

SWGL24



LAND SOUTH OF SACHEVERELL WAY, GROBY GEOPHYSICAL SURVEY REPORT

PLANNING REF. PRE-APPLICATION

Headland Archaeology Yorkshire & North
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Commissioned by Bloor Homes

13/08/2024

PROJECT INFORMATION:

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CONSULTANT/AGENT	Orion Heritage Ltd
CLIENT	Bloor Homes
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PARISH	Groby
LOCAL AUTHORITY	Leicestershire County Council
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PROJECT TEAM:

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PROJECT SUMMARY

Headland Archaeology (UK) Ltd was commissioned by Bloor Homes (the Client) to undertake a geophysical (magnetometer) survey on a parcel of land south of Sacheverell Way, Groby, in advance of the submission of a planning application for a proposed residential development. The results may also inform future archaeological strategy, if required.

The survey has recorded anomalies of agricultural, natural, and modern origin, identifying systematic patterns of field drains, ridge and furrow cultivation and modern ploughing trends, former field boundaries and ponds. Anomalies of uncertain origin have been recorded but these are all considered more likely to be of natural or agricultural origin than of archaeological origin. No anomalies of obvious archaeological origin have been recorded.

The detection of a range of magnetic anomalies gives confidence that the survey data likely provides a good indication of the archaeological potential of the site which, on the basis solely of the geophysical survey results, is assessed as low.

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LAND SOUTH OF SACHEVERELL WAY, GROBY, LEICESTERSHIRE

GEOPHYSICAL SURVEY REPORT

1. INTRODUCTION

Headland Archaeology (UK) Ltd was commissioned by Bloor Homes (the Client) to undertake a geophysical (magnetometer) survey on a parcel of land south of Sacheverell Way, Groby (Illus 1), where a planning application for a residential development is being prepared. This geophysical survey report will be submitted as part of the planning application for the proposed development. The results may also inform future archaeological strategy, if required.

The scheme of work was undertaken in accordance with the requirements of the National Planning Policy Framework (Department for Levelling Up, Housing and Communities DLUHC, 2023) and with the Written Scheme of Investigation for Geophysical Survey (WSI) (Headland Archaeology 2024).

The WSI was produced to the standards laid down in the European Archaeological Council's guideline publication, EAC Guidelines for the Use of Geophysics in Archaeology (Europae Archaeologia Consilium 2016) and the Chartered Institute for Archaeologists' (CIfA) Standard and Guidance for Archaeological Geophysical Survey (CIfA 2020). The survey was also carried out in line with the same best practice guidelines.

The survey was carried out on July 29th and July 30th, 2024.

1.1. SITE LOCATION, TOPOGRAPHY AND LAND-USE

The geophysical survey area (GSA) is located directly south of Groby, on the western periphery of Leicester (centred at SK 52626 06329) and covers approximately 10 hectares. It comprises of a single irregularly shaped arable field (Illus 2), currently uncultivated, that is bound to the north by Sacheverell Way, to the east by the A46 Leicester Western Bypass, and to all other sides by farmland.

Topographically the GSA gently undulates between 89m Above Ordnance Datum (AOD) and 77m AOD.

1.2. GEOLOGY AND SOILS

The bedrock geology underlying the majority of the GSA is recorded as mudstone of the Edwalton Member, a sedimentary bedrock formed between 237 and 228.4 million years ago during the Triassic period. A small intrusion of Cotgrave Sandstone Member Sandstone a sedimentary bedrock also formed between 237 and 228.4 million years ago during the Triassic period, is recorded in the very south-west of the GSA.

Superficial sedimentary deposits of diamicton (Thrussington Member) formed between 480 and 423 thousand years ago during the Quaternary period overlie most of the GSA. No superficial deposits are recorded in the west and south-west of the GSA (UKRI2024).

The soils are classified in the Soilscape 18 association which are described as seasonally wet, acidic loams

and clays with impeded drainage (Cranfield University 2024).

2. ARCHAEOLOGICAL BACKGROUND

The following information has been abstracted from the data available on the Heritage Gateway Explorer (Heritage Gateway, 2024). This identified that there are no designated heritage assets within the GSA. A single non-designated asset, (MLE9537), recorded as the findspot of a copper alloy horse harness pendant dating to the 12th or 13 century, is recorded in the north-west of the GSA,

Approximately 350m north-east of the GSA, a Corieltavian Iron Age stater coin was discovered during topsoil stripping along the route of the A46 Leicester Western Bypass in 1993 (MLE9386).

Approximately 500m to the south-west of the GSA, a fieldwalking study in 2005 recovered one sherd of Iron Age rock tempered pottery (MLE16386), six sherds of Roman pottery (MLE16387), and three sherds of medieval pottery, two being of Potters Marston ware and one of Midland Purple (MLE16413). Further south of here, roughly 750m south-west of the GSA, a 2001 watching brief identified evidence of both Roman (MLE15778 – 21 sherds of Roman pottery) and early medieval occupation (MLE15779 – 50 sherds of medieval pottery). A silver denarius of Hadrian was also found here in 1980 by metal detectorists. A possible section of Roman road was also identified here in the early 1990s as a 2.5m wide metal track running north-west to south-east. It is thought to be part of the Roman road out to Ibstock or Moira (MLE15824).

Approximately 330m north-west of the GSA, a 2009 geophysical survey recorded eight small positive discrete anomalies and a positive linear anomaly interpreted as possible pit and ditch cut features (MLE17766).

Directly adjacent to the western edge of the GSA, a late post-medieval to mid-20th century mineral railway is identified. The now dismantled railway ran from the Leicester to Swannington line to Groby Quarries north of Groby village. It is thought to have closed in the 1960s, coinciding with the closure of the Leicester to Swannington Line (MLE16161).

3. AIMS, METHODOLOGY & PRESENTATION

3.1. AIMS AND OBJECTIVES

The principal aim of the geophysical survey was to gather information to establish the presence/absence, character, and extent of any archaeological remains within the GSA. This will enable an assessment to be made of the impact of the proposed development on any sub-surface archaeological remains if present, and thereby inform any further investigation strategies, as appropriate.

