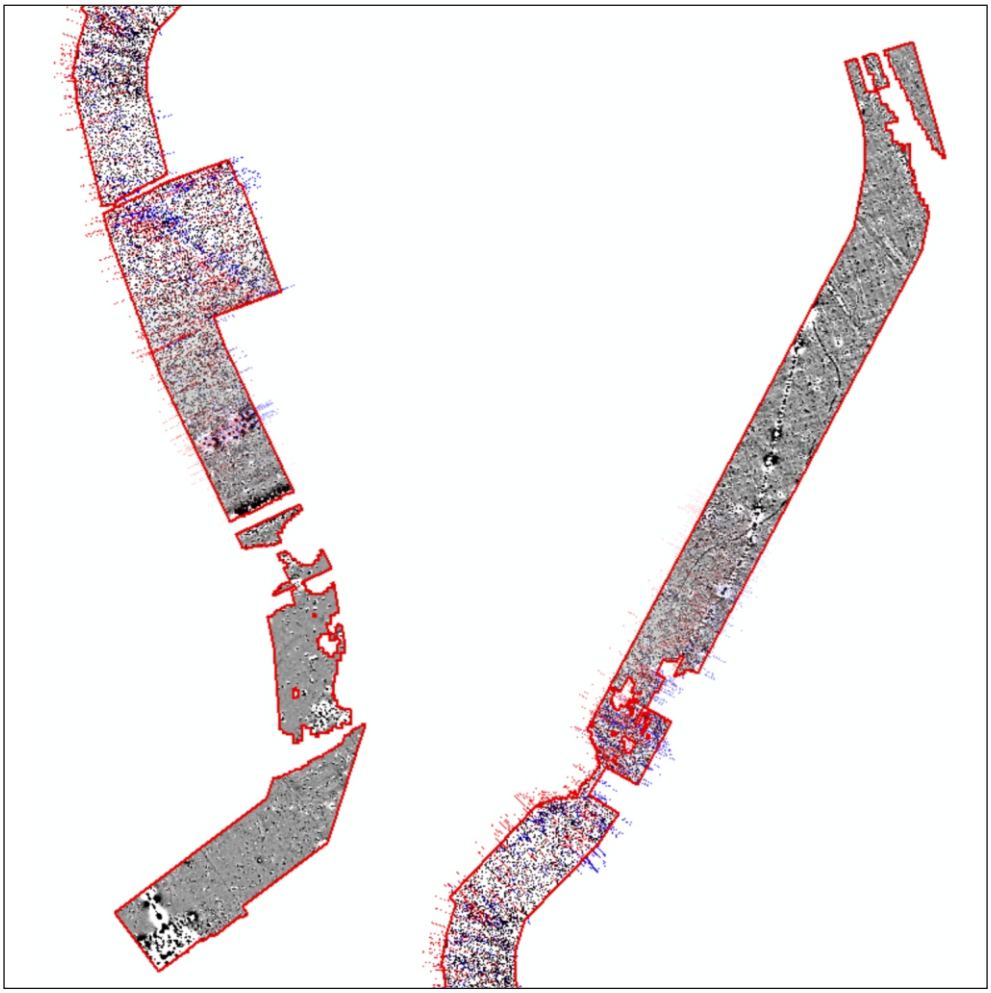
making sense of heritage

Bulford Garrison Back Gate
Wiltshire

Detailed Gradiometer Survey Report



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geoservices

Bulford Garrison Back Gate, Wiltshire

Detailed Gradiometer Survey Report

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* I = Internal Draft; E = External Draft; F = Final

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Detailed Gradiometer Survey Report

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Summary

A geophysical survey was conducted over land to the north and south of Bulford Droveway, Bulford, Wiltshire, within the southern limits of the Defence Training Estate (DTE) Salisbury Plain. The project was commissioned by WYG Planning and Design with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features on the site ahead of development.

The development proposes the construction of a trackway and washdown facility, and covers an area of 11ha, (measuring 1.7km in length and ranging from between 60m to 120m wide). It extends across a patchwork of fields comprising areas of marshland, pasture and arable cultivation.

A detailed gradiometer survey was undertaken over all accessible parts of the site, and covered an area of 10ha. The results have demonstrated the presence of anomalies of likely, probable and possible archaeological significance, along with several spreads of increased magnetic response and anomalies that suggest a number of modern services. The main concentration of archaeological features was located in the northern portion of the survey area and included a curvilinear ditch extending intermittently for 350m. A number of features in the dataset may relate to tracks crossing the land covered by the geophysical survey.

The survey was undertaken between 17th and 19th September 2014.

Bulford Garrison Back Gate, Wiltshire

Detailed Gradiometer Survey Report

Acknowledgements

The detailed gradiometer survey was commissioned by WYG Planning and Design, and Wessex Archaeology is grateful to Mathew Wilkey and Martin Brown in this regard.

