Archaeology South-East

ASE

Detailed Magnetometer Survey at Former Ford Airfield, Ford, West Sussex

NGR: 499643 103214

ASE Project No: 4929
OASIS ID: archaeol6-102477

ASE Report No. 2011130

By John Cook BSc (Hons) AIFA

June 2011

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Abstract

Archaeology South East was commissioned by Mott MacDonald to carry out a detailed fluxgate gradiometer survey on land at Former Ford Airfield, Ford in advance of pipeline instatement. The survey covered two hectares and took place on the 23rd and 24th of May 2011. The survey area consisted of arable land under wheat and an area of uncultivated land under rough grass bounded by hedges and fencing for a water treatment works compound. Due to the proximity to several metallic objects in and alongside the survey area such as pipes and fences a significant part of the resultant data consisted of magnetic disturbance. Several linear positive anomalies observed along the pipeline corridor may have an archaeological origin. However, these may also be the result of more recent agricultural activity. Two further areas of magnetic debris and bipolar anomalies may possibly relate to the former airfield.

CONTENTS

1.0 INTRODUCTION

1.1 Site background

1.1.1 Archaeology South-East was commissioned by Mott MacDonald to conduct a Magnetometer survey along a pipeline corridor on land at Former Ford Airfield, Ford, West Sussex hitherto referred to as 'the site' (NGR 499643 103214 ; Figure 1).

1.2 Geology and topography

1.2.1 According to the British Geological Survey the site lies over bedrock geology of White Chalk sub-group Lewes Nodular Chalk Formation, Seaford Chalk Formation, Newhaven Chalk Formation, Culver Chalk Formation and Portsdown Chalk Formation (Undifferentiated). This is overlain by River Terrace Deposits (Undifferentiated) – Sand, Silt and Clay.

1.3 Aims of geophysical investigation

1.3.1 The purpose of the geophysical survey was to detect any buried archaeological anomalies that might provide a measurable magnetic response.

Scope of report

1.4.1 The scope of this report is to report on the findings of the survey. The project was conducted by John Cook and Chris Russel; project managed by Neil Griffin (fieldwork) and by Jim Stevenson (post fieldwork).

2.0 ARCHAEOLOGICAL BACKGROUND

2.1 Within the area of the Waste Water Treatment Works an excavation prior to its instatement (Place 2004) uncovered evidence for significant prehistoric and Roman settlement activity as well as a co-axial field system. Several of the linear features identified are indicated as possibly intruding into the area covered by this survey. A further excavation in advance of development (ASE 2008) to the south of the site also identified a co-axial field system as well as isolated pits and post-holes, east-west oriented field boundaries and an east-west drove way.

3.0 SURVEY METHODOLOGY

3.1 Summary of methodology

3.1.1 A Bartington Grad 601-2 fluxgate gradiometer was used to survey an area of 2.0 hectares. The survey grid was set out using a differential GPS (Global Positioning Systems). A 30 metre grid was set out along the pipeline corridor and transects were walked every metre across these grids. Samples for the magnetometry survey were taken at 0.25m intervals along each transect.

3.2 Geophysical survey: methods used

3.2.1 The magnetometry survey was undertaken in the areas depicted in Figures 1 and 2.

3.2.2 Clay type geologies will normally provide a poor-average result for magnetic survey techniques however sand geologies generally respond well to magnetic prospection techniques (David 1995: 10; Gaffney & Gater 2003: 79). A 100% detailed area survey is the desirable strategy for any given area of land and has the potential to provide the best possible information on all types of feature including those where no significant occupation may have occurred. The fluxgate gradiometer method of magnetic detail survey was chosen as this instrumentation perfectly balances speed with quality of data collection. 30 x 20 metre grids were set out along the length of the pipeline corridor. Each grid was surveyed with 1 metre traverses; samples were taken every 0.25m for the magnetometry survey. The survey was undertaken over two days when the weather was consistently warm although cloudy with occasional sunshine.

3.3 Applied geophysical instrumentation

3.3.1 The Fluxgate Gradiometer employed was the Bartington Instrumentation Grad 601-2. This consists of two separate Fluxgate Gradiometers joined to work as a pair. The Fluxgate Gradiometer is based around a pair of highly magnetic permeable cores made out of an alloy called ‘Mu-metal’. They are driven in and out of magnetic saturation by the solenoid effect of an alternating ‘drive current’ in the coils wrapped around them. Every time the coils come out of saturation external fields can enter them; this will cause an electrical pulse in the detector coil proportional to the field strength. Two cores are used, with the cores in opposite direction, so that the drive current has no net magnetic effect arising on the sensor coil (Clark 1996: 69). A single sensor is very sensitive to tilt which causes the amount of ambient field flux along its axis to change, which will then alter the reading. The problem is solved by using two sensors arranged as a gradiometer with one sensor subtracting the output of the other (Clark 1996: 70). Before use the instrument is required to be ‘balanced’. That is the fine tuning of the detector alignment that reduces direction sensitivity to a minimum. The Grad 601-2 has an internal memory and a data logger that store the survey data. This data is downloaded into a PC and is then processed in a suitable software package.

3.3.2 The Fluxgate Gradiometer is an efficient technique of archaeological prospecting (Gaffney et al 1991: 6). It is suitable for detecting ditches, walls, kilns, hearths and ovens. The Fluxgate Gradiometer will pick up areas of a magnetic field that differ from the 'background' magnetic field of the local geology. A zero point is set over a magnetically stable area of the site to be surveyed. This is termed as balancing. A cut feature such as a ditch will have a different magnetic field to the local geology therefore will elicit a greater response from the sensors. The response will be positive if the fill has a higher magnetic gradient than the surrounding soil. Areas of burning or a ceramic dump (e.g. collapsed tile roof) will have a drastically different magnetic field. Modern rubbish, concrete and other modern activity can have an adverse effect upon the sensors during magnetic survey. Buildings may not be readily detected unless there was a high proportion of brick/tile used in their construction.

3.3.3 The Fluxgate Gradiometer uses a nanoTesla (nT) as a unit of measurement. A Tesla is a unit of magnetic measurement. NanoTeslas must be used as the deviation of the magnetic field due to buried archaeology can be very small. The Earths background magnetic field is in the region of 48000 nT.

3.3.4 The Fluxgate Gradiometer, in common with almost all geophysical techniques, is better at detecting archaeological sites from the Late Prehistoric period onwards. It should always be borne in mind that earlier periods of prehistory that have had less impact upon the landscape (e.g. in the form of significant boundaries, structures etc.) may not be detected by most geophysical techniques.

3.4 Instrumentation used for setting out the survey grid

3.4.1 It is vitally important for the survey grid to be accurately set out. The English Heritage guidelines (David 1995) state that no one corner of any given survey grid square should have more than a few centimetres of error. The survey grid for the site was geo-referenced using a Leica System 1200 Differential Global Positioning System (DGPS). The GPS base station collects satellite position to determine its position. This data is processed in survey specific software to provide a sub centimetre Ordnance Survey position and height for the base station. The survey grid is then tied in to this known accurate position by using a roving satellite receiver that has its position corrected by the static base station. Each surveyed grid point has an Ordnance Survey position; therefore the geophysical survey can be directly referenced to the Ordnance Survey National Grid.

3.5 Data processing

3.5.1 All of the geophysical data processing was carried out using Geoplot V3 published by Geoscan Research. Data processing must be done to the raw survey data to produce a meaningful representation of the results so that they can then be further interpreted. However it is important that the data is not processed too much. Data processing should not replace poor field work. Minimally processed data was produced using the following

schedule of processing. Due to the very high positive readings of some of the magnetic disturbance the values were replaced with a dummy value so as to avoid detrimentally affecting the dataset when further processed. The first process carried out upon the data was to apply a DESPIKE to the data set which removes the random ‘iron spikes’ that occur within fluxgate gradiometer survey data. A ZERO MEAN TRAVERSE was then applied to survey data. This removes stripe effects within grids and ensures that the survey grid edges match. Figures 5, 7 and 9 display the processed survey data.

