ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of

TEES ARCHAEOLOGY

Limestone Landscapes

heritage lottery fund
LOTTERY FUNDED

The Green, Elwick
Hartlepool
Teesside

geophysical surveys

report 3216
October 2013

Durham University

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted on Elwick village green as part of the 'Elwick Village Atlas' community project led by Tees Archaeology. The works comprised earth resistance and geomagnetic surveys of all practicable areas.

1.2 The works were commissioned by Tees Archaeology and conducted by Archaeological Services Durham University.

Results

1.3 Some high resistance linear and curvilinear anomalies in Area 1 and 3 could possibly reflect stone features such as possible wall footings or kerbs. Areas of probable rubble have also been detected, particularly in the west of the green.

1.4 Several ferrous pipes and cables have been detected across the western part of Area 1 and 3.

1.5 The presence of modern infrastructure such as buried utility services, inspection covers, telegraph poles, parked cars, bus stops, trees and a telephone box hindered the detection of possible archaeological features, particularly with the geomagnetic technique.

1.6 Intense magnetic and high resistance anomalies in the west of Area 3 reflect the remains of a Second World War air raid shelter.

2. Project background

Location (Figure 1)

2.1 The surveys were undertaken on The Green in Elwick village, near Hartlepool, in the ceremonial county of Durham, now part of Teesside (NGR centre: NZ 45537 32297). The Green is aligned broadly north-east/south-west in what is now the southern part of the village, and measures about 50m in width and 200m in length. It comprises several grassed areas divided by roads and driveways which service the residential and commercial properties on both sides of the green.

2.2 The surveys covered six of the grassed areas, where practicable, totalling approximately 0.5ha.

Objectives

2.3 The principal aim of the survey was to determine the nature and extent of any sub-surface features of potential archaeological or historic significance on The Green, which might then be further investigated by the Elwick Village Atlas project under the direction of Tees Archaeology.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from Tees Archaeology and with national standards and guidance (see para. 5.1 below).

Dates

2.5 Fieldwork was undertaken on 15th July 2013. This report was prepared for October 2013.

Personnel

2.6 Fieldwork was conducted Andy Platell, Nathan Thomas (Supervisor) and Duncan Hale (the Project Manager). The geophysical data were processed by Duncan Hale. This report was prepared by Duncan Hale with illustrations by David Graham.

Archive/OASIS

2.7 The site code is **EVG13**, for **E**lwick **V**illage **G**reen 20**13**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University is registered with the **O**nline **A**cces**S** to the **I**ndex of archaeological investigation**S** project (**OASIS**). The OASIS ID number for this project is **archaeol3-157304**.

Acknowledgements

2.8 Archaeological Services is grateful to Tees Archaeology for facilitating this research. The Elwick Village Atlas community project is funded by the Limestone Landscapes Partnership administered by the Heritage Lottery Fund.

3. Historical and archaeological background

3.1 The historical and archaeological background to The Green and the village is currently being researched by the Elwick Village Atlas project, of which these surveys form a part. Members of the project are studying the history of the village through old maps, aerial photographs and historic documents. The memories of local people are also being recorded through oral history. Field-based activities are also part of the project, including building recording and archaeological trial trenching. Other aspects of the project will include a hydrological study and a geological field survey.

3.2 The following information is taken from the Elwick Village Atlas webpage on the Tees Archaeology website (http://www.teesarchaeology.com/projects/Elwick_Village_Atlas/Elwick_Village_Atlas.html).

3.3 The village takes the traditional medieval form of a broad green with buildings fronting either side. However, the placename, meaning 'Ella's Dairy Farm' suggests that there was an Anglo-Saxon presence prior to the Norman Conquest. There are also Anglo-Scandinavian carvings built into the fabric of the Church of St Peter that date to the 10th or 11th centuries.

3.4 The village had a manor house (Elwick Hall) and the earthworks of a medieval fishpond survive to the west, built to ensure the lord of the manor had a constant supply of fresh fish for the dinner table.

3.5 Despite lying close to the A19 trunk road the village still has an agricultural feel and contains many cottages and farm buildings from the 18th and 19th centuries, and possibly earlier.

3.6 In World War II the village was classed as a coastal defended locality and a pillbox was built on the west side the village. The village expanded shortly after the war with additional housing built on its northern side along North Lane. A new school and several cul-de-sacs were also added in the latter half of the 20th century.

4. Landuse, topography and geology

4.1 The Green is a broad open space which comprises several grassed islands surrounded by roads and driveways. Six of the grassed areas were surveyed. Existing infrastructure, including manholes, lamp posts, telephone box and bins, as well as trees were located across these areas often restricting the surveys.

