ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
AOC Archaeology Group

Clachan an Diridh
Pitlochry
Perth and Kinross

geophysical survey

report 2979
September 2012

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted at Clachan an Diridh stone circle near Pitlochry in Perth and Kinross. The works comprised high resolution geomagnetic and earth electrical surveys of the stone circle and its immediate vicinity.

1.2 The works were commissioned by AOC Archaeology Group and conducted by Archaeological Services Durham University.

Results

1.3 The resistance survey has been the more useful technique in this instance, due to the magnetic component of the local rock, however, the techniques have been complementary in some regards.

1.4 An oval of high resistance anomalies around the standing stones appears to reflect a platform or cairn of deliberately placed stones rather than the rockhead. Four geomagnetic and resistance anomalies within this material could possibly reflect voids or cists within which burnt or fired materials have been placed. These anomalies could also reflect more recent materials or disturbance, however, they do not appear intense enough to reflect typical ferrous litter.

1.5 The surveys have not provided clear evidence for a kerb or ditch around the monument.

1.6 Several small magnetic anomalies could possibly reflect remains of small gullies, which do not appear to be associated with the monument.

1.7 Modern drainage channels across the site were detected by both techniques.

2. Project background

Location (Figures 1 & 2)

2.1 The survey area was located within forestry at Fonab, approximately 3km south-west of Pitlochry in Perth & Kinross (NGR centre: NN 9251 5574). The 40m x 40m survey area encompassed the Clachan an Diridh four-poster stone circle, the platform on which it is set and some of its environs.

2.2 The works comprised high resolution geomagnetic and earth electrical resistance surveys. It was not possible to collect data in the southern and western corners of the survey area due to brushwood, stumps and other debris from tree-felling operations.

Clachan an Diridh four-poster stone circle, looking NE

Objective

2.3 The principal aim of the surveys was to detect and map any sub-surface features associated with the stone circle, in order to broaden the understanding of the monument and to inform any further heritage management and conservation issues at the site.

Methods statement

2.4 The surveys have been undertaken in accordance with instructions from the client and to current national standards and guidance (see para. 5.1 below).

2.5 Since the survey was within a Scheduled Monument the surveys were undertaken in accordance with Scheduled Monument Consent granted by Scottish Ministers under the Ancient Monuments and Archaeological Areas Act 1979.

Dates

2.6 Fieldwork was undertaken on the 20th and 21st August 2012. This report was prepared for 7th September 2011.

Personnel

2.7 Fieldwork was conducted by Duncan Hale (the Project Manager) and Rebekah Watson. The geophysical data were processed by Duncan Hale. This report was prepared by Duncan Hale, the Project Manager, with illustrations by Janine Watson.

Archive/OASIS

2.8 The site code is **CAD12**, for **C**lachan **A**n **D**iridh 20**12**. The survey archive will be supplied on CD to the client for deposition with the project archive in due course. Archaeological Services Durham University 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 **archaeol3-133547**.

Acknowledgements

2.9 Archaeological Services Durham University is grateful for the assistance of personnel of the Tay Forest District branch of the Forestry Commission Scotland in facilitating this scheme of works.

3. Historical and archaeological background

3.1 Clachan an Diridh is a probable 'four-poster' stone circle, a type of monument typically regarded as dating to the Bronze Age. Burl suggested a date of *c.*1600 BC for this type of feature (Burl 1971), which is found uniquely in Britain and especially in Perthshire. These stone circles are typically classed as ritual or funerary monuments.

3.2 The monument comprises three standing stones up to 1.7m in height and 1.8m in width, however, a large fragment of a probable fourth corner stone is also present, lying on the ground. Several smaller rocks are also evident in the area of the monument.

3.3 The stones do not appear to occupy their own raised platform but they are sited on a larger rise. This small shoulder overlooked a lochan, Locahan na Moine Moire, shown on maps until the mid-20th century when the forestry scheme began.

3.4 The monument has also been known locally as 'Clachan-direach' and 'The Druids Stones'.

4. Landuse, topography and geology

4.1 At the time of survey the stone circle was within a large forestry plantation. Trees had been felled on all sides except to the north-east of the monument, and consequently much of the ground outside the actual stones was covered with brushwood, with tree stumps and larger debris also still remaining. It was therefore not possible to collect data in the southern and western corners of the 40m square survey.

4.2 The monument itself was in grass, with heather and sphagnum, on peaty soil. Narrow drainage channels cut across the survey area. Wheel ruts from forestry

vehicles formed a rough track along the north-eastern side of the survey area, immediately beyond which were mature plantation trees.

