Archaeological Services
University of Durham

Cloister Green, Durham Cathedral, Durham

geophysical survey

on behalf of

The Chapter of Durham Cathedral

Report 1713
August 2007

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The Chapter Office, The College, Durham DH1 3EH

Contents

1. Summary

The project

1.1 This report presents the results of an electrical resistance survey undertaken on the Cloister Green of Durham Cathedral.

1.2 The works were commissioned by The Chapter of Durham Cathedral and conducted by Archaeological Services in accordance with a Project Design provided by Archaeological Services.

Results

1.3 Areas of possible stone rubble and foundations have been identified.

1.4 A correlation between the resistance survey and an excavation undertaken in 1903 has been noted.

2. Project background

Location (Figure 1)

2.1 The study area is located within Durham Cathedral Cloister, Durham (NGR: NZ 2732 4203). The area measured approximately 32 x 32m and was completely enclosed by the cloisters.

Objective

2.2 The principal aim of the survey was to assess the nature and extent of any sub-surface features of potential archaeological significance enclosed by the cloisters.

Methods statement

2.3 The surveys have been undertaken in accordance with a Project Design provided by Archaeological Services.

Dates

2.4 Fieldwork was undertaken on the 6th August 2007. This report was prepared between the 7th and 10th August 2007.

Personnel

2.5 Fieldwork was conducted by Graeme Attwood (Supervisor) and Lorne Elliott. This report was prepared by Graeme Attwood with illustrations by Janine Wilson. The Project Manager was Duncan Hale.

Archive/OASIS

2.6 The site code is **CGD07**, for **C**loister **G**reen **D**urham 20**07**. The survey archive will be supplied on CD to The Fulling Mill. 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 **archaeol3-30004**.

Acknowledgements

2.7 Archaeological Services is grateful for the assistance of Mr Norman Emery, in facilitating this scheme of works.

3. Archaeological and historical background

3.1 The first church on the site was constructed in AD 995. This was little more than a timber shelter for the relics of St Cuthbert and was soon replaced by a larger timber structure known as the *Alba Ecclesia* or White Church. The White Church remained in use for three years, until the construction of the far grander *Ecclesia Major*, the first stone incarnation, was completed and consecrated on the 4th September 998 (Roberts, 2003).

3.2 The first Norman bishop, Walcher, was appointed in 1071. Walcher immediately started constructing monastic structures for the order of

Benedictine monks he was planning to introduce. However, in 1080 Bishop Walcher was murdered before seeing his plans completed. He was succeeded as bishop by William of St Calais (anglicised to Carileph), who continued his predecessor's plans for a new monastery and church, finally installing the Benedictine monks in 1083 (Roberts, 2003).

3.3 In 1088 Bishop Carileph fled into exile and spent the next three years in Normandy. It was there that he became influenced by the new Romanesque style of cathedral building. A year after his return in 1092 he initiated the building of a new cathedral on a much larger scale.

3.4 The Romanesque cathedral was constructed under the Bishoprics of Carileph and Flambard. The foundation stones were laid on the 11th August 1093 and the construction was largely completed by 1133 with the vaulting of the nave.

3.5 The construction of a much larger cathedral than was first planned meant that some alterations would have to be made to the monastic structures that had already been completed. Amongst other changes a grander Chapter House which befitted the new cathedral was constructed and the cloister was extended to the north and west.

3.6 The 11th-century square Lavatorium remained in its original location even after the expansion of the cloister and it was only in the mid-13th century that it was demolished and replaced. A new Lavatorium was built with an octagonal structure complete with a 'pyramidal roof covered with lead and containing a dovecot' (St John Hope, 1903). The Laver basin from this later Lavatorium can still be seen, having been moved in antiquity to its current location in the centre of the Cloister Garth.

3.7 The cloister has seen several alterations in style and decoration. The arcades were extensively remodeled under the Bishoprics of Shirlaw and Langley and the revised tracery was installed during the restoration work of 1764-9 (Pevsner, 1966).

3.8 An excavation was conducted in 1903 to prove that the Laver basin positioned in the centre of the cloister was not in its original location and to excavate the probable location of the Lavatorium (St John Hope, 1903). The plan of this excavation has been shown in Figure 2d to aid in the interpretation of the geophysical data.

4. Landuse, topography and geology

4.1 At the time of survey the area comprised the grassed Cloister Green of Durham Cathedral. Towards the centre of the survey area is a 15th-century Laver basin moved from its original position. To the south-east of the Laver is the cloister well. A series of drains surrounds the Green.

