Oxton 15” Duplication
Clifton, Nottinghamshire

Detailed Gradiometer Survey Report

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Document Information

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National grid reference	455830 336060 (SK 55830 36060)
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Date of fieldwork	04/03/2019
Fieldwork directed by	Chris Hirst
Project management by	Lucy Marston
Document compiled by	Alexander Schmidt
Contributions from	Hans Whitefield and Tom Richardson
Graphics by	Alexander Schmidt

Quality Assurance

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1	05/03/2019	First internal draft	AJS		TR
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Summary

A detailed gradiometer survey was conducted over land located to the north of the A453, Clifton (centred on NGR 455830 336060). The project was commissioned by NMC Nomenca on behalf of Severn Trent Water with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features ahead of the installation of an underground service.

The site comprised a linear portion of a single arable field located 1.6 km north-north-east of the centre of Clifton, Nottinghamshire, covering an area of 1.8 ha. In addition, two small areas forming the potential location of a works' compound, each measuring 25 m by 25 m, were also surveyed. The geophysical survey was undertaken on Monday 4th March 2019 and has demonstrated the presence of a number of anomalies.

Those anomalies identified as being of archaeological origin are primarily pit-like features of unknown origin and date, but which may be associated with a previously excavated Neolithic or Bronze Age pit alignment.

The areas of strong magnetic response are related to underground services and a pylon.

Acknowledgements

Wessex Archaeology would like to thank NMC Nomenca for commissioning the geophysical survey on behalf of Severn Trent Water. The assistance of Katie Rodrigues is gratefully acknowledged in this regard.

The fieldwork was undertaken by Chris Hirst and Owen Jenkins. Alexander Schmidt processed and interpreted the geophysical data, wrote the report, and prepared the illustrations. The geophysical work was quality controlled by Tom Richardson and Ben Urmston. The project was managed on behalf of Wessex Archaeology by Lucy Marston.

Oxton 15" Duplication, Clifton Nottinghamshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology was commissioned by NMC Nomenca on behalf of Severn Trent Water (hereafter 'the Client') to carry out a geophysical survey of land north of the A453 in Clifton, Nottinghamshire (centred on NGR 455830 336060, **Figure 1**; hereafter 'the Site). The survey forms part of a programme of archaeological works ahead of groundworks for the installation of a pipeline.

1.2 Scope of document

1.2.1 This report presents a brief description of the methodology followed by the detailed survey results and the archaeological interpretation of the geophysical data.

1.3 The Site

1.3.1 The Site is located 1.6 km north-north-east of the centre of Clifton and 4 km south-west of Nottingham, in the county of Nottinghamshire.

1.3.2 The survey comprised 2 ha of agricultural land. The survey area was bounded by open arable land on all sides and the field bounded by the River Trent to the north and the A453 to the south. Residential properties lay to the south-west and pasture land to the north-east.

1.3.3 The Site is on a slight south-facing slope, traversing south-west to north-east across the incline at 23 to 24 m above Ordnance Datum (aOD) throughout.

1.3.4 Two sets of overhead cables traverse the site toward the north-eastern end. Both sets are parallel and extend from north-east to south-west.

1.3.5 The solid geology comprises Mudstone of the Gunthorpe Member with overlying alluvial deposits of clay, silt, sand, and gravel (BGS 2019).

1.3.6 The soils underlying the Site are likely to consist of typical brown alluvial soils of the 561a (Wharfe) association (SSEW 1983). Soils derived from such geological parent material may limit the effectiveness of magnetic survey for detecting archaeological remains.

2 ARCHAEOLOGICAL BACKGROUND

2.1 Introduction

2.1.1 The following historical and archaeological background has been compiled using publicly available online resources, combined with the results of Wessex Archaeology's previous investigations in the area, including an Archaeological Desk-based Assessment (DBA) (2019) and in-house resources. The DBA examined the potential for the survival of buried archaeological remains within the Site and an approximate 1 km surrounding study area. While not exhaustive, the following is a summary of findings that are considered relevant to the interpretation of the geophysical survey data.

