NYCC HER	
SNY	8777
ENY	2361
CNY	5061
Parish	
Rec'd	13/04/2003

GEOPHYSICAL SURVEY OF AREAS WITHIN THE EASEMENT OF THE PROPOSED A165 REIGHTON BYPASS, REIGHTON, NORTH YORKSHIRE

A programme of research carried out
on behalf of

BHWB Limited

by

GeoQuest Associates

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1 INTRODUCTION

1.1 This report describes the methodology and results of geophysical surveys on 2 parcels of land to the S of Reighton village, in North Yorkshire (NGR TA127754; Figure 1). The research was carried out on behalf of BHWB Ltd, with the aim of testing for the presence of subsoil archaeological features for which mitigation may be required prior to construction of the proposed A165 Reighton Bypass. Within both study areas a fluxgate magnetometer was used to map subsoil anomalies in magnetic susceptibility and thermoremanent magnetisation, as a means of characterising possible buried archaeological features. The work was carried out in accordance with a specification drafted by Ed Dennison Archaeological Services Ltd, consultants to BHWB Ltd.

1.2 The areas of investigation were as follows:

Area A (1.44ha). A rectangular block measuring 360x40m along the eastern edge of an arable field, adjacent to Hunmanby Road. This field has been ploughed and harrowed prior to the survey and presented a level surface of fine soil, with a low density of stony material. A chicken run and car intruded into the NE corner of the area, while a tractor was parked immediately to the N of this enclosure (Figure 1). An entrance to the field is located 10m S of the chicken run and a spread of brick rubble extended into the field from this point along the presumed line of a old farm track. On the OS 1911 and 1928 25" maps Area A is within a region marked "Allotments". However, since no allotment features are depicted (only the name) it remains uncertain whether they actually existed within the specific geophysical block (Dennison, 2002; Dennison, *pers. comm.*)

Area B (0.68ha). A polygonal sample area, of maximum dimensions 140x80m, immediately S of the Dotterel public house, situated in a field corner bounded to the E by Bridlington Road (A165) and to the W by Grindale Road (C367). At the time of survey this arable field carried a 10cm tall cereal crop. A large timber notice, with steel fitments, was situated about 10m from the northern extent of the survey area, as indicated in Figure 1.

1.3 The desk-top archaeological assessment notes that a number of parallel ditches are seen as cropmarks within that part of Reighton Field W of Area A, and are thought to represent part of the Argham Dyke system (Dennison, 2002). Although the cropmarks cannot be traced as far as Hunmanby Lane, it seems possible that increasing soil depth or previous use as allotments has prevented their appearance. The Argham Dyke is thought to be a Bronze Age estate boundary, and can be traced for some 8km between Rudston and Reighton, on a general NNE-SSW alignment. Still visible as an earthwork during the medieval period, the dyke has since been reduced and levelled by ploughing. Nevertheless, in view of its size, it seems likely that traces of the structure will survive as substantial physical traces in the subsoil.

1.4 A further linear cropmark has been noted in the northern part of field 4744, between the Speeton and Bridlington Roads. This feature may represent an element of a prehistoric field system or an abandoned enclosure-period boundary (Dennison, 2002)

1.5 Geophysical survey of Areas A and B was carried out on 7th April 2003.

2 THE GEOPHYSICAL SURVEYS

2.1 Measurements of vertical geomagnetic field gradient were made in each area using a Geoscan FM36 fluxgate gradiometer. Data were logged at 0.5m intervals, along zig-zag traverses spaced 1.0m apart. Sampling used a combination of 20x20m and 100x20m rectangular blocks.

2.2 Data were downloaded on-site into a portable graphics computer for quality checks, initial processing and storage. These data were subsequently transferred to a laboratory computer for final processing, interpretation and archiving.

2.3 The GeoQuest InSite® software was used to process the geophysical data, converting field readings into continuous tone grey-scale images. In Figure 2 a convention has been used that shows positive anomalies as dark grey and negative anomalies as light grey. Technical details of the data processing algorithms are given in Appendix A.

2.4 An archaeological-geotechnical interpretation of the geophysical survey is presented in Figures 3 and 4. A key defines the colours and fill styles used in these drawings, while feature codes **f1**, **f2**, etc., are included in Figure 4 for reference in the discussion below.

