Geophysical Survey of Blacon Hall

Geophysical Survey Report

For

Big Heritage C.I.C

On Behalf Of

Cheshire West & Chester Council's Public Health Team

Magnitude Surveys Ref: MSSJ07

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Abstract

Magnitude Surveys was commissioned to carry out a geophysical survey on a communal green adjacent to the site of the former Blacon Hall. The survey aimed to detect any archaeological remains, which would be the target for further excavation work as part of the Dig Blacon project. All of the geophysical techniques show some part or aspect of the former field boundaries, which are known through historic mapping and aerial imagery. There are some undetermined anomalies that exhibit similar geophysical properties to the former field boundaries, but have no correlation with any known features.

Contents

List of Figures:

1. Introduction:

1.1. Magnitude Surveys Ltd (MS) was commissioned by Big Heritage C.I.C on behalf of Cheshire West & Chester Council's Public Health Team to conduct an archaeological geophysical survey on a communal green adjacent to the location of the former Blacon Hall, Blacon, Chester (SJ387684).

1.2. The archaeological geophysical survey comprised:

1.2.1. Hand pulled, cart mounted, magnetic gradiometer survey

1.2.2. Hand pulled, cart based, earth resistance survey

1.2.3. Hand pulled, cart mounted, electromagnetic conductivity survey

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England and the Charted Institute of Field Archaeologists (CifA 2014, David et al. 2008).

1.4. This survey was undertaken on the 25 August 2015.

2. Quality Assurance:

2.1. Project management, survey, data processing and report production has been carried out by qualified and professional geophysicists to standards exceeding the current best practice (CifA 2014, David et al. 2008).

2.2. Magnitude Surveys is a corporate member of ISAP (International Society of Archaeological Prospection).

2.3. Finnegan Pope-Carter is a Fellow of the London Geological Society, the Chartered UK body for geophysicists and geologists.

3. Objectives:

3.1. The geophysical work was carried out in conjunction with an open day for community participants to become educated and engaged in the geophysical component of the Dig Blacon project.

3.2. The geophysical survey aimed to locate any archaeological remains for further excavation work undertaken by the Dig Blacon project.

4. Geographic Background:

4.1. The investigation site comprises approximately 1Ha of a school grounds adjacent to the location of the former Blacon Hall.

4.2. The underlying Geology comprises Kinnerton Sandstone Formation (BGS 2015).

4.3. The soils are classified as slightly acid loamy and clayey soils with impeded drainage (Soilscapes 2015).

5. Archaeological Background:

5.1. From Big Heritage: "The areas [for geophysical survey] surround what once was Blacon Hall: an 18th century Manor House. Map regression indicates that no buildings or significant landscape has occurred on these fields since 1847. Field boundaries are likely to be evident and would make a useful target for test pitting."

6. Methodology:

6.1. Data Collection:

6.1.1. Geophysical prospection comprised magnetic, earth resistance and electromagnetic methods as described in the following table.

6.1.2. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic (Cart)	Geoscan Research FM256 on MSP25	1m	0.25m
Earth Resistance (Cart)	Geoscan Research RM85 on MSP25	1m	0.25m
Electromagnetic Coductivity	GF Instruments CMD Mini Explorer	2m	0.25m (5Hz)

6.1.3. Magnetometer and earth resistance data were collected simultaneously on a Geoscan Research MSP25 hand pulled cart.

6.1.3.1. The cart base is formed by an earth resistance square array. Current is injected through the wheels, with data collected continuously. 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 0.25m along lines spaced 1.0m apart.

6.1.3.2. The cart base also supports a Geoscan Research FM256 fluxgate gradiometer operating in time 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 1.0m apart.

6.1.4. Electromagnetic conductivity data were collected using a bespoke hand-pulled cart system.

6.1.4.1. The cart is comprised of a GF instruments CMD Mini Explorer operating in real-time output mode and a RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The data were logged on a USB flash drive housed in a custom data-logger and transferred to a laptop computer for processing. Data were collected at a sampling frequency of 5Hz along lines spaced 2.0m apart.

