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**Geophysical Survey Report  
York Gardens,  
Gosberton, Lincolnshire**

**For  
RPS**

**On Behalf Of  
Gleeson**

**Magnitude Surveys Ref: MSTF1042**

**HER Event Number: To be confirmed**

**OASIS Number: To be confirmed**

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**Issue Date:**

24 November 2021

## **Abstract**

Magnitude Surveys was commissioned to assess the subsurface archaeological potential of a c. 3.6ha area of land at York Gardens, Gosberton, Lincolnshire. A fluxgate gradiometer survey was successfully completed across the survey area, and has identified anomalies related to the superficial deposits and former agricultural use of the landscape. The magnetically enhanced natural background has possibly obscured any further, weaker anomalies, if they were present. In the west of the survey area, a gap, with sharp, distinct edges suggesting possible anthropogenic activity has been detected between the zones of natural deposits. The survey also detected a former field boundary, and other possible unmapped former field boundaries, along with modern ploughing. Modern interference relating to residential housing and fencing is limited to the edges of the survey area.

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## 1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS on behalf of Gleeson to undertake a geophysical survey over a c. 3.6ha area of land at York Gardens, Gosberton, Lincolnshire (TF 23973 31956).
- 1.2. The geophysical survey comprised hand-carried GNSS-positioned fluxgate gradiometer survey. Magnetic survey is the standard primary geophysical method for archaeological applications in the UK due to its ability to detect a range of different features. The technique is particularly suited for detecting fired or magnetically enhanced features, such as ditches, pits, kilns, sunken featured buildings (SFBs) and industrial activity (David *et al.*, 2008).
- 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, 2020) and the European Archaeological Council (Schmidt *et al.*, 2015).
- 1.4. It was conducted in line with a WSI produced by MS (Salmon, 2021).
- 1.5. The survey commenced on 29/10/2021 and took one day to complete.

## 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 for Archaeological Prospection).
- 2.2. The directors of MS are involved in cutting edge research and the development of guidance/policy. Specifically, Dr Chrys Harris has a PhD in archaeological geophysics from the University of Bradford, is a Member of CIfA and is the Vice-Chair of the International Society for Archaeological Prospection (ISAP); Finnegan Pope-Carter has an MSc in archaeological geophysics and is a Fellow of the London Geological Society, as well as a member of GeoSIG (CIfA Geophysics Special Interest Group); Dr Paul Johnson has a PhD in archaeology from the University of Southampton, is a Fellow of the Society of Antiquaries of London, has been a member of the ISAP Management Committee since 2015, and is currently the nominated representative for the EAA Archaeological Prospection Community to the board of the European Archaeological Association.
- 2.3. All MS managers, field and office staff have degree qualifications relevant to archaeology or geophysics and/or field experience.

## 3. Objectives

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

## 4. Geographic Background

- 4.1. The survey area was located c. 255m north of the centre of Gosberton (Figure 1). Gradiometer survey was undertaken across one arable field. The survey area was bordered to the north by a stream and an arable field, to the east by Low Gate road and further agricultural fields, to the south by residential housing and Low Gate road, and to the west by York Gardens road, Welby Drive and residential housing (Figure 2).
- 4.2. Survey considerations:

| Survey Area | Ground Conditions                                  | Further Notes                                                                                                                                                                                                                                                       |
|-------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1           | The area consisted of a flat arable stubble field. | The area was surrounded to the north and east by trees and hedges, and to the south and west by a mixture of residential fencing and trees. Gardening equipment was present in the southeast corner of the area, and borehole markers were present across the area. |

- 4.3. The underlying geology comprises Mudstone of the Oxford Clay Formation. The superficial deposits consist of clay and silt tidal flat deposits (British Geological Survey, 2021).
- 4.4. The soils consist of loamy and clayey soils of coastal flats with naturally high groundwater (Soilscapes, 2021).

## 5. Archaeological Background

- 5.1. The following is a summary of an Archaeological Desk-Based Assessment produced and provided by RPS (Behrendt, 2021).
- 5.2. A Roman coin was identified c. 300m northwest of the survey area, and a pot sherd was recorded c. 50m north. A pit containing Samian pottery, along with an animal bone were identified c. 700m east of the survey area.
- 5.3. The south-western corner of the survey area lies within the early medieval/medieval settlement core of Gosberton. Medieval settlement remains were identified through watching briefs, c. 100m and c. 300m south of the survey area, with post-medieval features and deposits recorded c. 300m and c. 350m south of the survey area. Medieval earthworks were also recorded during a previous survey, c. 600m northwest of the survey area, and are associated with Monk's Hall Manor, a formerly moated site.

## 6. Methodology

### 6.1. Data Collection

- 6.1.1. Magnetometer surveys are generally the most cost effective and suitable geophysical technique for the detection of archaeology in England. Therefore, a magnetometer survey should be the preferred geophysical technique unless its use is precluded by any specific survey objectives or the site environment. For this site, no factors precluded the recommendation of a standard magnetometer survey. Geophysical survey therefore comprised the magnetic method as described in the following section.