4.0 GEOPHYSICAL SURVEY RESULTS (Figures 3-10)

4.1 Description of site

4.1.1 The survey area consisted of approximately two hectares of arable land and an area of uncultivated land under rough grass along a linear pipeline corridor. The site was bounded by hedges and fencing for a water treatment works compound along its southern edge.

4.1.2 The vegetation of the site consisted of wheat crop bounded by hedgerows in the south and fencing along the north-western and western sides of the water treatment works and rough grass around the rest of the site.

4.2 Survey limitations

4.2.1 There were few physical barriers to the geophysical survey but those that existed are listed below and were omitted from the survey.

4.2.2 A series of inspection covers were observed around the perimeter of the water treatment works. Where these impacted on the survey, either as a physical barrier or forming an area of magnetic saturation, they were omitted from the survey. Several areas on the periphery of the site were over grown with scrub and were omitted from the survey.

4.3 Introduction to results

4.3.1 The results should be read in conjunction with the figures at the end of this report. The types of features likely to be identified are discussed below.

4.3.2 *Positive Magnetic Anomalies*
Positive anomalies generally represent cut features that have been in-filled with magnetically enhanced material.

4.3.3 *Negative Magnetic anomalies*
Negative anomalies generally represent buried features such as banks that have a lower magnetic signature in comparison to the background geology

4.3.4 *Magnetic Disturbance*
Magnetic disturbance is generally associated with interference caused by modern ferrous features such as fences and service pipes or cables.

4.3.5 *Dipolar Anomalies*
Dipolar anomalies are positive anomalies with an associated negative response. These anomalies are usually associated with discreet ferrous objects or may represent buried kilns or ovens.

4.3.6 *Bipolar Anomalies*
Bipolar anomalies consist of alternating responses of positive and negative magnetic signatures. Interpretation will depend on the strength

of these responses; modern pipelines and cables typically produce strong bipolar responses.

4.4 Interpretation of fluxgate gradiometer results (Figures 6, 8 and 9)

4.4.1 The survey has been divided into four areas based on the orientation of the survey grid (Figures 6, 8 and 10). There were several anomalies visible in the results displaying both high and low magnetic signatures.

Magnetometry results

4.4.2 Anomalies of possible archaeological origin are observed in Areas 2-4 represented by linear positive anomalies (A3, A7, A11 and A19). Due to the ephemeral properties of these anomalies, these responses may also be the result of agricultural activity.

4.4.3 Dipolar anomalies were observed in all four areas of the survey. Random scatters of these anomalies (A2, A6, A10 and A18) are likely to be due to discrete ferrous objects (such as modern material in the near surface). However, A14 (Figures 8 and 10) is a much larger anomaly and may be the response from a much larger ferrous object with an associated spread of dipolar anomalies (A17). With the proximity of this anomaly to the former runway this anomaly may be associated with the activity of RNAS Ford. Another cluster of dipolar anomalies (A15) is observed within an area of magnetic debris (A16) (see below).

4.4.4 Several areas of magnetic debris (A4, A8, A12 and A16) were identified within the survey data. A4 and A8 (Figures 6 and 8) are located adjacent to the Waste Water Treatment Works and are likely to relate to ground disturbance. A12 (Figure 8) is located near to the entrance both to the treatment works and to the field and is therefore probably the result of ground disturbance in relation to these. At the eastern end of the pipeline corridor (Figure 10) a large area of magnetic debris (A16) with associated dipolar anomalies (A15) may relate to features associated with the former Ford Airfield such as a taxiway.

4.4.5 Magnetic disturbance (A1, A5, A9 and A13) is observed along the majority of the southern boundary of the survey area (Figures 6, 8 and 10). This disturbance relates, in Areas 1-3 (Figures 6 and 8), to metallic fencing surrounding the Waste Water Treatment Works and in Area 4 (Figures 8 and 10) to a modern service such as a pipe running alongside the former runway.

4.4.6 Place (2004) identified brickearth sub-soils within the area of the Waste Water Treatment Works. In addition to this, several of the features indicated as possibly entering the area of the survey are recorded as being shallow and difficult to detect suggesting that the fills within these features may not vary significantly from the surrounding sub-soil. Therefore these features may still be present although not detected through magnetometry.

5.0 CONCLUSION

5.1 Discussion

5.1.1 The magnetometry survey successfully detected anomalies of possible archaeological origin across the site. Several linear positive anomalies observed along the pipeline corridor may have an archaeological origin. However, these may also be the result of more recent agricultural activity. As previously stated the shallow depth and lack of variation within the features identified in previous excavation work as possibly entering the survey area may lead to features having little or no magnetic contrast between fills and surrounding sub-soils. Due to the proximity of several metallic objects in and alongside the survey area, such as pipes and fences, a significant part of the resultant data consisted of magnetic disturbance. Two further areas of magnetic debris and bipolar anomalies may possibly relate to the areas use as a former airfield.

5.2 Statement of Indemnity

5.2.1 Geophysical survey is the collection of data that relate to subtle variations in the form and nature of soil and which relies on there being a measurable difference between buried archaeological features and the natural geology. Geophysical techniques do not specifically target archaeological features and anomalies noted in the interpretation do not necessarily relate to buried archaeological features. As a result, magnetic and earth resistance detail survey may not always detect sub-surface archaeological features. This is particularly true when considering earlier periods of human activity, for example those periods that are not characterised by sedentary social activity.

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Acknowledgements

Archaeology South-East would like to thank Mott MacDonald for commissioning the survey.

Appendix 1

Included on C.D

1. Raw Magnetometry Data

HER SUMMARY

Site Code	-					
Identification Name and Address	Fomer Ford Airfield					
County, District &/or Borough	Ford, west Sussex					
OS Grid Refs.	499643 103214					
Geology	River terrace deposits					
Arch. South-East Project Number	44929					
Type of Fieldwork	Eval.	Excav.	Watching Brief	Standing Structure	**Survey**	Other
Type of Site	Green Field	Shallow Urban	Deep Urban	Other		
Dates of Fieldwork	Eval.	Excav.	WB.	**23-24th may 2011**		
Sponsor/Client	Mott Macdonald					
Project Manager	Andy Leonard					
Project Supervisor	John cook					
Period Summary	Palaeo.	Meso.	Neo.	BA	IA	RB
	AS	MED	PM	Modern		

100 Word Summary.

Archaeology South East was commissioned by Mott MacDonald to carry out a detailed fluxgate gradiometer survey on land at Former Ford Airfield, Ford in advance of pipeline instatement. The survey covered two hectares and took place on the 23rd and 24th of May 2011. The survey area consisted of arable land under wheat and an area of uncultivated land under rough grass bounded by hedges and fencing for a water treatment works compound. Due to the proximity to several metallic objects in and alongside the survey area such as pipes and fences a significant part of the resultant data consisted of magnetic disturbance. Several linear positive anomalies observed along the pipeline corridor may have an archaeological origin. However, these may also be the result of more recent agricultural activity. Two further areas of magnetic debris and bipolar anomalies may possibly relate to the former airfield.

