

**magnitude
surveys**

**Bromborough Courthouse,
Merseyside**

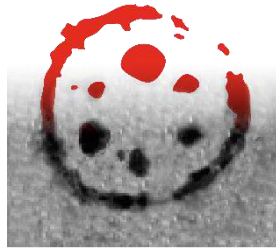
Geophysical Survey Report MSSJ22

**For
Big Heritage**

**On Behalf Of
The Land Trust**

Magnitude Surveys Ref: MSSJ22

May 2016



**magnitude
surveys**

Unit 17, Commerce Court

Challenge Way

Bradford

BD4 8NW

+44 (0)1274 926020

info@magnitudesurveys.co.uk

Report Written by:

Graeme Attwood MSc MCIfA

Figures Produced by:

Finnegan Pope-Carter BSc MSc FGS

Report Checked by:

Chrys Harris BA MSc

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Abstract

Magnitude Surveys was commissioned to assess the archaeological landscape of a c. 1 ha area of land at Bromborough Court House, Bromborough, Merseyside. A full coverage combined cart-based fluxgate gradiometer and earth resistance survey was successfully completed. A number of anomalies with an undetermined, but potential archaeological origin have been identified. While these anomalies exhibit the potential to be archaeological in origin, due to the limited extent and context of the survey area, a specific archaeological origin for these anomalies cannot be confidently attributed. However, it is likely excavation work will confirm specific archaeological origins for some of these anomalies.

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1. Introduction

- 1.1. Magnitude Surveys Ltd (MS) was commissioned by Big Heritage (BH) on behalf of the Land Trust (LT) to undertake a geophysical survey on land off Old Court House Road, Bromborough, Merseyside (SJ 344 842). The geophysical survey comprised:
 - 1.1.1. Hand pulled, cart-mounted fluxgate gradiometer survey.
 - 1.1.2. Hand pulled, cart-mounted earth resistance survey.
- 1.2. The survey was conducted in line with the current best practice guidelines produced by Historic England (David et al., 2008), the Chartered Institute of Field Archaeologists (CIfA, 2014) and the European Archaeological Council (Schmidt et al., 2015).
- 1.3. The survey was undertaken on 11 May 2016.

2. Quality Assurance

- 2.1. Project management, survey work, data processing and report production have been carried out by qualified and professional geophysicists to standards exceeding the current best practice (CIfA, 2014; David et al., 2008, Schmidt et al., 2015).
- 2.2. Magnitude Surveys is a corporate member of ISAP (International Society of Archaeological Prospection).
- 2.3. Director Graeme Attwood is a Member of the Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, as well as a member of GeoSIG, the CIfA Geophysics Special Interest Group.
- 2.4. 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.
- 2.5. All MS staff members have post-graduate qualifications in archaeological geophysics.

3. Objectives

- 3.1. The geophysical survey aimed to assess the archaeological landscape of the survey area.
- 3.2. The survey forms part of an archaeological investigation by Big Heritage into the history of the Bromborough Court House site. The survey builds upon a previous earth resistance survey undertaken by Big Heritage and will inform the locations for a series of test pit excavations.

4. Geographic Background

- 4.1. The underlying geology comprises Wilmslow Sandstone; overlain by Till (BGS, 2016). Historic England guidelines state a variable magnetic response to sandstone formations (David et al., 2008).
- 4.2. The soils consist of slowly permeable, seasonally wet and slightly acid but base-rich loamy and clayey soils (Soilscapes, 2016).

5. Archaeological Background

- 5.1. A thorough assessment of the archaeological and historical background of the site has been undertaken by Big Heritage (BH 2014, 2015). The following forms a brief summary of these reports in which to frame the context for the geophysical results.
- 5.2. The site has been occupied since the seventeenth century when the first records indicate the construction of a building on the site. This stood until 1969 when it was demolished.
- 5.3. There is evidence for earlier buildings and court houses. It is recorded that Edward I stayed at Bromborough in 1277, while only some 7 years later there is a further reference to the buildings destruction by fire. This building was reputedly replaced by another on the same site; however there are no known records of either buildings' locations.