4.2 The Green occupies a fairly level area with an approximate elevation of 85m OD.

4.3 The underlying solid geology of the area comprises dolostone of the Ford Formation, which is overlain by Devensian till deposits.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on site-specific factors including the nature of likely targets; depth of likely targets; ground conditions; proximity of buildings, fences or services and the local geology and drift.

5.3 In this instance, it was considered possible that the remains of both cut and built features, such as ditches and wall foundations, might be present on the site.

5.4 Given the anticipated depth of targets, the possible presence of building remains and the existing structures in and around the site, an electrical resistance survey was considered appropriate. Earth electrical resistance survey can be particularly useful for mapping stone and brick features, and is not affected by the presence of adjacent buildings or ironwork. When a small electrical current is injected through the earth it encounters resistance which can be measured. Since resistance is linked to moisture content and porosity, stone and brick features will give relatively high resistance values while soil-filled features, which typically retain more moisture, will provide relatively low resistance values.

5.5 Given the non-igneous geological environment of the study area a geomagnetic technique, fluxgate gradiometry, was also considered appropriate for detecting the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect archaeological features.

Field methods

5.6 A 20m grid was established across the survey area and related to the Ordnance Survey National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 10mm accuracy.

5.7 Measurements of earth electrical resistance were determined using Geoscan RM15D Advanced resistance meters and MPX15 multiplexers with a mobile twin probe separation of 0.5m. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was 0.1ohm, the sample interval was 0.5m and the traverse interval was 1m, thus providing 800 sample measurements per 20m grid unit.

5.8 Measurements of vertical geomagnetic field gradient were determined using Bartington Grad601-2 dual fluxgate gradiometers. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 1m, thus providing 1,600 sample measurements per 20m grid unit.

5.9 Data were downloaded on site into a laptop computer for initial processing and storage and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.10 Geoplot v.3 software was used to process the geophysical data and to produce both continuous tone greyscale images and trace plots of the raw (minimally processed) data. The greyscale images and interpretations are presented in Figures 2-6; trace plots of the resistance data are provided in Figure 7. Trace plots of the geomagnetic data have not been presented due to the interference from infrastructure. In the greyscale images, high resistance and positive magnetic anomalies are displayed as dark grey, while low resistance and negative magnetic anomalies are displayed as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla/ohm as appropriate.

5.11 The following basic processing functions have been applied to the resistance data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
add	adds or subtracts a positive or negative constant value to defined blocks of data; used to reduce discontinuity at grid edges
despike	locates and suppresses spikes in data due to poor contact resistance
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

5.12 The following basic processing functions have been applied to the geomagnetic data:

clip	clips data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic
zero mean traverse	sets the background mean of each traverse within a grid to zero; for removing striping effects in the traverse direction and removing grid edge discontinuities
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.25m x 0.25m intervals

Interpretation: anomaly types

5.13 Colour-coded geophysical interpretations are provided. Two types of resistance anomaly have been distinguished in the data:

high resistance	regions of anomalously high resistance, which may reflect foundations, tracks, paths and other concentrations of stone or brick rubble
low resistance	regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches

5.14 Three types of geomagnetic anomaly have been distinguished in the data:

positive magnetic	regions of anomalously high or positive magnetic field gradient, which may be associated with high magnetic susceptibility soil-filled structures such as pits and ditches
negative magnetic	regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids
dipolar magnetic	paired positive-negative magnetic anomalies, which typically reflect ferrous or fired materials (including fences and service pipes) and/or fired structures such as kilns or hearths

Interpretation: features

5.15 A colour-coded archaeological interpretation plan is provided.

5.16 Several narrow high resistance linear and curvilinear anomalies have been detected in Areas 1 and 3, which could possibly reflect the presence of stone features such as wall footings. Probable structural remains, rubble and ferrous items were found in subsequent trial excavations in Area 1 (Trenches C & D, Tees Archaeology forthcoming).

5.17 Broader areas of high resistance detected across the west of the site may reflect areas of buried hard surfaces, rubble or disturbed ground.

5.18 Several chains of intense dipolar magnetic anomalies have been detected across Areas 1 and 3, aligned broadly east-west, and north-south. These generally correspond to linear low resistance anomalies and almost certainly reflect ferrous pipes and cables.

5.19 Two parallel intense magnetic anomalies in the west of Area 3 correspond to an area of high resistance. The magnetic anomalies are up to 5m apart and 16m in length. Subsequent trial trench excavation (Trench A) by Tees Archaeology and the Elwick Village Atlas Project found that these anomalies reflected the concrete walls and corrugated iron of a Second World War air raid shelter.

5.20 Several discrete dipolar magnetic anomalies have been found in Area 3. These correspond to discrete high resistance anomalies and reflect inspection covers.

