



Archaeological Services
University of Durham

Whitley Castle, Tynedale, Northumberland

geophysical surveys

on behalf of



and



Report 2149
September 2009

Archaeological Services
Durham University
South Road
Durham DH1 3LE
Tel: 0191 334 1121
Fax: 0191 334 1126
archaeological.services@durham.ac.uk
www.durham.ac.uk/archaeological.services

Whitley Castle, Tynedale, Northumberland

geophysical surveys

Report 2149

September 2009

Archaeological Services Durham University

on behalf of

English Heritage

North Pennines AONB Partnership

and

Natural England

Contents

1. Summary	1
2. Project background	2
3. Archaeological and historical background	3
4. Landuse, topography and geology	5
5. Geophysical survey	6
6. Conclusions	17
7. Sources	18

Figures (inside back cover)

Figure 1: Study area

Figure 2: Location of survey areas

Figure 3: Geomagnetic survey results

Figure 4: Geomagnetic survey results with earthworks overlain

Figure 5: Geophysical interpretation of magnetic survey

Figure 6: Resistance survey results

Figure 7: Resistance survey results with earthworks overlain

Figure 8: Geophysical interpretation of resistance survey

Figure 9: Archaeological interpretation of geophysical surveys

Figure 10: Trace plots of geomagnetic data

Figure 11: Trace plots of resistance data

1. Summary

The project

- 1.1 This report presents the results of geophysical surveys conducted as part of an archaeological research project at Whitley Castle in Northumberland directed by English Heritage (EH). The study area comprised a well-preserved Roman fort (*Epiacum*) and its surroundings near Alston.
- 1.2 The works comprised geomagnetic survey of approximately 36ha over the fort earthworks and surrounding land, and targeted electrical resistance survey over approximately 8ha.
- 1.3 The majority of the works were commissioned by English Heritage through the North Pennines AONB Partnership and Durham County Council. Natural England also contributed towards the funding of the resistance survey through a Higher Level Stewardship Scheme with the landowners.

Results

- 1.4 The geophysical surveys have successfully detected a range of anomalies across most parts of the study area, which have helped to characterise former landuse in different areas at different times. For example, the anomalies variously reflect the remains of the fort wall and ramparts, intra-mural buildings, areas of probable *vicus* and official extra-mural buildings, several roads both within and outside the fort, possible pre-Roman settlement, agricultural features including probable potato-beds and ridge and furrow, post-medieval buildings and possible evidence for mining activities.
- 1.5 Several phases of activity can be interpreted from the geophysical results, including at least two phases of significant re-modelling of defences and other structures around the fort's southern corner.
- 1.6 In these regards the specific objectives of the geophysical surveys have been achieved. The surveys have added considerable value to existing knowledge of the site and its immediate environs and have helped improve understanding of the monument and its setting. The results will inform plans for future conservation and visitor access, particularly with regard to the area between the fort and Castle Nook.

2. Project background

Location (Figures 1 and 2)

- 2.1 The study area covered approximately 36ha of land at Whitley Castle in Northumberland, a scheduled Roman fort (*Epiacum*) and its immediate surroundings, about 3km north-west of Alston (NGR centre: NY 6949 4868). The geophysical survey area was defined by a track and path (the route of the ‘Pennine Way’) curving around to the south, west and north of the fort, by Castle Nook Farm and the A689 road to the north and north-east, and by Whitlow to the south-east.

Objective

- 2.2 The geophysical surveys form part of an archaeological research project at Whitley Castle directed by Dave Went and Stewart Ainsworth of English Heritage (EH). The project also included a Level 3 earthwork survey and studies of historical sources and the site’s archaeological background. The principal objective of the project was to improve understanding of the monument and its setting and so inform plans for future conservation and visitor access.
- 2.3 In view of that objective, the specific aims of the geophysical surveys were to identify, define the extent of and, if possible, characterise any sub-surface features of potential archaeological interest.
- 2.4 The results of the Whitley Castle research will contribute to the wider ‘Miner-Farmer Landscapes of the North Pennines AONB’ project, a landscape research partnership project between EH and the North Pennines AONB, led by the EH Research Department.

Methods statement

- 2.5 The surveys have been undertaken in accordance with a Project Brief supplied by English Heritage and with national standards and guidelines (see para 5.1 below).
- 2.6 Since a large part of the study area comprised a Scheduled Ancient Monument (SAM No. ND12) the surveys there were undertaken in accordance with a licence granted by English Heritage under Section 42 of the Ancient Monuments and Areas Act 1979 (as amended by the National Heritage Act 1983).

Dates

- 2.7 The geomagnetic surveys were undertaken between 5th and 27th January 2009. The electrical resistance surveys were undertaken between 23rd March and 7th May 2009. This report was completed in September 2009.

Personnel

- 2.8 Fieldwork was conducted by Jamie Armstrong, Matt Claydon, Ed Davies, David Graham, Duncan Hale, Andy Platell, Mark Randerson, Adam Rogers, Natalie Swann, Richie Willis (Supervisor) and David Webster. This report was

prepared by Duncan Hale (Project Manager) with illustrations by Ed Davies, David Graham and Janine Watson.

Archive/OASIS

- 2.9 The site code is **AWC09**, for Alston **Whitley Castle 2009**. The survey archive will be supplied on CD to English Heritage for deposition with the project archive at the National Monuments Record and the Archaeology Data Service in due course. Archaeological Services is registered with the **Online Access** to the **Index of archaeological investigationS** project (OASIS). The OASIS ID number for this project is **archaeol3-64054**.

Copyright

- 2.10 The copyright of datasets, documents and images generated by the geophysical surveys is assigned to Archaeological Services Durham University. English Heritage and the North Pennines AONB Partnership have permission for use for internal research, promotion of research and publication.

Acknowledgements

- 2.11 Archaeological Services is grateful to the following for supporting and facilitating these surveys: John and Elaine Edgar of Castle Nook Farm; Dave Went and Stewart Ainsworth of the English Heritage Archaeological Survey and Investigation team; Paul Frodsham of North Pennines AONB; Tom Gledhill of Natural England; Rob Young of English Heritage North-East Region; and Durham County Council for administration.
- 2.12 The majority of the works were commissioned by English Heritage through the North Pennines AONB Partnership and Durham County Council with HEEP funding. Natural England also contributed towards the funding of the resistance survey through a Higher Level Stewardship agreement for Castle Nook Farm.

3. Archaeological and historical background

- 3.1 Comprehensive accounts of the archaeological background to the site and reviews of historical sources are provided elsewhere (for example, Robertson 2007; Went & Ainsworth 2009/forthcoming). Only a brief introduction is provided here.
- 3.2 The impressive earthworks at Whitley Castle were recognised as being an important Roman station by William Camden as early as 1599. However, perhaps due to its isolated upland location and the nearby Hadrian's Wall complex, it has received relatively little attention over the centuries.
- 3.3 The fort stands on a spur overlooking the Maiden Way, a Roman military road which ran between the forts of *Bravoniacum* at Kirby Thore in Cumbria and *Magna* (Carvoran) on Hadrian's Wall near Greenhead in Northumberland. Its location was almost certainly chosen to enable control of the production and transportation of lead from the Alston ore-fields (Went & Ainsworth 2009).

- 3.4 The fort has a unique lozenge-shaped plan, best suited to fit the knoll on which it stands, and multi-vallate defences: seven ditches and intervening banks on the south-west side, four on the north-west, three on the south-east and two on the north-east, as determined necessary by local topographic factors. The number of ramparts and the exceptional level of preservation make the fort unparalleled in England and comparable to that at Ardoch, near Perth in Scotland.



Whitley Castle, north is to top-right (© English Heritage)



Ardoch, looking south-east across the eastern defences

- 3.5 The first stone fort on the site was built in the early 2nd century with an intra-mural area of about 1.2ha, within which the remains of building walls, robber trenches and collapses and dumps of material can still be seen. In the later phases of the fort a bath-house was constructed over infilled defences outside the northern corner. Extra-mural, *vicus*, settlement is believed to have been built over earlier terraced fields outside the fort's north-west gate and a more substantial building, possibly serving as a *mansio*, was built to the west. Apparently featureless level ground to the south of the fort has been tentatively interpreted as a parade ground (*ibid.*).
- 3.6 Little is known of the forts abandonment or subsequent use, however, bastle-like houses were constructed in the *retentura* in the late 16th or 17th centuries.
- 3.7 Few formal archaeological interventions have been undertaken at the site, with the exception of excavations in 1957/8 and limited geophysical survey in 2003 and 2006. The 1957/8 excavations were directed by Noel Shaw on behalf of the Excavation Committee of Durham University and initially comprised one trench, subsequently extended, over the north-western ramparts and a little way into the interior of the fort (Shaw 1959). This work confirmed the presence of a substantial, stone, fort wall as well as a series of stone building phases in the interior. The geophysical surveys were undertaken by GeoQuest Associates on behalf of local historian Alastair Robertson and detected blocks of buildings and roads within the fort and two substantial buildings and other features on land to the west of the fort (GeoQuest 2006).

4. Landuse, topography and geology

- 4.1 The geomagnetic survey area comprised 35.99ha within 15 fields of pasture, typically enclosed by dry-stone walls. Each magnetic survey area corresponds to one land parcel; the electrical resistance survey of areas totalling 8.11ha covered parts of numerous land parcels, as shown in Figure 2. The pasture to the east and south of the fort has been significantly improved by drainage and ploughing in relatively recent times, while the land to the north and west of the fort is largely unimproved rough grazing with boggy areas, particularly amongst and beyond the western ramparts. Similarly the fort interior and other ramparts are unimproved rough pasture. During the geomagnetic surveys (January 2009), and also during some of the subsequent electrical resistance surveys, the ground was variously snow-covered, frozen, boggy or held standing water in places.
- 4.2 Rubble tracks and streams were present in several areas. The only obstacles to survey comprised building remains, piles of stone/rubble and a pond near Whitlow (Areas 2, 3 and 18) and collections of steel animal feeders, machinery and scaffolding around Holymire (Areas 6 and 14).
- 4.3 The fort occupies a spur on a broad hillside on the western side of the South Tyne Valley. Although the fort interior has a mean elevation of about 325m OD, overlooking the valley, it is itself overlooked from the west by Little and Great Heaplaw and by Whitley Common. The elevation of the survey area

ranges from 340m OD on the track at the site's western limit to 270m OD on the A689 road due east of the fort. There is much natural variation in height around the fort, which has been enhanced on all sides to varying degrees by the fort ramparts. The ramparts are particularly well-preserved, forming steep and imposing banks, which proved particularly challenging during data collection along oblique traverses in often rather adverse weather and ground conditions.



Whitley Castle, geomagnetic survey with much of the snow gone

- 4.4 The underlying solid geology belongs to the Alston Formation, a succession of Carboniferous sedimentary rocks including bioclastic limestones, sandstones, mudstones, siltstones and rare coals. These strata are overlain by boulder clay.

