APPENDIX 13.2

GEOPHYSICAL SURVEY

KNAPTON – EBBERSTON PIPELINE, NORTH YORKSHIRE

GEOPHYSICAL SURVEY

Work undertaken for
Barton Willmore

June 2013

Report produced by
Neil Jefferson BSc (Hons)

OASIS Ref: archaeol1-154653
National Grid References:
Area 1: SE 89700 89400
Area 2: SE 83300 87000
Area 3: SE 87000 78700

ARCHAEOLOGICAL PROJECT SERVICES

Quality Control

Knapton – Ebberston pipeline,
North Yorkshire,
(KNEP13)

Project Coordinator	Gary Taylor
Site Staff	Jonathon Smith, Andy Failes
Survey processing and report	Neil Jefferson

Checked by Project Manager	Approved by Senior Archaeologist
Steve Malone	Tom Lane
Date: 9/7/13	Date: 10.7.13

CONTENTS

1. SUMMARY 1

2. INTRODUCTION 1

2.1 DEFINITION OF AN EVALUATION 1
2.2 BACKGROUND 1
2.3 TOPOGRAPHY AND GEOLOGY 1

3. GEOPHYSICAL SURVEY 2

3.1 METHODS 2
3.2 RESULTS 3

4. DISCUSSION 3

5. ACKNOWLEDGEMENTS 4

6. PERSONNEL 4

7. BIBLIOGRAPHY 4

8. ABBREVIATIONS 4

Appendix 1 The Archive

Appendix 2 Oasis Form

List of Figures

Figure 1 General location map

Figure 2 Locations of survey areas

Figure 3 Location and layout of survey areas

Figure 4 Minimally processed data greyscale plot

Figure 5 Minimally processed data trace plot

Figure 6 processed data greyscale plot

Figure 7 interpretative plot

Figure 8 processed data greyscale plot overlaid on map

1. SUMMARY

Detailed magnetic gradiometer survey was undertaken for Barton Willmore in connection with proposed pipeline between Knapton and Ebberston, North Yorkshire. Three targeted areas were surveyed totalling 2.4ha. These were targeted in areas adjacent to prehistoric earthworks and others where Roman pottery had been found.

The survey recorded two linear anomaly, four possible furrows and a number of pit-like features. Other responses represent modern disturbance, service and geological features.

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'* (IfA 2008).

2.2 Background

Archaeological Project Services was commissioned by Barton Willmore to undertake detailed magnetometer survey on three areas on the proposed pipeline between Knapton and Ebberston, North Yorkshire. Three separate areas, totalling 2.4ha, were surveyed was carried out between the 25th and 27th of May 2013.

2.3 Topography and Geology

The proposed pipeline passes principally through the civil parish of Allerston which is located 8km southeast of Pickering and 19km southwest of Scarborough, in the administrative district of Ryedale, North Yorkshire.

In addition to Allerston, the pipeline passes through the civil parishes of Ebberston and Yedingham, Wilton and Scampston.

The northernmost point of the route lies at a gas valve compound on Ebberston Moor (SE 8993 8964), on the parish boundary between Allerston and Ebberston and Yedingham. The compound is located on the eastern edge of Dalby Forest, within the North Riding Forest Park on the south-eastern fringe of the North York Moors National Park.

The proposed pipeline route continues in a broad trend to the southwest, traversing the parish of Allerston. It crosses the parish boundary to Wilton at SE 8697 8302, approximately 900m east of Wilton village, where it also crosses the A170. The route continues south, re-entering Allerston parish, to the northwest of Yedingham. After crossing the River Derwent, the pipeline route heads southward and then southeast towards the Knapton Generating Station, within Scampston parish at SE 8871 7690. The three surveyed areas are centred on SE 89700 89400, SE 83300 87000, SE 87000 78700 (Fig. 2).

Area 1 lies at a height of c. 247m OD on generally flat land. Area 2 lies at 90m OD on land sloping down to the south. Area 3 lies at 20m OD on flat land.

The geology in Areas 1 and 2 comprises Jurassic Limestone (BGS 1998), while

Area 3 consists of a Quaternary period Lacustrine deposits (Clay) over the solid geology of Ampthill clay created in the Jurassic period (BGS1998).

3. GEOPHYSICAL SURVEY

3.1 Methods

Location and layout of the survey areas is shown in Figure 3. Area 1 was reduced in size due to the very high readings created by an existing pipeline running parallel to the route.

Survey was undertaken in accordance with English Heritage (2008) and IfA (2011) guidelines and codes of conduct.

The magnetic survey was carried out using a dual sensor Grad601-2 Magnetic Gradiometer manufactured by Bartington Instruments Ltd. This records subtle changes in the magnetic field resulting from differing features in the soil. 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 mapping of anomalies in a systematic manner allows interpretation of the type of material present beneath the surface. Strong magnetic anomalies are generated by buried iron-based objects or by kilns or hearths, usually resulting in a bipolar (positive/negative) response. More subtle positive anomalies representing pits and ditches can be seen where these contain more topsoil which is normally richer in magnetic iron oxides and provides a contrast with the natural subsoil (but this can vary depending on the nature of the underlying deposits). A negative anomaly may result from upcast bank material. Wall foundations can also show as negative anomalies where the stone is less magnetic than the surrounding soil or as stronger positive and negative anomalies if of brick, but are not always responsive to the technique. It should be noted that not all features will be responsive and absence of anomalies does not necessarily indicate absence of archaeological features.