2.2 Summary of the archaeological resource

2.2.1 There is only one find identified as associated with the Palaeolithic and Mesolithic periods within the locale of the Site. This is a findspot of 13 flint flakes that were recovered from near a ring-ditch 230 m south-west of the Site on the opposite side of the A453.

2.2.2 There have been a limited number of Neolithic period heritage assets identified within the study area. Neolithic to Bronze Age pit alignments were originally identified from aerial photography and were then excavated during the A453 widening. A portion of this pit alignment appears to be located within the geophysical survey area. Fieldwalking has been previously conducted in this field, although there have been no other finds relating to the period.

2.2.3 A further nine heritage assets that relate to the Bronze Age are recorded within the study area, the most significant being a barrow cemetery comprising eight features, five circular, two semi-circular, and one rectangular, identified through aerial photography. One of the barrows was previously partially excavated and, towards the centre, the remains of a cremation inside a collared urn were uncovered. There are also several other burials that have been found within the vicinity of the barrow cemetery.

2.2.4 A pile settlement from the Bronze Age was uncovered during a dredging programme of the River Trent in 1938, 430 m from the Site. Wooden piles were discovered, in rows 1.2 m apart, driven 1.8 to 2.5 m into the gravel. A range of Bronze Age artefacts were recovered from the dredging, including skulls, deer antlers, several spearheads and three large wooden canoes.

2.2.5 Enclosure ditches and field boundaries dating from the Iron Age to Romano-British periods have been uncovered during evaluation excavations in Wilford, 750 m from the survey area. These probably relate to outlying activity from the nearby Iron Age/Romano-British farmstead.

2.2.6 Numerous Roman coins have been found in the area surrounding the Site. A coin of Gallienus was found at the Trentside Farm 815 m north-east of the Site across the river Trent. Four coins of various emperors were found through field walking and metal-detecting on the southern side of the A453, 128 m from the Site. A late 3rd century Roman hoard of coins was supposedly found in Wilford *c*. 1698, but the exact location is unknown. These coins were purportedly from the reigns of Tetricus, Gallienus, Victorinus, and Claudius Gothicus.

2.2.7 Saxon heritage assets are limited within the study area, with the 1938 gravel dredging of the River Trent recovering a Saxon shield boss of simple hemispherical type and a plain cruciform brooch. A metal detectorist found a lead medieval spindle whorl near the site of the Bronze Age barrow cemetery.

2.2.8 There are also limited heritage assets within the study area relating to the medieval period, with a variety of these objects being recovered from the 1938 dredging activities. On the south bank of the Trent, four uniface lead tokens were found, which varied in thickness and decoration. Fieldwalking undertaken by Trent and Peak Archaeology recovered a number of sherds of medieval pottery in the field to the south of the A453. A medieval to post-medieval oven was excavated during an evaluation at Fixing House, approximately 220 m east of the site.

2.2.9 Two finds have been identified in the study area during fieldwalking undertaken in the field to the north of the A453. A silver penny of Elizabeth I of London Tower mint was found

within 100 m of the Site to the north-west, and an oval cast silver post-medieval seal matrix, complete with conical handle and terminals in circular loop was found 250 m north-west of the Site.

3 METHODOLOGY

3.1 Introduction

3.1.1 The geophysical survey was undertaken by Wessex Archaeology's in-house geophysics team on 4 March 2019, and conditions were good throughout the fieldwork. An overall coverage of 1.9 ha was achieved. The north-east portion of the survey area was unsuitable for survey due to overgrown vegetation. Two additional areas which may potentially be used for a works' compound, each measuring 25 m by 25 m, were also surveyed.

3.1.2 The methods and standards employed throughout the geophysical survey conform to current best practice, and guidance outlined by the Chartered Institute for Archaeologists' (CIfA 2014) and European Archaeologiae Consilium (Schmidt *et al.* 2015).

