Archaeological Services
University of Durham

Irby to Caistor Pipeline, North Lincolnshire

geophysical surveys

on behalf of
ARCUS

Report 1727
September 2007

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Contents

1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted on land along the route of the proposed Irby to Caistor Pipeline in North East and North Lincolnshire. The works comprised two fluxgate gradiometer surveys measuring approximately 1 hectare in total.

1.2 The works were commissioned by ARCUS (Archaeological Research and Consultancy at the University of Sheffield) and conducted by Archaeological Services in accordance with instructions provided by ARCUS.

Results

1.3 Possible traces of ridge and furrow cultivation have been detected in both areas.

1.4 A large ferrous service pipe in Area A prevented detection of other anomalies in much of that area.

2. Project background

Location (Figure 1)

2.1 The study area is located between Irby and Caistor, North East and North Lincolnshire. The two areas surveyed were ploughed fields bounded by hedgrows, alongside the A1173 Irby to Caistor road. The survey area details are provided in Table 1.

Development proposal

2.2 The proposed development is the Irby to Caistor Pipeline.

Objective

2.3 The principal aim of the surveys was to assess the nature and extent of any sub-surface features of potential archaeological significance within two specified areas, so that an informed decision may be made regarding the nature and scope of any further scheme of archaeological works that may be required in advance of development there.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions provided by ARCUS (Archaeological Research and Consultancy at the University of Sheffield).

Dates

2.5 Fieldwork was undertaken on 30th August 2007. This report was prepared between 3rd and 12th September 2007.

Personnel

2.6 Fieldwork was conducted by Lorne Elliott (Supervisor) and Natalie Swann. This report was prepared by Lorne Elliott, with illustrations by Ed Davies, and has been edited by the Project Manager, Duncan Hale.

Archive/OASIS

2.7 The site code is **ICP07**, for **I**rby to **C**aistor **P**ipeline 20**07**. The survey archive will be supplied on CD to ARCUS for deposition with the project archive. Archaeological Services 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 **archaeol3-31043.**

3. Archaeological and historical background

3.1 The surveys were located in order to sample the proposed pipeline route where it passes close to two possible round barrows and a Roman artefact scatter. Many cropmarked features have previously been recorded in the general area.

3.2 A hoard of bronze coins apparently dating from AD 253-275 (NMR TA 10 NE 4) was found in 1953 at Riby Wold Farm, about 1 km north of Area B (English

Heritage 2007) and small fortified Roman town is known at Caistor, approximately 1 km southwest of Area A.

4. Landuse, topography and geology

4.1 At the time of survey the study area comprised two arable fields (Table 1). A service marker post was noted at the southern boundary of Area A in line with the survey area.

Table 1: Size and location of areas surveyed

Area	Size (ha)	NGR	mOD	Landuse
A	0.4	TA 1279 0210	*c*.130	crop stubble
B	0.4	TA 1700 0560	*c*.65	crop stubble

4.2 The survey areas were predominantly level.

4.3 The underlying solid geology of the area comprises chalk, which is overlain by topsoil.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage Research and Professional Services Guideline No.1, *Geophysical survey in archaeological field evaluation* (David 1995); the Institute of Field Archaeologists Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2001).

Technique selection

5.2 Geophysical surveying enables the relatively rapid and non-invasive identification of potential archaeological features within landscapes and can involve a variety of complementary techniques such as magnetometry, electrical resistance, ground-penetrating radar and electromagnetic survey. Some techniques are more suitable than others in particular situations, depending on a variety of 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 likely that cut features, such as ditches and pits, might be present on the site, and that other types of feature such as trackways, wall foundations and fired structures (for example kilns and hearths) might also be present.

5.4 Given the anticipated shallowness of targets and the non-igneous geological environment of the study area, a geomagnetic technique, fluxgate gradiometry,

was considered appropriate for detecting each of the types of feature mentioned above. This technique involves the use of hand-held magnetometers to detect and record minute 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

5.5 The survey covered two areas, each measuring 100m by 40m (Figure 1).

5.6 A 20m grid was established across each survey area and tied-in to known, mapped Ordnance Survey points using a Trimble Pathfinder Pro XRS global positioning system (GPS) with real-time correction.

