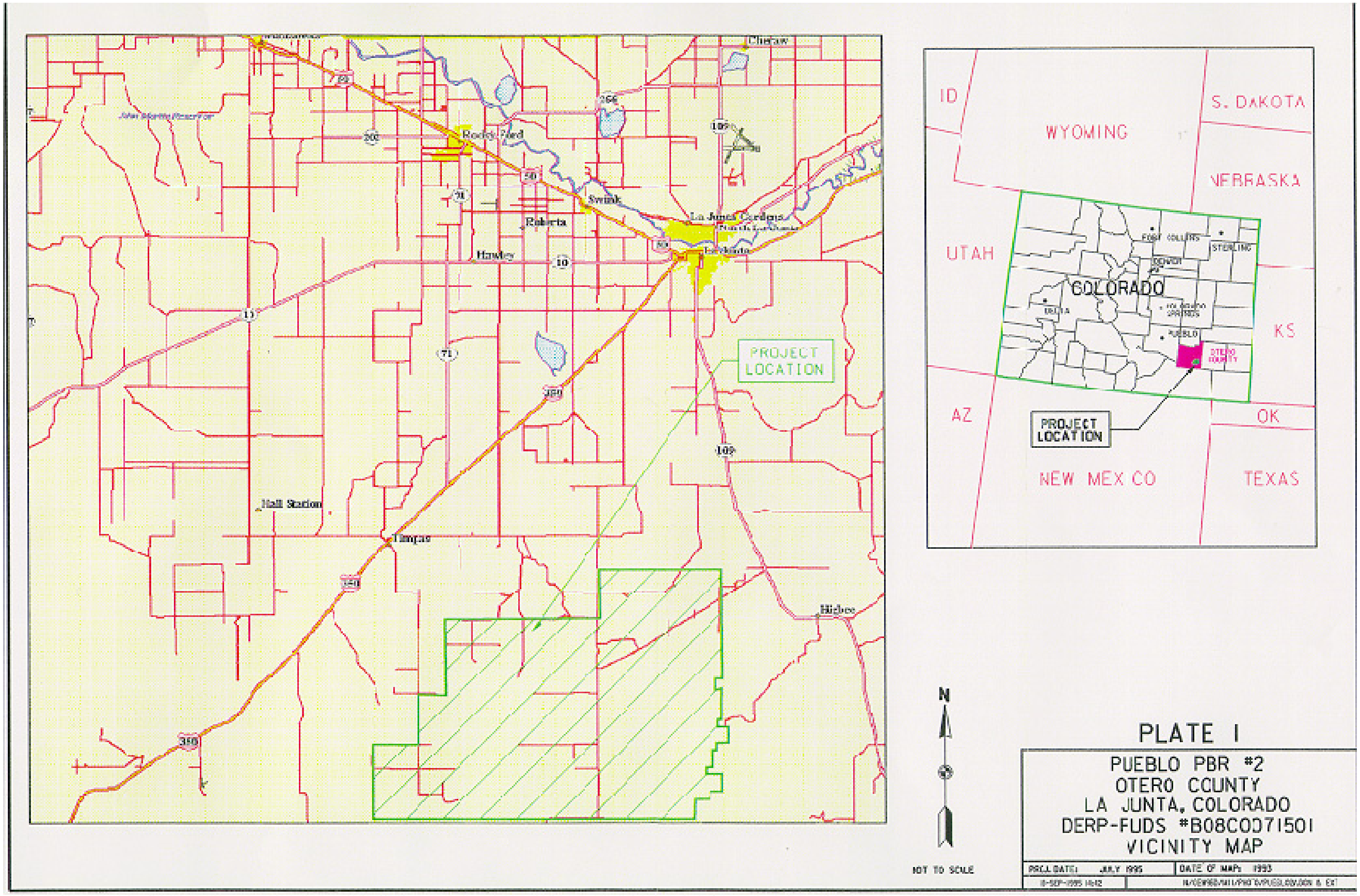

Fig. 1 – Area map showing the location of Pueblo Precision Bombing Range #2

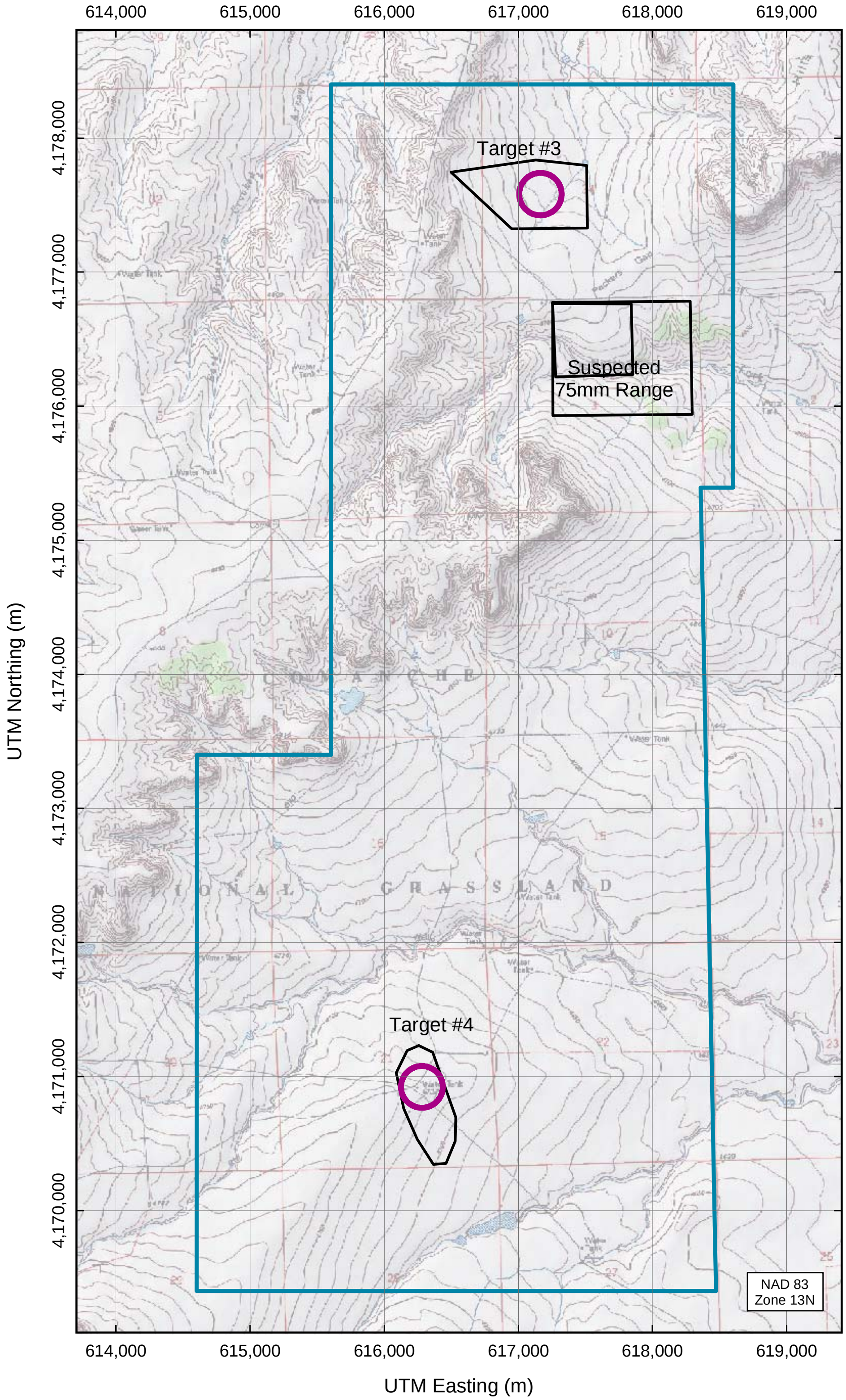

Fig. 2 – Detail of Pueblo PBR #2 showing the known and suspected targets

2.2 Demonstration Schedule

The top-level chronology of the demonstration at Pueblo PBR #2 is given in Table 2-1. Included in the Table are the survey dates for Phase I of the high-airborne surveys which was conducted in 2004. Details of the individual technology demonstrator's schedules will be contained in their respective demonstration reports.

Table 2-1. Performance Schedule for the Demonstration at Pueblo PBR #2

Date	Action
20 August 2004	LiDAR and orthophoto survey of BT4 begins
23 August 2004	LiDAR and orthophoto survey of BT4 complete
6 August 2005	LiDAR and orthophoto survey of remainder of site
29 August 2005	Ground surveys begin
8 September 2005	Helicopter magnetometry survey begins
20 September 2005	Helicopter magnetometry survey ends
7 October 2005	Ground survey break
18 October 2005	Resume ground survey
22 October 2005	Ground survey ends

2.3 High Airborne Surveys

As noted above, the high airborne measurements, LiDAR and orthophotography, were conducted in two phases. The initial measurements were conducted in 2004 as part of a base ESTCP demonstration. Five thousand additional acres were surveyed in 2005 as part of the WAA demonstration. The orthophotos collected are shown in Figure 3 and the LiDAR results in Figure 4. Obviously, from the scale shown here no individual features can be seen. In the next section we will discuss each area of interest individually and more detail will be presented from these data sets.