Southern part of survey area, looking S

Brushwood and felling debris

Western part of survey area, looking W

4.3 The survey area varied in elevation between approximately 351m OD and 354m OD. The stone circle occupied a relatively level raised area at approximately 354m OD. There was a small low mound approximately 6m north-west of the stones. Beyond this higher ground the land fell away gently in each direction.

4.4 The underlying solid geology of the area comprises Neoproterozoic-Paleozoic metalava and metatuff of the Southern Highland Group, overlain by till in this area.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Institute for Archaeologists (IfA) *Standard and Guidance for archaeological geophysical survey* (2011); the IfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service *Guide to Good Practice: Geophysical Data in Archaeology* (Schmidt & Ernenwein 2011).

Technique selection

5.2 Geophysical survey enables the relatively rapid and non-invasive identification of sub-surface features of potential archaeological significance and can involve a suite of complementary techniques such as magnetometry, earth electrical resistance, ground-penetrating radar, electromagnetic survey and topsoil magnetic susceptibility survey. Some techniques are more suitable than others in particular situations, depending on 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 stone-holes, post-holes, ditches and pits might be present on the site, and that other types of feature such as cairns, stone or timber burial chambers and fired structures (for example cremations, kilns and hearths) might also be present.

5.4 Given the anticipated depth and nature of targets and the geological environment of the study area, two complementary techniques were considered appropriate in this instance: earth electrical resistance and fluxgate gradiometry.

5.5 Electrical resistance survey is not affected by the local rock type and is suitable for detecting stone features such as cairns, walls, paths and culverts; it can also detect soil-filled features, depending on ground conditions at the time of survey. When a small electrical current is injected through the earth it encounters resistance which can be measured. Since resistance is linked to moisture content and porosity, stone and brick features will give relatively high resistance values while soil-filled features, which typically retain more moisture, will provide relatively low resistance values. Fluxgate gradiometry involves the use of hand-held magnetometers to detect and record anomalies in the vertical component of the Earth's magnetic field, which are caused by variations in soil magnetic susceptibility or permanent magnetisation; such anomalies can reflect, for example, ferrous, stone, brick and soil-filled features.

Field methods

5.6 A 20m grid was established across the survey area and related to the Ordnance Survey National Grid using a Leica GS15 global navigation satellite system (GNSS) with real time kinematic (RTK) correction typically providing accuracy of 10-15mm.

Resistance survey

5.7 Measurements of earth electrical resistance were determined using a Geoscan RM15D Advanced resistance meter with MPX15 multiplexer and 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 was 0.5m and the traverse interval was 0.5m, thus providing 1,600 sample measurements per 20m grid unit.

5.8 Measurements of vertical geomagnetic field gradient were determined using a Bartington Grad601-2 dual fluxgate gradiometer. A zig-zag traverse scheme was employed and data were logged in 20m grid units. The instrument sensitivity was nominally 0.03nT, the sample interval was 0.25m and the traverse interval was 0.5m, thus providing 3,200 sample measurements per 20m grid unit.

5.9 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

5.10 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 (minimally processed) data. The greyscale images and interpretations are presented in Figures 3-4; the trace plots are provided in Figure 5. In the greyscale images, positive magnetic and high resistance anomalies are displayed as dark grey while negative magnetic and low resistance anomalies are shown as light grey. Palette bars relate the greyscale intensities to anomaly values in ohm for the electrical resistance data and nanoTesla for the geomagnetic data.

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

despike	locates and suppresses spikes in data due to poor contact resistance
add	adds or subtracts a positive or negative constant value to defined blocks of data; used to reduce discontinuity at grid edges
interpolate	increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.125m x 0.125m intervals

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

clip	clips 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 geomagnetic anomalies caused by alternate zig-zag traverses

interpolate increases the number of data points in a survey to match sample and traverse intervals; in this instance the data have been interpolated to 0.125m x 0.125m intervals

Interpretation: anomaly types

5.13 Colour-coded geophysical interpretations are provided. Two types of resistance anomaly have been distinguished in the data:

high resistance regions of anomalously high resistance, which may reflect concentrations of stone or rockhead, foundations, tracks, paths and rubble

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

5.14 Three 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

negative magnetic regions of anomalously low or negative magnetic field gradient, which may correspond to features of low magnetic susceptibility such as wall footings and other concentrations of sedimentary rock or voids

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

5.15 A colour-coded archaeological interpretation is provided.

5.16 A large oval area of high resistance has been detected encompassing the standing stones. This could either reflect stone that was deliberately placed to form a platform or cairn, or could reflect near-surface bedrock.