Magnetometers measure changes in the Earth's magnetic field. With two sensors configured as a gradiometer the recorded values indicate the difference between two magnetic measurements separated by a fixed distance. The Grad601-2 consists of two high stability fluxgate gradiometers suspended on a single frame with a 1m separation between the sensing elements giving a strong response to deep anomalies.

Sampling interval and data capture
Readings were taken at 0.25m centres along traverses 1m apart. This equates to 3600 sampling points in a full 30m x 30m grid. The Grad 601 has a typical depth of penetration of 0.5m to 1.0m although a greater range is possible where strongly magnetic objects have been buried in the site.

Readings are logged consecutively into the data logger which is downloaded daily either into a portable computer whilst on site or directly to the office computer. At the end of each job, data is transferred to the office for processing and presentation.

Processing and presentation of results
Processing is performed using specialist ArcheoSurveyor software. This can emphasise various aspects contained within the data but which are often not easily seen in the raw data. Basic processing of the magnetic data involves flattening the background levels with respect to adjacent traverses and adjacent

grids (Destripe or zero mean traverse). Despiking is also performed to reduce the effect of the anomalies resulting from small iron objects often found on agricultural land. Further processing can then be carried out which may include low pass filtering to reduce 'noise' in the data and hence emphasise the archaeological or man-made anomalies.

The following are the processing techniques carried out on the processed gradiometer data used in this report:

1. DeStripe (sets the background mean of each traverse within a grid to zero and is useful for removing striping effects)

2. Despike (useful for display and allows further processing functions to be carried out more effectively by removing extreme data values)
Parameters: X radius = 1; Y radius = 1; Threshold = 3SD; Spike replacement = mean

3. Clip (excludes extreme values allowing better representation of detail in the mid range): -5to 5nT.

3.2 Results

The presentation of the data for the site involves a print-out of the raw or minimally processed data as greyscale and trace plots (Figs 4 and 5; clipped for display but otherwise unprocessed), together with greyscale plots of the processed data (Fig 6). Magnetic anomalies have been identified and plotted onto an interpretative drawing (Fig. 7) and are described below.

1 -Positive linear anomalies
Two positive anomaly of possible archaeological origin has been identified.

2 -Discrete positive anomalies
Examples of discrete positive anomalies are highlighted and possibly represent pit features. These are generally isolated, the responses are not strong, and these are difficult to interpret on the basis of form alone. However there is a greater concentration in Area 2 including one or two larger responses, which may have an archaeological origin.

3 -Modern/magnetic disturbance
Strong bipolar responses aligned NE-SW along the NW edge of Area 1 probably result from the presents of a existing pipe parallel to the proposed route.

4 -Iron spikes (discrete bipolar anomalies)
Iron items within the topsoil give a distinctive localised bipolar (strong positive with associated strong negative) response. Such items usually derive from relatively recent management or agricultural use of the land – broken or discarded pieces of agricultural machinery or other modern debris.

5 -Geological Features
Irregular linear features probably representing cracks or undulations in the limestone bedrock were noted in the northern part of Area 3.

6 -Agricultural features
A series of fairly weak parallel linear responses can be seen in Area 2 probably reflecting earlier ridge and furrow cultivation.

4. DISCUSSION

Area 1 was chosen because of the presence of prehistoric earthwork features in the vicinity. However, the strong bipolar response from an existing service/pipeline parallel to the proposed route effectively blanks out the whole of this area and little or nothing can be seen.

Area 2 was targeted on a scatter of Roman pottery found on the surface. Here, the results recorded part of a Medieval ridge and furrow pattern, a linear feature and possible pits of archaeological origin. The linear feature is probably a ditch, perhaps a field boundary. However, its alignment does not correspond with nearby field boundary's, suggesting it pre-dates the current field systems.

Area 3 was also chosen because of a spread of Roman pottery seen in the walkover survey. Although one possible ditch-like anomaly was recorded, it is more likely to have a geological origin, possibly as a crack in the bedrock. Patterns directly north of this linear are also probably due to geological variations.

5. ACKNOWLEDGEMENTS

Archaeological Project Services wishes to acknowledge Barton Willmore who commissioned the project; Steve Malone and Tom Lane (APS) edited the report.

6. PERSONNEL

Project coordinator: Gary Taylor
Geophysical Survey: Jonathon Smith, Andy Failes
Survey processing and reporting: Neil Jefferson

