Geophysical Survey Report

of

Western Bridge and Link Road,

Burgess Hill Goddards Green,

West Sussex

For

TEP

On Behalf Of

Homes England

Magnitude Surveys Ref: MSTQ571

HER Event Number: To be assigned upon submission to HER

OASIS Reference Number: magnitud1-403294

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Abstract

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c.2ha area of land at Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex. A fluxgate gradiometer survey was successfully completed across the survey area. No anomalies suggestive of significant archaeological features were identified. The geophysical results are characterised by a generally weak magnetic background, with small natural variations across the site. Anomalies related to historical agricultural use have been detected and interpreted as a probable shifting field boundary which borders a small stream in the north of the survey area. The results have been impacted by modern activity in the form of two service lines, and ferrous anomalies related to fencing between survey areas. Anomalies classed as “Industrial/ Modern” are not typically ferrous in nature and may relate to disturbed areas of fired material. Other anomalies identified have been classified as undetermined, where the magnetic signal is ambiguous, and a lack of context due to the shape of the survey area has prevented a more certain classification.

Contents

List of Figures

1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by TEP on behalf of Homes England to undertake a geophysical survey on a c.2 ha area of land at the Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex (TQ 29296 20194).

1.2. The geophysical survey comprised hand-pulled, cart-mounted and hand-carried GNSS-positioned fluxgate gradiometer survey.

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute for Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt et al., 2015).

1.4. It was conducted in line with a WSI produced by MS (Garst, L 2019).

1.5. The survey commenced on 4 November 2019 and was completed the following day.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society of Archaeological Prospection).

2.2. Director Dr. Chrys Harris is a Member of CIfA, has a PhD in archaeological geophysics from the University of Bradford and is the Vice-Chair of ISAP. Director Finnegan Pope-Carter is a Fellow of the London Geological Society, the chartered UK body for geophysicists and geologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group. Reporting Analyst Dr. Kayt Armstrong has a PhD in archaeological geophysics from Bournemouth University, is the Vice Conference Secretary and Editor of ISAP News for ISAP, and is the UK Management Committee representative for the COST Action SAGA.

2.3. All MS managers have relevant degree qualifications to archaeology or geophysics. All MS field and office staff have relevant archaeology or geophysics degrees and/or field experience.

3. Objectives

3.1. The objective of this geophysical survey is to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

4.1. The site is located c.2.6km northwest of Burgess Hill (Figure 1). Survey was undertaken across six fields; five were under pasture and one was in arable use. The site is bounded entirely by further pasture and arable fields, with West End Farm a short distance to the west, and the A2300 cutting through the centre of the site east-west (Figure 2).

4.2. Survey considerations (Figure 2):

Survey Area	Ground Conditions	Further Notes
1	The area was a flat field used for cattle pasture. Wet ground.	The field continued in the west, bound by barbed wire fencing to the south and east and by a large grass embankment to the north which separated the area from the A2300.
2	The area was a flat field used for cattle pasture. Wet ground.	The survey area was bound to the north and south by metal barbed wire fencing. The field continued to the east and west. There were trees located along the southern boundary.
3	The area was a flat field used for cattle pasture. Wet ground.	The survey area was bound to the north and south by barbed wire fencing within a tree line. The field continued to the east and west.
4	The area was used for cattle pasture that sloped down to the north. Wet ground.	The area was bound to the north by hedgerow. The area was bound to the south by wooden fencing and trees, which separated the area from the A2300. The field continued to the east and west. Large power lines ran across the survey area from the southeast to the west.
5	The area was used for cattle pasture that sloped down to the north. Wet ground.	The area was bound to the north by a stream, by hedges to the south and the field continued to east and west.
6	The area was a ploughed arable field that sloped down to the southwest.	The area was bound by a stream to the south and the field continued to the north, east and west.

4.3. The underlying geology comprises mudstone of the Weald clay formation, with narrow bands of Ironstone of the Weald clay formation cutting through the northern half of the survey area in Areas 4, 5, and 6. No superficial deposits are recorded across the majority of the survey area, however a narrow band of alluvium, clay, silt, sand and gravel is present between Areas 5 and 6 along the course of a small stream (British Geological Survey, 2019).