3 INTERPRETATION

General

3.1 A wide range of geomagnetic anomaly magnitudes has been detected, with the most intense disturbances occurring on ground S of the Chicken run and also W of the Dotterel (Area A). Elsewhere in Areas A and B, the survey has generally recorded a low concentration of small-scale magnetic dipoles, indicating that the topsoil contains very little brick, tile or ferrous debris. Moreover, the geomagnetic data provide no evidence to suggest that either survey area is underlain by land drains.

3.2 f1: In Figures 3 and 4 red cross-hatching has been used to denote areas where minor dipole clusters of geotechnical interest have been detected. The most prominent example is a linear band along the axis of a former farm track extending S from the field entrance adjacent to the chicken run, indicating brick or tile rubble in the subsoil. The remaining dipole scatters may reflect the sites of bonfires, areas of made ground or sites of small buildings or farm machinery. Had a series of allotments once been established in Area A, then it seems likely that much higher concentrations of magnetic debris would have been detected.

Area A

3.3 f2 & f3: The major geophysical feature detected by the survey comprises a set of strong, positive, curvilinear anomalies in the southern half of this area. The style of the anomalies is consistent with a group of substantial soil-filled ditches, one of which (f3) clearly continues W, beyond the area of investigation. Comparison of these anomalies with cropmarks plotted in Dennison (2002; Site 5) strongly suggests that the NE-SW oriented limbs of f2 and f3 represent a continuation of the Argham Dykes. The NW-SE

components of f2 may then comprise a ditched trackway or further element of the conjectured Bronze Age estate boundary.

3.4 f4: In Figure 2 it can be seen that ditch f2 bifurcates at a point about 55m SW of the Dotterel, possibly marking a crossing point through the dyke system. Alternatively, this section of ditch may have been abandoned and recut along a revised alignment, leading to the subsoil double-trace recorded here.

3.5 f5: Within the double ditch system of feature f2 a number of weak and diffuse, positive magnetic anomalies have been located. A proportion of these may simply reflect shallow soil structure created by modern ploughing, while the more intense examples may signify minor silted ditches or post hole clusters within the dyke system. f5 is one such example, being a subrectangular feature measuring about 12x8m, which may mark a timber structure or minor ditched enclosure.

3.6 f6: A large oval, positive magnetic anomaly has been detected, suggesting a substantial soil-filled pit or section of wide ditch, attached to the eastern side of one of the f2 ditch sections.

3.7 f7: Between the Dotterel and ditch f2 the survey has located a very weak and diffuse rectilinear anomaly, possibly suggesting a rectangular feature, of similar character to f5.

3.8 f8 & f9: A pair of ditches, 50m apart and both oriented NE-SW, have been located between the chicken run and feature f3 (as evidenced by positive magnetic anomalies). Ditch feature f8 appears to be shallow and/or narrow, and is clearly discontinuous, while ditch f9 is more substantial and unbroken. The style of f8 may be more consistent with a tile land drain.

3.9 f10: The final feature of archaeological interest in Area A comprises another substantial linear magnetic anomaly in the region S of the chicken run and N of f9. This anomaly provides convincing evidence for another infilled ditch which, in this case, is oriented parallel to Hunmanby road. Any connection between f10 and f9 (& f2, f3?) would appear to occur beneath the present field boundary or the easement of Hunmanby Road.

Area B

3.10 f11 & f12: A relatively dense pattern of rectilinear positive anomalies has been mapped within this block, a proportion of which may reflect soil structure and furrowing caused by ploughing. Hence, in Figures 3 and 4 only those anomalies judged to be of archaeological significance have been extracted. Among these, the most prominent are a pair of lineations: one parallel to, and one at right angles to Grindale Road. Possible interpretations include historic enclosure ditches or components of the prehistoric landscape connected with the Argham Dyke system.

