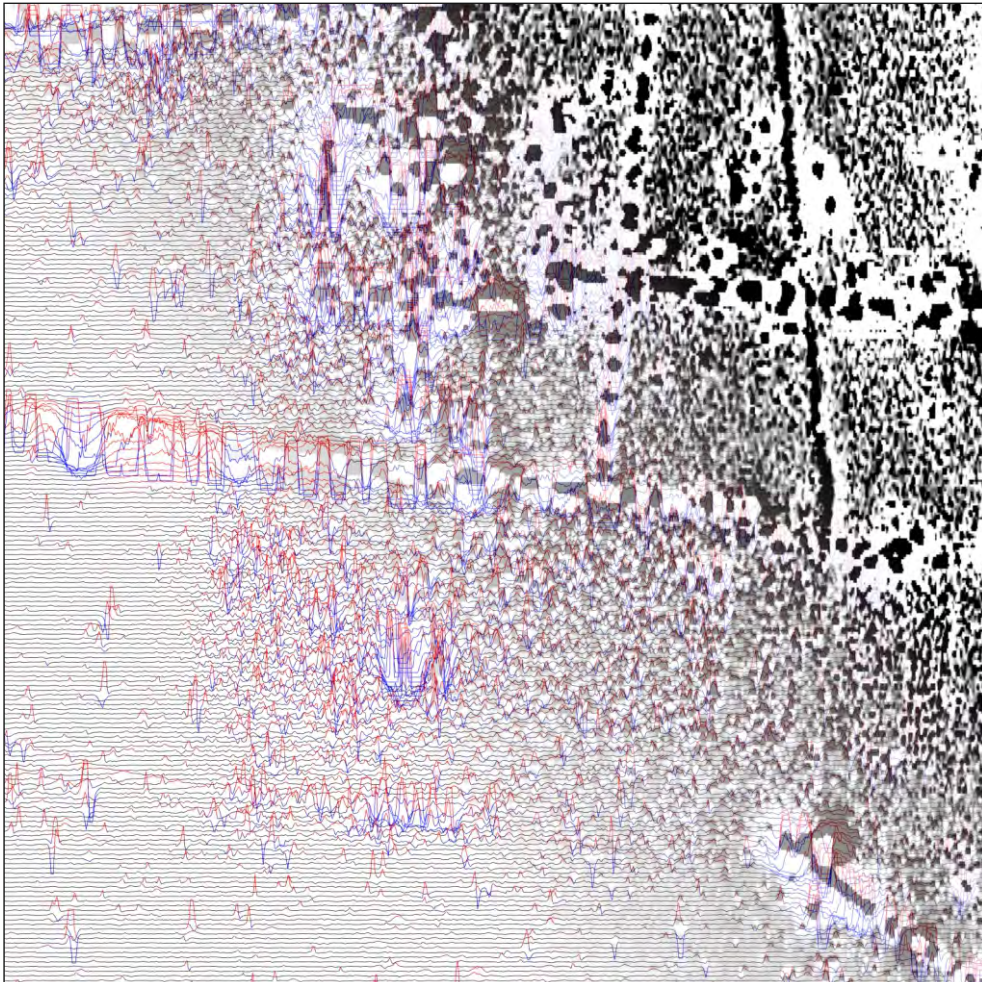




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# DIO Sites SPTA Near Amesbury, Wiltshire

Detailed Gradiometer and UAV Survey Report



Ref: 103760.01  
May 2014



**DIO Sites SPTA  
Near Amesbury, Wiltshire**

**Detailed Gradiometer and UAV Survey Report**

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## Detailed Gradiometer and UAV Survey Report

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# **DIO Sites SPTA Near Amesbury, Wiltshire**

## **Detailed Gradiometer and UAV Survey Report**

### **Summary**

Wessex Archaeology was commissioned by Landmarc Support Services to carry out a programme of geophysical and aerial surveys over two sites within the Salisbury Plain Training Area (SPTA) near Larkhill and Tidworth, to the northwest and northeast of Amesbury, Wiltshire. The aim of the work was to establish the presence, or otherwise, and nature of detectable archaeological features on the site as part of a programme of archaeological works ahead of proposed community excavations at the Sites.

The Sites surveyed comprised three areas located west of Larkhill, to the south of Fargo Road, covering the former horse hospital, and to the southwest of Tidworth, covering the former trench systems on the summit of Beacon Hill. The geophysical surveys were undertaken between 27<sup>th</sup> and 31<sup>st</sup> March 2014.

Detailed gradiometer survey was undertaken over all accessible parts of the site, a total of some 11ha, and has demonstrated the presence of anomalies of likely, probable and possible archaeological significance along with regions of increased magnetic response and a number of modern services.

The gradiometer survey was notably more effective at the Fargo site, where numerous modern features associated with the former camp and hospital were identified, including the course of the now-dismantled military railway.

Geophysical survey was made complicated at the Beacon Hill site through the presence of mature juniper trees and dense vegetation in places; the eroded nature of the trenches was also somewhat problematic for gradiometry although survey was conducted where safe and practicable to do so. A number of anomalies of possible interest were identified within the data, particularly towards the south of the survey area.

The aerial survey was conducted using an Unmanned Aerial Vehicle and was successful in producing datasets suitable for extracting topographic and archaeological information. Although the partial cover of mature trees prevented visibility of the trench system in places, the existing features at the site were effectively mapped using this technique.



# **DIO Sites SPTA Near Amesbury, Wiltshire**

## **Detailed Gradiometer and UAV Survey Report**

### **Acknowledgements**

The detailed gradiometer survey was commissioned by Landmarc Support Services Limited. The assistance of Sarah Hicks is gratefully acknowledged in this regard.

The fieldwork was carried out by Jennifer Smith, Alistair Salisbury and Clara Dickinson. The geophysical data was processed by Jennifer Smith and Clara Dickinson and this was interpreted by Ross Lefort. The UAV data were collected by Callen-Lenz and this was interpreted by Patrick Dresch. This report was written by Ross Lefort and Patrick Dresch. The geophysical work was quality controlled by Dr. Paul Baggaley and Ben Urmston. Illustrations were prepared by Ross Lefort. The project was managed on behalf of Wessex Archaeology by Ben Urmston.



# DIO Sites SPTA Near Amesbury, Wiltshire

## Detailed Gradiometer and UAV Survey Report

### 1 INTRODUCTION

#### 1.1 Project Background

- 1.1.1 Wessex Archaeology was commissioned by Landmarc Support Services Limited to carry out a programme of geophysical survey over two sites within the Salisbury Plain Training Area (SPTA) to the northwest and northeast of Amesbury.
- 1.1.2 The first site surveyed comprised two separate survey areas over the former location of Fargo Camp Military Hospital, located southwest of Larkhill (centred on NGR 411100, 143750 and 411625, 143745; **Figure 1**). The second site surveyed is at Beacon Hill, to the west of Shipton Bellinger (centred on NGR 421500, 145375; **Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken ahead of planned community excavations at the two sites.
- 1.1.3 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.
- 1.1.4 This report presents a brief description of the methodology followed, the detailed survey results and the archaeological interpretation of the geophysical data.

#### 1.2 Site Location and Topography

- 1.2.1 The Fargo Camp Military Hospital site is located approximately 1.5km southwest of the centre of Larkhill and approximately 4.6km northwest of the centre of Amesbury. The Site comprises three arable fields on the southern side of Fargo Road (**Figure 1**).
- 1.2.2 The site lies in an area of gently undulating land at the head of a dry valley running southwest towards the River Till which is the nearest mapped watercourse. The larger Fargo site to the west is set at an elevation around 110m above Ordnance Datum (aOD) with the smaller site further east set at an elevation of around 105m aOD. The western site is defined by the limits set by the client and the eastern area by field boundaries.
- 1.2.3 The Beacon Hill site is located a little to the NNE of the pinnacle of Beacon Hill approximately 1.6km west of Shipton Bellinger and 6.9km northeast of Amesbury. The site comprises a rough area of grazing with juniper bushes common across the survey area located on the east side of Tidworth Road (**Figure 1**).
- 1.2.4 The site lies on a SSW-NNE aligned ridge and is set at an elevation of 150m aOD on its east side and falls to below 144m aOD at the west side of the survey area. The highest local point is Beacon Hill further to the SSW at an elevation of 186m aOD. The nearest watercourse is the River Bourne which flows past the site, through Shipton Bellinger, to the east. The site boundary is defined by field boundaries to the south and east and a track on the northern and western sides.



### 1.3 Soils and Geology

- 1.3.1 The bedrock geology under the Beacon Hill site is recorded as Newhaven chalk formation (Cretaceous) with Seaford chalk formation (Cretaceous) further to the west (BGS). No superficial deposits are recorded under the Beacon Hill site although Quaternary head deposits of gravel are recorded in the lower lying areas to the east and west of the site (BGS).
- 1.3.2 The bedrock geology under the Fargo Camp sites is recorded as Seaford chalk formation (Cretaceous) (BGS). No superficial deposits are recorded under the Beacon Hill site although Quaternary head deposits of clay, silt, sand and gravel are recorded in the lower lying areas to the east and west of the site (BGS).
- 1.3.3 The soils recorded across the Beacon Hill site are grey rendzinas of the 342a (Upton 1) association. The soils recorded across the Fargo Camp sites consist of brown rendzinas of the 343h (Andover 1) association to the west and humic rendzinas of the 341 (Icknield) association towards the east (SSEW 1983). Soils derived from such geological parent material have been shown to produce magnetic contrasts acceptable for the detection of archaeological remains through magnetometer survey.

### 1.4 Historical Background

- 1.4.1 The Fargo Camp Military Hospital site is located within the Stonehenge World Heritage Site less than 1km north of the Stonehenge Cursus and less than 2km northwest of Stonehenge. This site, along with the Beacon Hill site, also fall within the Salisbury Plain Training Area (SPTA) and the military occupation of this landscape has resulted in the construction of numerous installations. Beacon Hill is located just outside of the world heritage site but is surrounded by a great many prehistoric remains. It is not possible to effectively summarize all significant remains within close proximity of these sites so only records relevant to the military installations investigated as a part of this project will be discussed.
- 1.4.2 The Army purchased around 40,000 acres of land on Salisbury Plain to serve as a training area in 1897 with two thirds located on the west side of the River Avon and the remaining third on the east side. Bulford Camp was established as a permanent base in 1902 but a permanent base was not established at Larkhill until 1914 (Bond 1991). Prior to the establishment of a permanent base at Larkhill a number of temporary camps were located in this area including Fargo Down Camp (James 1987: 123-125).
- 1.4.3 A building complex pre-dating the Army's acquisition of Salisbury Plain is recorded to the east of the later Fargo Camp Military Hospital. This building complex can be seen on OS maps as far back as 1880 and is visible on the 1887 OS map along with a circular feature to the south of the mapped buildings (**Figure 2c**). The site is named as Fargo Down Barn on the 1901 OS map but is no longer visible on maps by the 1920s (**Figure 2d**). The function of this site was likely to be agricultural but its function after the Army's takeover is less certain. The field that contains this site is known locally as horse hospital field.
- 1.4.4 A military railway known as the Larkhill Military Railway was constructed following the outbreak of the First World War as a means of supplying the new permanent camp (James 1987: 123-125). Fargo Camp Military Hospital was built in 1914 with records from 1917 stating the hospital had 11 officer beds, 1379 beds for other ranks along with 500 beds for prisoners of war (Wessex Archaeology 1998b). The 1924 Ordnance Survey map (**Figure 2a**) shows the layout of the camp at that time along with the nearby military railway.