5. Geophysical survey

Standards

- 5.1 The surveys and reporting were conducted in accordance with English Heritage guidelines, *Geophysical survey in archaeological field evaluation 2nd edition* (David, Linford & Linford 2008); the Institute for 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 2002).

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 known that cut features such as ditches and pits would be present on the site, and that built features such as trackways, wall-footings and fired structures (for example ovens and hearths) would also be present.
- 5.4 Given the anticipated nature and depth of targets and the geological environment of the study area, two complementary geophysical survey techniques were employed: geomagnetic and earth electrical resistance survey.
- 5.5 The geomagnetic method, fluxgate gradiometry, involved the use of hand-held magnetometers to detect and record 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. Earth electrical resistance survey can be particularly useful for mapping stone features. 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 features will give relatively high resistance values while soil-filled features, which typically retain more moisture, will provide relatively low resistance values.

Field methods

- 5.6 A 20m grid was established across the whole study area using a Trimble Pathfinder Pro XRS global positioning system (GPS) with real-time correction; this grid was a 20m sub-division of the National Grid. Together with the detailed GPS land survey data collected by the EH survey team, it has been demonstrated that the OS mapping of features in this area is inaccurate by up to several metres.
- 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 Measurements of earth electrical resistance were determined using Geoscan RM15D resistance meters with MPX15 multiplexers 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 to 0.5m and the traverse interval to 1.0m, thus providing 800 sample measurements per 20m grid unit.
- 5.9 Data were downloaded on site into laptop computers 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 (unfiltered) data. The greyscale images and interpretations are presented in Figures 3-9; the trace plots are provided in Figures 10 and 11. In the greyscale images, positive magnetic/high resistance anomalies are displayed as dark grey and negative magnetic/low resistance anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in nanoTesla/ohm as appropriate.

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

<i>clip</i>	clips, or limits data to specified maximum or minimum values; to eliminate large noise spikes; also generally makes statistical calculations more realistic.
<i>zero mean traverse</i>	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.
<i>destagger</i>	corrects for displacement of anomalies caused by alternate zig-zag traverses.
<i>interpolate</i>	increases the number of data points in a survey to match sample and traverse intervals. In this instance the data have been interpolated to 0.25m x 0.25m intervals.

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

<i>despike</i>	locates and suppresses poor contact resistance spikes in resistance data.
<i>add</i>	adds or subtracts a positive or negative constant value to defined blocks of data; used to reduce discontinuity at grid edges.
<i>interpolate</i>	increases the number of data points in a survey to match sample and traverse intervals. In this instance the data have been interpolated to 0.25m x 0.25m intervals.

Interpretation: anomaly types

5.13 Colour-coded geophysical interpretation plans are provided. With the exception of the intra-mural roads, and the open area within the front of the headquarters building, there is virtually no geomagnetic background within the fort; the measurements are all generally either strongly positive or strongly negative. For this reason it has not proved useful to include a colour-coded geomagnetic interpretation of the fort interior; such an exercise proved no more useful than simply viewing the greyscale plot, in which those anomalies are effectively colour-coded already as black and white.

5.14 Also, for clarity, the majority of negative magnetic anomalies outside the fort wall are not included on the geomagnetic interpretation plan as most are shadow effects associated with very strong positive magnetic anomalies.

- 5.15 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.
- 5.16 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

General comments

- 5.17 A colour-coded archaeological interpretation plan is provided (Figure 9). The density of geophysical anomalies recorded in the fort interior reflects a palimpsest of features from more than one phase, as well as robber-trenches and re-deposited rubble, however, an attempt has been made to present some possible building and road locations.
- 5.18 In general there is a very close correlation between the mapped earthwork features and the geophysical anomalies (Figures 4 and 7), especially with regard to the ramparts around the north- and south-western sides of the fort and the land beyond to the west and north. Notable exceptions to this, however, concern the probable earlier defences at the southern corner of the fort, and other nearby features, for which there is no longer any surface expression, as discussed below.
- 5.19 Indeed, in several extra-mural areas, the surveys have detected concentrations of probable building remains and other features, for which there is very little topographic evidence. In this regard the surveys have added considerable value to existing knowledge.
- 5.20 Positive magnetic anomalies have been detected throughout the surveys. As noted above, these anomalies reflect relative increases in high magnetic susceptibility materials, which are typically sediments within cut archaeological features (such as ditches, furrows or pits) whose magnetic

susceptibility has been enhanced by decomposed organic matter or by burning. In this instance, however, not only do positive magnetic anomalies reflect soil-filled features, but also earth- and rock-built features. The fort wall, which is known to be constructed of sandstone blocks, albeit now earth-covered, and the surrounding banks, known to be constructed of clay and stone, are all evident as positive magnetic anomalies.

- 5.21 Relatively low concentrations of small, discrete dipolar magnetic anomalies have been detected throughout the geomagnetic survey area. These almost certainly reflect items of near-surface ferrous and/or fired debris, such as horseshoes and brick/tile fragments, and in most cases have little or no archaeological significance. A sample of these is shown on the geomagnetic interpretations, however, they have been omitted from the archaeological interpretation plan and the following discussion. A high concentration of roof tiles within the fort would certainly contribute to the confusion of relatively intense magnetic anomalies there.
- 5.22 Particularly large dipolar magnetic anomalies were recorded around both Holymire and Whitlow, reflecting existing structures as well as rubble, steel animal feeders, machinery and scaffolding. Large dipolar magnetic anomalies detected on field boundaries typically reflect steel gates and gateposts.
- 5.23 The area numbers used below refer to the geomagnetic survey areas as shown on Figure 2, some of which also include resistance survey.

Area 1

- 5.24 The most prominent anomalies detected in this area are of recent origin. They comprise a broad band of many small dipolar magnetic anomalies, which reflect the materials used in the existing track to Whitlow, and a narrow chain of small dipolar magnetic anomalies, which almost certainly reflects a utility service to Whitlow. Some small, discrete positive magnetic anomalies here could possibly reflect soil-filled pits.

Area 2

- 5.25 No features of likely archaeological significance were detected in this marshy field, although some small, discrete positive magnetic anomalies could possibly reflect soil-filled pits.

Area 3

- 5.26 Three groups of parallel, alternate positive and negative magnetic anomalies have been detected here; two overlapping in the southern part of the field and one more extensive group in the central part of the field. These closely-spaced anomalies probably reflect 18th/19th-century horse-ploughing or potato-beds. Each group of anomalies is associated with further positive magnetic anomalies, almost certainly reflecting the former 'field' boundaries. The anomalies here are aligned with existing field boundaries and are particularly regular, making it less likely that they reflect the much earlier type of cultivation known as cord rig.

Area 4

- 5.27 Weak negative magnetic anomalies in this area correspond to existing and former courses of small streams across this boggy field. The northernmost of these courses appears to have followed a furrow from an earlier phase of ridge and furrow cultivation. A chain of small dipolar magnetic anomalies across the southern corner of the field corresponds to another small stream. Further anomalies associated with former ridge and furrow were detected in the south-western part of this field adjacent to Holymire.

Area 5

- 5.28 Two sets of weak, parallel anomalies were detected across this area. One set is slightly arcuate and is almost certainly associated with former ridge and furrow cultivation, while the other is straighter and could perhaps reflect land drains. The anomalies are all broadly spaced and generally aligned north-east/south-west.
- 5.29 Some large though weak positive magnetic anomalies in this field could reflect soil-filled pits.
- 5.30 A stream continues from Area 4 across the south-eastern corner of this field and then along the north-western boundary of Area 3. The earthen track which runs the length of this field does not give rise to a geomagnetic anomaly.

Area 6

- 5.31 Several weak, parallel magnetic anomalies which were detected across this area aligned north-east/south-west are a continuation of the ridge and furrow cultivation detected in adjacent fields. Other stronger positive magnetic anomalies on this alignment and perpendicular to it probably reflect small ditched plots along the western side of the Maiden Way, although the road itself is not clear here.
- 5.32 Some anomalies in the western part of this field are almost certainly associated with the Roman fort. Faint anomalies reflect traces of two parallel banks which head south across this area from the south-east gate of the fort, defining the road there. Adjoining the westerly of these is another strong positive magnetic anomaly (and a low resistance anomaly) which heads to the west. These anomalies appear to reflect a bank, or possible revetment of the existing slope, with a ditch on its southern side. These continue westwards around the base of the fort's southern defences.
- 5.33 The earthen track which comes up through Area 5 continues as an earthen track through this field until it crosses the stream north of Holymire, where it gains a hardcore base detected as a concentration of small, intense dipolar magnetic anomalies.

Area 7

- 5.34 Former ridge and furrow cultivation is evident across this field as very weak magnetic lineations and as quite clear electrical resistance anomalies. Recent

land drains have also been clearly detected as low resistance lineations aligned north-west/south-east.

- 5.35 The most prominent anomalies detected here are associated with the Maiden Way, a Roman road which is known to run broadly north-south to the west of the fort, although it is now barely discernible on the ground. A broad band of high resistance anomalies was detected along a very slight terrace aligned between Castle Nook farmhouse and the southern corner of the field. The anomalies almost certainly reflect the remains of an agger, perhaps surviving to a width of 5-6m here. A narrow low resistance anomaly was detected parallel to the road, some 6-8m to its east. This represents a roadside ditch. A slight positive magnetic lineation along the eastern side of the ditch appears to reflect upcast on its downward side.
- 5.36 Neither the road nor its eastern ditch are readily identified in the geomagnetic data, though several other magnetic anomalies were detected here, some of which correspond to other resistance anomalies. Although generally not well-defined in the data, both techniques do indicate the presence of a road heading north-east from the fort to join the Maiden Way, and a series of rectilinear roadside plots bounded by banks and/or ditches which could represent roadside settlement. The geomagnetic survey also detected the probable remains of small rectilinear enclosures further west, continuing into Area 8, to the north-east of the fort's north-east gate.

Area 8

- 5.37 This field included the northern and eastern parts of the fort as well as land to the north where a *vicus* has been supposed. The ramparts around the north corner of the fort and around to the east are less well preserved than elsewhere (presumably due to stone-robbing) and this is borne out by the geomagnetic survey. Even the fort wall is not readily identified in the data from near the fort's eastern corner. Resistance survey largely avoided the fort defences and was targeted towards areas where buildings were anticipated.
- 5.38 Two broad and well-defined bands of relatively smooth magnetic data were recorded crossing the fort interior. These reflect the *via principalis* and *via praetoria*, aligned north-west/south-east and north-east/south-west respectively. Both roads have been detected to varying degrees passing through the ramparts and out beyond the fort. The *via praetoria* continues north-eastwards to join the Maiden Way and appears to be flanked on its north side by some small enclosures or structures mid-way between the fort and the Maiden Way. Additional anomalies outside the fort here include ridge and furrow remains. The *via principalis* heads south-south-east and may join the Maiden Way to the south of Holymire barn. Extending north-west from the fort the *via principalis* appears to be a substantial metalled road for up to 90m from the fort wall, after which its geophysical anomalies become less evident.
- 5.39 Within the fort both the geomagnetic and resistance surveys have detected many anomalies, which appear to represent four substantial buildings to the north of the *via principalis* and at least three to its immediate south. Those in

the north are presumed to be barrack blocks and are aligned parallel to the fort's shorter (north-east and south-west) sides. There are some anomalies aligned with the long sides of the fort which appear to reflect the end walls of these buildings, however, it seems extremely unlikely that any buildings would be rhomboidal and those anomalies are interpreted as being associated with the edges or kerbs of intra-mural roads. The barracks are estimated to be up to 40m in length and up to 12m in width.

