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A350 Chippenham Bypass Improvements
Chippenham, Wiltshire

Detailed Gradiometer Survey Report

Ref: 110351.01
January 2016

geoservices

A350 Chippenham Bypass Improvements
Chippenham, Wiltshire

Detailed Gradiometer Survey Report

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January 2016

WA Ref. 110351.01

Quality Assurance

Project Code	110351	**Accession Code**		**Client Ref.**	
Planning Application Ref.		**Ordnance Survey (OS) national grid reference (NGR)**	389940 171690 to 389540 172788		

Version	Status*	Prepared by	Checked and Approved By	Approver's Signature	Date
v01	I	*JS*	*GJD*		14/12/2015
File:	X:\PROJECTS\110351_REPORTS\110351_A350_GEOPHYSICS_JS_GJDQC.DOCX				
v01	E	*CJRH*	*LJL*		18/12/2015
File:	X:\PROJECTS\110351_REPORTS\V01\110351_A350_QC_LJL.DOCX				
v02	F	*Andrew Holmes Atkins*	*LJL*		04/01/2016
File:	X:\PROJECTS\110351_REPORTS\V01\110351_A350_QC_LJL._Final.DOCX				

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

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Summary

A detailed gradiometer survey was conducted over land west of the A350 Chippenham Bypass, in the vicinity of Chequers Roundabout (from National Grid Reference (NGR) 389940 171690 to NGR 389540, 172788). The project was commissioned by Atkins Limited on behalf of Wiltshire County Council with the aim of establishing the presence, or otherwise, and nature of detectable archaeological features in support of a planning application for planned improvement works of the Chippenham Bypass, Chequers to Cepen Park South Section.

The site comprises a strip of land primarily consisting of the grassy verge alongside the carriageway, extending approximately 1.18 km along the western edge of the A350 and comprises a total area of 2.3 ha. The geophysical survey was undertaken on 8th and 10th December 2015.

The detailed gradiometer survey has demonstrated the presence of a number of anomalies, however very few of these are likely to be of archaeological interest. The anomalies identified as being of possible archaeological interest are primarily possible pit-like features. The relatively small survey area prevents further interpretation due to the lack of context. Some of these features therefore may be natural in origin or even relate to the construction of the A350 bypass.

Additionally, this archaeological investigation has detected a large quantity of ferrous, a modern service and a number of unidentified trends. Magnetic interference from passing vehicles on the A350 and the large volume of modern ferrous on the Site may have been masked any weaker anomalies present.

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Acknowledgements

Wessex Archaeology would like to thank Atkins Limited for commissioning the geophysical survey. The assistance of Andrew Holmes is gratefully acknowledged in this regard.

The fieldwork was undertaken by Jen Smith, Diana Chard and Nick Crabb. Jen Smith processed and interpreted the geophysical data and wrote the report. The geophysical work was quality controlled by Garreth Davey and Lucy Learmonth. Illustrations were prepared by Garreth Davey. The project was managed on behalf of Wessex Archaeology by Lucy Learmonth.

A350 Chippenham Bypass Improvements Chippenham, Wiltshire

Detailed Gradiometer Survey Report

1 INTRODUCTION

1.1 Project background

1.1.1 Wessex Archaeology (WA) was commissioned by Atkins Limited on behalf of Wiltshire County Council to carry out a geophysical survey of land west of the A350 Chippenham Bypass, in the vicinity of Chequers Roundabout (hereafter "the Site", located from National Grid Reference (NGR) 389940 171690 to NGR 389540 172788) (**Figure 1**). The survey forms part of an ongoing programme of archaeological works being undertaken in support of the planned improvement works of the Chippenham Bypass.

1.1.2 The aim of the geophysical survey was to establish the presence/absence, extent and character of detectable archaeological remains within the survey area.

1.1.3 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 defined as a long strip of open land immediately west of A350 Chippenham Bypass, located immediately to the west and north-west of the town of Chippenham, Wiltshire. The area currently comprises the western verge of the carriageway, and is mainly grassed with a pedestrian pavement. There is no barrier between the verge and the roadway, which operates under the national speed limit for this section.