4.4. The soils consist of slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils (Soilscapes, 2019).

5. Archaeological Background

5.1. The following section summarises the archaeological background of the site and the surrounding area (1km radius) following a search of Heritage Gateway (2019).

5.2. Prehistoric activity has been recorded by a watching brief c.280m east of the survey area in the form of undated worked flints (HENMR 1332798). Further worked flint was record at an excavation c.1km south-southeast of the survey area (HENMR 1098741).

5.3. The excavation c.1km south-southeast of the survey area also recorded a range of Romano-British features including a corn-drying oven, ditches, hearths and pits. Two sherds of saxon pottery were also recorded at this excavation site (HENMR 1098741).

6. Methodology

6.1.Data Collection

6.1.1. Geophysical prospection comprised the magnetic method as described in the following table.

6.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.1.3. The magnetic data were collected using MS' bespoke hand-pulled cart system and hand-carried GNSS-positioned system.

6.1.3.1. MS' cart and hand-carried system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.1.3.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.1.3.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.2.Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to Historic England's standards for "raw or minimally processed data" (see sect 4.2 in David et al., 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen et al. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.3.Data Visualisation and Interpretation

6.3.1. This report presents the gradient of the sensors' total field data as greyscale images. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Multiple greyscale images at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figure 6). XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historic maps, LiDAR data, and soil and geology maps. Google Earth (2019) was consulted as well, to compare the results with recent land usages.

6.3.3. Geodetic position of results - All vector and raster data have been projected into OSGB36 (ESPG27700) and can be provided upon request in ESRI Shapefile (.SHP) and Geotiff (.TIF) respectively. Figures are provided with raster and vector data projected against OS Open Data.

7. Results

7.1.Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports as well as reports of further work in order to constantly improve our knowledge and service.

7.2.Discussion

7.2.1. The geophysical results are presented in consideration with satellite imagery and historic maps (Figure 4).

7.2.2. The fluxgate gradiometer survey has responded well to the environment of the survey area. No anomalies suggestive of significant archaeological features were identified. The survey area has a quiet magnetic background allowing for the detection of weak anomalies relating to soil variations and colluvial processes. In the north of the survey area, to the northeast of a small stream a broader natural anomaly has been detected which may reflect a former route of the streambed. Modern interference has impacted the survey results with two service lines identified crossing the survey area, one in the northern half and the other in the south. Ferrous anomalies relating to the fencing between survey areas have also been detected.

7.2.3. Agricultural activity has been identified in the form of possible former field boundaries in the north of the survey area. Two weak linear anomalies detected in the southern half of the survey area may be related to former ploughing regimes or other agricultural activity.

7.2.4. An area of possible industrial/ modern anomalies has been identified in the southern half of the survey area. The origin of these anomalies is uncertain; however, it could represent some disturbed burnt or fired material.

7.2.5. Anomalies where the origin is undetermined have been classified as such due to a distinct alignment or configuration, however this could be coincidental, and a natural origin is possible, the narrow and elongated shape of the survey area means it has been difficult to compare possible anomalies to observed natural variations in the response.

7.3.Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures along the edges of the field have been classified as 'Magnetic Disturbance'. These magnetic 'haloes' will obscure the response of any weaker underlying features, should they be present, often over a greater footprint than the structure they are being caused by.

7.3.1.3. **Ferrous (Spike)** – Discrete ferrous-like, dipolar anomalies are likely to be the result of isolated modern metallic debris on or near the ground surface.

7.3.1.4. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentrated deposition of discrete, dipolar ferrous anomalies and other highly magnetic material.

7.3.1.5. **Undetermined** – Anomalies are classified as Undetermined when the anomaly origin is ambiguous through the geophysical results and there is no supporting or correlative evidence to warrant a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally not ferrous in nature.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Agricultural** – In the north of Area 5, three parallel linear anomalies have been identified [**5a**] (Figure 6). These anomalies exhibit continuous weakly positive magnetic signals indicative of ditch-type anomalies. The linear anomalies almost cross the full width of the survey area, with the longest being 22m in length, and the central shortest anomaly 13m. Each anomaly is aligned on the northwest to southeast axis, broadly parallel with the stream situated 10m north. With the narrow context of the survey area is it difficult to provide confident interpretation however, a former field boundary which has shifted over time depending on the stream to the north seems likely.