The specific archaeological objectives of the geophysical survey were:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified,
- to therefore determine the likely presence/absence and extent of any buried archaeological features, and
- To produce a comprehensive site archive and report.

3.2. METHODOLOGY

Magnetic survey methods rely on the ability of a variety of instruments to measure very small magnetic fields associated with buried archaeological remains. A feature such as a ditch, pit or kiln can act like a small magnet, or series of magnets, that produce distortions (anomalies) in the earth's magnetic field. In mapping these slight variations detailed plans of sites can be obtained, as buried features often produce reasonably characteristic anomaly shapes and strengths (Gaffney & Gater 2003). Further information on soil magnetism and the interpretation of magnetic anomalies is provided in Appendix 1.

Magnetometry is the most widely used geophysical survey technique in archaeology as it can quickly evaluate large areas and, under favourable conditions, identify a wide range of archaeological features including infilled cut features such as large pits, gullies and ditches, hearths, and areas of burning, and kilns and brick structures. It is therefore good at locating settlements of all periods, prehistoric field systems and enclosures, and areas of industrial or modern activity, amongst others. It is less successful in identifying smaller features such as

post-holes and small pits (except when using a non-standard sampling interval), unenclosed (prehistoric) settlement sites and graves/burial grounds. However, magnetometry is by far the single most useful technique and was assessed as the best non-intrusive evaluation tool for this site.

The survey was undertaken using four Bartington Grad601 sensors mounted at 1m intervals (1m traverse interval) onto a rigid frame. The system was programmed to take readings at a frequency of 10Hz (allowing for a 10-15cm sample interval) on roaming traverses (swaths) 4m apart (Illus 4). These readings were stored on an external weatherproof laptop and later downloaded for processing and interpretation. The system was linked to a Trimble R8s Real Time Kinetic (RTK) differential Global Positioning System (dGPS) outputting in NMEA mode to ensure a high positional accuracy for each data point.

MLGrad601 and MultiGrad601 (Geomar Software Inc.) software was used to collect and export the data. Anomaly GeoSurvey v1.12.3 (Lichenstone Geoscience) and QGIS v.3.28.5 software was used to process and present the data respectively.

3.3. DATA PRESENTATION AND TECHNICAL DETAIL

A general site location plan is shown in Illus 1 at a scale of 1:5,000. Illus 2 and Illus 3 are site condition photographs. Illus 4 shows the location and direction of the site condition photographs, at 1:2,500. Fully processed (greyscale) data, minimally processed (XY trace plot) data and the interpretative plan are presented, also at 1:2,500, in Illus 5, Illus 6 and Illus 7.

Technical information on the equipment used, data processing and magnetic survey methodology is given in Appendix 1. Appendix 2 details the survey location information and Appendix 3 describes the composition and location of the site archive. Data processing details are presented in Appendix 4. A copy of the OASIS entry (Online Access to the Index of Archaeological Investigations) is reproduced in Appendix 5.

The survey methodology, report and any recommendations comply with the Written Scheme of Investigation (Headland Archaeology 2024), guidelines outlined by Europae Archaeologia Consilium (EAC 2016) and by the Chartered Institute for Archaeologists (CIfA 2020).

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The Illustrations in this report have been produced following analysis of the data in 'raw' (minimally processed) and processed formats and over a range of different display levels. All illustrations are presented to display and interpret the data to best effect. The interpretations are based on the experience and knowledge of Headland management and reporting staff.

4. RESULTS & DISCUSSION

4.1. SITE CONDITIONS

Magnetometer survey is generally recommended over any sedimentary bedrock but the average response on sandstones and mudstone geologies can be poor with variable results depending on the presence of overlying superficial deposits (English Heritage 2008; Table 4). Nevertheless, magnetometry was still the most appropriate non-intrusive geophysical technique for evaluating the GSA, taking account of the limitations noted in Section 3.2 and above.

Surface conditions were good (Illus 2) with the resulting data quality also being good with only minimal post-processing required. No problems were encountered during the fieldwork.

The magnetic background is generally uniform within the GSA, with no discernible difference between the responses on the two bedrock geologies.

Against this magnetic background, anomalies of agricultural, natural, and modern origin have been recorded (Illus 7). The detection of a range of magnetic anomalies confirms that there was likely sufficient magnetic contrast, for the detection of archaeological features, if present, notwithstanding the limitations of magnetometer survey to identify the types, sizes, and period of archaeological features as described in Section 3.2 and keeping in mind the generally average to poor response to magnetometer survey on mudstones and sandstones. The results of the survey therefore likely provide a reasonably good indication of the archaeological potential of the site.

The anomalies are discussed below according to their interpreted origin.

4.2. FERROUS AND MODERN ANOMALIES

Ferrous anomalies, characterised as individual 'spikes', are typically caused by ferrous (magnetic) material, either on the ground surface or in the plough-soil. Little importance is normally given to such anomalies, unless there is any supporting evidence for an archaeological interpretation, as modern ferrous debris is common on most sites, often being introduced into the topsoil during manuring or tipping/infilling.

Bands or small areas of magnetic disturbance recorded along the field edges are likely to be due to the accumulation of ferrous debris around field margins or to ferrous material in the boundary itself.

Several small areas of magnetic disturbance are caused by telegraph poles. Three high magnitude linear dipolar anomalies, with two aligned north to south to the west and one aligned north-east to south-west, are caused by service pipes (Illus 7 - SP1, SP2 and SP3).

A small area of magnetic enhancement is present in the centre of the GSA (Illus 7 - FP1). This anomaly broadly correlates with the location of a pond recorded on historic mapping. The enhanced response is due to the material used to infill this former feature.

4.3. AGRICULTURAL ANOMALIES

The most common anomalies across the GSA are of agricultural origin, identifying former boundaries, (Illus 7 - FB1 to FB4 inclusive), systematic patterns of field drains, and ploughing trends of both historic (ridge and furrow) and modern origin. A further linear anomaly has been interpreted as a possible former field boundary (Illus 7 - FB25). No field boundary is recorded in this location, but its alignment is consistent with the pattern and orientation of other boundaries in close proximity.