The fieldwork was carried out by Laura Andrews, Alistair Black, Alistair Salisbury and Rachel Williams. The geophysical data was processed and interpreted by Alistair Salisbury. This report was written by Alistair Salisbury. The geophysical work was quality controlled by Ben Urmston and illustrations were prepared by Richard Milwain. The project was managed by Sue Farr.

Bulford Garrison Back Gate, Wiltshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by WYG Planning and Design to carry out a geophysical survey of land to the north and south of Bulford Droveway, Bulford, Wiltshire (**Figure 1**) hereafter "the Site" (located between NGR 417817 144043 in the south and 418132 145546 in the north).

1.1.2 The development proposes the construction of a trackway and washdown facility, and covers an area of 11ha, (measuring 1.7km in length and ranging from between 60m to 120m wide). It extends across a patchwork of fields comprising areas of marshland, pasture and arable cultivation.

1.1.3 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 Site is located immediately north-west of Bulford Camp and 2km east of Durrington, within the southern limits of the Defence Training Estate (DTE) Salisbury Plain in southern Wiltshire (**Figure 1**). The proposed trackway extends across a patchwork of fields comprising areas of marshland, pasture and arable cultivation.

1.2.2 The survey area was bounded by a dismantled railway forming a field boundary at the southern extent of the route, by an existing track to the north, and by open fields to the east and west interspersed by woodland plantations. It was bisected by an existing road, the Bulford Droveway, midway through the southern part of the route.

1.2.3 The survey area extends from the base of a shallow valley in the south, 80m above Ordnance Datum (aOD), to the brow of a hill to the north at an elevation of 114m aOD. The Nine Mile River, a tributary to the River Avon, flows parallel to the dismantled railway along the southern edge of the Site before becoming obscured by woodland.

1.3 Soils and geology

1.3.1 The soils underlying the Site are recorded as being composed solely of chalk formation, with the Culver Chalk Formation at the southern extent of the Site touching on the Newhaven Chalk Formation in the northern extent. All of these deposits date to the Upper Cretaceous. There are few superficial alluvium deposits recorded at the very southern extent including silty clay layers containing silt, sand, peat and basal gravel from the interglacial stage of the Holocene epoch (http://www.bgs.ac.uk/).

1.3.2 The soils underlying the Site are mostly recorded as shallow well-drained calcareous silty soils of the 343h (Andover 1) association. The southernmost area is defined by the well-drained calcareous fine silty soils of the 511f association (Coombe 1) (SSEW 1983), both of which are typical of a chalky geological parent material. 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 Archaeological & historical background

1.4.1 The following information is summarised from information available online at Heritage Gateway.

1.4.2 No recorded findspots lie within the boundaries of the Site, however there is a socketed axe mould less than 1km west of the Site, which dates to the Bronze Age.

1.4.3 Two possible barrows (MWI12370 & MWI12371) are recorded as cropmarks from aerial photography to the north of the proposed washdown facility, and a further ring ditch (MWI12097) west of the scheme is noted although it may be modern in origin. A linear ditch (MWI11652) extends NE-SW through the northernmost part of the survey area and is thought to relate to a historic boundary.

1.4.4 Rectangular and sub-rectangular cropmarks have also been transcribed from aerial photography and are likely to relate to 20th century military activity or be agricultural in origin. Field investigation of the cropmarks in 1969 found no surface traces.

A dispersed pattern of possible First World War or later slit trenches is recorded in the northwestern part of Bulford Camp. Further extensive tented encampments were also recorded within the existing barracks and date from the 1920s to 1950s.

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 17th and 19th September 2014. In total the geophysical survey covered 10ha.

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 (ZMT) function (±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. The deslope and add functions were used to account for errors in the ZMT function and to remove grid edge discontinuities. These four steps were applied to all survey areas, with no interpolation applied.

2.2.4 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 identified numerous anomalies of archaeological interest; these anomalies include a 350m curvilinear ditch, pit clusters and field system. Results are presented as a series of greyscale and XY plots, and archaeological interpretations, at a scale of 1:1500 (**Figures 2** to **6**). The data are displayed at -2nT (white) to +3nT (black) for the greyscales and ±25nT at 25nT per cm for the XY traces.

3.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figures 4** and **7**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**. The archaeology and probable archaeology interpretation categories have an additional weak response counterpart; these additional categories were added due to the greater variation in strength of magnetic response across this Site.

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.

3.2 Gradiometer survey results and interpretation

3.2.1 Near the southern extent of the survey area, south of Bulford Droveway, anomalies **4001** to **4003** were recorded and oriented NW-SE. These had similar magnetic readings and are indicative of ditches, most likely associated with former field boundaries. The clearer segments of ditches are defined as probable archaeology with a further isolated ditch segment perpendicular to the anomalies classed as possible archaeology. A number of small pit-like anomalies have also been classed as possible archaeology, although no relationship between these and the linear anomalies can be established.