7. BIBLIOGRAPHY

BGS, 1998 *Scarborough; solid and drift edition*, 1:50 000 map sheet 54

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

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

IfA, 2008 *Standard and Guidance for Field Evaluation.*

IfA, 2011 *Standard and Guidance for Geophysical Survey.*

8. ABBREVIATIONS

BGS British Geological Survey

IfA Institute for Archaeologists

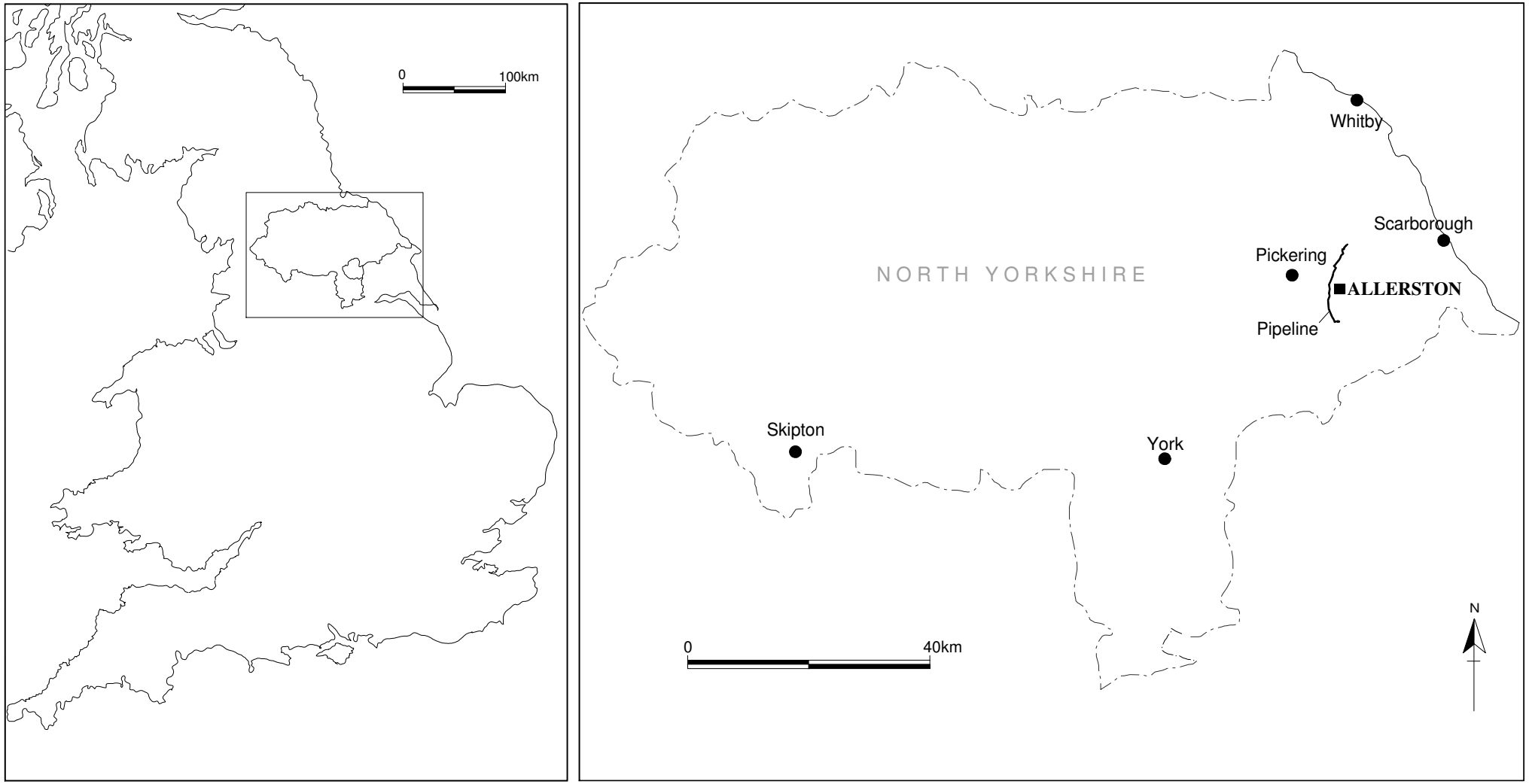
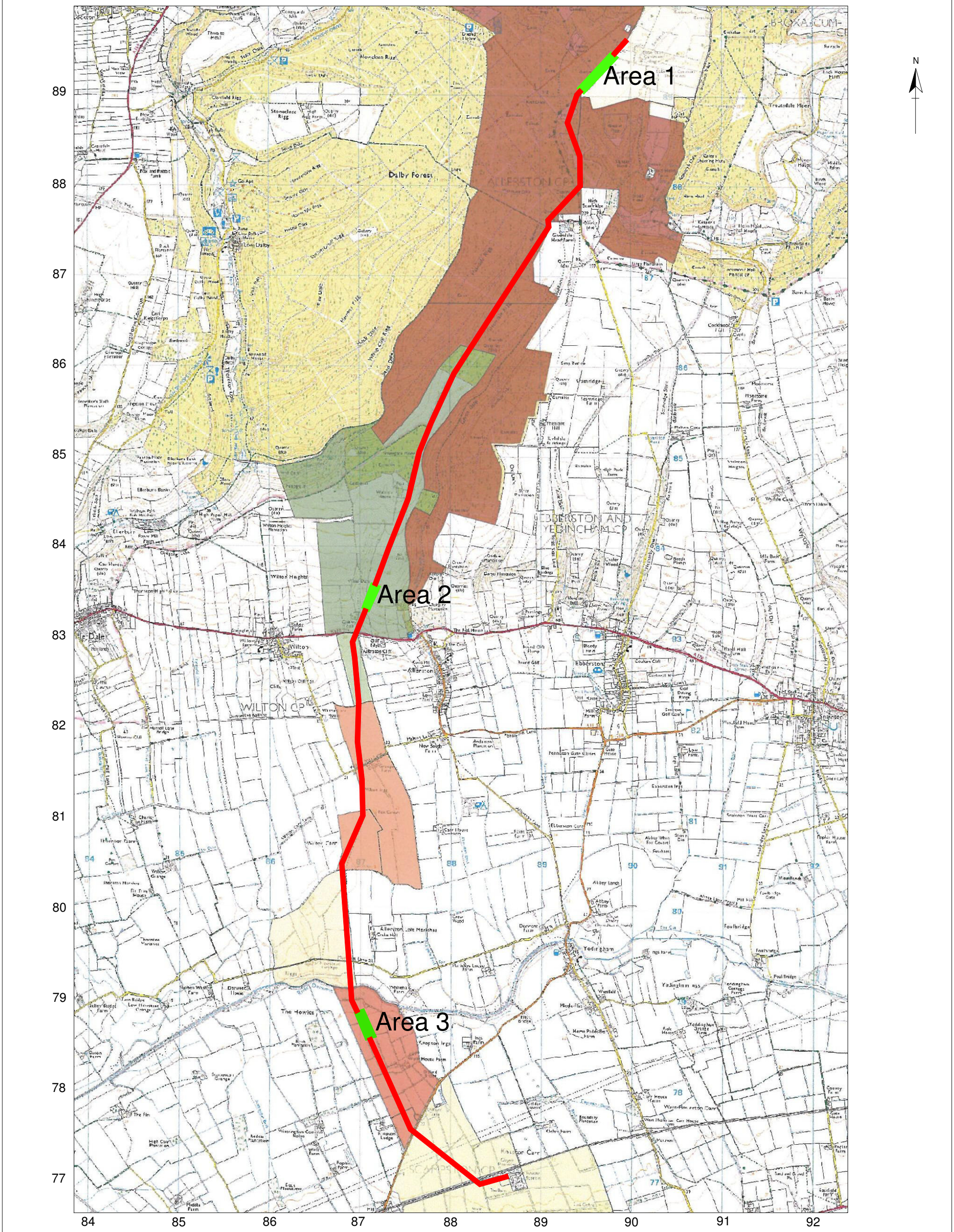