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

6.1.3. Table of survey strategies:

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

6.1.4. The magnetic data were collected using MS' bespoke hand-carried GNSS-positioned system.

6.1.4.1. MS' 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.

6.1.4.2. 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.

6.1.4.3. 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 the EAC and Historic England guidelines for 'minimally enhanced data' (see Section 3.8 in Schmidt *et al.*, 2015: 33 and Section IV.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, as well as the total field data from the lower sensors. 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. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images of the gradient and total field 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 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, historical maps, LiDAR data, and soil and geology maps. Google Earth (2021) was also consulted, to compare the results with recent land use.
- 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 from further work, in order to constantly improve our knowledge and service.

### 7.2. Discussion

- 7.2.1. The geophysical results are presented in combination with satellite imagery and historical maps (Figure 7).
- 7.2.2. A fluxgate gradiometer survey was conducted across the survey area, with the resulting magnetic data characterised by strongly enhanced anomalies across much of the survey area, likely to be caused by the superficial tidal flat deposits (Section 4.3). Despite this enhanced background, some anomalies of an agricultural origin have been identified across the survey area. The impact of modern activity on the survey area is generally limited to field edges, where residential housing was recorded (Section 4.2).
- 7.2.3. Across the survey area, anomalies of an agricultural origin have been identified. Strong linear anomalies have been identified in the centre of the area, corresponding with a former field boundary visible on 2<sup>nd</sup> Edition OS mapping (Figure 7). Further linear anomalies have been recorded to the east and west of this. While these do not collocate with any field boundaries visible on available mapping, they either present a similar magnetic signal, or follow a similar alignment to the one that does, and it is likely that these are unmapped former field boundaries or similar. Ploughing trends have been identified across the survey area and appear to correlate with the ploughing regime noted at the time of survey.
- 7.2.4. Within the survey area, multiple 'zones' of superficial deposits have been detected. These zones are separated by an area of much quieter magnetic enhancement, which in turn has produced very sharp, regular edges to these areas of un-consolidated, superficial material. Based on morphology alone, it is possible that some form of boundary or similar anthropogenic activity has divided these areas.

## 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. **Ferrous (Spike)** – Discrete dipolar anomalies are likely to be the result of isolated pieces of modern ferrous debris on or near the ground surface.
- 7.3.1.3. **Ferrous/Debris (Spread)** – A ferrous/debris spread refers to a concentration of multiple discrete, dipolar anomalies usually resulting from highly magnetic material such as rubble containing ceramic building materials and ferrous rubbish.
- 7.3.1.4. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures, typically including fencing, pylons, vehicles and service pipes, have been classified as 'Magnetic Disturbance'. These magnetic 'haloes' will obscure weaker anomalies relating to nearby features, should they be present, often over a greater footprint than the structure causing them.
- 7.3.1.5. **Undetermined** – Anomalies are classified as Undetermined when the origin of the geophysical anomaly is ambiguous and there is no supporting contextual evidence to justify 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 distinct from those caused by ferrous sources.

### 7.3.2. Magnetic Results - Specific Anomalies

- 7.3.2.1. **Natural (Zone & Strong)** – Across the survey area, strongly enhanced amorphous anomalies have been identified (Figures 3 – 5). These anomalies are likely to be caused by the tidal flat deposits that are present in the superficial layer within the site (Section 4.3), and their strong magnetic signal may have masked any further weaker anomalies, if they were present. In the west of the area, there appears to be a very distinct gap in the natural background, with defined edges. This gap does not correlate with any features marked on available historical mapping or satellite imagery (Figure 7), but the defined edges suggest possible anthropogenic activity.
- 7.3.2.2. **Agricultural (Strong & Weak)** – In the centre of the survey area, strong linear anomalies orientated north to south have been identified (Figure 5). These correspond with a former field boundary noted on 2<sup>nd</sup> Edition OS mapping (Figure 7). Further linear anomalies have been identified c. 50m to the east, and c. 30 and c. 75m to the west of the mapped field boundary respectively. While these anomalies do not collocate with former boundaries, they appear similar in either strength or orientation to the one that does and are likely to be unmapped former field boundaries.

- 7.3.2.3. **Agricultural (Trend)** – Across the survey area, regularly spaced, weak linear anomalies have been identified (Figures 4 & 5). These anomalies correspond with ploughing trends recorded at the time of survey.