- 5.40 Whilst the surveys clearly indicate the presence of some internal divisions within the barracks they are not sufficiently well-defined to provide a detailed building plan. In common with the rest of the fort interior, there are areas of rubble and spoil, robber trenches and partial wall footings, all of which create anomalies and hinder the precise interpretation of building walls.
- 5.41 To the south of the *via principalis*, a building inside the north-west gate almost certainly corresponds to Shaw's probable granary (Shaw 1959). As elsewhere, some parts of the building are better defined than others, but it seems that this building could be up to 10m in width and 30m in length, though the southern end is close to a field wall and cannot be identified with certainty. Some irregularities in the long walls could be due to buttress remains. Again there are indications of internal (sleeper) walls. An adjacent building to the south of this could be another granary, though it appears to be wider and perhaps shorter than the former. Other buildings that might be expected in this part of the fort include workshops and a hospital, either of which could be represented here.
- 5.42 To the south of this, and centrally placed within the fort, are the remains of the headquarters building. This building is bisected by a field wall and spans survey Areas 8 and 13. It is perhaps more evident on the ground than it is in the geophysical data, but its outline and some internal variation are evident. The field wall appears to traverse the central third of the building, the cross-hall or *basilica*. Whilst there are geophysical indications of a row of chambers along the back of the building, these cannot be clearly distinguished.
- 5.43 In the southern part of Area 8 there are a number of anomalies, particularly in the geomagnetic data, which reflect further building remains. Anomalies immediately south of the field wall corner, again spanning survey Areas 8 and 13, almost certainly correspond to the late 17th/early 18th-century Castle Nook farmhouse, with a probable south-east-facing entrance. Other possible wall-footings here, and more clearly to the immediate west of this house, could be associated with either the post-medieval occupation or with the commandant's house, which might be expected in this part of the fort.
- 5.44 Another probable building was detected in this area, just inside the south-eastern wall of the fort and roughly mid-way between the south-east gate and the southern corner tower. The building measures approximately 8m by 6m and could reflect the remains of an interval tower.

- 5.45 The northern corner of the fort and its inner defences are relatively well-defined, with a widening of the two innermost banks outside the corner tower giving a relative prominence to those defences. This is also evident to some extent around the southern corner tower. However, to the immediate west of the northern corner there is a concentration of intense magnetic anomalies. These anomalies represent the remains of a bath-house, built in a later phase of the fort, overlying earlier infilled defences. Although some structure can be discerned within these intense anomalies it is not possible to determine the plan of the building complex. Similarly it has not been possible to identify individual features in the resistance data, which show this general area as one of generally high resistance. To the immediate north of the bath-house a spring has been diverted into a ferrous pipe, which can be clearly seen as both a low resistance anomaly and as a chain of intense dipolar magnetic anomalies heading towards Castle Nook farm.
- 5.46 The *via principalis* exits the fort on the south side of the bath-house and to the south of the road is a particularly regular, square structure, which appears to overlie the outermost bank. A possible ditch or small hollow-way heads north-west from here, parallel to the road. The remainder of this field, north-west of the fort, contains many very weak magnetic and resistance anomalies which almost form a rectilinear pattern across the land. These anomalies correspond well with very slight topographic features and appear to reflect small enclosed platforms or fields. Other than the area of the bath-house and the adjacent road, the area is characterised by a general absence of any strong anomalies that might reflect structural remains or other indicators of occupation such as pits or hearths. Whilst timber structures can sometimes be difficult to detect, it would seem that this land may have been used for stock or small-scale agriculture rather than a *vicus*.

Areas 9 and 10

- 5.47 No features of likely archaeological significance were detected in these small areas. Area 9 was generally waterlogged and bisected by the ferrous pipe which continues downslope from Area 8 to the south.

Area 11

- 5.48 This area was not surveyed as it was removed from the survey requirement at an early stage in the fieldwork.

Area 12

- 5.49 Although poorly drained and boggy, this area contained quite a few geophysical anomalies of archaeological potential in two principal areas, almost certainly contemporary with the fort. In the northern half of the survey, several anomalies appear to be a continuation of features associated with the well-defined structures to the immediate east in Area 13. Similarly, in the southern half of the survey a concentration of less well-defined anomalies almost certainly represents a continuation of the structured settlement detected either side of the road heading south-west from the fort in Area 13.

Area 13

- 5.50 The survey of this field has provided a wealth of geophysical evidence for buildings and roads both within and outside the fort, and for the multi-vallate defences on this south-western side of the fort. Outside the fort, as mentioned above, two complexes of very strong, orthogonal anomalies almost certainly reflect the remains of buildings sited along roads. The road heading south-west from the fort measures between 5-7m in width and is flanked on both sides by substantial structures extending some 20m back from the road. The probable buildings nearer the western corner of the fort again appear to be separated by roads. One large structure here measures approximately 28m by 20m and may have served an official function such as a *mansio*.
- 5.51 The fort's defences are particularly clear in the geomagnetic survey here and also in the resistance survey where that was used. The results of both techniques correlate almost perfectly with the earthwork survey within this field. On the north-west side, the fort wall, berm and four banks are evident; the fourth, outermost bank continues around the south-western side of the fort as the seventh bank there. The geomagnetic plot of the fort creates the impression of an extra bank on each side of the fort. Although this corresponds to the berm in front of the fort wall it may indicate some revetment of the berm's outer edge.
- 5.52 There appears to have been some re-modelling of the defences at some time on this side, with some banks apparently being left incomplete. The 'D'-shaped arrangement formed by joining banks four and five on this side of Whitley Castle is also present at Ardoch fort, using banks two and three.
- 5.53 Within the fort there are again a great many anomalies, variously reflecting tumble, rubble, robber trenches and wall footings. Again there are indications of buildings with internal divisions, aligned parallel with the shorter fort sides, but further determination of buildings is tentative. Three possible buildings, further barrack blocks, may be present on the north side of the *via decumana*, though these appear to be slightly smaller than those in the north of the fort. South of the road there may be another three barracks, though these are less clear, partly due to the presence of later, post-medieval structural remains, possibly a bastle with a walled yard to its north-east.
- 5.54 To the rear of the headquarters building there are some orthogonal anomalies which appear to represent two further possible building remains. One of these appears to comprise three cells while the other is relatively small and almost abuts the western corner of the headquarters building. Another strong magnetic anomaly is adjacent to the southern corner of this building and corresponds to the location of a small vaulted structure on the ground.
- 5.55 As mentioned above, there appear to be further building remains between the headquarters building and the post-medieval farmhouse, some of which may extend east beyond the farmhouse, and these are likely to reflect parts of the commandant's house, however, they have been partially destroyed and obscured by the later activity.

Area 14

- 5.56 The survey of this area extended south-eastwards across two adjacent land parcels; Areas 16 and 17 were effectively subsumed into Area 14.
- 5.57 The southern corner of the fort is contained within the northern corner of the modern field. A post-medieval mining pit immediately east of the south corner tower is only evident geomagnetically as a break in the rampart there. The site of the Roman corner tower, the fort wall, berm and several defensive banks have been detected. The high resistance anomalies reflecting the banks correspond particularly well with the mapped earthwork features, however, some of the strongest geomagnetic anomalies have little correlation with the existing earthworks. Some of the original outer defences must have been re-modelled to form the earthworks visible today, but much of the magnetically susceptible material in those earlier banks survives below the surface.
- 5.58 An earthwork prominence in the slight, outermost bank, some 45m south of the corner tower, has an associated magnetic anomaly but no anomaly indicative of a bank or ditch around it. However, *c.*25m north-east of here are magnetic anomalies which suggest the similar possible presence of an outlying tower, above the base of a small knoll, but with geomagnetic evidence for two further banks bulging around it, rather like those around the northern, and to some extent southern, corner towers. These earlier outer banks do appear to be continuations of the south-western defences, however, their course becomes less clear further round to the south-east where they are obscured by probable later farming features.
- 5.59 These earlier, outermost banks appear to have been a very short fifth side to the fort's outermost defences, however, it appears there may have been another, earlier phase of fort defences before that. The geomagnetic survey, and to some extent the resistance survey, also detected a group of substantial structures in this part of the site, which appear to be overlain by these earlier banks from the geomagnetic survey. This would imply that any defences contemporary with this group of structures must have lain further north or north-east, preceding both the ramparts identified geomagnetically and those visible on the ground today.
- 5.60 The anomalies associated with these early structures appear to reflect parts of three sides of an enclosure or substantial building complex, measuring approximately 35m across, within and adjacent to which further intense anomalies may reflect further building remains. The anomalies are similar in nature to others interpreted as probable buildings at various other locations on the site. The nearest correlation to this particular group is the bath-house complex outside the north-west gate. These two groups of anomalies are broadly similar in nature and extent, are both situated just outside the fort itself and are both located next to springs. Perhaps this group of anomalies reflects the original bath-house for the fort before the southern and north-western defences were re-modelled.

- 5.61 Additional anomalies detected in this northern part of the field appear to reflect the remains of two small, well-defined, sub-rectangular features measuring 12-15m across. The possible, partial remains of more similar and sub-circular features have also been detected here. Although the function and date of these small structures is not known, they could reflect potentially early settlement.
- 5.62 Anomalies associated with broad ridge and furrow have been detected in the north of this field. A small area of narrowly-spaced linear anomalies detected next to the ridge and furrow, east of Holymire, probably reflects 18th/19th-century horse-ploughing or potato-beds, similar to that in Area 3.
- 5.63 Clusters of large intense dipolar magnetic anomalies in this field and those to the west and south (Areas 15 and 18), together with concentrations of small dipolar magnetic anomalies and possible structural features in the south of this field may be associated with former mining activities.
- 5.64 A stream has been culverted in this area, evident as a chain of small intense anomalies, re-surfacing in the adjacent field, Area 4.

Area 15

- 5.65 In addition to the intense anomalies mentioned above, the survey here recorded some very weak, tentative soil-filled features, the existing track and a possible drain.

Area 18

- 5.66 In addition to the intense anomalies mentioned above, the survey here detected a probable former stream course heading for Whitlow, and very weak possible soil-filled features on its north-western side.