4.2 The survey area was level at a mean elevation of *c*.66m OD.

4.3 The underlying solid geology of the area comprises sandstone of the Carboniferous Westphalian coal measures, which is overlain by sands and gravel.

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 Given the likely presence of stone features such as wall-footings and floors an electrical resistance survey was considered appropriate. Earth electrical resistance is the most widely used electrical survey method and relies on the relative inability of materials to conduct an electrical current. When a small electrical current is injected through the earth it encounters sub-surface resistance which can be measured. In the dry state, most soils and rocks are insulators but, when they become moist, electric currents are able to flow through the movement of ions dissolved in the porewater. As the soil or rock absorbs more water its conductivity increases. Hence electrical resistance surveying primarily maps the volume concentration of ground moisture which varies according to lithology, porosity and time of year.

5.4 Since resistance is linked to moisture content and porosity, rocky features such as wall foundations will give relatively high resistance values while soil-filled cut features, which retain more moisture, will provide relatively low resistance values. When measurements are taken over a regular grid, a map of sub-surface archaeological features can be produced. Although more time-consuming than magnetometry, this method can be used in a wider range of locations since it is not affected by the presence of buildings/fences or igneous geology.

Field methods

5.5 A 20m grid was established across the survey area and tied-in to known, mapped architectural features of the cloister.

5.6 Measurements of electrical resistance were determined using a Geoscan RM15D resistance meter with a mobile twin probe separation of 0.5m. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was set to 0.1ohm, the sample interval to 0.5m and the traverse interval to 1.0m, thus providing 800 sample measurements per 20m grid unit.

5.7 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

5.8 Geoplot v.3 software was used to process the geophysical data and to produce both a continuous tone greyscale image and a trace plot of the raw (unfiltered) data. The greyscale image and interpretations are presented in Figure 2; the trace plot is provided in Appendix I. In the greyscale image, high resistance anomalies are displayed as dark grey and low resistance anomalies as light grey. A palette bar relates the greyscale intensities to anomaly values in ohm.

5.9 The following basic processing functions have been applied to the data:

Despike — locates and suppresses spikes caused by very high probe contact resistance.

Interpolate — increases the number of data points in a survey to match sample and traverse intervals. In this instance the resistance data have been interpolated to 0.25 x 0.25m intervals.

Interpretation: anomaly types

5.10 A colour-coded geophysical interpretation plan is provided in Figure 2b. Two types of resistance anomaly have been distinguished in the data:

high resistance — regions of anomalously high resistance, which may reflect foundations, tracks, paths and other concentrations of stone or brick rubble.

low resistance — regions of anomalously low resistance, which may be associated with soil-filled features such as pits and ditches.

Interpretation: features

5.11 A colour-coded archaeological interpretation plan is provided in Figure 2c and an overlay of the 1903 excavation plan in 2d.

5.12 An area of anomalously high resistance has been detected across the central part of the survey. This may reflect an area of stone rubble or a peak in the underlying rock outcrop on which the cathedral sits. Due to the straight edges of the anomaly on its northern and western limits it is more likely caused by stone foundations. The south-western edge of this anomaly does correspond to the possible first phase cloister wall as excavated in 1903.

5.13 A line of anomalously high resistance orientated north-south was detected in the south-west corner of the survey. This may reflect stone rubble or foundations possibly associated with structures outside the limits of the earlier Norman cloister.

5.14 Both high and low resistance anomalies were detected in the central southern part of the survey and correspond to an existing well.

5.15 A line of anomalously low resistance data orientated north-south traverses the survey. This corresponds to a lead service which was noted in the 1903 excavation.

5.16 A number of linear and curvilinear high resistance anomalies were detected across the survey. These form no discernible plan but could reflect areas of stone rubble, slabs or foundations.

5.17 A circular high resistance anomaly was detected in the central northern part of the survey which would reflect an area of stone foundations.

5.18 Three low resistance linear anomalies were detected in the north-west corner of the survey. These may be the result of soil-filled features such ditches or gullies.