5.7 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 set to 0.1nT, the sample interval to 0.25m and the traverse interval to 1.0m, thus providing 1600 sample measurements per 20m grid unit.

5.8 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

5.9 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 (unfiltered) data. The greyscale images and interpretations are presented in Figures 2 and 3; the trace plots are provided in Appendix I. In the greyscale images, positive magnetic anomalies are displayed as dark grey and negative magnetic anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in nanoTesla.

5.10 The following basic processing functions have been applied to each dataset:

clip	clips, or limits 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.
destagger	corrects for displacement of anomalies caused by alternate zig-zag traverses.
despike	locates and suppresses random iron spikes in gradiometer data.
interpolate	increases the number of data points in a survey to match sample and traverse intervals. In this instance the

gradiometer data have been interpolated to 0.25 x 0.25m intervals.

Interpretation: anomaly types

5.11 Colour-coded geophysical interpretation plans are provided. Two 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.

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

5.12 Colour-coded archaeological interpretation plans are provided.

Area A (Figure 2)

5.13 A chain of intense dipolar magnetic anomalies with a broadly north-south alignment was detected in the western half of the survey. This almost certainly reflects a large ferrous service pipe, also clearly evident in the trace plot. A service marker post was noted at the southern boundary of Area A in line with the survey area.

5.14 Weak parallel anomalies aligned northwest-southeast in the eastern half of the survey possibly reflect traces of ridge and furrow cultivation.

Area B (Figure 3)

5.15 A series of sinuous parallel weak positive magnetic anomalies possibly reflecting traces of former ridge and furrow cultivation have been detected across this survey.

5.16 The only other anomalies detected in either survey comprise small, discrete dipolar magnetic anomalies. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick fragments.

6. Conclusions

6.1 Fluxgate gradiometer surveys have been undertaken in two fields along the route of a proposed pipeline between Irby and Caistor in North Lincolnshire.

6.2 Possible traces of ridge and furrow cultivation have been detected in both areas.

6.3 A large ferrous service pipe in Area A prevented detection of other anomalies in much of that area.

7. Sources

David, A, 1995 *Geophysical survey in archaeological field evaluation,* Research and Professional Services Guideline **1**, English Heritage

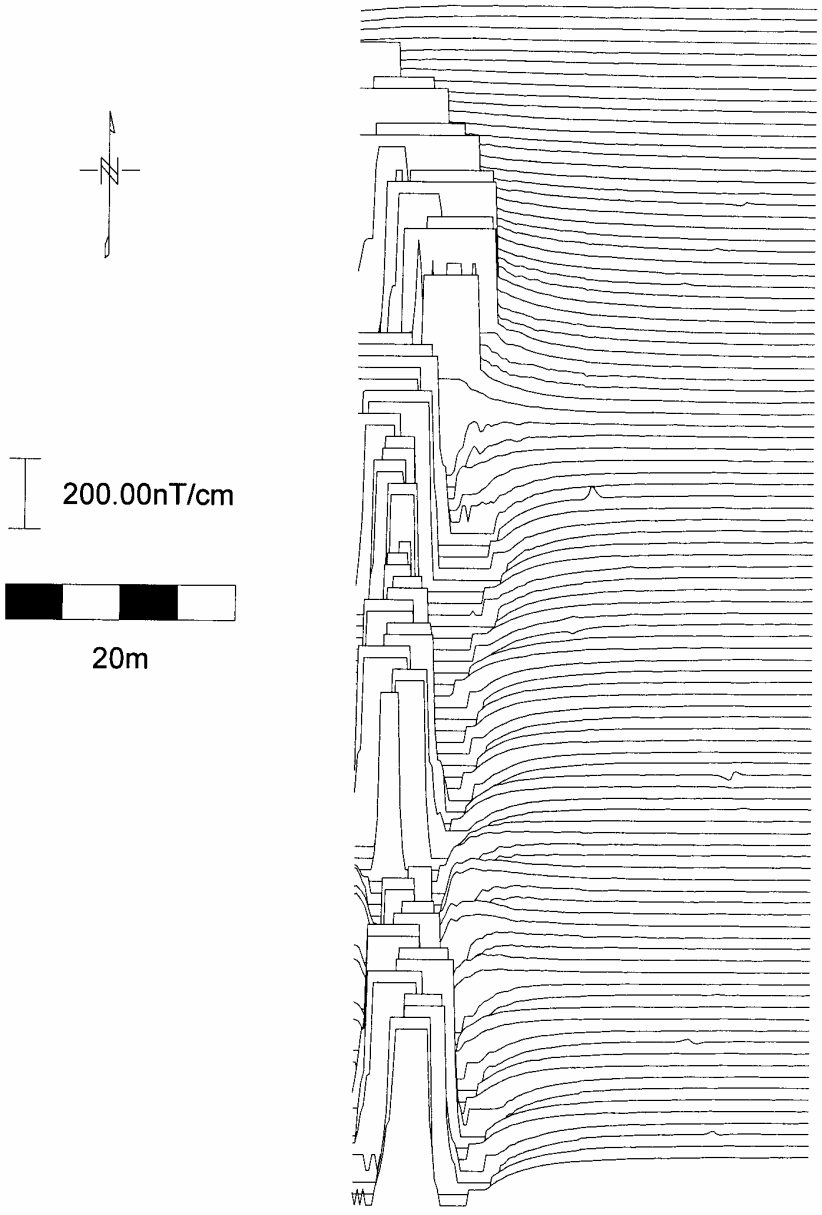
English Heritage 2007 *Pastscape Database* http://pastscape.english-heritage.org.uk