1.2.2 The survey area is made up of a strip of land extending for approximately 1.18 km with a total area of 2.3ha.

1.2.3 The Site is relatively level at approximately 78 m above Ordnance Datum (aOD).

1.3 Soils and geology

1.3.1 The bedrock geology under the Site is recorded as sandstone, limestone and argillaceous rock of the Great Oolite Group with no overlying deposits recorded (BGS, 2015).

1.3.2 The soils underlying the Site are recorded as primarily brown redzinas of the 343d (Sherborne) association with typical stagnoley soils of the 711g (Wickham 3) association (SSEW 1983) banded through the middle of the Site. 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 background

1.4.1 The following information is summarised from a search of Heritage Gateway (accessed 7th December 2015) for 1 km surrounding the Site, which has been included to provide context and inform the geophysical interpretation.

1.4.2 There are no World Heritage Sites, Scheduled Monuments, designated historical assets, Registered Parks and Gardens or Historic Battlefields identified within the Site. The nearest designated heritage assets comprise a cluster of Listed Buildings at Chequers Farm, *c.* 650 m to the east.

1.4.3 A Neolithic pit containing pottery, flints and burnt hazelnut shells along with a *grubenhaus* (Monument No. 993588) were uncovered during works prior to the construction of the Sainsburys supermarket located immediately east of the Site on the other side of the A350. Further excavations during the road construction uncovered a pottery scatter, a coin and ditches of Romano-British date origin (Monument No. 993477) immediately west of the Site.

1.4.4 A number of cropmarks have been identified within the vicinity of the Site. Two possible round barrows have been identified, one to the east dated only as prehistoric (Monument No. 994252) and the other to the north-west dated as potentially Bronze Age (Monument No. 1579844). A number of enclosures have also been identified from cropmarks. An undated double-ditched enclosure lies immediately west of the Site (Monument No. 994350) with further rectilinear enclosures of potentially Iron Age/Romano-British origin located immediately east of the Site (Monument No.1580703) and another to the north-west (Monument No.1579848).

1.4.5 A number of cropmark features identified to be of medieval origin have been identified throughout the area. These have been interpreted as ridge and furrow features with some further evidence for former field boundaries.

1.4.6 Additionally, the Heritage Gateway information is complimented and supported by the following asset descriptions and accompanying Historic Environment Record (HER) mapping as provided by Atkins:

- MWI2283 – undated earthworks and cropmarks, probably a deserted medieval village
- MWI2221 – small Mesolithic flint tool assemblage
- MWI2240 – two fragments of Romano-British pottery excavated in 1998
- MWI2222 – Later Mesolithic flint tools excavated prior to construction of bypass
- MWI2285 – two ditches, probably Romano-British
- MWI2228 – a Bronze Age settlement site, comprising gullies, pits and stakeholes

2 METHODOLOGY

2.1 Introduction

2.1.1 The geophysical survey was undertaken by WA's in-house geophysics team between the 8th and 10th December 2015. Field conditions at the time of the survey were good, with showery conditions throughout the period of survey. An overall coverage of 1 ha was achieved. The reduction in surveyable area was mainly due to a 2 m exclusion zone from the road due to the lack of permanent barriers to reduce the risk to personnel and road users. Other artificial obstructions further reduced the survey area, including the fences and hedgerows.

2.2 Method

2.2.1 Individual survey grid nodes were established based on 30 m x 30 m intervals using a Leica Viva RTK GNSS instrument, which is precise to approximately 0.02 m and therefore exceeds Historic England recommendations (English Heritage 2008). Due to the width of the survey area, the majority of these were "partial" grids.

2.2.2 The detailed gradiometer survey was conducted using a Bartington Grad601-2 fluxgate gradiometer instrument, which has a vertical separation of 1 m between sensors. Data were collected at 0.25 m intervals along transects spaced 1 m apart with an effective sensitivity of 0.03nT, in accordance with Historic England guidelines (English Heritage 2008). Data were collected in the zigzag method.

2.2.3 Data from the survey was subject to minimal data correction processes. These comprise a zero mean traverse 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. These two steps were applied throughout the survey area, 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 detailed gradiometer survey has identified magnetic anomalies across the Site, along with large amounts of ferrous. Results are presented as a series of greyscale plots, XY plots and archaeological interpretations at a scale of 1:1500 (**Figures 2** to **7**). The data are displayed at -2nT (white) to +3nT (black) for the greyscale image and ±25nT at 25nT per cm for the XY trace plots.