3.2 Aims and objectives

3.2.1 The aims of the survey comprise the following:

- *to conduct a detailed survey covering as much of the specified area as possible, allowing for artificial obstructions;*
- *to clarify the presence/absence and extent of any buried archaeological remains within the Site; and*
- *to determine the general nature of the remains present.*

3.3 Fieldwork methodology

3.3.1 The cart-based gradiometer system used a Leica Captivate RTK GNSS instrument, which receives corrections from a network of reference stations operated by the Ordnance Survey (OS) and Leica Geosystems. Such instruments allow positions to be determined with a precision of 0.02 m in real-time and therefore exceed European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015).

3.3.2 The detailed gradiometer survey was undertaken using four Bartington Grad-01-1000L gradiometers mounted on a non-magnetic cart at 1 m intervals. Data were collected at a rate of 10 Hz with an effective sensitivity of 0.03 nT, producing intervals of 0.15 m along transects spaced 4 m apart.

3.4 Data processing

3.4.1 Data from the survey was subject to minimal data correction processes. These comprise a 'Destripe' function (±5 nT thresholds), applied to correct for any variation between the sensors, and an interpolation used to grid the data and discard overlaps where transects have been collected too close together.

3.4.2 Further details of the geophysical and survey equipment, methods and processing are described in **Appendix 1**.

4 GEOPHYSICAL SURVEY RESULTS AND INTERPRETATION

4.1 Introduction

4.1.1 The detailed gradiometer survey has identified magnetic anomalies across the Site. Results are presented as a greyscale plot and archaeological interpretation at a scale of 1:2000 (**Figures 2** and **3**). The data are displayed at -2 nT (white) to +3 nT (black) for the greyscale image.

4.1.2 The interpretation of the datasets highlights the presence of potential archaeological anomalies, ferrous responses, burnt or fired objects, and magnetic trends (**Figure 3**). Full definitions of the interpretation terms used in this report are provided in **Appendix 2**.

4.1.3 Numerous ferrous anomalies are visible throughout the dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

4.1.4 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 present than have been identified through geophysical survey.

4.1.5 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.

4.2 Gradiometer survey results and interpretation

4.2.1 Several large (2.5 – 3 m diameter), positive anomalies are noted at **4000** in the central portion of the survey area. The anomalies are likely to indicate large pit features in the underlying deposits. These are located close to the known position of a Neolithic to Bronze Age pit alignment identified from aerial imagery and excavated during the widening of the A453. The anomalies have been interpreted as archaeology due to their consistent alignment (approximate 20 m spacing) and position immediately adjacent to previously recorded features.

4.2.2 Approximately 45 m north-east of **4000**, a further four positive, pit-like anomalies with 2 – 3 m diameter are noted in a broadly square form at **4001**. These anomalies have also been interpreted as archaeological in origin due to their proximity to the previously excavated pits.

4.2.3 Numerous smaller (1 – 2 m diameter) discrete positive anomalies have also been identified in the survey data. These anomalies also indicate pit-like features and are interpreted as possible archaeology. It is possible such features could also be evidence of sparse settlement activity. However, it is equally likely these anomalies are caused by localised variation in the underlying superficial alluvial deposits.

4.2.4 An area of increased magnetic response has been noted at **4002**, which covers an area 20 m north-west to south-east and 68 m north-east to south-west. This anomaly has no clear origin, although it is possible such a response is the result of an area of extraction and infilling activity; it is also possible this could be caused by a spread of surface deposits. It is not thought to be archaeological in origin.

4.2.5 A strongly magnetic linear response has been identified toward the north-eastern end of the survey area (**4003**). This type of response indicates a modern service, such as a pipe.

4.2.6 A second highly magnetic response has been detected in the central portion of the survey area at **4004**. This corresponds to the position of a pylon base.

4.2.7 At **4005**, a smaller highly magnetic response has been identified in the north-east of the survey. This corresponds to the location of metallic fencing and a borehole cover.

4.2.8 The remaining survey area presents a moderately increased magnetic background response. This is likely to be the result of modern debris in the underlying deposits. The highly magnetic response noted traversing the southern boundary of the site is the result of peripheral fencing and objects outside the survey area.