5.21 Two broad bands of small, strong dipolar magnetic anomalies have been detected in the geomagnetic survey, aligned north-west/south-east in Area 1. These correspond to roads that cross the survey area.

5.22 Other large dipolar magnetic anomalies around the edges of the areas reflect adjacent houses, roads, utilities and parked vehicles.

6. Conclusions

6.1 Geomagnetic and earth resistance surveys have been undertaken over Elwick village green as part of the 'Elwick Village Atlas' community project led by Tees Archaeology.

6.2 Some high resistance linear and curvilinear anomalies in Area 1 and 3 could possibly reflect stone features such as possible wall footings or kerbs. Areas of probable rubble have also been detected, particularly in the west of the green.

6.3 Several ferrous pipes and cables have been detected across the western part of Area 1 and 3.

6.4 The presence of modern infrastructure such as buried utility services, inspection covers, telegraph poles, parked cars, bus stops, trees and a telephone box hindered the detection of possible archaeological features, particularly with the geomagnetic technique.

6.5 Intense magnetic and high resistance anomalies in the west of Area 3 reflect the remains of a Second World War air raid shelter.

7. Sources

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

Gaffney, C, Gater, J, & Ovenden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper **6**, Institute of Field Archaeologists

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service

Tees Archaeology (forthcoming) *Elwick Village Green Excavations, The Elwick Village Atlas Project, Hartlepool*

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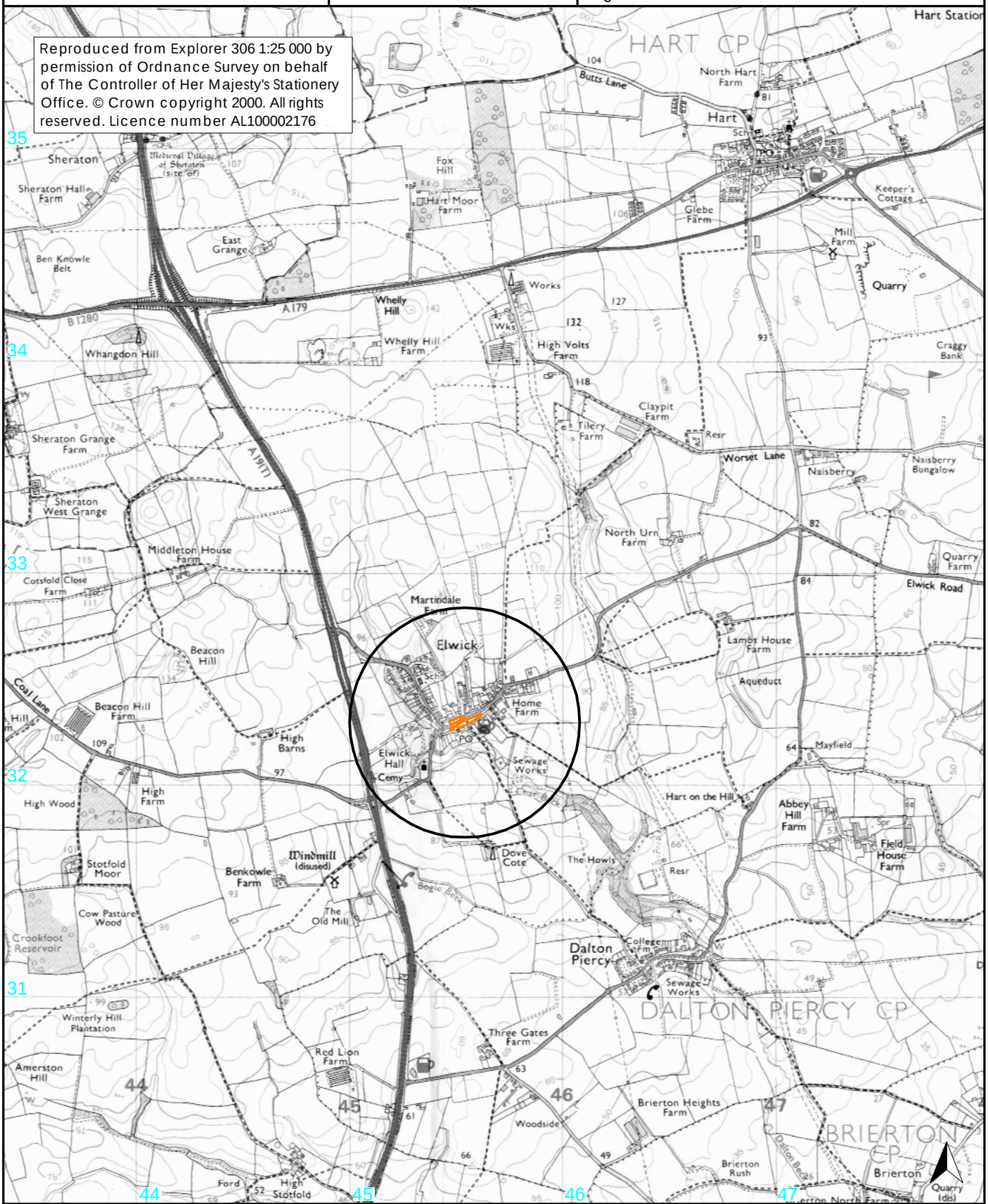
Figure 1: Site location



