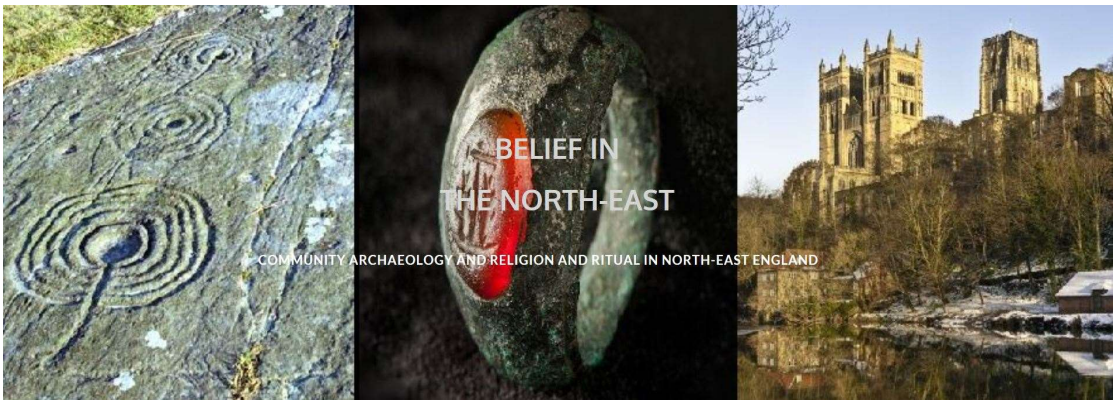
ARCHAEOLOGICAL SERVICES
DURHAM UNIVERSITY

on behalf of
Belief in the North-East



Low Grange, Billingham
Stockton-on-Tees

geophysical survey

report 5215
January 2020

HERITAGE FUND

Durham University

Contents

Figures

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1. Summary

The project

1.1 This report presents the results of geophysical surveys conducted at Low Grange former monastic grange, Billingham, Stockton-on-Tees, as part of a larger research project *Belief in the North-East*, a community archaeology project led by the Department of Archaeology at Durham University. The project aims to explore the archaeology of religion, ritual and belief across the north-east of England from prehistory to the modern day, with funding from the National Lottery Heritage Fund.

1.2 The works comprised electrical resistance and targeted ground-penetrating radar surveys of approximately 1.4ha of land over the former monastic grange.

1.3 The surveys were commissioned by Dr David Petts, the project director, and conducted by Archaeological Services Durham University with community volunteers.

Results

1.4 Structural remains were identified by both techniques in the central part of the survey area. Some irregularly-shaped anomalies detected close to the surface probably reflect spreads of rubble, however, evidence for *in situ* remains of several buildings was detected beneath those deposits. The majority of the building remains are estimated to be at between 0.75m and 1.25m below ground level.

1.5 The identified wall footings appear to represent substantial buildings on four sides of a courtyard, with an additional building extending eastward and a gin gang attached to the northern range. This layout broadly corresponds to that shown on the 1918 Ordnance Survey edition, however, the remains of additional buildings were also identified. Some of these probably pre-date the first edition OS and could be associated with the manorial complex, while others, predominantly to the north of an existing footpath, correspond to structures recorded on a 1948 aerial photograph.

1.6 Several rectangular anomalies in and around the buildings could reflect hard surfaces, such as metalled yards and internal floors. More irregularly-shaped anomalies could reflect rubble spreads. Probable former tracks were also detected to the south of the building complex.

1.7 Traces of former ridge and furrow cultivation were identified to the north and west of the buildings.

1.8 Some linear anomalies to the north, east and south of the buildings correspond to former boundaries shown on C19 Ordnance Survey maps. These boundaries are generally associated with the farm complex.

1.9 Two further linear anomalies are interpreted as services.

2. Project background

Introduction

2.1 Geophysical surveys were undertaken at Low Grange, Billingham, with community volunteers, as part of *Belief in the North-East*, a community archaeology project led by Durham University. The project is directed by Dr David Petts of the Department of Archaeology at Durham University, with funding from the National Lottery Heritage Fund.