3.2.2 An area of increased magnetic response to the immediate south-west of **4001** may be attributed to the former railway or discarded agricultural material, or perhaps associated with modern service **4000**.

3.2.3 The marshy area north of the Nine Mile River is relatively quiet magnetically, aside from regions of more extensive magnetic disturbance probably associated with modern debris. A region of sinuous increased response appears to be geological in origin and may indicate a former channel.

3.2.4 Immediately to the north of Bulford Droveway, a linear trend of ferrous anomalies **4004** extends NW-SE. An extensive region of magnetic disturbance **4005** is likely to be associated with the installation of modern services apparent in the dataset.

3.2.5 A cluster of pit-like anomalies **4006** is considered to be of possible archaeological interest given their sub-circular distribution. However, the individual anomalies are poorly defined from the magnetic background and it is possible that they are the result of agricultural or geological processes.

3.2.6 Segments of the Site have anomalies congruous with those of agricultural activity. The most obvious of these are ploughing trends oriented NE-SW positioned adjacent to the pit-like anomalies at **4006**, north of modern service **4007** and **4008** and at **4011**. These are regularly spaced and conform to the weakly magnetic signatures that are typical of historic or modern ploughing.

3.2.7 A dispersed cluster of pit-like anomalies **4009** is of uncertain origin, and it is possible that they are agricultural in nature, rather than being archaeological.

3.2.8 Linear anomaly **4010** crosses the survey corridor oriented E-W. The clear direction suggests a ditch of unknown age, although it is possible that it relates to a former

boundary. The anomaly has been described as probable archaeology due to the strong nature of the magnetic readings; it is also interesting to note that this anomaly extends eastwards towards the two possible barrows that lie immediately outside the survey area.

3.2.9 Weakly defined negative anomalies coincident with **4010** are typical of modern activity, which may represent a track, probably for vehicles; the regular spacing and the very weak positive margin both support this interpretation. Similar trends are better defined and more extensive at **4012**, approximately 200m to the north.

3.2.10 Extensive tracks and pathways of numerous orientations alongside a strongly varying magnetic background at **4012** and **4013** are indicative of frequent modern activity. The presence of a probable modern service has contributed to the general disturbance.

3.2.11 The most significant archaeological feature within the Site is a curvilinear anomaly spanning from **4014** through **4015** and **4016**, and finishing at **4018**. The total recorded length from **4014** to **4018** is some 350m although it almost certainly extends beyond the limits of the surveyed area. The anomaly is more clearly defined than the other ditches seen elsewhere in the dataset, although it is unclear whether its fragmentary appearance is by design or through later truncation.

3.2.12 A sub-circular trend can be seen between **4018** and **4019**, which is of uncertain origin. The response over this anomaly is clearly different in character from that of the nearby ditch at **4018**, and is more similar to those at **4019**, suggesting that it may be modern in origin and associated with vehicle tracks; as noted previously (**1.4.3**), a ring ditch of probable modern provenance has been noted to the west of the survey area.

3.2.13 Two groups of parallel linear anomalies **4019** and **4020** are of uncertain origin; their character is consistent with former field boundaries, although the prevalence of vehicle tracks in the vicinity suggests that they might be more recent in provenance.

3.2.14 Areas of disturbance and negative linear trends can be seen flanking the existing track at the northernmost extent of the scheme, e.g. **4021** and **4022**. These are considered likely to be modern in origin given their proximity to the track.

3.3 Gradiometer survey results and interpretation: modern services

3.3.1 A number of modern services have been identified in the geophysical data, (**4000**, **4005**, **4007**, **4008** and **4017**), however determining the function and status of these services lies beyond the remit of this geophysical survey, and it should be noted that gradiometer survey alone 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 DISCUSSION

4.1 Conclusions

4.1.1 The detailed gradiometer survey has been successful in detecting anomalies of likely, probable and possible archaeological interest, in addition to spreads of increased magnetic response and a number of modern services.

4.1.2 One feature of likely archaeological interest is a long curvilinear ditch within the northernmost portion of the dataset, which extends beyond the survey area to the north and south. There is little indication from the geophysical data alone as to which period the ditch may belong, although the lack of ferrous anomalies along its length suggests that an earlier date may be more likely.

4.1.3 A linear ditch, thought to be a former boundary, has been mapped as crossing through part of this dataset oriented NE-SW on the Wiltshire and Swindon Historic Environment Record (MWI11652); no linear anomaly has been detected in the geophysical survey that exactly matches the course of this cropmark feature.

4.1.4 Several possible and probable former field boundaries have been identified, some of which are probably historical in origin. Perhaps the most interesting of these is located towards the northern part of the survey area, and extends towards the two possible barrows that lie immediately east of the scheme. No trace of either barrow can be seen in the geophysical data however, and it is therefore not possible to infer any direct relationship.

4.1.5 Numerous isolated pit-like anomalies have been detected, although they generally lack any coherency to their distribution. The exception to this is the sub-circular cluster of pit-like responses **4006**, which may be of archaeological interest.