4.4. ANOMALIES OF GEOLOGICAL ORIGIN

No noticeable differences are evident in the data across the two different bedrock geologies or along the southern boundary where no overlying deposits are mapped. The only anomalies considered of natural or geological origin are discrete low magnitude anomalies randomly distributed across the GSA, likely reflecting changes in the depth and composition of the bedrock geology, superficial deposits, and the overlaying soils.

4.5. ANOMALIES OF UNCERTAIN ORIGIN

Several anomalies have been interpreted as of uncertain origin on the basis that they cannot be confidently interpreted in any other category. Given the absence of any anomalies of obvious archaeological potential and the absence of any known assets within the GSA boundary a non-archaeological cause for each is thought most likely.

Two weakly positive linear anomalies are recorded in the north of the GSA (Illus 7 - L1). These anomalies are considered likely to be former field boundaries or ploughing headlands as they run parallel to former and extant boundaries and orthogonal to ridge and furrow cultivation recorded immediately to the south-west.

In the west of the GSA a discrete weakly positive anomaly and a curvilinear anomaly have been identified (Illus 7 - U1). These anomalies are distinct from the agricultural anomalies identified within the GSA but lack any discernible pattern or morphology that would allow for a more confident interpretation. It is considered that these anomalies are most likely natural or agricultural in cause, but an archaeological origin cannot be completely discounted.

4.6. ANOMALIES OF POSSIBLE OR PROBABLE ARCHAEOLOGICAL ORIGIN

No anomalies of obvious archaeological potential have been identified by the survey.

5. CONCLUSION

The survey has recorded anomalies of agricultural, natural, and modern origin, identifying systematic patterns of field drains, ridge and furrow cultivation and modern ploughing trends, former field boundaries and ponds. Anomalies of uncertain origin have been recorded but are considered more likely to be of natural or agricultural origin than of archaeological origin. No anomalies of obvious archaeological origin have been recorded.

The detection of a range of magnetic anomalies gives confidence that the survey data likely provides a good indication of the archaeological potential of the site which, on the basis solely of the geophysical survey results is assessed as low.

6. REFERENCES

Chartered Institute for Archaeologists (CIfA) 2020 Standard and guidance for archaeological geophysical survey (Reading) https://www.archaeologists.net/sites/default/files/CIfA%26GGeophysics_3.pdf accessed 1st August 2024

Cranfield University 2024 Cranfield Soil and Agrifood Institute Soilscales <http://www.landis.org.uk/soilscales/> accessed 1st August 2024

English Heritage (2008) Geophysical Survey in Archaeological Field Evaluation: Research and Professional Services Guidelines (2nd edn) <https://content.historicengland.org.uk/images-books/publications/geophysical-survey-in-archaeological-field-evaluation/geophysics-guidelines.pdf/> accessed 1st August 2024

Europae Archaeologia Consillium (EAC) 2016 EAC Guidelines for the Use of Geophysics in Archaeology: Question to Ask and Points to Consider (Namur,

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The Department for Levelling Up, Housing and Communities (DLUHC) 2023 The National Planning Policy Framework https://assets.publishing.service.gov.uk/media/65a11af7e8f5ec000f1f8c46/NPPF_December_2023.pdf accessed 1st August 2024

7. APPENDICES

APPENDIX 1 MAGNETOMETER SURVEY

Magnetic susceptibility and soil magnetism

Iron makes up about 6% of the earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haematite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of the topsoil, subsoil, and rock, into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected.

The magnetic susceptibility of a soil can also be enhanced by the application of heat. This effect can lead to the detection of features such as hearths, kilns, or areas of burning.

Types of magnetic anomaly

In most instances anomalies are termed 'positive'. This means that they have a positive magnetic value relative to the magnetic background on any given site. However, some features can manifest themselves as 'negative' anomalies that, conversely, means that the response is negative relative to the mean magnetic background.

Where it is not possible to give a probable cause of an observed anomaly a '?' is appended.

It should be noted that anomalies interpreted as modern in origin might be caused by features that are present in the topsoil or upper layers of the subsoil. Removal of soil to an archaeological or natural layer can therefore remove the feature causing the anomaly.

The types of response mentioned above can be divided into five main categories that are used in the graphical interpretation of the magnetic data:

Isolated dipolar anomalies (iron spikes)

These responses are typically caused by ferrous material either on the surface or in the topsoil. They cause a rapid variation in the magnetic response giving a characteristic 'spiky' trace. Although ferrous archaeological artefacts could produce this type of response, unless there is supporting evidence for an archaeological interpretation, little emphasis is normally given to such anomalies, as modern ferrous objects are common on rural sites, often being introduced into the topsoil during manuring.

Areas of magnetic disturbance

These responses can have several causes often being associated with burnt material, such as slag waste or brick rubble or other strongly magnetised/fired material. Ferrous structures such as pylons, mesh or barbed wire and buried pipes can also cause the same disturbed response. A modern origin is usually assumed unless there is other supporting information.

Lightning-induced remnant magnetisation (LIRM)

LIRM anomalies are thought to be caused in the near surface soil horizons by the flow of an electrical current associated with lightning strikes. These observed anomalies have a strong bipolar signal which decreases with distance from the spike point and often appear as linear or radial in shape.

Linear trend

This is usually a weak or broad linear anomaly of unknown cause or date. These anomalies are often caused by agricultural activity, either ploughing or land drains being a common cause.

Areas of magnetic enhancement/positive isolated anomalies

Areas of enhanced response are characterised by a general increase in the magnetic background over a localised area whilst discrete anomalies are manifest by an increased response (sometimes only visible on

an XY trace plot) on two or three successive traverses. In neither instance is there the intense dipolar response characteristic exhibited by an area of magnetic disturbance or of an 'iron spike' anomaly (see above). These anomalies can be caused by infilled discrete archaeological features such as pits or post-holes or by kilns. They can also be caused by pedological variations or by natural infilled features on certain geologies. Ferrous material in the subsoil can also give a similar response. It can often therefore be very difficult to establish an anthropogenic origin without intrusive investigation or other supporting information.