6. Methodology

6.1. Data Collection

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

6.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Geoscan Research FM256 mounted on Geoscan MSP25	0.5 m	0.25 m
Earth Resistance	Geoscan Research RM85 with MSP25 square array (alpha, beta and gamma)	0.5 m	0.25 m

6.1.3. Magnetic and earth resistance data were collected using a Geoscan Research MSP25 hand pulled cart.

6.1.3.1. The Geoscan Research MSP25 base is formed by an $a = 0.75$ m square electrode array. Current is injected and potential difference is measured continuously through the wheels. Measurements are logged in the Geoscan Research RM85 at regular distance intervals, triggered by the optical encoder wheel. The odometer wheel is calibrated for the traverse length at the beginning of survey. Square alpha, beta and gamma configurations were collected simultaneously with a sampling interval of 0.25 m along lines spaced 0.5 m apart.

6.1.3.2. The cart base also supports a Geoscan Research FM256 fluxgate gradiometer operating in trigger mode. Measurements are logged in the Geoscan Research FM256 at regular distance intervals, triggered by the optical encoder wheel. Data were collected at a sampling frequency of 0.25m along lines spaced 0.5m apart.

6.1.4. A series of temporary sight markers were established in each survey area to guide the surveyor and ensure full coverage with the cart. Grid nodes were set out using a Hemisphere S321 RTK GPS to sub 5 cm accuracy.

6.2. Data Processing

6.2.1. Data were processed using bespoke software developed by MS and a commercial software package, Geoplot 4.0 (Beta Version).

6.2.2. Magnetic processing steps were limited to:

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. Care is taken to ensure this filter does not remove linear trends running parallel to the survey direction.

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.

6.2.3. Earth resistance processing steps were limited to:

Despike—Erroneous measurements (“spikes”) due to high contact resistance or poor electrode-to-ground contact are corrected by analysing the mean of measurements in a specified window size and replacing measurements outside a defined threshold with the average measurement of neighbouring positions.

High Pass Filter—Low frequency background responses are removed to emphasise near-surface archaeological responses by subtracting the weighted average from the central reading in a specified window.

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

6.3.1. Magnetic greyscales should be viewed alongside the accompanying XY trace plots, which are available on the archive disk. XY trace plots visualise the magnitude and form of the geophysical response, aiding in anomaly interpretation.

6.3.2. The combined earth resistance greyscale is an average of the alpha and beta configurations (Figure 3), reducing the directional biases of the individual configurations. The gamma configuration is presented separately (Figure 35), due to its uniqueness from the alpha and beta configurations.

7. Survey Considerations

Survey Area	No. Survey Blocks	Surveyed Y/N	Ground Conditions	Further notes:
1	1	Y	The ground had recently been cleared. Fern stumps and similar undergrowth was still present in places although did not overly effect data collection or quality.	A fire had recently been set in the middle of the survey area. The burning has increased the magnetic values in this area, creating an area of magnetic noise.

Refer to Figure 2 for survey area locations.

8. Results

8.1. Qualification

8.1.1. *Geophysical techniques 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.*

8.2. Discussion

8.2.1. The geophysical results, both greyscale images and XY traces, were interpreted in consideration with historic mapping (Ordnance Survey, 6" 2nd edition c.1882-1913; Figure 5) and satellite imagery (Google Earth, 2016; Figure 6).

8.2.2. The earth resistance survey has responded well to the geological and pedological conditions of site, despite challenging soil moisture differences between northern and southern areas. This moisture differential is best visible in the unfiltered data (Figure 3). Anomalies have been detected across the survey area that potentially reflect the degraded sandstone structures that were identified during trenching; however, due to the limited extent of the survey area, the background and context of these anomalies is poorly understood. As a result, they cannot confidently be categorised as archaeological in origin. Compared to previous geophysical surveys on site, these results further demonstrate the effectiveness of earth resistance survey at this site. The higher sampling density of these results has led to a better definition of individual anomalies.