3.1.2 The interpretation of the datasets highlights the presence of possible archaeological anomalies, ferrous/burnt or fired objects, and magnetic trends (**Figure 4** and **7**). 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 dataset. These are presumed to be modern in provenance and are not referred to, unless considered relevant to the archaeological interpretation.

3.1.4 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.

3.1.5 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.

3.2 Gradiometer survey results and interpretation

3.2.1 All the identified anomalies are characterised by highly positive and negative ferrous anomalies within their vicinity, making any interpretation of the dataset very difficult.

3.2.2 There are numerous positive responses of +2-3nT, comprising of the anomalies identified at **4000** to **4003** (**Figure 4**) and **4005** (**Figure 7**). Positioned at the edge of the Site, these anomalies may represent pit-like features and have therefore been interpreted as possible archaeology. It is not possible to make further interpretations regarding the likely origin or date of these features based on the data currently available.

3.2.3 Several linear and curvilinear trends can also be seen at **4001** and **4002**. These trends have no common orientation and may relate to the construction of the A350 bypass.

3.3 Modern services

3.3.1 There is at least one modern service located at **4000** near the northern extent of the Site. The service appears to be ferrous pipe and is oriented roughly north to south. The extents of the anomaly continue beyond the limits of the geophysical survey area. It is not clear from the geophysical data whether the service identified is in active use.

4 CONCLUSION

4.1.1 The detailed gradiometer survey has detected anomalies within the survey area which have been interpreted as of possible archaeological interest. In addition to these, anomalies interpreted as trends have also been identified.

4.1.2 The anomalies of possible archaeological interest are primarily pit-like features. Due to the small size of the survey area it is not possible to positively identify these anomalies due to the lack of context. Some of these features may therefore be natural in origin or relate to the construction of the A350 bypass.

4.1.3 Magnetic interference from passing vehicles on the A350 and the large volume of modern ferrous on the Site may have been masked any weaker anomalies present.

5 REFERENCES

5.1 Bibliography

Wessex Archaeology, 2015. A350 *Chippenham Bypass Improvements, Chippenham, Wiltshire: Written Scheme of Investigation for Archaeological Geophysical Survey*. Unpublished Client Report.

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

5.2 Cartographic and documentary sources

Soil Survey of England and Wales, 1983. *Sheet 4, Soils of Eastern England*. Ordnance Survey, Southampton.

5.3 Online resources

British Geological Survey
http://www.bgs.ac.uk/discoveringgeology/geologyofbritain/viewer.html [accessed 07/12/2015]

Heritage Gateway

http://www.heritagegateway.org.uk/gateway/ [accessed 07/12/2015]

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 1 m 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 0.25 m. 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 20 m or 30 m 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 0.02 m in real-time and therefore exceed the level of accuracy recommended by Historic England (English Heritage 2008) for geophysical surveys.

Scanning surveys consist of recording data at 0.25 m intervals along transects spaced 10 m 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 20 m x 20 m or 30 m x 30 m grids, and data are collected at 0.25 m intervals along traverses spaced 1 m apart. These strategies give 1600 or 3600 measurements per 20 m or 30 m 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 0.125 m intervals along traverses spaced up to 0.25 m apart, resulting in a maximum of 28800 readings per 30 m grid, exceeding that recommended by Historic England (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.
- Possible archaeology – used for features which give a response but which form an incomplete or indiscernible pattern or trend.