- 1.4.5 During the 1920s some of the buildings were used as accommodation for RAF officers and by 1929 the site had been re-named Fargo Lodge with many buildings removed by 1939 based on the Ordnance Survey (OS) map (**Figure 2b**) of that year (James 1987: 127-128). Fargo Lodge is recorded on OS maps up until 1972, after which time no buildings are recorded here. There is some evidence that this site may also have served as a horse isolation hospital but very little information is available concerning this function (Wessex Archaeology 1998b); it is possible Fargo Down Barn (discussed above) may be the location of the horse hospital. The military railway running from Larkhill to Fargo Camp fell into disuse in the 1920s and had been removed entirely by 1939 (Bond 1991).
- 1.4.6 A much larger hutted camp was built in the area during the Second World War in 1943 that housed prisoners-of-war from 1944. This camp was removed sometime after the war in the late 1940s or 1950s (Wessex Archaeology 1998b).
- 1.4.7 The Beacon Hill site has a number of zigzag practice trenches that were found to be in good condition at the time of the Defence of Britain survey (1995-2002) (MW117705). A survey of trench systems within the SPTA was carried out by Brown and Field (2007) that found trenches at Beacon Hill covering a 7ha area and extending for 350m. The layout consists of a front-line trench to the west aligned SSW-NNE, a supporting trench running parallel behind with the two trenches linked by 11 communication trenches (**Figure 3**). Three wider spaced trenches run east from the rear of the support trench and link up with a Bronze Age ditch that was incorporated into the trench system. Some possibly earlier trenches lie close to this Bronze Age ditch and a number of circular hollows were identified behind the support trench (Brown and Field 2007: 172-173).
- 1.5 Archaeological Background**
- 1.5.1 A geophysical survey conducted by Bartlett-Clark Consultancy in 1998 for the Stonehenge visitor centre revealed part of the former military railway as a parallel pair of linear positive anomalies associated with higher concentrations of ferrous responses (Bartlett 1998).
- 1.5.2 This same site was then excavated by Wessex Archaeology the same year revealing the imprint of four railway sleepers along the route of the former railway. A concentration of ferrous responses to the southwest of the western end of the cursus was found to correspond to the First World War Stonehenge Airfield Camp (Wessex Archaeology 1998a).



## 2 METHODOLOGY

### 2.1 Introduction

- 2.1.1 The detailed magnetometer survey was conducted using Bartington Grad601-2 dual fluxgate gradiometer systems. The survey was conducted in accordance with English Heritage guidelines (2008).
- 2.1.2 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team between 27<sup>th</sup> and 31<sup>st</sup> March 2014. Field conditions at the time of the survey were good, with firm conditions under foot although high crop reduced the area that was covered at Fargo Camp. In total the geophysical survey covered 11ha.

### 2.2 Method

- 2.2.1 Individual survey grid nodes were established at 30m x 30m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02m and therefore exceeds English Heritage recommendations (2008).
- 2.2.2 The magnetometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1m between sensors. Data were collected at 0.25m intervals along transects spaced 1m apart with an effective sensitivity of 0.03nT, in accordance with EH guidelines (2008). Data were collected in the zigzag method.
- 2.2.3 Data from the survey were subject to minimal data correction processes. These comprise a zero mean traverse function ( $\pm 5nT$  thresholds) applied to correct for any variation between the two Bartington sensors used, and a de-step function to account for variations in traverse position due to varying ground cover and topography. These two steps were applied to all survey areas, with no interpolation applied.
- 2.2.4 Photogrammetry data were acquired by Callen-Lenz in the RGB spectral range over the Study Areas using a G2 Fixed-Wing UAS equipped a Sony NEX5n with a 23mm Lens (34.5mm equivalent). The data were provided as Tiff files with a 0.1m horizontal resolution, which were converted to ASCII files for ArcGIS 10.1. The ASCII files were then processed using the IVS Fledermaus (v. 7.4) suite, which allows full 3D visualisation. This allowed digital terrain models (DTM) to be created whilst maintaining the 0.1m horizontal resolution. These data could then be interpreted based on height and rugosity while also allowing the RGB data to be overlain onto the 3D surface.
- 2.2.5 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.



### 3 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

#### 3.1 Introduction

- 3.1.1 The gradiometer survey has been successful in identifying anomalies relating to the military installations along with a few other anomalies of possible archaeological interest. Some practice trenches were identified at Beacon Hill and numerous metallic pipes were identified at Fargo Camp along with the railway. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1,250 (**Figures 2 to 10**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and  $\pm 25\text{nT}$  at 25nT per cm for the XY trace plots.
- 3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figures 5, 7 and 10**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.
- 3.1.3 Numerous ferrous anomalies are visible throughout the detailed survey dataset. These are presumed to be modern in provenance although many may relate to the twentieth century military occupation in the area. Regular ferrous anomalies have been classed as coherent ferrous where noticeable patterns can be seen in the data.
- 3.1.4 The UAV data were interpreted following the National Mapping Programme guidance (Aerial Survey and Investigation, Swindon 2010; Bishop S. and Oakey M. 2010; National Mapping Programme 2010). The aerial photographic data for the entire area was examined, along with the processed topographic data and rugosity analysis.

#### 3.2 Gradiometer Survey Results and Interpretation: Fargo Camp Military Hospital

- 3.2.1 The data from the western survey area around Fargo Camp (**Figures 4 to 8**) are dominated by ferrous responses with numerous pipes visible running through the data such as at **4000 to 4009**. Some of these pipes appear to terminate or turn at buildings recorded on the 1924 OS map with **4000 to 4003** shown to terminate or turn at a building. The pipe at **4004** runs out of the survey area towards a building recorded just outside the survey area. The pipe at **4005 to 4009** is flanked by regularly spaced ferrous anomalies (classed as coherent ferrous) that maybe inlets to or outlets from this pipe. The function of these pipes is unclear as they could be related to sewerage or water supply. These pipes are considered to relate to the camp but it cannot be determined whether any still function.
- 3.2.2 The other clear feature is a parallel pair of curvilinear positive anomalies at **4010 and 4011** that possess magnetic values around +3nT. These anomalies closely correspond to the position of the now disused and dismantled military railway recorded on the 1924 OS map. A building is recorded at **4003** that appears to be serviced by a pipe; this building and its pipe are considered to relate to the functioning of the railway. A regular ferrous anomaly at **4012** is situated at the end of the railway as it existed in 1924 and is considered to be a structural feature of the railway and is classed as coherent ferrous.
- 3.2.3 There are other ferrous anomalies in the data that do not clearly resemble pipes. The linear at **4013** may be a disturbed pipe but **4014 to 4016** do not appear to resemble pipes at all. The linear at **4014 and 4015** may be a ditch filled with ferrous material and is on a slightly different alignment to the mapped camp. This feature may date to a different period of military occupation. The linear at **4016** is far stronger and may represent a ferrous structure rather than an infilled ditch.
- 3.2.4 A pair of linear anomalies **4017 and 4018** are aligned parallel on a differing alignment to other mapped camp features and the possible ditch at **4014 and 4015**. The linear at **4017**



is a strong coherent ferrous anomaly whereas the linear at **4018** is a much weaker positive anomaly. These anomalies could also belong to a different phase of occupation like **4014** and **4015**.

- 3.2.5 The remaining features within this survey area include numerous small positive anomalies such as the pit-like anomaly at **4019** and trends of uncertain origin such as the three parallel trends at **4020**.
- 3.2.6 The second survey area around Fargo Camp is located further east (**Figures 9 to 11**) and is also dominated by ferrous responses. One pipe is visible at **4021** that appears to run to the area where Fargo Down Barn is recorded on the 1877 OS map. This area around the recorded building has a number of coherent ferrous anomalies such as at **4022** and **4023** that may indicate structural remains. A large circular anomaly at **4024** is recorded on the map although this feature is not identified on the map; the geophysical data indicates it may be a cut feature filled with ferrous material. Some more coherent ferrous anomalies are visible further south at **4025** but these do not coincide with mapped features.
- 3.2.7 The remaining anomalies in this field include some small positive anomalies of possible archaeological significance along with numerous weak linear trends of uncertain origin.

### **3.3 Gradiometer Survey Results and Interpretation: Beacon Hill**

- 3.3.1 The data at Beacon Hill (**Figures 12 to 14**) also has a large concentration of ferrous anomalies. Only some of the trench system recorded by Brown and Field could be observed within the geophysical data with communication trenches detected at **4026** to **4028**. The front-line trench and the support trench could not be detected and this is partly due to these well preserved trenches preventing survey taking place directly over them and partly due to the high concentrations of ferrous responses elsewhere that have masked the trenches. A linear at **4029** looks similar to the response from a trench but also sits over a track; this feature has been interpreted as possible archaeology only.
- 3.3.2 The high concentrations of ferrous, such as around **4030**, may be the result of military practice in the area although no structural remains could be discerned from these responses. The remaining anomalies include some small positive anomalies of possible archaeological significance along with numerous weak linear trends of uncertain origin.

### **3.4 Gradiometer Survey Results and Interpretation: Modern Services**

- 3.4.1 Numerous pipes are visible running through the data collected at Fargo Camp at **4000** to **4009**. It is unclear what function these pipes served but most are considered to relate to the military camp.
- 3.4.2 It is not clear from the geophysical data whether any of the services identified is in active use. It should also be noted that gradiometer survey may not detect all services present on Site. This report and accompanying illustrations should not be used as the sole source for service locations and appropriate equipment (e.g. CAT and Genny) should be used to confirm the location of buried services before any trenches are opened on Site.



## 4 UNMANNED AERIAL VEHICLE (UAV) SURVEY RESULTS AND INTERPRETATION

### 4.1 Introduction

4.1.1 The UAV survey was successful in acquiring high resolution photogrammetry data of the Beacon Hill site. This dataset could then be used to identify the system of training trenches using both aerial photographs and DTM products of the survey. Although some areas of the site are obscured by vegetation, it was possible to establish the extents of the trench system.

### 4.2 UAV Survey Results and Interpretation

4.2.1 A total of 23 features were identified within the Beacon Hill site using the photogrammetry dataset acquired using a UAV. All of the features identified appear to be 20<sup>th</sup> century in origin although this cannot be confirmed without ground trothing. The most extensive of these features are what appear to be training trenches composed of ditches (**1000**) and banks (**1001**). These features form a system of trenches based on two trenches running south-west by north-east with islands and zigzags along their lengths. These are approximately 50m apart and are connected by 11 evenly spaced zigzag trenches at 22m intervals. All trenches are approximately 2m wide. There are four zigzag trenches extending up to 118m to the east. There are a number of craters around the southern two of these extending trenches. Total depth of trenches including associated banks is approximately 1m.

4.2.2 At the southern end of the trench system, on its eastern side, there is a concentration of 19 sub-rounded features (**1003-1021**). These average approximately 6.5m in diameter and often exhibit both positive and negative elements, seen as a cut feature with surrounding bank. These are likely to be the remains of craters caused by explosions or possibly training defences.

4.2.3 North of this concentration of features mound **1022** has been identified. This is partially obscured by vegetation but appears to be sub-rounded and approximately 6m in diameter. Unlike the features to the south, **1022** does not exhibit any negative elements. It is likely to be associated with the wider complex of training earthworks; however there is a possibility that it predates them, which would require further investigation to determine.





## 5 DISCUSSION

### 5.1 Summary

- 5.1.1 The detailed gradiometer and UAV surveys have been successful in detecting anomalies relating to past military activity at both Fargo Camp Military Hospital and Beacon Hill respectively, in addition to a few other anomalies of possible archaeological interest.
- 5.1.2 Numerous pipes were identified at the site of Fargo Camp Military Hospital, which mirror in plan the mapped layout of the hospital. The geophysical data did not reveal the buildings relating to the camp; this is considered to be due to the materials used in their construction. Photos of the construction of Larkhill camp in 1915 show the erection of timber-framed buildings (James 1987: 121-141). If Fargo Camp was built in the same way then the only remains would be buried services and a scatter of debris from use of the camp and from its demolition.
- 5.1.3 The second survey area further east contains coherent ferrous anomalies that appear to relate to Fargo Down Barn with a large circular feature detected of uncertain function.
- 5.1.4 The military railway detected in this data is similar in form to the section excavated further southwest, where the two positive anomalies appeared to correspond to four railway sleepers (Wessex Archaeology 1998). Together with the pipe leading to a building alongside the railway at **4003** and the probable structural feature at **4012**, a layout closely corresponding to the 1924 OS map can be discerned.
- 5.1.5 It cannot be established from the available records and the geophysical data alone which of the two Fargo Camp survey areas was the site of the horse isolation hospital. It is possible that Fargo Down Barn survived for a while after the Army takeover and, if the agricultural complex already in existence possessed stables, this may have been an opportune site to establish a horse hospital.
- 5.1.6 The geophysical survey at Beacon Hill was restricted by the presence of dense vegetation and mature juniper trees across the Site. Survey was undertaken where practicable and safe to do so, although the large number of animal burrows and other erosion of the former trenches resulted in many of these areas being unsurveyable.
- 5.1.7 A few of the practice trenches were identifiable but geophysical survey revealed notably less detail than the UAV survey and the earthwork survey carried out by Brown and Field (2007). Aside from identifying concentrated regions of ferrous that might prove to be of interest, the geophysical survey has added little to our understanding of this trench complex.
- 5.1.8 The UAV survey was successful in identifying a range of features, particularly within the southern portion of the Beacon Hill site. Whilst the partial coverage of mature juniper bushes precluded archaeological features being obscured in places, the dataset provides an interesting comparison with the previous earthwork survey (Brown & Field 2007) and was acquired and interpreted in a relatively short amount of time. Whilst geophysical survey has provided some additional information on sub-surface anomalies, the viability of large area aerial survey is clearly demonstrated by this technique.
- 5.1.9 The relative dimensions of the modern services identified by the gradiometer survey are indicative of the strength of their magnetic response, which is dependent upon the



materials used in their construction and the backfill of the service trenches. The physical dimensions of the services indicated may therefore differ from their magnetic extents in plan; however, it is assumed that the centreline of services is coincident with the centreline of their anomalies. Similarly, it is difficult to estimate the depth of burial of the services through gradiometer survey.