## 8. Conclusions

- 8.1. A fluxgate gradiometer survey has been undertaken across the survey area. The geophysical survey is characterised by the strong mottled background, caused by the tidal flat deposits that underlie the survey area. The strong magnetic background has made it difficult to identify weaker, more subtle anomalies, if they were present, however several anomalies of an agricultural origin were able to be identified. The natural background in the west appears split, with very distinct edges, suggesting possible anthropogenic activity. Modern interference is limited to the edges of the survey area, surrounding residential housing and fencing.
- 8.2. Anomalies of agricultural origin have been identified across the survey area. One former field boundary that was depicted on 2<sup>nd</sup> Edition OS mapping was detected in the centre of the area, with other possible unmapped former field boundaries identified to the east and west. Evidence of modern ploughing was also identified across the survey area.

## 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 any dictated time embargoes.

## 10. Copyright

- 10.1. Copyright and 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

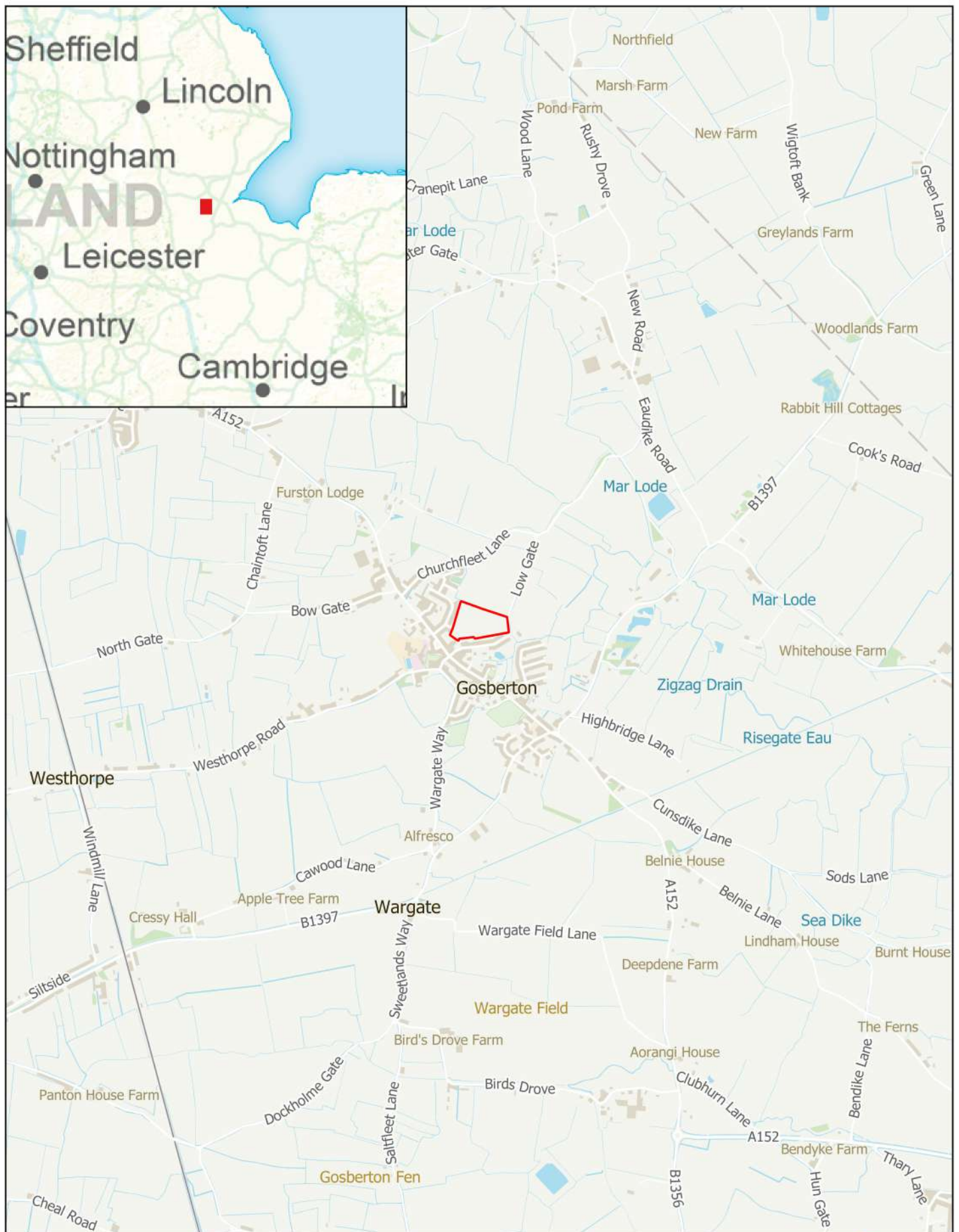
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## 12. Project Metadata

|                   |                                |
|-------------------|--------------------------------|
| MS Job Code       | MSTF1042                       |
| Project Name      | York Gardens, Gosberton        |
| Client            | RPS                            |
| Grid Reference    | TF 23973 31956                 |
| Survey Techniques | Magnetometry                   |
| Survey Size (ha)  | 3.61ha (Magnetometry)          |
| Survey Dates      | 2021-10-29                     |
| Project Lead      | Frederick Salmon BSc FGS ACIfA |
| Project Officer   | Frederick Salmon BSc FGS ACIfA |
| HER Event No      | TBC                            |
| OASIS No          | TBC                            |
| S42 Licence No    | N/A                            |
| Report Version    | 1.0                            |

