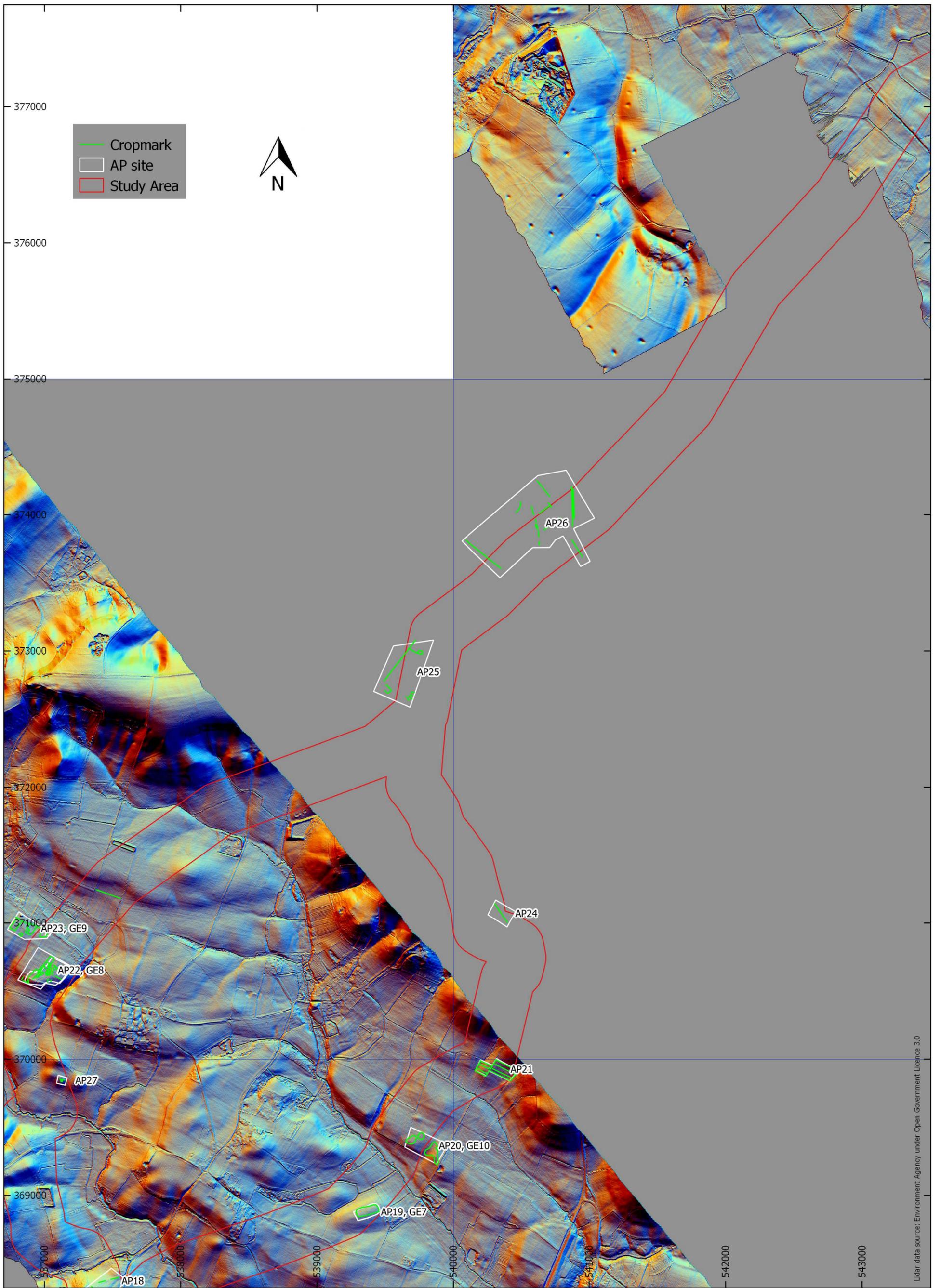



 Figure 13 Features identified from air-photographic survey (4 of 6)
 1:25000@ A3

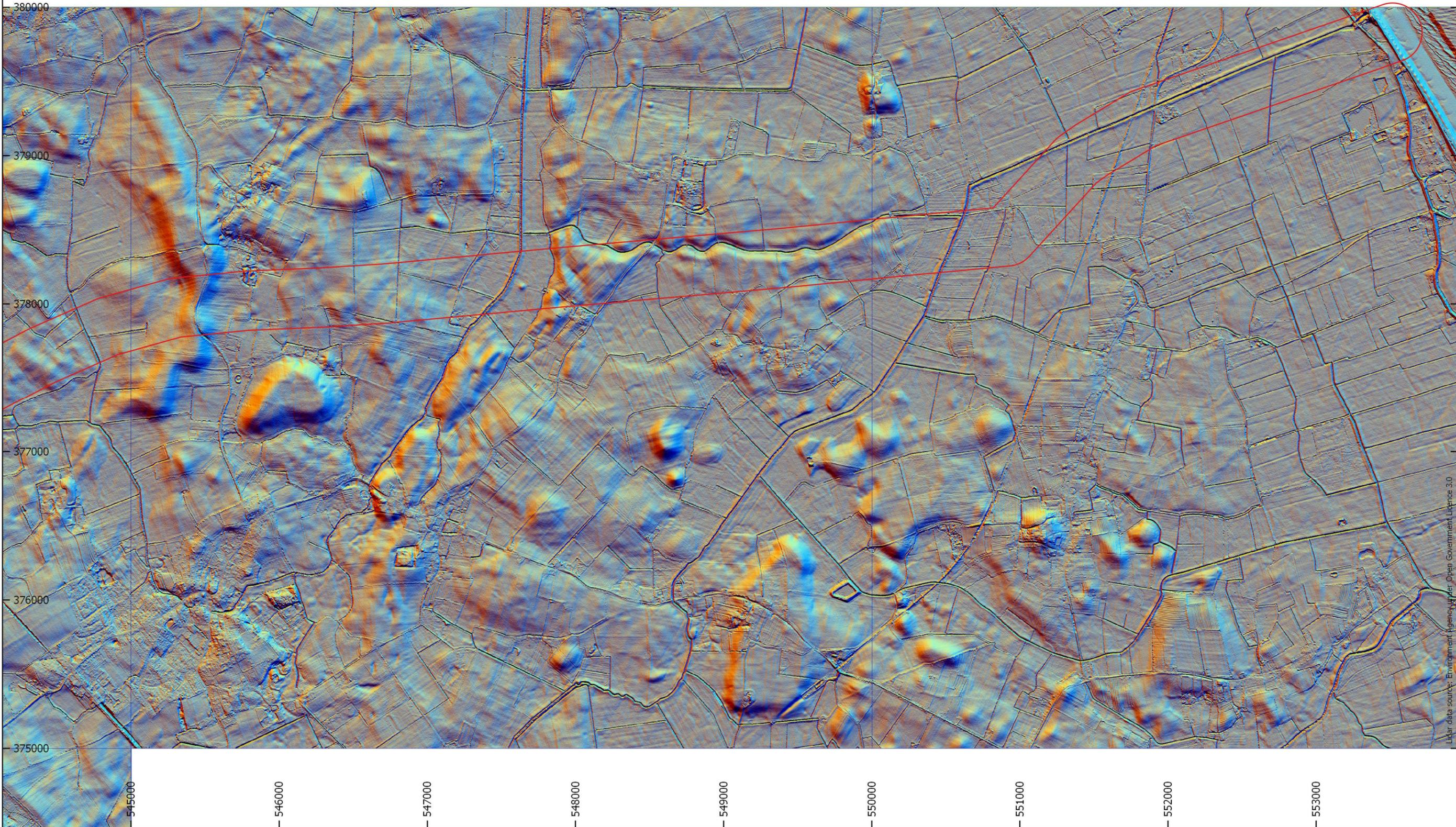


Lidar data source: Environment Agency, Open Government Licence 3.0



Lidar data source: Environment Agency under Open Government Licence 3.0

- Cropmark
- AP site
- Study Area



Lidar data source: Environment Agency, Der Open Government Licence 3.0



Figure 15 Features identified from air-photographic survey (6 of 6) 1:25000@ A3



Appendix 12.3 Geophysical Survey Report

SUMO Services Ltd was commissioned by Arcadis Consulting (UK) Ltd on behalf of National Grid Viking Link to undertake a geophysical (magnetometer) survey at 69 locations along the proposed DC cable route. The survey was carried out in order to provide information on the archaeological potential of the proposed DC cable route corridor.