2.2 The project works with local people of all ages to explore the archaeology of religion, ritual and belief across the north-east of England, from prehistory to the modern day, using a range of traditional and technological archaeological techniques to record and research selected sites. A key element of the project is to provide community engagement and training opportunities.

Location (Figures 1 & 2)

2.3 The survey area was located at the former Low Grange monastic site in Billingham, Stockton-on-Tees (NGR centre: NZ 4684 2528). The site of the former grange is now used as municipal parkland and is surrounded by housing to the north, east and south. To the west the area was bounded by Neasham Avenue, with Northfield School and Sports College beyond.

2.4 Electrical resistance and ground-penetrating radar (GPR) surveys were undertaken across approximately 1.4ha of land.

Objectives

2.5 The overarching aims of the fieldwork were twofold: to provide training and engagement opportunities for community volunteers, and to determine the nature and extent of any sub-surface features of potential archaeological or historic significance.

2.6 The regional research framework *Shared Visions: The North-East Regional Research Framework for the Historic Environment* (Petts & Gerrard 2006) contains an agenda for archaeological research in the region. In this instance, the scheme of works was designed to address the following research priorities: Later Medieval MDi. Settlement, MDii. Landscape, MDv. Churches and religion.

Methods statement

2.7 The surveys have been undertaken in accordance with instructions from the client, a Methods Statement prepared by Archaeological Services Durham University and national standards and guidance (see para. 5.1 below).

Dates

2.8 Fieldwork was undertaken on 11th to 14th November 2019. This report was prepared for January 2020.

Personnel

2.9 Fieldwork was conducted by volunteers from Belief in the North-East:

Simon Bull	Stephen Gibson	John Guest
Chris Dixon	Heather Grantham	Lisa Howsden
Martin Edgar	Lucy Griffiths	Donna Jarps

Rob Lamey	Nicola McNeil	Sue Vojvodic
Louise McAfee	Daniel Simpson	Malcolm Warin
Paul McCue	Pete Vojvodic	Benjamin Watson

2.10 The volunteers were trained and supervised by Alice Naylor and Richie Villis (Archaeological Services Durham University). Geophysical data processing was conducted by Richie Villis. This report was prepared by Richie Villis and Duncan Hale, with illustrations by David Graham. The project manager for Archaeological Services was Duncan Hale. The project is directed by Dr David Petts.

Archive/OASIS

2.11 The site code is **BLG19**, for **B**illingham **L**ow **G**range 20**19**. The survey archive will be retained at Archaeological Services Durham University and a copy 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 **archaeol3-382474**.

Acknowledgements

2.12 Archaeological Services Durham University is grateful for the support of the landowners, the local community and Robin Daniels of Tees Archaeology in facilitating this scheme of works.

3. Historical and archaeological background

3.1 The following paragraphs 3.2-3.5 are taken from *Low Grange, Billingham: a Great House of the Prior of Durham* (Daniels 2019) provided by Tees Archaeology.

3.2 In the medieval period Durham Priory (the monks who served the Cathedral) held large amounts of land in the north-east of England. The produce and revenue from these lands paid for the monks at Durham. In order to manage the lands Durham Priory established Administrative Centres near their major landholdings and these centres sometimes developed into Great Houses with a complex of buildings and farms. The main buildings might be quite lavish and would have been used as a retreat by the Prior and noble guests.

3.3 Durham Priory was given land at Billingham shortly after the Norman Conquest and it had a farming centre at Bewley by 1244 at the latest. It is recorded that Prior Hugh de Darlington built a Manor House here between 1258 and 1273 AD. The name Bewley is derived from the French *Beau Lieu* meaning fair or lovely place. The nearby villages of Newton and Cowpen Bewley take the last element of their name from the manor and were run from there.

3.4 The Manor House of Hugh of Darlington was a major structure, one of the four grandest houses built by the Prior of Durham. It was grand enough to have a clock in the 14th century at a time when clocks were extremely rare. It would have been used to chime the hours on a bell rather than show the time on dial. The Manor House contained a Great Hall, private chambers and kitchens. In addition there was a working farm with barns, stables, byres. We also know about a dovecote, fishponds with swans and a water mill in the area.