OASIS FORM

OASIS ID: archaeol6-102477

Project details

Project name	Fomer Ford Airfield, West sussex
Short description of the project	Archaeology South East was commissioned by Mott MacDonald to carry out a detailed fluxgate gradiometer survey on land at Former Ford Airfield, Ford in advance of pipeline instatement. The survey covered two hectares and took place on the 23rd and 24th of May 2011. The survey area consisted of arable land under wheat and an area of uncultivated land under rough grass bounded by hedges and fencing for a water treatment works compound. Due to the proximity to several metallic objects in and alongside the survey area such as pipes and fences a significant part of the resultant data consisted of magnetic disturbance. Several linear positive anomalies observed along the pipeline corridor may have an archaeological origin. However, these may also be the result of more recent agricultural activity. Two further areas of magnetic debris and bipolar anomalies may possibly relate to the former airfield.
Project dates	Start: 23-05-2011 End: 24-05-2011
Type of project	Field evaluation
Site status	None
Current Land use	Cultivated Land 1 - Minimal cultivation

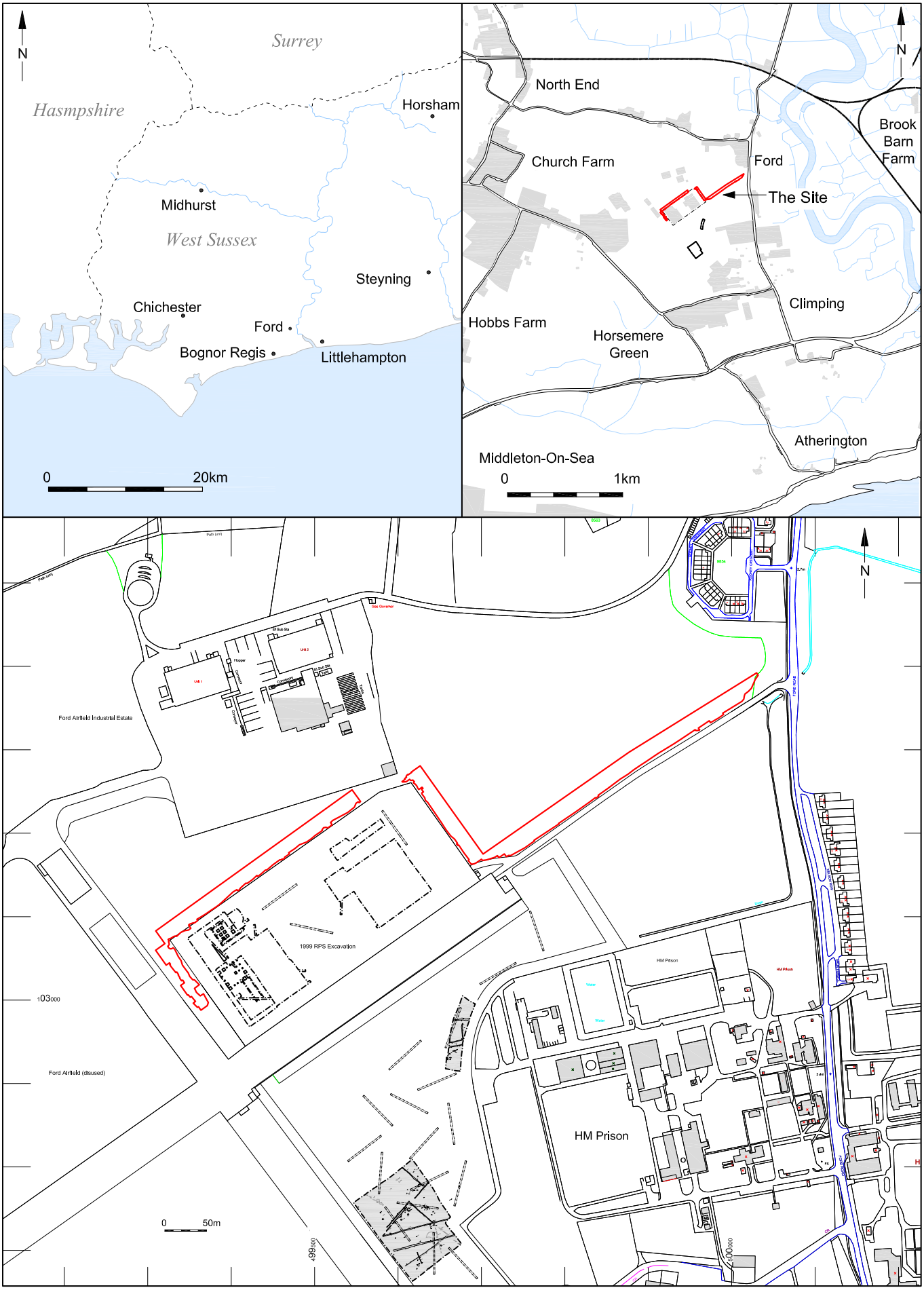
Project location

Country	England
Site location	WEST SUSSEX ARUN ARUNDEL Ford Airfield
Study area	2.20 Hectares
Site coordinates	SU 499643 103214 50.8896600788 -1.289561168140 50 53 22 N 001 17 22 W Point

