LAND AT
FOOD ENTERPRISE ZONE,
(DISTILLERY FARM),
HOLBEACH,
LINCOLNSHIRE

GEOPHYSICAL SURVEY

Work undertaken for
South Holland District Council
C/O Robert Doughty Consultancy

November 2016

Report produced by
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OASIS Ref: archaeol1-267660
National Grid Reference: TF 34750 25800
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Accession No: LCNCC:2016.99

APS Report No: **81/16**

ARCHAEOLOGICAL
PROJECT
SERVICES

Quality Control

Food Enterprise Zone,
(Distillery Farm),
Holbeach,
Lincolnshire

HFEZ16

Project Coordinator	Sean Parker
Site Staff	Sean Parker and Jonathon Smith
Survey processing and report	Sean Parker and Jonathon Smith

Checked by Project Manager	Approved by Team Leader
Gary Taylor	Denise Drury
Date: 16/11/16	Date: 17/11/16

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1. SUMMARY

A detailed magnetic gradiometer survey was undertaken for South Holland District Council C/O Robert Doughty Consultancy Ltd in connection with proposed development on land at Distillery Farm, Holbeach, Lincolnshire. The survey area totalled c.9.48ha.

The majority of the anomalies found within the area are thought to relate to modern agricultural features or natural geological features. Some of the features identified are former field boundaries present in historic mapping.

2. INTRODUCTION

2.1 Definition of an Evaluation

Geophysical survey is a non-intrusive method of archaeological evaluation. Evaluation is defined as *'a limited programme of non-intrusive and/or intrusive fieldwork which determines the presence or absence of archaeological features, structures, deposits, artefacts or ecofacts within a specified area or site. If such archaeological remains are present Field Evaluation defines their character and extent, quality and preservation, and it enables an assessment of their worth in a local, regional, national or international context as appropriate'* (CIfA 2014a).

2.2 Project Background

Archaeological Project Services (APS) was commissioned by Robert Doughty Consultancy, on behalf of South Holland District Council, to undertake a detailed magnetometer survey totalling some 9.48ha on land at Distillery Farm, Holbeach, Lincolnshire. This was in advance of proposed development of the area. The work was undertaken in accordance with a specification prepared by APS and approved by the Planning Archaeologist, Lincolnshire County Council. The survey was carried out over three days between the 31st October and the 2nd November 2016. A portion of the development site to the south lay outside of the current survey area.

2.3 Topography and Geology

Holbeach is situated 11km east of Spalding and 20km south of Boston, in the administrative district of South Holland, Lincolnshire (Fig. 1).

The proposed development site is located 1.4km northwest of the centre of Holbeach, as defined by the Market Place, at National Grid Reference TF 34750 25800 (Fig. 2). The site lies to the west of the junction of the A17 and A151 on land surrounding Distillery Farm.

Local soils are of the Wisbech Series, typically coarse silty calcareous alluvial gley soils (Robson 1990, 36). These soils are developed upon a drift geology of younger marine alluvium which in turn seals a solid geology of Upper Jurassic West Walton Formation mudstones and Ampthill Clay (BGS 2016).

The local topography is generally flat land within the fens of South Lincolnshire. The site lies at a height of *c*. 3m OD.

2.4 Archaeological Setting

In a desk based assessment carried out by Archaeological Project Services prior to this survey it states that there is little evidence prior to the medieval period but summarises thus: "*During the medieval period (AD 1066-1540), the site probably lay within the open fields of Holbeach. There is some evidence for medieval settlement 250m to the south of the site. However, investigations immediately east of the site did not reveal any remains"* (Smith 2016).

In addition, a geophysical survey just to the south (Evershed 2016) only revealed anomalies associated with a field boundary (Fig 7) known from the 1839 map (LAO D88).

3. GEOPHYSICAL SURVEY

3.1 Methods

A magnetic gradiometry survey was carried out with a Bartington Grad 601-2 fluxgate magnetometer. The fields were divided into grids and each grid was walked systematically in a zigzag pattern, taking readings every 0.25m in traverses 1m apart.

The layout of the survey area is shown in Figure 3. The survey area was divided in two based on the current plating regime; Area 1 immediately west of distillery farm and Area 2 to the north and slightly further west. The fields were covered in partially levelled potato ridges and as such the 40m^2 survey grids were set out aligned with the regime in order to minimize the number of ridges that had to be crossed with each survey traverse. Aside from the crop ridges, the site was otherwise flat (Plate 1).

The survey was undertaken in accordance with English Heritage (2008) and CIfA (2014b) guidelines and codes of conduct. Detailed methodology can be found in Appendix 1.

3.2 Results

The presentation of the data for the site involves a greyscale print-out of the minimally processed data (Fig 4; clipped for display but otherwise unaltered) and the processed data (Fig 5). Magnetic anomalies have been identified and plotted on to an interpretative drawing (Fig 6) and then overlaid onto a figures incorporating the previous geophysical survey (Figs 7 and 8). In the following text, the numbers in brackets refer to annotations on Figures 6 and 7. The results have also be overlaid onto a historic maps (Fig 9).

The fields were significantly rutted due to recent potato ridges which had only partially been flattened before the commencement of the survey. The survey was designed to minimize the impact of these ridges by orientating data collection along the same plane, which would allow easy manipulation of the data. This strategy was very successful and for the most part, these ridges are invisible in the processed data. However, where the direction of the planting scheme was different at the edges of the survey areas, a closely spaced series of parallel lines caused by the ridges are visible, which may obscure weaker features in this area.