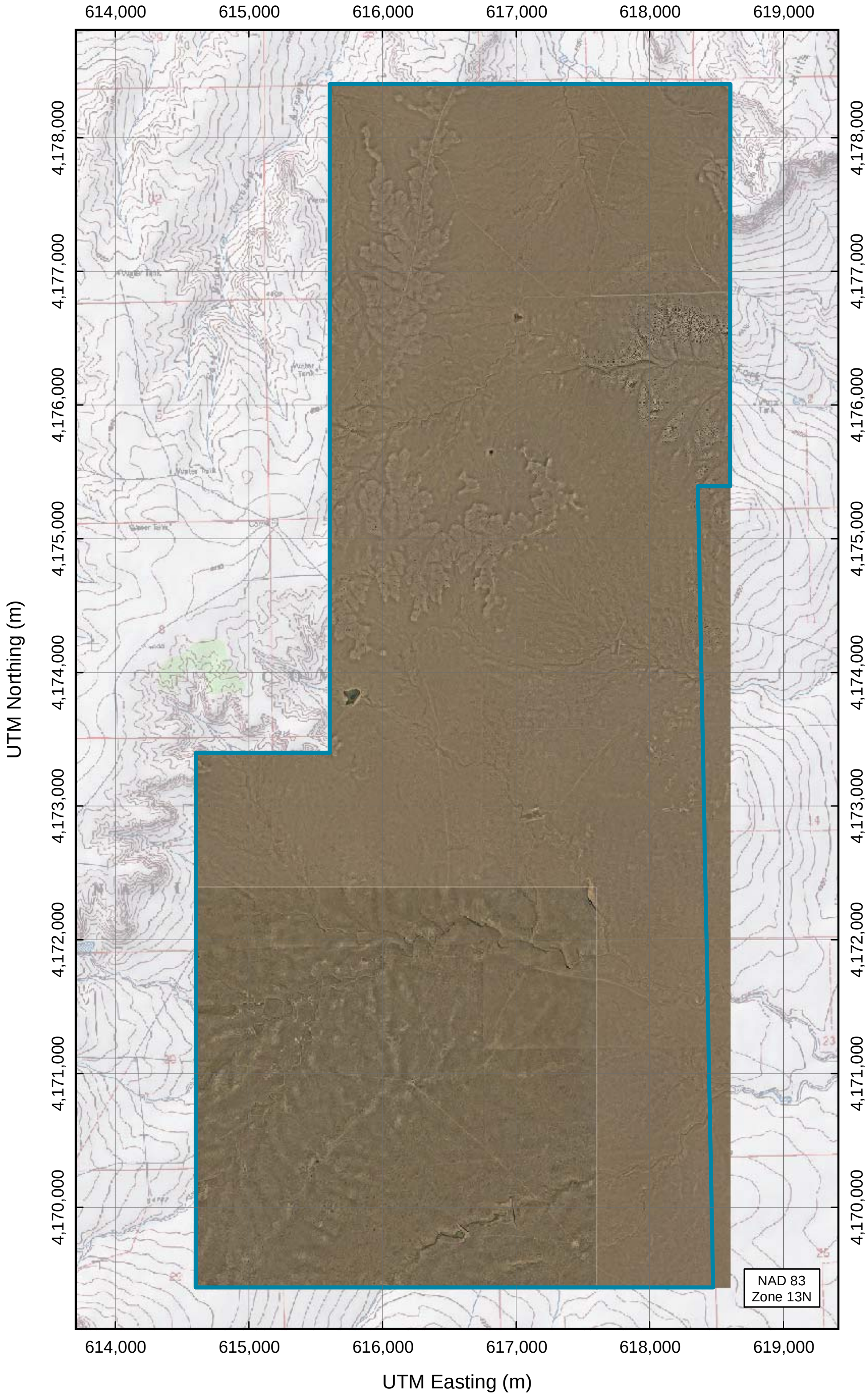

Fig. 3 – Orthophotograph of the Pueblo PBR #2 WAA site

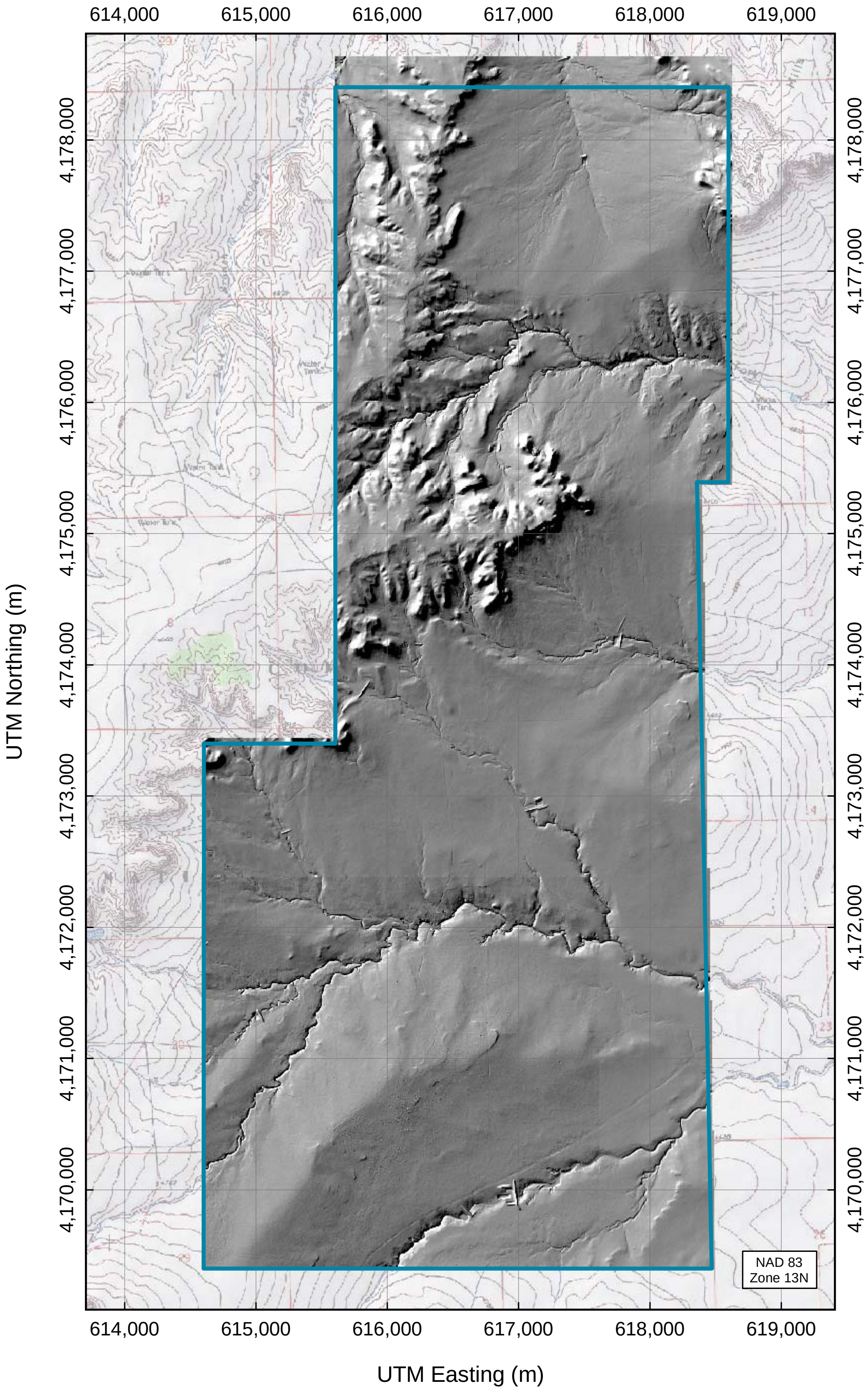

Fig. 4 – LiDAR results from the Pueblo PBR #2 WAA site

2.4 Magnetometry

An overview of the helicopter-borne magnetometer array data is shown in Figure 5. Although only 5,000 acres of helicopter array surveying was planned at this site, the coverage by this platform is not as complete as the high airborne sensors due to the challenging terrain and trees near the deep wash that cuts through the site. The effect of the trees is seen in particular near the suspected 75mm area on the eastern side of the site.

The vehicular magnetometer array was used in two ways during this demonstration. In the first series of measurements, the magnetometer array was used to survey preplanned transects across the site. These transects were planned using Visual Sample Plan developed and implemented for this site by researchers from Pacific Northwest National Laboratory. Two sets of transects were surveyed in this way: an initial set designed to locate the expected targets based on the information in version 0 of the Conceptual Site Model, and a follow-on set, developed after the results of the initial transects had been analyzed, designed to better define the extent of areas of high anomaly density identified by the first transects. The follow-on transects were perpendicular to the original N-S transects. The results of these transect measurements are shown in Figure 6 where the lines indicate the actual course-over-ground of the vehicular array and the symbols represent anomalies coded by amplitude.

Following completion of the transect measurements, the vehicular array was used to conduct 100% coverage surveys of selected areas on the site. These areas were chosen to better define the target density fall-off away from the center of identified targets, determine a background anomaly density on presumably uncontaminated regions of the site, and determine if there is any measurable contamination in the suspected 75mm area. An overview of the full coverage survey data is shown in Figure 7.

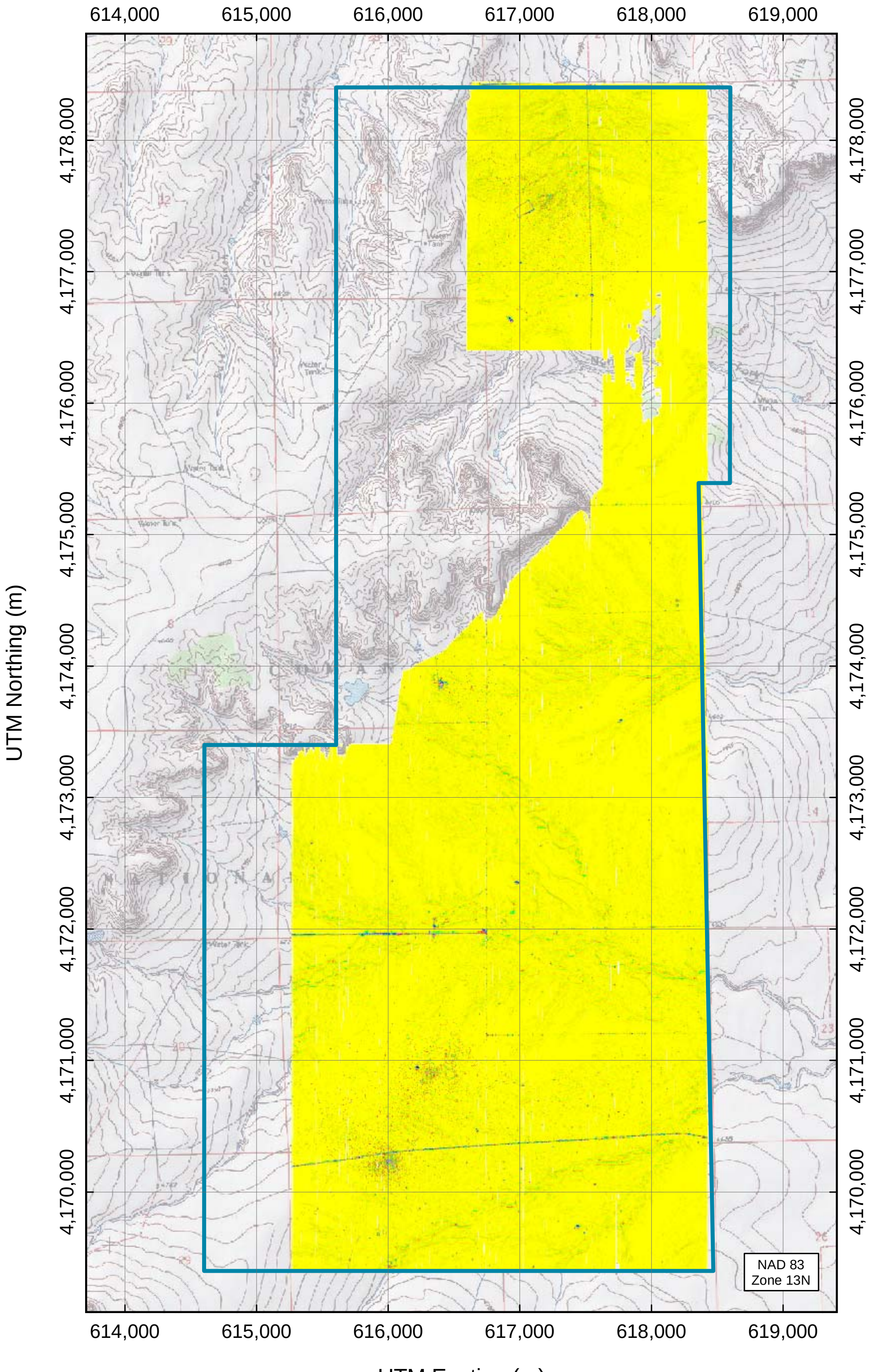

Fig. 5 – Overview of helicopter-borne magnetometer array data from the Pueblo PBR #2 WAA site

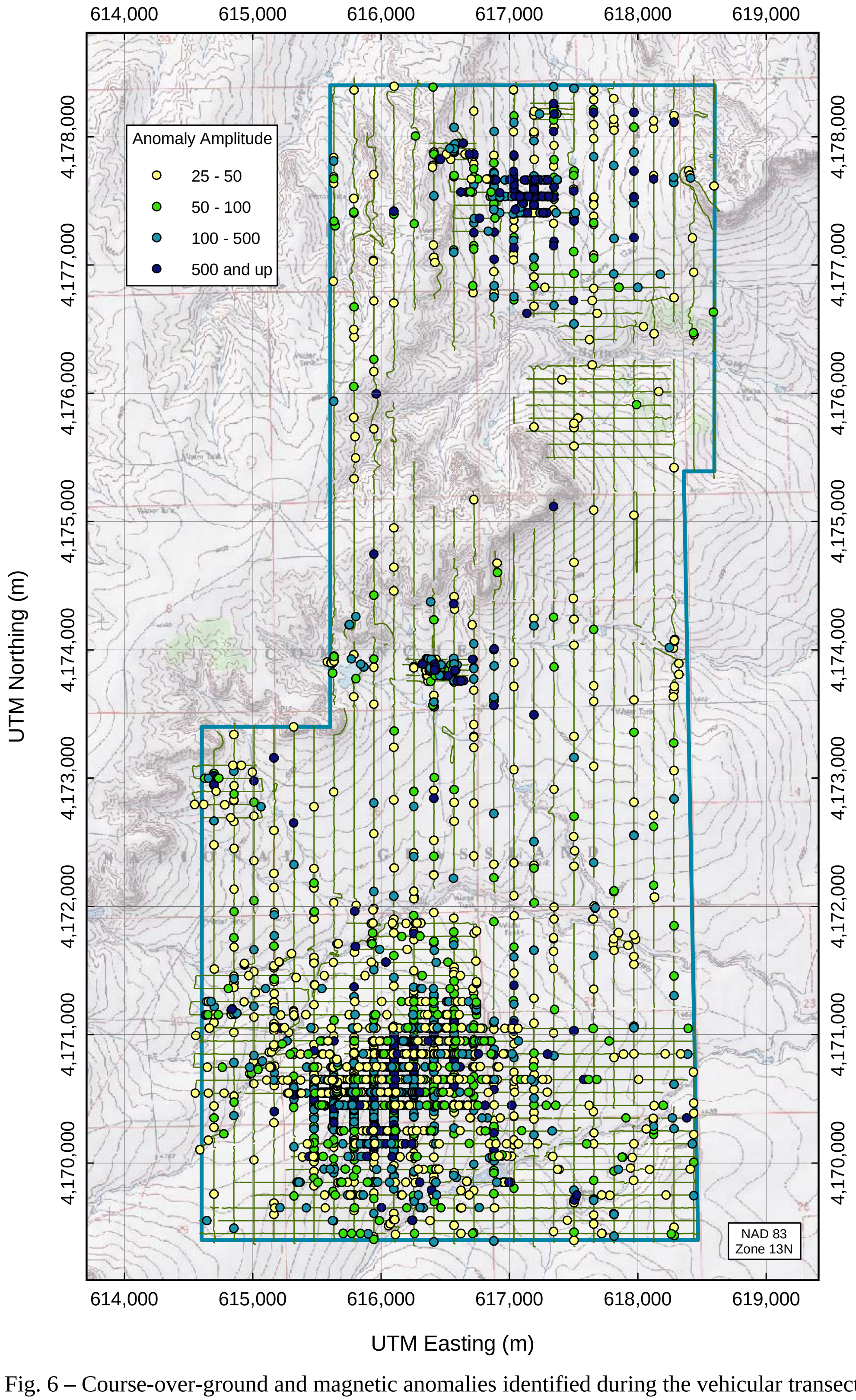

Fig. 6 – Course-over-ground and magnetic anomalies identified during the vehicular transect survey of the Pueblo PBR #2 WAA site. Both the original N-S transects and the later E-W transects added to improve target definition are shown.

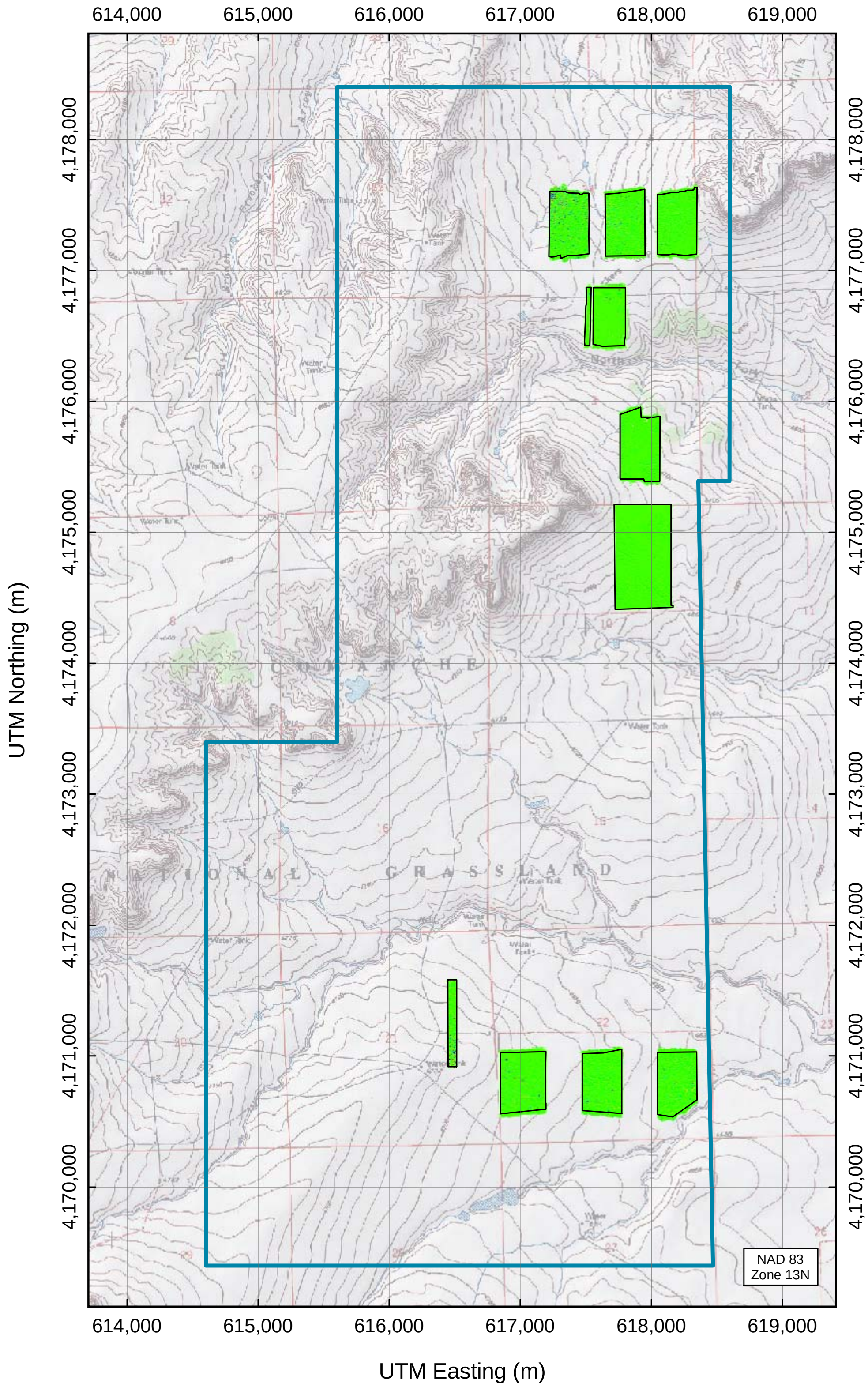

Fig. 7 – Vehicular full coverage areas at the Pueblo PBR #2 WAA site

3. Validation

The specific validation activities planned will be discussed in the following sections organized by sub-areas of the WAA site. The locations of these areas are shown in Figure 8.