Linear and curvilinear anomalies

Such anomalies have a variety of origins. They may be caused by agricultural practice (recent ploughing trends, earlier ridge and furrow regimes or land drains), natural geomorphological features such as palaeochannels or by infilled archaeological ditches.

APPENDIX 2 SURVEY LOCATION INFORMATION

An initial survey base station was established using a Trimble VRS differential Global Positioning System (dGPS). The magnetometer data was georeferenced using a Trimble RTK differential Global Positioning System (Trimble R10 model).

Temporary sight markers were laid out using a Trimble VRS differential Global Positioning System (Trimble R8s model) to guide the operator and ensure full coverage. The accuracy of this dGPS equipment is better than 0.01m.

The survey data were then super-imposed onto a base map provided by the client to produce the displayed block locations. However, it should be noted that Ordnance Survey positional accuracy for digital map data has an error of 0.5m for urban and floodplain areas, 1.0m for rural areas and 2.5m for mountain and moorland areas. This potential error must be considered if coordinates are measured off hard copies of the mapping rather than using the digital coordinates.

Headland Archaeology cannot accept responsibility for errors of fact or opinion resulting from data supplied by a third party.

APPENDIX 3 GEOPHYSICAL SURVEY ARCHIVE

The geophysical archive comprises an archive disk containing the raw data in XYZ format, a raster image

of each greyscale plot with associate world file, and a PDF of the report.

The project will be archived in-house in accordance with recent good practice guidelines (http://guides.archaeologydataservice.ac.uk/g2gp/Geophysics_3). The data will be stored in an indexed archive and migrated to new formats when necessary.

APPENDIX 4 DATA PROCESSING

The gradiometer data has been presented in this report in processed greyscale and minimally processed XY trace plot format.

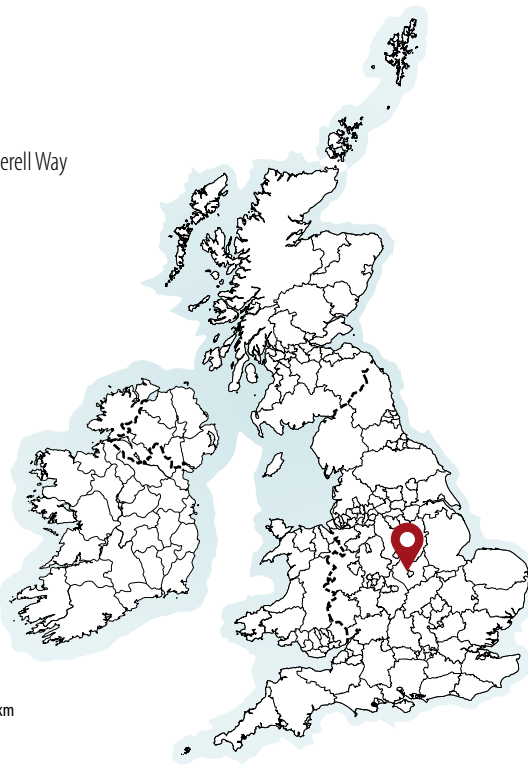
Data collected using RTK GPS-based methods cannot be produced without minimal processing of the data. The minimally processed data has been interpolated to project the data onto a regular grid and de-striped to correct for slight variations in instrument calibration drift and any other artificial data.

A high pass filter has been applied to the greyscale plots to remove low frequency anomalies (relating to survey tracks and modern agricultural features) to maximise the clarity and interpretability of the archaeological anomalies.

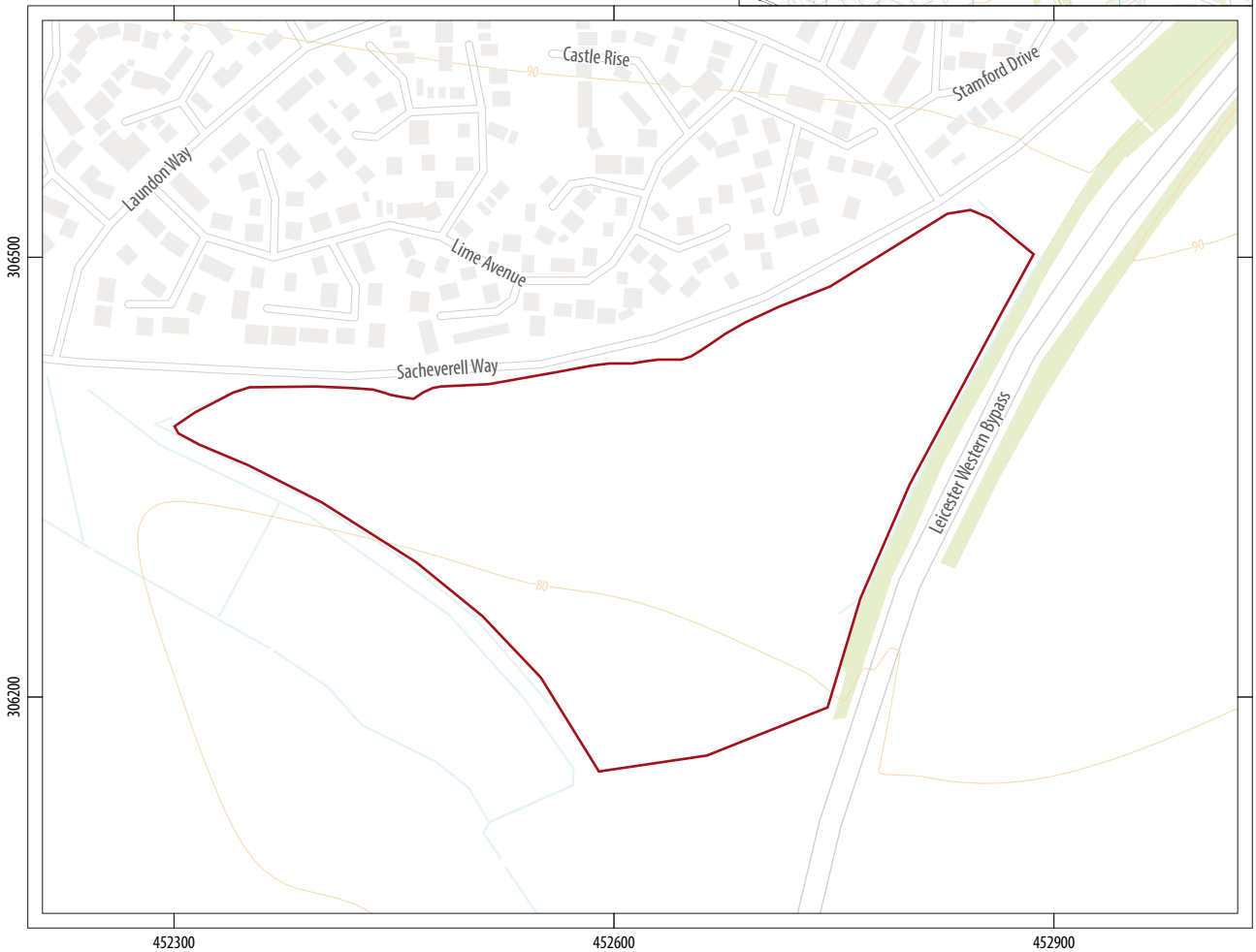
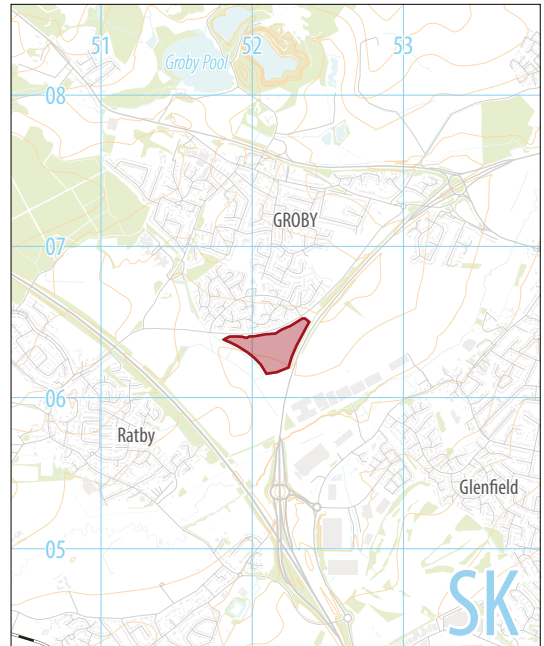
The data has also been clipped to remove extreme values and to improve data contrast.