5.17 Relatively low resistance values were recorded in the central part of this area. Additionally, four small pockets of low resistance were detected within the generally high resistance area. Given the presence of these it is perhaps more likely that the high resistance values reflect a man-made structure as opposed to bedrock with apparent voids. The four pockets of low resistance indicate an absence of stone, and each corresponds to a strong magnetic anomaly. The magnetic anomalies do not appear to be intense enough to reflect ferrous materials, but are of considerably higher magnetic susceptibility than typical soils and sediments; these anomalies could reflect burnt earth or other burnt/fired materials. It is probable then that these could reflect voids containing magnetically enhanced earth or burnt materials, which by extension could be interpreted as possibly cists, pots and cremated materials. Two of these features are within and adjacent to the standing stones. The most westerly feature could be within or beneath a small low mound noted on the ground about 6m west of the stones.

5.18 Small high resistance anomalies have been detected immediately adjacent to the three standing stones. These anomalies could reflect packing stones and backfill associated with the erection of the three stones.

5.19 Some discrete positive magnetic anomalies could possibly reflect the remains of narrow soil-filled features such as gullies, though these do not appear to be related to the monument.

5.20 Narrow parallel anomalies have been detected by both techniques across much of the survey area. These reflect existing drainage channels at the site.

5.21 Although some geomagnetic anomalies can be identified and interpreted, the data are relatively 'noisy'. This is almost certainly due to the local rock.

6. Conclusions

6.1 High resolution geomagnetic and earth electrical resistance surveys were undertaken at Clachan an Diridh four-poster stone circle near Pitlochry in Perth and Kinross.

6.2 The resistance survey has been the more useful technique in this instance, due to the magnetic component of the local rock, however, the techniques have been complementary in some regards.

6.3 An oval of high resistance anomalies around the standing stones appears to reflect a platform or cairn of deliberately placed stones rather than the rockhead. Four geomagnetic and resistance anomalies within this material could possibly reflect voids or cists within which burnt or fired materials have been placed. These anomalies could also reflect more recent materials or disturbance, however, they do not appear intense enough to reflect typical ferrous litter.

6.4 The surveys have not provided clear evidence for a kerb or ditch around the monument.

6.5 Several small magnetic anomalies could possibly reflect remains of small gullies, which do not appear to be associated with the monument.