Figure 1 - General Location Map



Archaeological Project Services

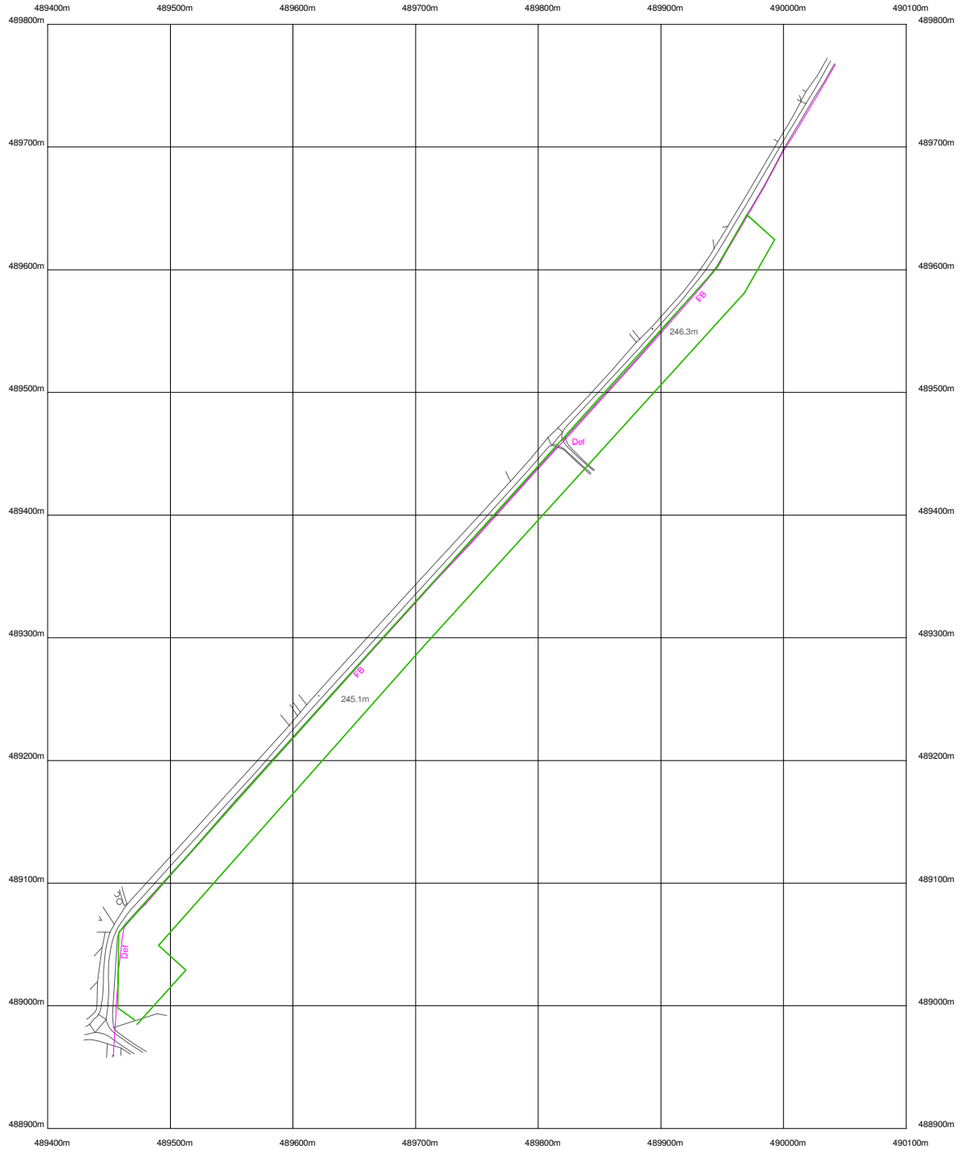
Project Name: Knapton - Ebberston Pipeline, (KNEP13)