Area 1

Positive linear anomalies

Four positive linear anomalies are visible in Area 1. The first (highlighted with a red line) is orientated east-west and slightly curving (**1**). This corresponds with a field boundary shown on the 1839 tithe apportionment map (Smith 2016). The second is quite weak, was orientated north-south and was almost certainly caused by a field margin that was visible at the time of the survey (highlighted with a green line) (**2**). The remaining two positive linears are orientated east-west, run parallel to each other, and have very weak signals (highlighted with a broken green line). These are very likely to be field drains.

Areas of bipolar disturbance

At the southeast of Area 1, a patch of bipolar disturbance is visible (highlighted with blue cross hatching). This disturbance is likely to be due to the proximity of metal fences. A second area of bipolar disturbance is visible where the former field boundary (**1**) and agricultural margin (**2**) intersect.

Area 2

Positive linear anomalies

Many weak, curvilinear positive anomalies are visible in Area 2 (highlighted with broken red lines). These sinuous features are very likely to be natural palaeochannels. Several straighter positive linears are also visible. Towards the south of this area, a northeast-southwest linear is visible (**3**) which corresponds to a ditch seen in historical maps between 1839-1955 (Smith 2016).

At the north of this area are two weak positive linear features running in parallel (**4**). Towards the east of this area are three radiating weak positive linears (**5**). Both of these sets of features are possibly the result of recent agricultural activity, although this cannot be stated with certainty.

Agricultural activity

Several weak, straight positive anomalies run in parallel to each other, NNW-SSE in the north of the area and northeast-southwest in the south of the area (highlighted with broken green lines). These are almost certainly field drains.

Bipolar linear anomalies

Bisecting the area is a diffuse bipolar linear (highlighted with a broken blue line) (**6**). There is no corresponding feature on historic maps, but there is a feature visible in lidar images of the site (Smith 2016). Given this feature runs parallel to the land drains to the south and appears to be receiving the land drains to the north, it is likely this feature is related to the post-medieval drainage of the field.

Dipolar anomalies

Some dipolar anomalies are visible (a sharp positive reading adjacent to a sharp negative reading). Examples of these have been highlighted with a blue circle. These are typically caused by small pieces of iron detritus in the topsoil, such as nails or other pieces of rubbish that find their way into manure piles subsequently spread on the land and as such are not usually considered archaeologically significant.

Area of positive disturbance

Several discrete, amorphous features are visible in the survey data (highlighted with a red

hatching). They are likely to be geological in origin, although the possibility of the anomalies being caused by some large pit-like feature or industrial deposit cannot entirely be discounted.

Discrete bipolar anomalies
Several broad areas of bipolar disturbances are visible in the survey. The majority are likely to be due to modern detritus, particularly around the field edges. However, one area occurs at the confluence of palaeochannels (**7**) and may be caused by a pond or similar natural feature.

4. DISCUSSION

The majority of the anomalies seen in the survey are likely to be of natural origin, in the case of the curvilinear features and discrete positive features, or related to relatively modern agricultural features, such as the field drains and ditches known from historical maps (**1** & **3**). A field boundary identified from historic mapping was also recorded in a previous survey immediately to the south (Fig 7). The only features not easy to ascribe to a particular function or period are the straight linears (**4** & **5**) which do not appear to key into the existing drainage network.

5. ACKNOWLEDGEMENTS

Archaeological Project Services wishes to acknowledge the Robert Doughty Consultancy Ltd who commissioned the project. Gary Taylor and Denise Drury edited the report.

6. PERSONNEL

Project coordinator: Sean Parker
Geophysical Survey: Jonathon Smith, Sean Parker
Survey processing and reporting: Jonathon Smith, Sean Parker

7. BIBLIOGRAPHY

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CIfA, 2014b *Standard and Guidance for Geophysical Survey.*

English Heritage, 2008 *Geophysical Survey in Archaeological Field Evaluation.*

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their use in Eastern England, Soil Survey of England and Wales **13**

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Robson, J.D. 1990 *Soils of the Boston and Spalding District [Sheet 131]*, Memoirs of the Soil Survey of Great Britain

Smith, J. 2016, *Archaeological Desk Based Assessment Of Land At The Food Enterprise Zone, Distillery Farm, Holbeach, Lincolnshire*. APS Report No: **55/16**