## 13. Document History

| Version | Comments                                        | Author | Checked By | Date             |
|---------|-------------------------------------------------|--------|------------|------------------|
| 0.1     | Initial draft for Project Lead to Review        | AL     | FS         | 03 November 2021 |
| 0.2     | Draft for Director Review                       | AL     | PSJ        | 03 November 2021 |
| 0.3     | Corrections from Director                       | AL     | FS         | 04 November 2021 |
| 1.0     | Corrections from client, report issued as Final | AL     | PSJ        | 24 November 2021 |



MSTF1042 - York Gardens, Gosberton

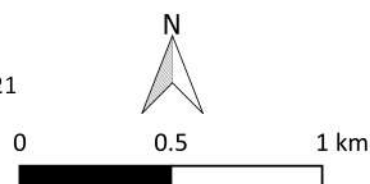
Figure 1 - Site Location

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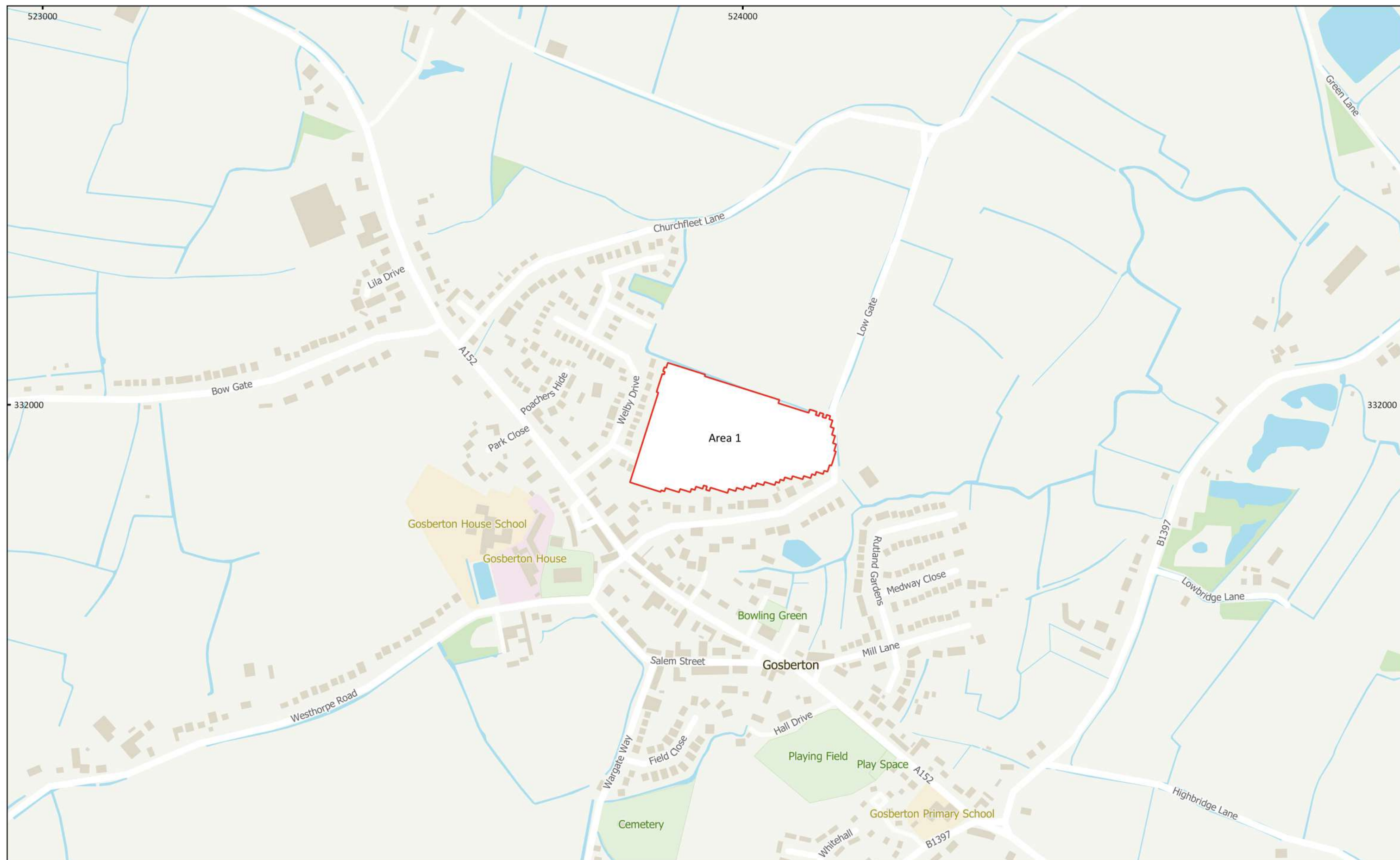
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 Site Boundary