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

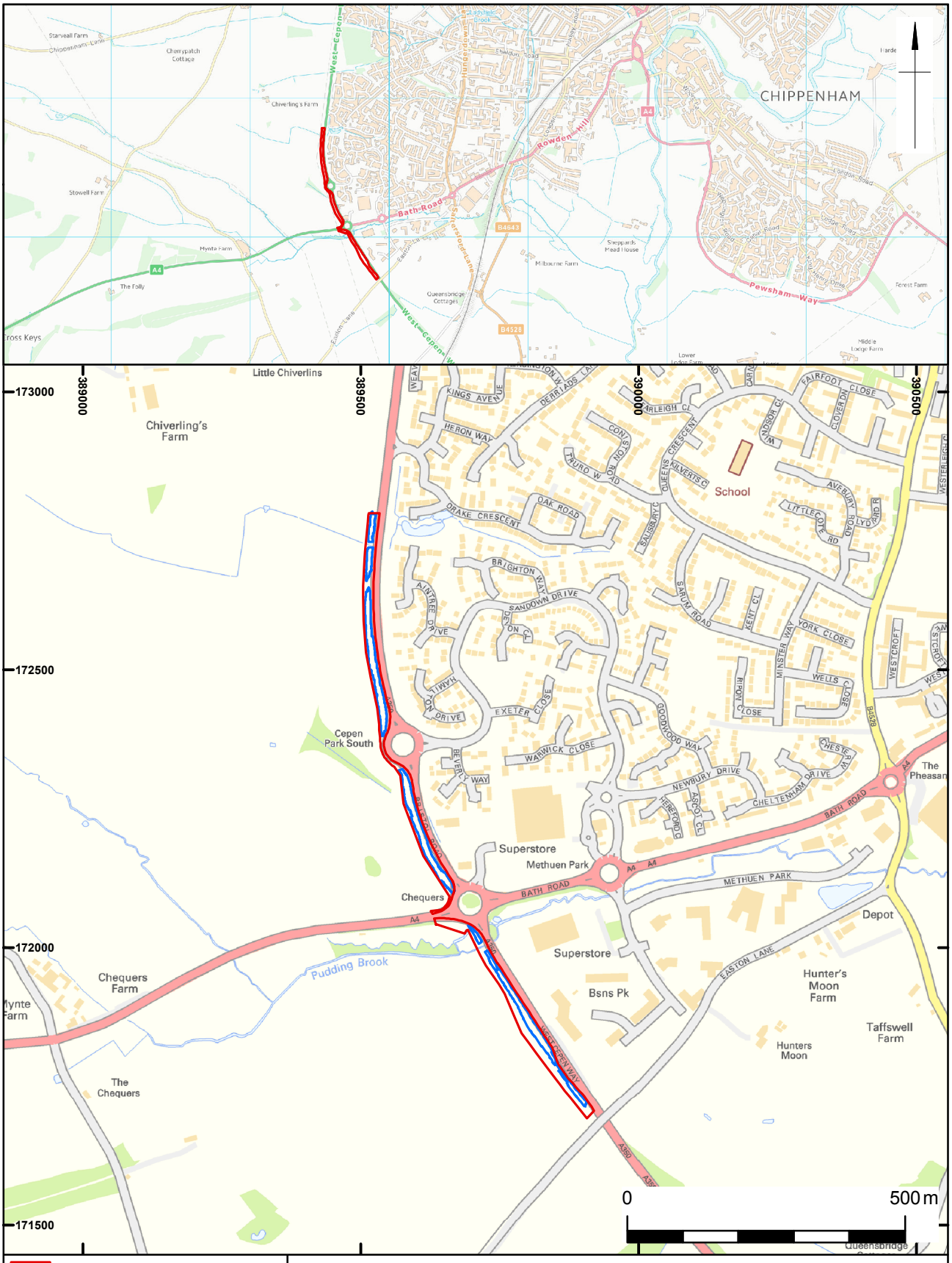
- Ferrous – used for responses caused by ferrous material. These anomalies are likely to be of modern origin.
- Modern service – used for responses considered relating to cables and pipes; most are composed of ferrous/ceramic material although services made from non-magnetic material can sometimes be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



Site Boundary

Detailed Survey Extents

Date:	11/12/2015	Revision Number:	0
Scale:	1:40,000 and 1:10,000 at A4	Illustrator:	GJD
Path:	X:\PROJECTS\110351\GIS\FigsMXD\2015_12_11\110351_Fig1.mxd		