3.11 f13 & f14: Several small-scale positive lineations suggest the existence of minor ditches in the extreme northern part of the block. However, wheel ruts in this part of the field suggest that topsoils may be heavily disturbed, possibly accounting for some of the geophysical anomalies that have been detected. It is worthwhile noting that no obvious connection can be made between subsoil features mapped in Areas A and B, supporting the view that several of the anomalies may reflect localised, modern soil disturbance. A more detailed

characterisation of features detected in both Areas B and A will require a programme of evaluation, via trial trenching.

4 SUMMARY AND CONCLUSIONS

4.1 Detailed geophysical surveys have been successfully carried out over a total of 2.12ha, within 2 areas S of Reighton, within the easement of the proposed A165 bypass, North Yorkshire. A fluxgate gradiometer was used to map variations in subsurface magnetic susceptibility and thermoremanent magnetisation associated with buried archaeological features. The study was carried out on behalf of BHWB Ltd, under the direction of Ed Dennison Archaeological Services Ltd, archaeological consultants to BHWB Ltd.

4.2 The geophysical data provide convincing evidence for the presence beneath the study area of a number of substantial soil-filled ditches, the most impressive examples being found in the southern half of Area A (W of Hunmanby Road). Elements of this pattern appear to represent a continuation NE of the Argham Dyke system which is seen as cropmarks further W in Reighton Field. Further characterisation of ditches and other features located by the geophysical survey will require a progamme of selective trial trenching.

5 CONFIDENCE LIMITS

5.1 The following are the levels of confidence which we assign to features inferred from the geophysical data:

f1	As brick, tile & iron debris	90%
f2	Ditches	80%
f3	Ditch	80%
f4	Ditches	60%
f5	Ditched enclosure	20%
f6	Pit or ditch	70%
f7	Ditched enclosure	15%
f8	Ditch	70%
f9	Ditch	75%
f10	Ditch	70%
f11	Ditch	60%
f12	Ditch	30%
f13	Ditches	40%
f14	Pit	20%

6 REFERENCE

Dennison, E., 2002. *A165 Reighton Bypass, Reighton, North Yorkshire. Updated Stage 2 Cultural Heritage Desk-top Assessment*. Report to BHWB Ltd.

7 CREDITS

Survey & Report: M. J. Noel PhD, FRAS
Date: 13th April 2003

Note: Whilst every effort has been taken in the preparation and submission of this report in order to provide as complete an assessment as possible within the terms of the brief, GeoQuest Associates cannot accept any responsibility for consequences arising as a result of unknown and undiscovered sites or artifacts, or geotechnical features.

PROPOSED REIGHTON BYPASS, N. YORKSHIRE

Location of Geophysical Survey Areas

0 1:1750 80m

SURVEY BY GeoQuest Associates FOR BHWB Ltd

N

REIGHTON ROAD (A165)

Reighton Reservoir

SPEETON ROAD (B1229)

BRIDLINGTON ROAD (A165)

The Dotterel (PH)

Sign

5 m

20 m

3 m

3 m

HUNMANBY ROAD

300 m

3 m

Car

Tractor

Chicken run

AREA A

AREA B

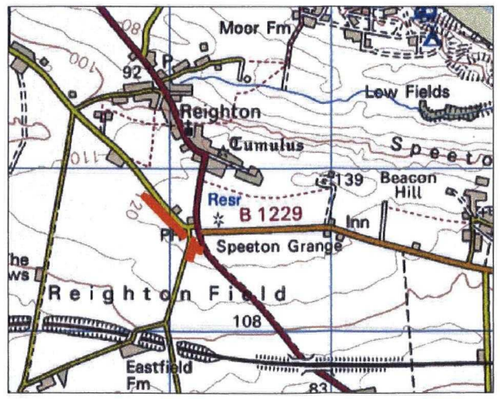
Reighton Field

3 m

GRINDALE ROAD (C367)

AREA A: SETTING OUT
Origin of baseline is in SE field corner with 3m & 5m offsets as indicated. Baseline continues with 3m offset from hedge centre bordering Hunmanby Road.

AREA B: SETTING OUT
Baseline is in N field corner with 20m and 3m offsets shown and then continues with a fixed 3m offset from centre of hedge along Grindale Road, as indicated.