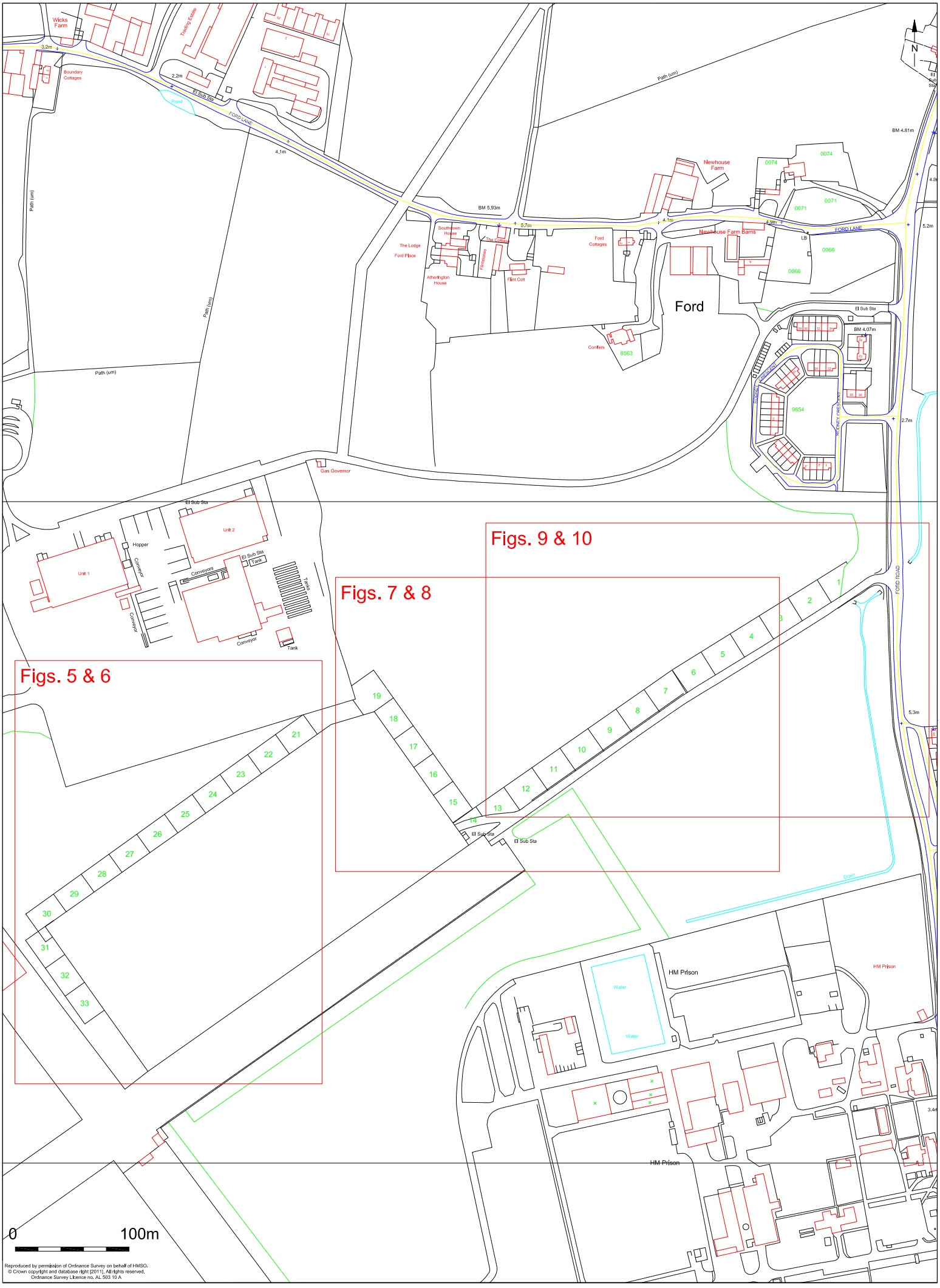
Project creators

Name of Organisation	Archaeology South East
Project director/manager	Jon Sygrave
Project supervisor	John Cook

Entered by	Jim Stevenson (jim.stevenson@ucl.ac.uk)
Entered on	3 June 2011



© Archaeology South-East		Former Ford Airfield, Ford, West Sussex	Fig. 1
Project Ref: 4929	May 2011	Site Plan	
Report Ref: 2011130	Drawn by: JC		



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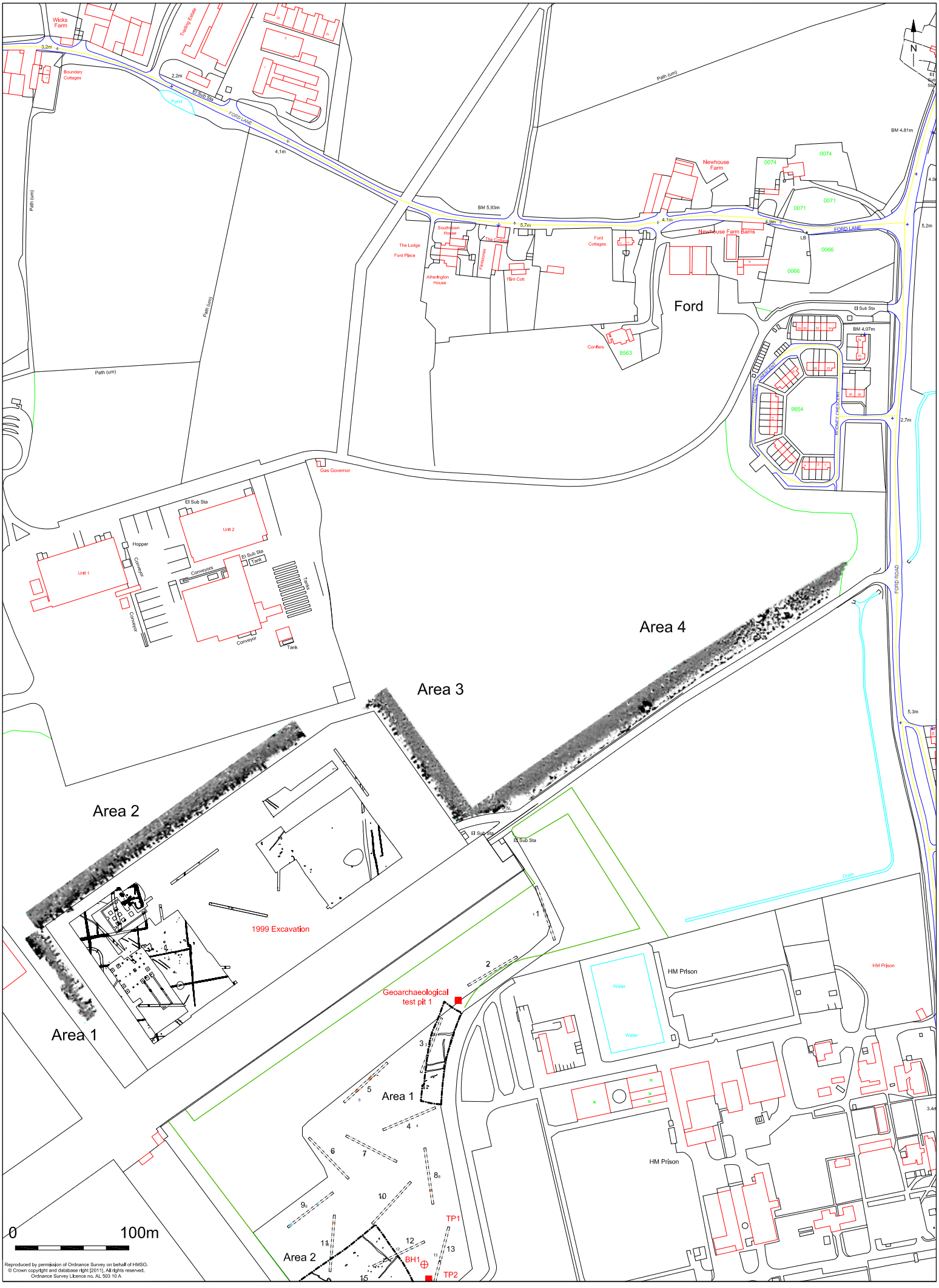

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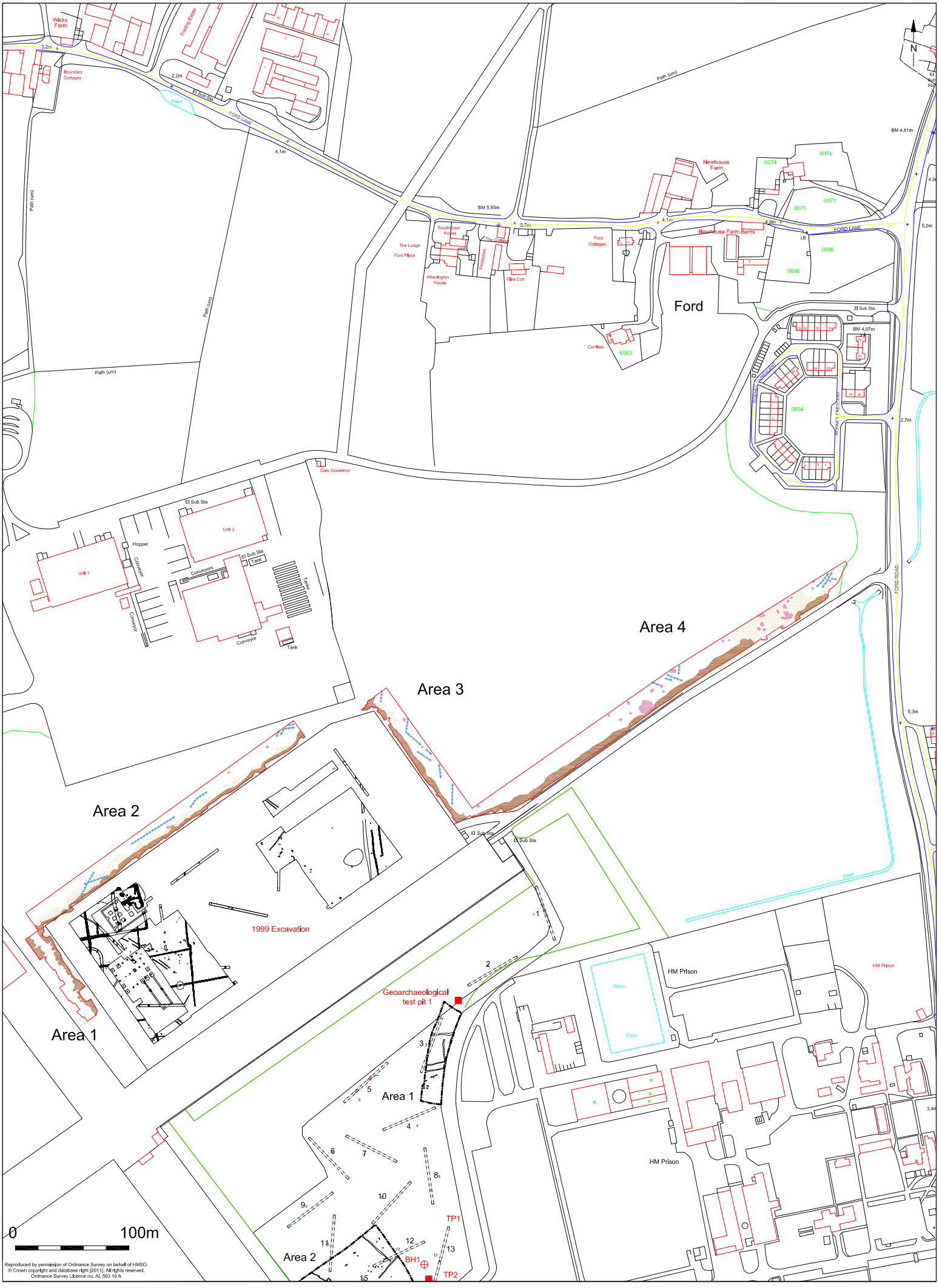
Project Ref: 4929	May 2011	Plan showing shade plots of all areas	
Report Ref: 2011130	Drawn by: JC		