6.1.5. A series of temporary sight markers were established in each survey area to guide the surveyor and ensure full coverage with the cart. Data were collected by traversing the survey area along the longest possible lines, to ensure the data were efficiently collected and processed.

6.2. Data Processing:

6.2.1. Data were processed in bespoke in-house software produced by MS and Geoscan Research Geoplot 4.0.

6.2.2. Magnetometer 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 affects 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. Electromagnetic processing steps were limited to:

Rolling Zero Median – The median of a rolling window is calculated within a specified range and subtracted from the collected data. This removes striping affects caused by drift in sensor electronics. Care is taken to ensure this filter does not remove linear trends running parallel to the survey direction.

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

High Pass Filter – A high pass filter is used to remove large scale background trends related to changes in geology or soil moisture content. These trends can mask small scale features which may be of archaeological significance. The resultant data is compared to pre-filtered data to ensure no features have been lost.

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. Unprocessed and processed data are presented as greyscales within a layered environment. Multiple greyscales with different plotting ranges may be suitable to highlight features spanning different response strengths.

7. Results:

7.1. Qualification:

7.1.1. 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 always 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; while there will be degrees of certainty for others. 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 were interpreted in consideration with historic mapping *c.* 1900 (Flintshire XI.SW from National Library Scotland), aerial photography *c.* 1945 (GeoInformation Group from Google Earth) and satellite imagery *c.* 2010 (Bluesky from Google Earth).

7.2.2. The historic mapping and 1945 aerial image outline Blacon Hall, its grounds and field boundaries. These field boundaries are still visible in the 2010 satellite imagery.

7.2.3. Of the geophysical results, the geophysical anomalies which correlate with the historic mapping, aerial and satellite imagery are interpreted as Former Field Boundary. All of the prospection techniques detect some segment or aspect of these former field boundaries, but due to the different nature of techniques, resolve the features differently.

7.2.4. Discrete anomalies which exhibit contrast from the background but do not correlate with the field boundaries in the historic mapping, 1945 aerial and 2010 satellite imagery are interpreted as Unknown. While these anomalies are discrete, their origin is inconclusive.

7.3. Magnetometer Interpretation:

7.3.1. The magnetometer data shows a relatively homogeneous background.

7.3.2. The anomaly characterised as the Former Field Boundary exhibits high magnetic contrast from the background. This anomaly correlates with a field boundary mapped in the historic mapping and visible in the 1945 aerial imagery. It is faintly visible in the 2010 satellite imagery as darker vegetation growth.

7.3.3. The anomalies characterised as Undetermined exhibit high magnetic contrast from the background. However, the Undetermined anomalies do not correlate with any feature evident on the historic mapping, aerial or satellite imagery.

7.3.4. The anomalies characterised as Ferrous Spike are associated with ferrous materials; their origins are unknown.

7.4. Earth Resistance Interpretation:

7.4.1. The earth resistance data is noisier than the other techniques, showing a highly variable background.

7.4.2. The anomaly identified as the Former Field Boundary exhibits a higher resistance and positive contrast from the background. The Former Field Boundary earth resistance anomaly is broadly similar to the magnetometer and electromagnetic conductivity anomalies. This anomaly correlates with a boundary mapped in the historic mapping and visible in the 1945 aerial imagery. It is faintly visible in the 2010 satellite imagery as darker vegetation growth.

7.4.3. The anomalies characterised as Undetermined exhibit similar properties as the anomalies identified as the Former Field Boundary (i.e. discrete and high resistance). However, they do not correlate with any feature evident on the historic mapping, aerial and satellite imagery.

7.4.4. The survey area was impacted near the hedgerow and its effect is demarcated by the Effect of Hedgerow classification.

7.5. Electromagnetic Conductivity Interpretation:

7.5.1. The electromagnetic conductivity data shows variability in the conductivity of the subsurface. Areas with a distinct, but diffuse, change in conductivity from the background are classified as Undetermined Zone, as the origin of these changes is unknown.