Site location and survey extents

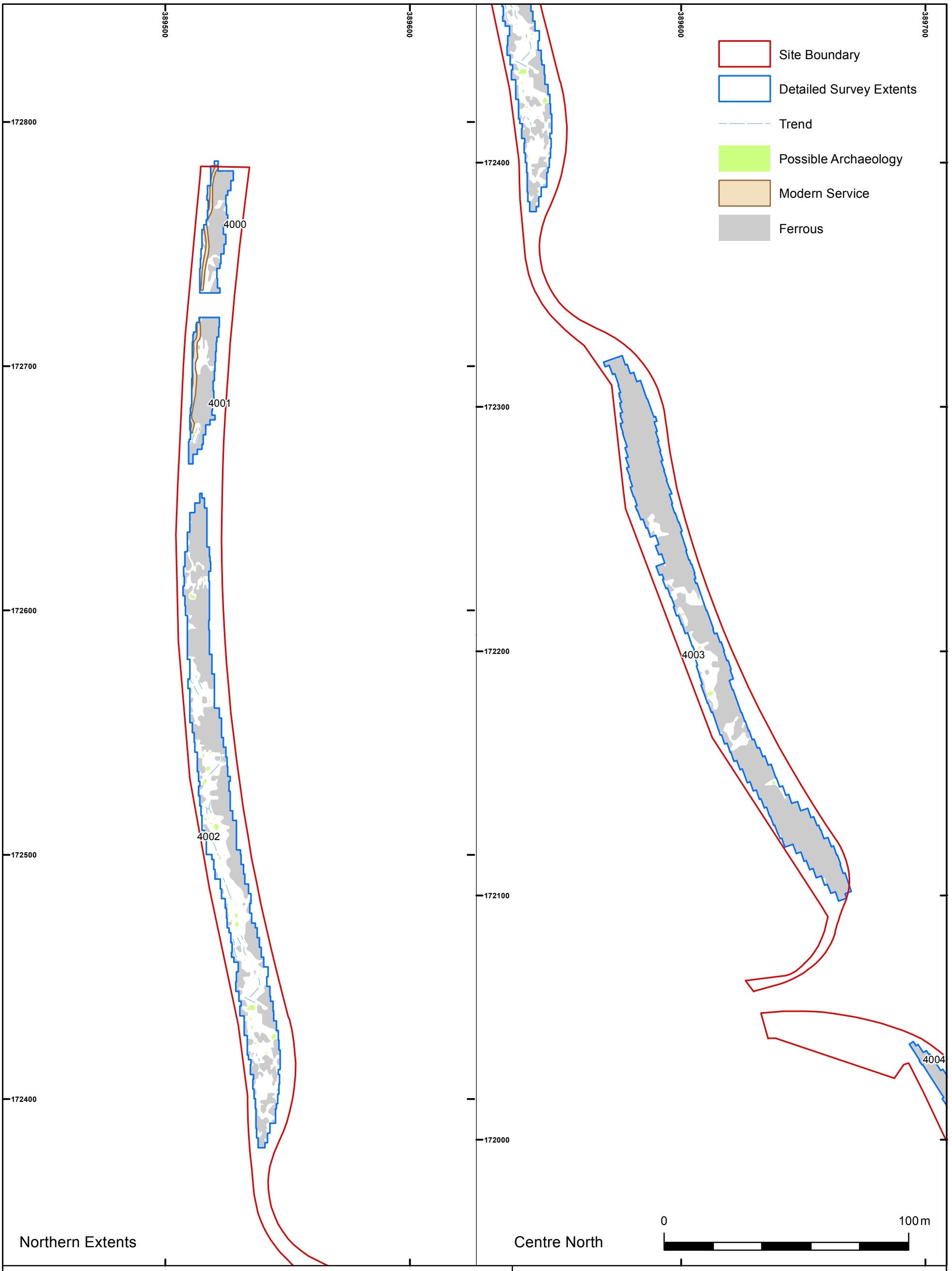
Figure 1

389500
389600
389600
389700
172800
172700
172600
172500
172400
172400
172300
172200
172100
172000
+3nT
-2nT
0
100 m
Northern Extents
Centre North
Site Boundary
Detailed Survey Extents

Date:	11/12/2015	Revision Number:	0
Scale:	1:1,500 at A3	Illustrator:	GJD
Path:	X:\PROJECTS\110351\GIS\FigsMXD\2015_12_11\110351_Fig2.mxd		

Greyscale plots (North)

Figure 2



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Archaeological Interpretation (North)

Figure 4

389700
389800
389800
389900
172100
172000
172000
171900
171900
171800
171800
171700
171700
171600
+3nT
-2nT
0
100 m
Centre South
Southern Extent

Site Boundary

Detailed Survey Extents

Date:	11/12/2015	Revision Number:	0
Scale:	1:1,500 at A3	Illustrator:	GJD
Path:	X:\PROJECTS\110351\GIS\FigsMXD\110351_Fig5.mxd		

Greyscale plots (South)