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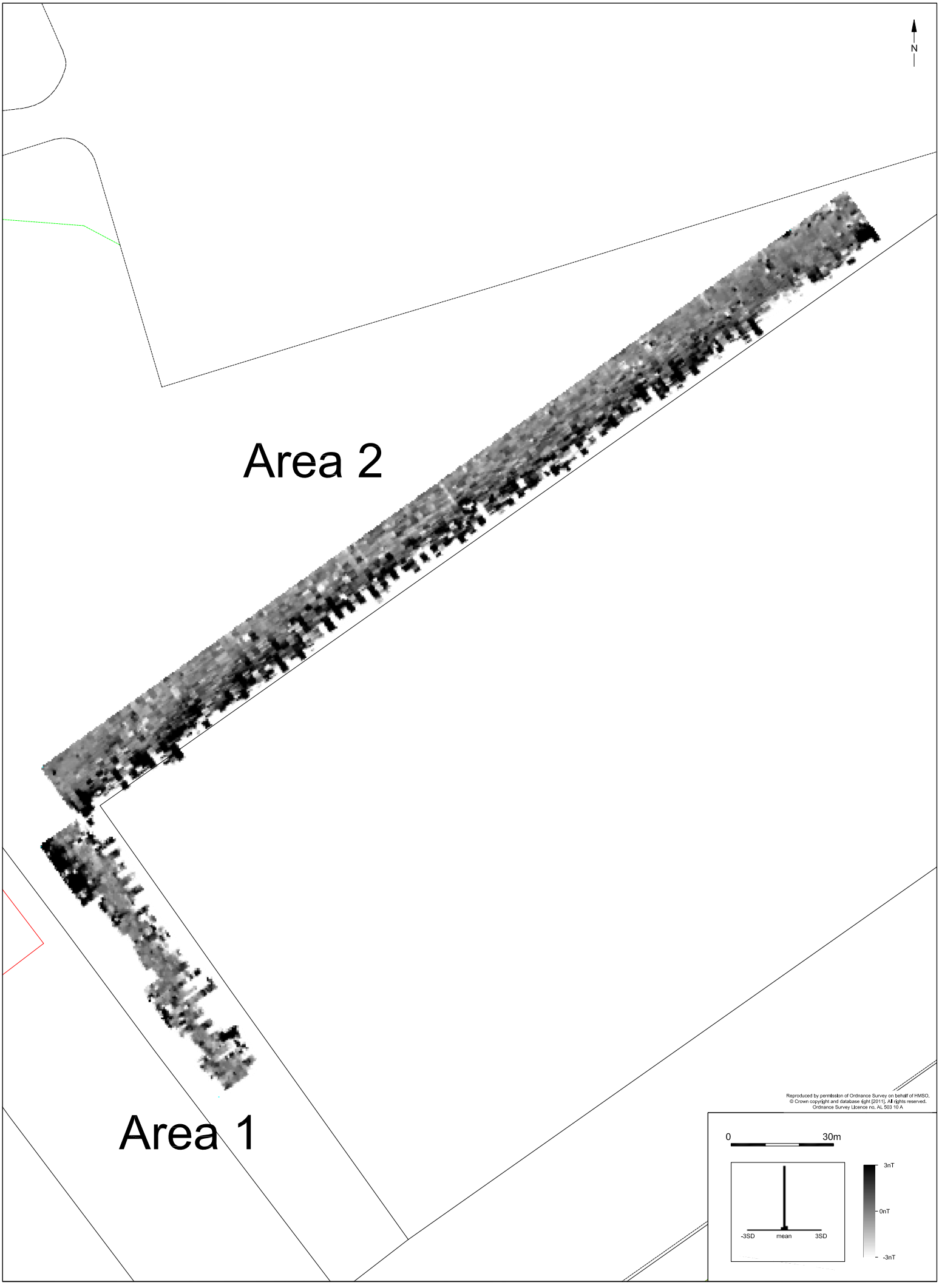