8. ABBREVIATIONS

APS Archaeological Project Services

BGS British Geological Survey

CIfA Chartered Institute for Archaeologists

LAO Lincolnshire Archive Office

Lidar Light Radar

Figure 1 - General location plan

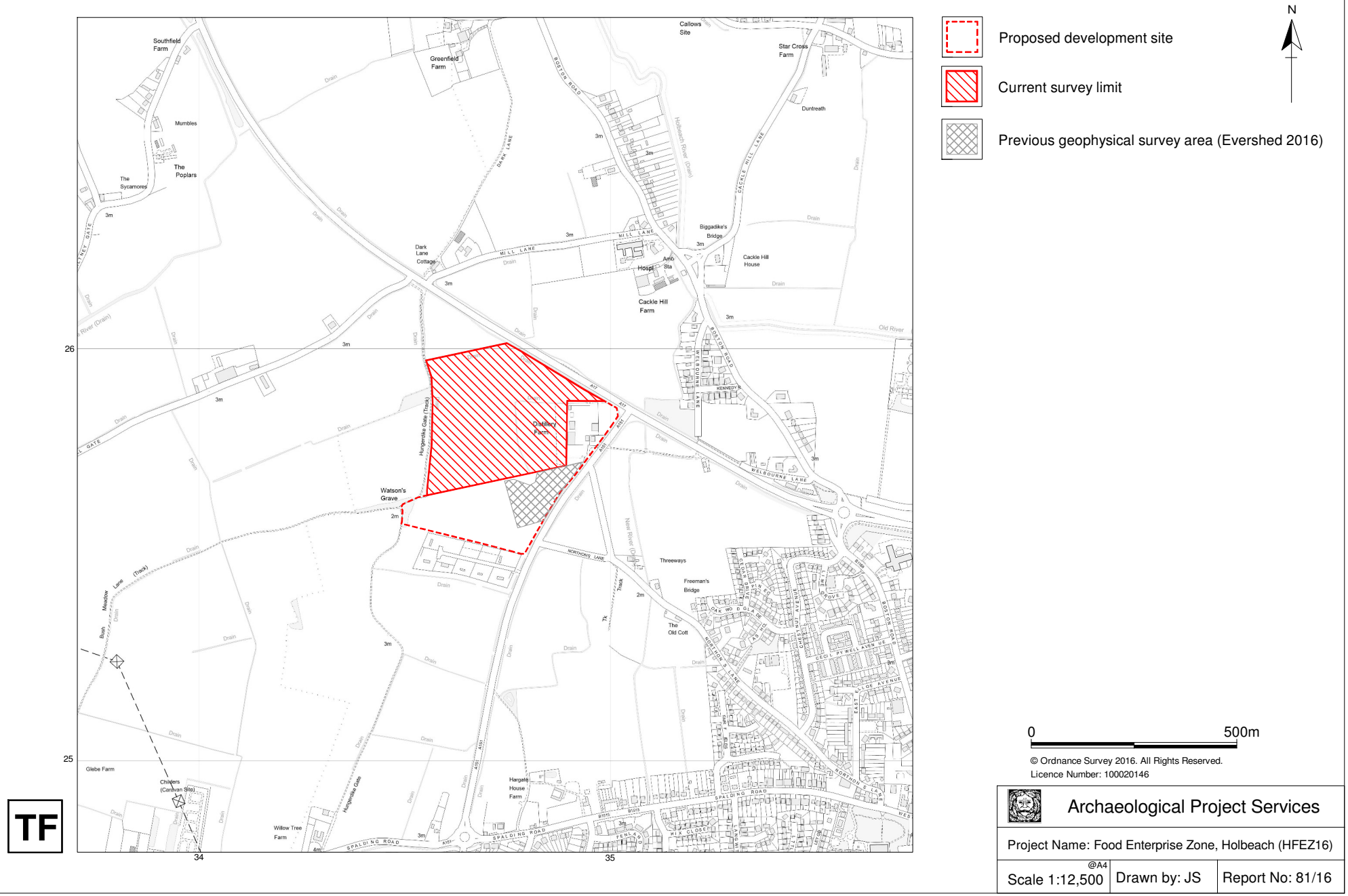


Figure 2 - Site Location

Figure 3 - Site Layout

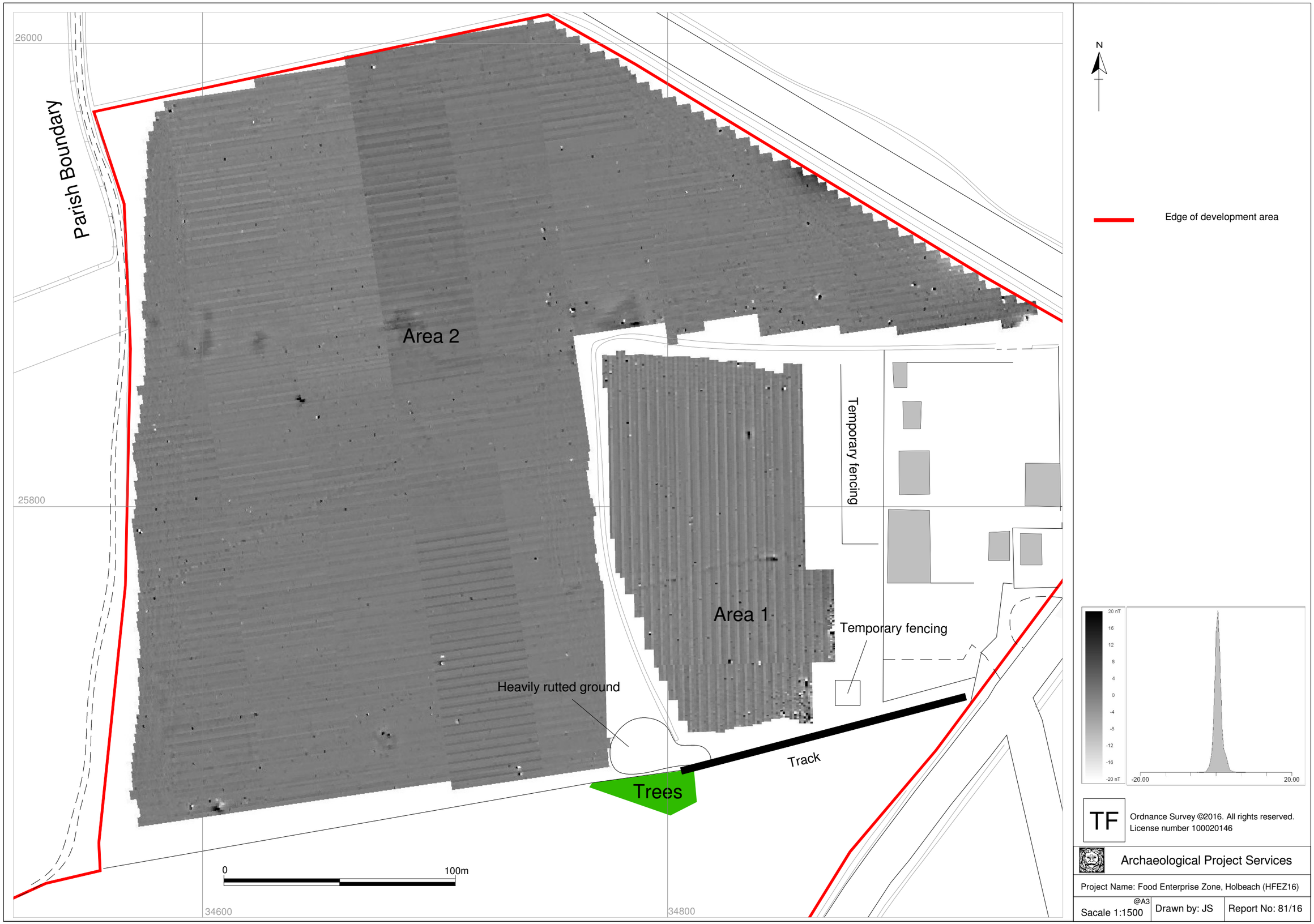


Figure 4 - Minamally Processed Greyscale Plot

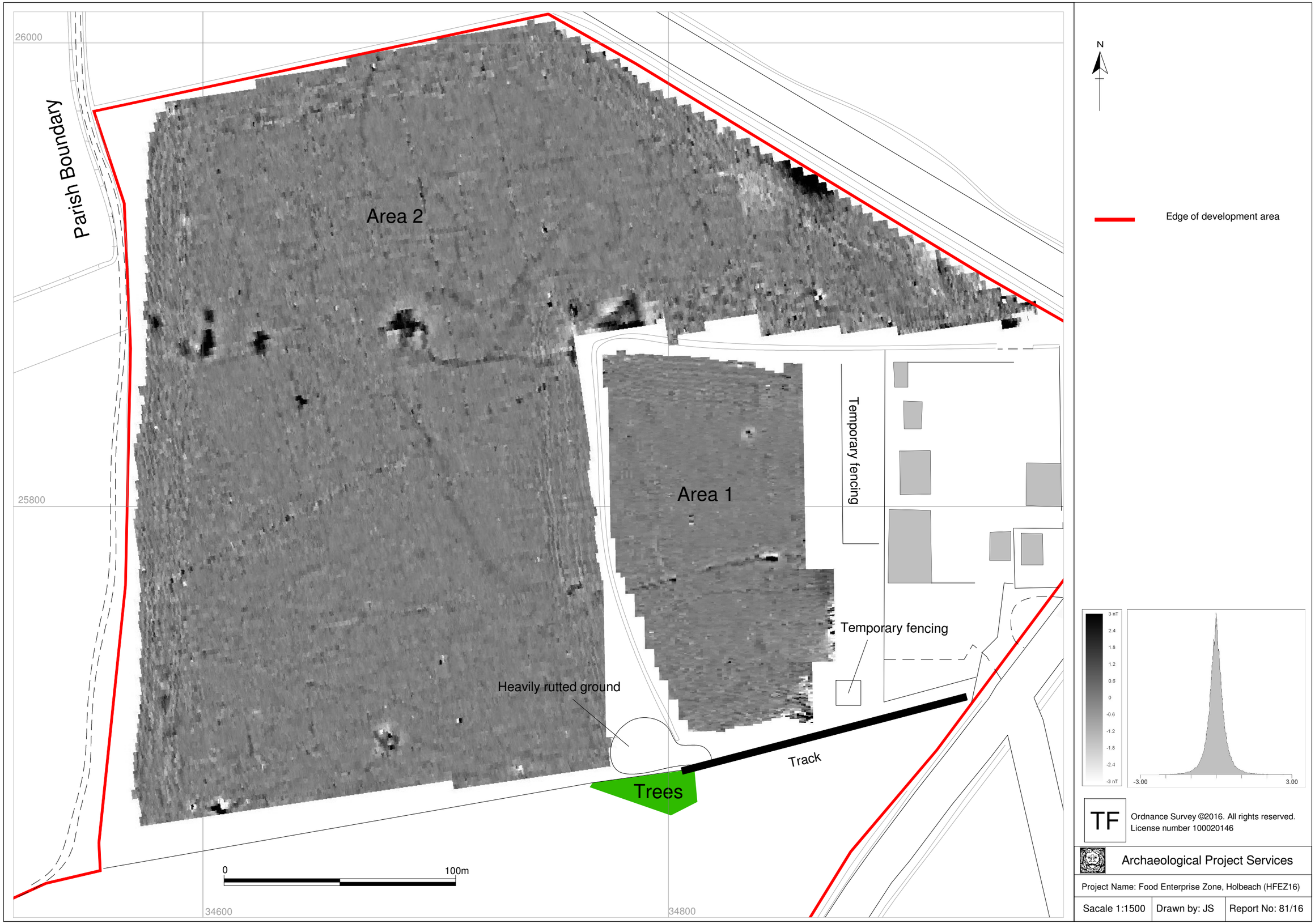


Figure 5 - Processed Greyscale Plot

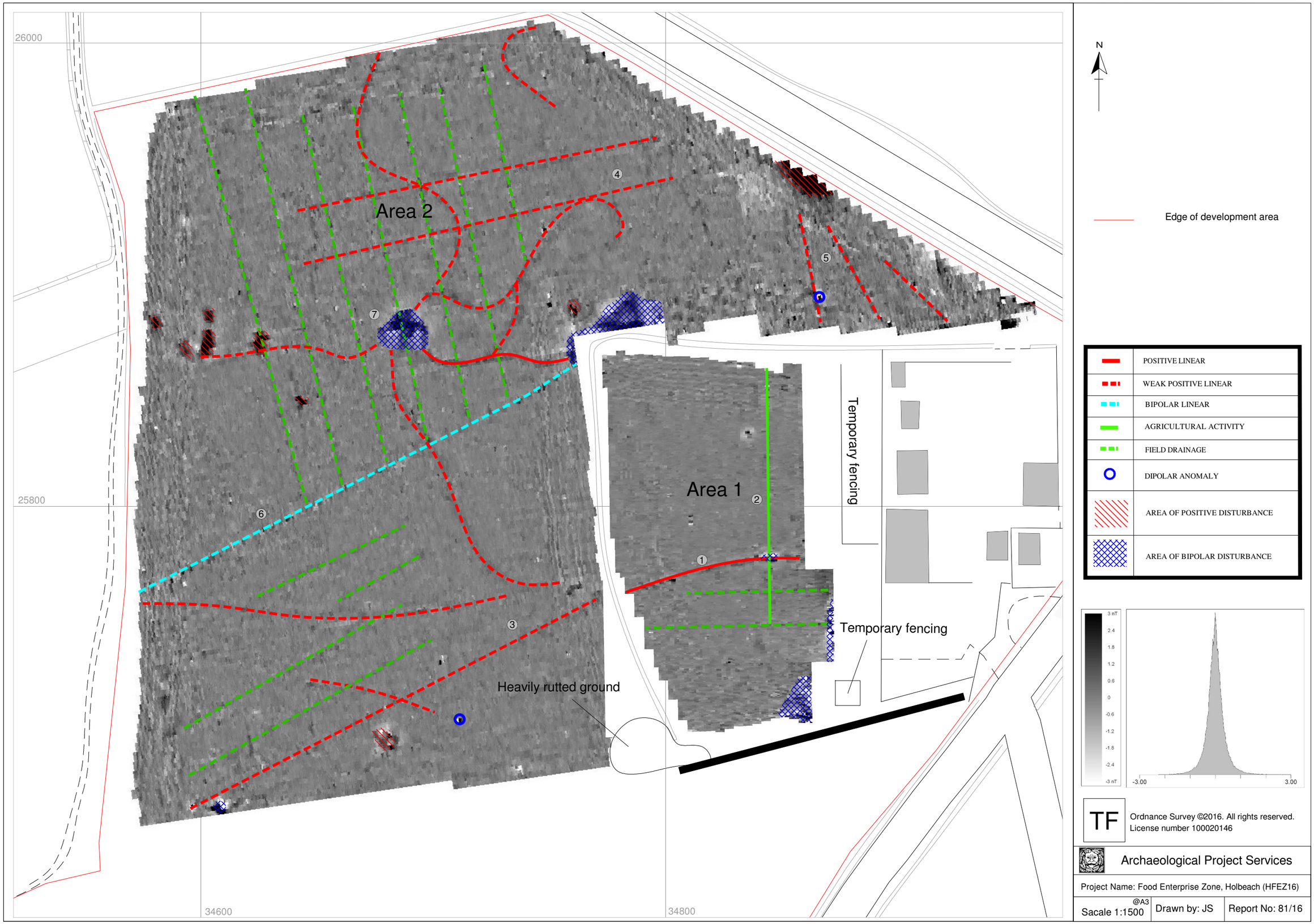


Figure 6 - Interpreted Data

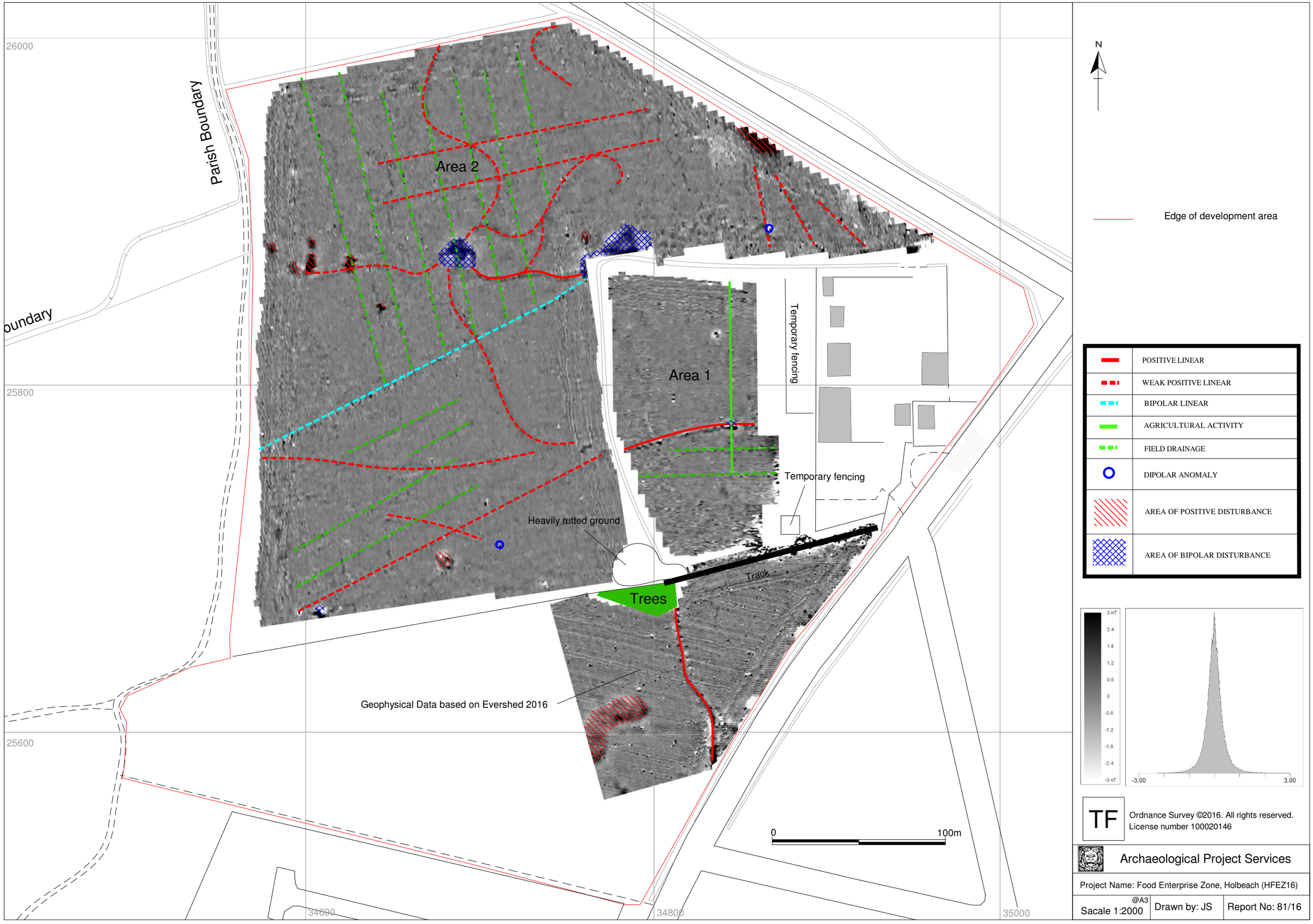


Figure 7 - Combined Geophysics Data

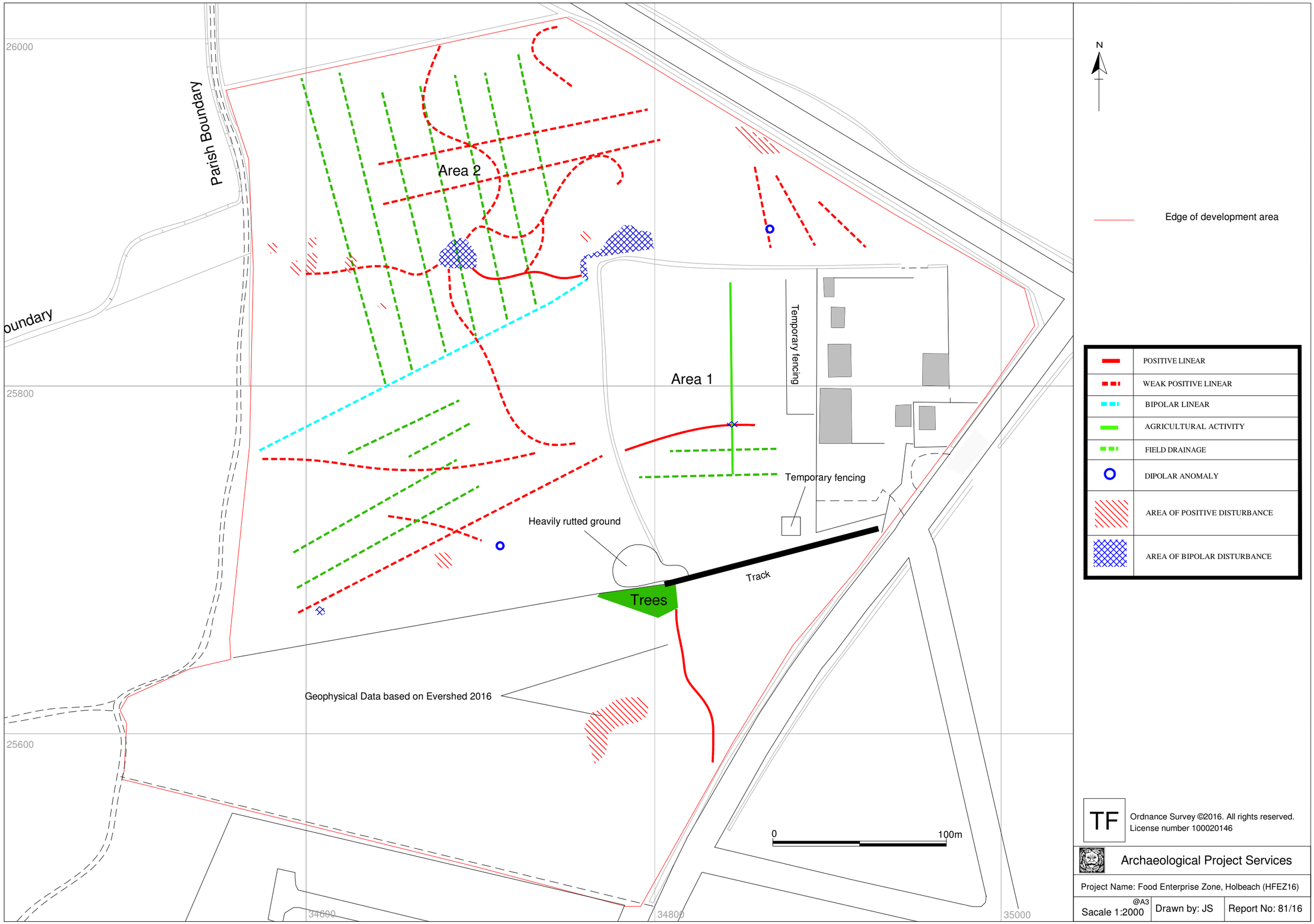