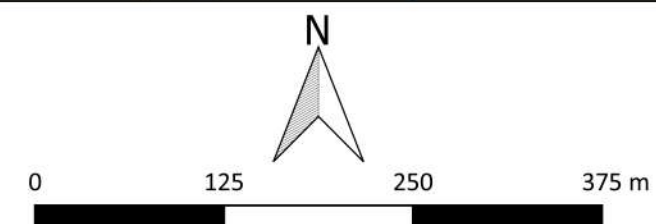


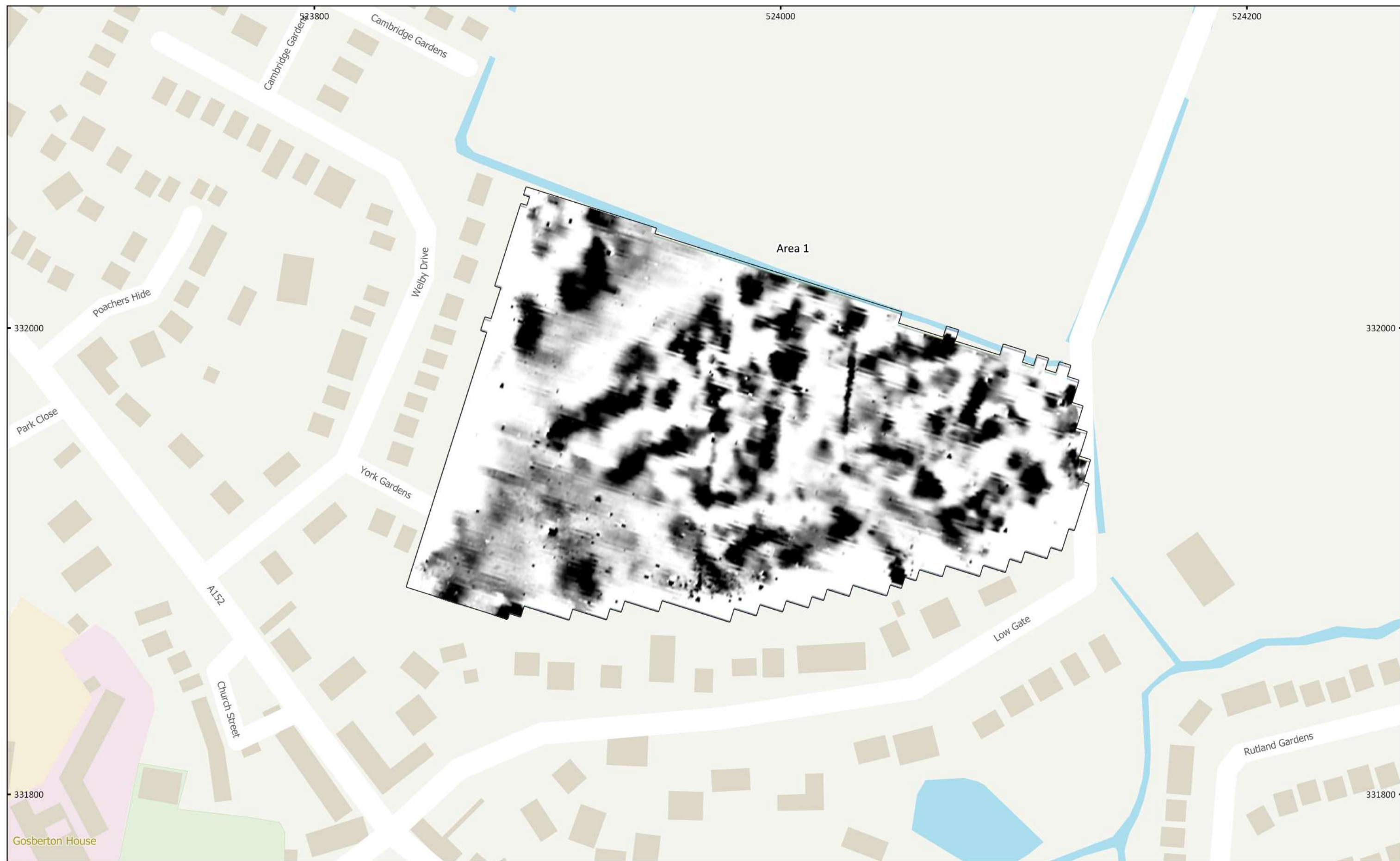
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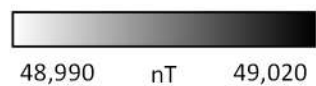
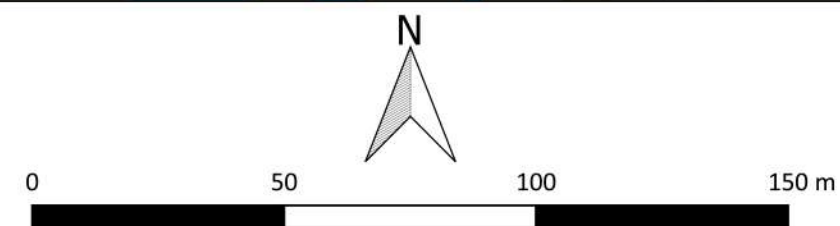
MSTF1042 - York Gardens, Gosberton  
 Figure 2 - Location of Survey Area  
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 Survey Extent