3.5 The manor house went out of use in the 17th century, though a farm continued on the site; the whole complex was demolished in the early 1960s. The area now comprises a well-kept area of grass with some mature trees and clear traces of earthworks, no buildings survive.

Previous works

3.6 A magnetometer (fluxgate gradiometer) survey was conducted across much of the park in 2016. In the area of the grange buildings, the data were characterised by concentrations of intense dipolar magnetic anomalies, which were presumed to reflect relatively modern made-ground (PSI 2016 and pers. comm.). However, the technique gives no indication of the thickness of the made-ground (or demolition rubble) and some of the linear magnetic anomalies did appear to correspond to walls shown on early Ordnance Survey (OS) maps. It was therefore considered that the site had potential for further geophysical investigations, using different techniques to measure different physical properties in the ground.

4. Landuse, topography and geology

4.1 At the time of fieldwork, the survey area comprised municipal parkland, including tarmacked paths with street lights, benches, bins and semi-mature trees. To the south-east was Cowbridge Beck, with trees, bulrushes and waterlogged areas along its banks. To the north-east were the remains of a 'moat' (probable former fishpond), with mature trees along its length. To the north-west was wooden fencing to residential properties' rear gardens. To the south-west the survey area was open to a small car-park and access road, and residential property frontages. The grass throughout the survey area was close-cropped, with occasional waterlogged patches due to recent heavy rainfall, covered with a light carpet of autumnal leaves, much thicker under the trees to the east of the area.

4.2 The topography of the survey area was slightly undulating and generally sloped gently downwards from approximately 12m OD in the north and west to approximately 10m OD near Cowbridge Beck in the south-east.

4.3 The underlying solid geology of the survey area comprises Permian-Triassic sandstone of the Sherwood Sandstone Group, which is predominantly overlain by Pleistocene glaciolacustrine deposits of silty clay, with some alluvium of gravel, sand and silt alongside Cowbridge Beck.

5. Geophysical survey

Standards

5.1 The surveys and reporting were conducted in accordance with Historic England guidelines, *Geophysical survey in archaeological field evaluation* (David, Linford & Linford 2008); the Chartered Institute for Archaeologists (CIfA) *Standard and Guidance for archaeological geophysical survey* (2014); the CIfA Technical Paper No.6, *The use of geophysical techniques in archaeological evaluations* (Gaffney, Gater & Ovenden 2002); and the Archaeology Data Service & Digital Antiquity *Geophysical Data in Archaeology: A Guide to Good Practice* (Schmidt 2013).

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, based on historic OS maps and the earlier magnetic survey, it was considered likely that the remains of structural features such as wall foundations and trackways would be present on the site, and that other types of cut features such as ditches and pits might also be present.

5.4 Given the anticipated nature and depth of targets, two complementary geophysical survey techniques were considered appropriate: earth electrical resistance and ground-penetrating radar (GPR).

5.5 Earth electrical resistance survey can be particularly useful for mapping stone features, for example. 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.

5.6 GPR generates a short high-frequency radar pulse which is transmitted into the ground via an antenna; the energy is reflected by buried interfaces and the return signal is received by a second antenna. The amplitude of the return signal relates to the electromagnetic responses of different sub-surface materials and conditions, which can be features of archaeological or historic interest. The time which elapses between the transmission and return of radar pulses to the surface can be used to estimate the depth of reflectors. As well as conducting traditional 2D area surveys, GPR also has a depth component and so can be used to create pseudo 3D models of the data, provided sufficient data are collected at closely-spaced intervals; these models can then be viewed in plan at different levels known as ‘time-slices’ (or ‘depth-slices’ where time has been converted to estimated depth).

Field methods

5.7 For the resistance surveys, a 20m grid was established across the survey area and related to the OS National Grid using a Leica GS15 global navigation satellite system (GNSS) with real-time kinematic (RTK) corrections typically providing 5-10mm accuracy.

5.8 Measurements of earth electrical resistance were determined using Geoscan RM15D Advanced 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 0.1ohm, the sample interval was 0.5m and the traverse interval was 1m, thus providing 800 sample measurements per 20m grid unit.