8.2.3. Compared to the earth resistance survey, the magnetic results are less informative. The effectiveness of magnetic survey has been limited in part due to a fire being set on the

land prior to the survey. The fire has left a scatter of burnt material and ashes across a large portion of the northern half of the site.

8.3. Interpretation

8.3.1. General Statements

8.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually. Specific anomalies discussed within the text have been assigned numbers, which are emboldened within square parenthesis e.g. [1].

8.3.1.2. **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 often the result of geological, pedological or agricultural processes. In the case of this survey an archaeological origin for some of these anomalies is entirely plausible, indeed likely, however due to the small nature and awkward shape of the survey area it is not possible to identify which may be the most likely. Undetermined anomalies are generally not ferrous in nature.

8.3.1.3. **Ferrous** – A number of discrete ferrous-like anomalies have been mapped throughout the survey area. These responses are likely to be the result of modern metallic disturbance on or near the ground surface and recent burning. These ferrous responses may mask any weaker underlying archaeological anomalies should they be present.

8.3.2. Earth Resistance Results - Specific Anomalies

8.3.2.1. **Undetermined** – Anomaly [1] a low resistance feature is likely to have been caused by a backfilled test-pit dug by BH in the 2015 season of excavations. This anomaly is surrounded by a group of high resistance anomalies [2a, 2b & 2c] and linear anomalies [3]. The linear edge anomalies are best viewed in the gamma data (Figure 3). While it is tempting to interpret these more definitively as archaeology (especially 2b a possible continuation of feature 305, 306 (BH 2015)) given the findings in Trench 3, the limited context and background readings do not allow for this.

8.3.2.2. **Undetermined** – Towards the centre of the survey area are a group of high resistance and linear anomalies [3]. These anomalies have both parallel and perpendicular orientation to one another, which may be indicative of wall lines. However, the limited extent and context of the survey area prevents a more specific classification without further supportive evidence.

8.3.2.3. **Undetermined** – Parallel, linear low resistance anomalies [4] are present at the northern end of the survey area. These may be indicative of a track or roadway. Surrounding these are several edge anomalies, visible in the gamma data. However, the limited extent and context of the survey area prevents a more specific classification without further supportive evidence.

9. Conclusions

- 9.1. The combined magnetic and earth resistance survey has been successfully completed across the available land at Bromborough Court House. Anomalies first identified in the BH survey of 2014 have been mapped and further defined. MS' survey results have expanded on the previous geophysical work, contributing a number of new high and low resistance anomalies. Due to the limited extent and context of the survey area, a confident classification of anomaly origin is difficult without further supportive evidence. However, some of these anomalies are likely to be archaeological in origin, specifically [2b], [4] and potentially [3]. In particular, [2b] may be related to a degraded sandstone structure identified through test pitting, while a potential trackway [4] may have been identified.

10. Archiving

- 10.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013).
- 10.2. MS contributes all reports to the ADS Grey Literature Library subject to any time embargo dictated by the client.
- 10.3. Whenever possible, MS has a policy of making data available to view in easy to use forms on its website. This can benefit the client by making all of their reports available in a single repository, while also being a useful resource for research. Should a client wish to impose a time embargo on the availability of data this can be achieved in discussion with MS.

11. Copyright

- 11.1. 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.