6. Conclusions

- 6.1 Geomagnetic and electrical resistance surveys were undertaken as part of a research project at Whitley Castle in Northumberland directed by English Heritage. The study area comprised a well-preserved Roman fort (*Epiacum*) and its immediate surroundings.
- 6.2 The geomagnetic survey covered approximately 36ha over the fort earthworks and surrounding land, and the electrical resistance surveys targeted approximately 8ha of land within that larger area, based on the geomagnetic survey results.
- 6.3 The geophysical surveys have successfully detected a range of anomalies across most parts of the study area, which have helped to characterise former landuse in different areas at different times. For example, the anomalies variously reflect the remains of the fort wall and ramparts, intra-mural buildings, areas of probable *vicus* and official extra-mural buildings, several roads both within and outside the fort, possible pre-Roman settlement, agricultural features including probable potato-beds and ridge and furrow,

post-medieval buildings and possible evidence for mining activities. Several phases of activity can be interpreted from the geophysical results, including at least two phases of significant re-modelling of defences and other structures around the fort's southern corner.

- 6.4 In these regards the specific objectives of the geophysical surveys have been achieved. The surveys have added considerable value to existing knowledge of the site and its immediate environs and have helped improve understanding of the monument and its setting. The results will inform plans for future conservation and visitor access, particularly with regard to the area between the fort and Castle Nook.

7. Sources

- David, A, Linford, N, & Linford, P, 2008 *Geophysical Survey in Archaeological Field Evaluation*, 2nd edition. English Heritage
- Gaffney, C, Gater, J, & Oviden, S, 2002 *The use of geophysical techniques in archaeological evaluations*. Technical Paper 6, Institute of Field Archaeologists
- GeoQuest 2006 *Preliminary Geophysical Surveys at Whitley Castle Roman Fort (Epiacum), Tynedale, Northumberland*. GeoQuest Associates
- Robertson, AF, 2007 *Whitley Castle, Epiacum, A Roman Fort near Alston in Cumbria*. Hundy Publications, Alston
- Schmidt, A, 2002 *Geophysical Data in Archaeology: A Guide to Good Practice*. Archaeology Data Service, Arts and Humanities Data Service
- Shaw, N, 1959 Excavation at Whitley Castle, Northumberland, 1957 and 1958. *Archaeologia Aeliana* 4th series 37 191-202
- Went, D, & Ainsworth, S, 2009/forthcoming *Whitley Castle, Tynedale, Northumberland: An Archaeological Investigation of the Roman Fort*. Research Department Report **/2009, English Heritage



Archaeological Services
University of Durham

Whitley Castle, Tynedale, Northumberland

geophysical surveys

Report 2149

Figure 1

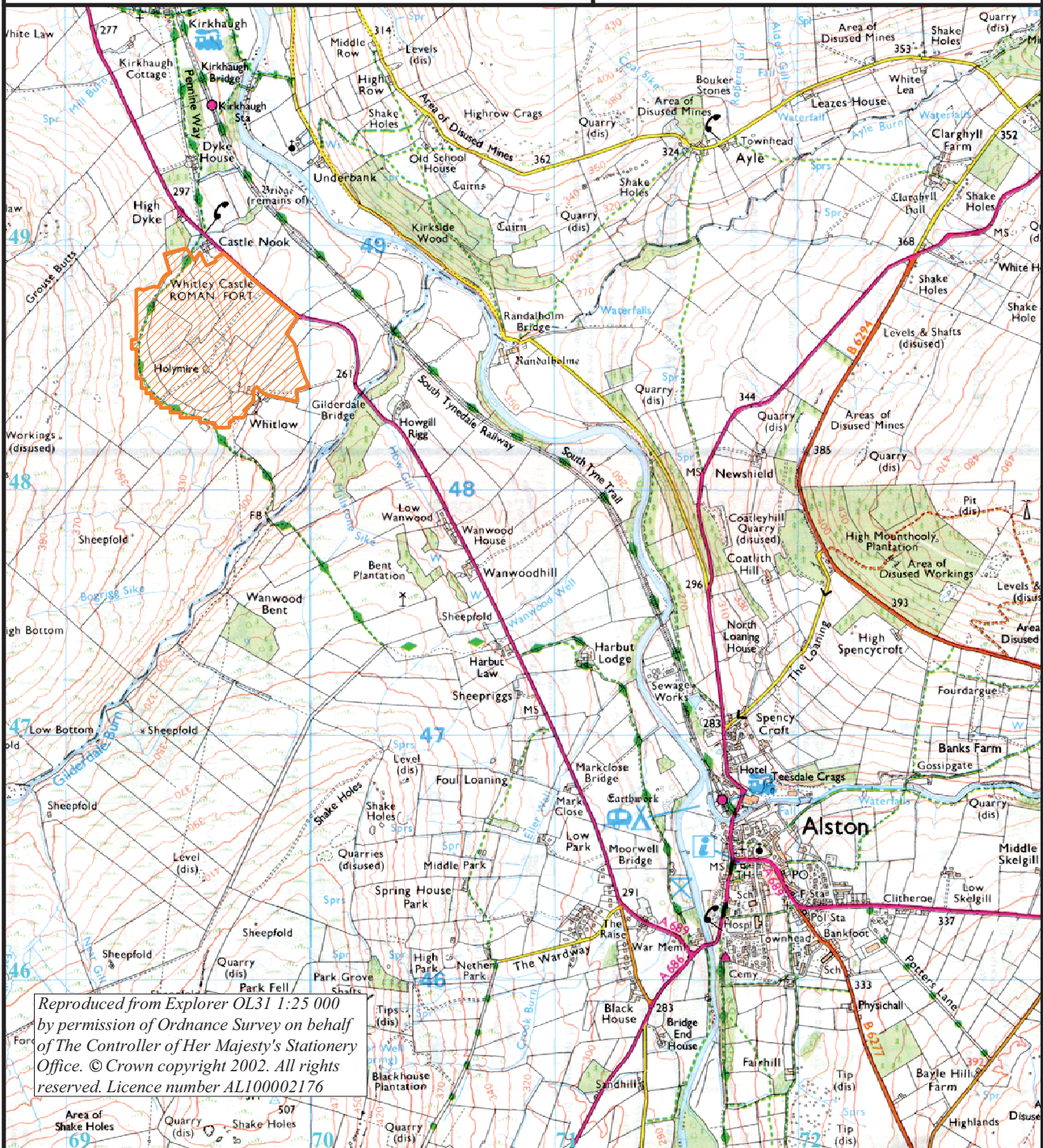
Study area



ENGLISH HERITAGE

NORTH PENNINES AONB PARTNERSHIP

Working together for the North Pennines



study area



scale 1:25 000 - for A4 plot



Reproduction in whole or in part is prohibited without the prior permission of English Heritage