APPENDIX 5 OASIS ARCHIVE

Land South of Sacheverell Way
Groby
Leicestershire



0 200km
1:12,500,000 @ A4



0 100m
1:5,000 @ A4

 geophysical survey area

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t 0127 493 8019
e yorkshireandnorth@headlandarchaeology.com
w www.headlandarchaeology.com

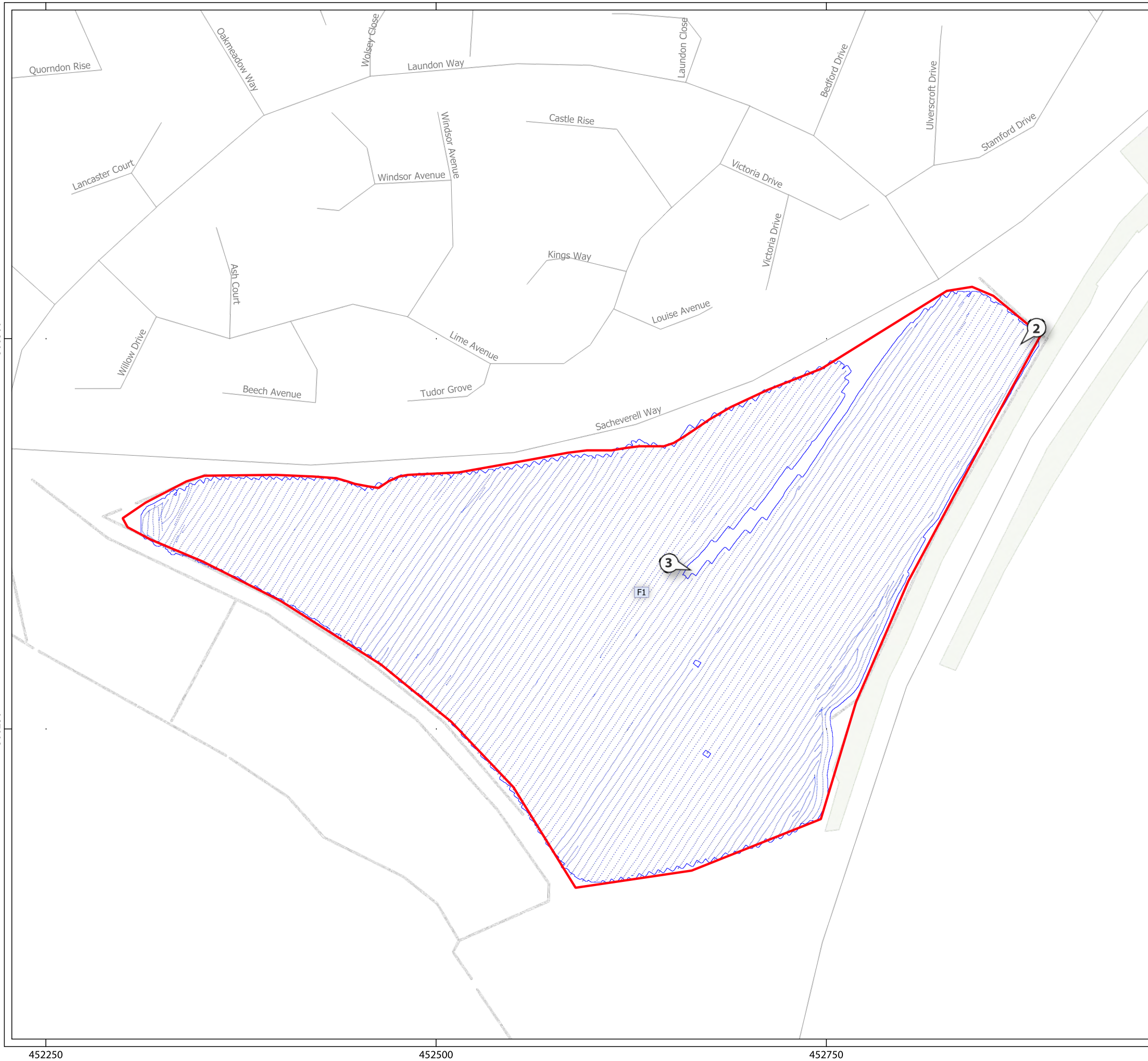
ILLUS 1 Site location



Illus 2 F1, looking south-west

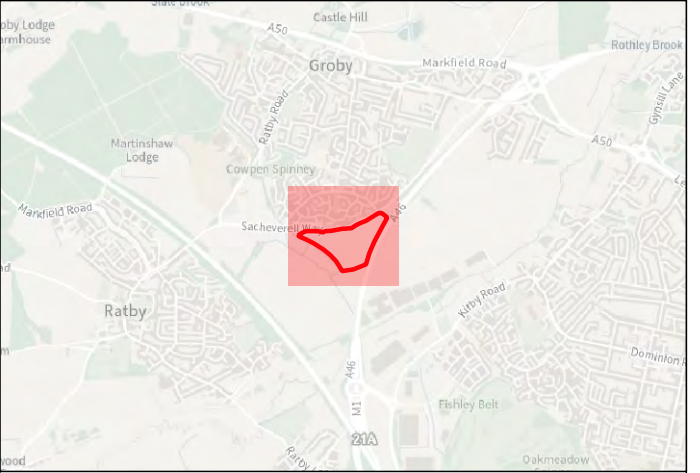



Illus 3 F1, looking east

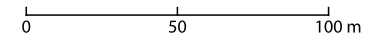




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- Key**
- ▭ Geophysical Survey Area
 - ▭ Survey Extent
 -  Location and Direction for Illus 02 to 03
 - ⋯ GPS Swaths



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Site:	SWGL24
Created by:	KS
Checked by:	MB
Version:	v1.0
Date:	05/08/2024
Scale:	1:2,500 @ A3