6.6 Modern drainage channels across the site were detected by both techniques.

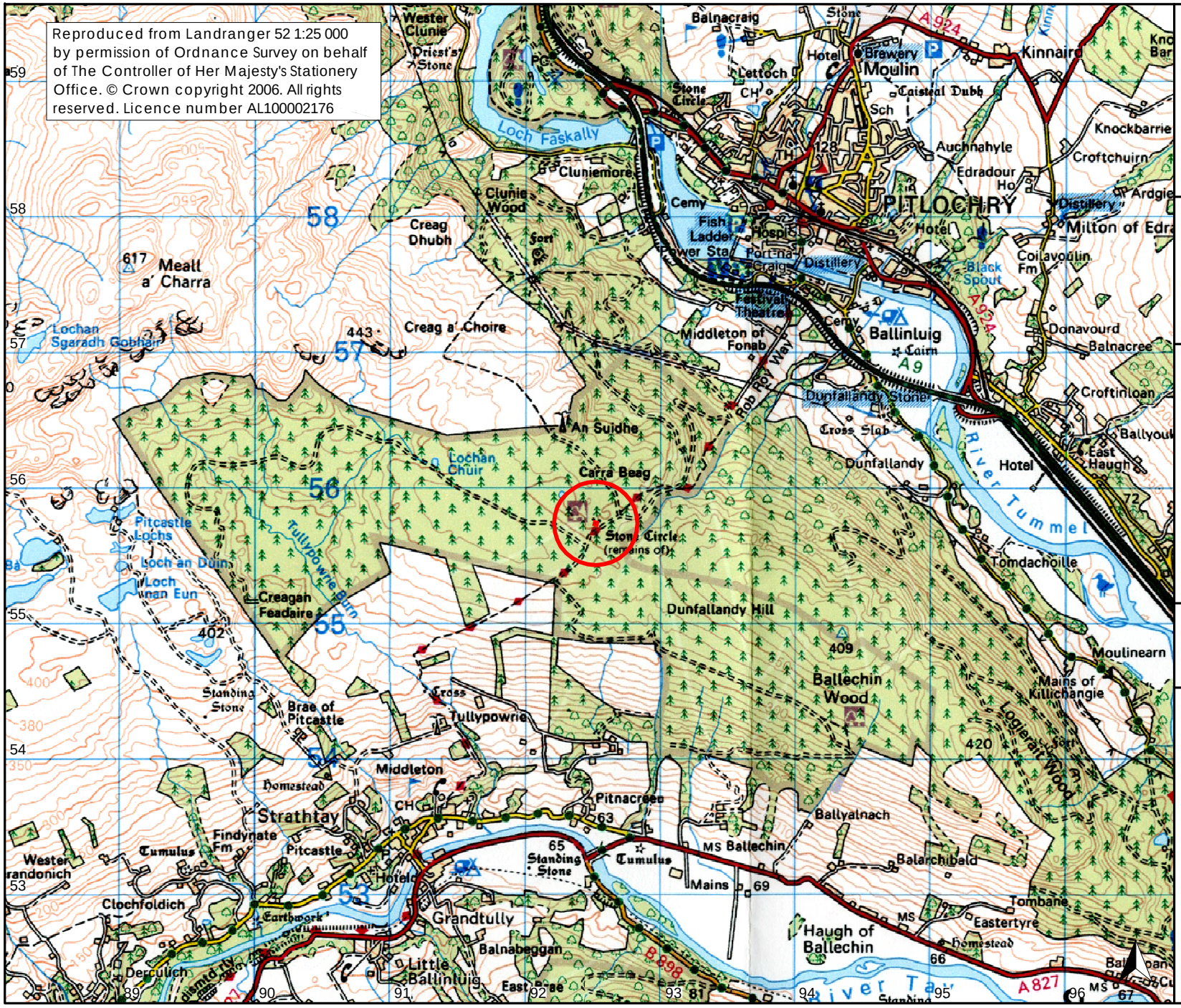
7. Sources

David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*. English Heritage

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

IfA 2011 *Standard and Guidance for archaeological geophysical survey*. Institute for Archaeologists

Schmidt, A, & Ernenwein, E, 2011 *Guide to Good Practice: Geophysical Data in Archaeology*. Archaeology Data Service