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Figure 1 - Site Location

1 : 25,000 @ A4


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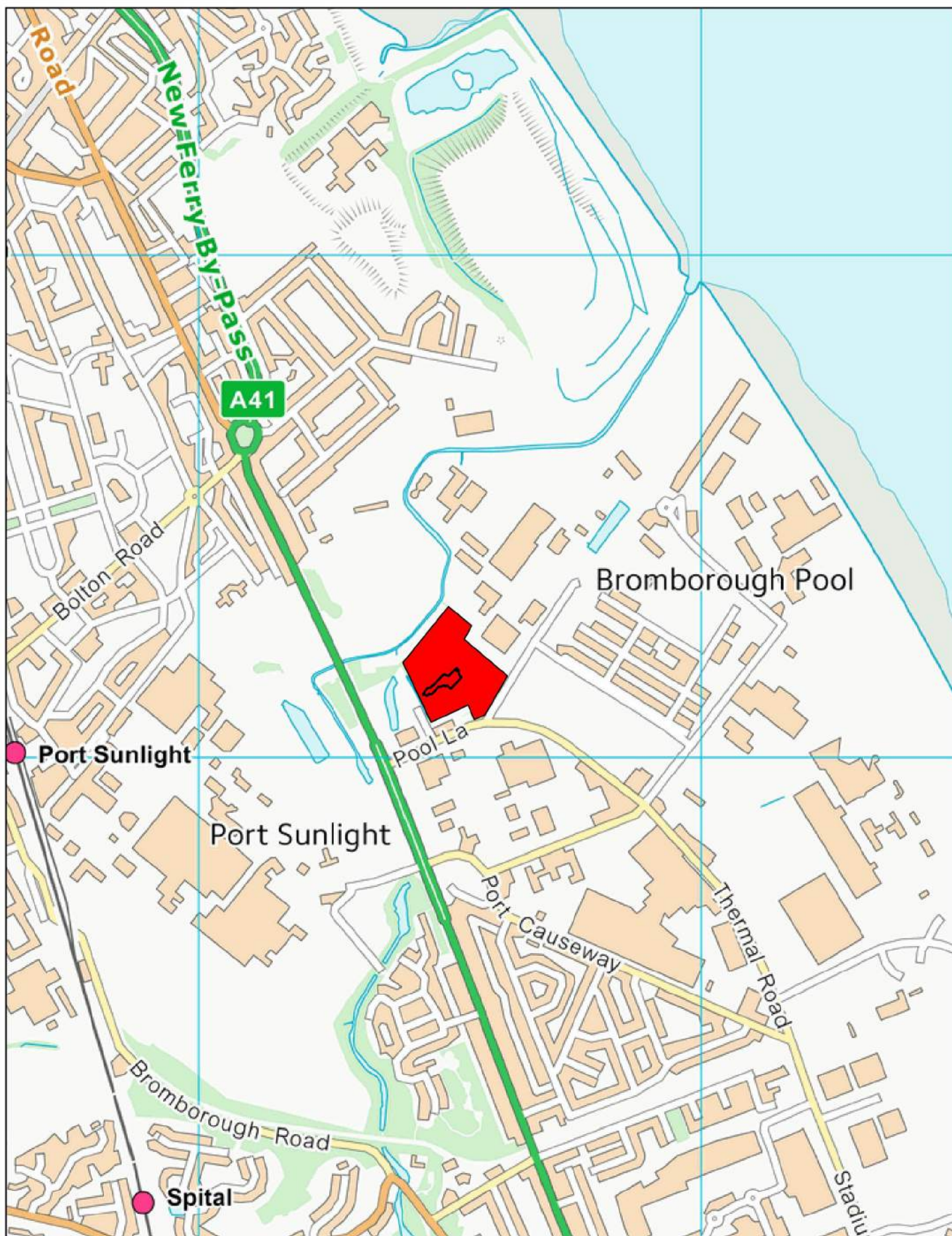
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 Study Area



0 0.5 1 km



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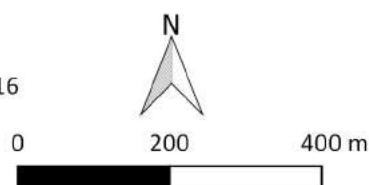
Figure 2 - Location of Survey Area