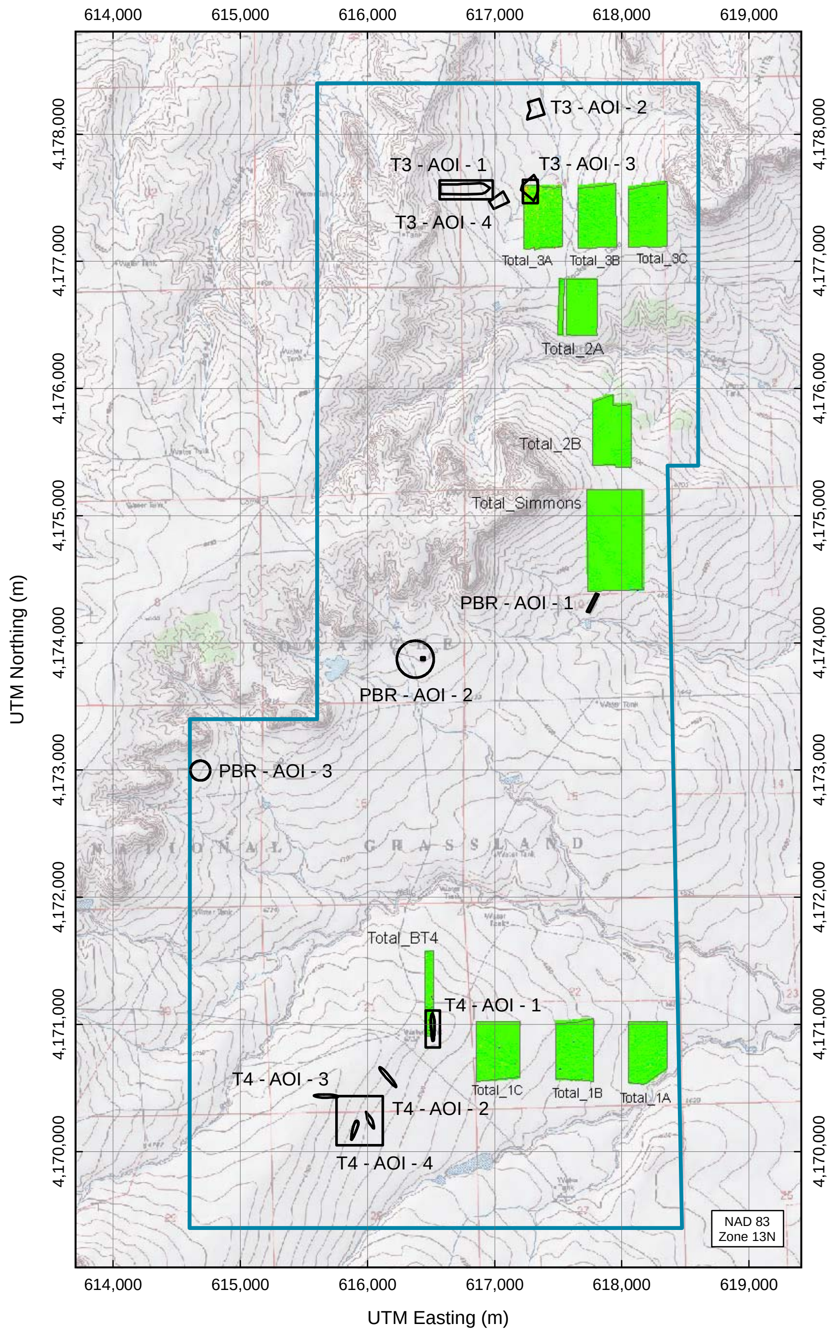

Fig. 8 – Individual areas of the Pueblo WAA site that will be the subject of validation activities

In general, there will be two phases of validation. In the first phase, a ground reconnaissance effort, features that have been identified in one of the geophysical data sets that might be ordnance-related will be visited, photographed, and, if needed, interrogated with a hand-held geophysical instrument. Examples of features that will be visited in this phase include the berm in PBR-AOI-1 and the structure preliminarily identified as a pump house in T3-AOI-2 in Figure 8. During this phase a selection of the features identified from the high-airborne techniques such as ship target outlines, target circles, and suspected craters will be visited and verified. An example reconnaissance contact sheet is shown in Appendix A. Quantitative validation of the precise location and sizes of these features will be conducted in the second phase of validation.

The second phase of validation will consist of intrusive recovery of selected items. The items to be dug will be chosen based on analysis of the anomaly signatures measured by the helicopter-borne and ground magnetometer arrays. All anomalies detected in the ground total coverage areas shown in Figure 8 and ~2,000 anomalies from the helicopter data have been fitted to a dipole response model and target parameters such as location, depth, and rough size extracted. The inversion results for two of the ground areas are given in Appendix B. These target parameters can be sorted to yield lists of targets in a narrow range of size, or depth, or position. An example dig sheet for the intrusive investigation is shown in Appendix C.

3.1 Bombing Target 3

3.1.1 Reconnaissance

The LiDAR data from the area around BT3 is shown in Figure 9. In addition to the central target rings, four other areas of interest have been identified from these data. The area labeled T3-AOI-1 is reminiscent of the ship targets that will be discussed in conjunction with Bombing Target 4 but is much larger in size. Areas T3-AOI-2 and T3-AOI-3 are raised areas and T3-AOI-4 is a fenced area, all of which need to be visited during the reconnaissance phase of the validation effort. There are also a number of possible craters seen in the LiDAR data and flagged by Sky Research. The ASR did not indicate that HE was used on this target. The possible craters will have to be visited in the reconnaissance phase to verify their origin. Some of these same features are seen in the orthophotograph of this area shown in Figure 10.

3.1.2 Intrusive Investigation

The helicopter magnetometry data for this area is shown in Figure 11 and the ground transect data in Figure 12. The transect data clearly show some enhanced anomaly density associated with T3-AOI-2, in fact the presence of E-W transects indicates that this area was flagged by the VSP analysis for further investigation. This enhanced density is not seen in the helicopter data, possibly indicating that these anomalies are associated with small, surface items such as fence wire scrap. Depending on the results of the reconnaissance, a selection of these targets may require digging.

The anomaly maps from both platforms make it likely that the anomalies inside T3-AOI-1 and T3-AOI-3 are spillover from the main bombing target. Unless the reconnaissance provides contrary evidence, these anomalies can be assigned to BT3. Although the helicopter system did not record a significant number of anomalies inside the fenced area designated T3-AOI-4, the

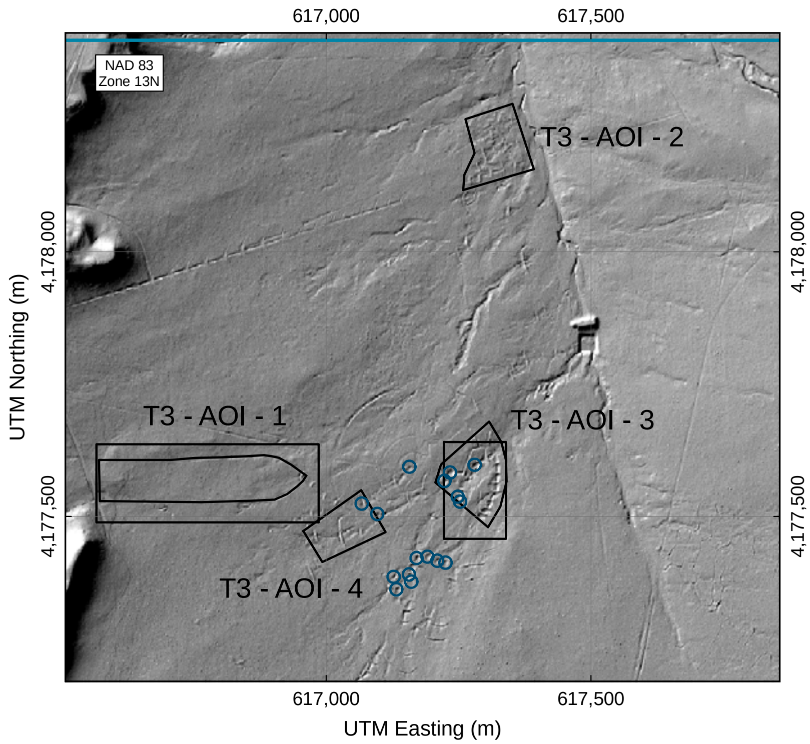

Fig. 9 – LiDAR data from the area near BT3. Possible craters identified from the data are marked.

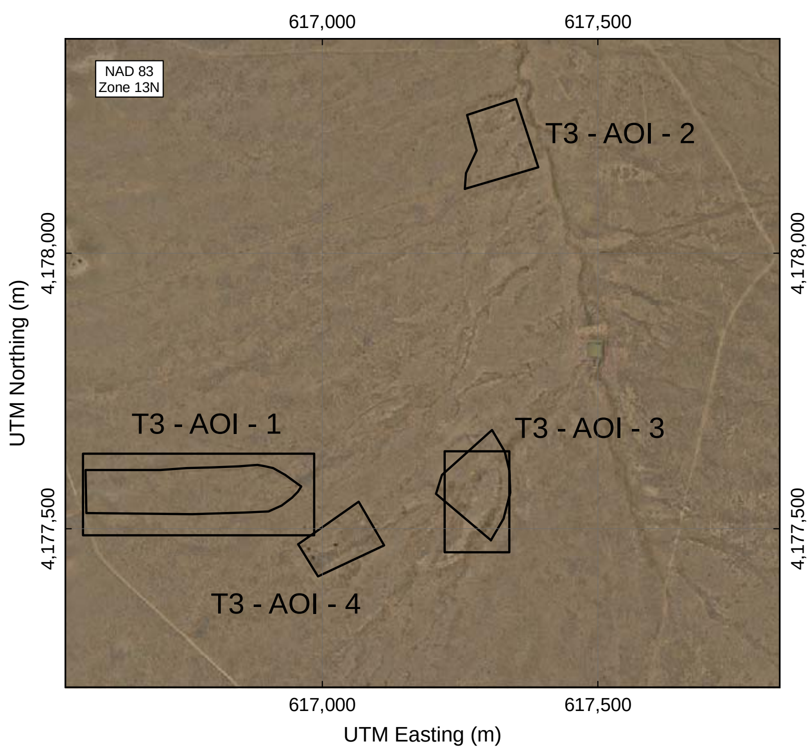

Fig. 10 – Orthophotograph of the area near BT3

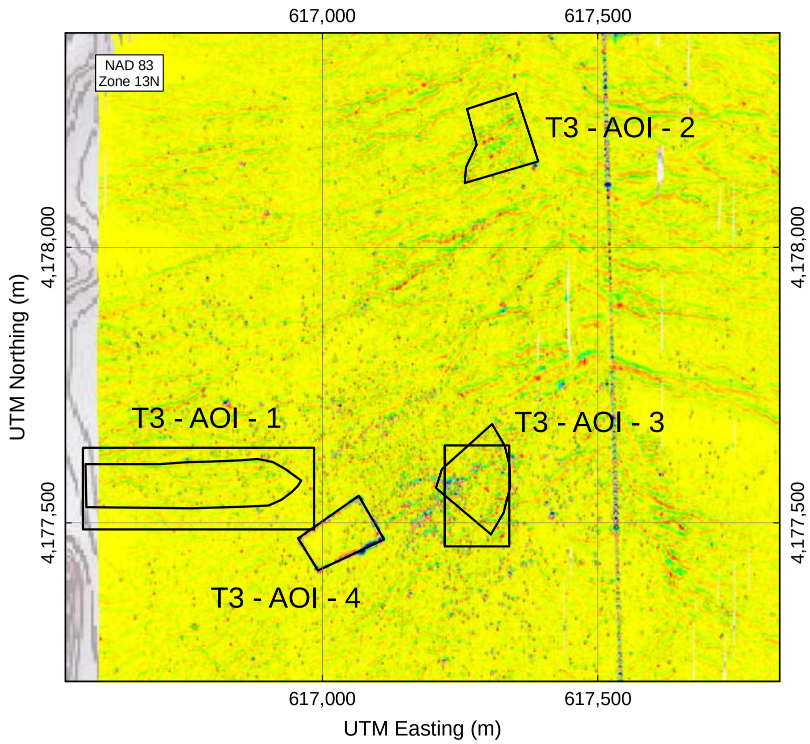

Fig. 11 – Helicopter magnetometry data from the area near BT3

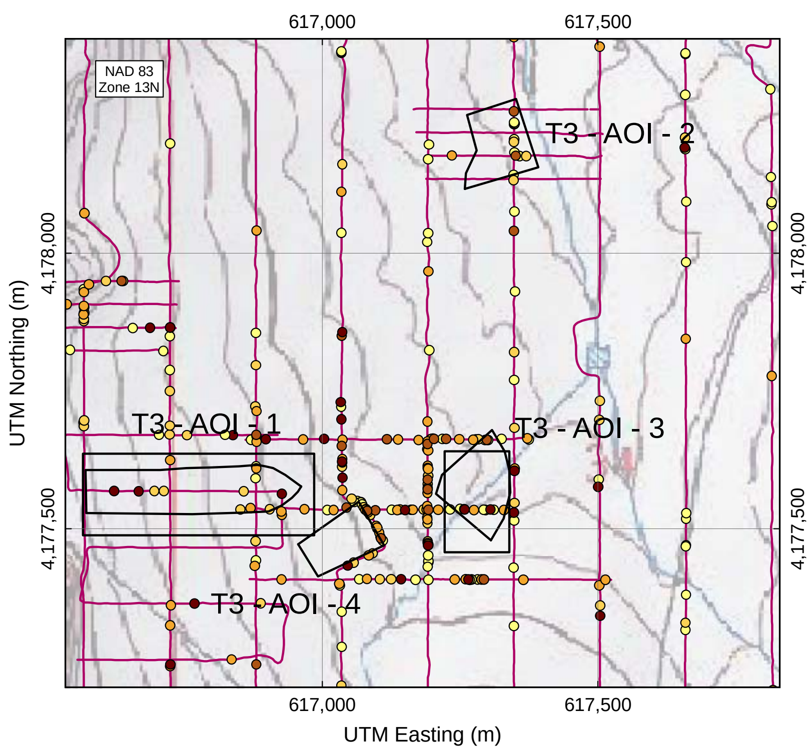

Fig. 12 – Ground transect data from the area near BT3

vehicular system was not able to survey inside the fence. A judgment on this area will be made following reconnaissance.

The vehicular total coverage in this area is shown in Figure 13. Two of the total coverage areas associated with BT3 partially appear in this view. The three total coverage areas designated Total_3A, Total_3B, and Total_3C are shown in Figure 14.