7.3.2.2. **Industrial/ Modern (Spread)** – In the south of Area 2, an area of numerous strong dipolar anomalies has been detected [**2a**] (Figure 9). These are not typically ferrous in origin, and some of the magnetic signals have a slight "double-peak" effect which is typical of burnt or fired material. However, this spread of anomalies is not typical of an in-situ burning event, the jumbled mass of anomalies is more indicative of dumped or disturbed fired material, such as bricks or tiles.

8. Conclusions

8.1. A fluxgate gradiometer survey has successfully been undertaken across the site. No anomalies suggestive of significant archaeological features were identified. The geophysical survey has detected a range of different types of anomalies of natural, agricultural, and modern/ industrial origin. The magnetic background of the survey area is quiet with some weak variations of the soils being visible within the dataset. Modern interference is present including two service lines and anomalies related to fencing between areas.

8.2. Agricultural activity is present in the form of a possible shifting former field boundary present to the south of a small steam. The anomalies reflect three possible locations of the former field boundary.

8.3. Anomalies indicative of modern/ industrial activity is present in the southern half of the survey area. These anomalies are indicative an area of disturbed burnt or fired material.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to the any dictated time embargoes.

10. Copyright

10.1. Copyright and the intellectual property pertaining to all reports, figures, and datasets produced by Magnitude Services Ltd. is retained by MS. The client is given full licence to use such material for their own purposes. Permission must be sought by any third party wishing to use or reproduce any IP owned by MS.

11. References

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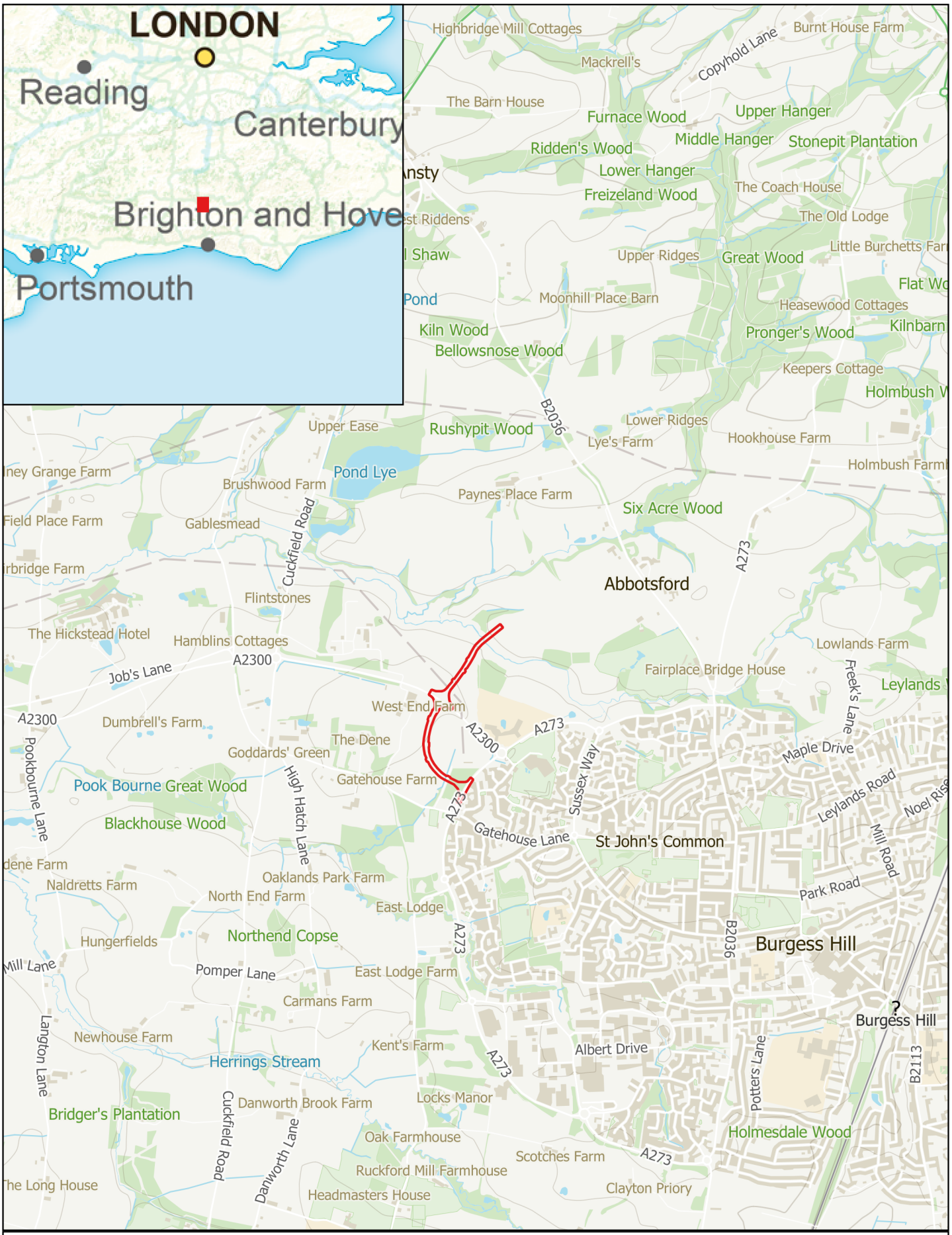
Soilscapes, 2019. [Burgess Hill, West Sussex]. Cranfield University, National Soil Resources Institute [http://landis.org.uk]. [Accessed 12/11/2019].