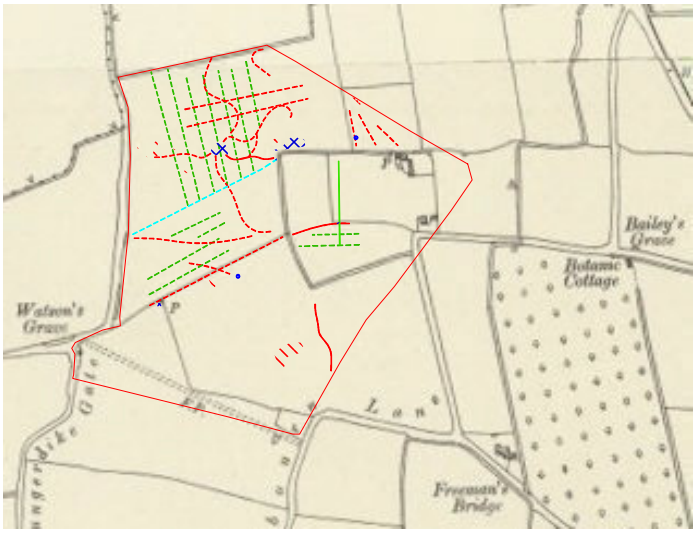


Figure 8 - Overall results

1839 Tithe Apportionment Map

	POSITIVE LINEAR
	WEAK POSITIVE LINEAR
	BIPOLAR LINEAR
	AGRICULTURAL ACTIVITY
	FIELD DRAINAGE
	DIPOLAR ANOMALY
	AREA OF POSITIVE DISTURBANCE
	AREA OF BIPOLAR DISTURBANCE



Extract from OS map 1903 CXXXV.SW

0 500m

Archaeological Project Services		
Project Name: Food Enterprise Zone, Holbeach		
Scale 1:10,000 @A4	Drawn by: JS	Report No: 81/16

Figure 9 - Geophysical data overlaid on historic maps

Plate 1: Site conditions showing partially-levelled planting ridges. Area 2, looking west

Appendix 1
TECHNICHAL INFORMATION

Principles of magnetometry