- 5.1.10 It should be noted that small, weakly magnetised features may produce responses that are below the detection threshold of magnetometers. It may therefore be the case that more archaeological features may be encountered than have been identified through geophysical survey.

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## **6.2 Cartographic Sources**

British Geological Survey

<http://www.bgs.ac.uk/discoveringgeology/geologyofbritain/viewer.html>

Soil Survey of England and Wales (SSEW), 1983: Sheet 5, Soils of South West England.  
Ordnance Survey: Southampton.

Ordnance Survey, 1880. 1:2500, Wiltshire (Sheet 54)

Ordnance Survey, 1887. 1:10560, Wiltshire (Sheet 54)

Ordnance Survey, 1901. 1:2500, Wiltshire (Sheet 54)

Ordnance Survey, 1924. 1:2500, Wiltshire (Sheet 54)

Ordnance Survey, 1926. 1:10560, Wiltshire (Sheet 54)

Ordnance Survey, 1939. 1:2500, Wiltshire (Sheet 54)

Ordnance Survey, 1972. 1:10560, Wiltshire

## **6.3 HER Records Consulted**

MWI17705 – Modern military trenches, west of Shipton Bellinger



## APPENDIX 1: SURVEY EQUIPMENT AND DATA PROCESSING

### *Survey Methods and Equipment*

The magnetic data for this project was acquired using a Bartington 601-2 dual magnetic gradiometer system. This instrument has two sensor assemblies fixed horizontally 1m apart allowing two traverses to be recorded simultaneously. Each sensor contains two fluxgate magnetometers arranged vertically with a 1m separation, and measures the difference between the vertical components of the total magnetic field within each sensor array. This arrangement of magnetometers suppresses any diurnal or low frequency effects.

The gradiometers have an effective resolution of 0.03nT over a  $\pm 100$ nT range, and measurements from each sensor are logged at intervals of 0.25m. All of the data are stored on an integrated data logger for subsequent post-processing and analysis.

Wessex Archaeology undertakes two types of magnetic surveys: scanning and detail. Both types depend upon the establishment of an accurate 20m or 30m Site grid, which is achieved using a Leica Viva RTK GNSS instrument and then extended using tapes. The Leica Viva system receives corrections from a network of reference stations operated by the Ordnance Survey and Leica Geosystems, allowing positions to be determined with a precision of 0.02m in real-time and therefore exceed the level of accuracy recommended by English Heritage (2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25m intervals along transects spaced 10m apart, acquiring a minimum of 80 data points per transect. Due to the relatively coarse transect interval, scanning surveys should only be expected to detect extended regions of archaeological anomalies, when there is a greater likelihood of distinguishing such responses from the background magnetic field.

The detailed surveys consist of 20m x 20m or 30m x 30m grids, and data are collected at 0.25m intervals along traverses spaced 1m apart. These strategies give 1600 or 3600 measurements per 20m or 30m grid respectively, and are the recommended methodologies for archaeological surveys of this type (EH, 2008).

Data may be collected with a higher sample density where complex archaeological anomalies are encountered, to aid the detection and characterisation of small and ephemeral features. Data may be collected at up to 0.125m intervals along traverses spaced up to 0.25m apart, resulting in a maximum of 28800 readings per 30m grid, exceeding that recommended by English Heritage (2008) for characterisation surveys.



### **Post-Processing**

The magnetic data collected during the detail survey are downloaded from the Bartington system for processing and analysis using both commercial and in-house software. This software allows for both the data and the images to be processed in order to enhance the results for analysis; however, it should be noted that minimal data processing is conducted so as not to distort the anomalies.

As the scanning data are not as closely distributed as with detailed survey, they are georeferenced using the GPS information and interpolated to highlight similar anomalies in adjacent transects. Directional trends may be removed before interpolation to produce more easily understood images.

Typical data and image processing steps may include:

- Destripe – Applying a zero mean traverse in order to remove differences caused by directional effects inherent in the magnetometer;
- Destagger – Shifting each traverse longitudinally by a number of readings. This corrects for operator errors and is used to enhance linear features;
- Despike – Filtering isolated data points that exceed the mean by a specified amount to reduce the appearance of dominant anomalous readings (generally only used for earth resistance data)

Typical displays of the data used during processing and analysis:

- XY Plot – Presents the data as a trace or graph line for each traverse. Each traverse is displaced down the image to produce a stacked profile effect. This type of image is useful as it shows the full range of individual anomalies.
- Greyscale – Presents the data in plan view using a greyscale to indicate the relative strength of the signal at each measurement point. These plots can be produced in colour to highlight certain features but generally greyscale plots are used during analysis of the data.





## APPENDIX 2: GEOPHYSICAL INTERPRETATION

The interpretation methodology used by Wessex Archaeology separates the anomalies into four main categories: archaeological, modern, agricultural and uncertain origin/geological.

The archaeological category is used for features when the form, nature and pattern of the anomaly are indicative of archaeological material. Further sources of information such as aerial photographs may also have been incorporated in providing the final interpretation. This category is further sub-divided into three groups, implying a decreasing level of confidence:

- Archaeology – used when there is a clear geophysical response and anthropogenic pattern.
- Probable archaeology – used for features which give a clear response but which form incomplete patterns.
- Possible archaeology – used for features which give a response but which form no discernible pattern or trend.

The modern category is used for anomalies that are presumed to be relatively modern in date:

- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be observed.

The agricultural category is used for the following:

- Former field boundaries – used for ditch sections that correspond to the position of boundaries marked on earlier mapping.
- Agricultural ditches – used for ditch sections that are aligned parallel to existing boundaries and former field boundaries that are not considered to be of archaeological significance.
- Ridge and furrow – used for broad and diffuse linear anomalies that are considered to indicate areas of former ridge and furrow.
- Ploughing – used for well-defined narrow linear responses, usually aligned parallel to existing field boundaries.
- Drainage – used to define the course of ceramic field drains that are visible in the data as a series of repeating bipolar (black and white) responses.

The uncertain origin/geological category is used for features when the form, nature and pattern of the anomaly are not sufficient to warrant a classification as an archaeological feature. This category is further sub-divided into:

- Increased magnetic response – used for areas dominated by indistinct anomalies which may have some archaeological potential.
- Trend – used for low amplitude or indistinct linear anomalies.
- Superficial geology – used for diffuse edged spreads considered to relate to shallow geological deposits. They can be distinguished as areas of positive, negative or broad bipolar (positive and negative) anomalies.