12. Project Metadata

MS Job Code	MSTQ571
Project Name	Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Client	TEP
Grid Reference	TQ 29296 20194
Survey Techniques	Magnetometry
Survey Size (ha)	2ha
Survey Dates	2019-11-04 to 2019-11-05
Project Manager	Chrys Harris BA MSc PhD MCIfA
Project Officer	Leanne Swinbank, BA ACIfA
HER Event No	To be assigned upon submission to HER
OASIS No	N/A
S42 Licence No	N/A
Report Version	1

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Officer to Review	LS	JC	12 November 2019
0.2	Draft for Project Manager to review.	LS	KA	13 November 2019
1.0	Comments from client	MA	LS	19 November 2019



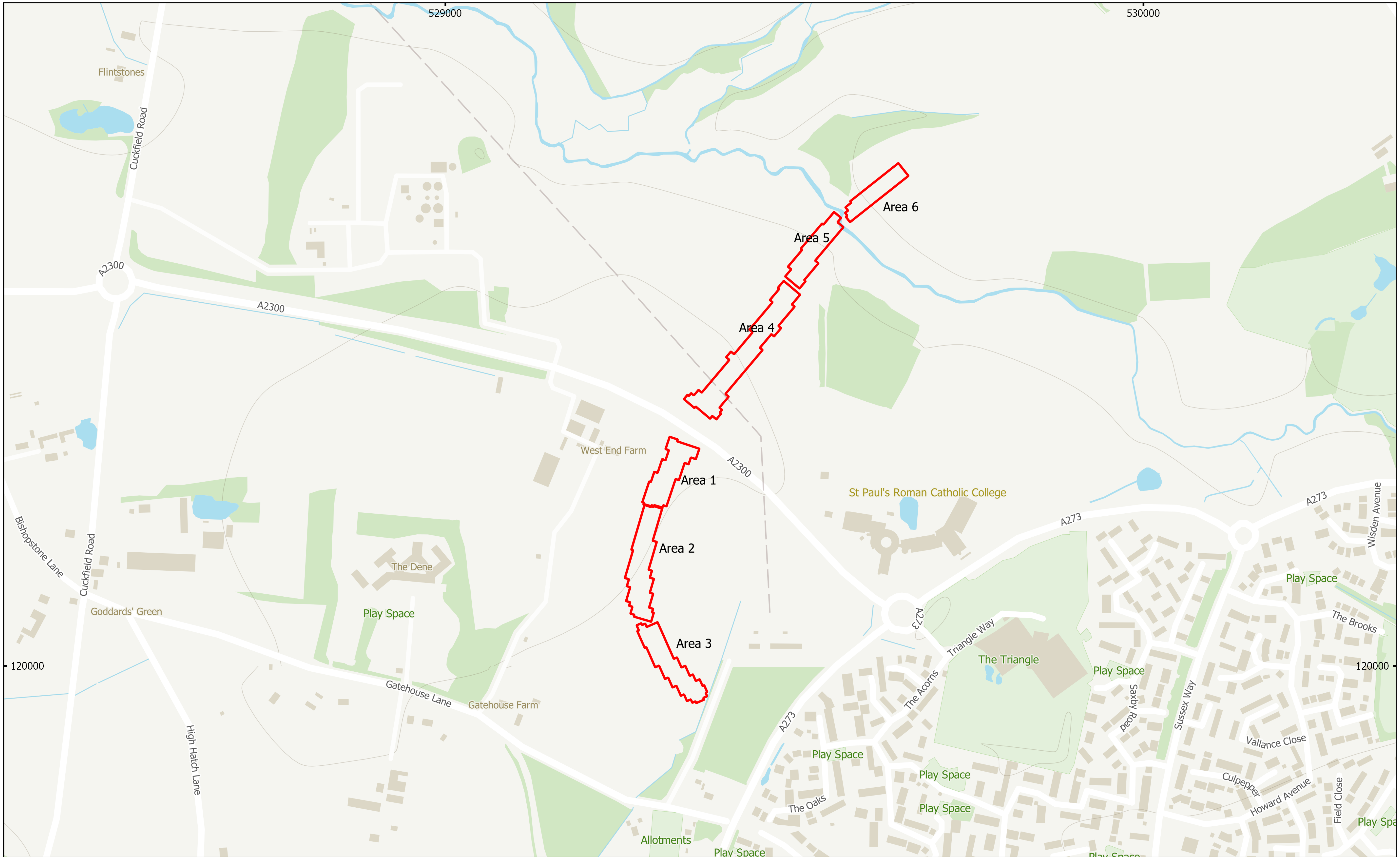
MSTQ571 - Western Bridge and Link Road, Burgess Hill, West Sussex
Figure 1 - Site Location
1:25,000 @ A4

Survey Boundary

N

0 0.5 1 km

magnitude surveys



MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 2 - Location of Survey Areas
1:5,000 @ A3

magnitude surveys

120400
529200
529400
529600
120600
529800
120200
120000
529200

West End Farm

A2300

Area 1

Area 2

Area 3

Area 4

Area 5

Area 6

St Paul's Roman Catholic College

MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 3 - Magnetic Gradient Overview
1:2,000 @ A3

-1 nT 2

N

0 50 100 150 m

magnitude surveys

MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 4 - Magnetic Interpretation Over Historic Maps and Satellite Imagery Overview
1:2,000 @ A3

529300
529400
529500
529600
529700
52980
120700
120600
120500
120400
Area 6
Area 5
Area 4
A2300

MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 5 - Magnetic Gradient North
1:1,500 @ A3