Scale 1:40000	Drawn by: NMJ	Report No: 80/13

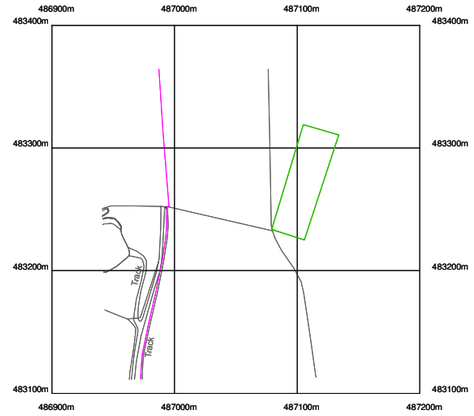
Figure 2, Locations of survey areas

N

Area 1



Area 2



Area 3

0 400m

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Scale 1:5000	Drawn by: NMJ	Report No: 80/13

Figure 3, Location and layout of survey areas

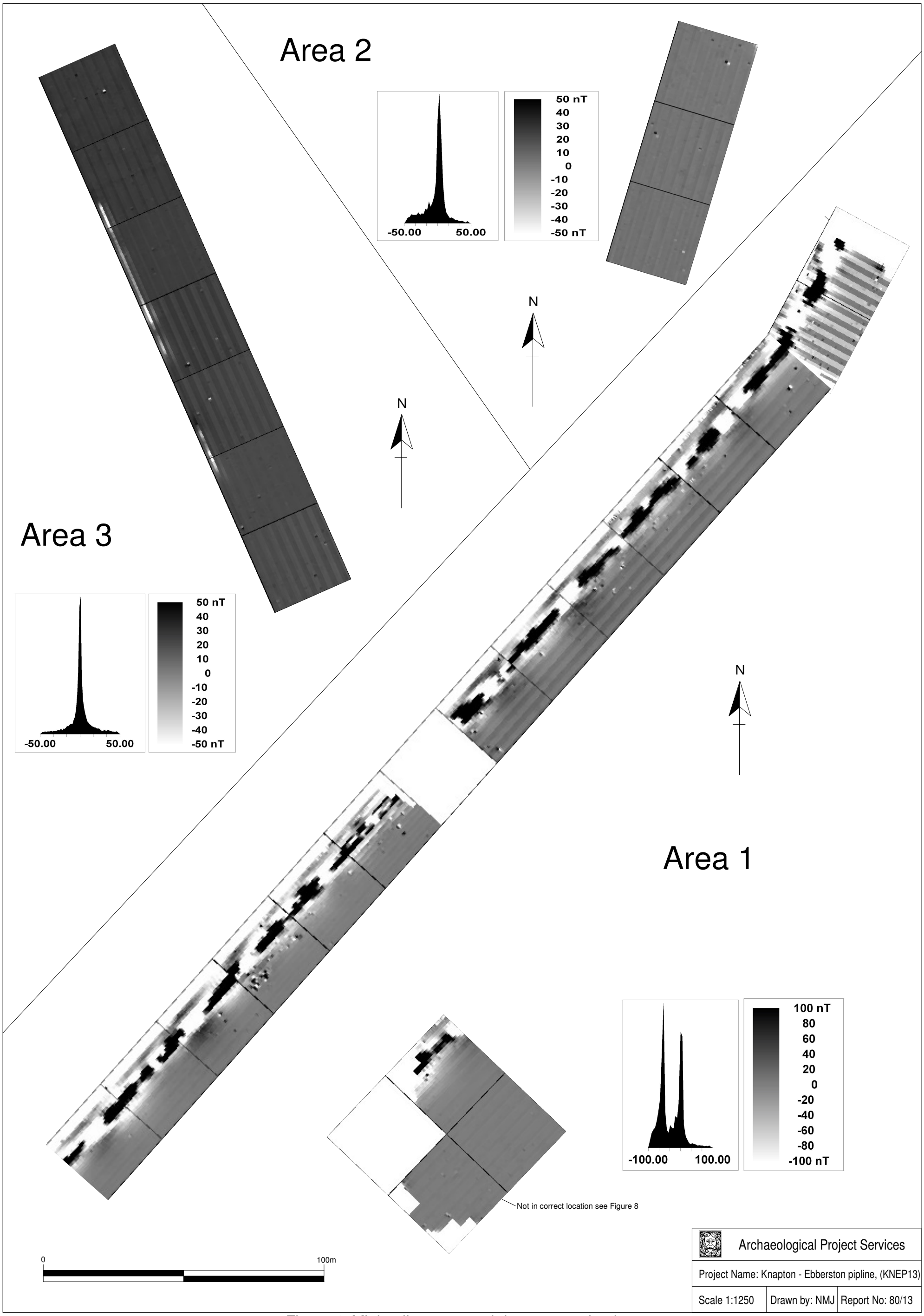

Figure 4, Minimally processed data greyscale plot