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

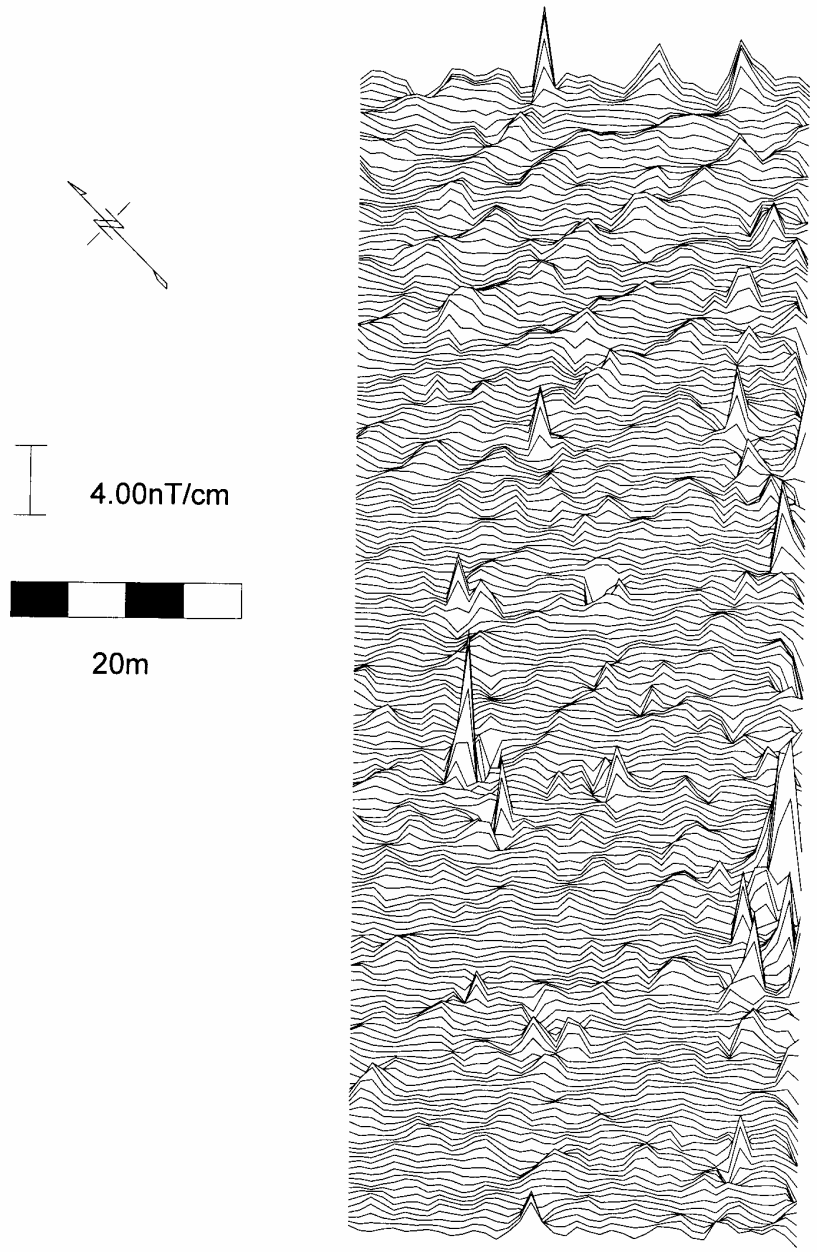
Schmidt, A, 2001 *Geophysical Data in Archaeology: A Guide to Good Practice*, Archaeology Data Service, Arts and Humanities Data Service