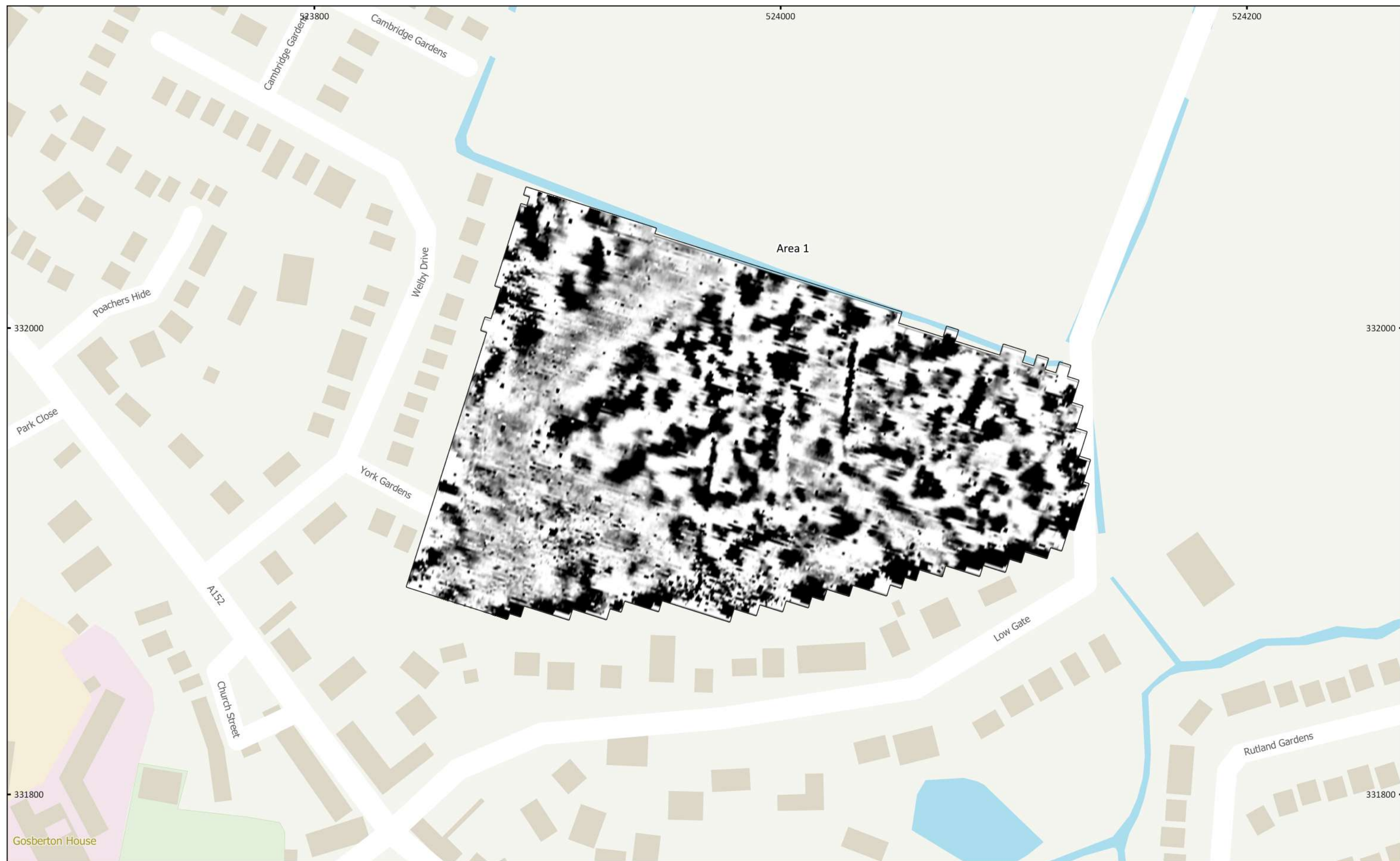




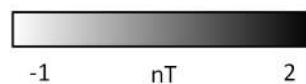
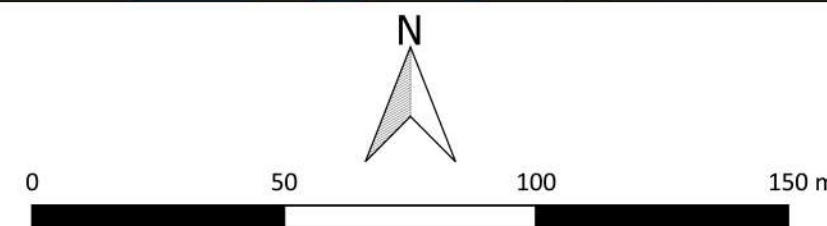
MSTF1042 - York Gardens, Gosberton  
Figure 3 - Magnetic Total Field (Lower Sensor)  