4.1.6 The geophysical data has revealed numerous tracks and pathways that may be related to the neighbouring MOD activity. Often these can be seen in cropmarks and aerial photography. The sub-circular trend seen near the northern extent of the scheme may relate to such modern activity, although this cannot be demonstrated conclusively.

4.1.7 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.

5 REFERENCES

5.1 Bibliography

English Heritage, 2008. *Geophysical Survey in Archaeological Field Evaluation. Research and Professional Service Guideline* No 1, 2nd edition.

5.2 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.

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 ±100nT 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:

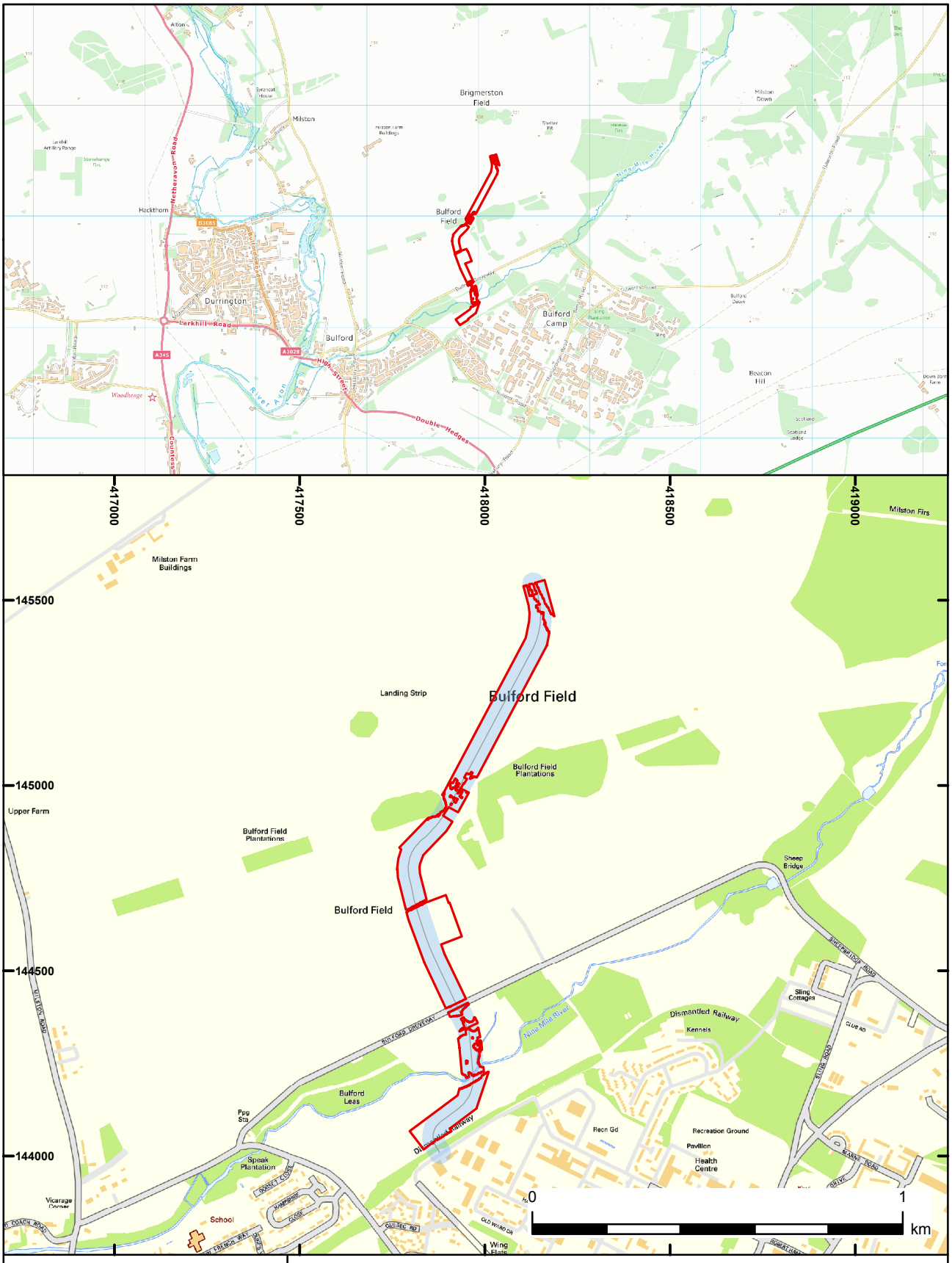
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be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



Survey Extents

Scheme Centreline

Scheme 30m Buffer

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Site location and survey extents