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Perth and Kinross

geophysical survey
report 2979

Figure 1: Site location

0 2km
scale 1:40 000 for A4 plot

survey location

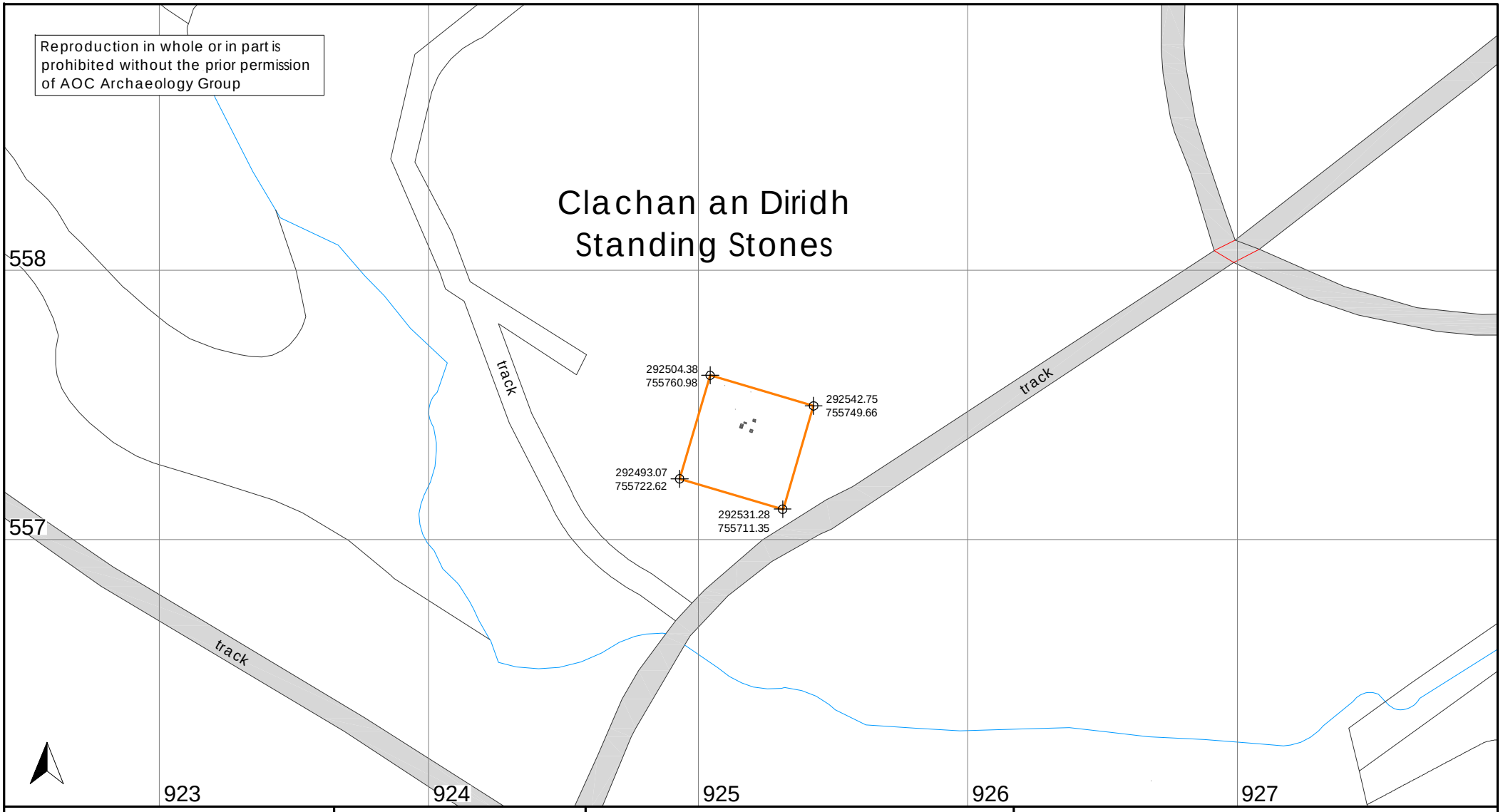

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Figure 2: Survey area

location of geophysical survey

standing stones

0 100m

scale 1:2000 for A4 plot

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magnetic survey

resistance survey

0 20m
scale 1:400 for A3 plot

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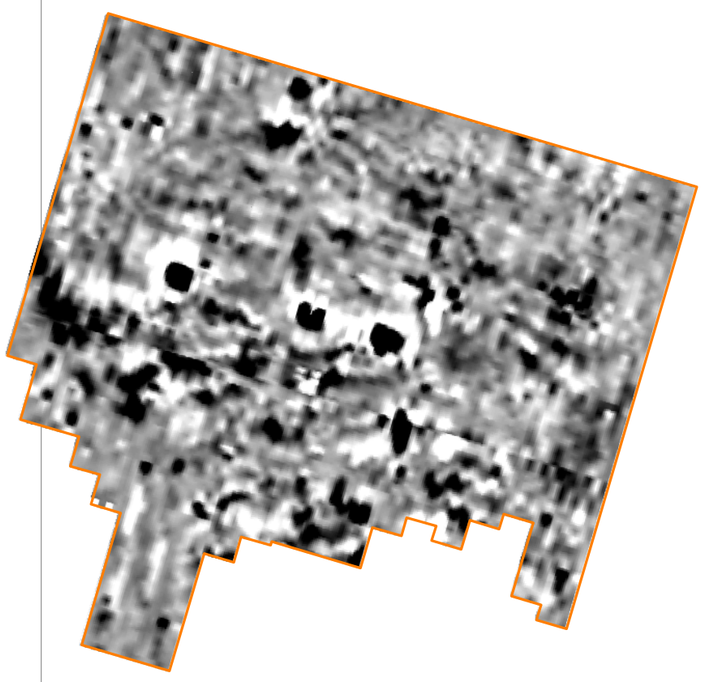
Pitlochry
Perth and Kinross

geophysical survey
report 2979

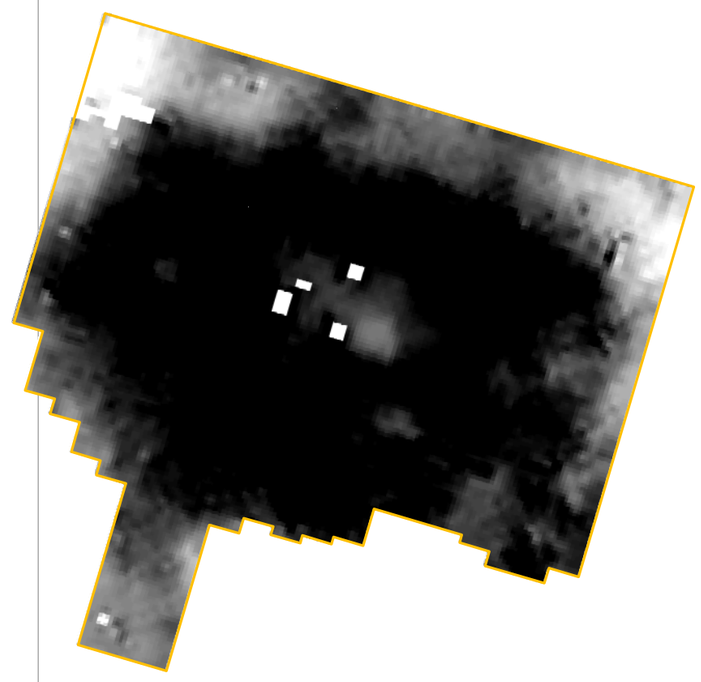
Figure 3: Geomagnetic and resistance surveys