GEOPHYSICAL SURVEY REPORT

sumo

Survey

GEOPHYSICS FOR
ARCHAEOLOGY &
ENGINEERING

Viking Link

Client

Arcadis

Survey Report

11360

Date

June 2017

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GEOPHYSICAL SURVEY REPORT

Project name:
Viking Link

SUMO Job reference:
11360

Client:
Arcadis

Survey dates:
22 May – 6 June 2017

Report date:
16 June 2017

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Appendix A Technical Information: Magnetometer Survey Method

Appendix B Technical Information: Magnetic Theory

DIGITAL CONTENT (Archive Data)

- Minimally Processed Greyscale Images and XY Trace Plots in DWG format
- DWG Viewer
- Digital Copies of Report Text and Figures (both PDF and native formats)

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1 SUMMARY OF RESULTS

Viking Link is a proposed 1400 megawatt (MW) High Voltage Direct Current (HVDC) electricity link between the Danish and British transmission systems. It will allow electricity to be exchanged between Great Britain and Denmark. The Project comprises approximately 760 km of Direct Current (DC) onshore and offshore electricity transmission cables between new converter stations at each end of the Project. These are in turn connected to the high voltage electricity transmission networks at existing substations at Revsing, south Jutland in Denmark and Bicker Fen, Lincolnshire in Great Britain

This report covers the results from the first phase of investigation of sixty-nine areas earmarked for survey. The majority of anomalies of archaeological interest were detected towards the western end of the proposed DC cable route (in Areas 33, 43, 52, 53 and 54). The responses include ditches and enclosures as well as ring ditches. Elsewhere, occasional lengths of ditch and isolated pit-like anomalies were recorded but an archaeological interpretation is tentative. At the eastern end of the survey area, anomalies of a natural origin are very much in evidence; ridge and furrow cultivation patterns are also present in many of the areas.

2 INTRODUCTION

2.1 Background synopsis

SUMO Services Ltd were commissioned to undertake a geophysical survey of an area outlined for a proposed 1400MW HVDC electricity link between the Danish and British transmission systems. This survey forms part of an archaeological investigation being undertaken by **Arcadis**.

2.2 Site details

HER/SMR	Lincolnshire
District	East Lindsey
Parish	1, 4, 5, 5a, 5b, 6, 7 & 8- Huttoft
Area Nos	11c, 13, 17 - Bilsby 24, 25 - Alby with Greenfield 27, 27e, 29, 30- Rigsby with Alby 32f, 32, 33- Ulceby with Fordington 43 - Dalby 52, 53- Raithby 54, 55, 56, 59, 62- East Keal 63, 65, 66, 67- West Keal 69 - Stickford
Topography	Mostly flat
Current Land Use	Agricultural and pasture
Weather	Varied - sunny, overcast and rain
Geology	Solid: 1, 4, 5, 5a, 5b, 6, 7, 8, 11c - Burnham Formation - chalk 13, 17, 30, 32f, 32, 33 - Welton Formation - chalk 24, 25, 29, 43 - Ferriby Formation - chalk 27, 27e - Carstone Formation- sandstone 52, 55 - Hundleby Clay Member - mudstone; Claxby Formation - ironstone

53, 54, 59 - Spilsby Formation - sandstone
55- Claxby Formation - ironstone
55, 56- Tealby Formation - mudstone
62, 63, 65, 66, 67, 69 - Kimmeridge Clay Formation – mudstone

Superficial:

1, 4, 5, 5a, 5b, 6, 7, 8, 11c - Tidal Flat Deposits - clay and silt
13, 17, 24, 25, 27, 27e, 29, 62, 63, 65, 66, 67, 69 – Till - Devensian-
Diamicton
32f, 32, 33, 43, 53, 54, 55, 56, 59 - None recorded
52- Till - mid Pleistocene- Diamicton
(BGS 2017).