5 DISCUSSION

5.1 Conclusions

5.1.1 The detailed gradiometer survey has been successful in detecting anomalies thought to be archaeological in origin. An alignment of at least five pit-like anomalies has been identified close to the known position of a similar Neolithic to Bronze Age pit alignment that was excavated during the widening of the A453. A further four anomalies in an approximate square are also noted 45 m north-east of the alignment. These anomalies are likely to indicate wider settlement activity. It is possible these anomalies are contemporaneous with other Bronze Age heritage assets identified by the DBA in the surrounding landscape.

5.1.2 Numerous smaller anomalies have been interpreted as possible archaeology in origin. It is possible these anomalies could indicate features associated with wider settlement activity such as extraction or refuse pits. These could in turn be contemporaneous with Neolithic or Bronze Age settlement activity noted in the surrounding landscape. However, these anomalies are equally likely to be natural and represent localised variation in the underlying superficial deposits.

5.1.3 Gradiometer survey is effective detecting archaeological features up to a depth of approximately 1 m, depending on the strength of magnetisation of the feature and the nature of the overlying material. Given the potential for significant alluvial deposits across the Site, it is possible that archaeological features exist below this depth of detection.

5.1.4 The remaining anomalies are thought to be modern in provenance, pertaining to an underground service and pylon bases, as well as an area of highly magnetic response in the area adjacent to the A453.

REFERENCES

Bibliography

Schmidt, A, Linford, P, Linford, N, David, A, Gaffney, C, Sarris, A and Fassbinder, J. 2015 *Guidelines for the use of geophysics in archaeology: questions to ask and points to consider.* EAC Guidelines 2, Belgium: European Archaeological Council.

Chartered Institute for Archaeologists [CIfA] 2014 *Standards and guidance for archaeological geophysical survey*. Reading, CIfA

Wessex Archaeology 2019 *Oxton 15" Duplication, Nottinghamshire Archaeological Desk-based Assessment*

Cartographic and documentary sources

Ordnance Survey 1983 *Soil Survey of England and Wales Sheet 3, Soils of Midland and Western England.* Southampton.

Online resources

British Geological Survey Geology of Britain Viewer (accessed March 2019) http://mapapps.bgs.ac.uk/geologyofbritain/home.html

Magic Maps (accessed March 2019) https://magic.defra.gov.uk/

National Library of Scotland (accessed March 2019) https://maps.nls.uk/geo/explore/

Old Maps (accessed March 2019) https://www.old-maps.co.uk

Open Domesday (accessed March 2019) http://opendomesday.org

APPENDICES

Appendix 1: Survey Equipment and Data Processing

Survey methods and equipment

The magnetic data for this project will be acquired using a non-magnetic cart fitted with 4x Bartington Grad-01-1000L magnetic gradiometers. The instrument has four sensor assemblies fixed horizontally 1 m apart allowing four 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 0.03 nT over a ±100 nT range, and measurements from each sensor are logged at intervals of 0.25 m. All of the data are then relayed to a Leica Viva CS35 tablet, running the MLgrad601 program, which is used to record the survey data from the array of Grad601 probes at a rate of 10 Hz. The program also receives measurements from a GPS system, which is fixed to the cart at a measured distance from the sensors, providing real time locational data for each data point.

The cart-based system relies upon accurate GPS location data which is collected using a Leica Viva system with rover and base station. This 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 European Archaeologiae Consilium recommendations (Schmidt *et al.* 2015) for geophysical surveys.

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 0.125 m intervals along traverses spaced up to 0.25m apart.

Post-processing

The magnetic data collected during the detail survey are downloaded from the Bartington cart 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.

The cart-based system generally requires a lesser amount of post-processing than the handheld Bartington Grad 601-2 fluxgate gradiometer instrument. This is largely because mounting the gradiometers on the cart reduces the occurrence of operator error; caused by inconsistent walking speeds and deviation in traverse position due to varying ground cover and topography.