-4 nT 6
geomagnetic survey



557
925

500 ohm 1000
resistance survey



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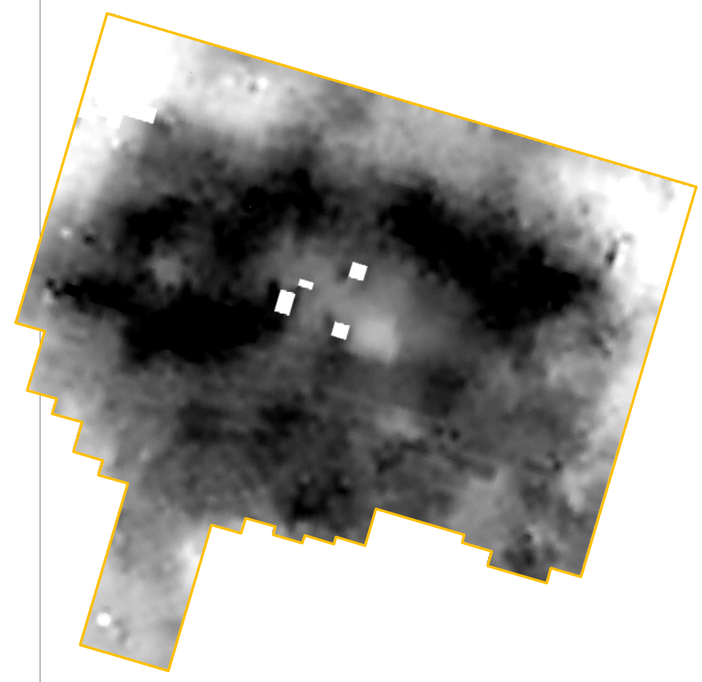
600 ohm 1200
high contrast resistance survey



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- magnetic survey
- resistance survey
- standing stones
- dipolar magnetic anomaly
- positive magnetic anomaly
- negative magnetic anomaly
- high resistance anomaly
- low resistance anomaly
- soil-filled feature
- stone / bedrock
- possible burnt / fired material

0 20m
scale 1:400 for A3 plot

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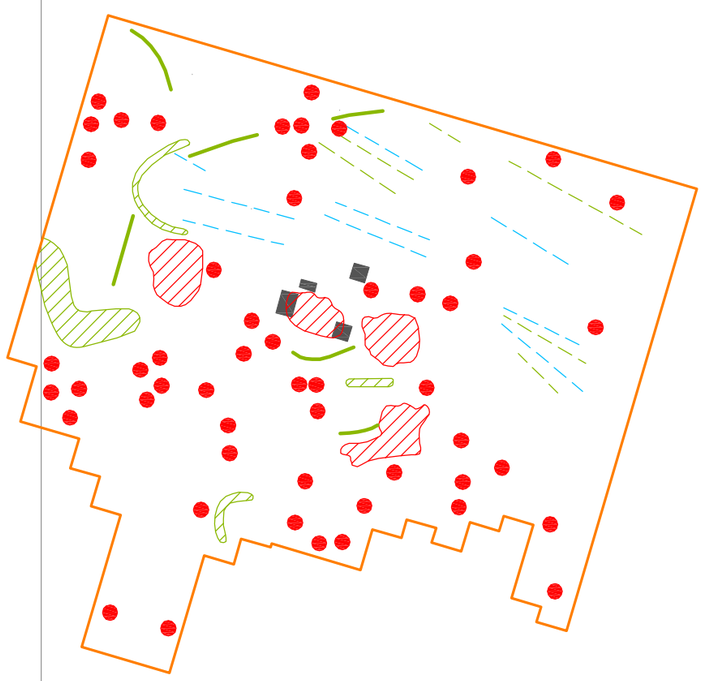
Pitlochry
Perth and Kinross