Figure 1

Survey Extents

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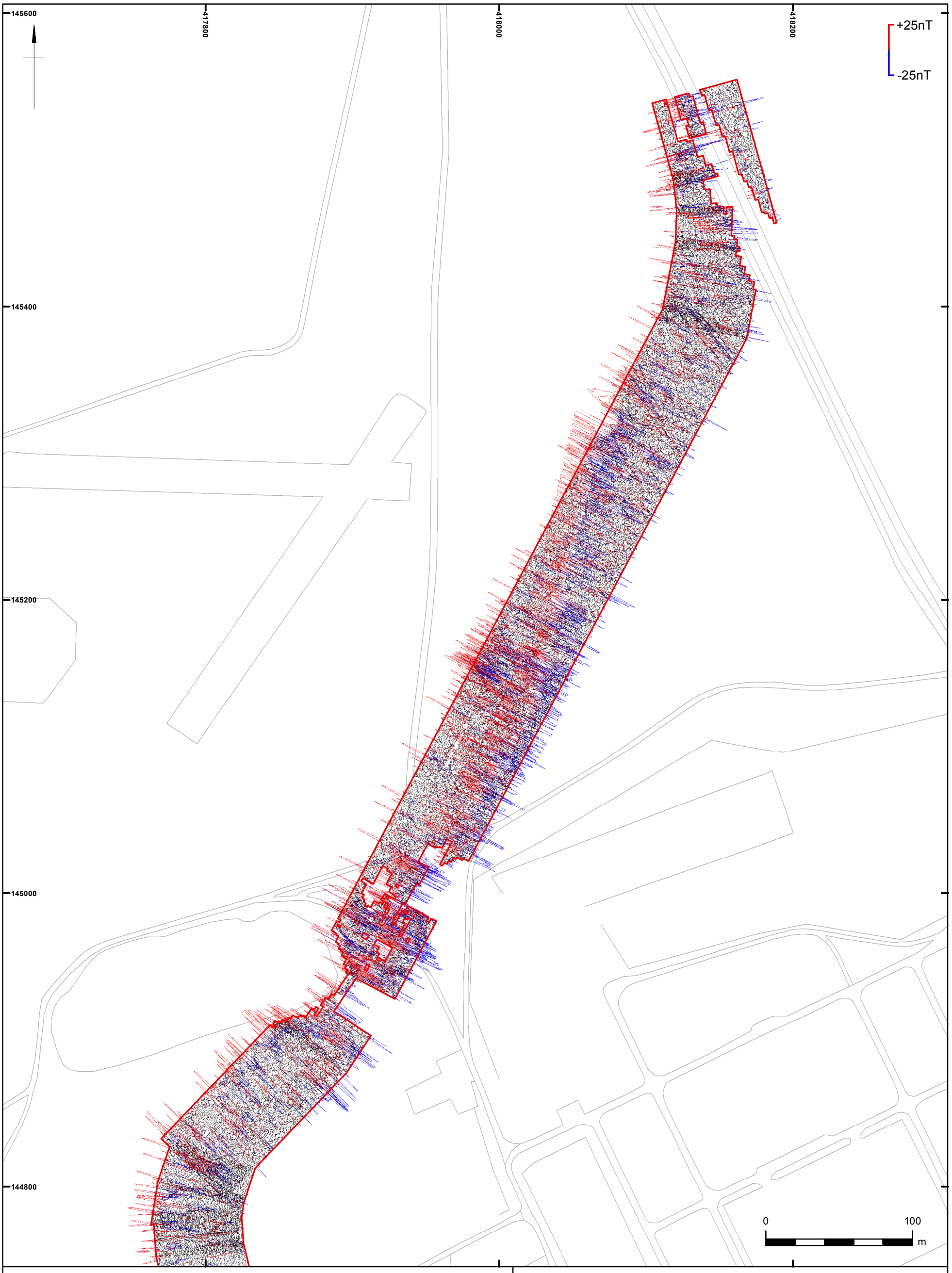
Greyscale (north)