Site Boundary
  Survey Extents

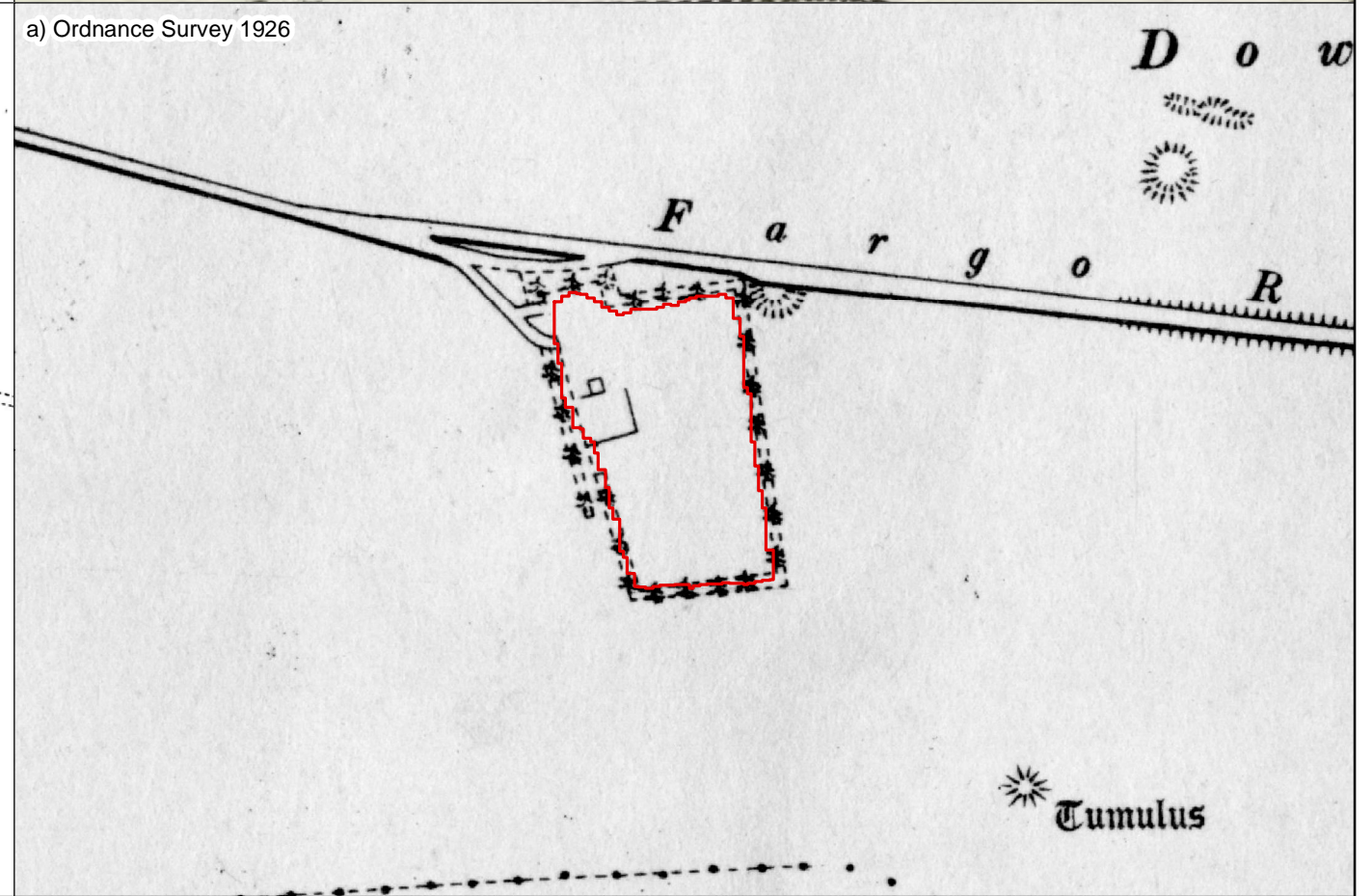
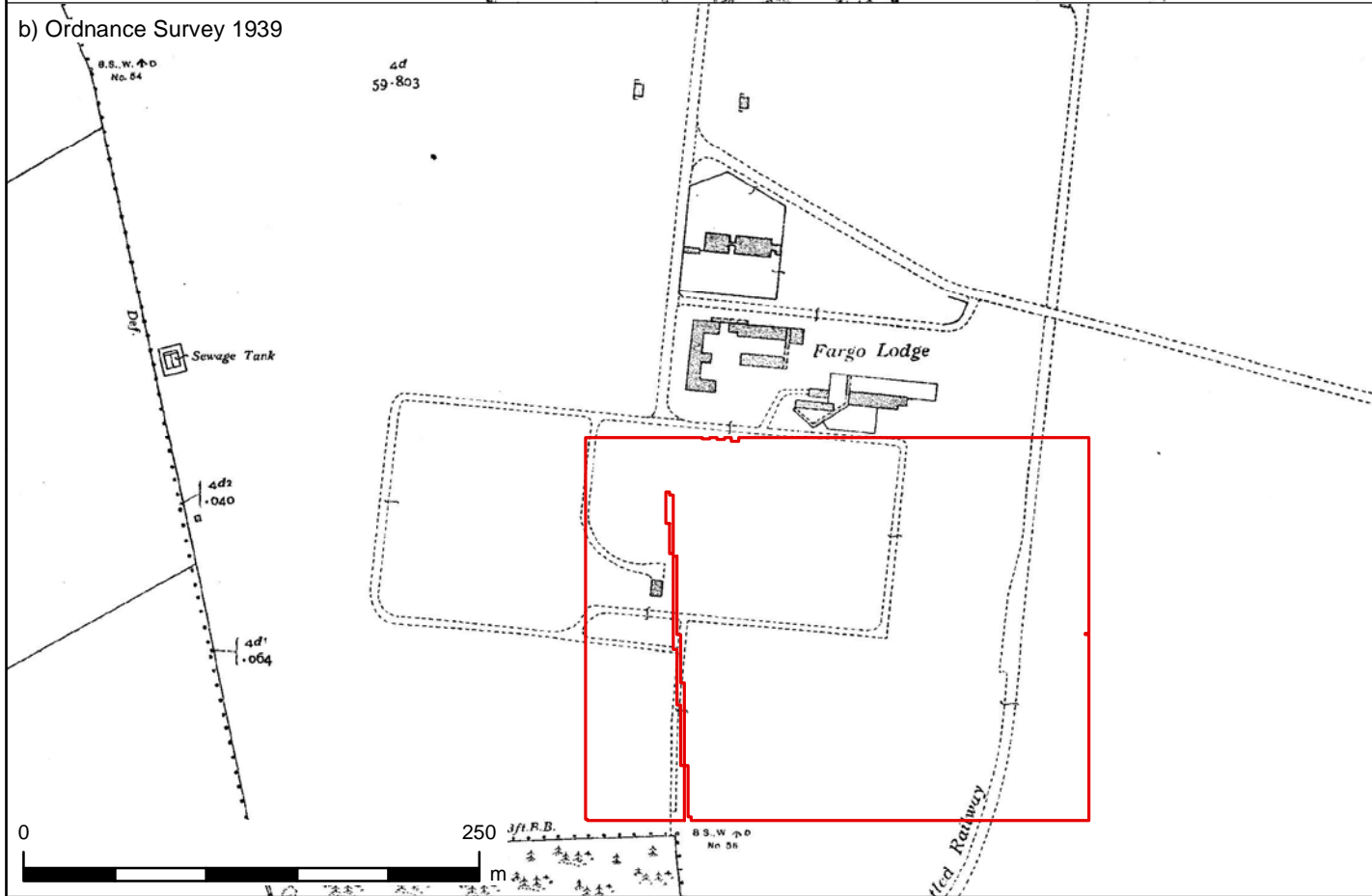
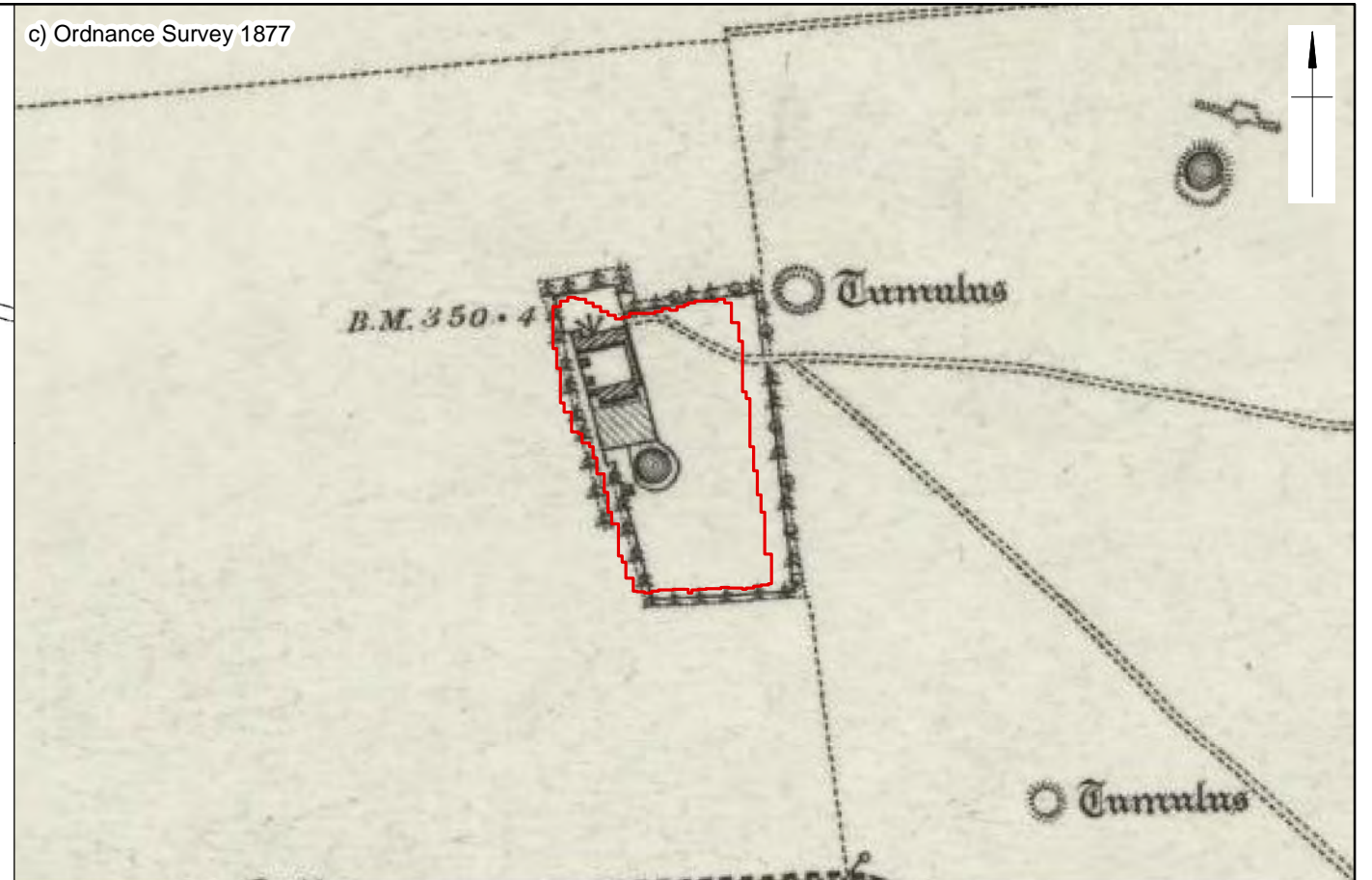
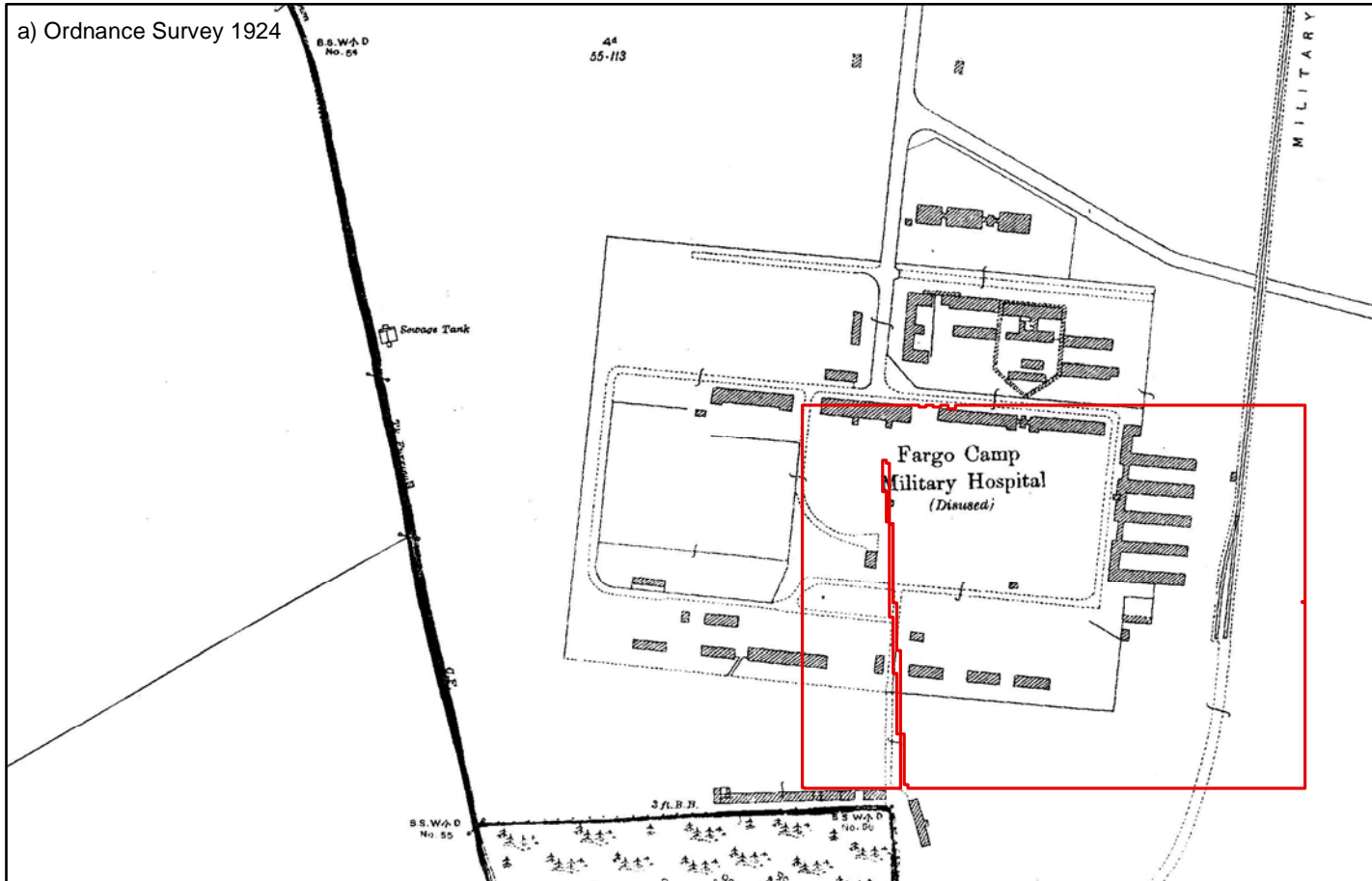
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Site location and detailed survey extents