The basis for magnetic prospecting is the presence of weakly magnetised iron oxides in the soil. Depending on the state of iron oxides, the material will exhibit either a weak or a strong magnetisation (Gaffney and Gater 2003).

Human activities tend to enrich sediments with magnetic particles. Strong heat, such as that generated by fires, cause surrounding iron particles in the soil to become aligned with the earth's magnetic field and take on a magnetic charge. Where these particles accumulate, such as in cut features like ditches and pits, a weak positive magnetic anomaly is apparent. In cases where very strong heat has been applied, such as furnace and kiln bases, a bipolar magnetic anomaly will be apparent, with one area having a strong positive signature and one area having a strongly negative area. Where banks have been built up from natural geological material which excludes magnetically enriched sediments, or walls have been made of stone, this may result in a negative anomaly. Modern metallic items and fired bricks cause sharp bipolar spikes. Modern services have a tendency to alternate between positive and negative readings along their length.

It should be noted that not all features will be responsive and absence of anomalies does not necessarily indicate absence of archaeological features (Clark 1996).

Bartington Grad 601-2
A gradiometer uses two sensors separated by a fixed distance in order to measure the difference in strength between the earth's magnetic field and the soil. The Bartington Grad 601 uses two fluxgate sensors separated vertically by 1m to take these readings, which reduces variations associated with the Earth's magnetic field and deep geology. Changes as small as 0.2 nanoTesla (nT) in an overall field strength of c. 49,000nT can be accurately detected using this instrumentation, although in practice instrument interference and soil noise can limit sensitivity. The instrument has typical penetration of 0.5m-1m, although stronger anomalies can be detected at greater depths. The 601-2 model uses two pairs of sensors to take parallel readings 1m apart.