Illus 04 - Survey location showing GPS swaths and photograph locations

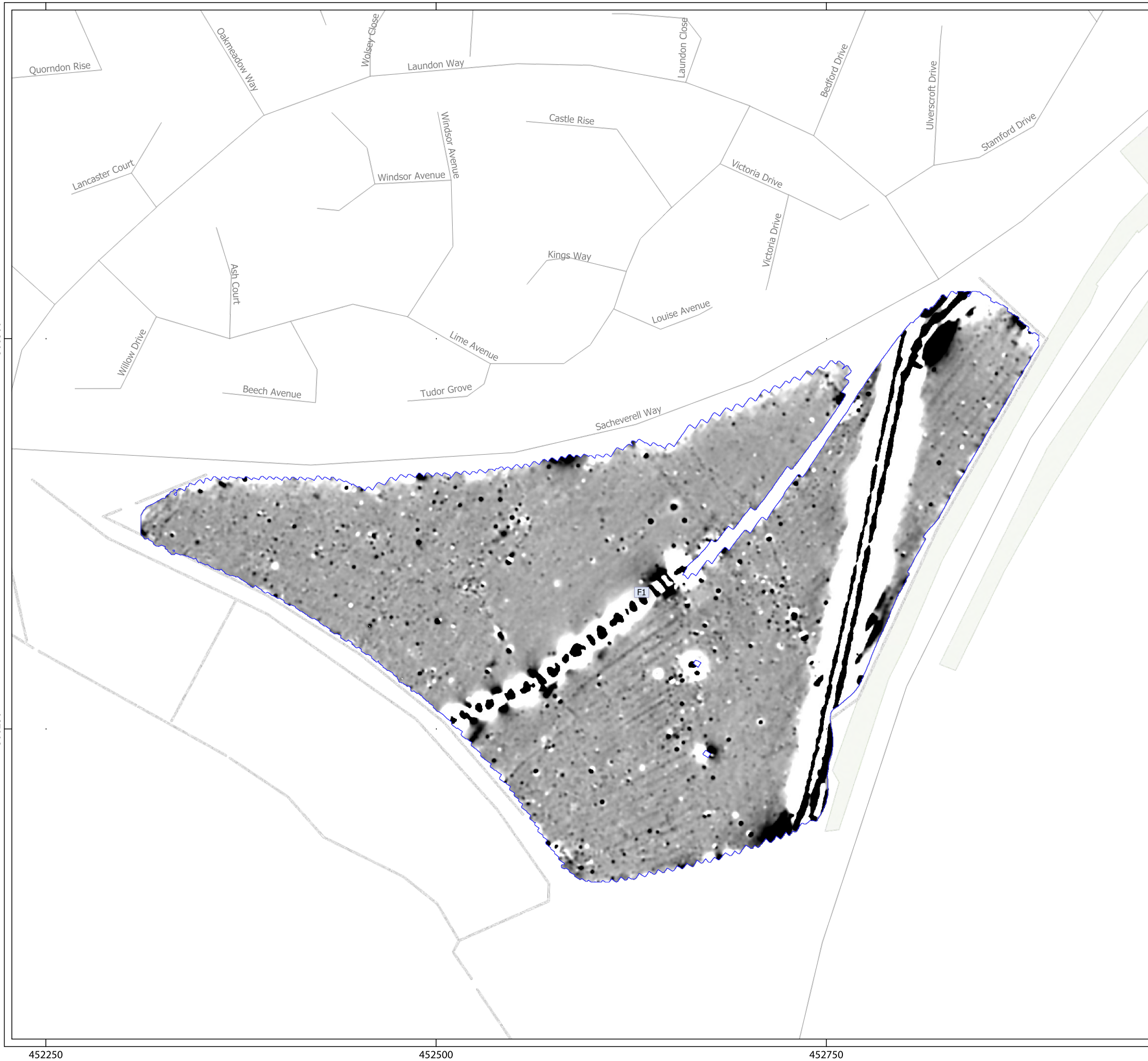
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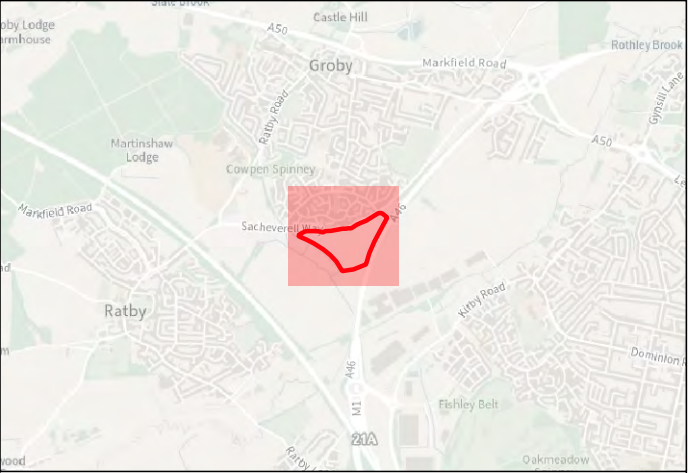
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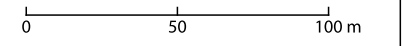
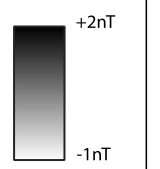