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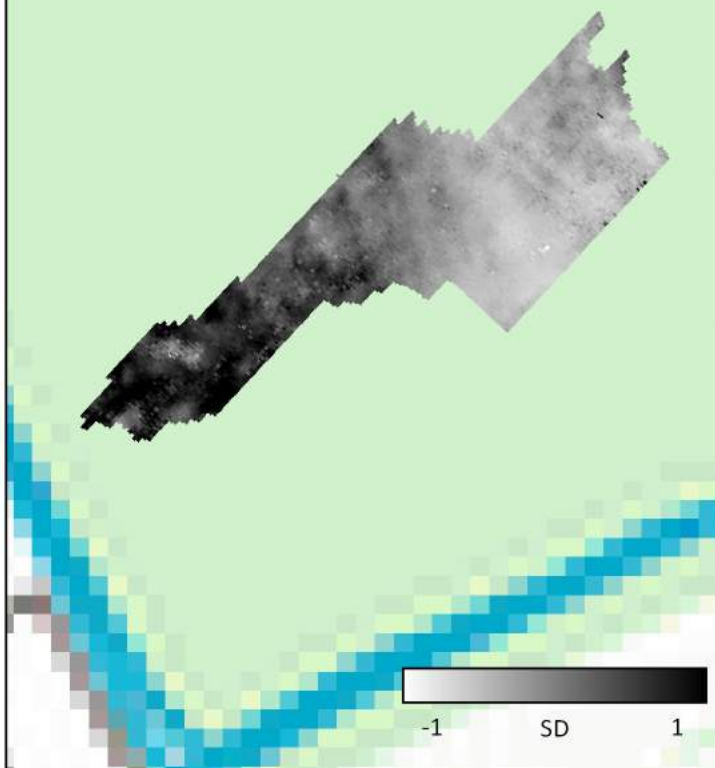
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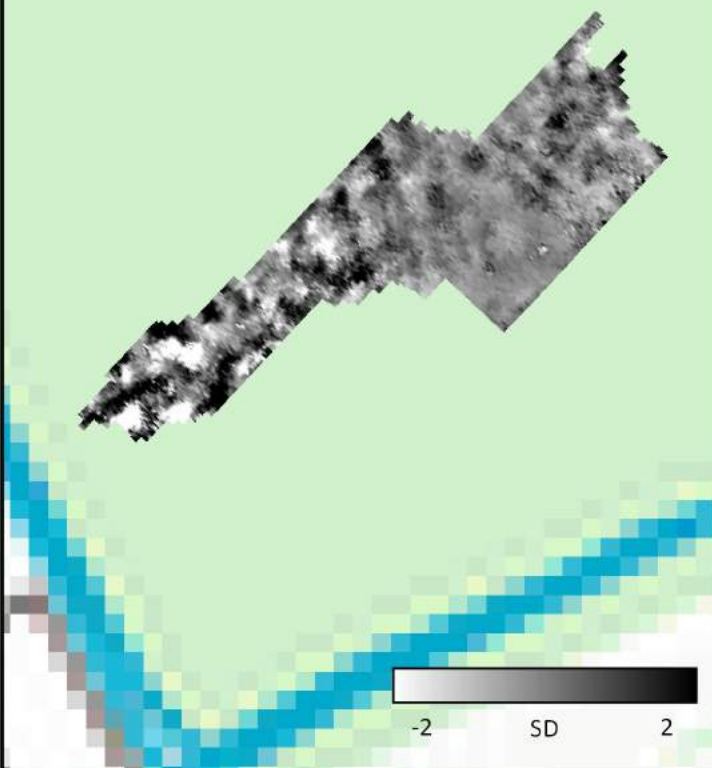
- Study Area
- Survey Border