Figure 2



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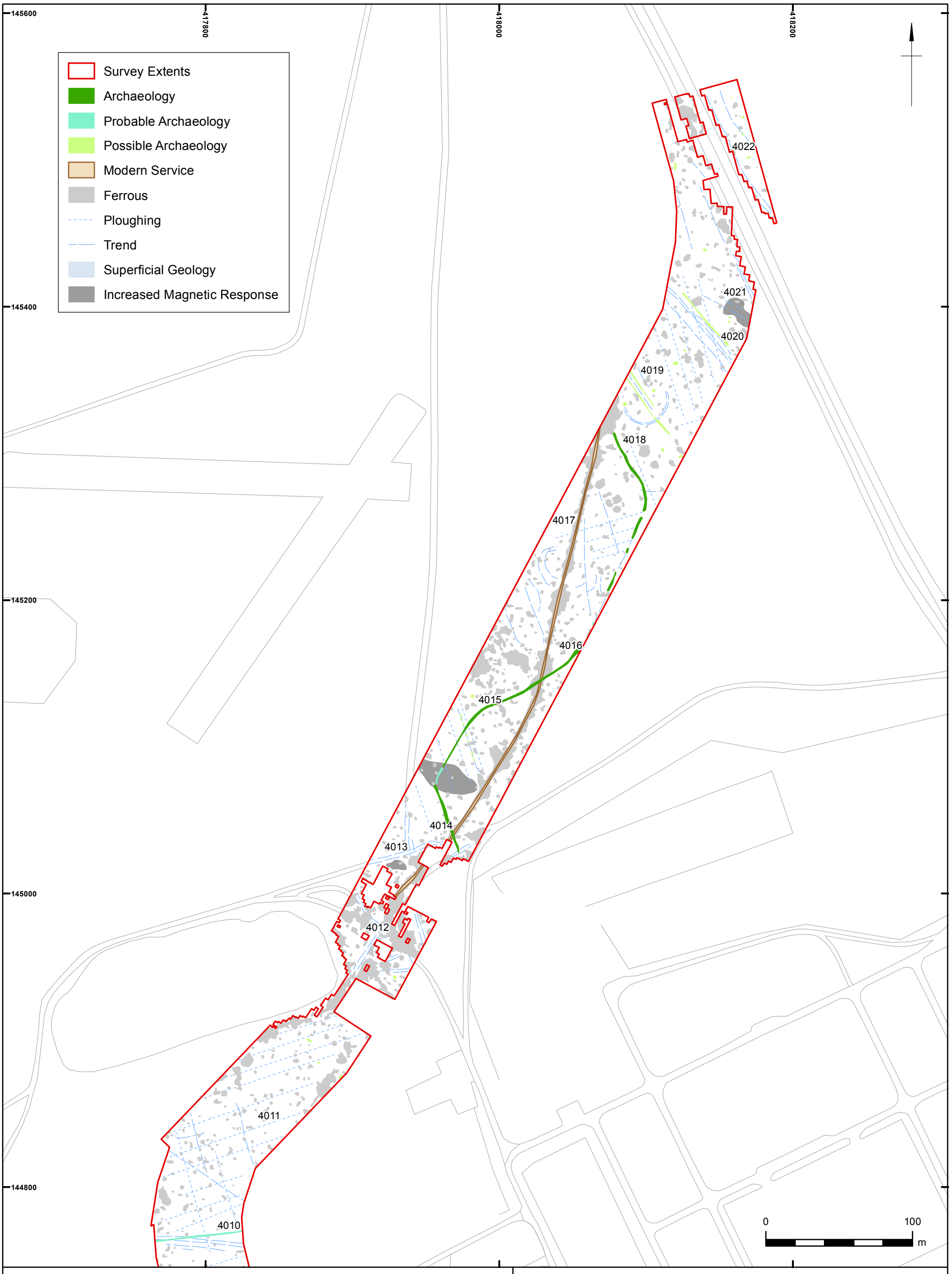
XY Trace (north)

Figure 3



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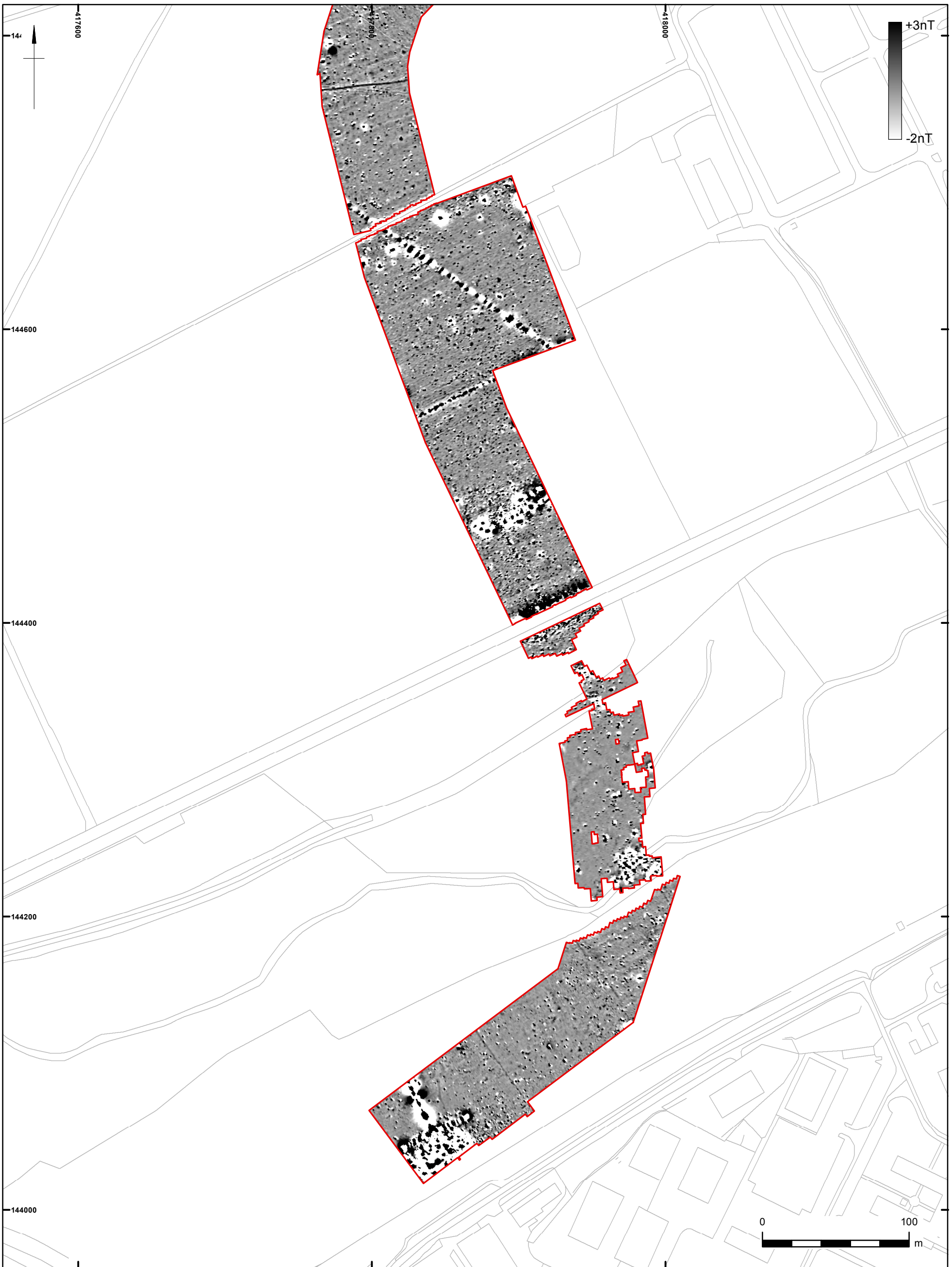
Interpretation (north)