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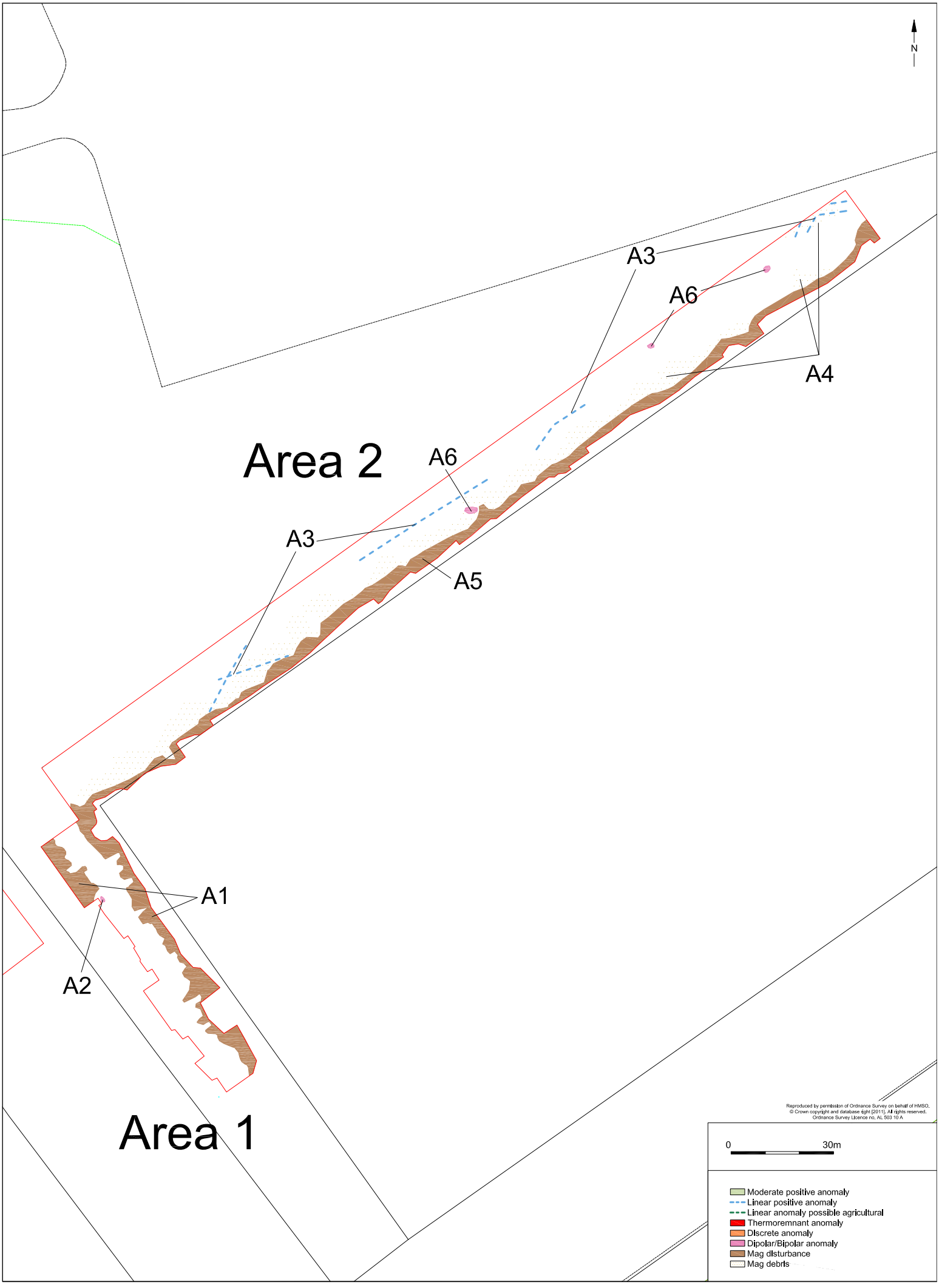

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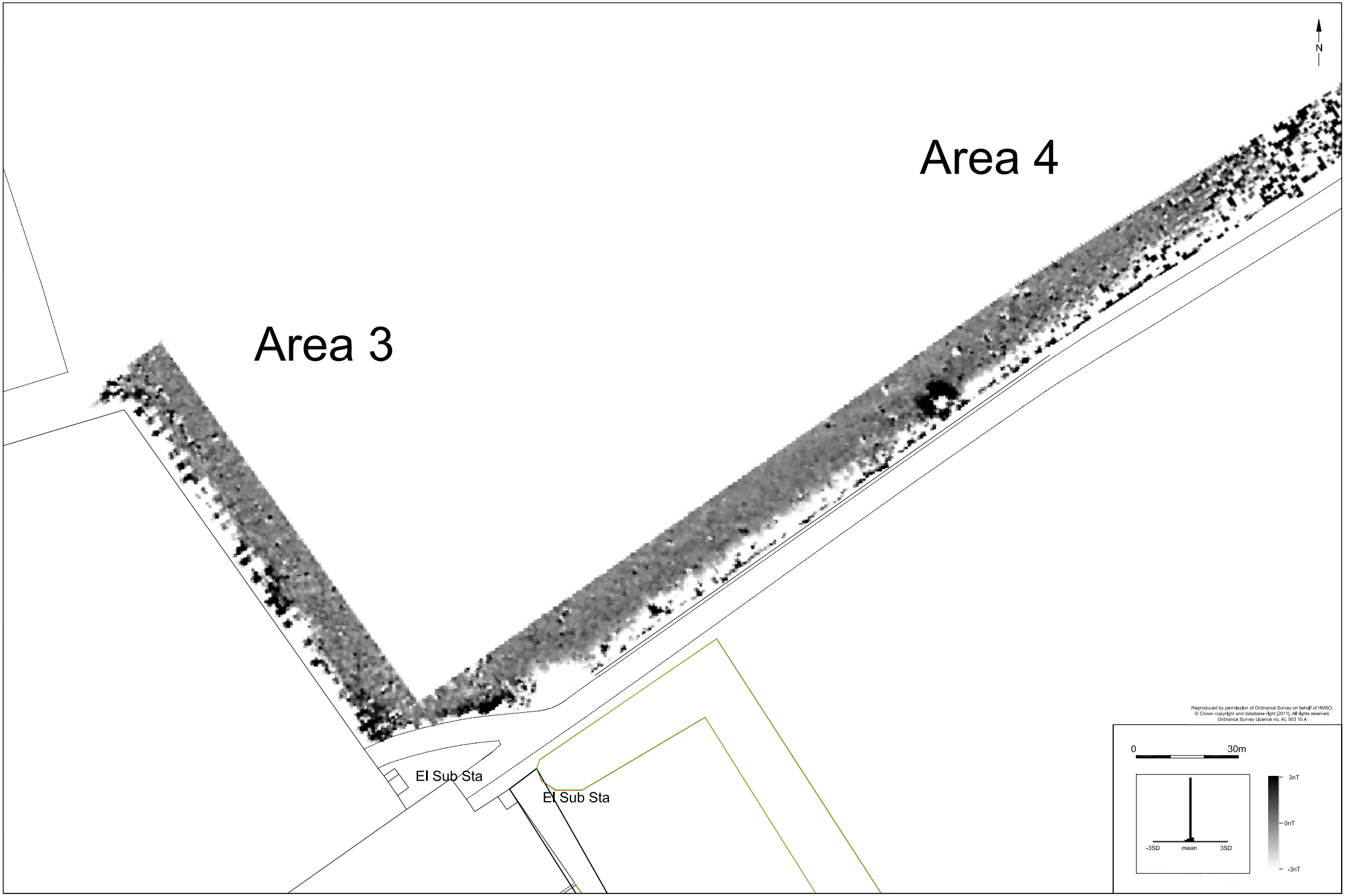