Typical data and image processing steps may include:

- GPS Destripe – Determines the median of each transect and then subtracts that value from each datapoint in the transect. May be used to remove the striping effect seen within a survey caused by directional effects, drift, etc.

- GPS Base Interpolation – Sets the X & Y interval of the interpolated data and the track radius (area around each datapoint that is included in the interpolated result).

- Discard Overlaps - Intended to eliminate a track(s) that have been collected too close to one another. Without this, the results of the interpolation process can be distorted as it tries to accommodate very close points with potentially differing values.

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.
- 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.
- 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.

Appendix 3: OASIS form

Project Details:

Project name	Oxton 15" Duplication, Clifton, Nottinghamshire				
Type of project	Detailed gradiometer survey (Field evaluation)				
Project description	A detailed gradiometer survey was conducted over land at to the north of A453, Clifton (centred on NGR 455830 336060). The project was commissioned by NMCNomenca on behalf of North Midlands Construction PLC with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features ahead of works for the installation of an underground service. The site is comprised of a linear portion of a single arable field located 1.6 km north north-east of the centre of Clifton, Nottinghamshire, covering an area of 1.8 ha. The geophysical survey was undertaken on Monday 4th March 2019 and has demonstrated the presence of a number of anomalies. The anomalies identified as being of archaeological origin are primarily pit-like features of unknown origin and date, but which may be associated with a previously excavated Neolithic or Bronze Age pit alignment. The areas of strong magnetic response are related to underground services and a pylon.				
Project dates	**Start:** 04-03-2019		**End:** 04-03-2019		
Previous work	Yes - DBA				
Future work	Not known.				
Project Code: 216431	**HER event no.**	N/A	**OASIS form ID:**	wessexar1- 345378	
	NMR no.	N/A			
	SM no.	N/A			
Planning Application Ref.					
Site Status	None.				
Land use	Cultivated Lane 3 – Operations to a depth greater than 0.25m				
Monument type	N/A	**Period**	N/A		

Project Location:

Site Address	Land off the A453, Clifton, Nottingham			**Postcode**	NG11 8HH
County	Nottinghamshire	**District**	Nottingham	**Parish**	Nottingham
Study Area	1.8 ha	**Height OD**	23 – 24 m aOD	**NGR**	455830 336060

Project Creators:

Name of Organisation	Wessex Archaeology		
Project brief originator	NMCNomenca	**Project design originator**	Wessex Archaeology
Project Manager	Lucy Marston	**Project Supervisor**	Chris Hirst
Sponsor or funding body	NMCNomenca	**Type of Sponsor**	Client

Project Archive and Bibliography:

Physical archive	N/A	**Digital Archive**	Geophysics, survey and report	**Paper Archive**	N/A
Report title	Oxton 15 Duplication, Clifton, Nottinghamshire Detailed Gradiometer Survey Report			**Date**	2019
Author	Wessex Archaeology	**Description**	Unpublished report	**Report ref.**	216431.03

Geophysical Survey Area

Coordinate system:
OSGB36 (OSTN15/OSGM15)

Date:	15/02/2019	Revision Number:	0
Scale:	1:100,000 1:7,500 at A4	Illustrator:	AJS
Path:	S:\PROJECTS\216431\GIS\FigsMXD\geophysics		