Figure 1





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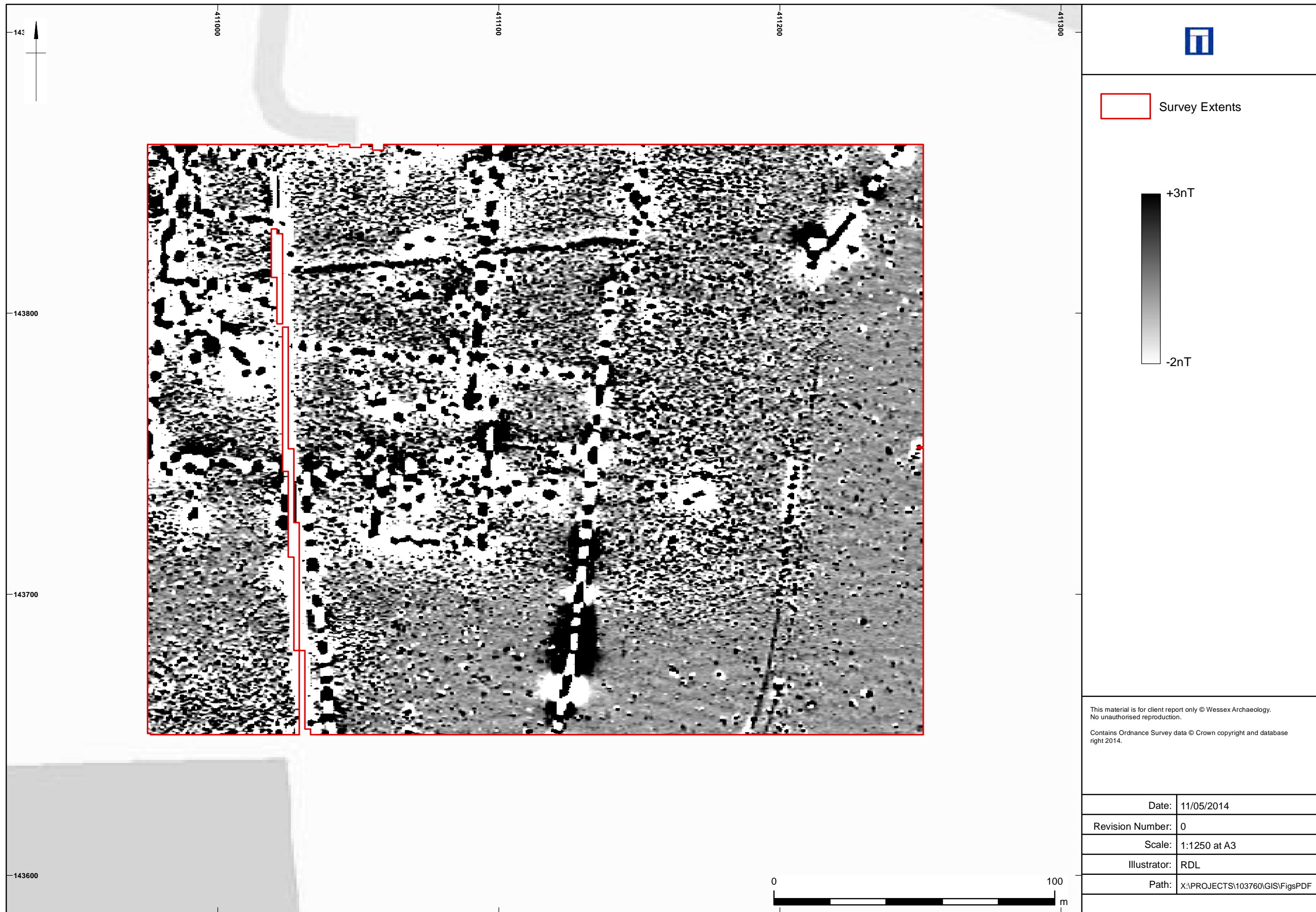


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Beacon Hill trench system, earthwork survey. After Brown and Field (2007: 173)

Figure 3

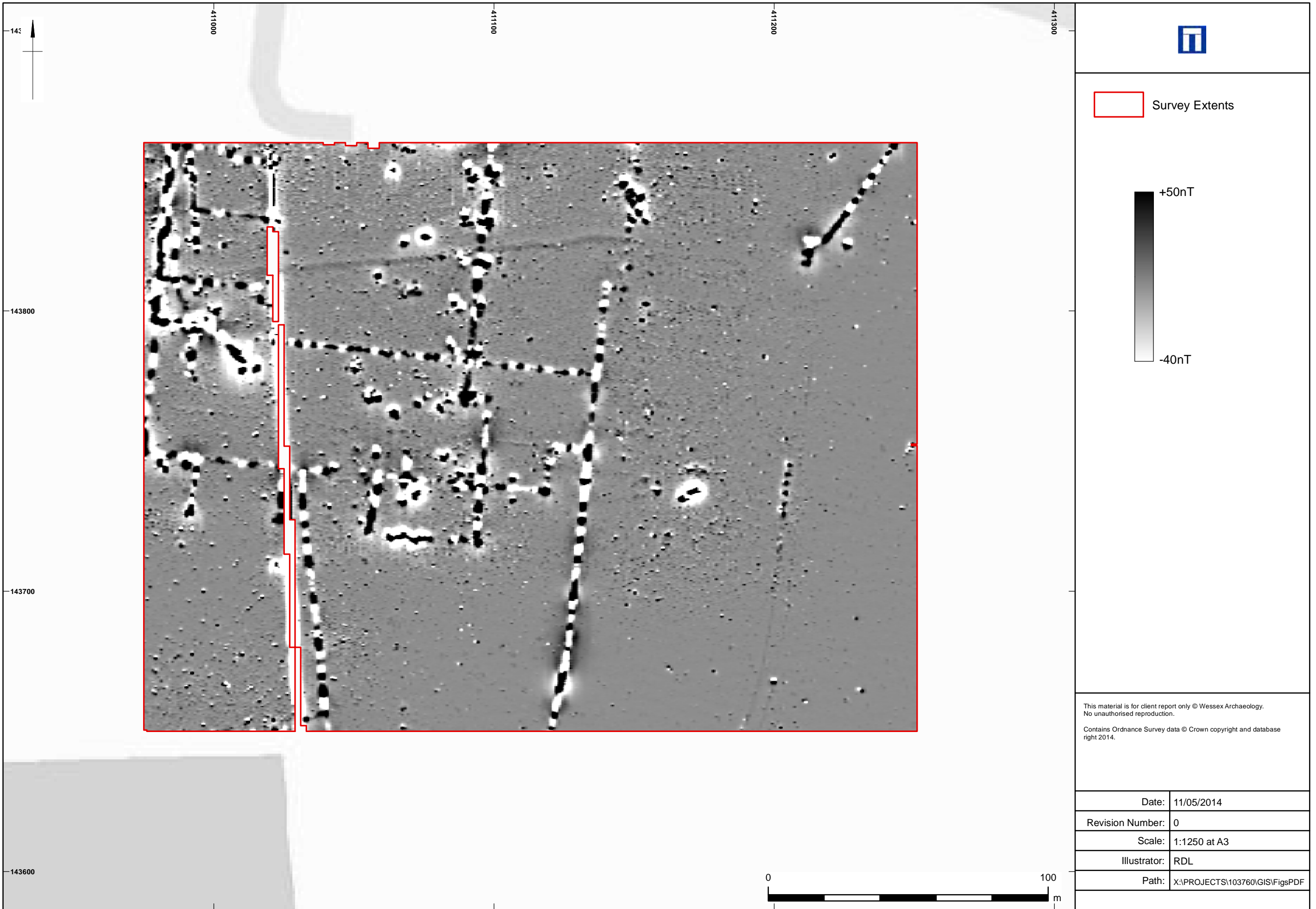





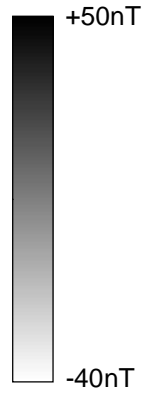
Greyscale plot, Fargo Camp, Site 1

Figure 4





 Survey Extents



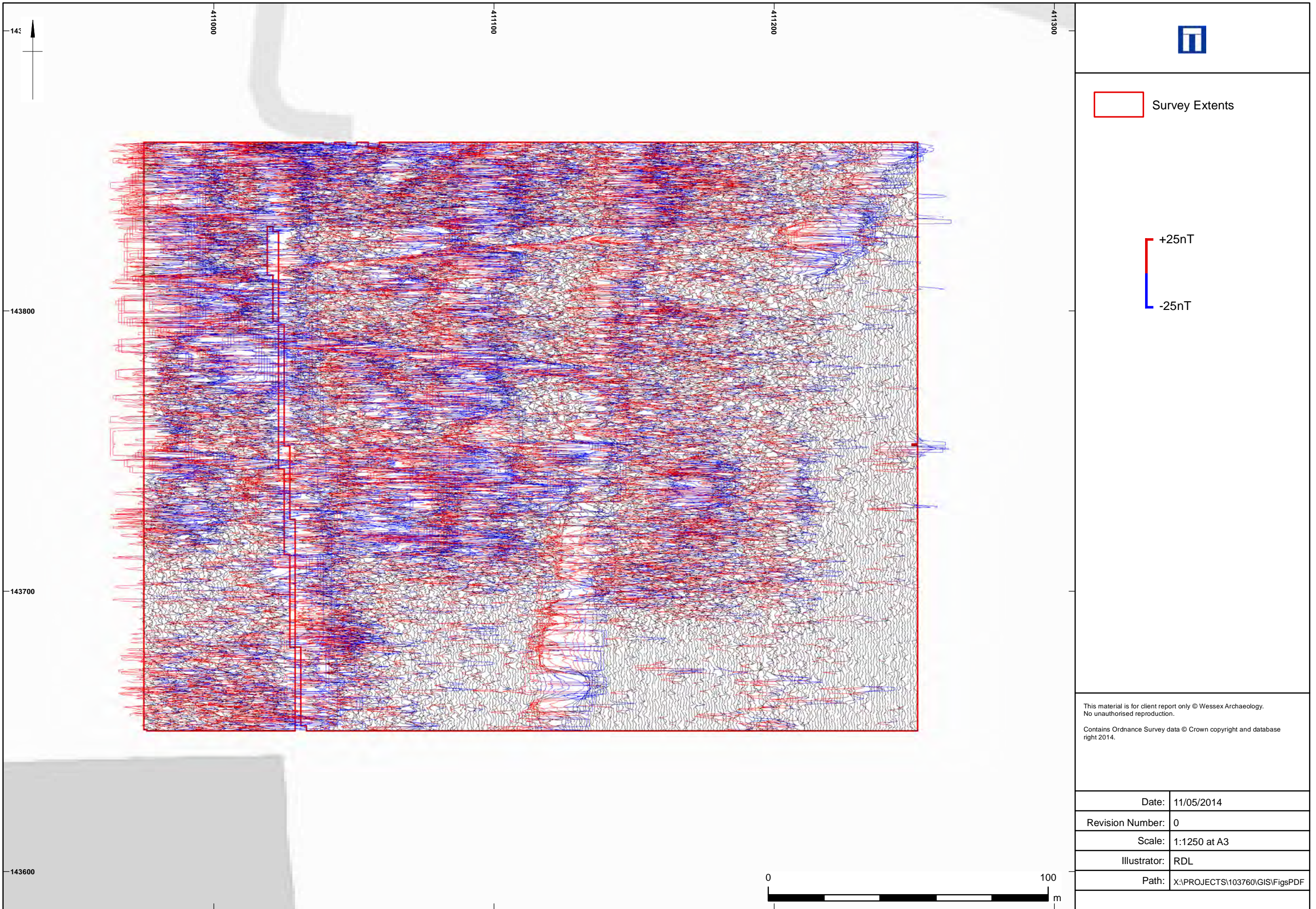
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Greyscale plot (Wide Range), Fargo Camp, Site 1