7.5.2. The Former Field Boundary anomalies within the electromagnetic data are broadly similar to the features identified within the earth resistance and magnetic data. The coarser data collection used for the electromagnetic data means the Former Field Boundary anomalies are not as finely resolved, compared to the earth resistance and magnetic data.

7.5.3. Discrete anomalies that are distinct from the background conductivity, but are not correlated with are classified as Undetermined. The high conductivity Undetermined anomalies are roughly in a similar location to the mapped field boundaries, but their exact location and orientation are not well correlated with these features.

8. Conclusions:

8.1. There is good correlation between the three techniques used at Blacon for resolving the Former Field Boundary. Each survey has delineated some segment or aspect of the Former Field Boundary, which means it exhibits both distinct magnetic and electrical contrast from the surrounding soil.

8.2. There are many Undetermined anomalies, which exhibit similar properties to the Former Field Boundary, but do not correlate with the historic mapping, 1945 aerial and 2010 satellite imagery.

9. Archiving:

9.1. Magnitude Surveys Ltd maintains an in-house digital archive which aims to conform to (Schmidt, A. 2013).

9.2. Magnitude Surveys Ltd contributes all reports to the ADS Grey Literature Library subject to any timed embargoes dictated by the client.

9.3. Whenever possible Magnitude Surveys 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.

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.

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0 25 50km

1:1,250,000 @ A3

0 1 2km

1:50,000 @ A3

Numbered unitary areas:
6 LIVERPOOL
7 BOLTON
8 SALFORD
9 TRAFFORD
10 ROCHDALE
11 MANCHESTER
12 TAMESIDE
13 OLDHAM
14 WARRINGTON
15 CITY OF WOLVERHAMPTON
16 WALSALL
17 SANDWELL
18 DUDLEY
19 BIRMINGHAM
20 SOLIHULL
21 COVENTRY

Geophysical Survey on land of Kipling Road, Blacon

Figure 1: Site Location

Drawn By: GSA

magnitude surveys

on behalf of:

big Heritage

magnitude surveys

on behalf of:

big Heritage

Geophysical Survey on land of Kipling Road, Blacon

Figure 2: Location of Survey Area

Drawn By: GSA

0 20 40m

1:1000 @ A3

-1 SD 1

N

Former Field Boundary

Undetermined

Ferrous Spike

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Geophysical Survey on land of Kipling Road, Blacon

Figure 3: Magnetometer Survey

Drawn By: GSA

0 20 40m

1:1000 @ A3

-1 SD 1

N

Former Field Boundary

Undetermined

Effect of Hedgerow

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Geophysical Survey on land of Kipling Road, Blacon

Figure 4: Earth Resistance Survey

Drawn By: GSA

0 20 40m

1:1000 @ A3

-1 SD 1

N

Former Field Boundary

Strong Contrast Weak

Undetermined

Strong Contrast Weak

Undetermined

Zone

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Geophysical Survey on land of Kipling Road, Blacon

Figure 5: Electromagnetic Survey

Drawn By: GSA


Blacon Hall


Shelley Rd
Morgan Close
Griffin Close
Donne Pl
Meynell Pl
Wordsworth Crescent
Wordsworth Square
Palgrave Close
Tennyson Walk
Marlowe Close
Wordsworth Mews
Mostyn Pl
Harthill Rd
Alderley Pl
Hatton Rd
Stamford Rd
Lynwood Rd
Norris Rd
Kipling Rd
Brentwood Rd
Blacon Ave
Carlisle Rd
Warwick Rd
Lincoln Rd
Lichfield Rd
Google earth
Image © 2015 The GeoInformation Group


Shelley Rd
Mostyn Pl
Alderley Pl
Harthill Rd
Morgan Close
Griffin Close
Donne Pl
Meynell Pl
Hatton Rd
Stamford Rd
Wordsworth Crescent
Wordsworth Square
Palgrave Close
Palgrave Walk
Norris Rd
Lynwood Rd
Kipling Rd
Brentwood Rd
Warlowe Close
Wordsworth Mews
Blacon Ave
Carlisle Rd
Warwick Rd
Lincoln Rd
Lichfield Rd
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