Whitley Castle, Tynedale,
Northumberland

geophysical surveys

Report 2149

Figure 2

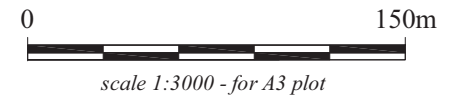
Location of survey areas



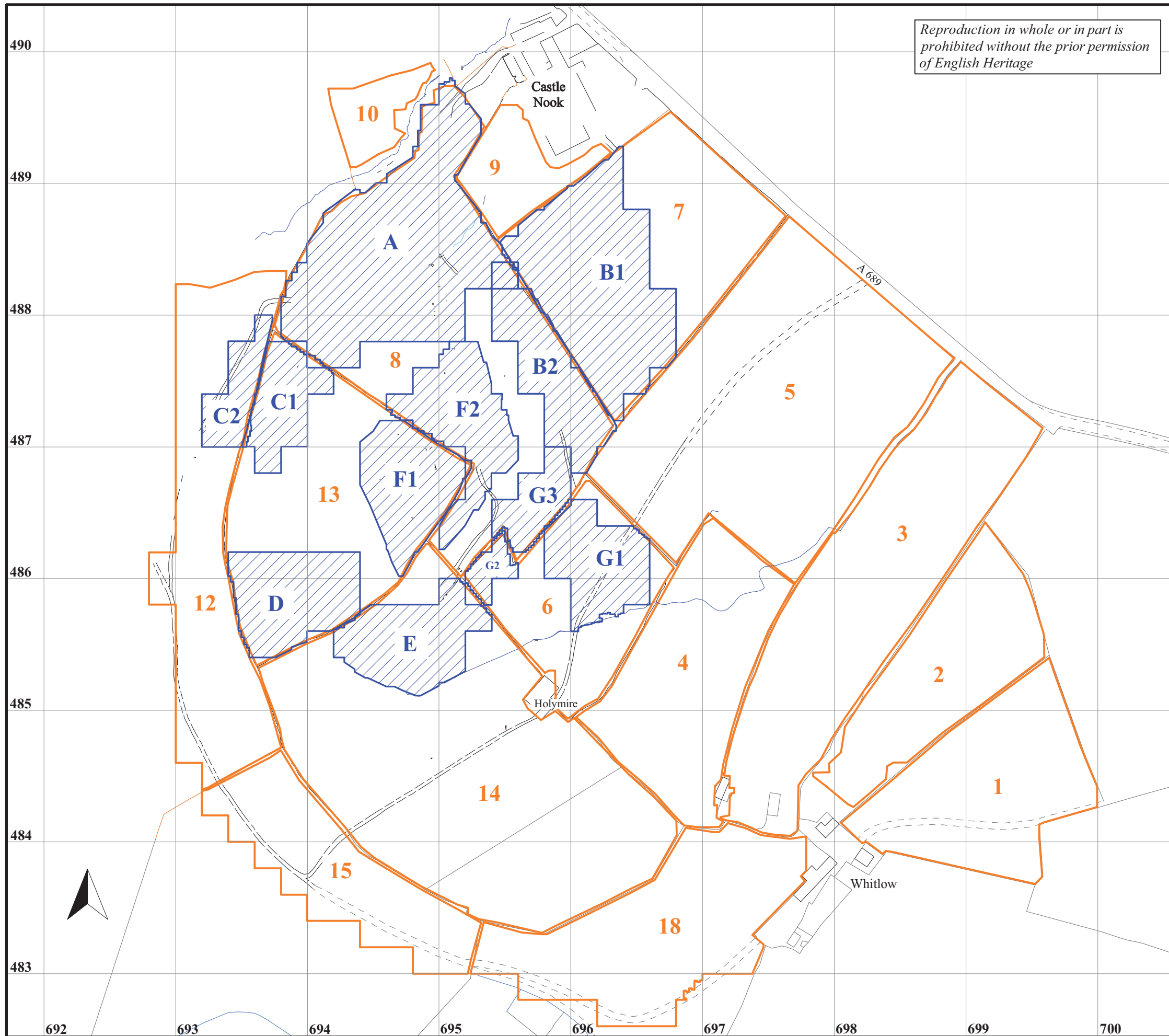
ENGLISH HERITAGE

NORTH PENNINES AONB PARTNERSHIP

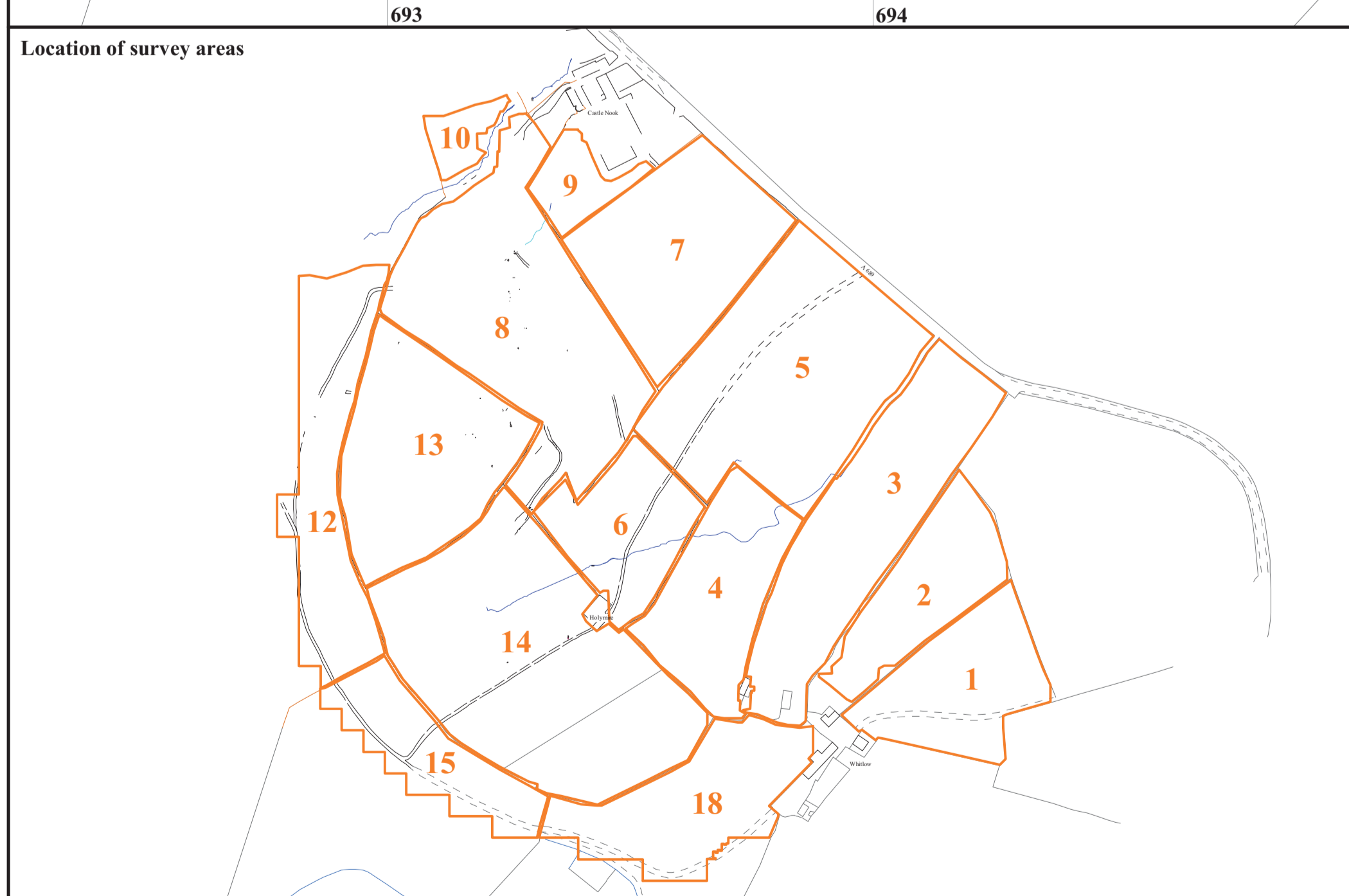
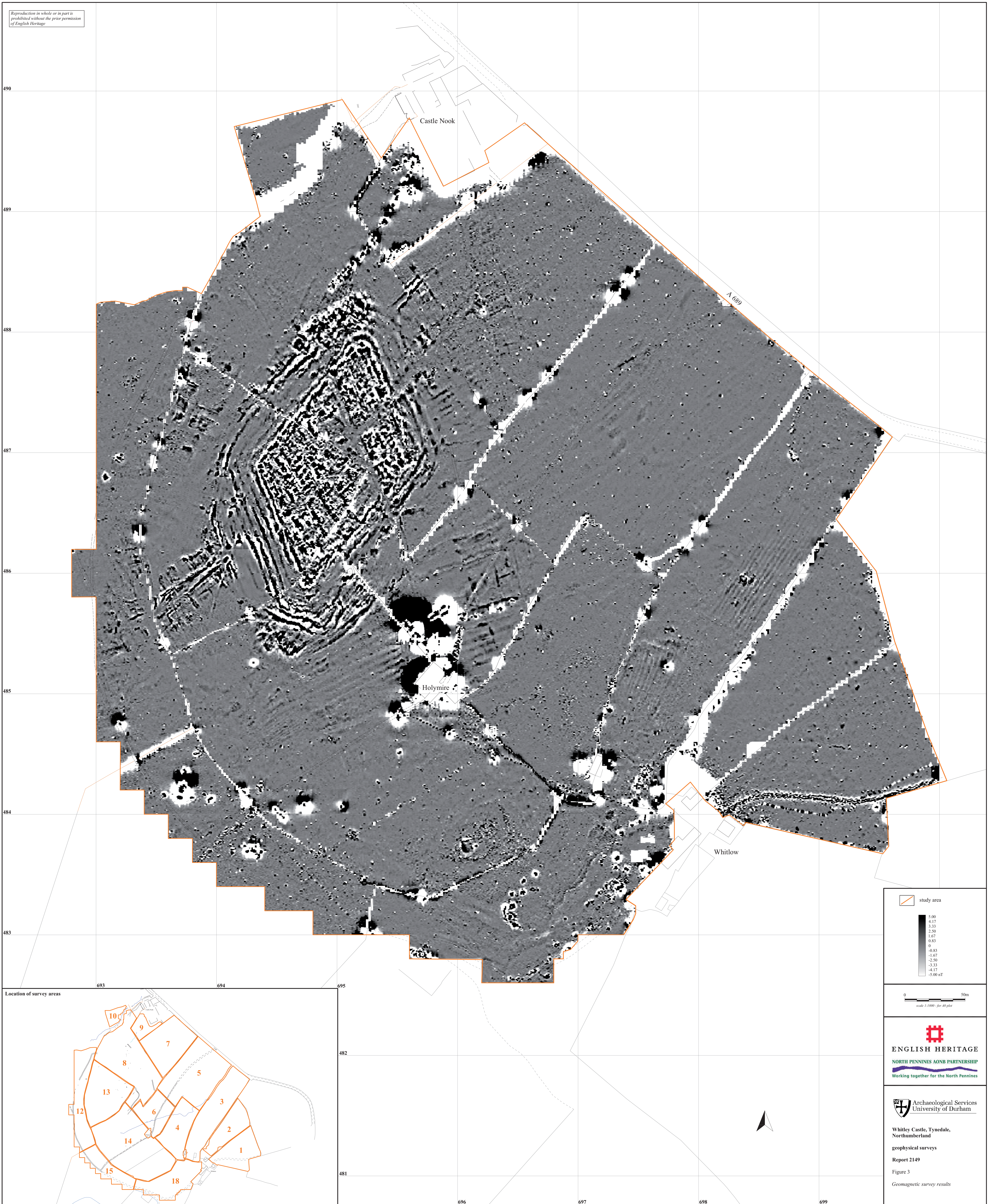
Working together for the North Pennines



- geomagnetic survey area
- electrical resistance survey area



Reproduction in whole or in part is prohibited without the prior permission of English Heritage



study area

5.00
4.17
3.33
2.50
1.67
0.83
0
-0.83
-1.67
-2.50
-3.33
-4.17
-5.00 nT

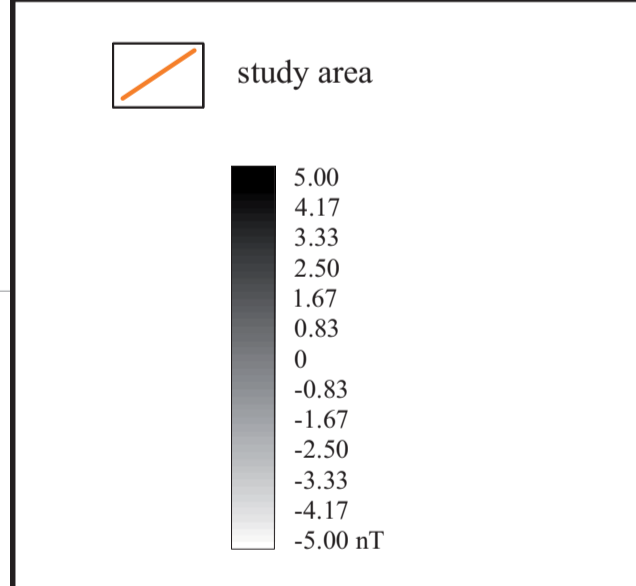
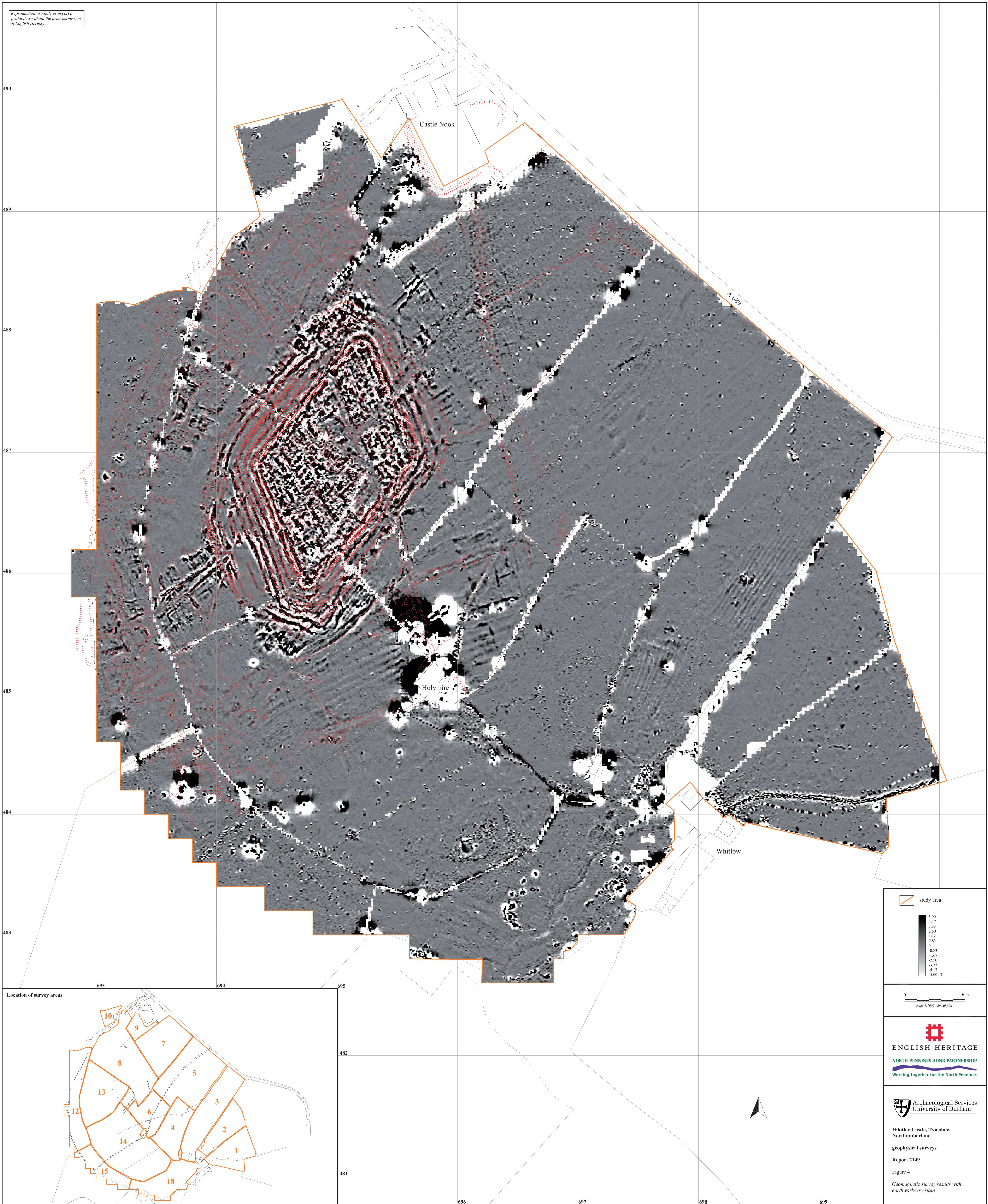
0 50m
scale 1:1000 - see A6 plan