Figure 5

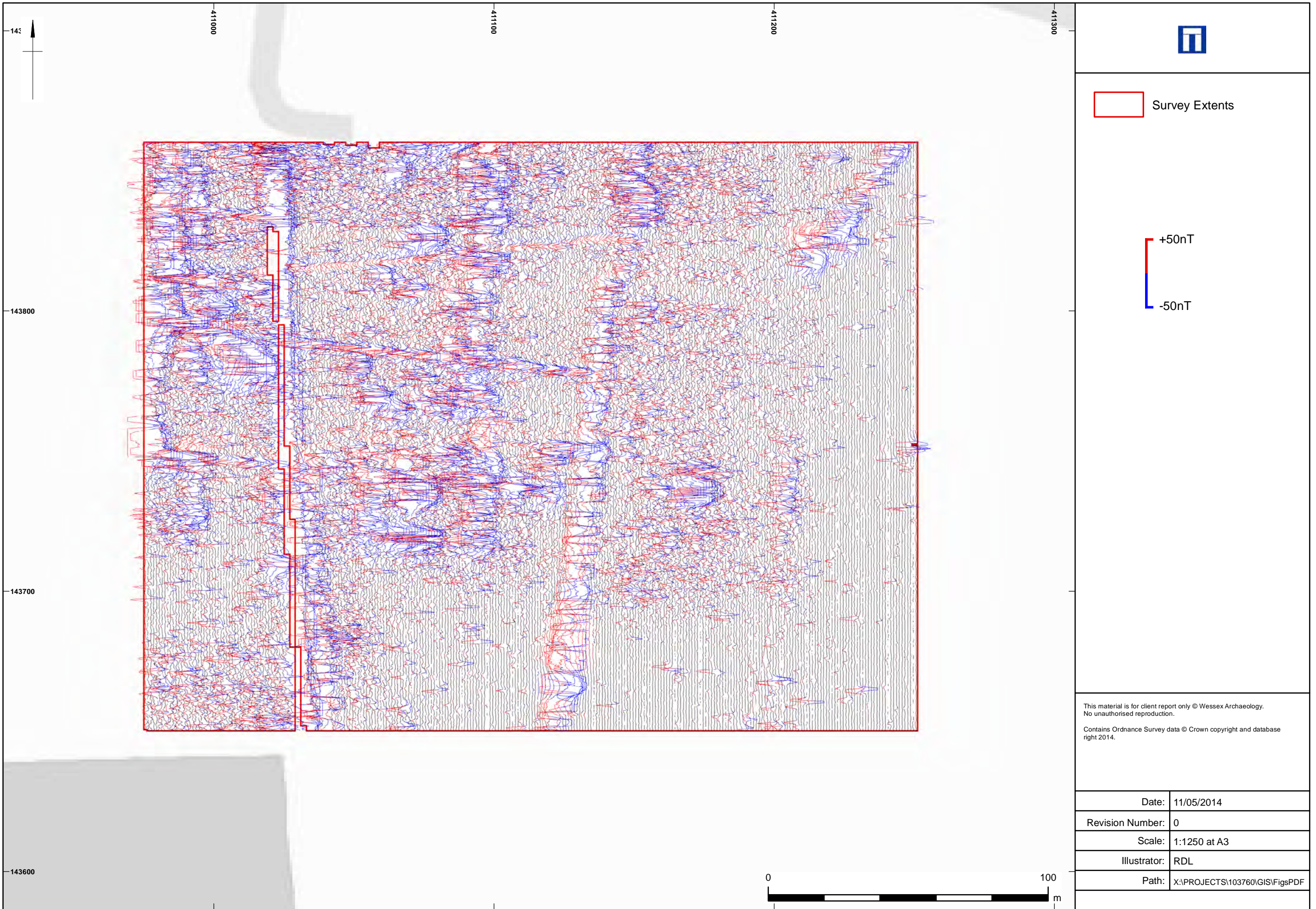




XY trace plot, Fargo Camp, Site 1

Figure 6

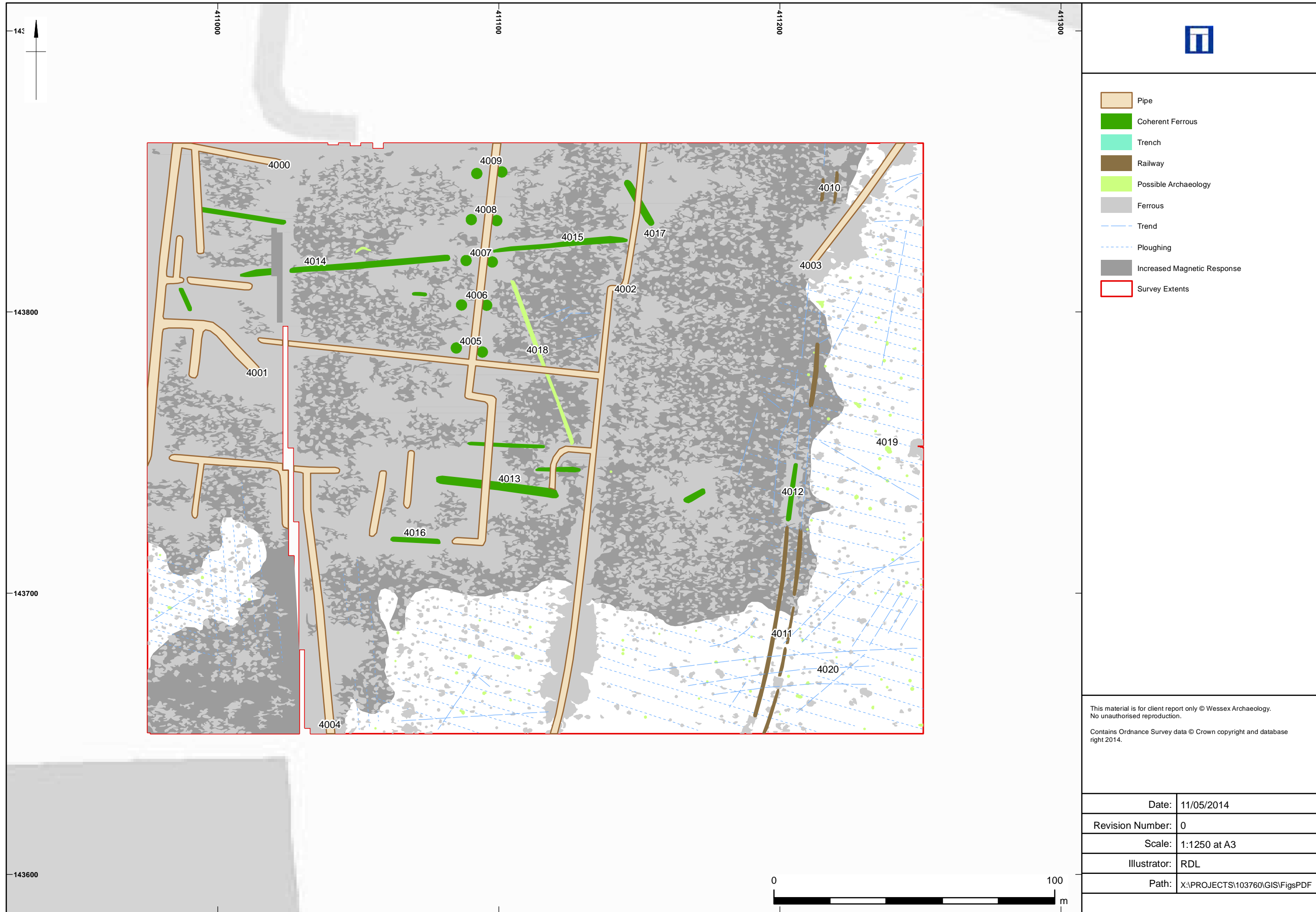




XY trace plot (Wide Range), Fargo Camp, Site 1

Figure 7





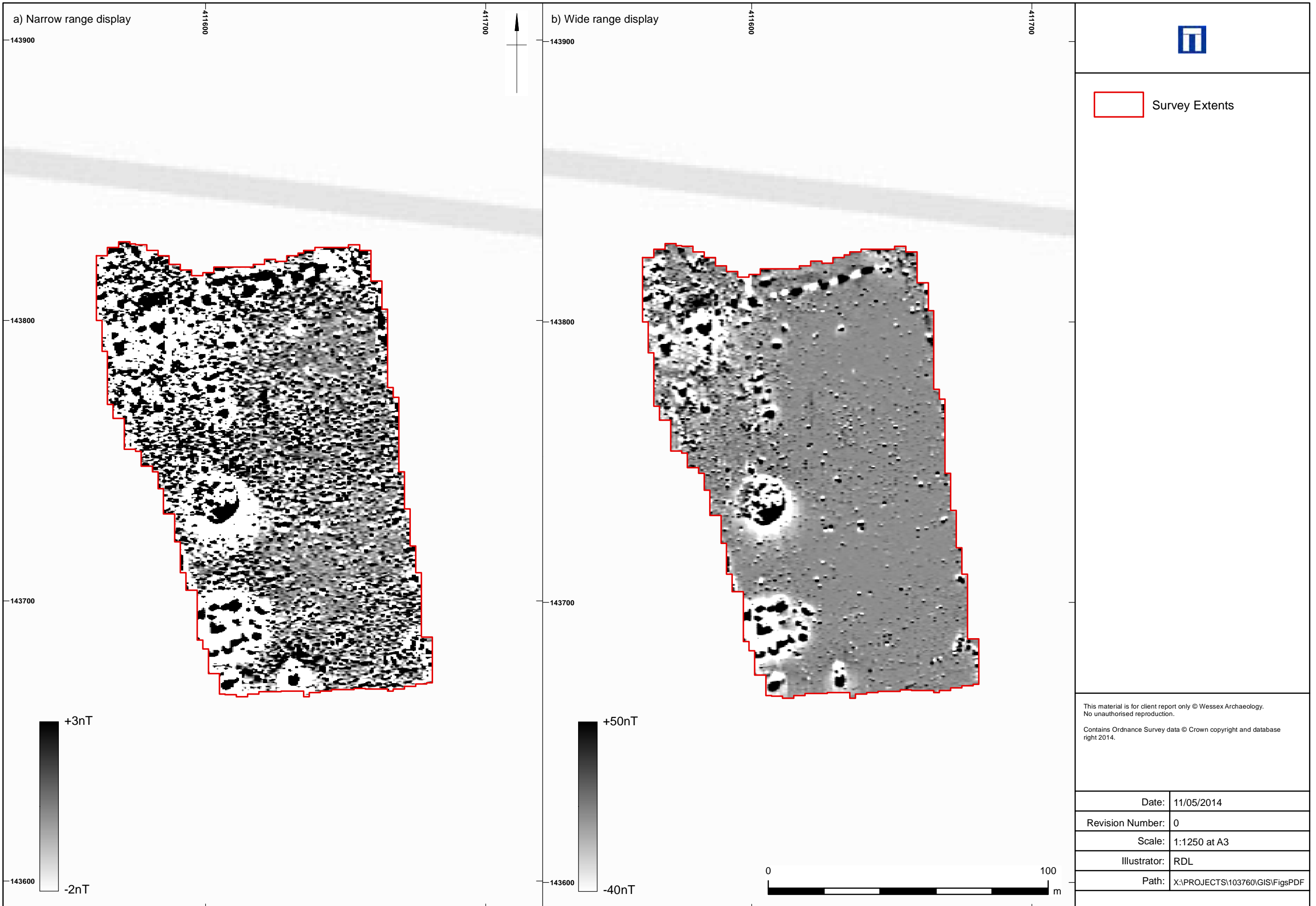
- Pipe
- Coherent Ferrous
- Trench
- Railway
- Possible Archaeology
- Ferrous
- Trend
- Ploughing
- Increased Magnetic Response
- Survey Extents

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Interpretation, Fargo Camp, Site 1