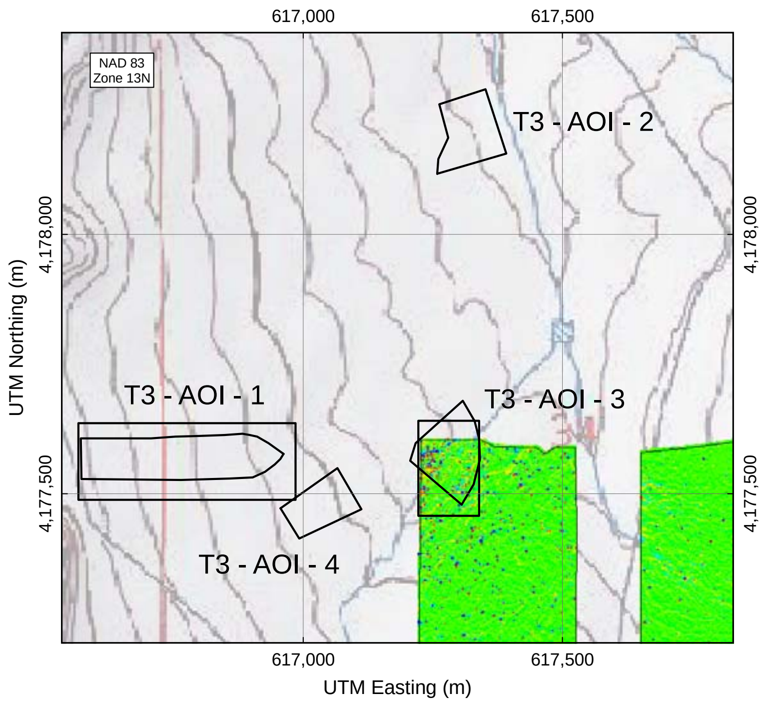

Fig. 13 – Ground total coverage areas near BT3

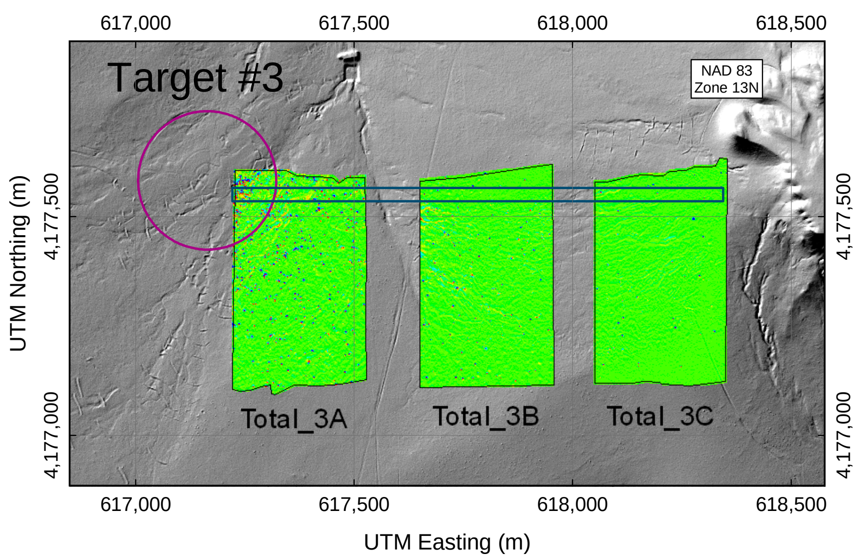

Fig. 14 – The three ground total coverage areas associated with BT3 with the band used to calculate density shown

Nova Research scientists counted the anomaly density in a series of 30 x 30-m cells across the top of these three total coverage areas. A plot of the density as a function of distance from the center of BT3 is shown in Figure 15.

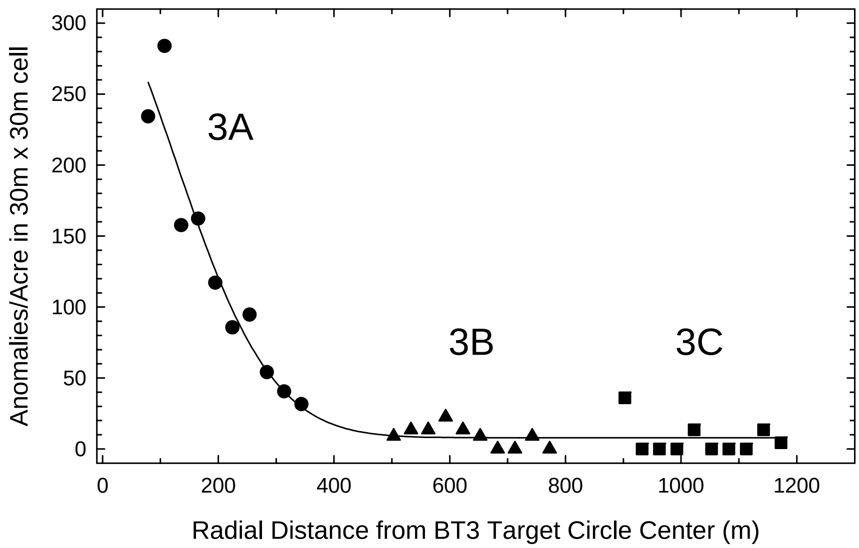

Fig.15 – Anomaly density as a function of distance from the center of BT3 for a transect across the top of the total coverage areas shown in Fig. 14

The symbols in Figure 15 are the counted densities and the line is a fitted function assuming a normal distribution of anomalies centered on the target with a small background level independent of the target. The labels on the plot denote which of the three areas the points are from. If the model is correct, the anomalies in Total_3B and Total_3C are background anomalies. All the anomalies corresponding to the points shown in Figure 15 will be dug to verify this.

3.2 Bombing Target 4

Bombing Target 4 is the target identified from the historical documents in the southern part of the WAA site. Like BT3, it has a number of areas of interest associated with it as seen in the LiDAR image of the area shown in Figure 16. The orthophotograph of the equivalent portion of the site is shown in Figure 17.

3.2.1 Reconnaissance

There are no unexplained observations associated with this target. The four AOIs contain ship-shaped targets surrounding the central target ring. There are a number of likely craters throughout the area, a number of which will be verified during reconnaissance and revisited during the intrusive investigation for quantitative determination of their location and size.

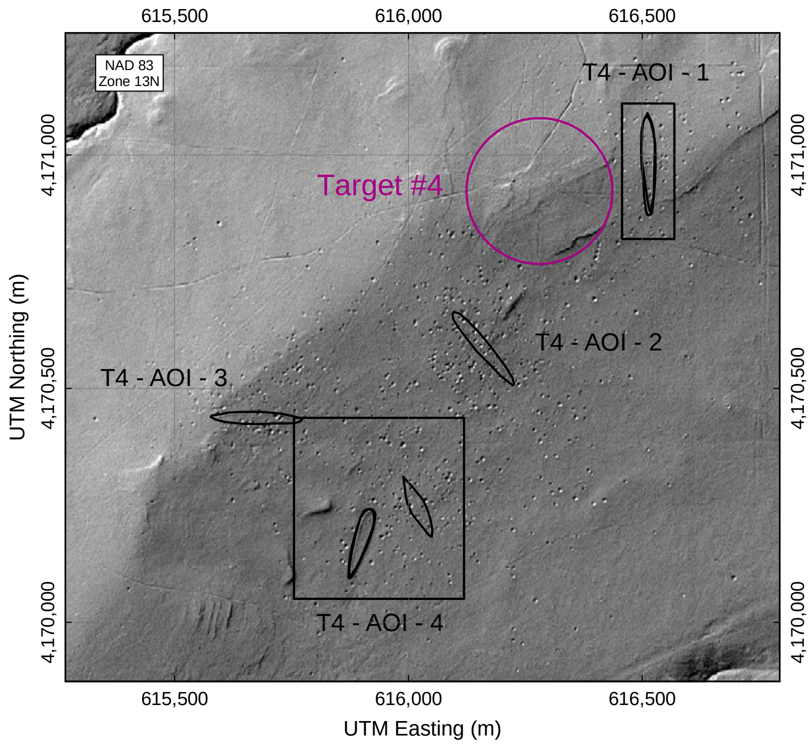

Fig. 16 – LiDAR image of the area around BT4

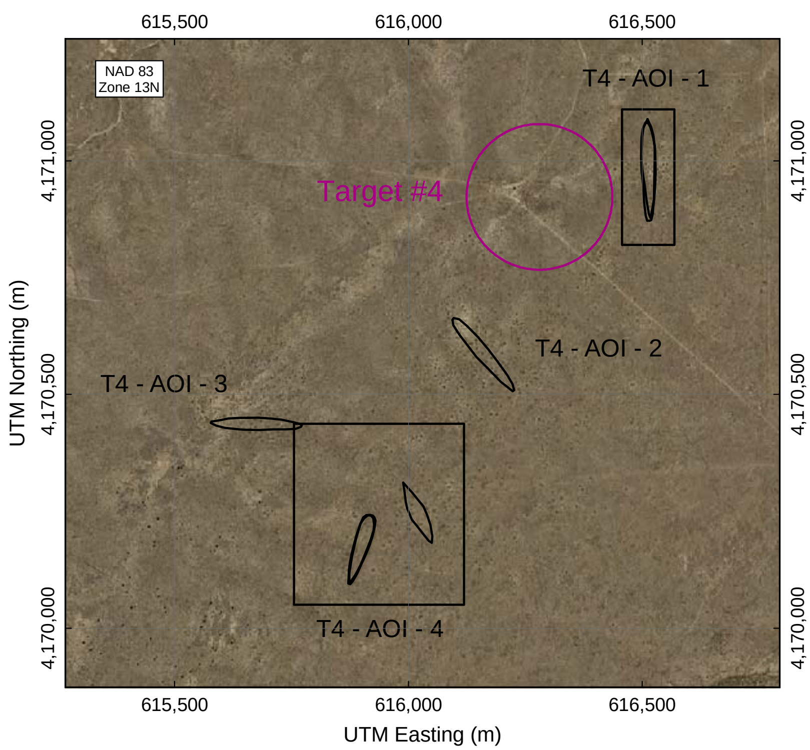

Fig. 17 – Orthophotograph of the area around BT4

3.2.2 Intrusive Investigation

The helicopter magnetometry anomaly image of this area is shown in Figure 18 and the ground transect data in Figure 19.

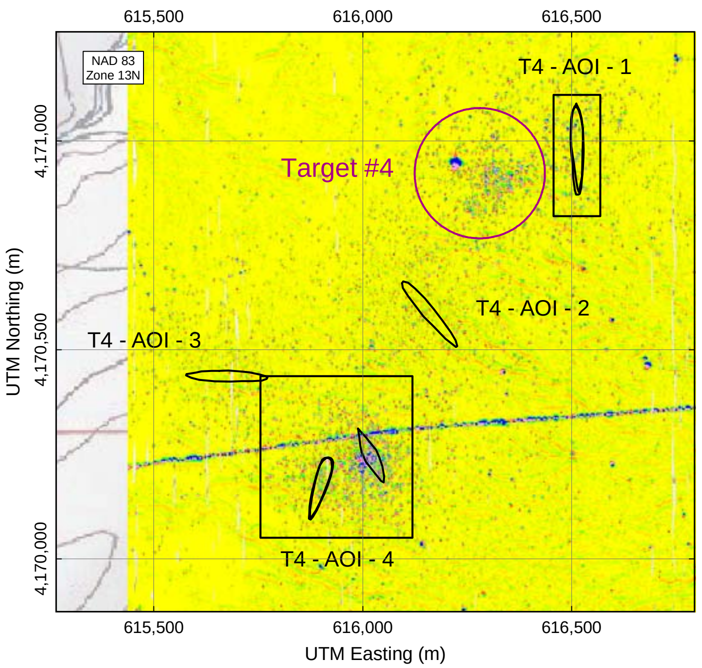

Fig. 18 – Helicopter magnetic anomaly map of the area around BT4

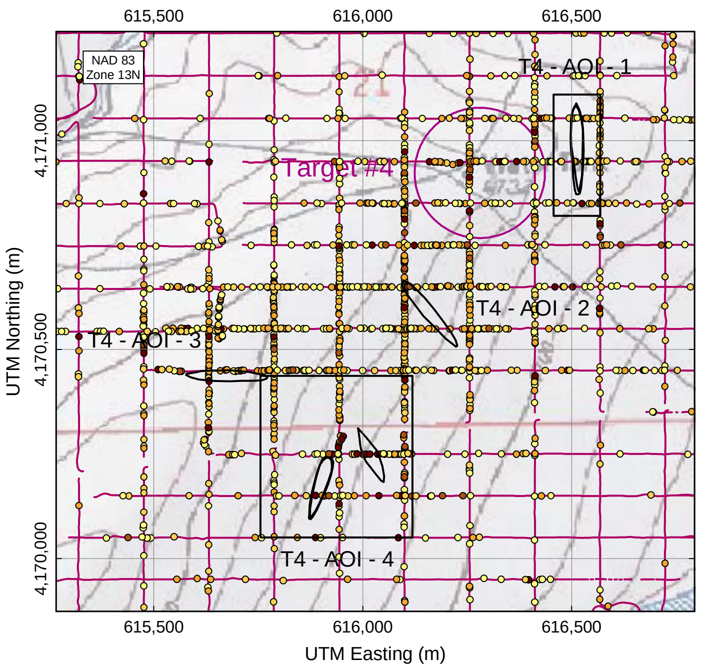

Fig. 19 – Ground transect data from the area around BT4

All the anomalies seen in these two figures can be associated with either the main target circle or the auxiliary ship targets. As part of the planning process for an eventual remediation of the site, there is interest in knowing if the same ordnance types were used against the ship targets as against the central ring. Several dozen likely UXO targets in the central ring and one of the ship targets have been selected from the helicopter array data and analyzed. All of these targets will be dug to provide data on ordnance use.

As was the case for BT3, three patches, increasingly far from the target center, were completely surveyed using the ground system. These data are shown in Figure 20. For reference, the LiDAR image of the same area is shown in Figure 21. As can be seen, the 100% coverage patches start on the eastern edge of the target and continue to the eastern edge of the WAA site.