geophysical survey
report 2979

Figure 4: Geophysical and archaeological interpretations



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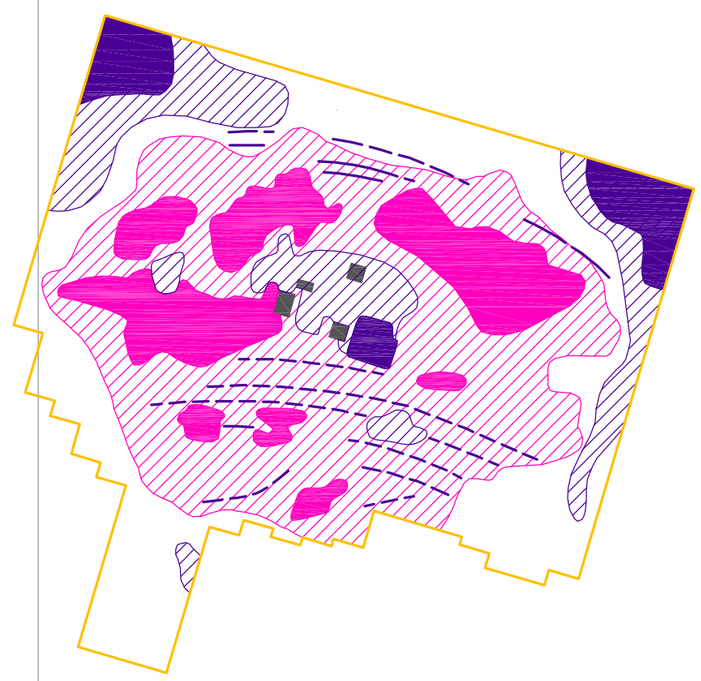

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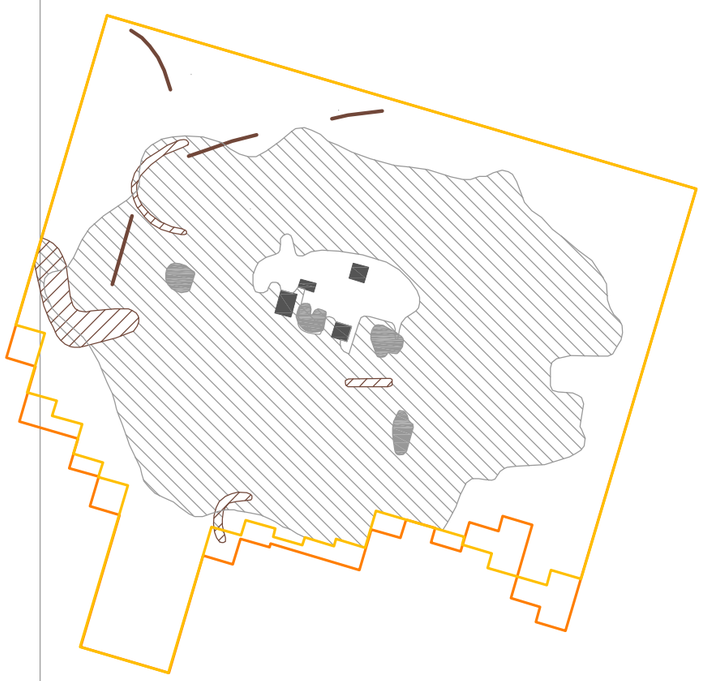