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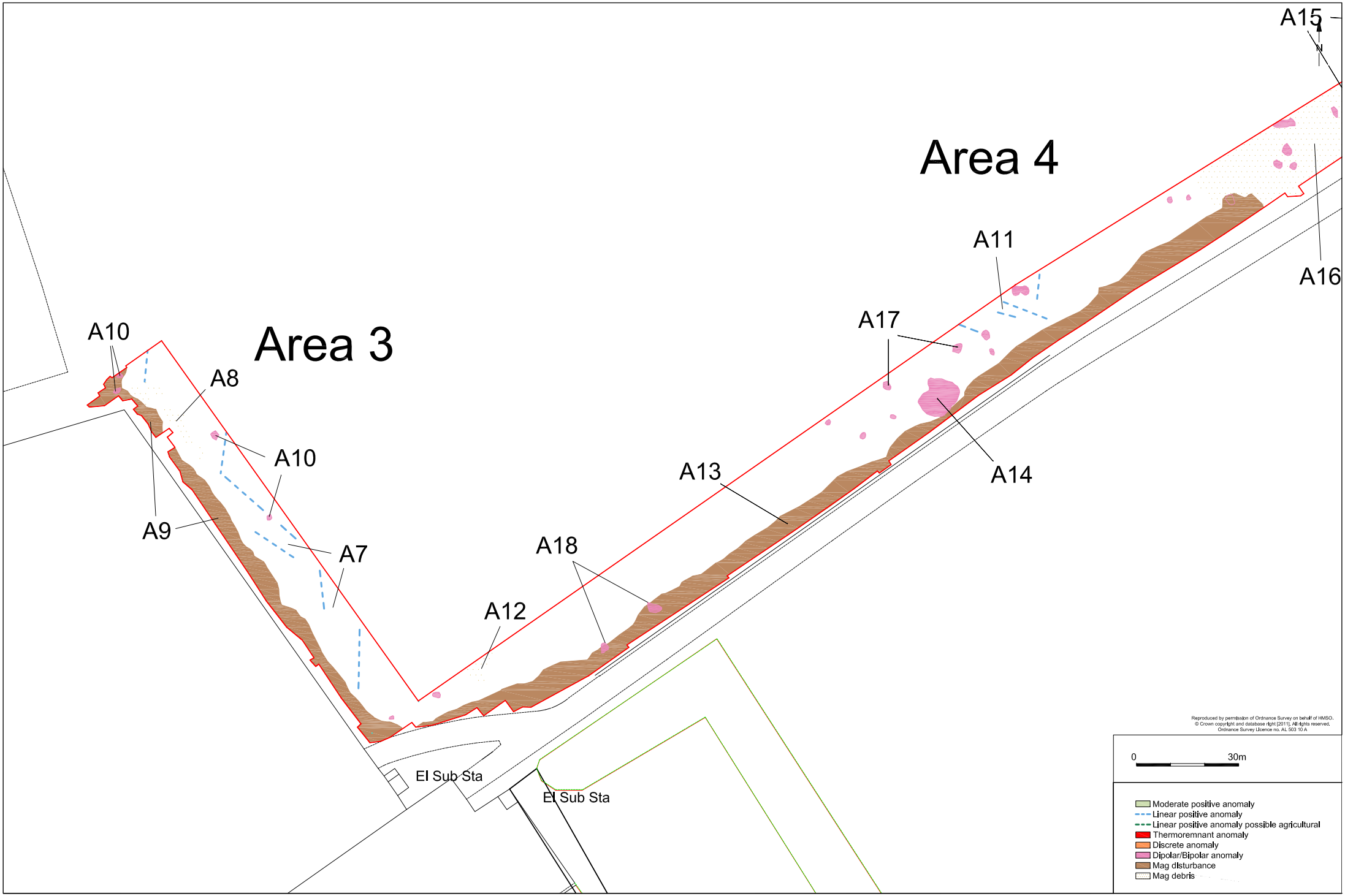

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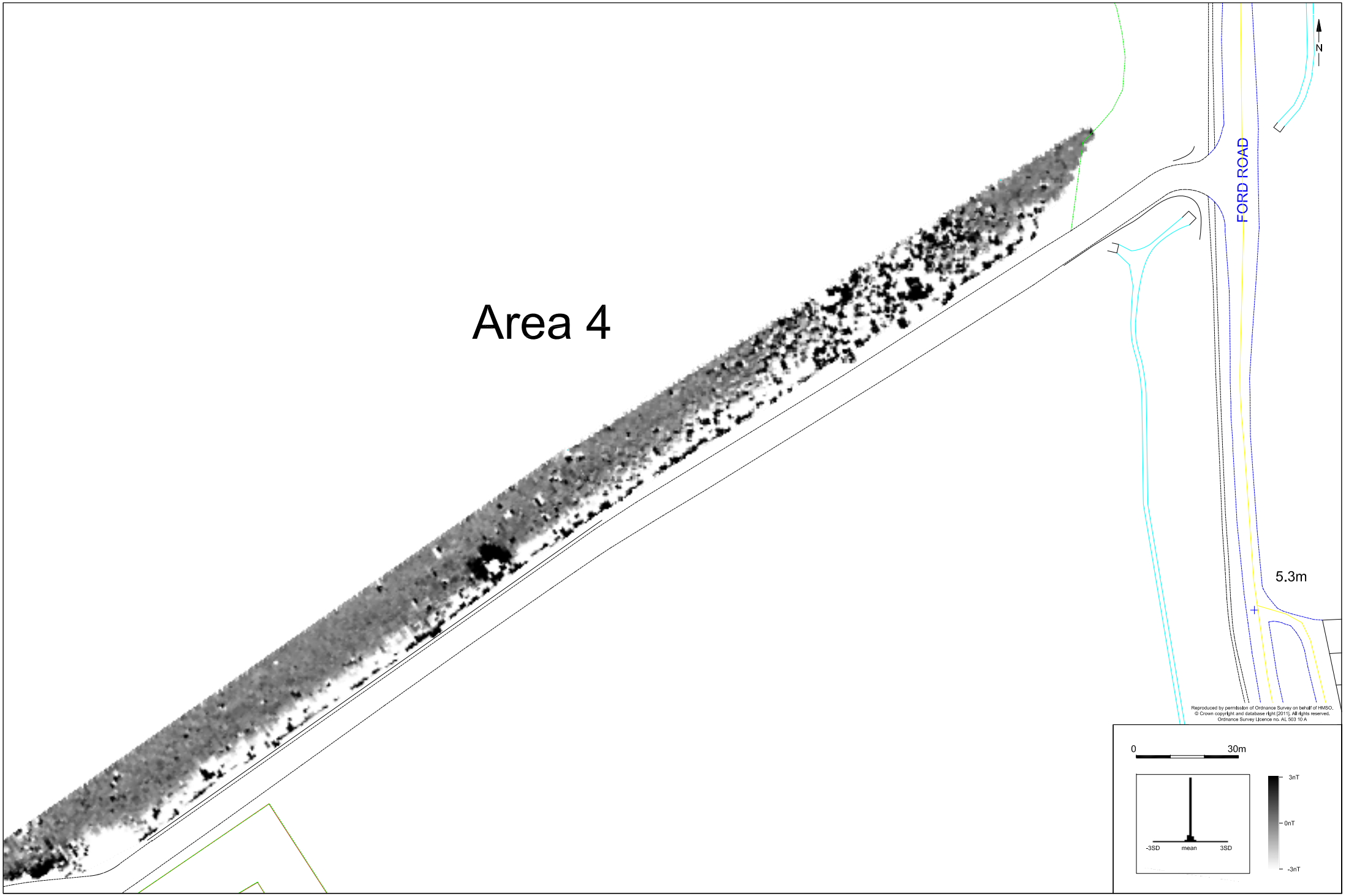