Soils

1, 4, 5, 5a, 5b, 6, 7, 8, 11c, 24, 25 - Wallasea 2 (813g) Association -
marine alluvium- deep stoneless clayey soils.
13, 17, 27, 27e, 29 - Holderness (711u) Association - chalky till - slowly
permeable seasonally waterlogged fine loamy soils.
30, 32f, 33, 43 - Andover 1 (343h) Association – chalk - shallow well
drained calcareous silty soils over chalk.
32, 52, 59, 62, 63, 69- Salop (711m) Association Reddish – till - reddish
fine loamy over clay.
53 - 54, 55, 56 Cuckney 2 (551c) Association - Cretaceous sand and
sandstone - well drained sandy and ferruginous fine loamy soils over soft
sandstone. (SSEW 1983)

Archaeology

A baseline study is currently underway; Historic Environment Record
(HER) data, National Heritage List for England data, LiDAR and aerial
photographs have been consulted for the proposed DC cable route and
a site walkover is being carried out to help inform the results.
Archaeological remains have been recorded along proposed DC cable
route, the majority of which relate to medieval settlement, however there
are numerous areas of prehistoric crop mark enclosures and
contemporary burial landscapes. (NVGL 2016).

Survey Methods

Magnetometer survey (fluxgate gradiometer)

Study Area

99 ha – 30m corridor along sections of a 65km proposed DC cable route

2.3 Aims and Objectives

The aims and objectives of the programme of geophysical survey is to gather sufficient information to establish the presence/absence, character, extent, of any archaeological remains within the specific areas to be impacted by the proposed development, and to inform further strategies as necessary.

The specific aims of the survey are:

- to provide information about the nature and possible interpretation of any magnetic anomalies identified;
- to interpret identified anomalies and determine the presence/absence and extent of any buried archaeological features;
- to compare the survey findings to known archaeological remains to help inform interpretation and confidence of reporting;
- to produce a comprehensive site archive and report

3 METHODS, PROCESSING & PRESENTATION

3.1 Standards & Guidance

This report and all fieldwork have been conducted in accordance with the latest guidance documents issued by Historic England (EH 2008) (then English Heritage), the Chartered Institute for Archaeologists (CIfA 2014) and the European Archaeological Council (EAC 2016).

3.2 Survey methods

Detailed magnetic survey was chosen as an efficient and effective method of locating archaeological anomalies.

Technique	Instrument	Traverse Interval	Sample Interval
Magnetometer	Bartington Grad 601-2	1.0m	0.25m

More information regarding this technique is included in Appendix A.

3.3 Data Processing

The following basic processing steps have been carried out on the data used in this report:

De-stripe; de-stagger; interpolate

3.4 Presentation of results and interpretation

The presentation of the results for each site involves a grey-scale plot of processed data. Magnetic anomalies are identified, interpreted and plotted onto the 'Interpretation' drawings. The minimally processed data are provided as a greyscale image in the Archive Data Folder with an XY trace plot in CAD format. A CAD viewer is also provided.

When interpreting the results, several factors are taken into consideration, including the nature of archaeological features being investigated and the local conditions at the site (geology, pedology, topography etc.). Anomalies are categorised by their potential origin. Where responses can be related to other existing evidence, the anomalies will be given specific categories, such as: *Abbey Wall* or *Roman Road*. Where the interpretation is based largely on the geophysical data, levels of confidence are implied, for example: *Probable*, or *Possible Archaeology*. The former is used for a confident interpretation, based on anomaly definition and/or other corroborative data such as cropmarks. Poor anomaly definition, a lack of clear patterns to the responses and an absence of other supporting data reduces confidence, hence the classification *Possible*.

4 RESULTS

This report covers the results from the first phase of investigation of sixty-nine areas earmarked for survey (Areas 1-69). It should be noted at the outset when examining the data from a corridor that is only 30m wide it is often difficult to accurately interpret linear single responses which cross the corridor or zones of variable magnetic response. It is particularly difficult to gauge whether the latter are simply a result of localised variations in the soils and geology.