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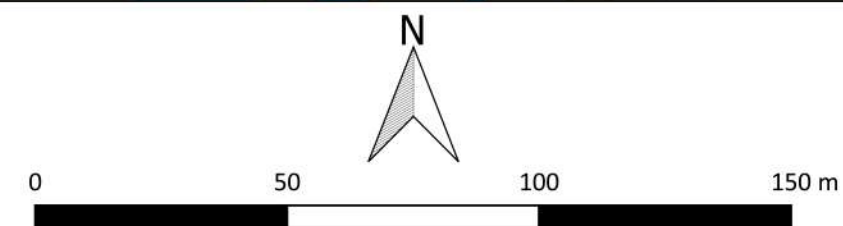
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Figure 4 - Magnetic Gradient  
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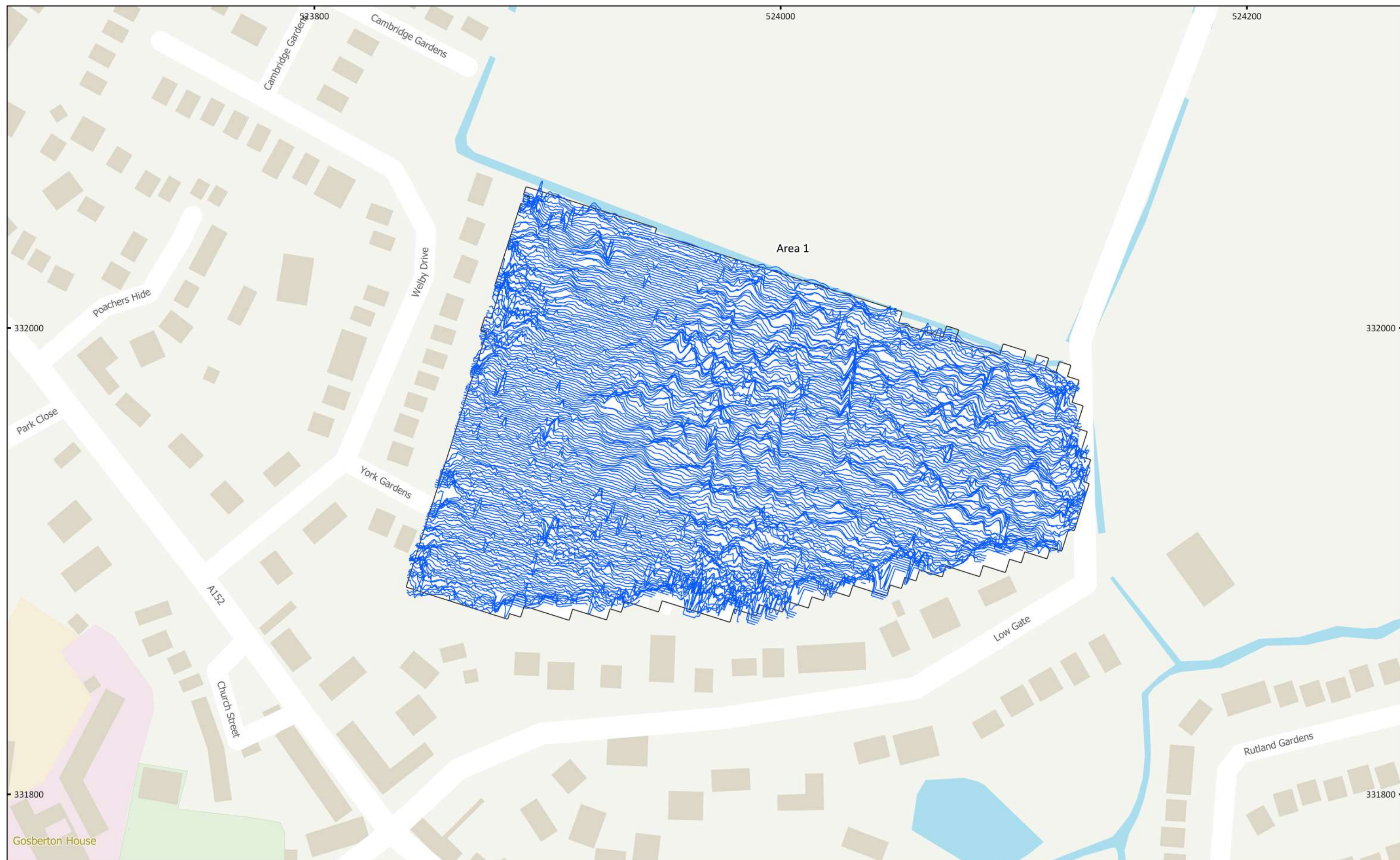