ENGLISH HERITAGE
NORTH PENNINES AONB PARTNERSHIP
Working together for the North Pennines


Archaeological Services
University of Durham

Whitley Castle, Tynedale,
Northumberland
geophysical surveys
Report 2149
Figure 3
Geomagnetic survey results

Reproduction in whole or in part is prohibited without the prior permission of English Heritage

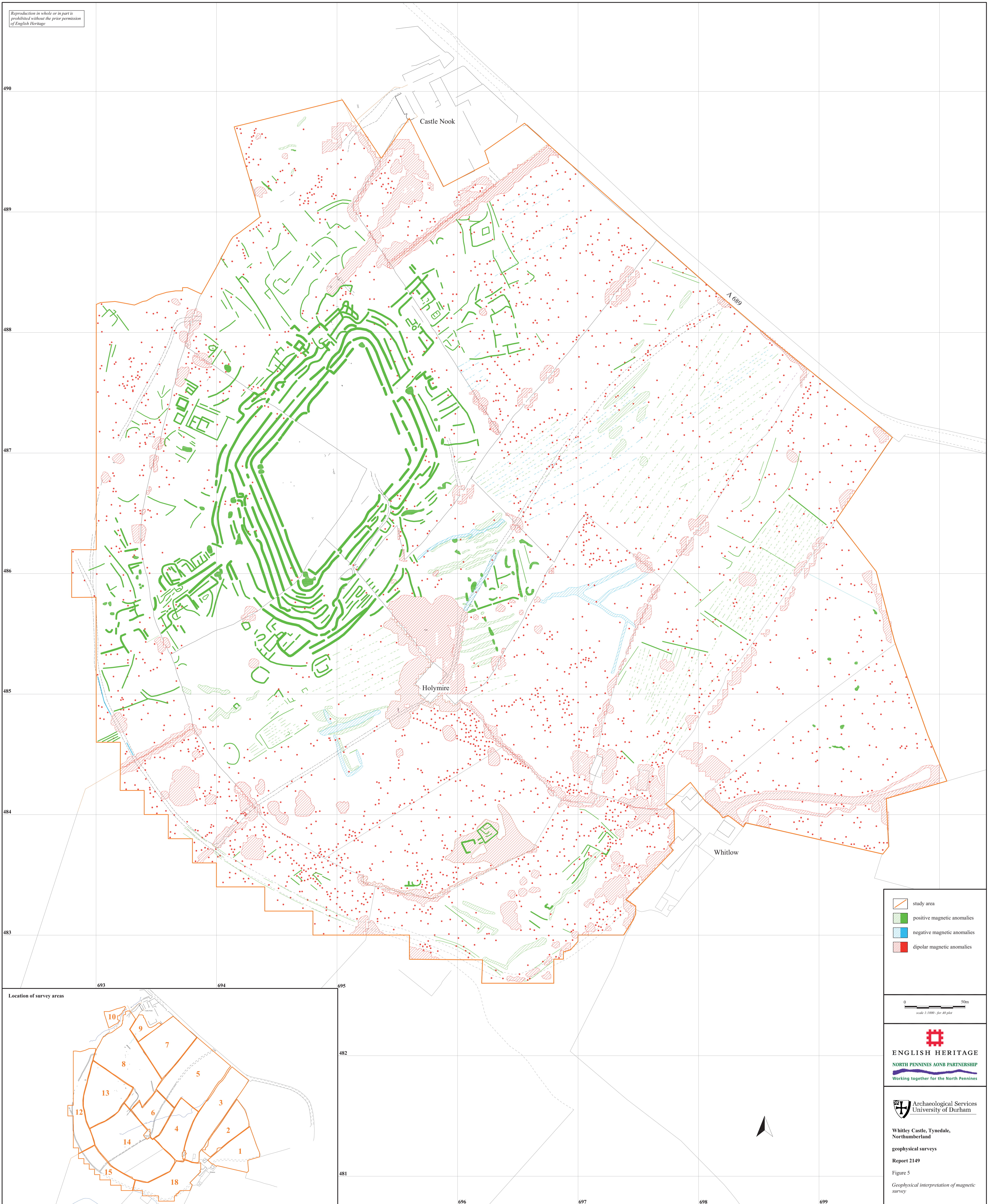



ENGLISH HERITAGE
NORTH PENNINES AONB PARTNERSHIP
Working together for the North Pennines

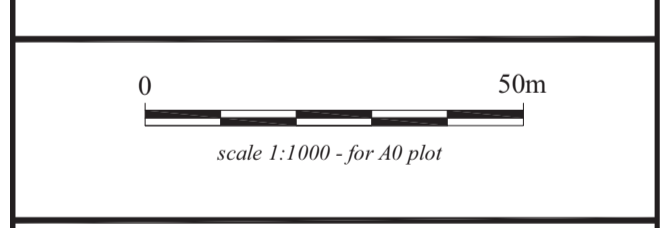
 Archaeological Services
University of Durham

Whitley Castle, Tynedale,
Northumberland
geophysical surveys
Report 2149
Figure 4
*Geomagnetic survey results with
earthworks overlain*

Reproduction in whole or in part is prohibited without the prior permission of English Heritage



- study area
- positive magnetic anomalies
- negative magnetic anomalies
- dipolar magnetic anomalies



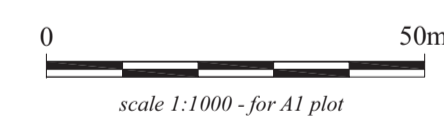
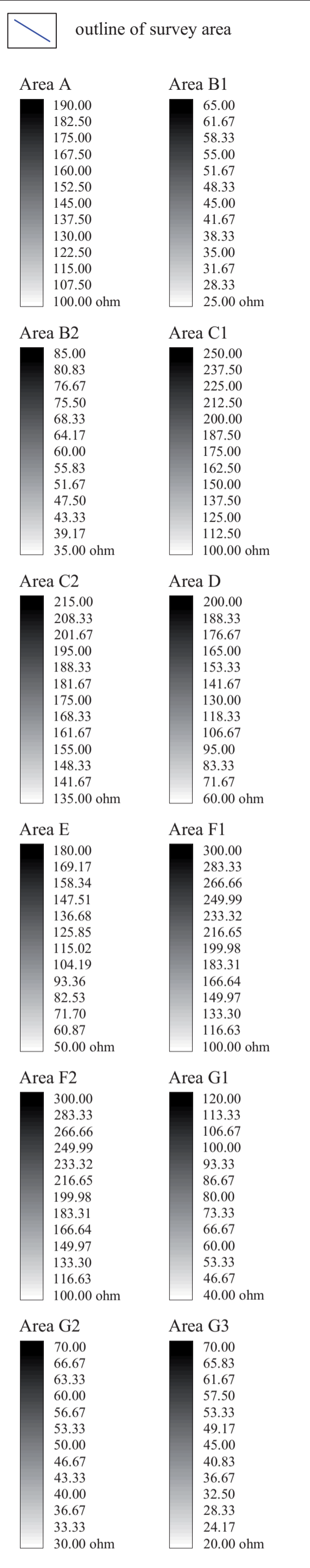
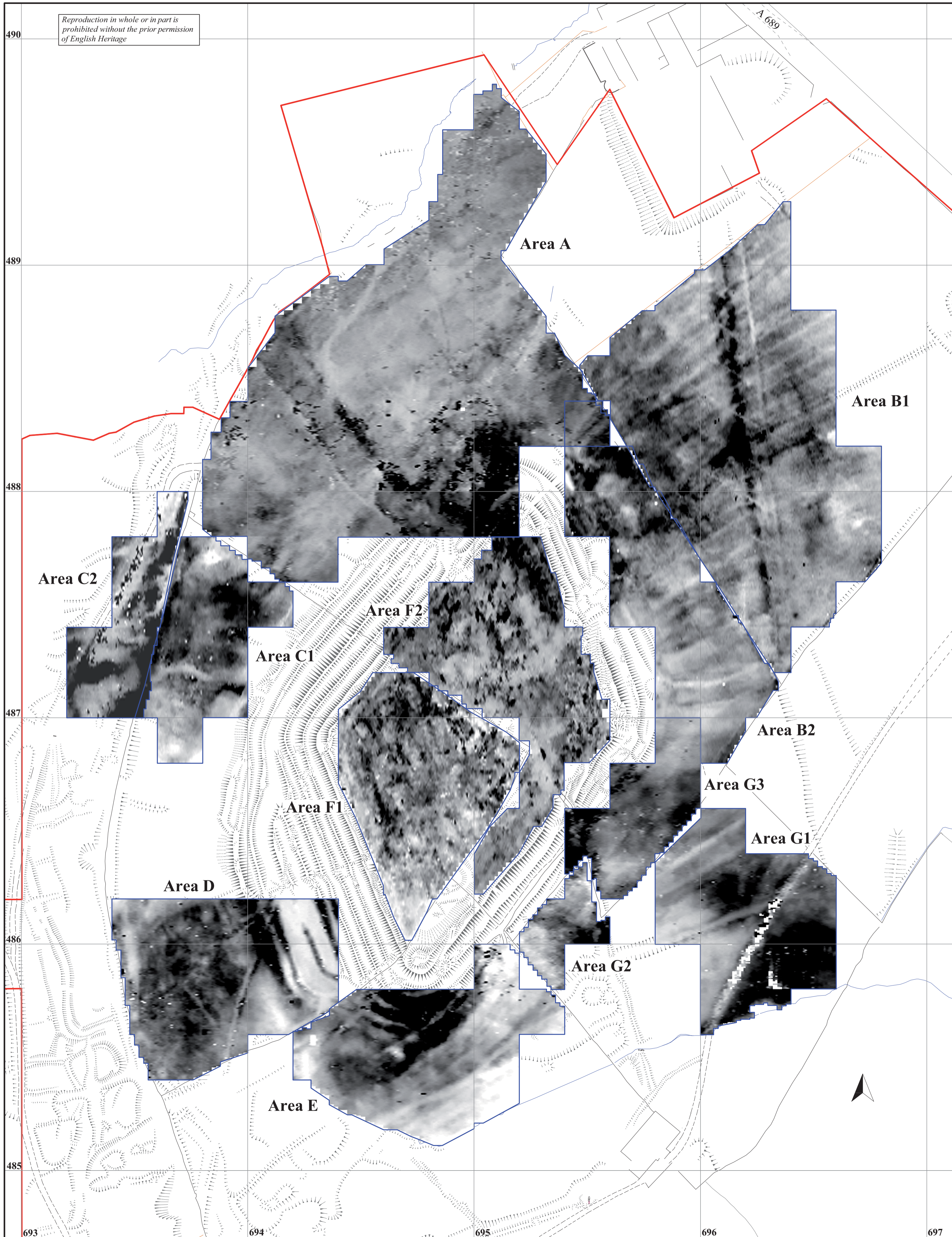
ENGLISH HERITAGE
NORTH PENNINES AONB PARTNERSHIP
Working together for the North Pennines