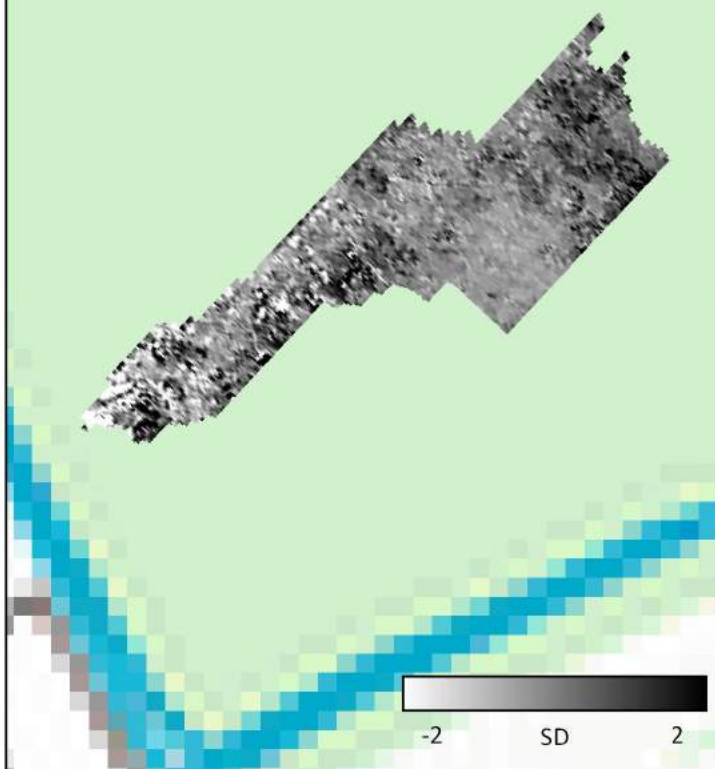
Unfiltered Earth Resistance Plot
Alpha + Beta



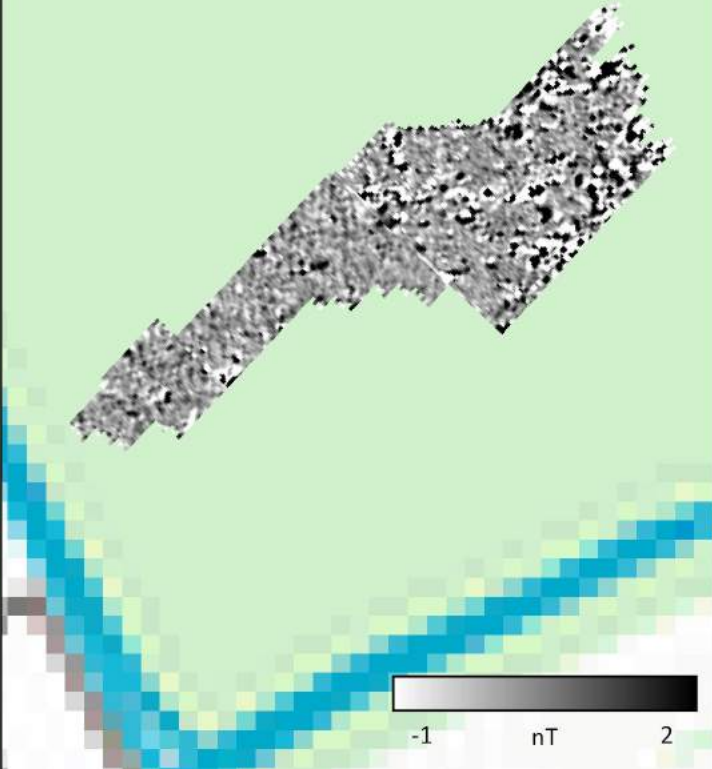
High Pass Filtered Earth Resistance Plot
Alpha + Beta