-1 nT 2

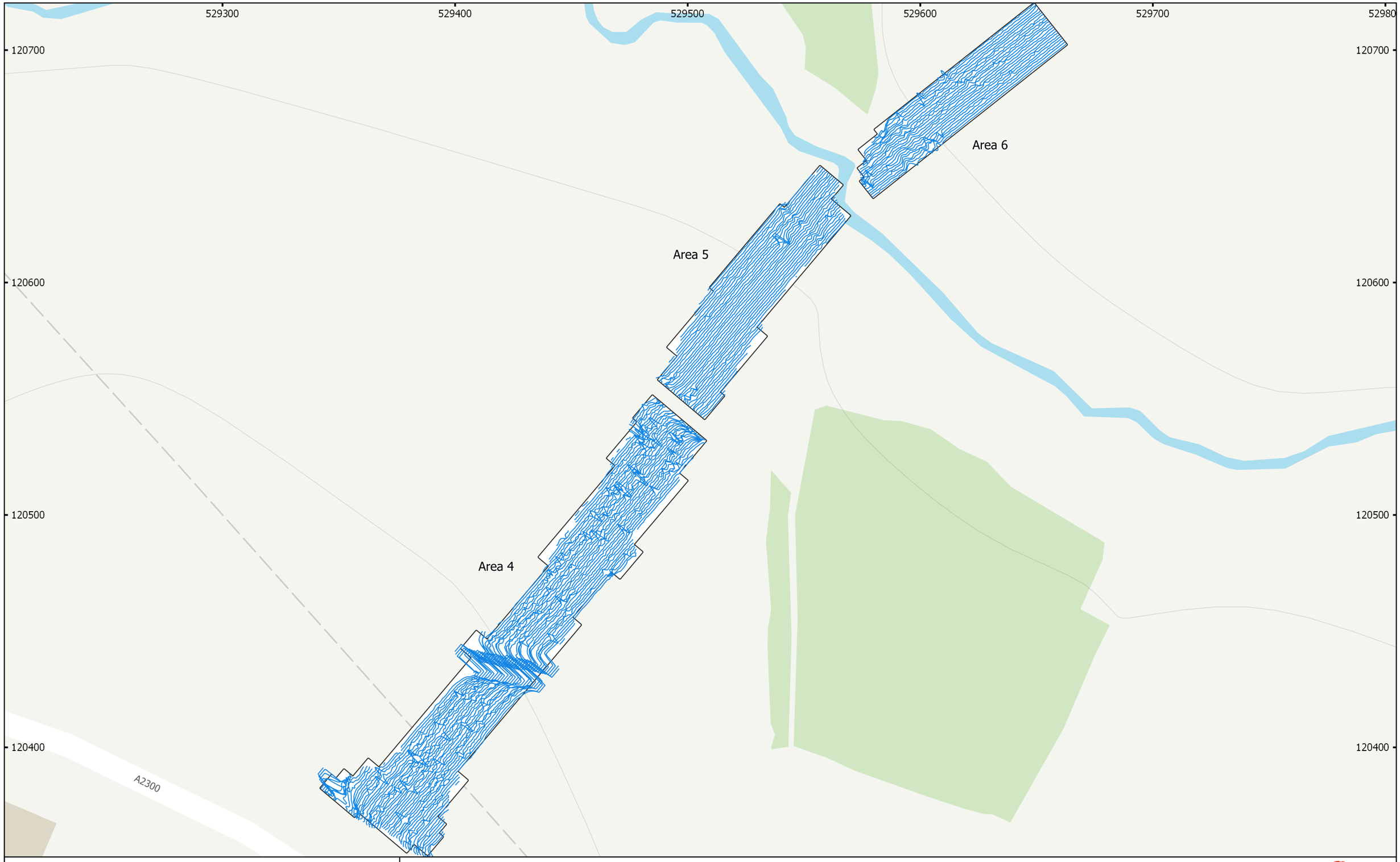
N

0 20 40 60 m

magnitude surveys

529300
529400
529500
529600
529700
52980
120700
120600
120500
120400
Area 6
5a
Area 5
Area 4
A2300
MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 6 - Magnetic Interpretation North
1:1,500 @ A3

Agricultural (Strong)
Agricultural (Weak)
Agricultural (Trend)
Undetermined (Strong)
Undetermined (Weak)
Undetermined (Trend)
Natural (Strong)
Natural (Weak)
Magnetic Disturbance
Service
Ferrous Spike
N
0
20
40
60 m
magnitude surveys



MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 7 - XY Trace Plot North
15nT/cm at 1:1,500 @ A3