Site location and survey area

Figure 1

455600
455800
456000
336200
336000

Geophysical Survey Area
Detailed Survey Extents

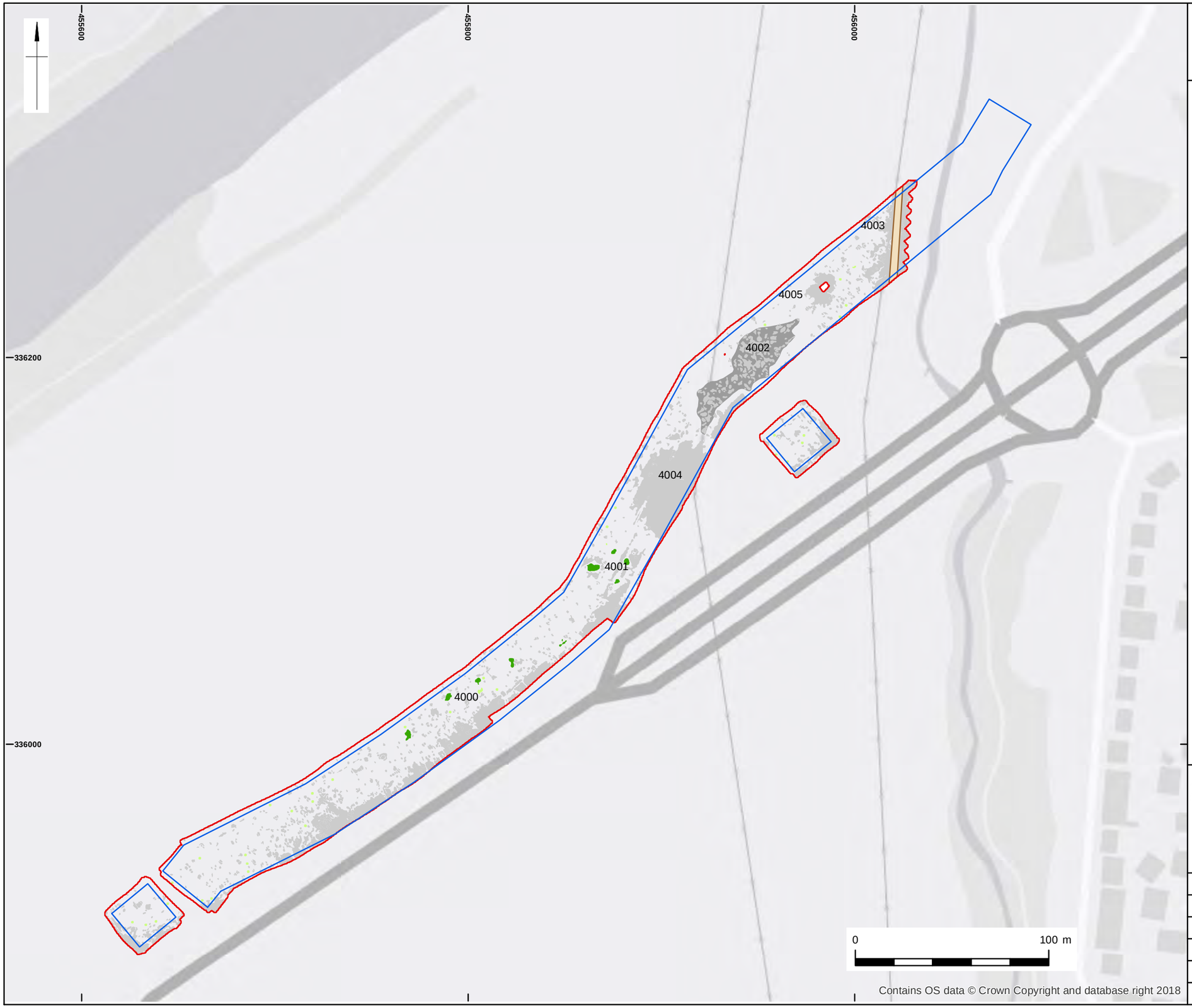
-2nT +3nT

0 100 m

Date:	05/03/2019
Revision Number:	0
Scale:	1:2000 at A3
Illustrator:	AJS
Path:	S:\PROJECTS\216431\GIS \FigsMXD\geophysics

Detailed gradiometer survey results: Greyscale plot

Figure 2



Geophysical Survey Area
Detailed Survey Extent
Archaeology
Possible Archaeology
Modern Service
Ferrous
Increased Magnetic Response

Date:	05/03/2019
Revision Number:	0
Scale:	1:2000 at A3
Illustrator:	AJS
Path:	S:\PROJECTS\216431\GIS \FigsMXD\geophysics

Detailed gradiometer survey results: Interpretation

Figure 3

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