Responses considered to have archaeological potential are discussed by Area, starting in the east and moving west. Following this, a brief description is provided for the differing types of responses recorded in the survey. Thereafter, a brief summary is provided for all of the survey area where non-archaeological responses will be described.

4.1 **Probable / Possible Archaeology**

4.1.1 Area 33 Figure 15

Disjointed linear anomalies appear to form a small rectilinear enclosure in the north of the survey area. Moving southwards there is a string of possible pit-like features and a tentative ring-ditch. Other ditch lengths are visible and a few more pit-like responses.

4.1.2 Area 43 Figure 16

A clear ring-ditch is visible in the centre of the survey area. It appears to have a break on the south, though a linear ditch-like anomaly partially masks the picture; it is unclear if the ditch is associated with the ring. A second ditch of probable archaeological interest crosses the survey area and there are several possible pit-like responses.

4.1.3 Area 53 Figure 17

Well-defined magnetic anomalies indicate the presence of a small enclosure; it appears to be subdivided and contain several pit-like responses. There is another ditch attached to the north-west corner and a possible small ring-ditch. An area of increased magnetic response to the north is likely to reflect a complex of archaeological features and these appear to extend beyond the survey area to the east and west. Approximately 40m south of the enclosure are two ditches which may be of archaeological interest.

4.1.4 Area 54a Figure 18

In the centre of this survey strip two linear anomalies are visible and they may well form an enclosure of archaeological interest. There appear to be a cluster of pits or other cut-features and a general increase in the magnetic responses which could reflect archaeological activity.

4.1.5 Areas 54b and 54c Figure 19

At the southern tip of Area 54b there is a linear anomaly which could be a ditch, perhaps associated with further ditch-like responses in Area 54c. However, the ditch in 54b appears to mark the limit of ridge and furrow cultivation visible through most of the survey area. The line is also parallel to an existing footpath which suggests it could be an old field boundary. By contrast the two ditches in 54c are adjacent to an area of increased magnetic response. Therefore, while the latter could be archaeological, the anomalies appear more natural in origin.

4.2 **Uncertain / Natural / Geological / Pedological**

4.2.1 As explained above in the introductory section to the results, it is inevitable that a number of anomalies and trends, plus zones of increased magnetic response are going to be difficult to interpret with a high degree of confidence. Linear anomalies can result from old boundaries

(not always marked on maps), ploughing, headlands, land drains and some service trenches (with cables or plastic as opposed to ferrous pipes); usually the data have characteristic responses but not always. Changes in geology, the topsoils, alluvial areas or made ground can all result in differing magnetic responses; but a 30m wide corridor can only give a narrow window through the results when a much wider area is usually required to interpret the responses.

4.3 **Former Field Boundary**

4.3.1 Single linear anomalies are often associated with former field boundaries and analysis of old maps can help verify the interpretation.

4.4 **Agricultural – Ploughing, Land Drains**

4.4.1 As a general rule, broadly spaced parallel anomalies are indicative of ridge and furrow cultivation, while more closely spaced parallel anomalies / trends reflect more modern ploughing. Land drains are easy to interpret when they form herringbone patterns and when they result in characteristic chains of small dipole anomalies.

4.5 **Ferrous / Magnetic Disturbance**

4.5.1 Where ferrous responses are at the survey edges they are often the result of adjacent fences and gates. Ferrous pipes result in a variety of strong magnetic responses which are usually easily distinguishable from other buried features. Smaller scale ferrous anomalies ("iron spikes") are present throughout the data and their form is best illustrated in the XY trace plots. These responses are characteristic of small pieces of ferrous debris (or brick / tile) in the topsoil and are commonly assigned a modern origin. Only the most prominent of these are highlighted on the interpretation diagram.