site location

0 1km

scale 1:25 000 for A4 plot

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magnetic survey

-20 nT 20

0 25m
scale 1:500 for A3 plot

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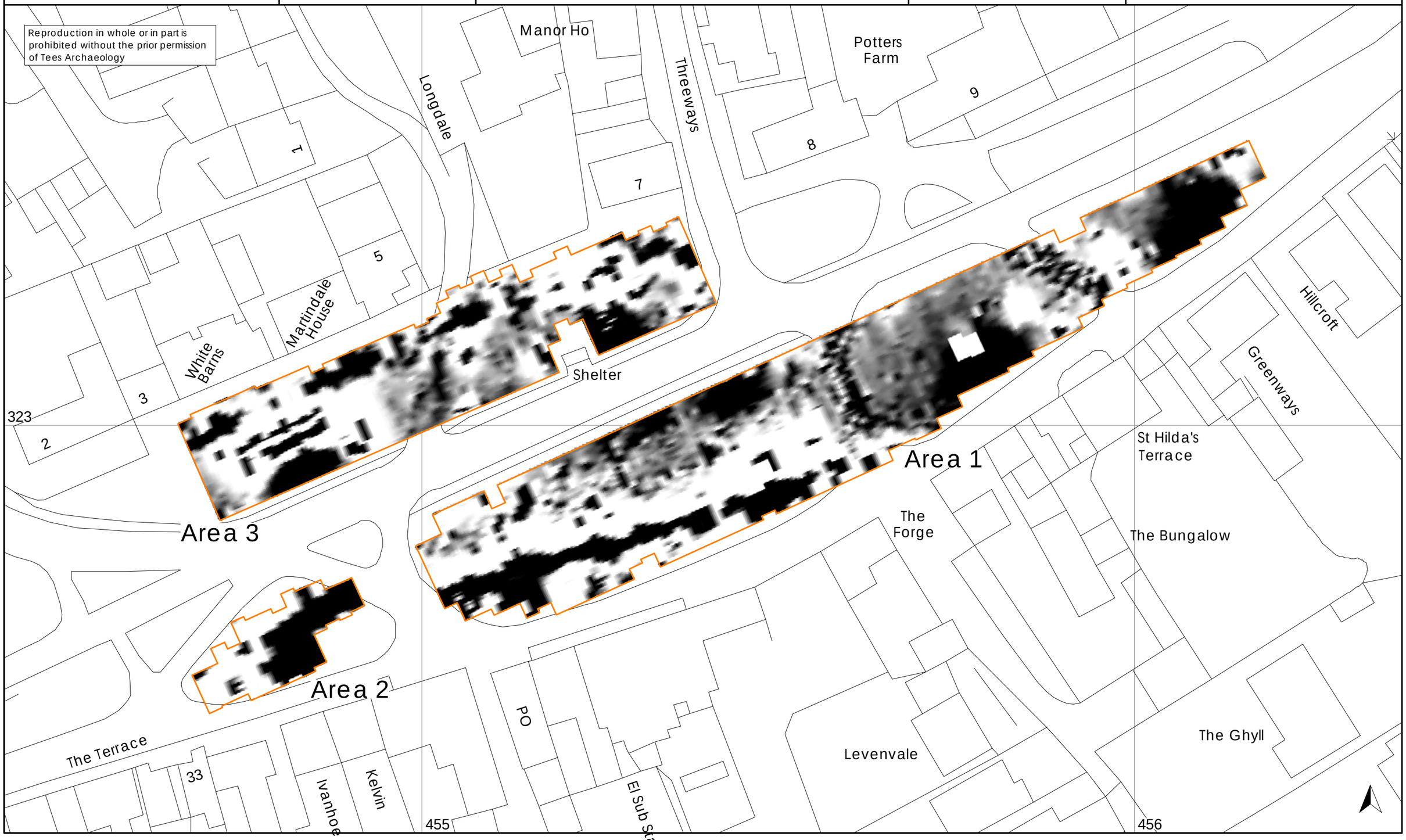
Figure 2: Geomagnetic survey