Methodology
The survey area is divided into grid squares of $30m^2$ or $40m^2$, depending on the terrain. The grids are set out using a survey grade GPS, accurate to 0.03m. The grids are systematically walked in a zig-zag pattern with the gradiometer taking readings every 0.25m along a traverse, and each traverse being separated by 1m. This equates to 3600 sampling points in a full 30m x 30m grid or 6400 in a 40m x 40m grid. Readings are automatically recorded on a datalogger which is downloaded at the end of each day. The gradiometer is 'zeroed' at the start of each day and at intervals throughout to ensure consistent results are achieved throughout the survey.

Data Processing
The data is downloaded and processed using TerraSurveyor software (version 3.0.25.1). The raw data is then adjusted to emphasise possible features. At each stage the data is examined as a greyscale image and as a trace plot.

Minimally Processed data
The data is clipped so that the mid-range of readings is most visible. This involves excluding all readings outside of the -20nT to 20nT range.

Processed Data
The following processes are applied to produce the processed greyscale image:

- Destripe: Each traverse is flattened with regard to surrounding traverses by setting the median value of the traverse to 0nT. This produces cleaner images, but may cause bleeding where particularly strong signals are present at one end of a traverse.
- Data Clip: The data is clipped to provide the most suitable contrast for seeing archaeological features. This excludes readings outside of the -5nT to 5nT range.

The following processes may also be applied to improve the clarity of the processed greyscale images:

- Despike: Isolated anomalous readings, such as those generated by tiny iron fragments, are removed from the data. This makes the images cleaner. The parameters used are: X radius = 2; Y radius = 2; Threshold = 3SD; Spike replacement = median.
- Destagger: Minor inconsistences in the way an operator walked grids can be corrected by shifting a traverse up to 0.5m to match edges with adjacent traverses.

Data is exported as a JPG image and georeferenced for use in scale plans of the site. Anomalies are then checked against historical maps, and where available, lidar contour data.

References

Clark, A., 1996 *Seeing Beneath the Soil*, London, 2nd edn.

Gaffney C. and Gater, J., 2006 *Revealing the Buried Past: Geophysics for Archaeologists,* The History Press

Appendix 2
THE ARCHIVE

The archive consists of:

1 Daily record sheets
1 Report text and illustrations
1 Digital data

File names	HFEZ16 area 1.xyz HFEZ16 area 2.xyz
Explanation of codes used in file names	.xyz files allow whole composite to be generated and stored easily.
Description of file formats	All files are in xyz format where Z= nT reading
List of codes used in files	
Hardware, software and operating systems	TerraSurveyor 3.0.25.1 running under Windows 10
Date of last modification	04/11/16
Indications of known areas of weakness in data	
Survey Technique	Zigzag
Origin	Starts at 0
Grid size	40m x 40m
Interval	X=0.25, Y=1m
Dummy Value	32702
XYZ Separation	Comma

All primary records are currently kept at:

Archaeological Project Services, The Old School, Cameron Street, Heckington, Sleaford, Lincolnshire NG34 9RW

Final destination of the archive is:

The Collection
Art and Archaeology in Lincolnshire
Danes Terrace
Lincoln
LN2 1LP

Accession number: LCNCC:2016.99

OASIS code: archaeol1-267660

Site Code: HFEZ16

OASIS DATA COLLECTION FORM: England

OASIS ID: archaeol1-267660

Project details

Project name	LAND AT FOOD ENTERPRISE ZONE, (DISTILLERY FARM), HOLBEACH, LINCOLNSHIRE
Short description of the project	Geophysical survey of arable land outside Holbeach prior to development. The survey revealed several likely paleochannels and agricultural features known from historic maps. Several unidentified linear features were also observed.
Project dates	Start: 31-10-2016 End: 02-11-2016
Previous/future work	Yes / Yes
Any associated project reference codes	HFEZ16 - Sitecode
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 4 - Character Undetermined
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	"""Geophysical Survey"""
Development type	Not recorded
Prompt	Planning condition
Position in the planning process	Not known / Not recorded
Solid geology (other)	Upper Jurassic West Walton Mudstone and Clay
Drift geology	ALLUVIUM
Techniques	Magnetometry

Project location

Country	England
Site location	LINCOLNSHIRE SOUTH HOLLAND HOLBEACH Food Enterprise Zone
Study area	15.2 Hectares
Site coordinates	TF 34750 25800 52.812532787623 -0.000459313421 52 48 45 N 000 00 01 W Point
Height OD / Depth	Min: 3m Max: 3m

Project creators

Name of Organisation	Archaeological Project Services
Project brief originator	Contractor (design and execute)
Project design originator	Archaeological Project Services
Project director/manager	Gary Taylor
Project supervisor	Sean Parker
Type of sponsor/funding body	Developer

Project archives

Physical Archive Exists?	No
Digital Archive recipient	The Collection
Digital Archive ID	LCNCC:2016.99
Digital Contents	"Survey"
Digital Media available	"Geophysics","Images raster / digital photography","Survey","Text"
Paper Archive recipient	Archaeological Project Services
Paper Archive ID	81/16
Paper Contents	"Survey"
Paper Media available	"Diary","Drawing","Photograph","Report","Survey "

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
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