GENERAL LOCATION

FIGURE 1

PROPOSED REIGHTON BYPASS, N. YORKSHIRE
Results of Geophysical Surveys

0 1:1750 80m

SURVEY BY GeoQuest FOR BHWB Ltd

ANOMALIES, nT/m
-12.4 -1.4 0.0 1.4 12.4

N

REIGHTON ROAD (A165)

Reighton Reservoir

SPEETON ROAD (B1229)

BRIDLINGTON ROAD (A165)

The Dotterel (PH)

Sign

Reighton Field

AREA B

HUNMANBY ROAD

Tractor

Chicken run

Car

AREA A

GRINDALE ROAD (C987)

FIGURE 2

PROPOSED REIGHTON BYPASS, N. YORKSHIRE
Archaeological Interpretation

0 1:1750 80m

SURVEY BY GeoQuest Associates FOR BHWB Ltd

ANOMALIES, nT/m
-12.4 -1.4 0.0 1.4 12.4

N

REIGHTON ROAD (A165)

Reighton Reservoir

SPEETON ROAD (B1229)

BRIDLINGTON ROAD (A165)

The Dotterel (PH)

Sign

Reighton Field

AREA B

HUNMANBY ROAD

Tractor

Chicken run

Car

AREA A

GRINDALE ROAD (C367)

KEY

- Iron & brick debris
- Ditch or tile drain
- Soil-filled pit

FIGURE 3

PROPOSED REIGHTON BYPASS, N. YORKSHIRE
Archaeological Interpretation

0 1:1750 80m

SURVEY BY GeoQuest Associates FOR BHWB Ltd

N

REIGHTON ROAD (A165)

Reighton Reservoir

SPEETON ROAD (B1229)

BRIDLINGTON ROAD (A165)

The Dotterel (PH)

Sign

HUNMANBY ROAD

Tractor

Chicken run

C/F

f1

f2

f3

f4

f5

f6

f7

f8

f9

f10

f11

f12

f13

f14

AREA A

AREA B

Reighton Field

GRINDALE ROAD (C367)

KEY

Iron & brick debris

Ditch or tile drain

Soil-filled pit

FIGURE 4

APPENDIX A

DATA PROCESSING

PROCESSING THE SURVEY DATA

The geophysical images contained in this report were prepared within Microsoft Windows® using the InSite® program published by GeoQuest Associates. Geophysical images were then placed onto a map which was digitised from the Ordnance Survey, edited and then plotted using a computer aided drafting (CAD) system and colour inkjet printer.

Data were downloaded from the meter to a portable computer in the field for storage, visualisation and quality control (QC) assessment. These data were then transferred to a laboratory computer for final processing, printing and archiving.

A number of process steps have been applied to the geophysical data obtained during the survey and those which have been used are linked to the main flow path by arrows. Steps were applied in the order shown and are designed to reduce artifacts in the data and enhance geophysical features of archaeological interest. The following sections describe each step in more detail.

REMOVE STRIPING

Reduces a data artifact comprising alternating changes in level in readings logged along zig-zag traverses. This artifact is common in fluxgate magnetometer data. InSite uses a proprietary algorithm to reduce this error.

INFILL SMALL BLANK AREAS

Fills isolated blank data cells with the mean of near-neighbours or a suitable approximation entered manually. Small blank areas will have been logged if it was not possible to obtain a geophysical reading over, for example, a manhole cover in the case of a resistivity survey.

REMOVE SPIKES

Replaces isolated, anomalously high or low values with the mean of near neighbours or a suitable approximation entered manually. 'Spike' readings are commonly associated with ferrous litter or poor electrical contact in the case of geomagnetic and resistivity data, respectively.

REDUCE WALK HARMONICS

Reduces a regular oscillation in traverse data caused by walking movements of the operator during a geomagnetic survey. InSite employs a fast Fourier transform to determine the optimum amplitude and phase of the walk-induced harmonic which is then subtracted from each traverse.

REDUCE SHEAR ARTIFACTS

Corrects for apparent shear in geomagnetic anomalies surveyed by zig-zag traversing in a geomagnetic survey. The shearing effect arises from the interaction of the operator+magnetometer with the geomagnetic field and also from the lag in the instrument response to changes in the field. InSite uses a proprietary algorithm to reduce this error.