6. Conclusions

6.1 An electrical resistance survey has been carried out on the Cloister Green of Durham Cathedral.

6.2 Areas of possible stone rubble and wall foundations have been identified.

6.3 A correlation between the resistance survey and an excavation undertaken in 1903 has been noted.

7. Sources

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

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

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Report 1713
Figure 1
Location of survey

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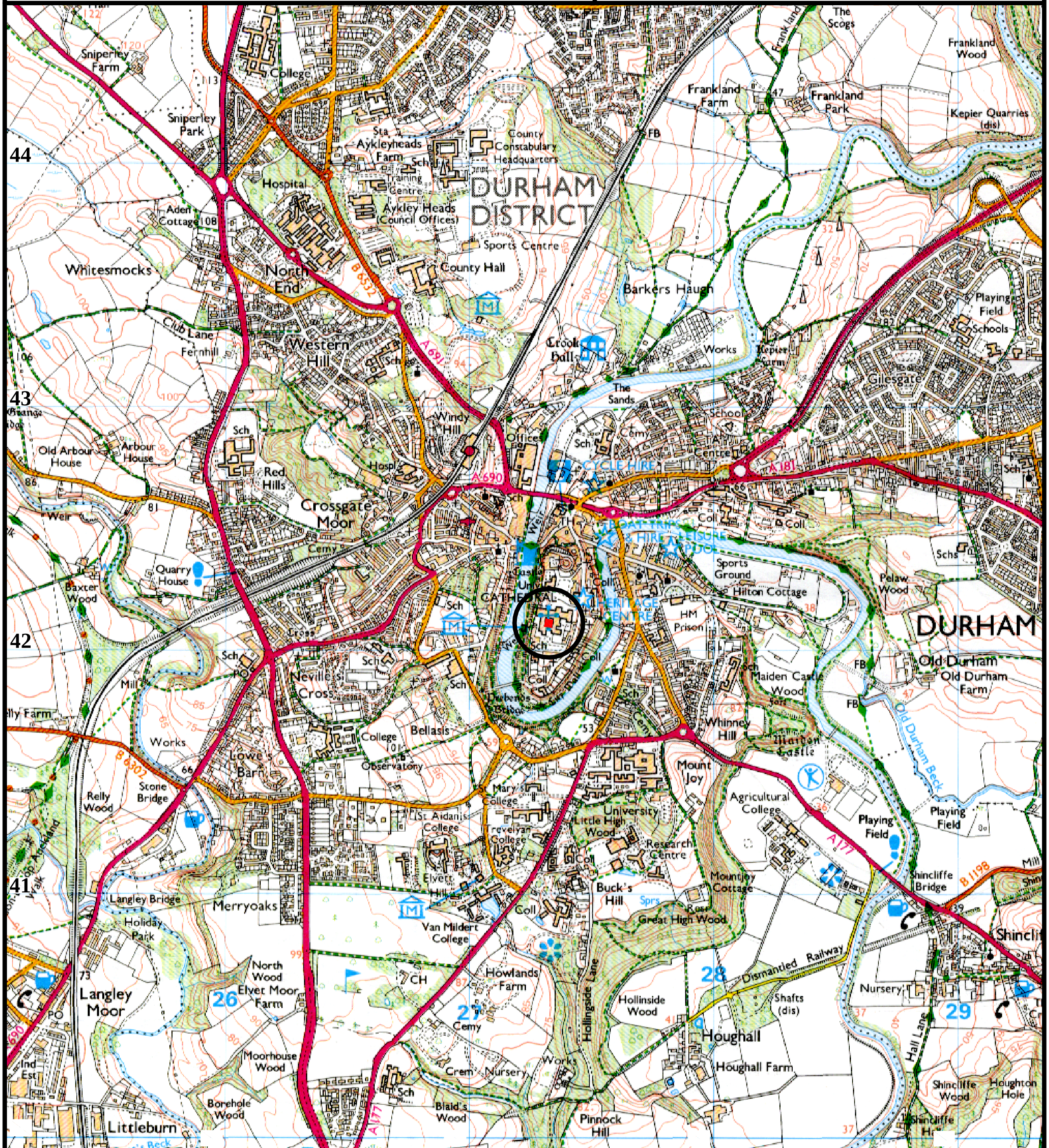

Cloister Green, Durham Cathedral

0 1km

scale 1:25 000 - for A4 plot

a) Earth resistance

outline of survey area

90.00
85.00
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00 ohm

b) Geophysical interpretation

high resistance anomalies

low resistance anomalies

c) Archaeological interpretation

possible stonework / bedrock

possible soil-filled features

lead pipe in service trench

d) Archaeological interpretation and 1903 excavation plan

first cloister wall

12th century features

13th century features

lead pipe

0 10m

scale 1:250 - for A1 plot

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Report 1713

Figure 2

Geophysical surveys, geophysical and archaeological interpretations

Appendix I: Trace plot of geophysical data