N

0 20 40 60 m

magnitude surveys

120200 529100 529200 120300 529300 529400 120400 529500

120400
529600
120300
120200
529700
120100

120100
120000
529100
119900

Area 1
Area 2
Area 3

A2300
A273

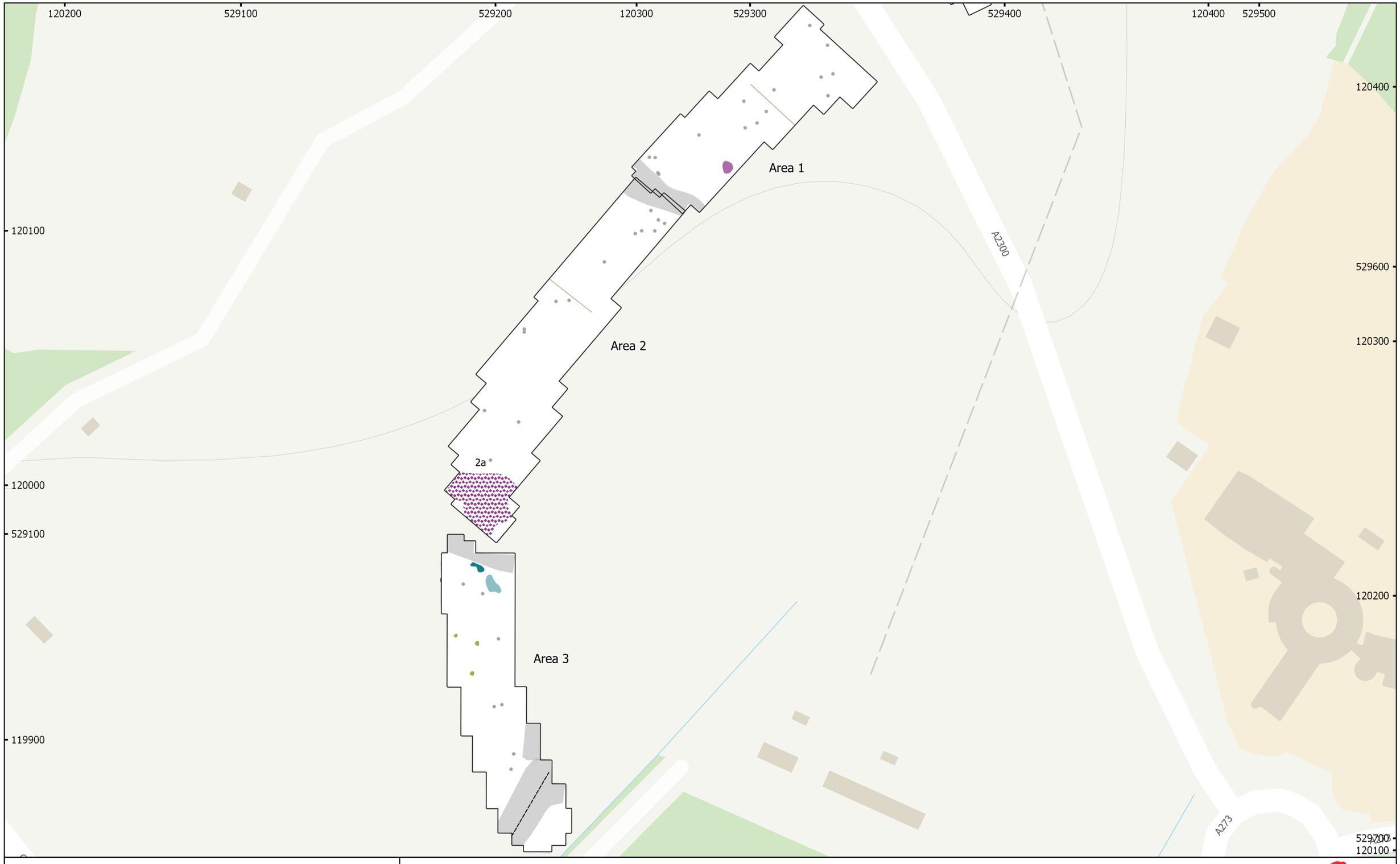
MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 8 - Magnetic Gradient South
1:1,500 @ A3