Appendix I: Trace plots of geophysical data

Area A, Magnetic data



Area B, Magnetic data



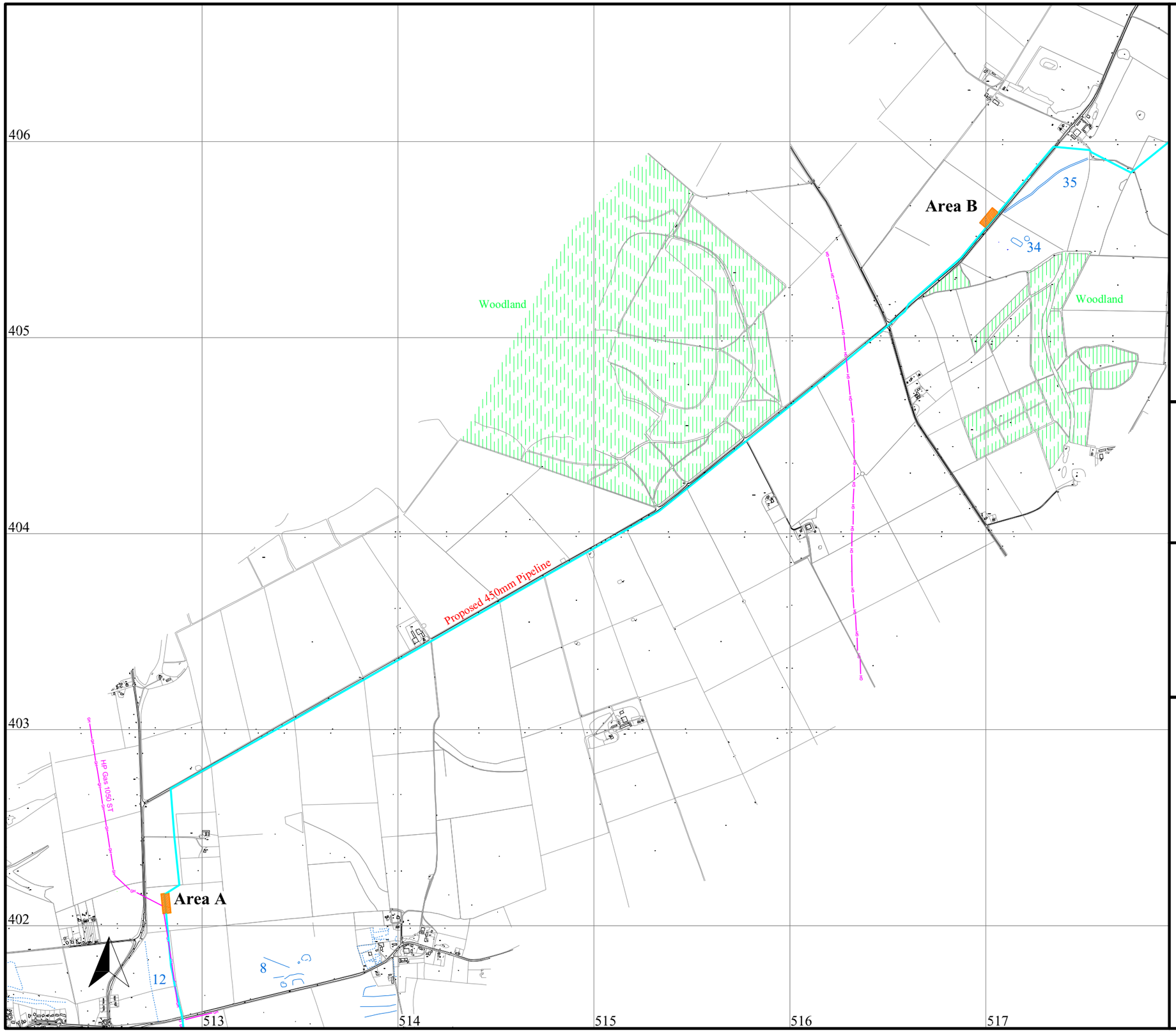


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Figure 1

Location of survey areas

on behalf of
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0 1km

scale 1:20 000 - for A3 plot

- proposed route of pipeline
- existing pipe
- survey areas
- crop marks (34)

020 021 022

128

outline of survey area
proposed route of pipeline
existing pipe
3.00
2.50
2.00
1.50
1.00
0.50
0
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00 nT

020 021 022

128

outline of survey area
proposed route of pipeline
existing pipe