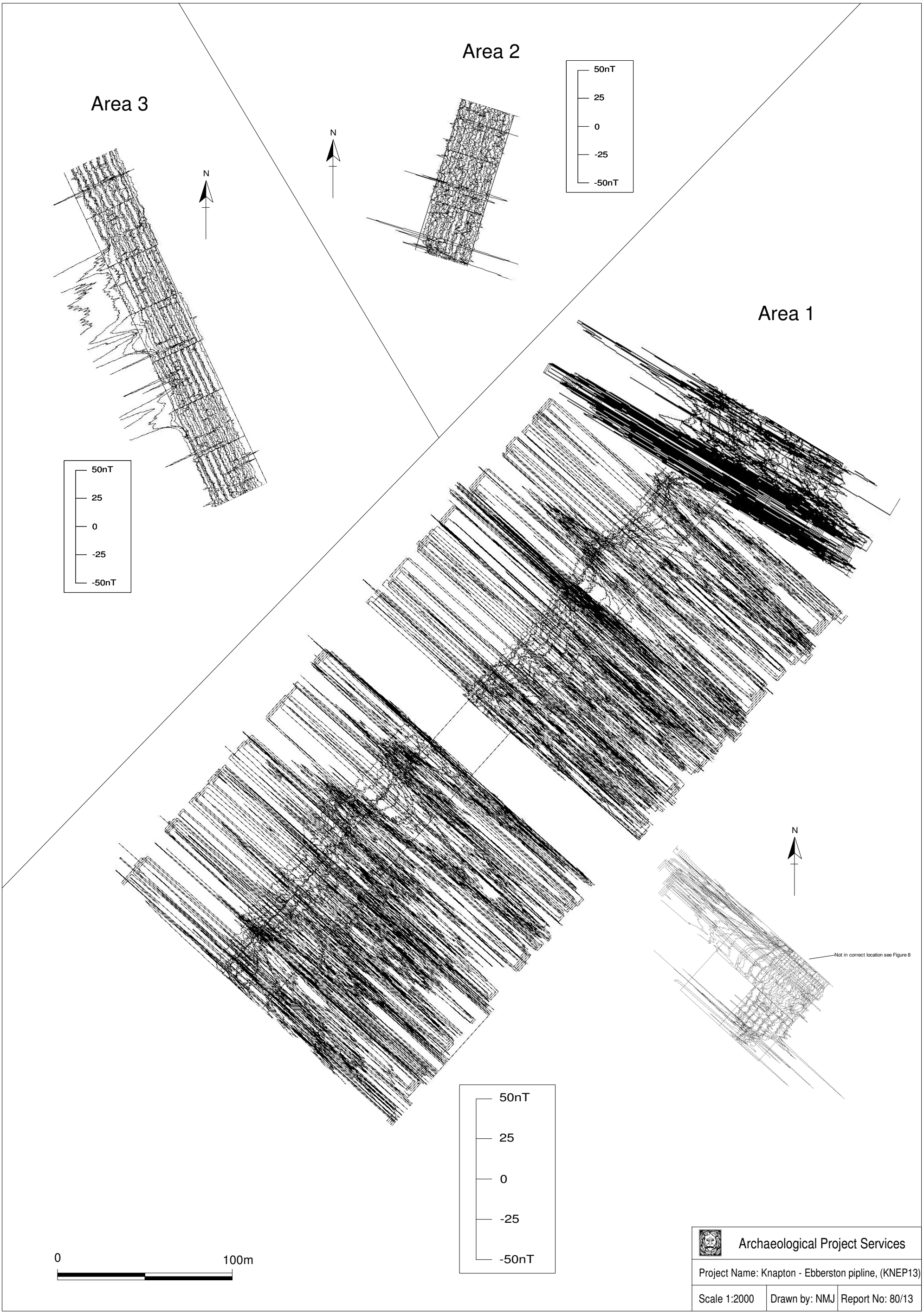

Figure 5, Minimally processed data trace plot

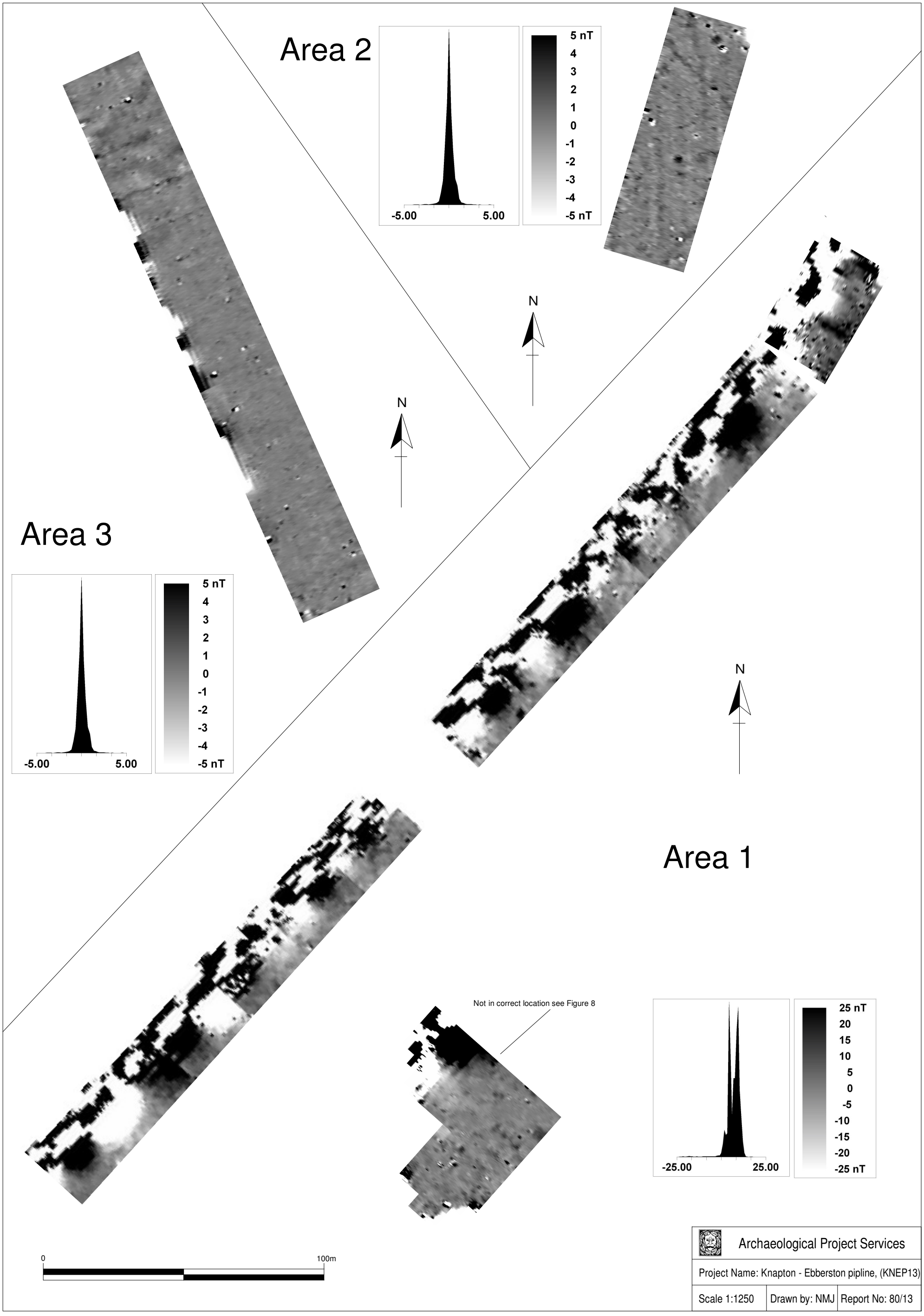

Figure 6, Processed data greyscale plot

Area 2

-5.00 5.00

5 nT 4 3 2 1 0 -1 -2 -3 -4 -5 nT

N

Area 3

-5.00 5.00

5 nT 4 3 2 1 0 -1 -2 -3 -4 -5 nT

N

Area 1

Key (For all Areas)

- Positive linear anomaly
- Examples of ferrous responses