Archaeological Services
University of Durham

Whitley Castle, Tynedale,
Northumberland
geophysical surveys
Report 2149
Figure 5
Geophysical interpretation of magnetic
survey



Reproduction in whole or in part is prohibited without the prior permission of English Heritage



Archaeological Services
University of Durham

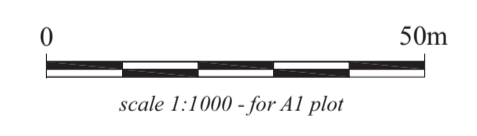
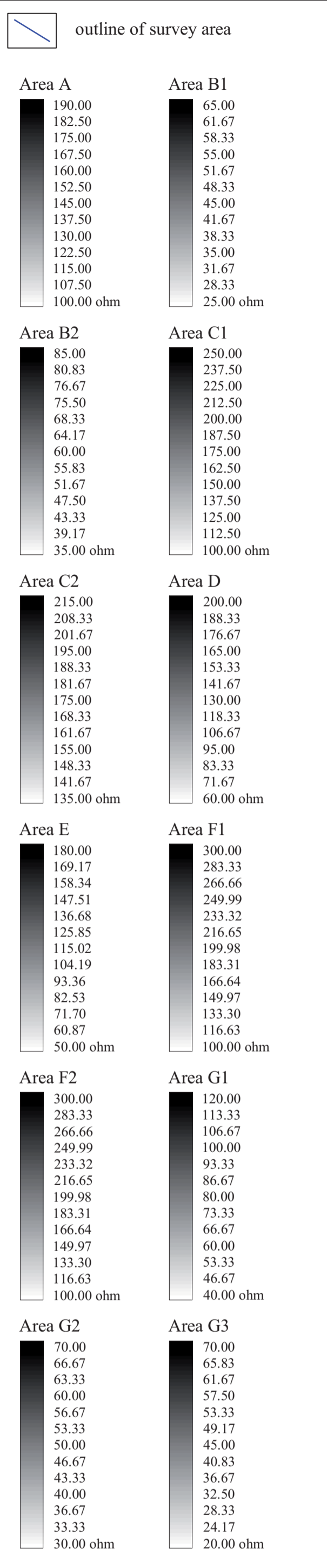
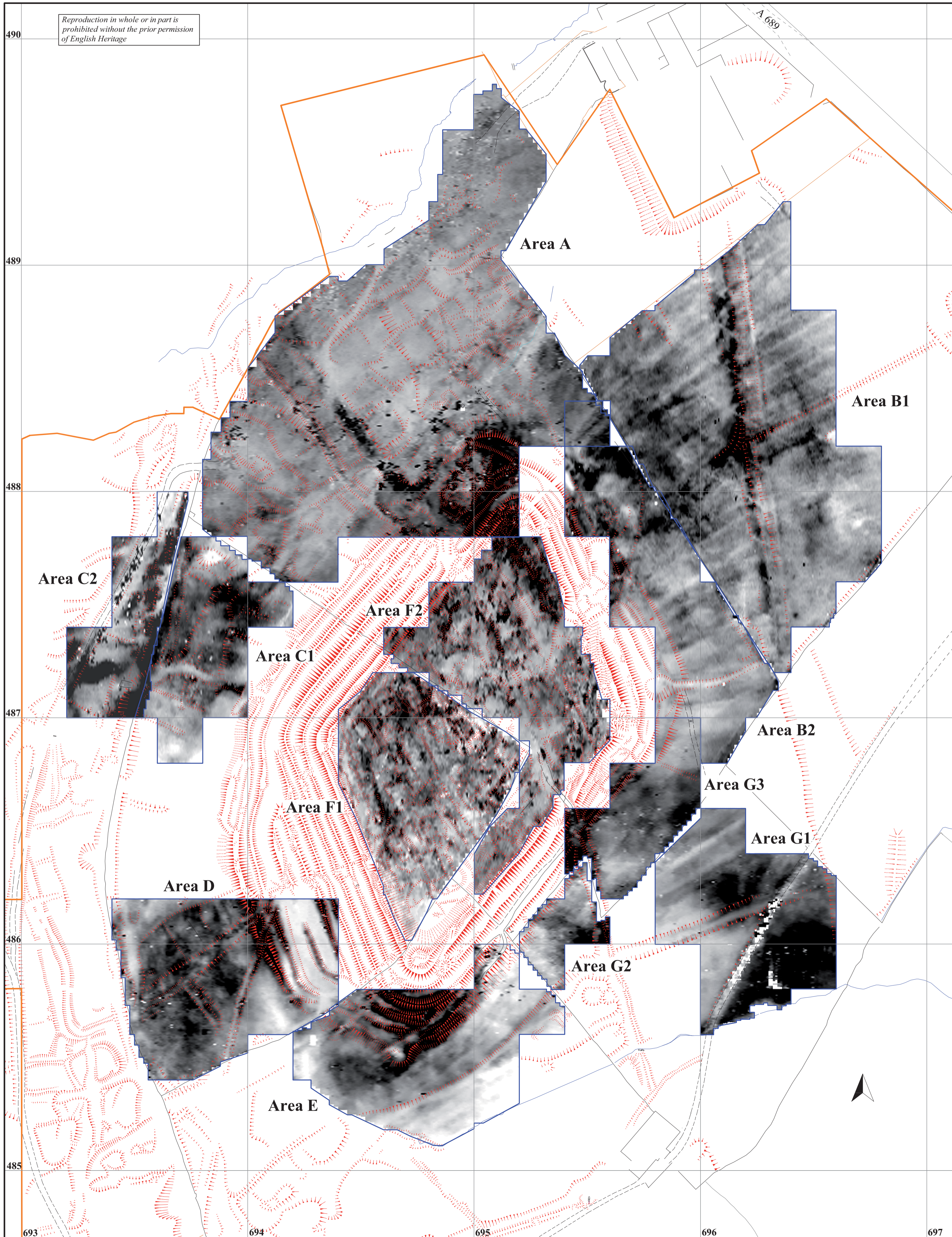
Whitley Castle, Tynedale,
Northumberland

geophysical surveys

Report 2149

Figure 6
Resistance survey results

Reproduction in whole or in part is prohibited without the prior permission of English Heritage



Archaeological Services
University of Durham

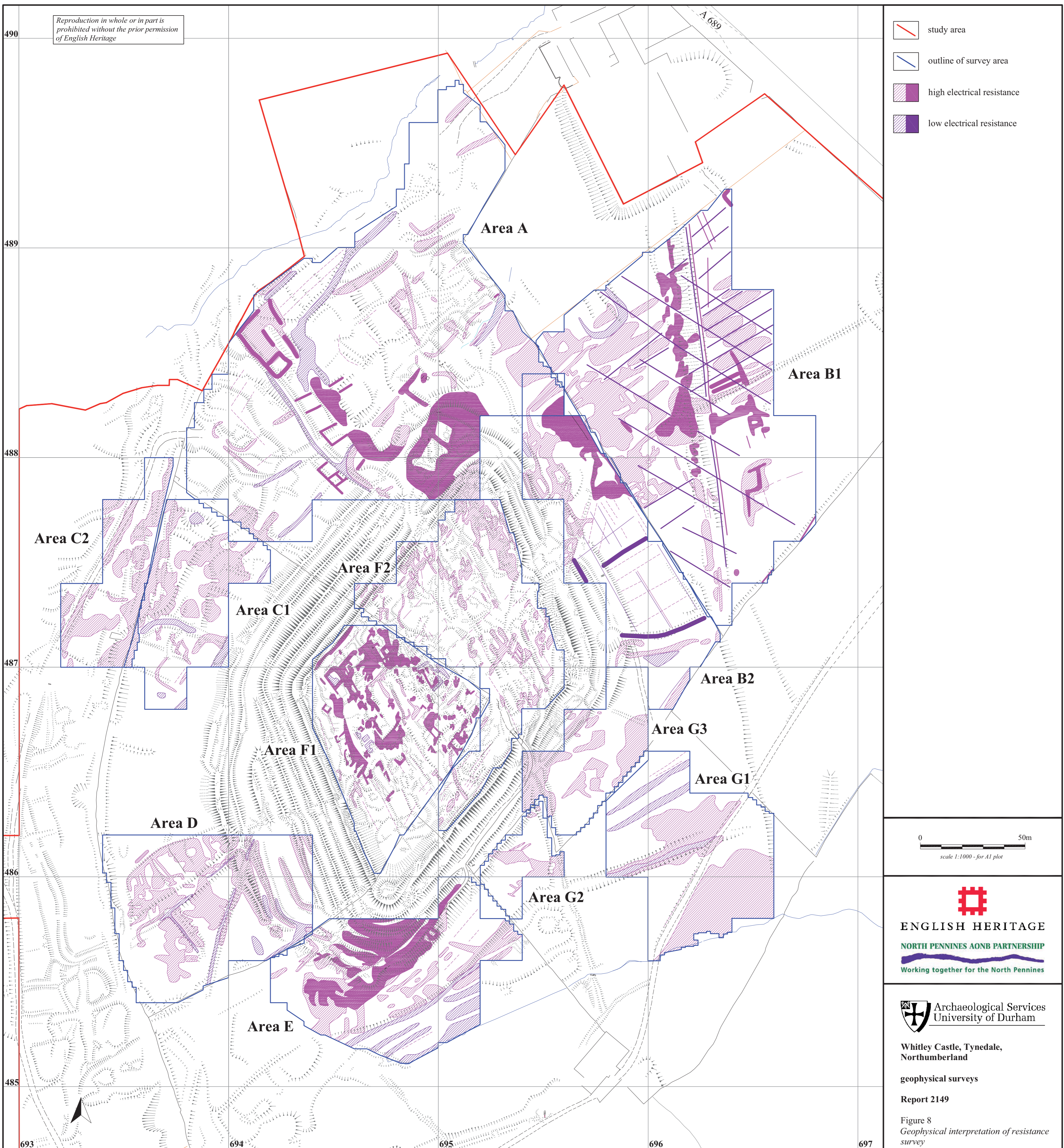
Whitley Castle, Tynedale,
Northumberland