positive magnetic anomalies
dipolar magnetic anomalies

020 021 022

128

outline of survey area
proposed route of pipeline
existing pipe
ferrous pipe
orientation of ridge and furrow

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Figure 2

Area A, geophysical survey results and interpretations

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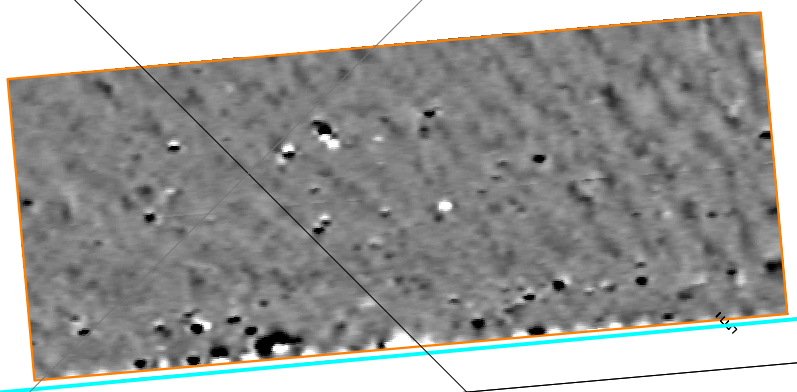
0 50m

scale 1:1000 - for A3 plot



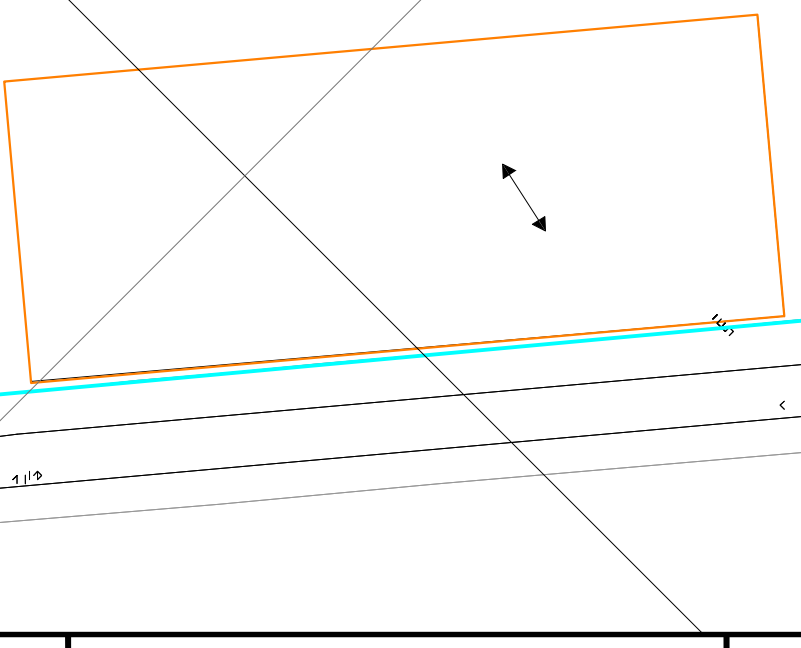


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Figure 3

Area B, geophysical survey results and interpretations

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0 50m

scale 1:1000 - for A3 plot