- Examples of discrete positive anomalies
- Magnetic disturbance
- Service
- Geological feature
- Agricultural features

Not in correct location see Figure 8

-25.00 25.00

25 nT 20 15 10 5 0 -5 -10 -15 -20 -25 nT

0 100m

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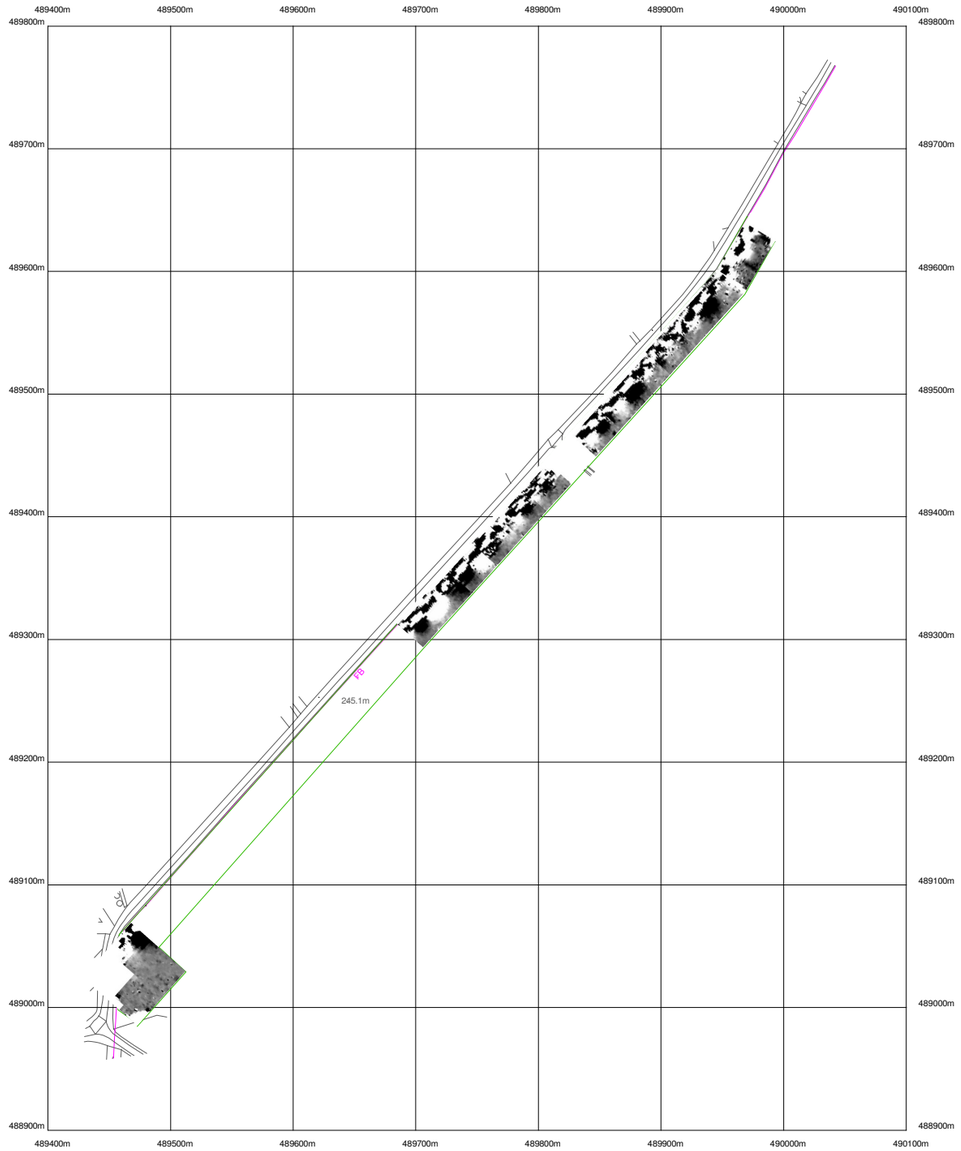
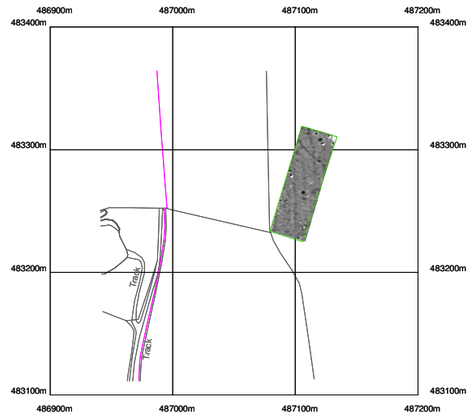
Figure 7, Interpretative plot