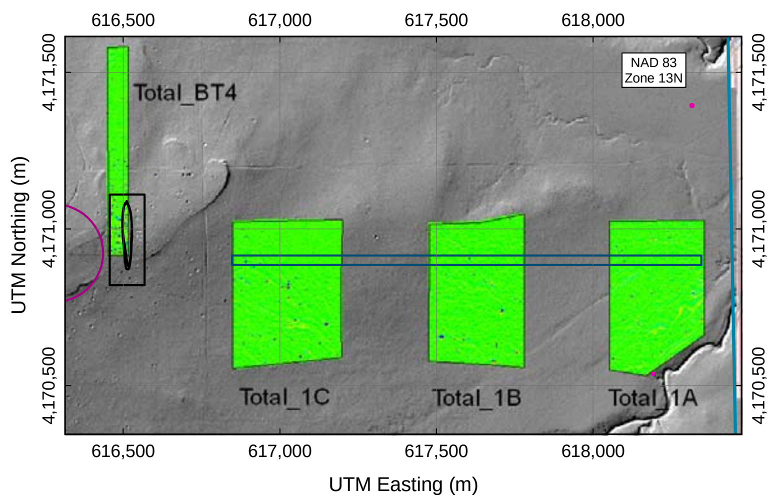

Fig. 20 – Ground total coverage areas associated with BT4 showing the band used to calculate anomaly density

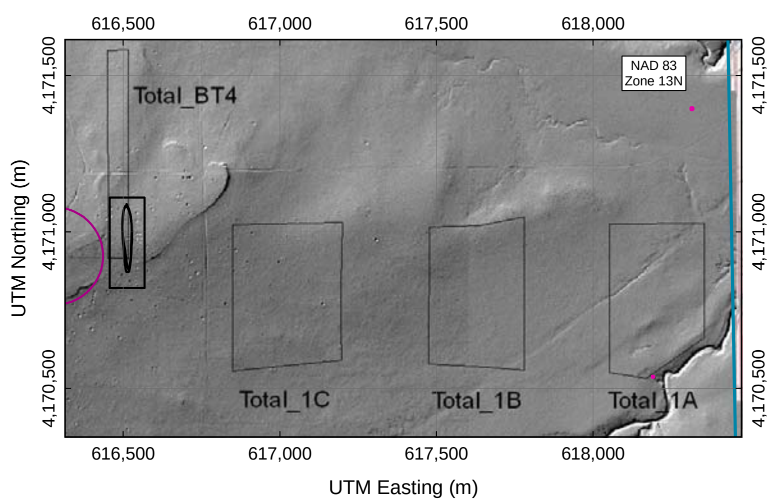

Fig. 21 – LiDAR image of the area shown in Fig. 20

As was done for the total coverage data from BT3, a density vs. radial distance plot was made for these data also and is shown in Figure 22. The form of the plot is similar to that from BT3 and the tentative conclusions are the same. Anomalies in the two patches farthest from the target will be dug to confirm that they are not ordnance-related.

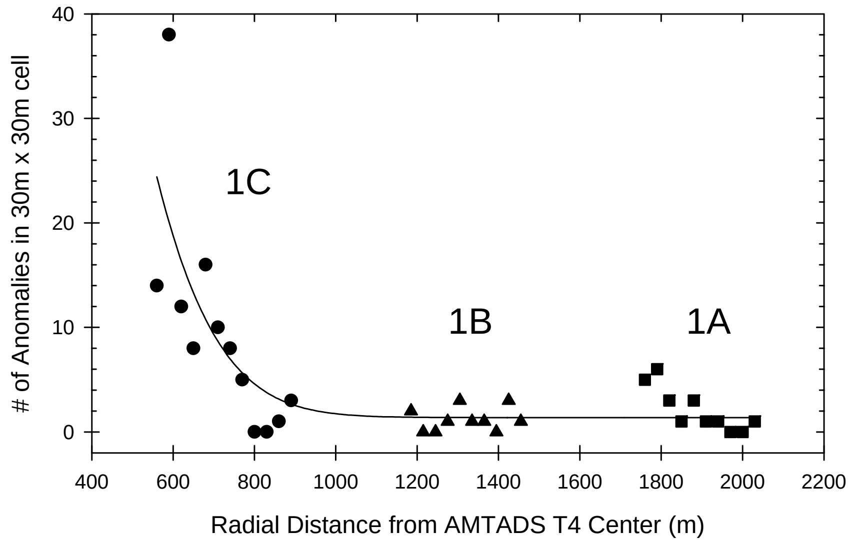

Fig. 22 – Anomaly density as a function of distance from the center of BT4 for a transect across the top of the total coverage areas shown in Fig. 20

3.3 Suspected 75mm Range

3.3.1 Intrusive Investigation

The high airborne data for the suspected 75mm range is shown in Figures 23 and 24. Both images show the deep wash that cuts across the WAA site here but the roughness of the terrain above and below the wash is better seen in the LiDAR image. By contrast, the trees above and below the wash are better seen in the orthophotograph.

This combination of rough terrain and substantial number of trees limited the coverage possible by the other sensors, especially the helicopter magnetometer array as seen in Figure 25. Only data collected when the helicopter was below 4-m above the ground is plotted in this figure. Obviously, many of the trees forced the helicopter above this limit. In the data that remain, there are very few anomalies seen. This is echoed in the ground transect data which is shown in Figure 26. It appears there is no large concentration of ferrous metal in this part of the WAA site.

To confirm this judgment, two patches of 100% ground coverage were obtained near the suspected 75mm range. The data are shown in Figure 27. One of the patches, Total_2A, is on the north edge of the area and the other, Total_2B, is just to the south of the area and is intended to serve as baseline. It appears that the top of area 2A is contaminated with anomalies associated

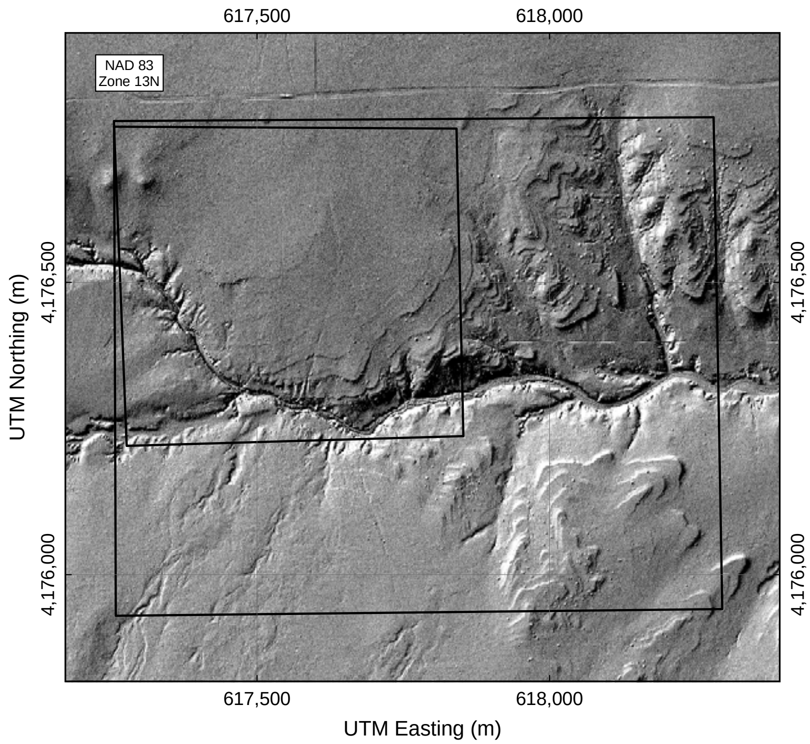

Fig. 23 – LiDAR data from the suspected 75mm range

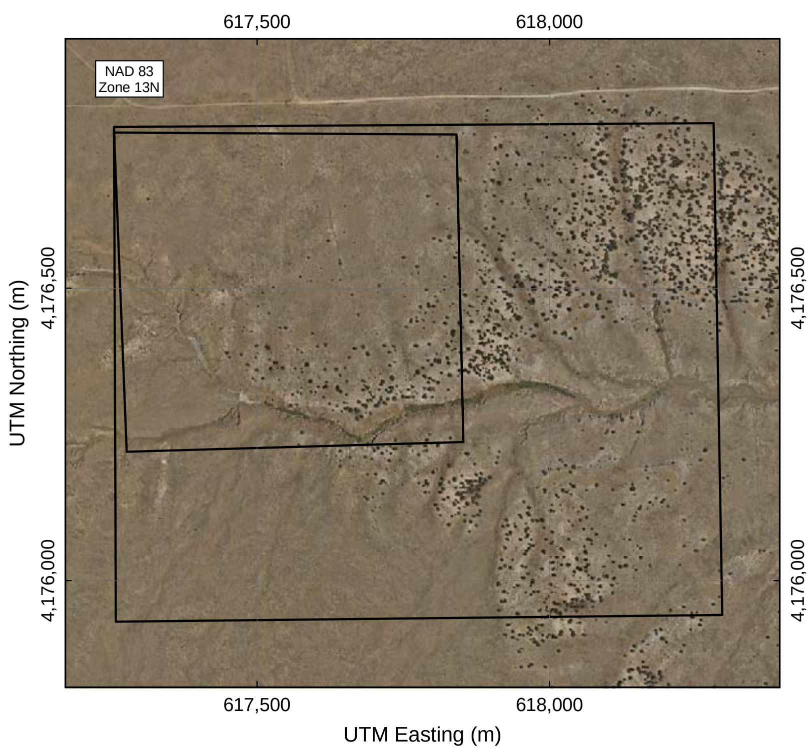

Fig. 24 – Orthophotograph of the suspected 75mm range

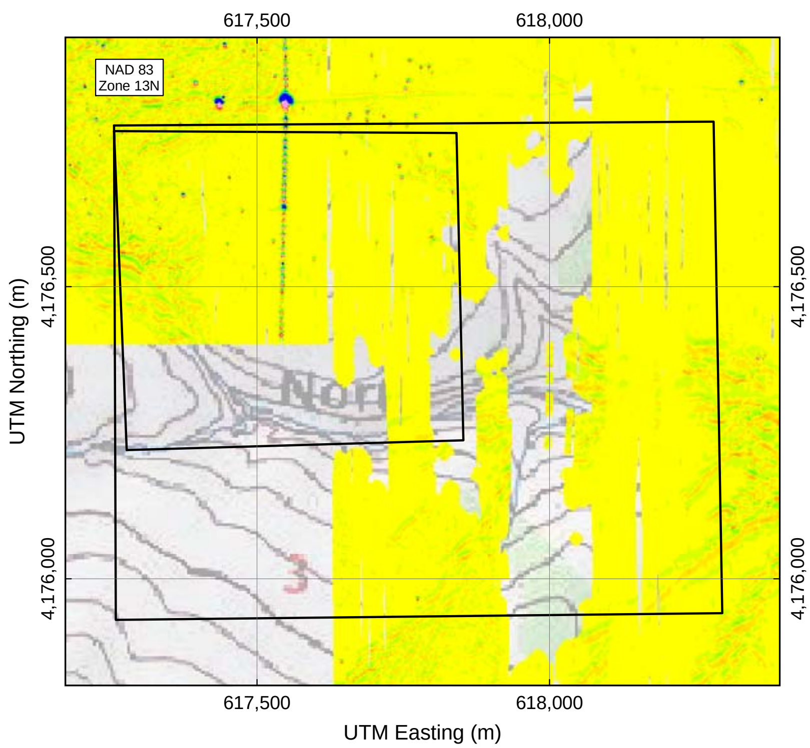

Fig. 25 – Helicopter magnetometry anomaly image of the suspected 75mm range

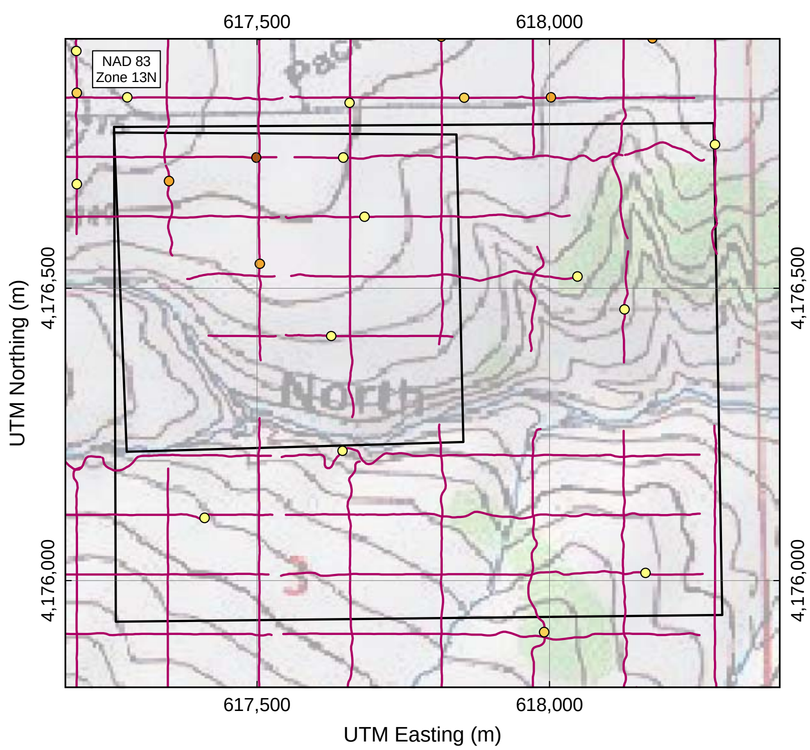

Fig. 26 – Ground transect data from the suspected 75mm range

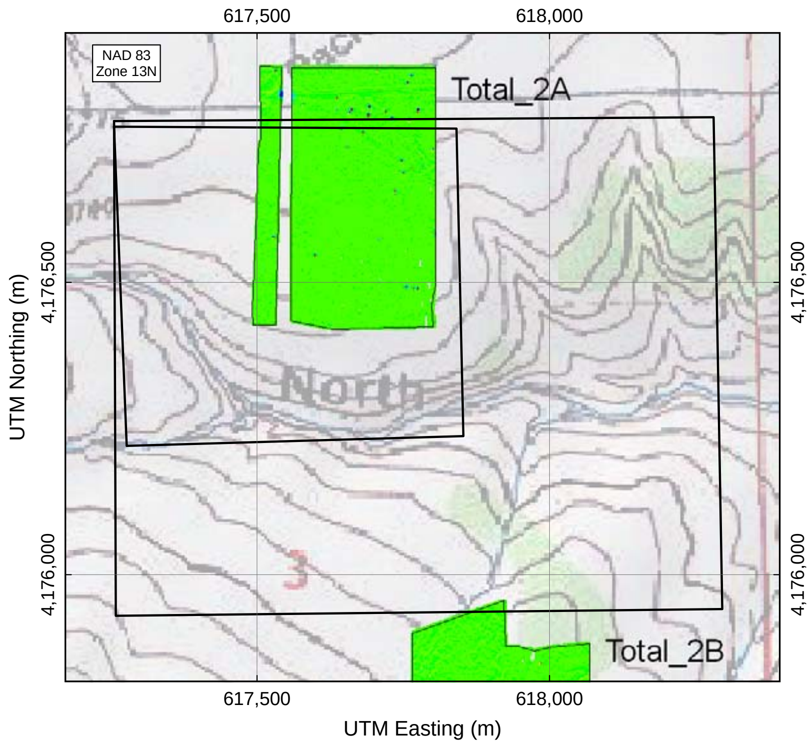

Fig. 27 – Ground total coverage areas associated with the suspected 75mm range

BT3 which is to the northwest of this area. All anomalies in total coverage areas 2A and 2B will be investigated.