Figure	Area	Summary of results
06	1, 4, 5	No anomalies of archaeological interest. Area 1 is magnetic disturbance with a strong ferrous response from the sea wall at the eastern limit. Anomalies of natural origin dominate Areas 4 and 5; they might just indicate areas of greenwaste.
07 / 08	5a, 5b, 6	No anomalies of archaeological interest. All areas are dominated by anomalies of natural origin. Land drains are visible in Area 5b. There is a pipe or service in the north of Area 6.
09 / 10	7, 8, 11c, 13	No anomalies of archaeological interest. Areas 7, 8 and 11c are dominated by anomalies of natural origin. The natural appears to be cut by ridge and furrow in Area 8. Two uncertain linear responses in Area 8 are parallel to the modern field boundaries and probably modern or agricultural.
11	17, 24, 25	No anomalies of archaeological interest. In Area 17, a pipe follows the centreline of the cable route for a short distance. An uncertain trend in Area 17 is most likely agricultural.
12	27, 27e	No anomalies of archaeological interest. A couple of pit-like anomalies in Area 27 and 27e are of uncertain origin given their lack of a wider context into to which the results can be placed. A couple of poorly defined trends are not thought to be of specific interest.

13	29, 30	No anomalies of archaeological interest. A fragmented curvilinear trend in Area 30 could be a plough damaged ditch or simply an agricultural effect. The origin of a small area of magnetic disturbance in Area 29 is probably modern.
14	32f	No anomalies of archaeological interest. Weak trends are probably agricultural; there are indications of ploughing in the data. A poorly defined linear response running diagonally through the eastern half of the area coincides with an old boundary on 6 inch OS map dated 1885-1913.
15	32, 33	See 4.1.1 for archaeology. A few uncertain trends in the data may be of interest because of the nearby archaeological features, but they could equally be agricultural.
16	43	See 4.1.2 for archaeology. Plough lines are visible in the data and a pipe or service runs parallel to the A26 in the east. An uncertain trend is probably agricultural.
17	52, 53	See 4.1.3 for archaeology. Areas of increased magnetic response are probably modern or natural, but the proximity of recorded archaeological features means an anthropogenic origin should not be dismissed. There is a possible pipe south of the enclosure in Area 53.
18	54a, 54b	See 4.1.4 for archaeology. There are clusters of pit-like responses and areas of increased magnetic response which may have an anthropological origin, but they could be natural or agricultural. Ploughing and possible ridge and furrow cultivation may be present, as may be land drains.
19	54b, 54c	See 4.1.5 for archaeology. Areas of increased magnetic response associated with the ditches may have archaeological origins but they appear natural. Ridge and furrow is also in evidence.
20	55, 56	No anomalies of archaeological interest. Ridge and furrow plus headlands are present in both areas. There are uncertain linear responses in Area 55.
21	59	No anomalies of archaeological interest. Magnetic disturbance at the northern end is almost certainly modern in origin.
22	62	No anomalies of archaeological interest. A few trends of uncertain origin have been recorded and agricultural practices (ridge and furrow) are in evidence.
23	63	No anomalies of archaeological interest. There are a few trends of uncertain origin; they form no recognisable patterns and are not thought to be significant.
24	65, 66	No anomalies of archaeological interest. Two linear anomalies cross the width of Area 65; it is difficult to categorise these in the absence of any other evidence. Ridge and furrow cultivation dominates both areas.
25	67, 69	No anomalies of archaeological interest. Ridge and furrow cultivation dominates the results in Area 67 and there appears to be land drains present. Uncertain linear trends are in both areas but they remain of uncertain origin.