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magnetic survey

dipolar magnetic anomaly

0 25m
scale 1:500 for A3 plot

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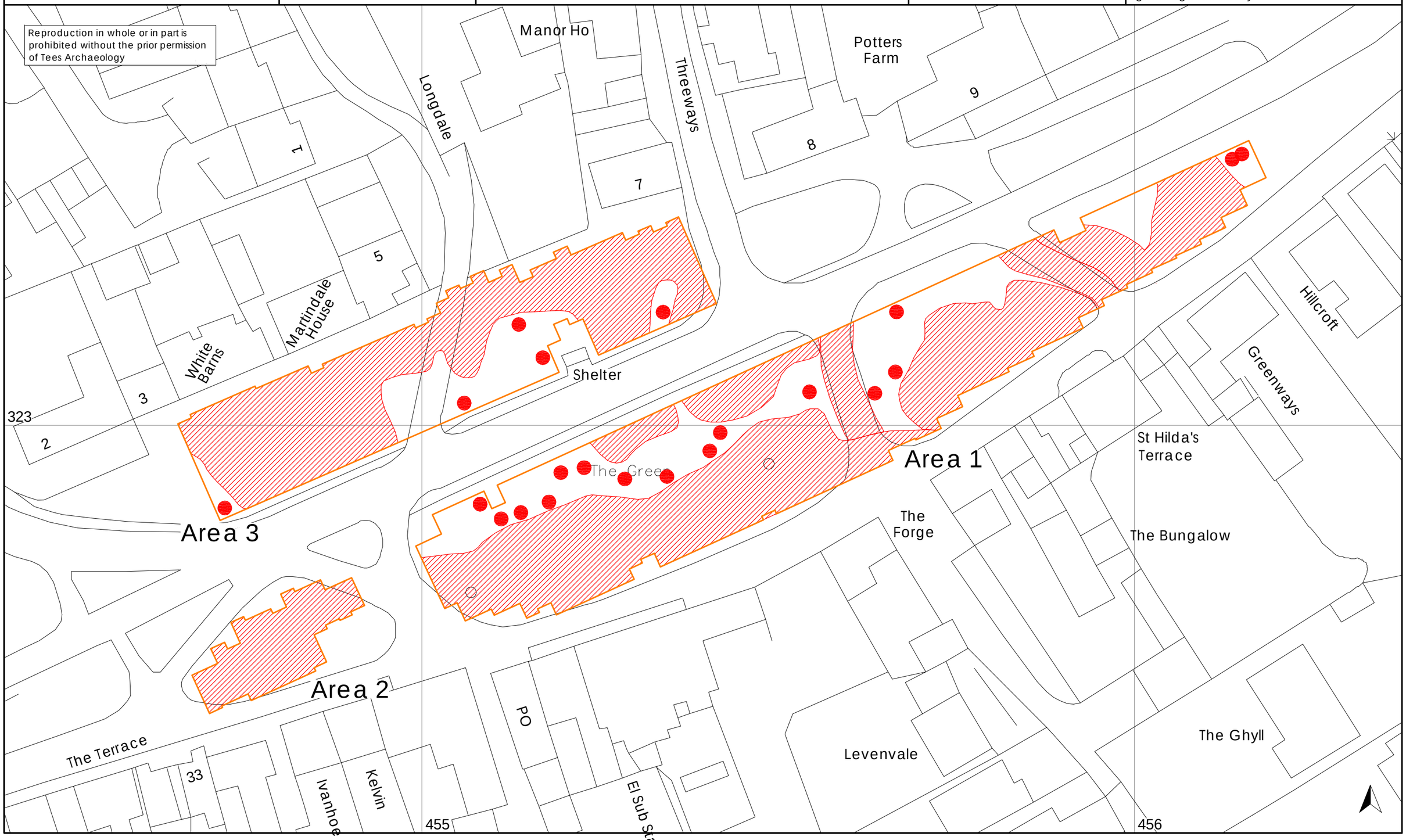
Figure 3: Geophysical interpretation of geomagnetic survey