3.4 Simmons Area

3.4.1 Intrusive Investigation

A large area in the center, east of the site was chosen to represent the naturally-occurring background of this site. The Simmons Area, so named because the Simmons family leases this land for their cattle, shows no areas of particular interest in the data collected by any sensor. The ground transect data is shown in Figure 28 as an example. A 100% coverage survey was conducted on this area using the ground system (100% coverage also was obtained by the helicopter system) and an anomaly image is shown in Figure 29. There are 72 anomalies identified in this area, 15 of which the analyst judged as likely geology. All 72 will be investigated.

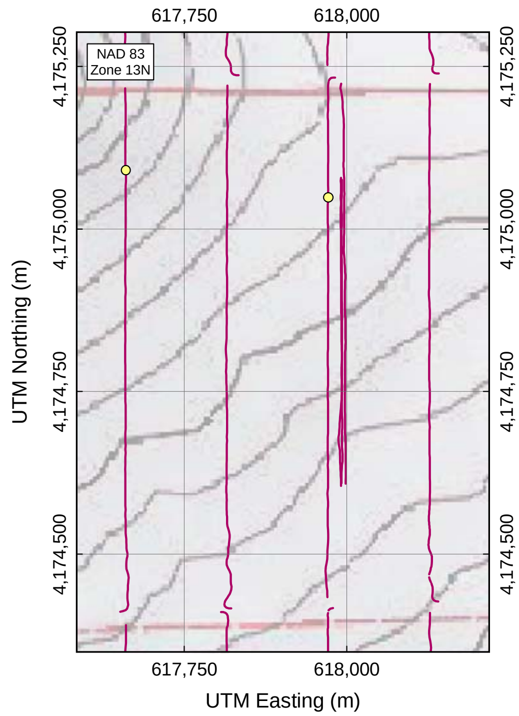

Fig. 28 – Ground transect results from the Simmons Area

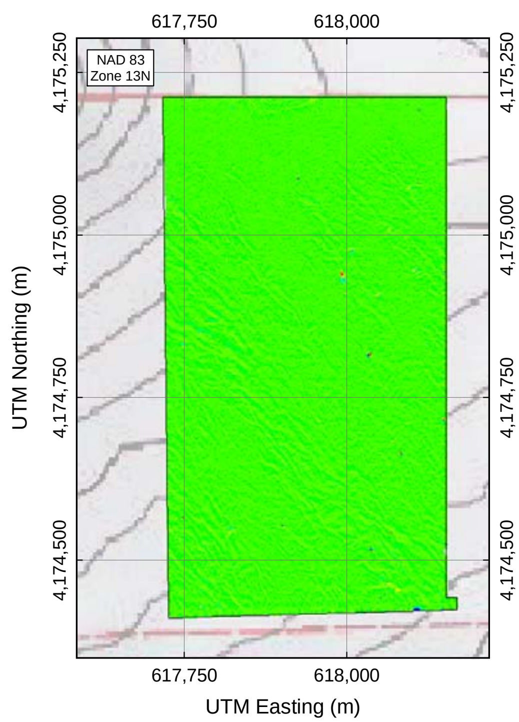

Fig. 29 – Ground total coverage data for the Simmons Area

3.5 PBR-AOI-1

3.5.1 Reconnaissance

The LiDAR image from the area of interest denoted PBR-AOI-1 is shown in Figure 30. There is a large berm-like feature in the image that is not explained. There is no concentration of magnetic anomalies associated with this feature as can be seen from the helicopter anomaly image in Figure 31. This feature will be investigated in the reconnaissance phase of the validation.

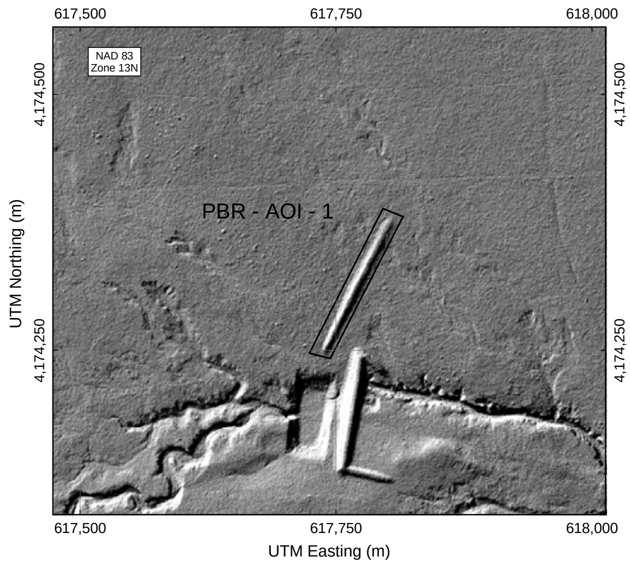

Fig. 30 – Anomalous feature denoted PBR-AOI-1

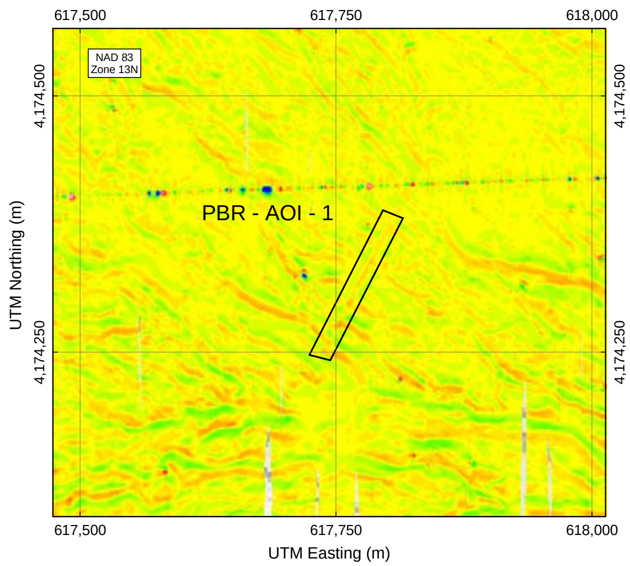

Fig. 31 – Helicopter magnetometer data near PBR-AOI-1

3.6 PBR-AOI-2

3.6.1 Reconnaissance

The LiDAR data from the area denoted PBR-AOI-2 is shown in Figure 32. Enclosed in a box in the center of the figure is a small structure. The helicopter magnetometry data from this area is shown in Figure 33 and the ground transect data in Figure 34. There are clearly significant magnetic anomalies associated with this structure. The ground survey crew report that this is an old homestead with a significant amount of barbed wire fragments scattered about. This will be investigated during the reconnaissance phase and, if appropriate, a number of the targets from the helicopter data dug in the later phase.

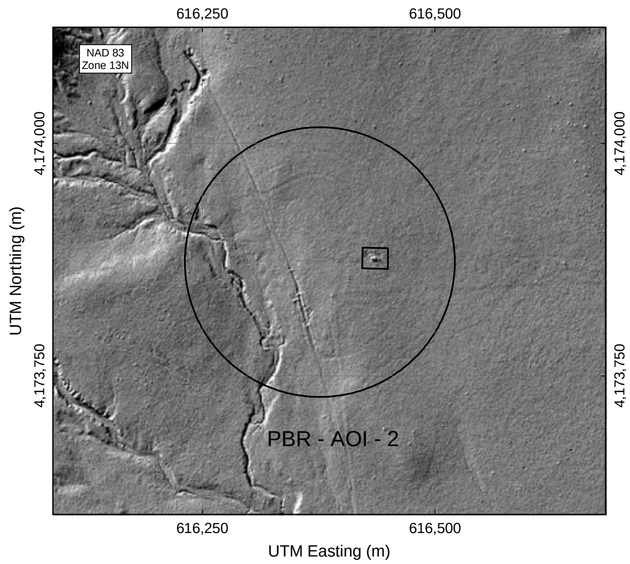

Fig. 32 – LiDAR from the area denoted PBR-AOI-2

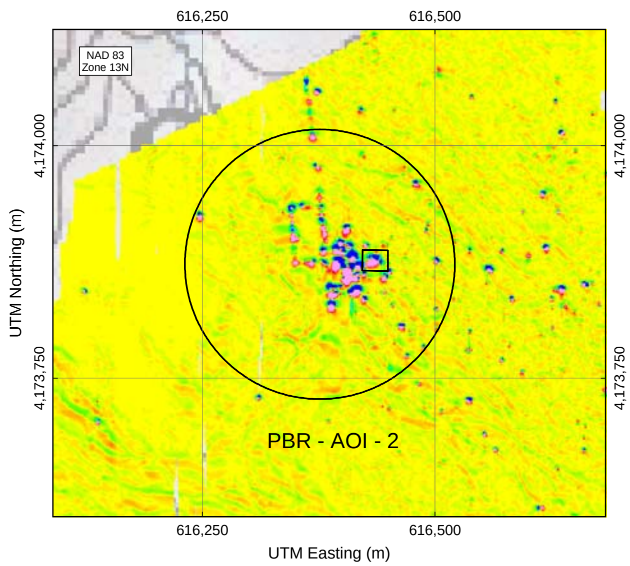

Fig. 33 – Helicopter magnetometry data from the area denoted PBR-AOI-2

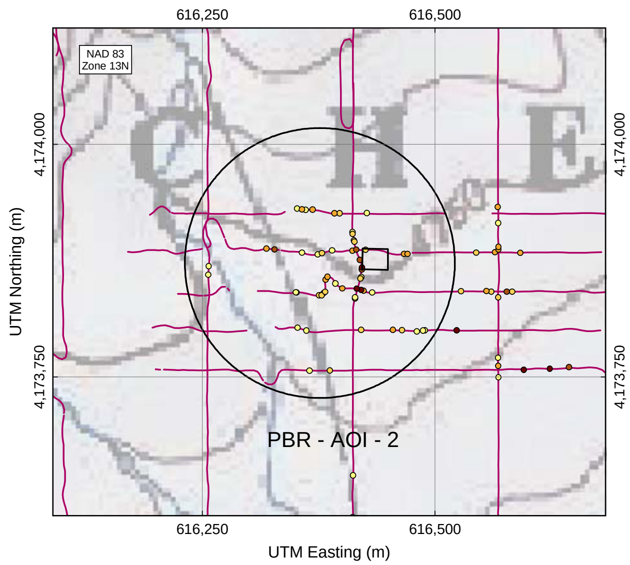

Fig. 34 – Ground transect data from the area denoted PBR-AOI-2

3.7 PBR-AOI-3

3.7.1 Reconnaissance

LiDAR data from PBR-AOI-3 is shown in Figure 35. There is a significant, unexplained depression on the western edge of the WAA site. There are a number of ground transect anomalies associated with this area of interest, Figure 36. The reconnaissance crew will visit this area and investigate with their hand-held instruments. Based on their results, additional digital geophysics and intrusive investigation may be required.

3.8 Other Areas

3.8.1 Reconnaissance

Because of the difficult terrain, none of the sensors was able to collect complete data in the wash the runs across the WAA site. The sides are quite steep in most places but the bottom is relatively flat and walkable. The reconnaissance crew will walk as much of the wash as possible employing both hand-held geophysical instruments and visual observation to search for evidence of possible UXO.

3.8.2 Intrusive Investigation

Several areas on the site that are not associated with one of the known targets have been designated for complete remediation as background; most notably the Simmons Area and ground total coverage area 2B. In addition to these areas, a number of anomalies from the helicopter magnetometer data not near any known target of area of interest will be to check for possible ordnance-related items.

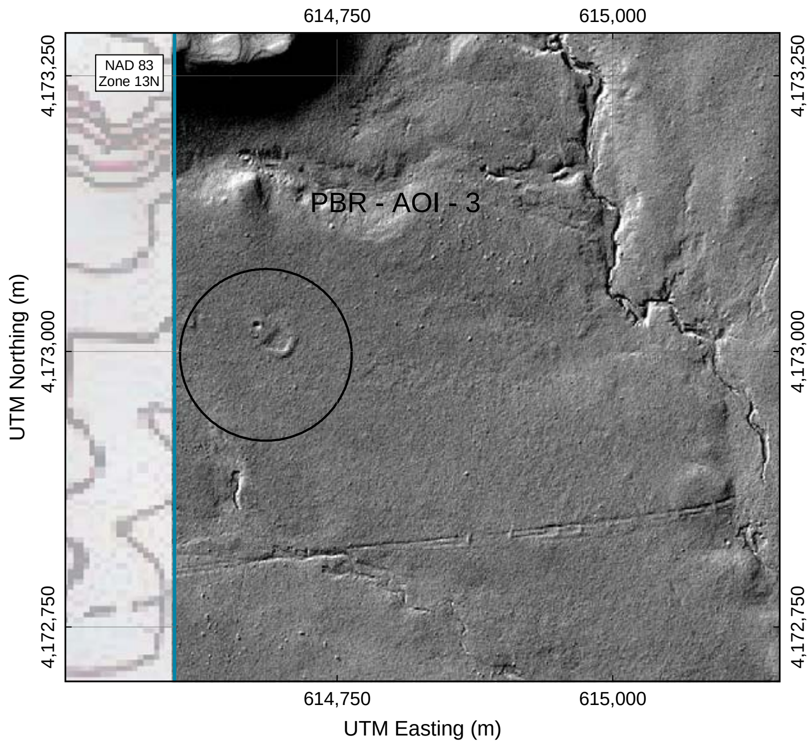

Fig. 35 – LiDAR data from the area denoted PBR-AOI-3

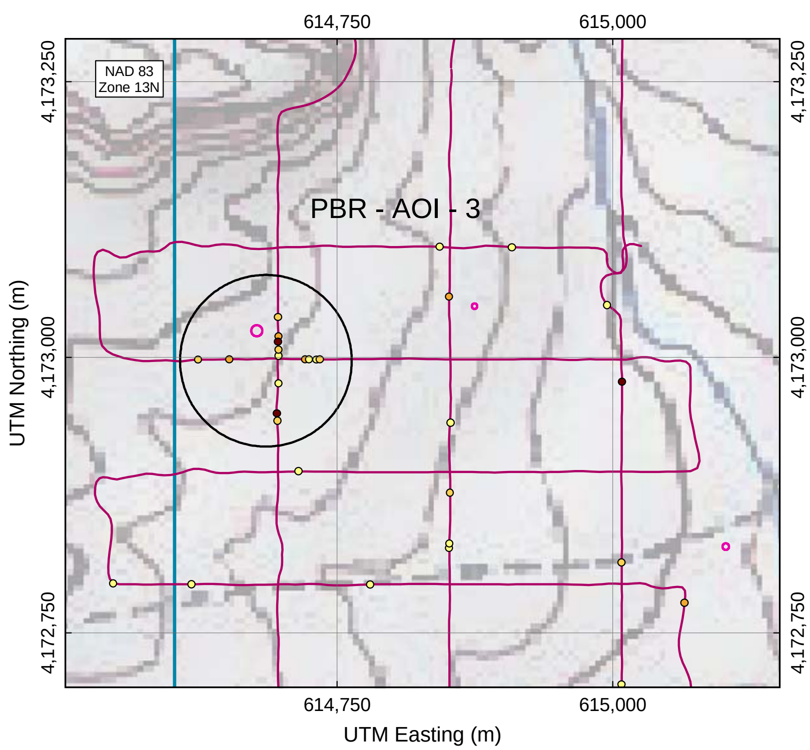

Fig. 36 – Ground transect data from the area denoted PBR-AOI-3

4. Implementation Issues

4.1 Regulatory Issues

Representatives from the US EPA and the Colorado Department of Public Health and Environment (see Section 6) are members of the Site Team for this demonstration and have been briefed on all planned activities in advance. Likewise, two representatives form the Comanche National Grassland are on the Site Team.