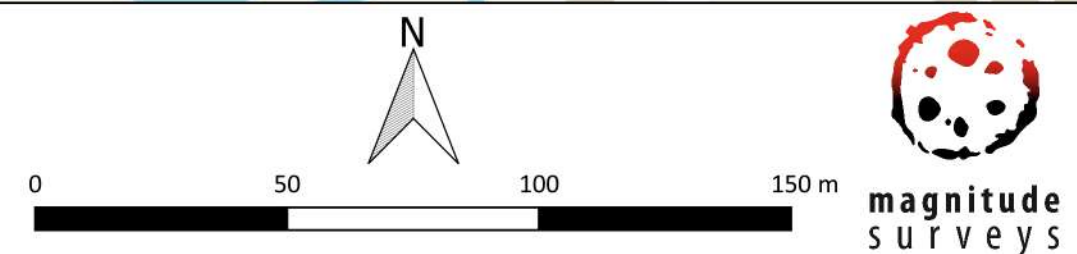
MSTF1042 - York Gardens, Gosberton  
 Figure 5 - Magnetic Interpretation  
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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <span style="display: inline-block; width: 10px; height: 10px; background-color: brown; border: 1px solid black;"></span> Agricultural (Strong)                                                                    | <span style="display: inline-block; width: 10px; height: 10px; background-color: lightgrey; border: 1px solid black;"></span> Magnetic Disturbance                                                                                                                                                            |
| <span style="display: inline-block; width: 10px; height: 10px; background-color: #a0522d; border: 1px solid black;"></span> Agricultural (Weak)                                                                    | <span style="display: inline-block; width: 10px; height: 10px; background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px); border: 1px solid black;"></span> Ferrous/Debris (Spread)                                                                                    |
| <span style="display: inline-block; width: 10px; height: 10px; background-color: #808000; border: 1px solid black;"></span> Natural (Strong)                                                                       | <span style="display: inline-block; width: 10px; height: 10px; border-bottom: 1px solid black;"></span> Agricultural (Trend)                                                                                                                                                                                  |
| <span style="display: inline-block; width: 10px; height: 10px; background-color: #90ee90; border: 1px solid black;"></span> Natural (Weak)                                                                         | <span style="display: inline-block; width: 10px; height: 10px; background-color: white; border: 1px solid black; position: relative;"><div style="position: absolute; top: 50%; left: 50%; transform: translate(-50%, -50%); width: 2px; height: 2px; background-color: black;"></div></span> Ferrous (Spike) |
| <span style="display: inline-block; width: 10px; height: 10px; background: repeating-linear-gradient(-45deg, transparent, transparent 2px, black 2px, black 4px); border: 1px solid black;"></span> Natural (Zone) |                                                                                                                                                                                                                                                                                                               |





MSTF1042 - York Gardens, Gosberton  
Figure 6 - XY Trace Plot  
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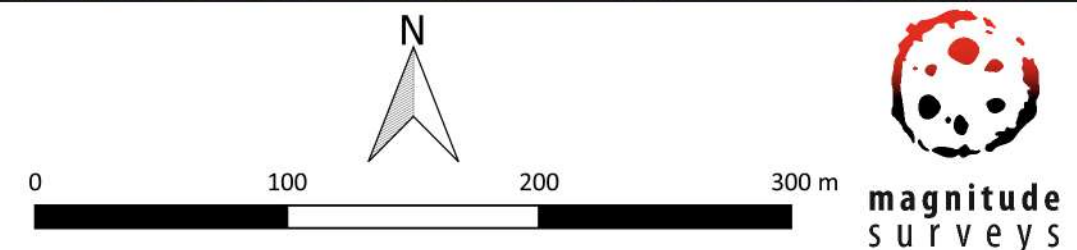


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MSTF1042 - York Gardens, Gosberton  
Figure 7 - Magnetic Interpretation Over Historical Maps and Satellite Imagery  
1:3,000 @ A3  
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Contains historical mapping © CLS Data 2021: Ordnance Survey, 6" 2nd  
edition c. 1882-1913  
Contains satellite imagery © Bing Satellite 2021

- |                       |                         |
|-----------------------|-------------------------|
| Agricultural (Strong) | Magnetic Disturbance    |
| Agricultural (Weak)   | Ferrous/Debris (Spread) |
| Natural (Strong)      | Agricultural (Trend)    |
| Natural (Weak)        | Ferrous (Spike)         |
| Natural (Zone)        |                         |



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