5 DATA APPRAISAL & CONFIDENCE ASSESSMENT

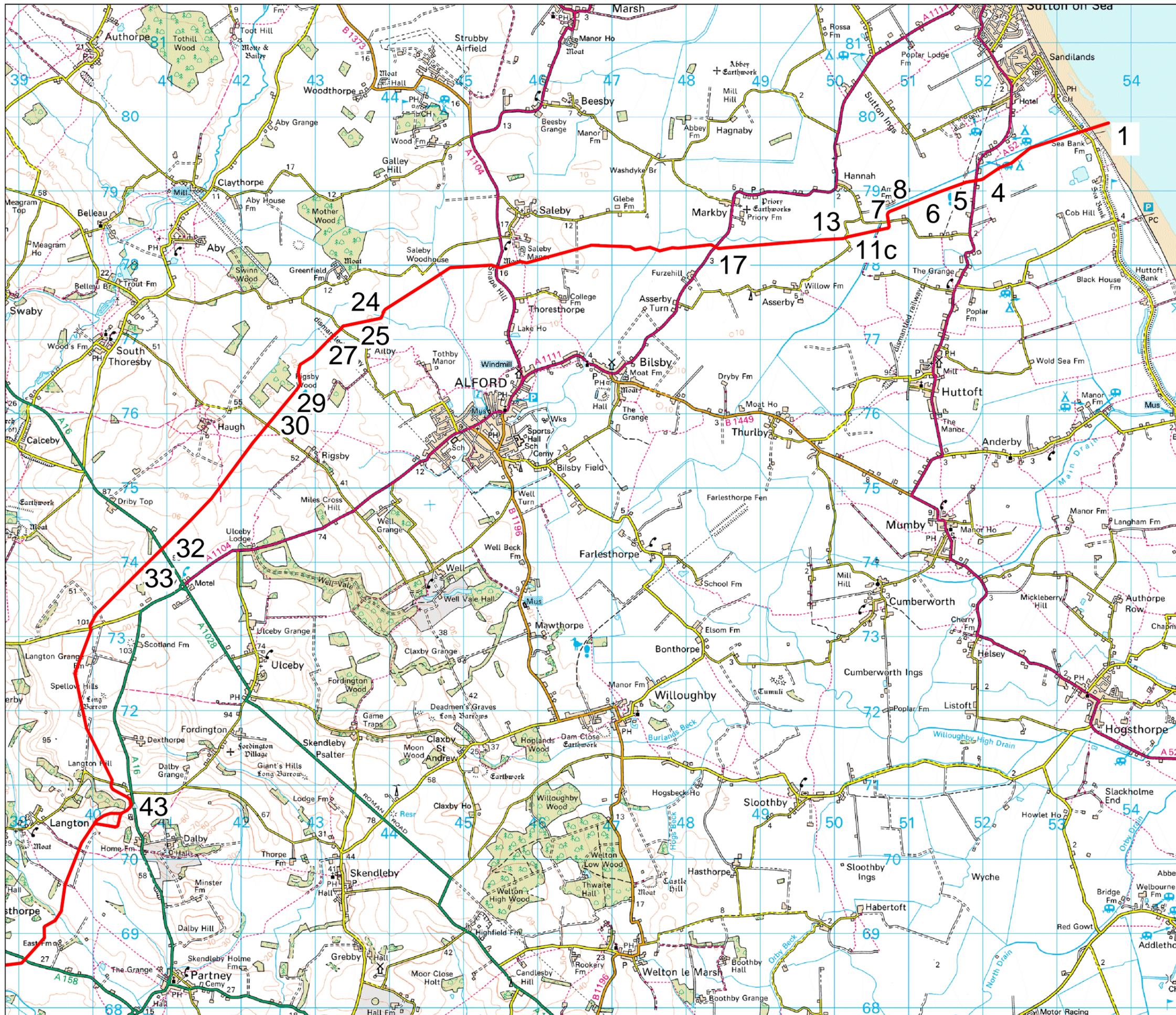
- 5.1 The survey corridor passes over a variety of geologies but none are particularly poor for magnetic survey. Apart from areas of very strong magnetic responses, it is believed that the results provide a good indication of the presence of archaeological features.

6 CONCLUSION

- 6.1 The survey has succeeded in meeting the main aims of the project. It has identified and mapped, as far as is possible within a 30m corridor, features of definite archaeological interest. Most were detected towards the western end of the proposed DC cable route (in Areas 33, 43, 52, 53 and 54). The responses include ditches, enclosures and ring ditches. Elsewhere, occasional lengths of ditch and isolated pit-like anomalies were recorded but an archaeological interpretation remains tentative. Anomalies of a natural origin are very much in evidence at the eastern end of the survey area and ridge and furrow cultivation patterns are also present in many of the areas.

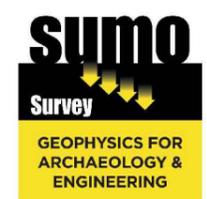
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KEY

Survey Corridor



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Title:	Site Location Diagram [East]	
Client:	Arcadis	
Project:	11360 Viking Link	
Scale:	 1:50000 @ A3	Fig No: 01