4.2 Stakeholder Issues

There are a number of stakeholder issues associated with this validation. There are several privately owned parcels within the preliminary site boundaries. Each of these landowners was contacted before data collection and made aware of the demonstration goals and plans. The largest portion of the preliminary site comprises part of the Comanche National Grasslands. These lands are used for recreation and permitted cattle grazing. The grazing permittees were notified at a briefing in La Junta before demonstration activities were conducted on site and verbal permission to proceed was obtained from all stakeholders.

Another meeting with the stakeholders was held on April 6, 2006 before the start of validation activities. The goals of the validation effort were discussed as well as the specific targets chosen for remediation. As before, stakeholder approval was obtained before initiation of field activities.

5. References

1. “Report of the Defense Science Board Task Force on Unexploded Ordnance,” December 2003, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, Washington, D.C. 20301-3140, http://www.acq.osd.mil/dsb/uxo.pdf.

2. “Wide Area Assessment (WAA) Site Selection,” Versar, Inc. Memorandum, March 23, 2005.

6. Points of Contact

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<u>EOTI</u> (Ground Reconnaissance & Intrusive Investigation)

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<u>Comanche National Grasslands</u>

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Colorado State Board of Land Commissioners

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Russell Round		Tel: 719-383-4615
Brian & Janet Simmons		Tel: 719-456-0334 (H) 719-456-1559 (W)

Appendix A. Example Reconnaissance Contact Report

Pueblo Precision Bombing Range #2 La Junta, CO

Item Number	UTM Northing (m)	UTM Easting (m)
P-076	4171029.56	617035.44
Actual:		

Description:	Possible Crater
Question:	Is this munitions related?

Field Observations:

Photograph Number:	
Team Supervisor:	
Date & Time:	

Appendix B. Target Parameters from Vehicle Data

Table B1. Target Parameters for PBR #2, Area 1A

ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
P1A-1	618253.26	4171037.28	0.28	0.050	0.0662	11	20	0.9574	
P1A-2	618251.98	4171036.49	0.35	0.027	0.0105	77	111	0.9859	
P1A-3	618218.20	4171027.51	0.33	0.034	0.0208	55	30	0.9879	
P1A-4	618188.42	4171037.68	1.45	0.122	0.9852	-14	131	0.8819	Diffused Dipole - Geologic?
P1A-5	618049.96	4171020.07	0.85	0.072	0.1977	23	73	0.8082	Poor Fit
P1A-6	618068.69	4171022.04	1.32	0.107	0.6672	-1	200	0.8460	Diffuse Dipole - Geologic?
P1A-7	618093.09	4171025.88	0.53	0.042	0.0404	-10	359	0.6639	Non-dipole
P1A-8	618123.06	4171029.55	1.12	0.076	0.2353	-2	323	0.6228	Most likely geology
P1A-9	618155.48	4171004.35	1.21	0.086	0.3431	8	341	0.7713	Geology?
P1A-10	618290.15	4170999.91	0.99	0.065	0.1497	19	7	0.7871	
P1A-11	618238.43	4170987.79	0.50	0.087	0.3513	16	64	0.9930	
P1A-12	618235.51	4170994.69	1.02	0.185	3.3901	25	350	0.7781	Overlapping targets?
P1A-13	618050.14	4170978.80	1.44	0.148	1.7470	-17	4	0.9547	
P1A-14	618056.33	4170977.49	0.58	0.063	0.1362	0	266	0.9219	
P1A-15	618056.22	4170976.66	0.56	0.046	0.0525	-22	224	0.9084	
P1A-16	618183.43	4170979.75	1.18	0.116	0.8369	-2	40	0.8072	Diffuse dipole - Geology?
P1A-17	618294.29	4170970.58	1.20	0.092	0.4175	9	38	0.8413	Diffuse dipole - Geology?
P1A-18	618244.62	4170975.69	1.51	0.174	2.8421	24	230	0.7025	Probably geology
P1A-19	618239.54	4170974.16	1.31	0.149	1.7645	-31	301	0.9719	Diffuse dipole - Geology?
P1A-20	618196.77	4170971.13	2.04	0.158	2.1298	14	323	0.8857	Likely geology
P1A-21	618186.70	4170968.37	0.59	0.105	0.6311	-16	46	0.7900	Complex non-dipole signal
P1A-22	618125.27	4170974.01	0.58	0.051	0.0733	15	107	0.9258	
P1A-23	618111.88	4170974.96	1.13	0.069	0.1767	86	90	0.7356	
P1A-24	618142.37	4170973.21	1.33	0.085	0.3365	23	253	0.9398	Geology?
P1A-25	618164.87	4170958.75	0.97	0.076	0.2388	11	162	0.9440	

ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
P1A-26	618167.90	4170961.16	1.39	0.112	0.7578	9	247	0.8734	
P1A-27	618228.39	4170958.92	2.07	0.165	2.4045	30	162	0.9336	Geology?
P1A-28	618246.29	4170962.56	1.41	0.108	0.6776	20	27	0.8717	Diffuse dipole - Geology?
P1A-29	618291.30	4170959.59	0.29	0.034	0.0208	10	14	0.9962	
P1A-30	618304.05	4170966.98	2.09	0.151	1.8500	-6	318	0.9365	Diffuse dipole - Geology?
P1A-31	618328.86	4170953.00	0.39	0.058	0.1072	31	322	0.9948	
P1A-32	618309.11	4170952.83	0.31	0.029	0.0128	10	0	0.9797	
P1A-33	618279.50	4170955.64	0.25	0.024	0.0072	57	79	0.9406	
P1A-34	618271.69	4170948.54	0.34	0.080	0.2765	76	315	0.9540	
P1A-35	618253.20	4170955.86	0.46	0.064	0.1442	-43	350	0.9042	
P1A-36	618071.54	4170946.49	0.44	0.171	2.6832	69	22	0.9555	
P1A-37	618082.91	4170941.42	0.31	0.021	0.0050	40	336	0.9681	
P1A-38	618088.91	4170937.54	0.33	0.039	0.0320	30	36	0.9688	
P1A-39	618190.10	4170944.20	0.34	0.047	0.0562	24	347	0.9939	
P1A-40	618327.36	4170947.21	0.48	0.041	0.0376	8	30	0.8772	
P1A-41	618177.44	4170934.39	2.09	0.151	1.8599	6	262	0.7522	Likely geology
P1A-42	618168.74	4170936.06	0.23	0.025	0.0083	22	281	0.9461	
P1A-43	618106.68	4170935.53	0.85	0.067	0.1622	15	61	0.9102	Diffuse dipole - Geology?
P1A-44	618090.46	4170934.65	0.62	0.133	1.2772	64	358	0.9966	
P1A-45	618079.95	4170928.64	0.47	0.119	0.8991	81	318	0.9946	
P1A-46	618077.69	4170929.00	0.55	0.041	0.0360	-4	110	0.8246	
P1A-47	618074.76	4170932.01	0.35	0.037	0.0263	21	12	0.9577	
P1A-48	618071.03	4170930.65	2.01	0.213	5.2250	-14	317	0.9369	
P1A-49	618055.17	4170932.11	0.59	0.042	0.0403	16	24	0.8752	
P1A-50	618139.10	4170920.22	0.58	0.107	0.6633	12	108	0.8651	Overlapping targets?
P1A-51	618143.03	4170921.08	0.66	0.071	0.1915	-37	31	0.9145	
P1A-52	618148.93	4170919.07	0.34	0.045	0.0503	-9	33	0.9925	
P1A-53	618334.81	4170908.61	0.41	0.054	0.0861	58	13	0.9912	
P1A-54	618174.33	4170915.03	0.33	0.038	0.0287	24	16	0.9311	

ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
P1A-55	618172.13	4170908.76	0.30	0.038	0.0284	14	353	0.9678	
P1A-56	618143.74	4170914.24	0.47	0.035	0.0231	7	108	0.8969	
P1A-57	618117.97	4170911.75	0.45	0.056	0.0937	17	110	0.9684	
P1A-58	618092.89	4170913.71	2.45	0.237	7.2155	15	339	0.9431	
P1A-59	618091.25	4170907.43	0.65	0.050	0.0683	4	279	0.9459	
P1A-60	618083.25	4170915.89	0.85	0.066	0.1535	2	40	0.9403	
P1A-61	618071.04	4170914.09	0.58	0.137	1.3902	70	41	0.9898	
P1A-62	618072.22	4170916.20	0.32	0.024	0.0071	-85	95	0.8634	
P1A-63	618072.77	4170909.73	0.44	0.140	1.4701	58	335	0.9793	
P1A-64	618056.76	4170910.22	0.32	0.030	0.0150	24	36	0.9809	
P1A-65	618096.76	4170899.19	1.26	0.162	2.2890	-2	57	0.9715	
P1A-66	618136.42	4170900.22	1.52	0.130	1.1714	-2	225	0.9542	
P1A-67	618195.24	4170901.03	0.69	0.047	0.0574	4	204	0.9145	
P1A-68	618195.37	4170897.40	0.31	0.037	0.0278	10	11	0.9911	
P1A-69	618224.24	4170904.37	0.42	0.106	0.6455	20	27	0.9447	
P1A-70	618087.01	4170890.52	0.50	0.040	0.0354	6	2	0.9824	
P1A-71	618085.53	4170894.82	0.63	0.124	1.0327	82	244	0.9931	
P1A-72	618081.23	4170893.38	1.53	0.140	1.4752	10	295	0.9591	
P1A-73	618072.69	4170896.29	0.49	0.113	0.7748	58	335	0.9883	
P1A-74	618069.95	4170886.90	0.29	0.031	0.0162	30	27	0.9752	
P1A-75	618091.27	4170884.94	0.34	0.032	0.0170	20	7	0.9878	
P1A-76	618110.62	4170886.06	1.96	0.129	1.1692	18	145	0.8980	Likely geology
P1A-77	618241.64	4170887.67	2.05	0.135	1.3293	-53	240	0.8789	Likely geology
P1A-78	618255.47	4170881.81	0.32	0.020	0.0046	10	44	0.8180	
P1A-79	618308.43	4170879.37	3.04	0.278	11.5925	6	181	0.9439	Geology?
P1A-80	618273.75	4170874.90	0.72	0.051	0.0704	-9	346	0.8774	
P1A-81	618214.73	4170877.90	0.48	0.047	0.0565	-8	82	0.8900	
P1A-82	618141.01	4170871.52	0.35	0.062	0.1258	-14	87	0.7221	
P1A-83	618144.72	4170868.63	0.37	0.028	0.0121	22	355	0.9695	

ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
P1A-84	618083.64	4170868.32	0.84	0.153	1.9378	74	0	0.9955	
P1A-85	618073.92	4170870.52	0.51	0.145	1.6369	67	15	0.9984	
P1A-86	618335.55	4170869.19	1.25	0.080	0.2726	15	349	0.9262	Geology?
P1A-87	618339.12	4170865.23	0.82	0.077	0.2489	4	138	0.8600	
P1A-88	618215.00	4170850.09	0.32	0.021	0.0051	5	317	0.9465	
P1A-89	618058.17	4170850.84	0.62	0.047	0.0575	21	52	0.6664	
P1A-90	618095.80	4170842.59	0.36	0.143	1.5737	63	323	0.9890	
P1A-91	618104.31	4170839.93	1.82	0.122	0.9715	45	159	0.9214	Geology?
P1A-92	618185.51	4170845.63	1.91	0.149	1.7912	11	65	0.8921	Geology?
P1A-93	618226.13	4170838.23	0.80	0.061	0.1218	2	320	0.9559	
P1A-94	618251.61	4170841.06	2.17	0.226	6.2233	-3	253	0.9311	
P1A-95	618064.33	4170828.72	0.29	0.037	0.0272	8	19	0.9825	
P1A-96	618051.38	4170822.73	2.87	0.279	11.6829	-10	166	0.8580	Geology?
P1A-97	618091.93	4170822.73	1.46	0.129	1.1505	8	58	0.8912	Geology?
P1A-98	618233.63	4170819.84	1.21	0.134	1.2855	12	238	0.9294	
P1A-99	618335.15	4170830.51	1.56	0.109	0.6971	-19	323	0.8202	Likely geology
P1A-100	618262.42	4170811.65	0.27	0.030	0.0145	7	341	0.9879	
P1A-101	618129.62	4170817.33	1.16	0.110	0.7205	-12	209	0.9252	
P1A-102	618099.43	4170800.80	0.33	0.028	0.0114	35	315	0.9549	
P1A-103	618185.95	4170800.22	2.62	0.314	16.6585	-8	242	0.9573	
P1A-104	618237.40	4170801.47	1.29	0.117	0.8536	12	148	0.8896	
P1A-105	618317.12	4170799.19	2.02	0.282	12.0971	5	227	0.9099	Geology?
P1A-106	618123.12	4170789.52							10m x 10m complex signal
P1A-107	618123.62	4170780.27	2.21	0.164	2.3950	18	34	0.9342	Diffuse dipole - Geology?
P1A-108	618128.52	4170765.30	0.82	0.076	0.2354	0	191	0.9199	
P1A-109	618124.16	4170763.96	2.41	0.172	2.7387	-4	315	0.9221	Geology?
P1A-110	618279.09	4170753.66	0.65	0.043	0.0443	23	327	0.9201	
P1A-111	618244.13	4170750.72	1.10	0.096	0.4816	2	284	0.7098	Poor fit
P1A-112	618112.15	4170738.33	1.74	0.131	1.2124	-10	208	0.9202	

ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
P1A-113	618163.19	4170738.57	0.92	0.062	0.1272	5	208	0.9081	
P1A-114	618269.96	4170748.20	0.89	0.087	0.3510	-7	193	0.8358	
P1A-115	618289.60	4170742.70	1.21	0.139	1.4338	-2	344	0.9613	
P1A-116	618260.71	4170729.58	0.75	0.051	0.0716	-3	342	0.8942	
P1A-117	618255.61	4170728.33	0.88	0.061	0.1243	-2	75	0.8428	
P1A-118	618213.56	4170735.59	1.27	0.105	0.6259	-24	246	0.8099	Geology?
P1A-119	618153.64	4170736.17	0.52	0.066	0.1548	-5	273	0.9180	
P1A-120	618109.29	4170727.94	0.75	0.071	0.1927	7	298	0.9776	
P1A-121	618073.91	4170730.25	0.29	0.018	0.0029	7	2	0.9369	
P1A-122	618162.76	4170723.81	0.91	0.067	0.1594	5	176	0.8529	
P1A-123	618342.94	4170714.53	1.22	0.254	8.8149	-2	3	0.9177	
P1A-124	618346.47	4170708.59	0.59	0.046	0.0522	5	156	0.8910	
P1A-125	618211.01	4170715.11	1.45	0.110	0.7095	-8	350	0.7571	Geology?
P1A-126	618198.33	4170713.95	0.29	0.018	0.0033	34	126	0.8806	
P1A-127	618095.67	4170711.36	1.57	0.154	1.9487	-7	357	0.9728	
P1A-128	618061.97	4170715.61	0.31	0.031	0.0166	71	76	0.9839	
P1A-129	618051.18	4170703.99	1.63	0.144	1.5996	30	304	0.9083	
P1A-130	618285.42	4170702.08	0.50	0.061	0.1237	7	203	0.9473	
P1A-131	618345.67	4170701.22	0.68	0.052	0.0775	-16	249	0.9121	
P1A-132	618276.59	4170695.08	0.90	0.113	0.7708	-4	78	0.8320	
P1A-133	618226.07	4170691.42	0.35	0.029	0.0135	1	20	0.9348	
P1A-134	618223.85	4170688.63	0.29	0.040	0.0343	0	358	0.9912	
P1A-135	618204.96	4170692.30	0.32	0.034	0.0217	14	12	0.9888	
P1A-136	618170.12	4170695.61	1.03	0.139	1.4528	2	312	0.9626	
P1A-137	618143.38	4170696.92	1.59	0.152	1.8976	2	61	0.4981	Likely geology
P1A-138	618136.38	4170705.63	3.95	0.320	17.7065	12	259	0.7639	Geology
P1A-139	618163.44	4170681.80	0.61	0.050	0.0680	10	25	0.7626	
P1A-140	618224.16	4170680.27	0.77	0.075	0.2233	24	128	0.9389	
P1A-141	618269.37	4170688.38	0.85	0.054	0.0845	22	337	0.8882	

ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
P1A-142	618294.69	4170673.77	2.22	0.223	6.0004	-4	6	0.6993	Geology
P1A-143	618063.55	4170662.41	0.94	0.096	0.4816	9	305	0.8698	Poor fit
P1A-144	618195.81	4170669.61	3.99	0.251	8.4763	32	117	0.8711	Geology
P1A-145	618244.25	4170666.92	0.83	0.098	0.4992	-9	296	0.8025	Poor fit
P1A-146	618298.73	4170658.30	0.99	0.078	0.2604	5	174	0.9476	
P1A-147	618244.54	4170654.95	0.92	0.080	0.2772	4	22	0.8576	
P1A-148	618058.05	4170657.70	0.74	0.047	0.0573	14	111	0.8999	
P1A-149	618096.06	4170646.41	0.90	0.072	0.2022	-4	59	0.8351	
P1A-150	618240.79	4170639.46	0.97	0.085	0.3254	7	236	0.8527	
P1A-151	618161.17	4170635.17	0.41	0.052	0.0765	47	48	0.9225	
P1A-152	618104.18	4170635.93	0.76	0.057	0.1013	-2	338	0.8648	
P1A-153	618230.29	4170616.99	0.58	0.073	0.2056	0	168	0.9028	
P1A-154	618215.01	4170609.96	1.76	0.177	2.9760	-3	336	0.9256	
P1A-155	618158.01	4170612.04	1.14	0.084	0.3149	14	10	0.7450	
P1A-156	618148.81	4170616.56	0.30	0.051	0.0708	24	23	0.9943	
P1A-157	618110.17	4170616.87	0.57	0.053	0.0787	18	322	0.6485	Poor Fit
P1A-158	618056.34	4170614.70	1.05	0.073	0.2101	11	184	0.9037	Likely geology
P1A-159	618115.03	4170611.22	0.69	0.046	0.0511	-13	44	0.8405	
P1A-160	618246.63	4170603.91	0.75	0.122	0.9862	21	323	0.9158	
P1A-161	618249.57	4170598.17	0.48	0.060	0.1154	-15	163	0.8980	
P1A-162	618250.17	4170599.30	0.49	0.039	0.0310	14	299	0.9699	
P1A-163	618186.76	4170598.39	1.35	0.116	0.8459	19	130	0.8873	
P1A-164	618163.03	4170593.06	0.56	0.058	0.1050	11	150	0.9653	
P1A-165	618061.80	4170589.84	1.47	0.279	11.7024	15	319	0.9714	
P1A-166	618151.43	4170578.44	0.94	0.136	1.3681	2	271	0.9638	
P1A-167	618203.50	4170582.01	0.57	0.040	0.0346	-17	115	0.7784	Poor fit
P1A-168	618079.25	4170540.43	1.82	0.164	2.3949	1	329	0.9422	
P1A-169	618167.86	4170539.46	0.43	0.055	0.0884	-5	242	0.7121	Poor fit

Table B2. Target Parameters for PBR #2, Simmons Area

ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
PSA-1	617723.94	4175157.80	0.28	0.035	0.0228	8	21	0.9833	
PSA-2	618065.38	4175144.70	0.82	0.055	0.0915	40	312	0.8753	
PSA-3	618119.74	4175103.76	0.29	0.042	0.0390	6	348	0.8716	
PSA-4	618107.75	4175078.72	0.83	0.088	0.3631	-4	27	0.9702	
PSA-5	618014.20	4175108.54	0.62	0.051	0.0701	19	44	0.9536	
PSA-6	617993.64	4175086.53	0.70	0.062	0.1258	-4	156	0.8075	
PSA-7	617967.04	4175119.89	0.28	0.039	0.0331	5	119	0.9865	
PSA-8	617924.43	4175086.70	0.43	0.091	0.4113	25	17	0.9950	
PSA-9	617821.10	4175103.92	0.76	0.083	0.3073	3	313	0.7828	
PSA-10	617790.80	4175083.09	0.25	0.026	0.0091	73	312	0.9028	
PSA-11	617737.86	4175034.89	1.66	0.113	0.7684	13	47	0.9404	Geology?
PSA-12	617892.96	4175054.59	0.38	0.035	0.0239	4	34	0.9521	
PSA-13	618046.74	4175045.79	0.79	0.063	0.1366	-27	4	0.9021	Filtering artifact?
PSA-14	618062.71	4175009.60	2.41	0.165	2.4269	40	296	0.8322	Geology?
PSA-15	617980.90	4174998.20	0.59	0.054	0.0830	-9	309	0.9231	
PSA-16	618005.44	4174976.77	2.39	0.193	3.8512	-14	128	0.7595	Geology?
PSA-17	618148.86	4174943.51	2.10	0.189	3.6548	21	210	0.8153	Geology?
PSA-18	618103.88	4174947.55	1.82	0.154	1.9655	-3	116	0.7867	Geology?
PSA-19	617991.22	4174938.02	4.89	0.396	33.5197	31	178	0.7372	Geology
PSA-20	617996.04	4174909.78	1.10	0.103	0.5848	8	190	0.9499	
PSA-21	618046.97	4174906.81	1.87	0.169	2.6081	-17	104	0.7377	Geology?
PSA-22	617725.96	4174856.83	0.33	0.040	0.0353	62	346	0.9815	
PSA-23	617748.25	4174831.64	1.21	0.098	0.5056	13	3	0.7987	Geology/Filtering artifact?
PSA-24	617773.99	4174851.33	2.51	0.173	2.7691	1	343	0.8823	Geology?
PSA-25	617790.95	4174839.43	1.82	0.107	0.6580	40	342	0.8783	Geology?
PSA-26	617966.56	4174842.71	0.74	0.056	0.0934	2	70	0.8559	Filtering artifact?
PSA-27	618100.60	4174845.32	0.34	0.043	0.0426	61	277	0.8972	
PSA-28	618121.35	4174832.24	0.68	0.059	0.1125	-16	32	0.8946	

ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
PSA-29	618133.95	4174836.46	0.75	0.060	0.1180	8	115	0.8934	
PSA-30	618033.31	4174816.88	1.56	0.267	10.2711	1	237	0.9780	Something large and compact
PSA-31	617783.46	4174780.93	0.27	0.047	0.0576	0	289	0.9871	
PSA-32	617941.56	4174728.84	0.32	0.050	0.0679	21	331	0.9248	
PSA-33	617970.39	4174767.39	0.28	0.031	0.0157	28	48	0.9706	
PSA-34	618094.45	4174737.24	1.07	0.081	0.2852	5	22	0.8562	
PSA-35	618146.88	4174717.60	1.36	0.145	1.6464	-8	209	0.8127	Geology?
PSA-36	618146.70	4174704.95	0.52	0.040	0.0341	3	228	0.8561	Filtering artifact?
PSA-37	618118.43	4174715.10	0.80	0.061	0.1250	0	31	0.8963	
PSA-38	617955.96	4174714.20	1.73	0.129	1.1635	32	195	0.9098	Geology?
PSA-39	618015.55	4174697.42	0.75	0.070	0.1828	-1	233	0.8237	
PSA-40	618070.74	4174683.26	1.32	0.122	0.9736	-5	176	0.9203	
PSA-41	618082.38	4174665.13	1.56	0.163	2.3278	-2	152	0.9472	
PSA-42	618135.54	4174685.35	0.77	0.055	0.0902	1	149	0.9061	
PSA-43	618141.66	4174681.84	0.85	0.055	0.0914	-4	15	0.9282	
PSA-44	617932.37	4174619.92	0.69	0.058	0.1057	-13	320	0.9307	
PSA-45	617904.61	4174646.62	0.65	0.049	0.0637	2	178	0.9219	
PSA-46	617748.01	4174567.02	0.65	0.160	2.2275	-56	39	0.5764	Two overlapping dipoles?
PSA-47	617806.47	4174576.56	0.73	0.051	0.0731	-3	348	0.8620	
PSA-48	617811.30	4174569.13	0.72	0.075	0.2313	-4	268	0.8626	Filtering artifact?
PSA-49	617899.68	4174555.20	0.80	0.121	0.9650	-2	1	0.7245	Non-dipole
PSA-50	617905.28	4174565.19	0.67	0.064	0.1407	7	142	0.6786	Non-dipole
PSA-51	617992.52	4174553.59	0.29	0.042	0.0409	43	356	0.9919	
PSA-52	618150.41	4174525.28	0.69	0.088	0.3715	22	39	0.7828	Bad fit
PSA-53	618142.95	4174526.35	0.40	0.045	0.0495	2	22	0.9598	
PSA-54	618151.76	4174521.85	0.46	0.030	0.0150	27	10	0.8133	
PSA-55	618153.50	4174520.10	0.49	0.060	0.1140	82	46	0.9577	
PSA-56	618119.77	4174505.14	0.30	0.053	0.0782	43	25	0.9820	
PSA-57	618065.68	4174544.82	0.33	0.123	0.9921	49	23	0.8204	Overlapping dipoles?

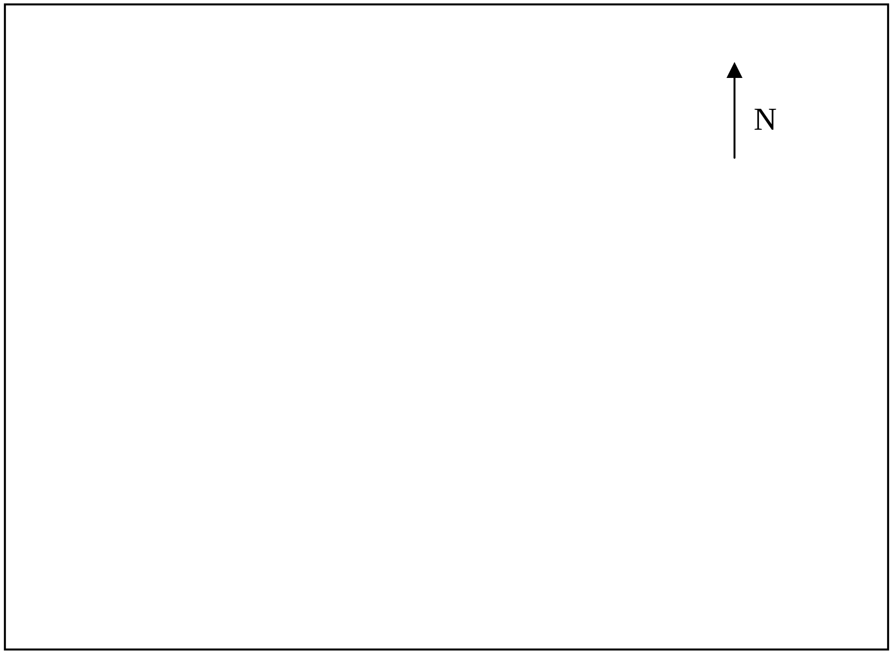
ID	UTM X (m)	UTM Y (m)	Depth (m)	Size (m)	Moment (Amps-m2)	Inclin (°)	Azim (°)	Goodness of Fit	Comments
PSA-58	618035.91	4174517.36	0.83	0.150	1.8264	16	331	0.8059	Non-dipole
PSA-59	617994.27	4174517.32	0.28	0.029	0.0132	16	50	0.9591	
PSA-60	617882.73	4174521.92	0.25	0.024	0.0074	5	46	0.9701	
PSA-61	617819.32	4174547.12	3.37	0.218	5.5830	5	347	0.7215	Geology
PSA-62	617748.35	4174534.78	0.72	0.058	0.1037	13	45	0.5671	Non-dipole
PSA-63	617770.42	4174477.14	0.35	0.031	0.0158	-21	48	0.8393	
PSA-64	617891.19	4174487.70	0.86	0.061	0.1247	-7	328	0.8374	Geology?
PSA-65	618122.61	4174495.87	0.36	0.030	0.0145	6	341	0.9131	
PSA-66	618139.04	4174500.58	0.29	0.028	0.0123	0	9	0.9257	
PSA-67	618146.44	4174499.02	0.29	0.023	0.0069	20	6	0.9142	
PSA-68	618147.16	4174494.71	0.29	0.028	0.0116	22	94	0.9880	
PSA-69	618114.78	4174461.97	0.21	0.042	0.0392	69	75	0.8918	
PSA-70	618123.34	4174456.96	0.27	0.042	0.0408	10	351	0.9946	
PSA-71	618060.30	4174465.79	2.32	0.143	1.5783	46	268	0.6824	Geology
PSA-72	617892.62	4174466.08	0.80	0.057	0.0993	18	19	0.8226	

Appendix C. Example Dig Sheet

Pueblo PBR #2 **DIG SHEET** ESTCP WAA

	Target Num.	UTM Northing (m)	UTM Easting (m)	Depth (ft)	Latitude (DD.DD…)	Longitude (DD.DD…)
Predicted	P-0001	4171029.56	617035.44	1.0	37.67897636	-103.67225960
Actual						
Fit Quality = 0.9885	Analyst's Comments:					

Field Drawing



Field Comment: ______________________________

____

____

____

Field ID: ______________________________

☐ Fuzed ☐ Unfuzed

☐ Live ☐ Inert

☐ Ordnance ☐ Ordnance Related ☐ Non-ordnance

Estimated Size: ____________________

Photograph Number: ____________________

Site: ____________ Date: ____________ Time: ____________ UXO Supervisor: ____________