Figure 4



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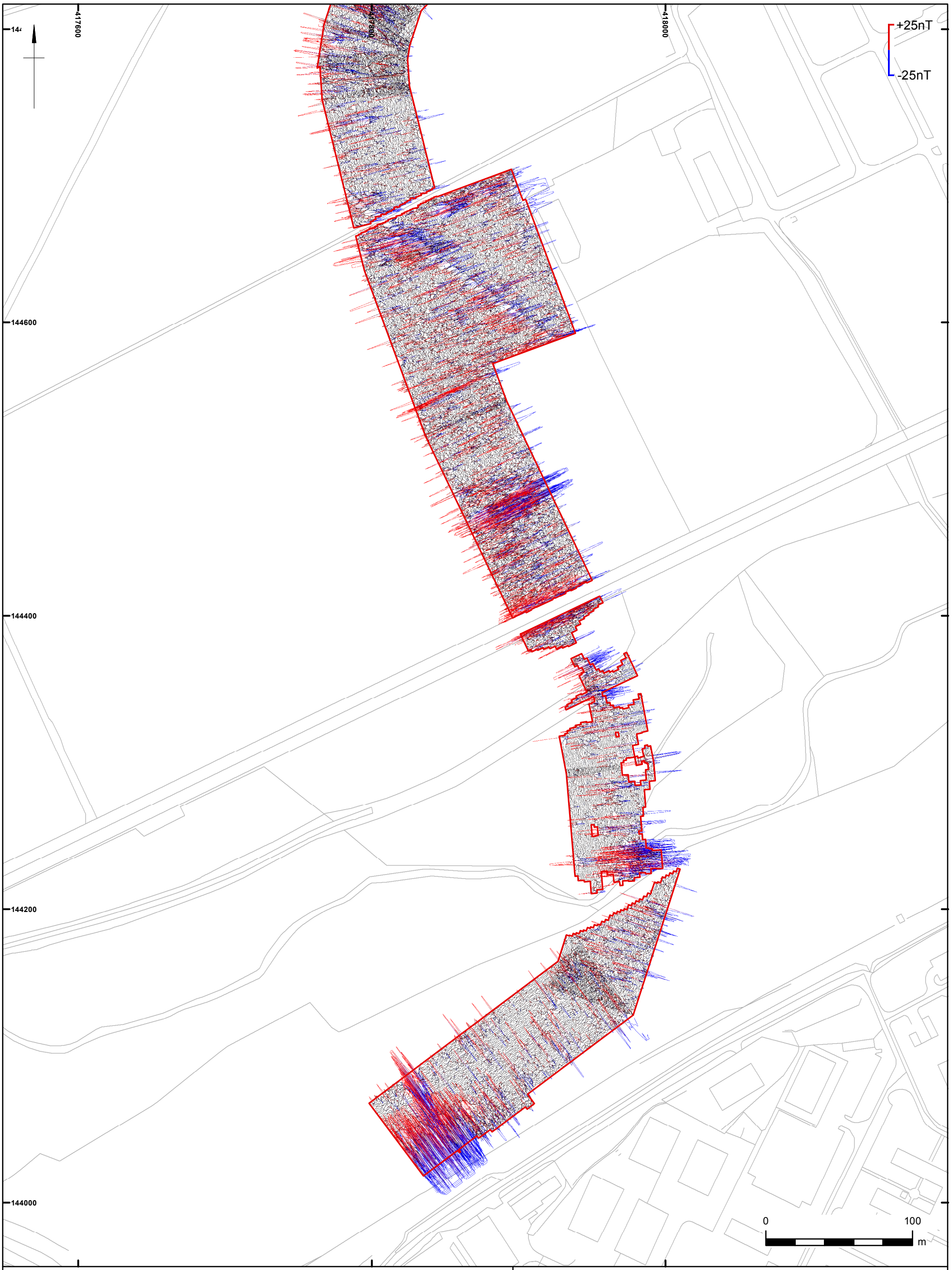
Greyscale (south)