5.9 Electrical resistance data were downloaded on site into a laptop computer for initial processing and storage, backed up on removable media and subsequently transferred to a desktop computer for processing, interpretation and archiving.

5.10 GPR data were collected using a Malå Ramac X3M radar system with 500MHz antenna. Parallel transects of GPR data were collected across the majority of the central and western parts of the survey area, broadly centred on the former location of the buildings. Data traces were logged at 0.05m intervals along parallel traverses spaced 0.5m apart and between 45-100m in length, across an area 92.5m wide.

5.11 Data were initially stored and inspected on-site using the Malå Ramac XV11 system, backed up on removable media and subsequently transferred to a desktop computer for processing, interpretation and archiving.

Data processing

5.12 Geoplot v4 software was used to process the electrical resistance data and to produce both a continuous tone greyscale image and a trace plot of the raw (minimally processed) data. A plot of filtered resistance data is also provided. The greyscale images are presented in Figure 2; in these images, high resistance anomalies are displayed as dark grey and low resistance anomalies as light grey. Palette bars relate the greyscale intensities to anomaly values in ohms (raw data) and standard deviations (filtered data). The trace plot and geophysical interpretation of the resistance data are presented in Figure 3.

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

add	adds or subtracts a positive or negative constant value to defined blocks of data; used to reduce discontinuity at grid edges
de-spike	locates and suppresses spikes in data due to poor contact resistance
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 0.25m x 0.25m intervals

5.14 A striping defect can sometimes occur in resistance data when the RM15/MPX15 system is used in Parallel Twin mode in wet conditions, as was the case here. In order to remove this striping the data have been filtered, using a combination of low pass and high pass filters. This processing, however, while removing the striping defect, has also reduced the magnitude of other linear anomalies on the same alignment, some of which are probably associated with former walls while others may be associated with former ploughing. Both unfiltered and filtered data are therefore presented (Figure 2).

5.15 ReflexW v7.5 software was used to process the GPR 2D radargrams, to stack and interpolate the radargrams to produce a 3D data cube, and to produce greyscale images of profiles and time-slices. QGIS v3.8 software with the TimeManager plugin (Creative Commons Licence: Anita Grasser & Karolina Alexiou) were used to georeference and subsequently animate time-slice images on current and historical

OS mapping (video file provided with this report: 5215_BiNE_Low_Grange_GPR.mp4).

5.16 Combinations of the following processing functions have been applied to the 2D radargrams:

dewow	removes very low frequency components by subtracting the mean from each trace
static correction	moves the start times for traces in each profile to 0nS
gaining the data	compensates for amplitude loss as the radio pulse penetrates deeper and/or amplifies the area of interest by adding a determined value
bandpass filter	removes low-amplitude frequencies
background removal	reduces data ringing

5.17 GPR profiles and time-slices have been examined; representative time-slices and interpretations are presented in Figure 4. In this instance, the time-depth conversion is based on a soil velocity of 0.1m/ns; the velocity is only an estimate and therefore any depths mentioned in the text below are only approximate.

Interpretation: anomaly types

5.18 A colour-coded geophysical interpretation plan of electrical resistance data is provided. 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

5.19 A colour-coded archaeological interpretation plan is provided in Figure 5. For ease of reference, anomaly labels shown bold in the text below (eg **1**, **2** etc) are also shown on the archaeological interpretation plan.

5.20 Two series of parallel high and low resistance striations are evident across parts of the resistance survey; one series has also been detected as parallel high amplitude reflections in the northern part of the GPR survey at relatively shallow depths (approximately 4-10ns, 0.2-0.5m deep; corresponding to 5-8 seconds in the accompanying animation). These anomalies almost certainly reflect traces of former ridge and furrow cultivation (**1**, **2**), which is also evident in LiDAR data of the area and on a 1948 aerial photograph. Very slight undulations were also apparent on the ground in the northern part of the survey area, particularly when viewed in low-angled sunlight or when holding standing water.

5.21 The electrical resistance values are generally low, with quite uniform data across much of the area. However, the central part of the survey area, in the region of the former manor house, is characterised by higher electrical resistance. This higher resistance almost certainly reflects a higher concentration of building materials here, as suggested by the earlier magnetic survey. The resistance data show both linear and polygonal areas of high resistance, indicating probable wall remains as well as possible hard surfaces and spreads of rubble associated with the early 1960s demolition of the farm buildings. Some of the more irregularly-shaped high amplitude GPR reflections in the near-surface probably also reflect patches of rubble.