CORRECT FOR METER DRIFT

Corrects for a linear drift in the meter calibration with time. Such drift is a common problem with fluxgate magnetometers, particularly during periods of rapid air temperature change. InSite uses least-squares regression on the mean of data along each traverse to estimate the change in calibration level across each grid. This gradient is then removed from the data.

ADJUST GRID MEAN LEVELS

Adjusts for differences in the mean level in data grids due to changes in instrument calibration (fluxgate magnetometer survey) or alteration in remote electrode spacing (resistivity survey).

INTERPOLATE AND COMBINE

Combines grids to form an array of regularly-spaced data on a square mesh. InSite uses bilinear interpolation to accomplish this.

LOW PASS FILTER

If this process task is indicated then a 3x3 or 5x5 boxcar filter has been used to smooth the data and reduce noise or 'speckle' seen in the original image.

HIGH PASS FILTER

If this process task is indicated then a 3x3 or 5x5 filter, with appropriate coefficients, has been used to pass short-wavelength information into the resulting image.

EDGE DETECT FILTER

Signifies that a Sobel, Laplace or other specialised filter has been applied to enhance significant lateral transitions in the geophysical image.

DIRECTIONAL FILTER

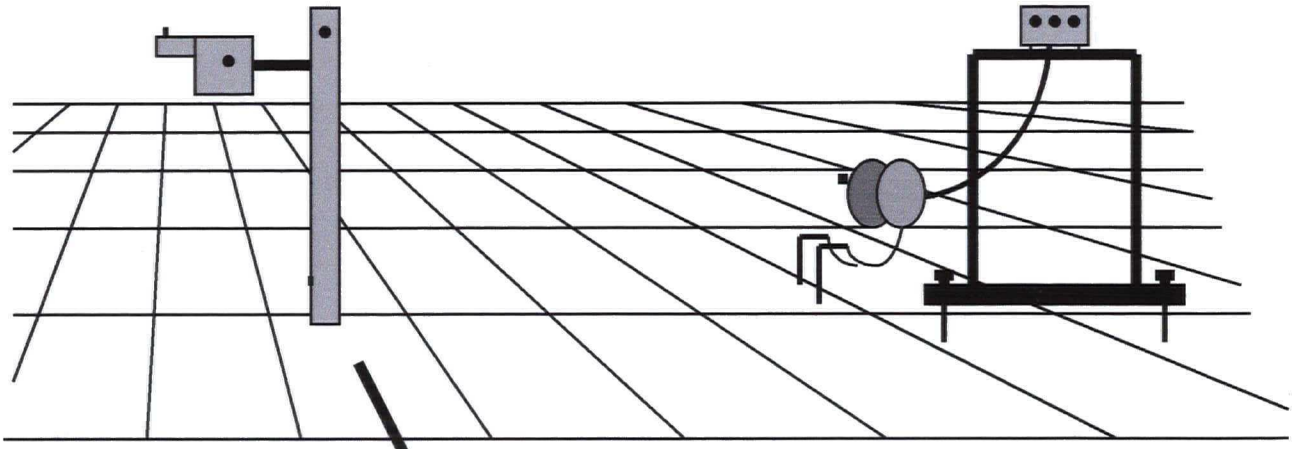
This filter is equivalent to illuminating the data from one direction to produce a pseudo-relief image. Directional filtering is usually employed to aid the identification of subtle anomalies in resistivity data. This filter highlights features trending at right angles to the direction of illumination.

NOTE

GeoQuest Associates can supply the geophysical images presented in this report in a variety of digital formats for visualisation on microcomputers running Microsoft Windows. These formats include the TIF, BMP and PCX standards. Please complete the request form at the rear of this report if you would like to receive such image files.

InSite

APPENDIX A
DATA PROCESSING



FIELD PC

LAB PC

QC

DATA ARCHIVE

IMAGE RAW GRID DATA

REMOVE STRIPING

REMOVE SPIKES

REPORT FIGURE 2

INTERPOLATE AND COMBINE

ADJUST GRID MEAN LEVELS

CORRECT FOR METER DRIFT

REDUCE SHEAR

PROJECT: Reighton Bypass

SITE: Areas A & B

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