Figure 5



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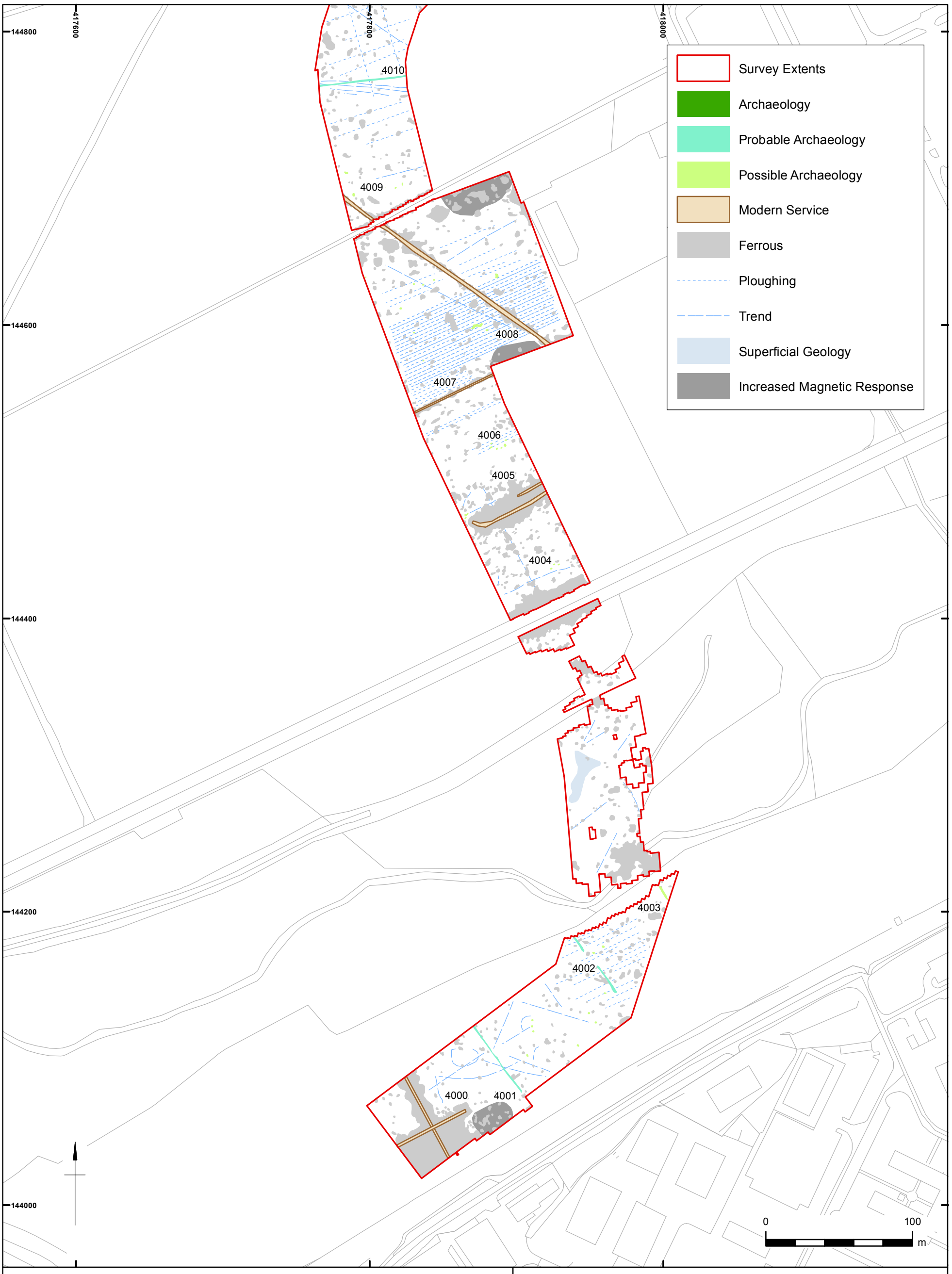
XY Trace (south)

Figure 6



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Interpretation (south)

Figure 7

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