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resistance survey

20 ohm 70

0 25m
scale 1:500 for A3 plot

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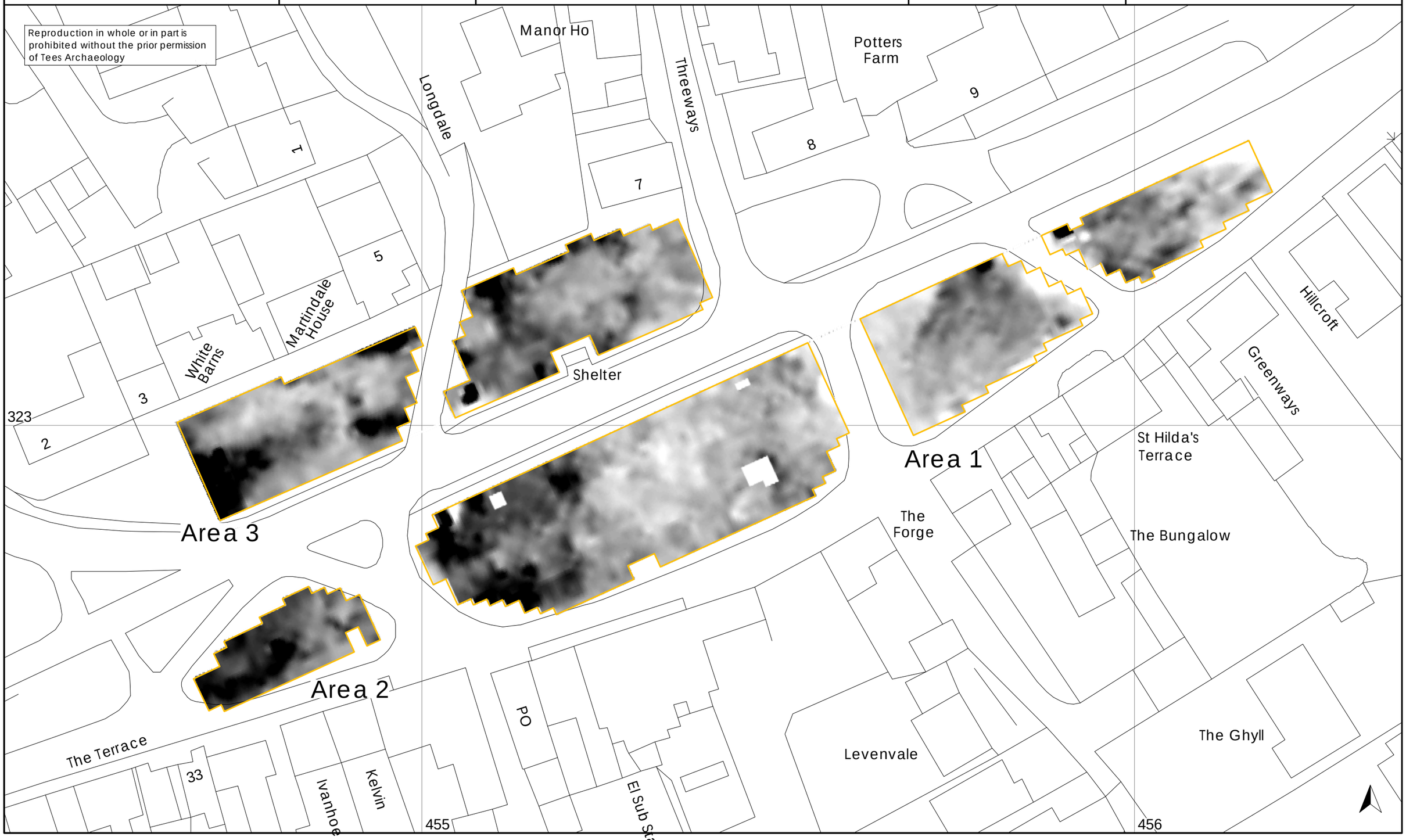
Figure 4: Resistance survey



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resistance survey
high resistance anomaly
low resistance anomaly