geophysical surveys

Report 2149

Figure 7
Resistance survey results with earthworks
overlay


Reproduction in whole or in part is prohibited without the prior permission of English Heritage



- study area
- outline of survey area
- high electrical resistance
- low electrical resistance

0 50m
scale 1:1000 - for A1 plot

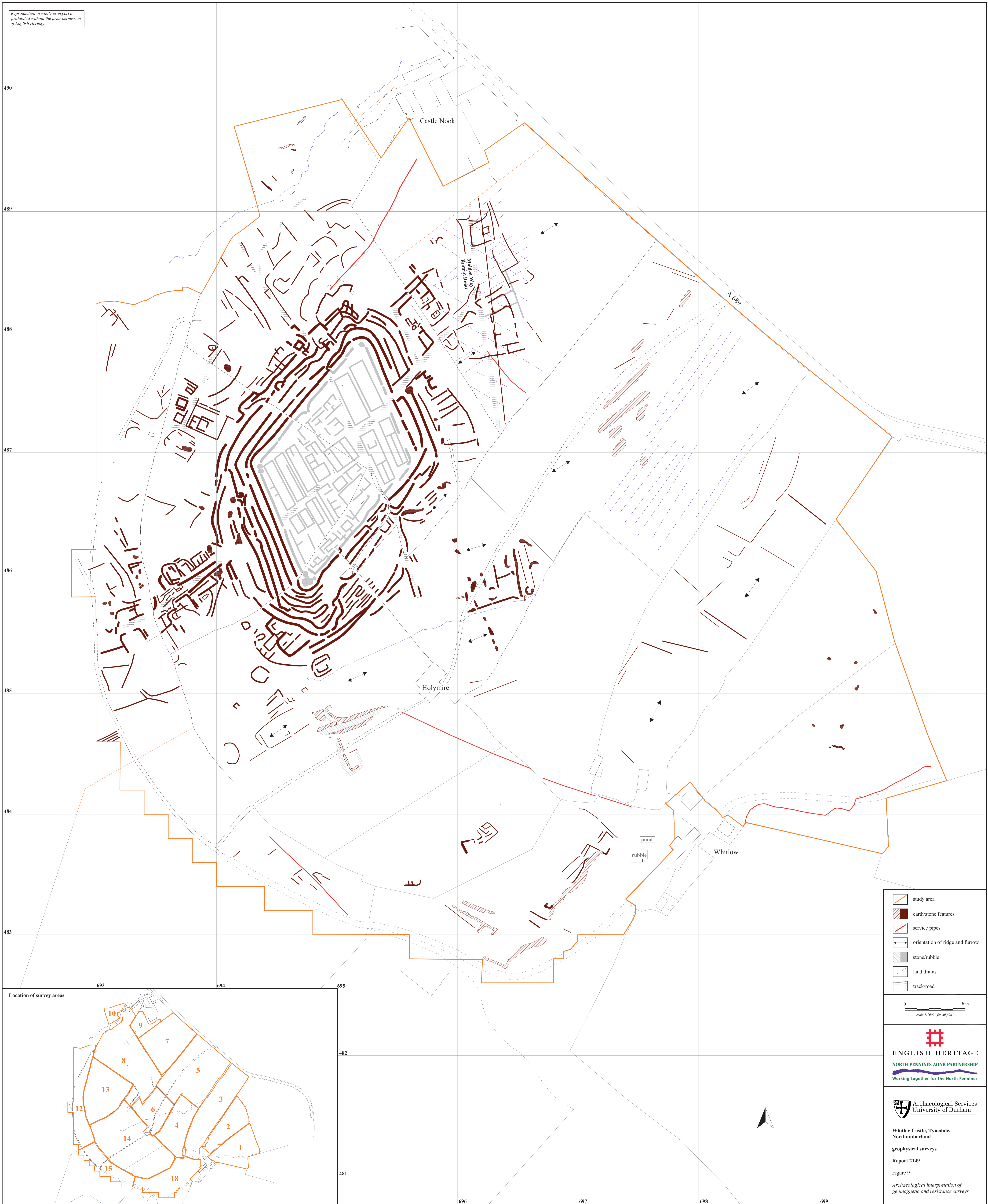

ENGLISH HERITAGE
NORTH PENNINES AONB PARTNERSHIP
Working together for the North Pennines

 Archaeological Services
University of Durham

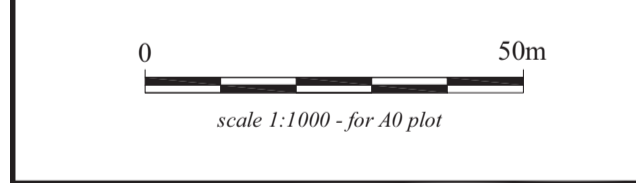
Whitley Castle, Tynedale,
Northumberland
geophysical surveys
Report 2149

Figure 8
Geophysical interpretation of resistance survey

Reproduction in whole or in part is prohibited without the prior permission of English Heritage



study area
earth/stone features
service pipes
orientation of ridge and furrow
stone/rubble
land drains
track/road




ENGLISH HERITAGE
NORTH PENNINES AONB PARTNERSHIP
Working together for the North Pennines



Archaeological Services
University of Durham
Whitley Castle, Tynedale,
Northumberland
geophysical surveys
Report 2149
Figure 9
Archaeological interpretation of
geomagnetic and resistance surveys

Figure 10: Trace plots of geomagnetic data

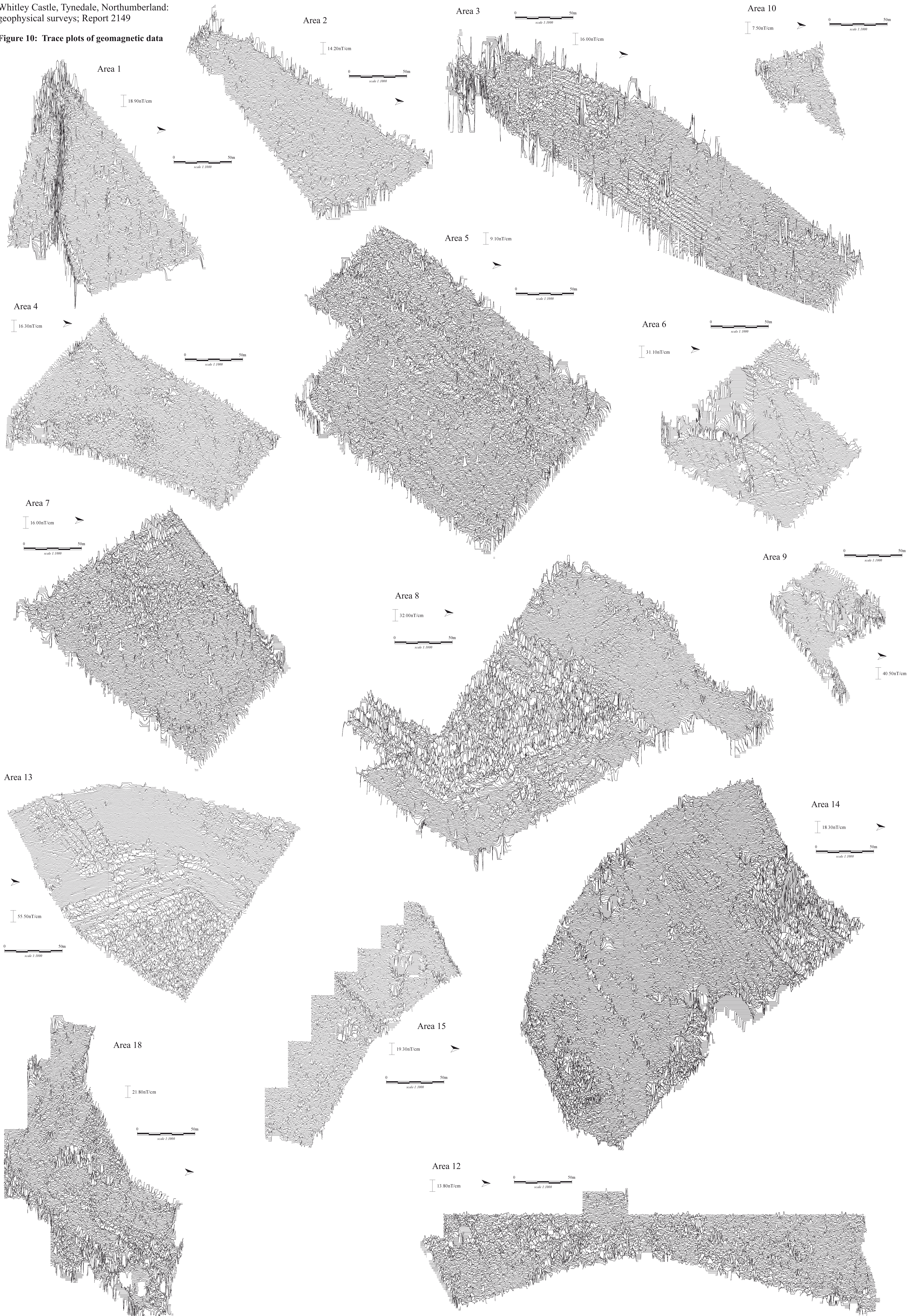


Figure 11: Trace plots of resistance data