5.22 Many distinct linear and rectilinear high resistance anomalies have been recorded in the area of the former buildings, many of which have corresponding high amplitude GPR reflections. The most prominent GPR reflections in the near-surface correspond to the existing tarmacked paths across the site, which were unsuitable for electrical resistance survey.

5.23 A very high resistance anomaly, and corresponding sequence of high amplitude and very near-surface GPR reflections, has been detected aligned broadly north/south in the central part of the area. These anomalies almost certainly represent a recent path (**3**) connecting the two existing paths, but could possibly reflect a recent trackway, maybe associated with the 1960s demolition work. This feature is also evident as a parch-mark on Google Earth aerial photographs.

5.24 To the south of the probable recent path/track **3** another broadly north/south aligned high resistance anomaly has been detected, which could also represent a former track (**4**). The southern end of this feature appears as two narrow, parallel high resistance anomalies, which could represent kerbs or drains either side of the track. Although no features are recorded here on current or former OS maps, the anomalies lie between two former north/south boundaries shown on early maps and are aligned with the southern entrance of the courtyard. A curvilinear, much weaker, high resistance anomaly branches off to the right, and also appears to represent the remains of a former track associated with the former manor house or later farm buildings.

5.25 Within the central part of the survey area, in the vicinity of the former manor house and farm buildings shown on historic OS maps, several linear and rectilinear high resistance anomalies can be distinguished. Many of these also correspond to high amplitude reflections in the GPR data, especially at arrival times of 15-25ns (0.75-1.25m depth; at 25-35s in the video). Three well-defined rectilinear anomalies with corresponding high amplitude reflections (most evident at 22-25ns, over 1m depth) have been detected at the east end of the building complex. These almost certainly represent the remains of wall footings surviving below any demolition rubble and comprise two large (15m x 7m) rectangular structures (**5**, **6**), aligned broadly east/west, with a smaller north/south aligned building (**7**) abutting the south side of one of the larger buildings. The north-eastern building (**5**) broadly corresponds to one shown on the 1st edition OS map of 1856, though this group as a whole appears to pre-date the OS. The GPR and resistance data indicate that the probable wall footings of these buildings are between 1-1.5m wide, an appropriate size to support a substantial manor house.

5.26 Additional probable wall footings have also been detected to the north and west, at various estimated depths between 0.3m and 1.25m. A corner of a building (**8**) has been detected a few metres north-west of building **5**; this broadly corresponds to the east end of the northern range of the courtyard. A little further west, abutting the north side of the north range, a curvilinear high resistance anomaly with a small central anomaly, reflects the remains of a horse-engine house or gin gang (**9**), shown as a hexagonal structure on early OS maps. The building to the immediate south of this would have been the threshing barn.

5.27 Many of the probable wall remains are more clearly defined in the GPR data, and survive below the demolition deposits. These include the probable remains of a long farm building aligned broadly north/south, forming the western range of the courtyard (**10**), and traces of another building (**11**) aligned east/west at the south-western corner of the courtyard. These buildings (**8**, **9**, **10**, **11**) broadly correspond to the layout of farm buildings shown on later OS maps (for example, the 1918 edition).

5.28 Several quite clearly defined rectangular areas of high resistance (relative to the undisturbed background) have also been detected across the central part of the survey area. These could represent former hardstanding surfaces in the farmyard and elsewhere, and in some instances could represent floors within former buildings (eg **12**, **13**).

5.29 Historic OS maps after the 1st edition and a 1948 aerial photograph show buildings to the north of the original manorial complex, north of the existing path. Some high resistance anomalies and GPR reflections (**14**) in this area are probably associated with those later buildings. The GPR reflections are generally very near-surface, within the top 1m of ground.

5.30 Several additional linear high resistance anomalies and associated high amplitude GPR reflections have also been detected across the survey area. Some of these correspond to former boundaries shown on historic OS maps. These have been indicated on the archaeological interpretation plan (eg **15**, **16**). The boundaries are generally associated with the farm complex.