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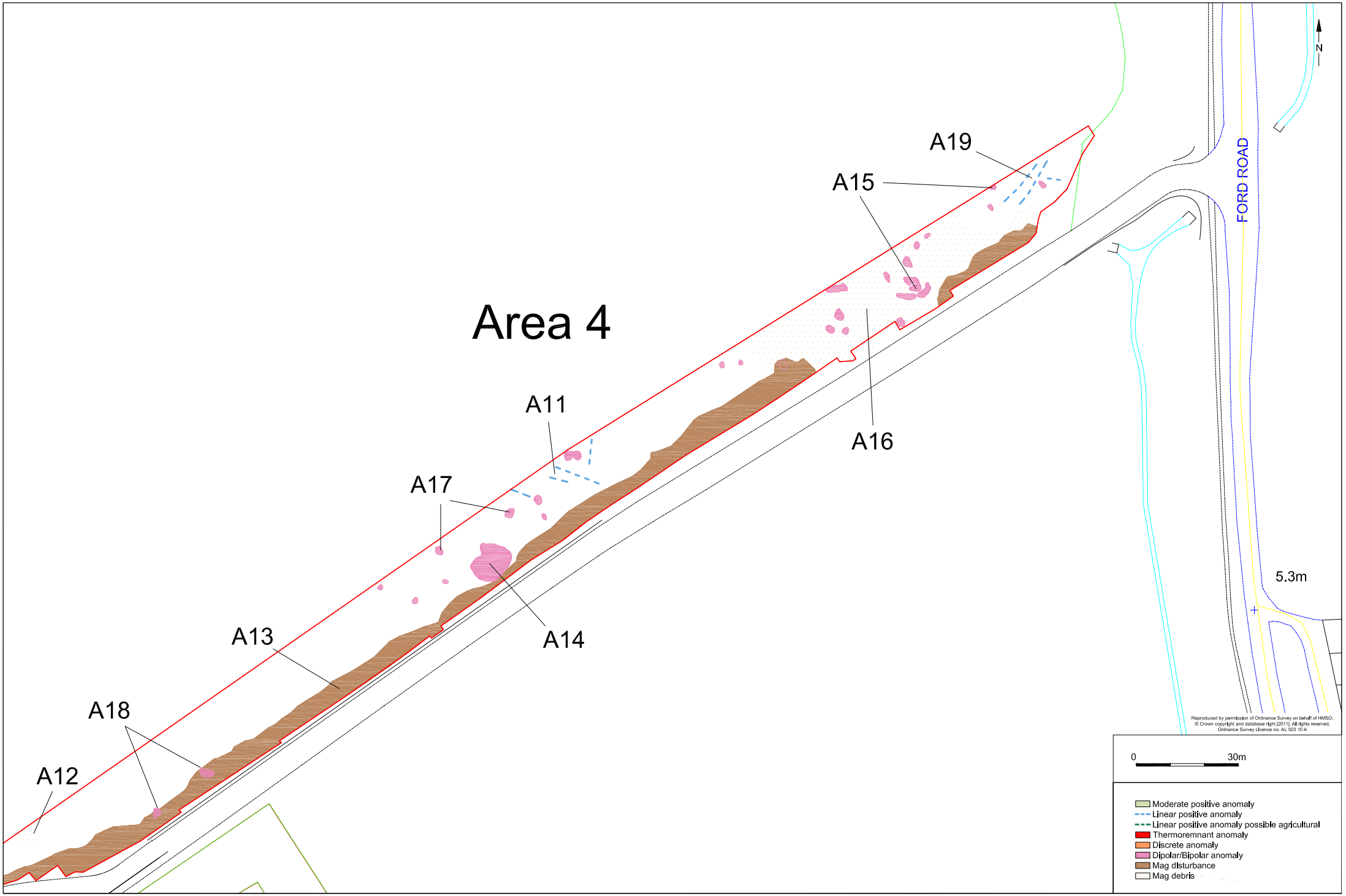

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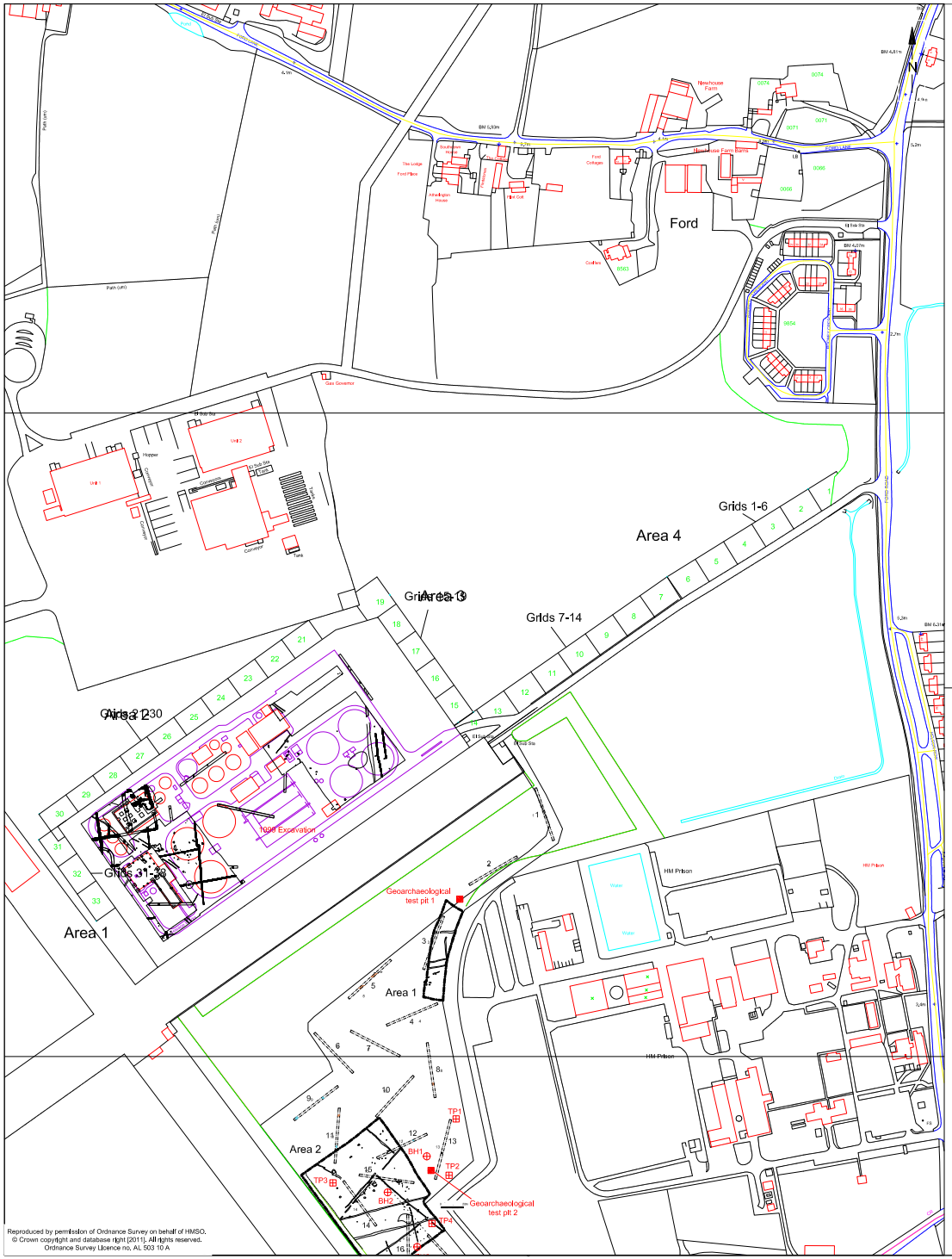
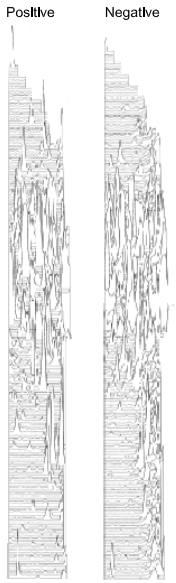
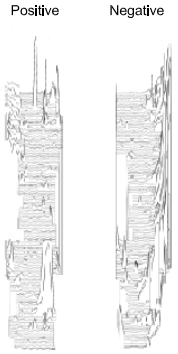




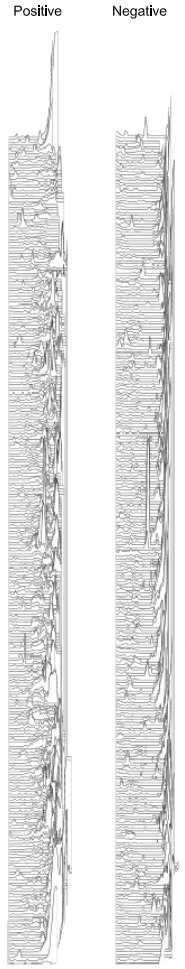
Grids 1-6 Area 4

Grids 7-14 Area 4

Grids 15-19 Area 3



Grids 31-33 Area 1



Grids 21-30 Area 2

Positive trace plots 0-100nT
Negative trace plots -100-0nT

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Report Ref: 2011130	Drawn by: JC		