Unfiltered Earth Resistance Plot
Gamma



Magnetic Plot



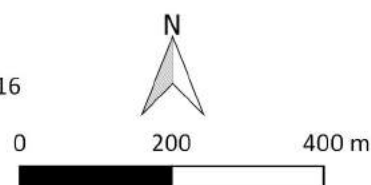
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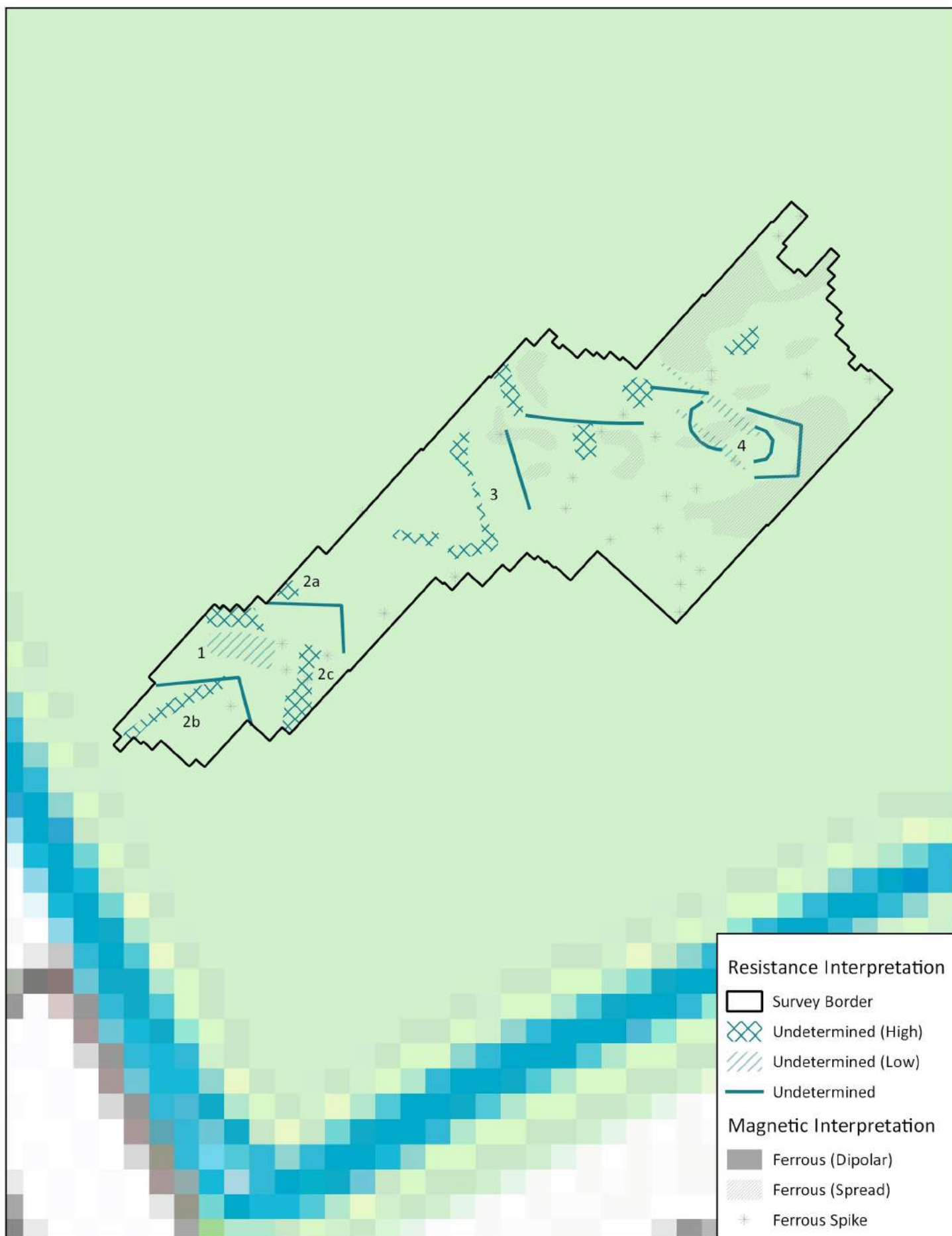
Figure 3 - Greyscale Plots