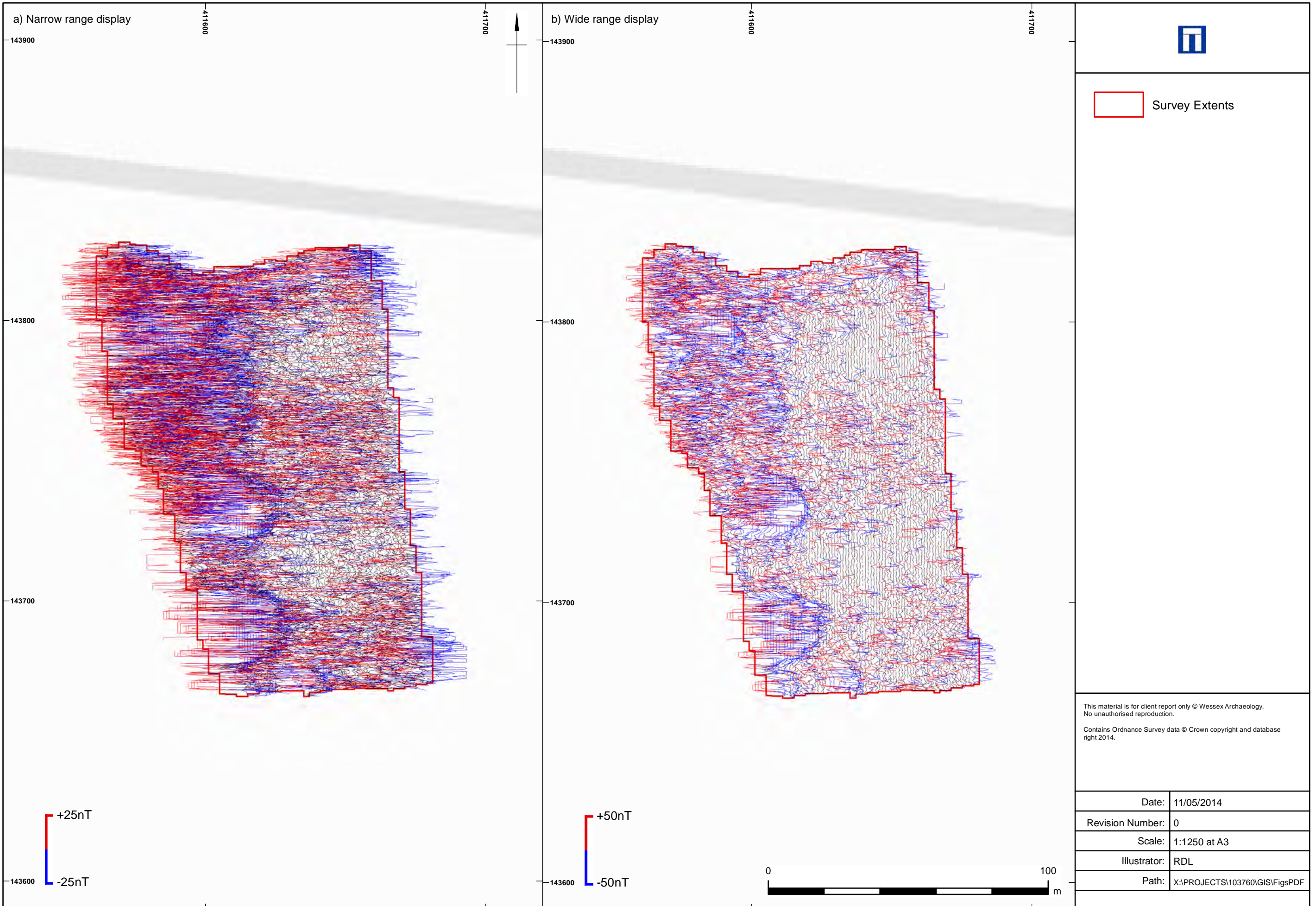
Figure 8



Greyscale plots, Fargo Camp, Site 2

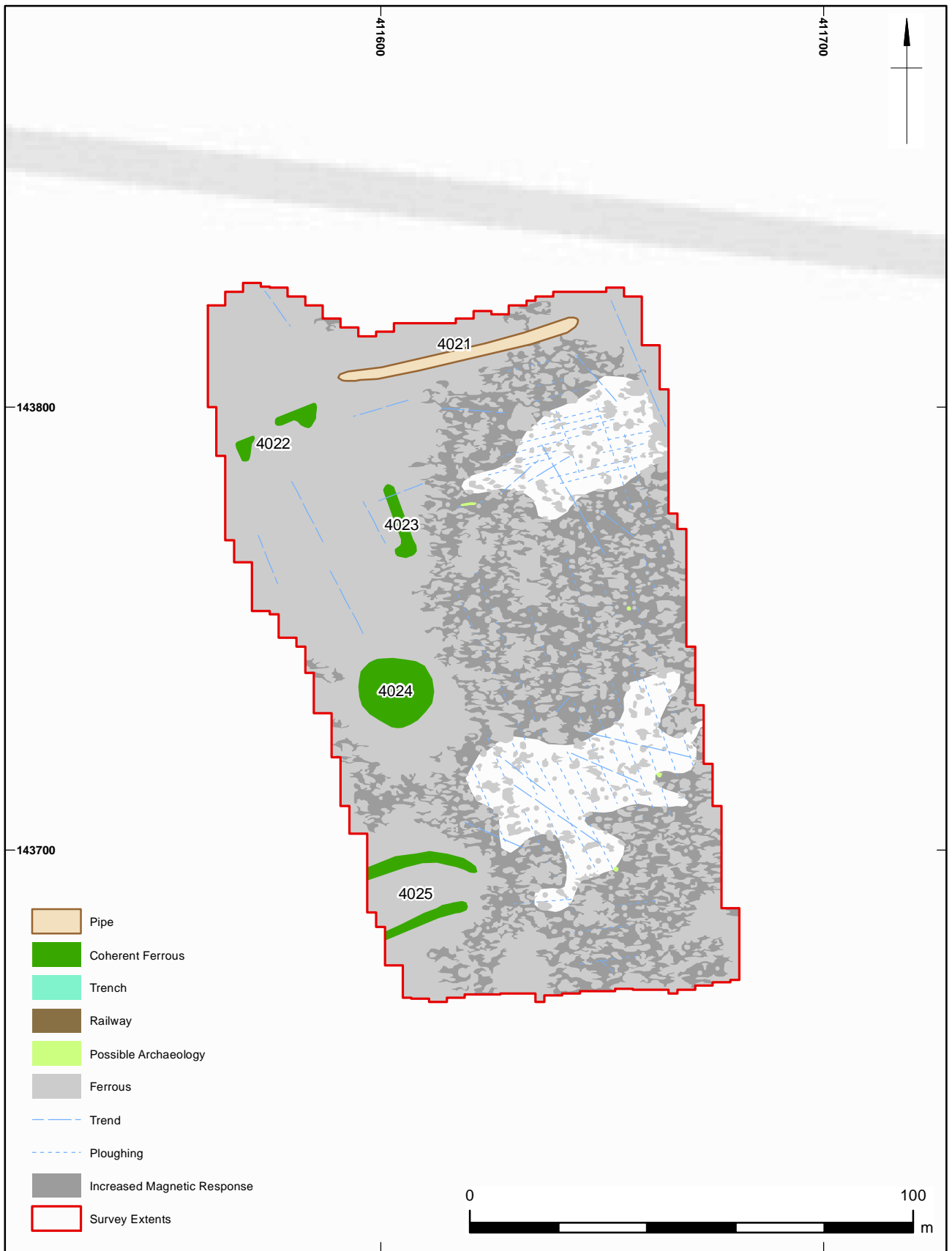
Figure 9





XY trace plots, Fargo Camp, Site 2

Figure 10

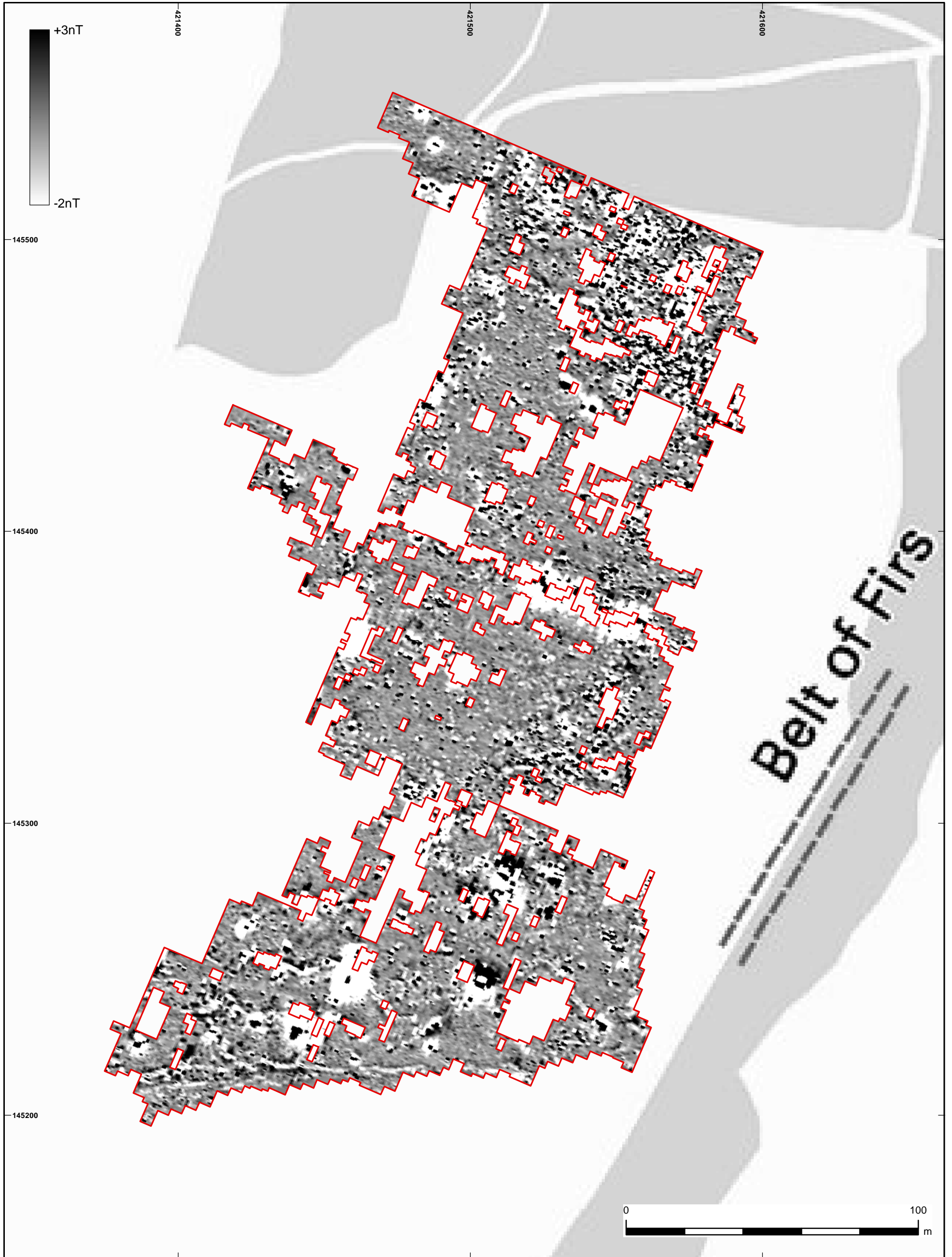



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Interpretation, Fargo Camp, Site 2

Figure 11





 Survey Extents



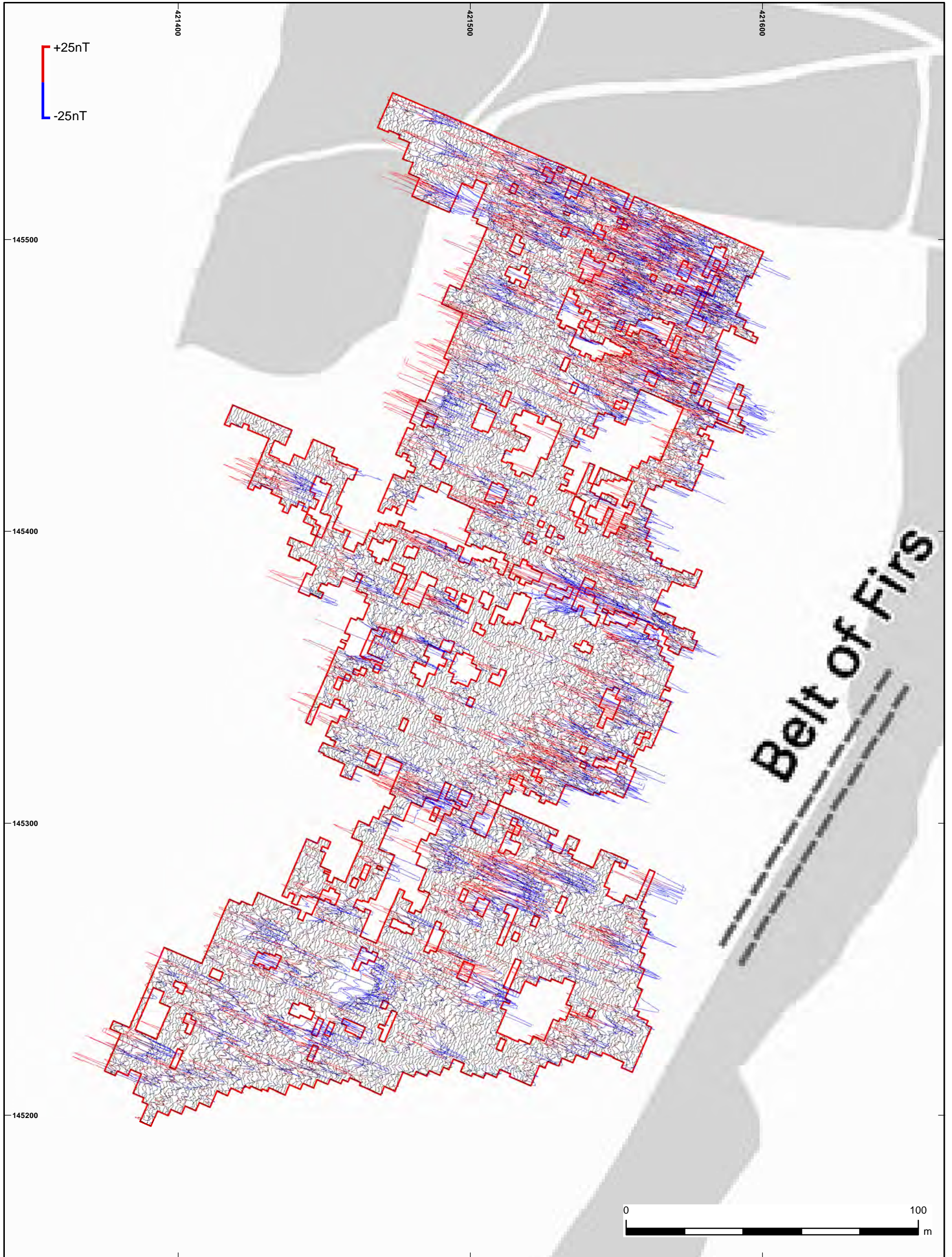
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Greyscale plot, Beacon Hill