0 25m
scale 1:500 for A3 plot

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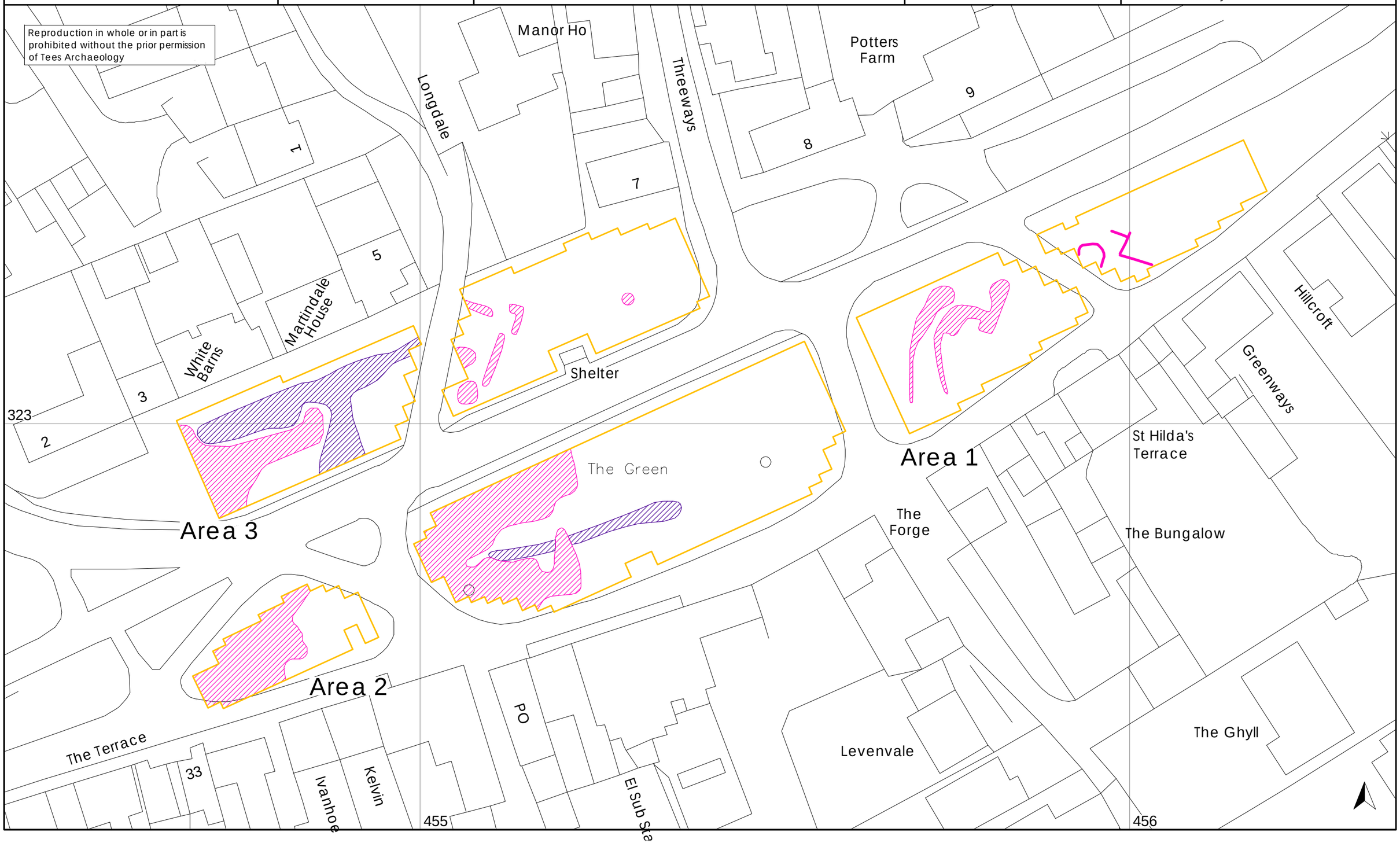
Figure 5: Geophysical interpretation of resistance survey



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survey outline
possible stone
possible rubble
service pipe
well
inspection cover
telegraph pole