5.31 Two linear resistance anomalies, with occasional corresponding GPR reflections, have been detected across the survey area. These probably reflect drains or services.

6. Conclusions

6.1 Geophysical surveys were undertaken by volunteers at Low Grange former monastic grange, Billingham, Stockton-on-Tees, as part of 'Belief in the North-East', a community archaeology project led by Durham University. Electrical resistance and ground-penetrating radar (GPR) techniques were used to detect sub-surface features.

6.2 Structural remains were identified by both techniques in the central part of the survey area. Some irregularly-shaped anomalies detected close to the surface probably reflect spreads of rubble, however, evidence for *in situ* remains of several buildings was detected beneath those deposits. The majority of the building remains are estimated to be at between 0.75m and 1.25m below ground level.

6.3 The identified wall footings appear to represent substantial buildings on four sides of a courtyard, with an additional building extending eastward and a gin gang attached to the northern range. This layout broadly corresponds to that shown on the 1918 Ordnance Survey edition, however, the remains of additional buildings were also identified. Some of these probably pre-date the first edition OS and could be associated with the manorial complex, while others, predominantly to the north of an existing footpath, correspond to structures recorded on a 1948 aerial photograph.

6.4 Several rectangular anomalies in and around the buildings could reflect hard surfaces, such as metalled yards and internal floors. More irregularly-shaped anomalies could reflect rubble spreads. Probable former tracks were also detected to the south of the building complex.

6.5 Traces of former ridge and furrow cultivation were identified to the north and west of the buildings.

6.6 Some linear anomalies to the north, east and south of the buildings correspond to former boundaries shown on C19 OS maps. These boundaries are generally associated with the farm complex.

6.7 Two further linear anomalies are interpreted as services.

7. Sources

CIfA 2014 *Standard and Guidance for archaeological geophysical survey*. Chartered Institute for Archaeologists

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Figure 1: Site location

site location

0 1km
scale 1:25 000 for A4 plot

resistance survey

GPR outline

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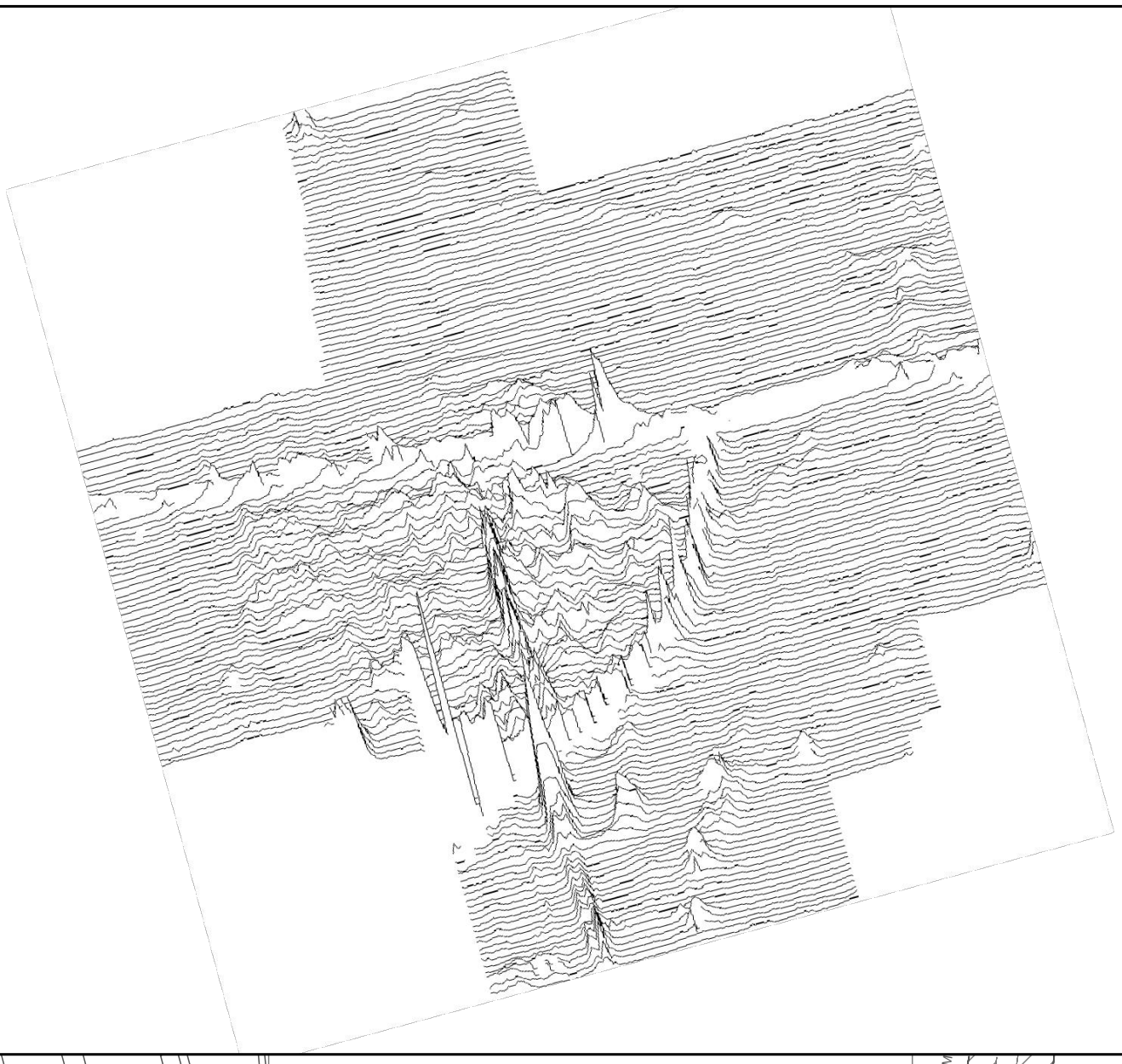
Figure 2: Resistance survey and filtered resistance data