Figure 5

389700
389800
389800
389900
172100
172000
172000
171900
171900
171800
171800
171700
171700
171600
+25nT
-25nT
0
100 m
Centre South
Southern Extent
Site Boundary
Detailed Survey Extents

Date:	11/12/2015	Revision Number:	0
Scale:	1:1,500 at A3	Illustrator:	GJD
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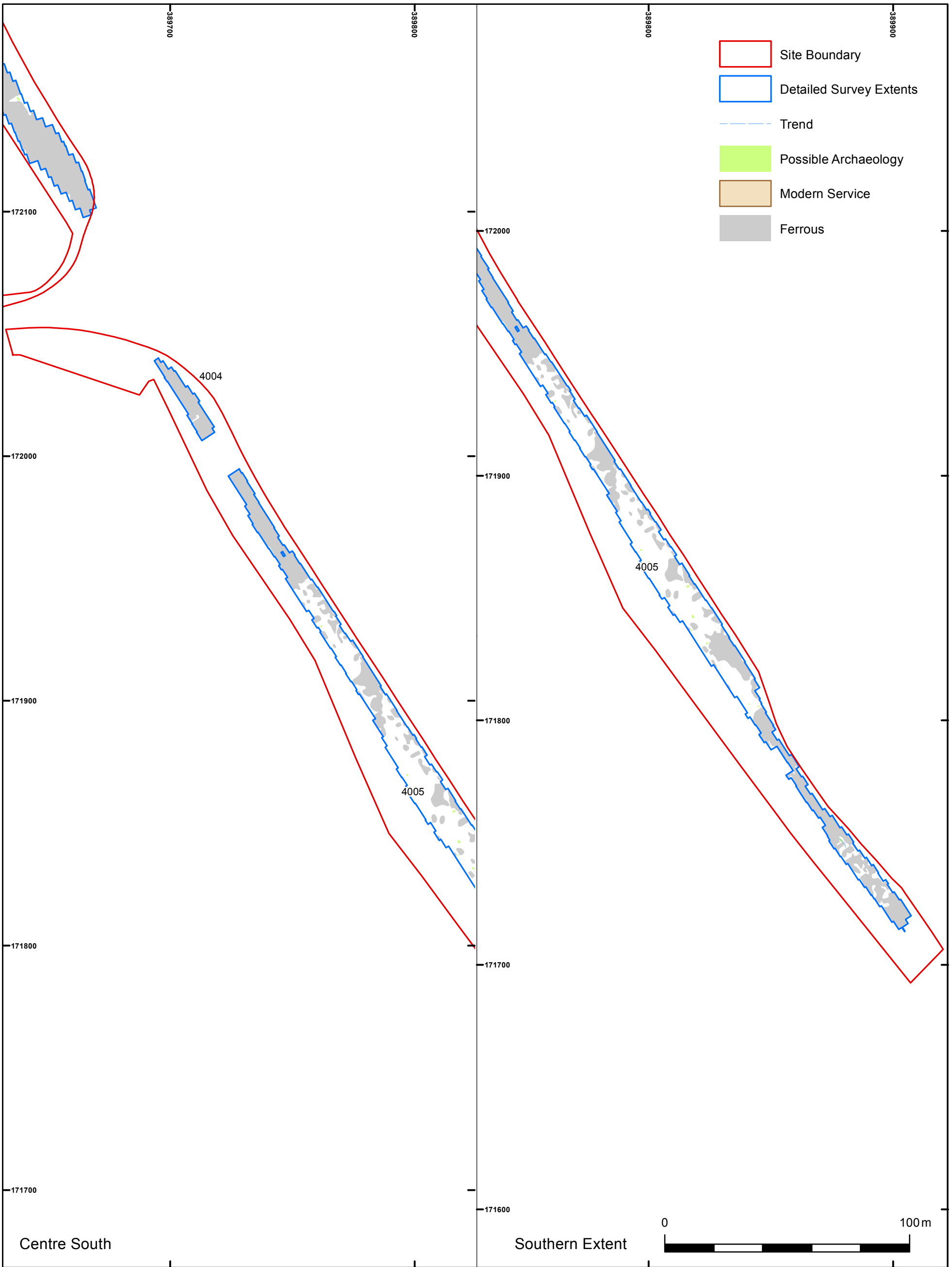
XY Trace plots (South)

Figure 6



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Archaeological Interpretation (South)

Figure 7

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