0 25m
scale 1:500 for A3 plot

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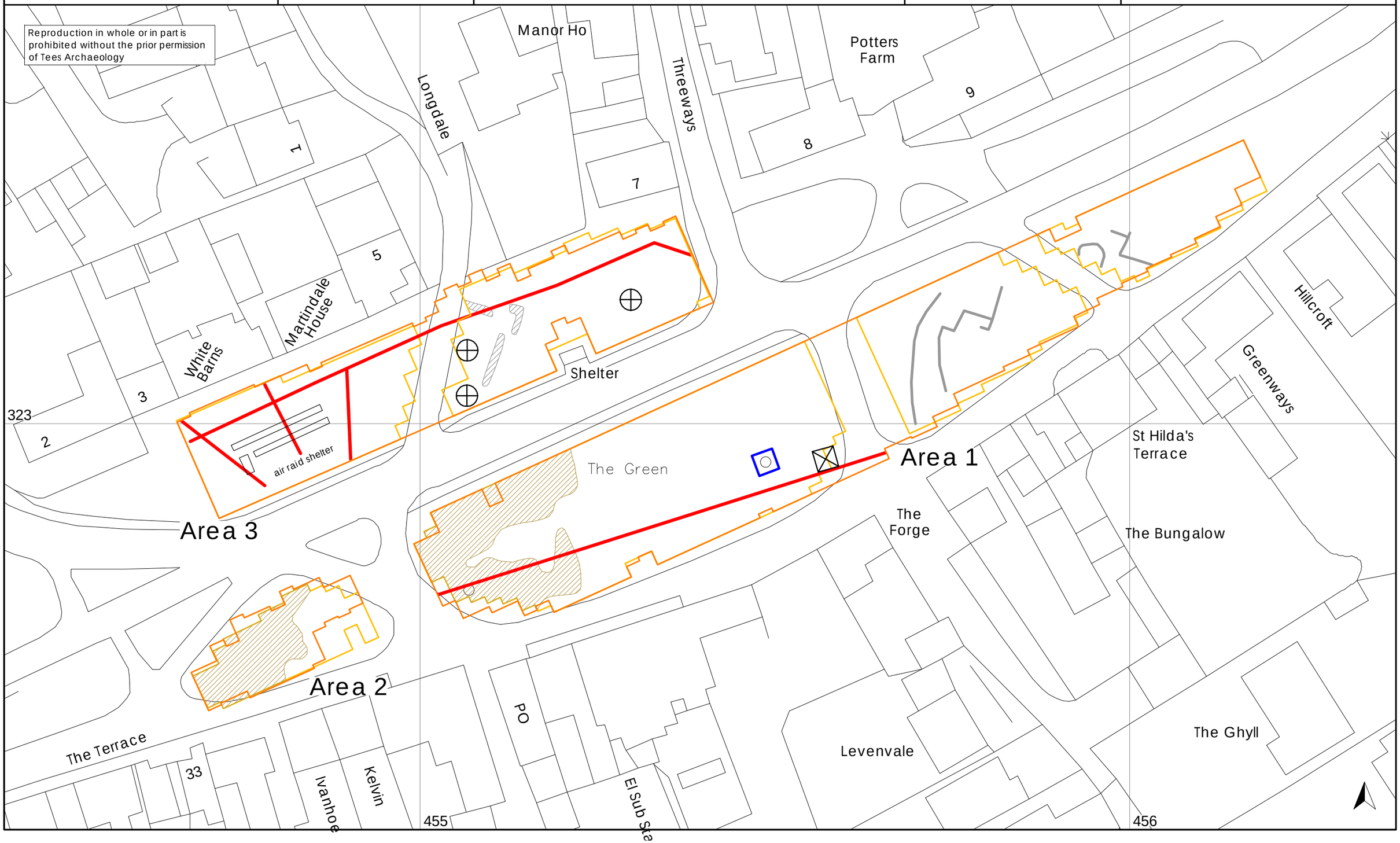
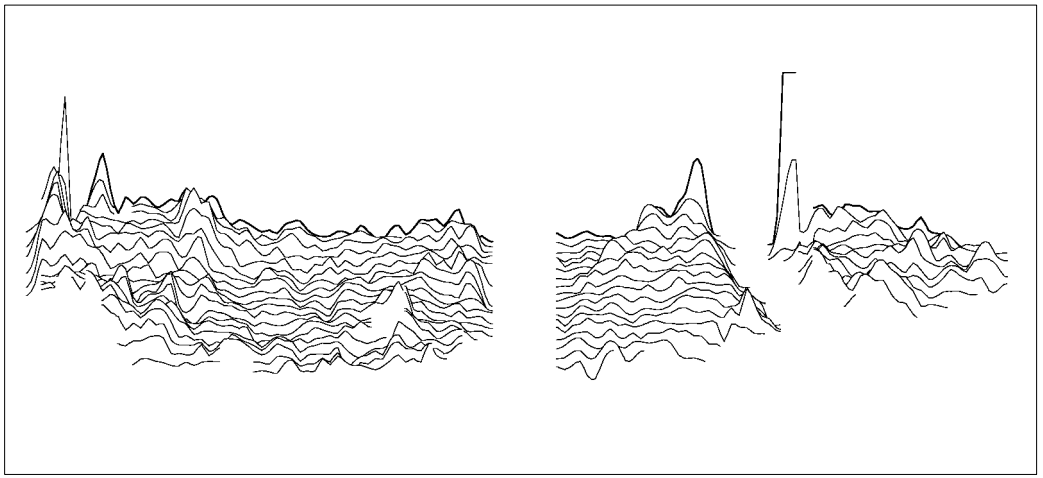
Figure 6: Archaeological interpretation



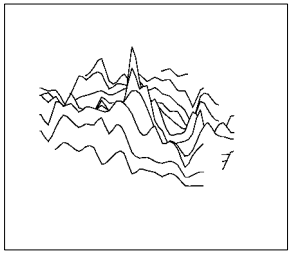
Area 1

58.20ohm/cm



Area 2

41.50nT/cm



Area 3

64.00nT/cm

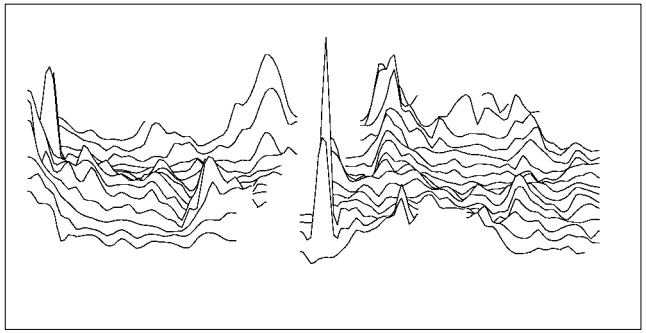


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Figure 7: Trace plots of resistance data

0 50m
scale 1:1000 for A4 plot