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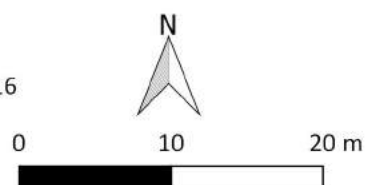
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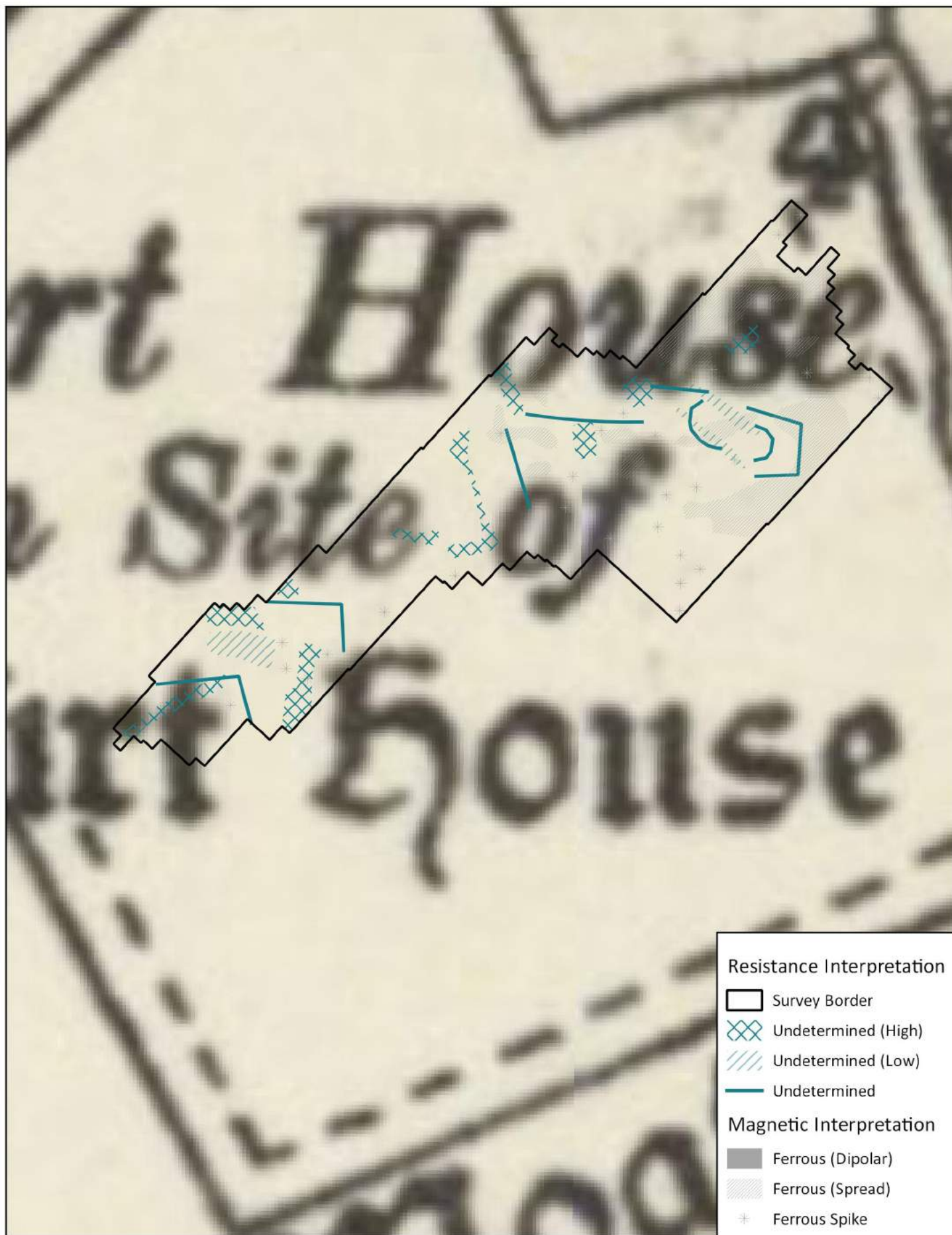
Figure 4 - Combined Interpretation

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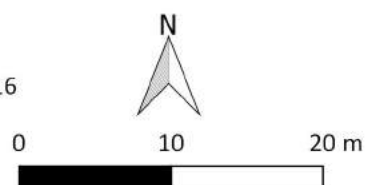
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Figure 5 - Combined Interpretation - Historic Mapping

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Figure 6 - Combined Interpretation - Satellite Imagery

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