N

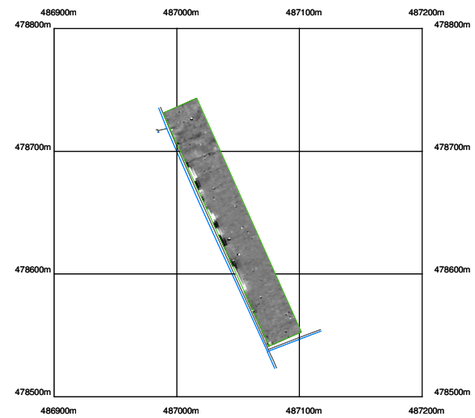
Area 1



Area 2



Area 3



0 400m

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Archaeological Project Services		
Project Name: Knapton - Ebberston pipline, (KNEP13)		
Scale 1:5000	Drawn by: NMJ	Report No: 80/13

Figure 8, Processed data greyscale plot overlaid on map

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OASIS ID: archaeol1-154653

Project details

Project name	KNAPTON - EBBERTON PIPELINE, NORTH YORKSHIRE
Short description of the project	Detailed magnetic gradiometer survey was undertaken for Barton Willmore in connection with proposed pipeline between Knapton and Ebberston, North Yorkshire. The survey totalled c. 2.4ha. The survey recorded a linear anomaly, four possible ridge and furrows and a number of pit like features. Other responses represent modern disturbance, service and geological features.
Project dates	Start: 25-05-2013 End: 30-05-2013
Previous/future work	Not known / Not known
Type of project	Field evaluation
Site status	Area of Archaeological Importance (AAI)

Project location

Country	England
Site location	NORTH YORKSHIRE RYEDALE EBBERSTON AND YEDINGHAM KNAPTON – EBBERTON PIPELINE, NORTH YORKSHIRE
Site coordinates	SE 83300 87000 54 0 54 16 18 N 000 43 14 W Point
Site coordinates	SE 89700 89400 54 0 54 17 31 N 000 37 18 W Point
Site coordinates	SE 87000 78700 54 0 54 11 47 N 000 39 58 W Point
Height OD / Depth	Min: 20.00m Max: 247.00m

Project creators

Name of Organisation	Archaeological Project Services
Project brief originator	Contractor (design and execute)

Project design originator	Gary Taylor
Project director/manager	Gary Taylor
Project supervisor	Neil Jefferson
Project supervisor	Andrew Failes
Type of sponsor/funding body	Developer

Entered by	Neil Jefferson (neil.jefferson@apsarchaeology.co.uk)
Entered on	8 July 2013

OASIS:

Please e-mail English Heritage for OASIS help and advice
 Created by Jo Gilham and Jen Mitcham, email Last modified Wednesday 9 May 2012
Cite only: http://www.oasis.ac.uk/form/print.cfm for this page

Appendix 2
THE ARCHIVE

The archive consists of:

3 Daily record sheets
1 Report text and illustrations
Digital data

File names	KNEP13-01.xgd KNEP13-02.xgd KNEP13-03.xgd KNEP13-04.xgd KNEP13-05.xgd KNEP13-06.xgd KNEP13-07.xgd KNEP13-08.xgd KNEP13-09.xgd KNEP13-10.xgd KNEP13-11.xgd KNEP13-12.xgd KNEP13-13.xgd KNEP13-14.xgd KNEP13-15.xgd KNEP13-16.xgd KNEP13-17.xgd	KNEP13-18.xgd KNEP13-19.xgd KNEP13-20.xgd KNEP13-21.xgd KNEP13-22.xgd KNEP13-23.xgd KNEP13-24.xgd KNEP13-25.xgd KNEP13-26.xgd KNEP13-27.xgd	
Explanation of codes used in file names	xgd files are magnetometer grids, named with site code and number in the order surveyed. xcp files are composites containing record of all the data and processes used to produce the end product		
Description of file formats	All files are in plain text xml format with header data defining survey and processing parameters		
List of codes used in files	D indicates a "dummy" value within the composite data		
Hardware, software and operating systems	ArcheoSurveyor 2.5.15 running under Windows XP Service Pack 3		
Date of last modification	08/07/13		
Indications of known areas of weakness in data			

All primary records are currently kept at:

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

Site Code: KNEP13