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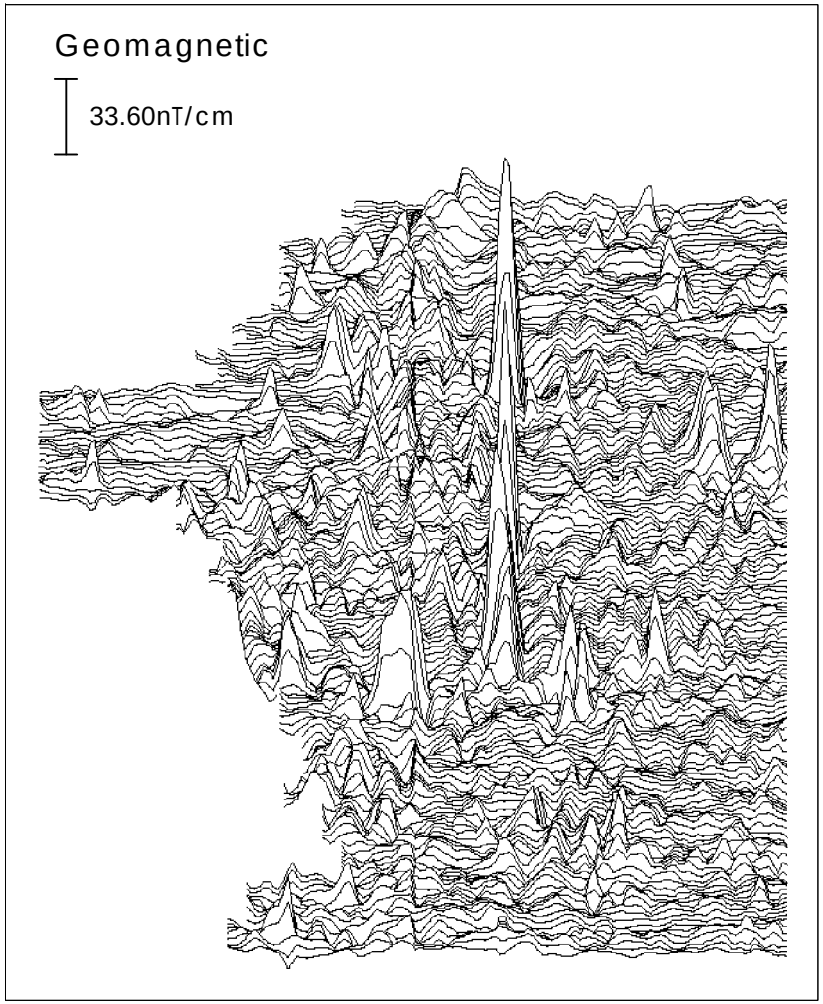

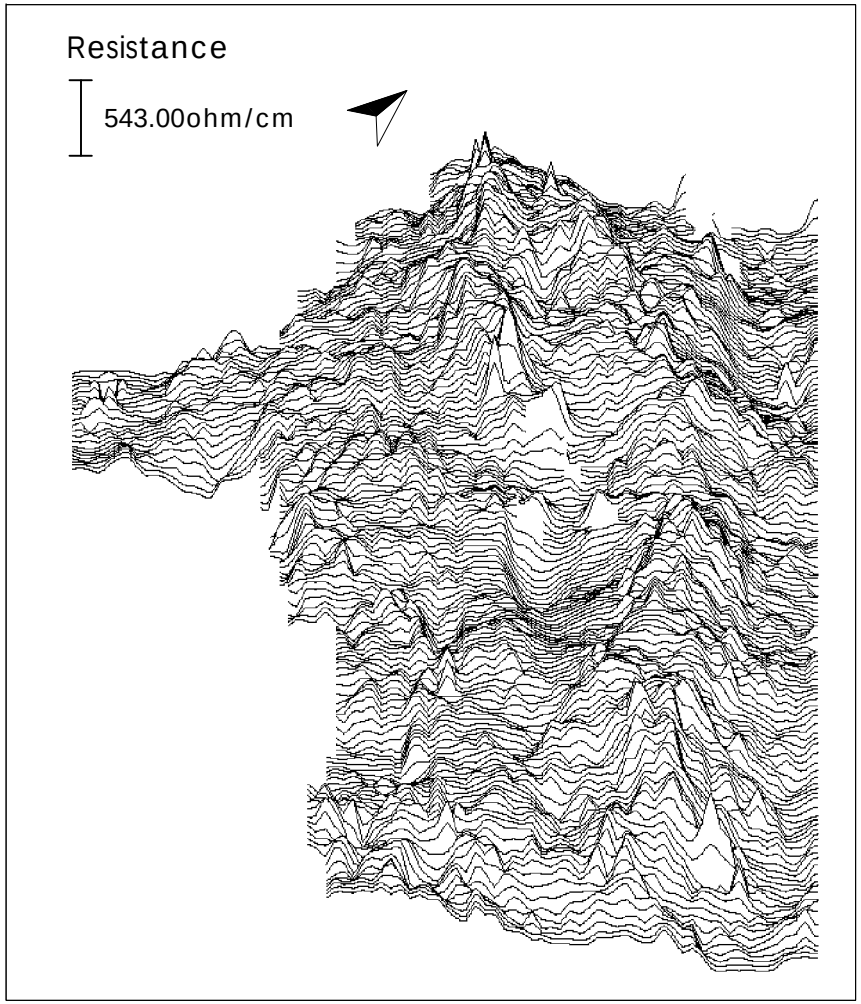

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Perth and Kinross

geophysical survey
report 2979

Figure 5: Trace plots of geophysical data

0 20m
scale 1:400 for A3 plot