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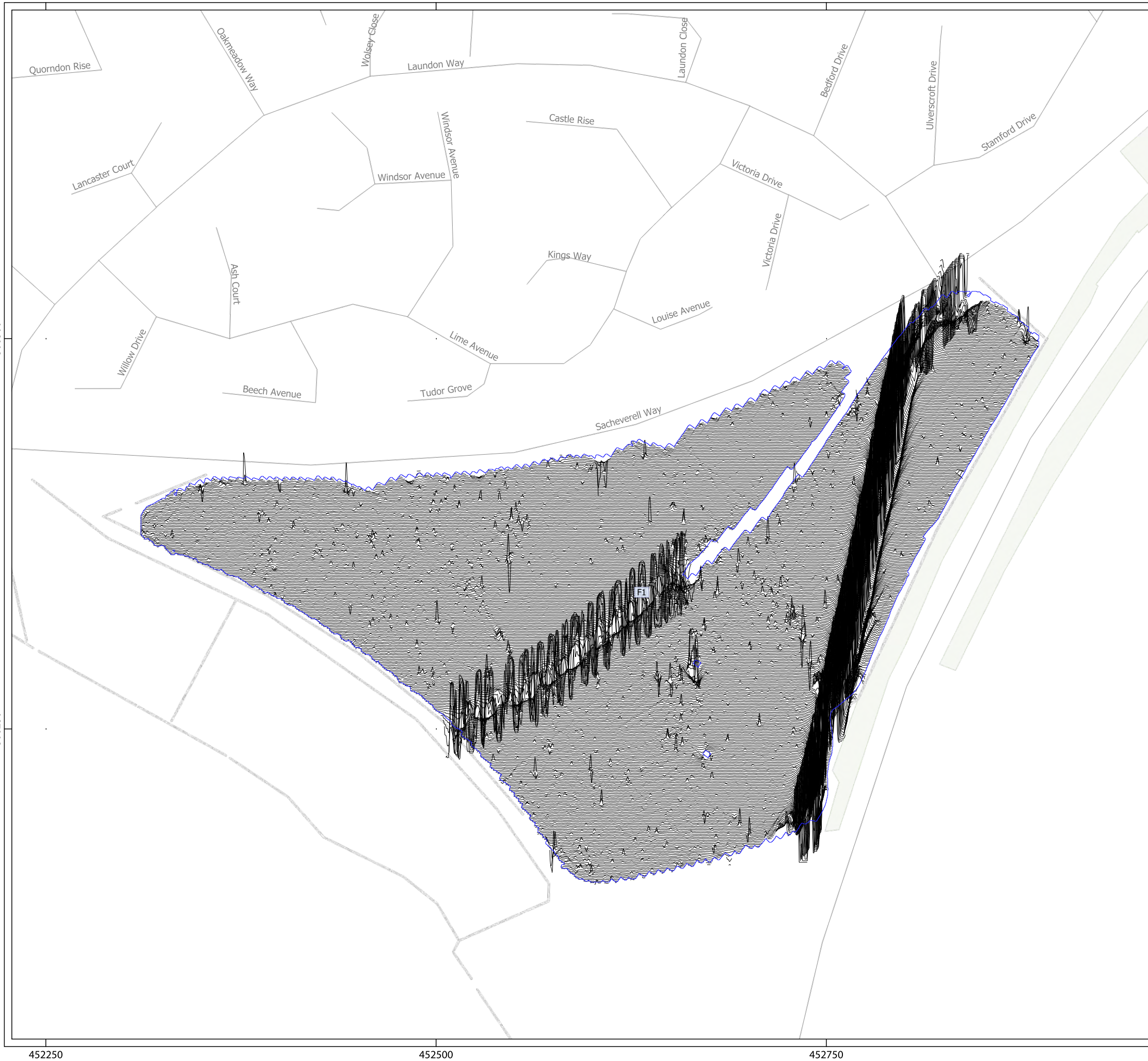


Key
 Survey Extent



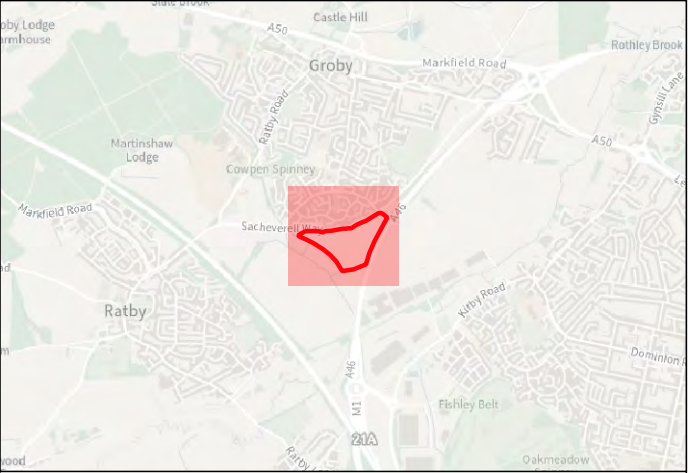
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Site:	SWGL24
Created by:	KS
Checked by:	MB
Version:	v1.0
Date:	05/08/2024
Scale:	1:2,500 @ A3