-1 nT 2

N

0 20 40 60 m

magnitude surveys



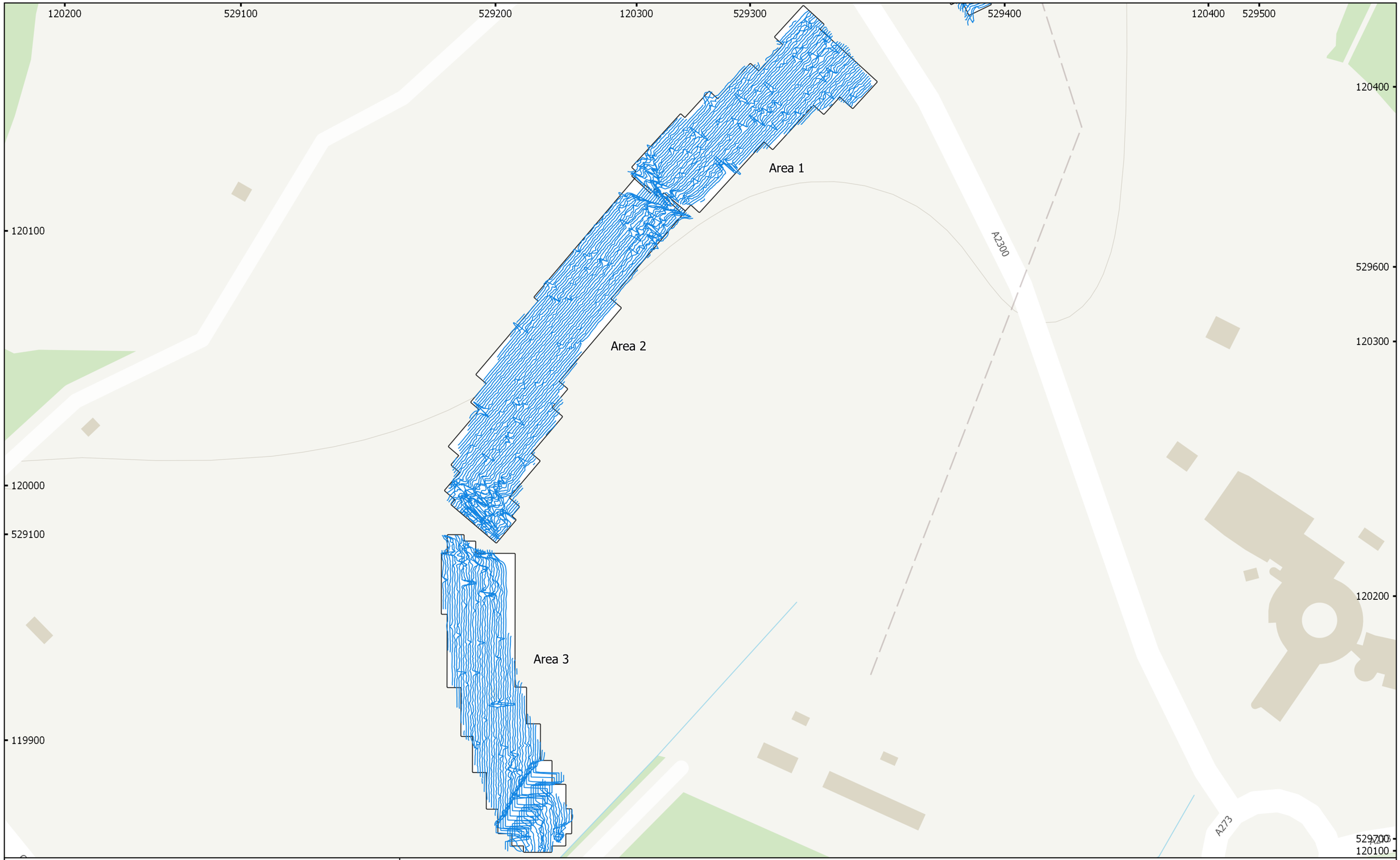
MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 9 - Magnetic Interpretation South
1:1,500 @ A3

Agricultural (Trend)
Industrial/Modern
Industrial/Modern (Spread)
Undetermined (Strong)
Undetermined (Weak)
Magnetic Disturbance
Service
Ferrous Spike

N

0 20 40 60 m

magnitude surveys



MSTQ571 - Western Bridge and Link Road, Burgess Hill Goddards Green, West Sussex
Figure 10 - XY Trace Plot South
15nT/cm at 1:1,500 @ A3

N

0 20 40 60 m

magnitude surveys