Figure 12





 Survey Extents



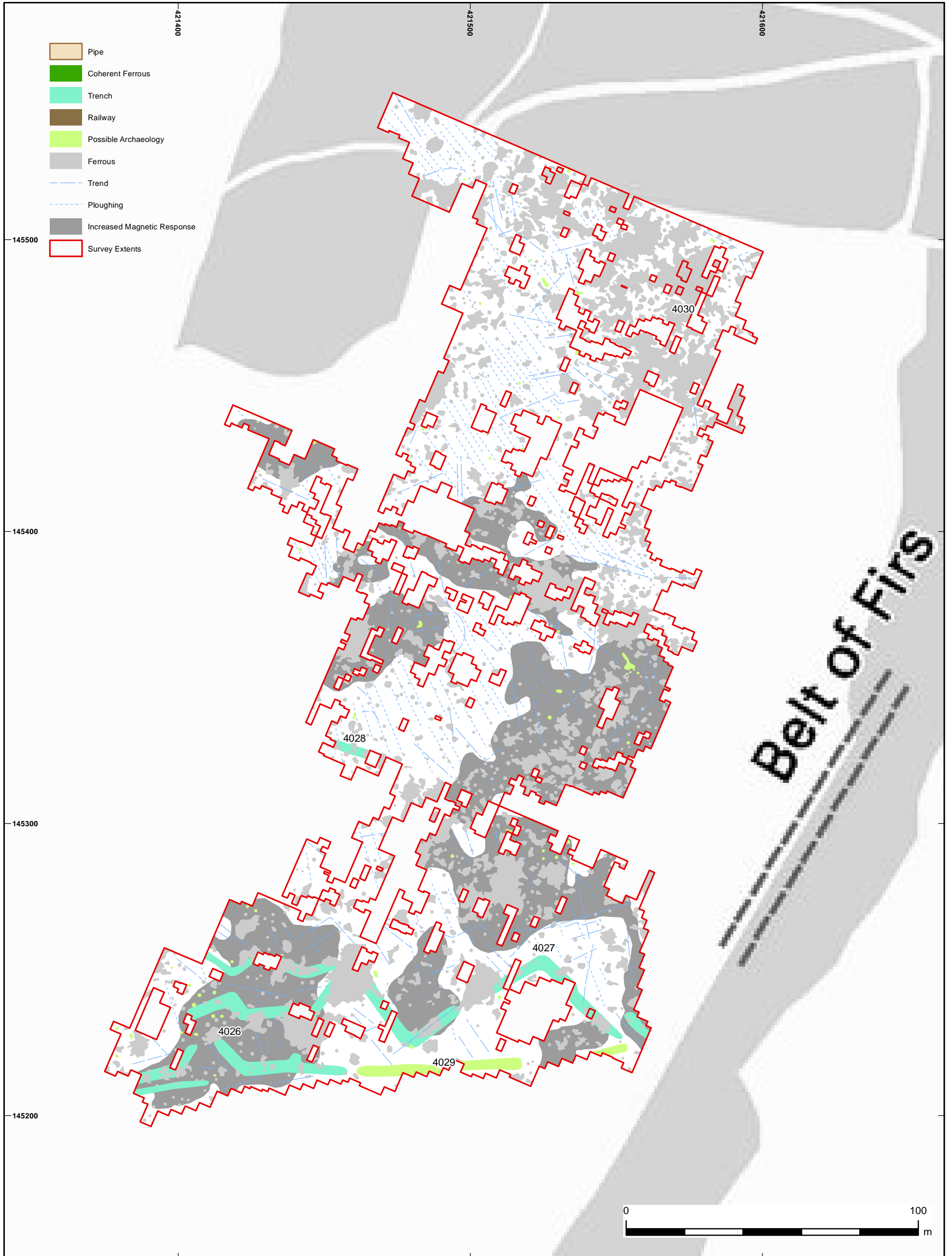
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XY trace plot, Beacon Hill

Figure 13

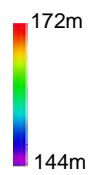
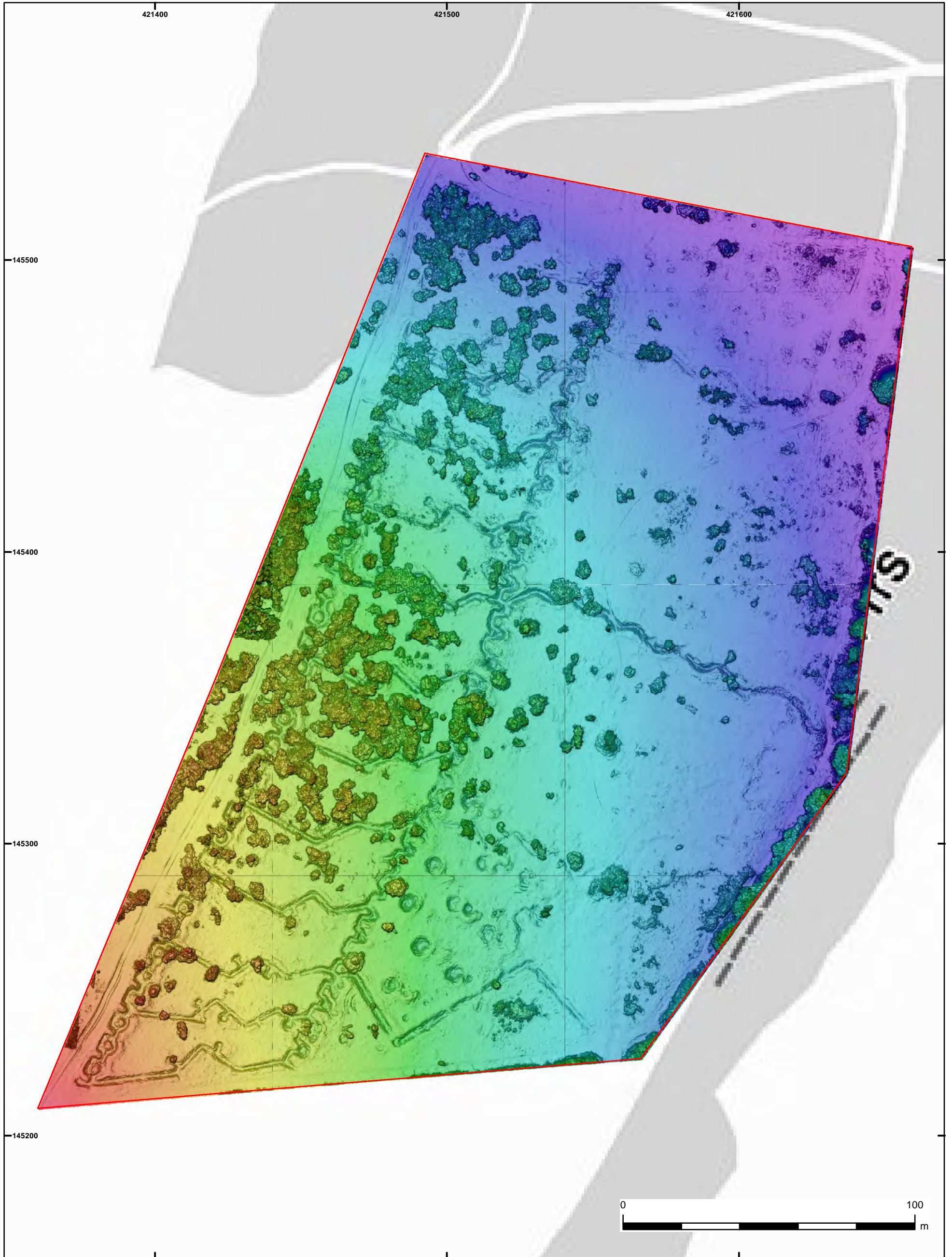




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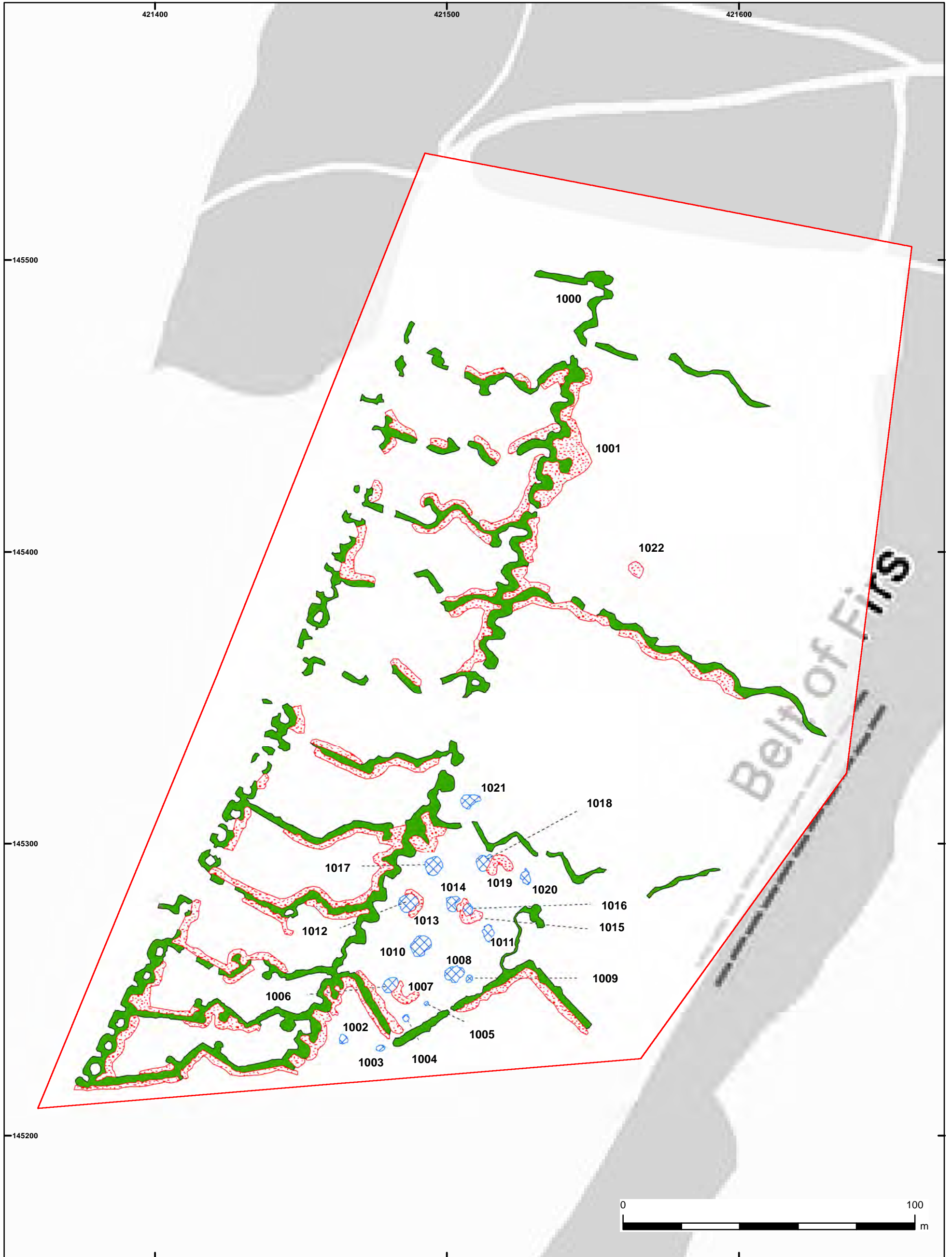
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Data Coverage Showing Topography and Rugosity Analysis (Beacon Hill)

Figure 15





Extent of UAV Survey  
 Bank  
 Ditch  
 Large Cut Feature

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Archaeological Interpretation of UAV Data (Beacon Hill)

Figure 16



salisbury rochester sheffield edinburgh



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