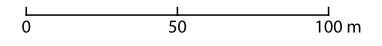




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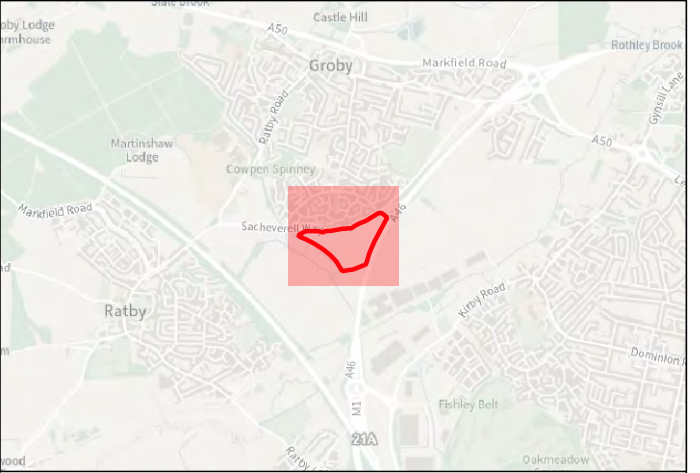
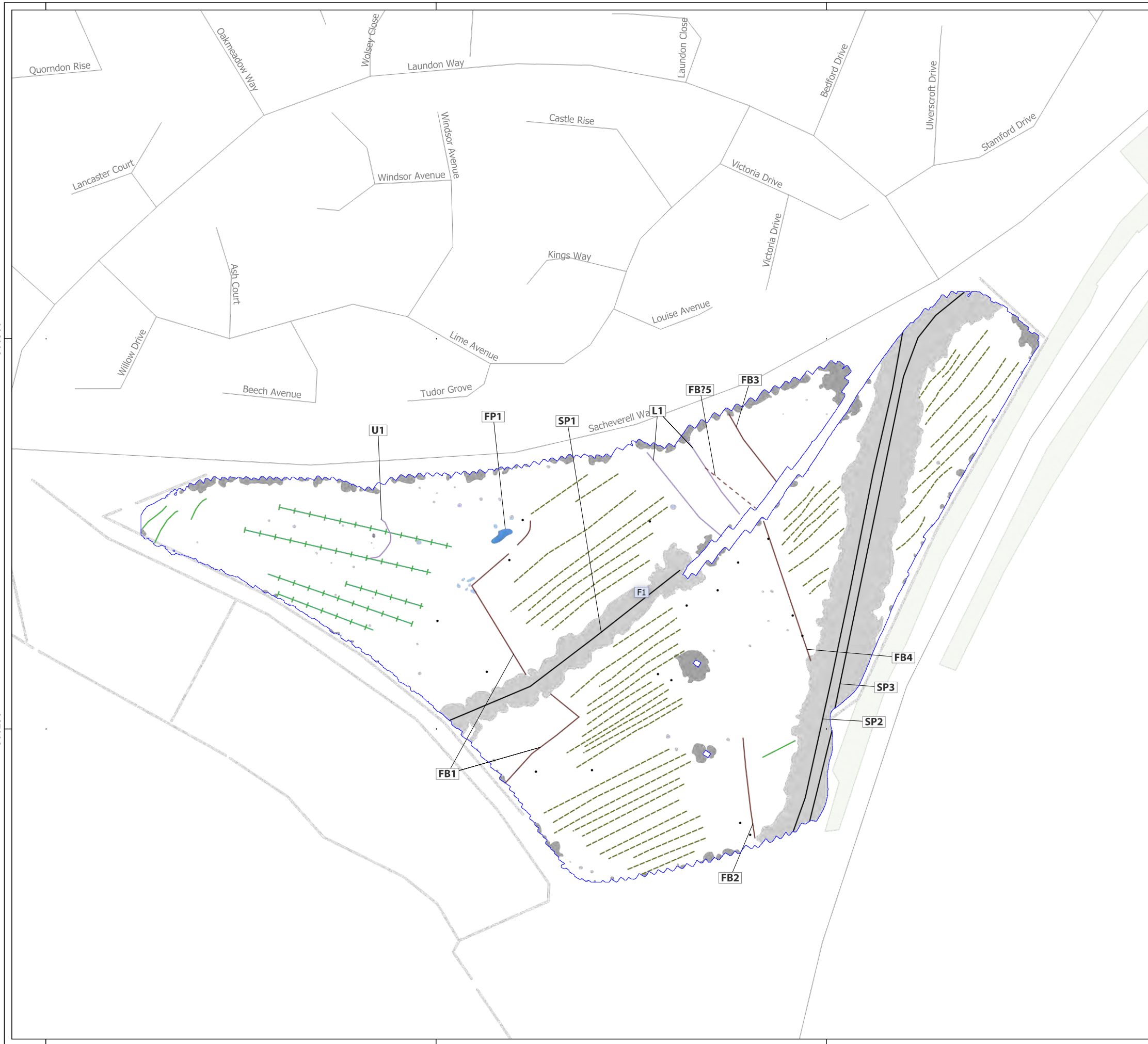
Key
 Survey Extent
 XY Trace (25nT/cm)



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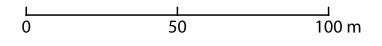
Site:	SWGL24
Created by:	KS
Checked by:	MB
Version:	v1.0
Date:	05/08/2024
Scale:	1:2,500 @ A3

Illus - 06 XY trace plot of minimally processed magnetometer data



Key	
	Survey Extent
	Ferrous Objects
	Agriculture
	Field Boundary
	Possible Field Boundary
	Field Drain
	Service
	Uncertain
	Ridge and Furrow
	Magnetic Disturbance (Above Ground)
	Magnetic Disturbance (Below Ground)
	Natural
	Uncertain
	Former Pond

Abbreviation	
FB	Former Boundary
FB?	Former Boundary?
FP	Former Pond
L	Linear
SP	Service Pipe
U	Uncertain



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