resistance survey

GPR outline

high resistance anomaly

low resistance anomaly



12.00ohms/cm

253

468

469

Gas Gov

NEASHAM AVENUE

Car Park

Path

Path

FB

Cowbridge Beck

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0 50m

scale 1:1000 for A3 plot

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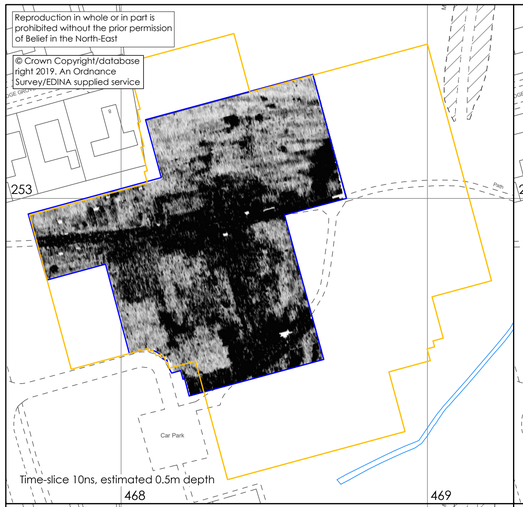
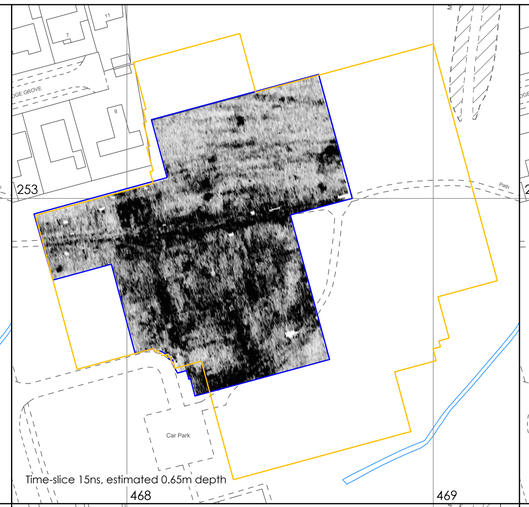
Figure 3: Trace plot and geophysical interpretation of resistance data



Time-slice 10ns, estimated 0.5m depth

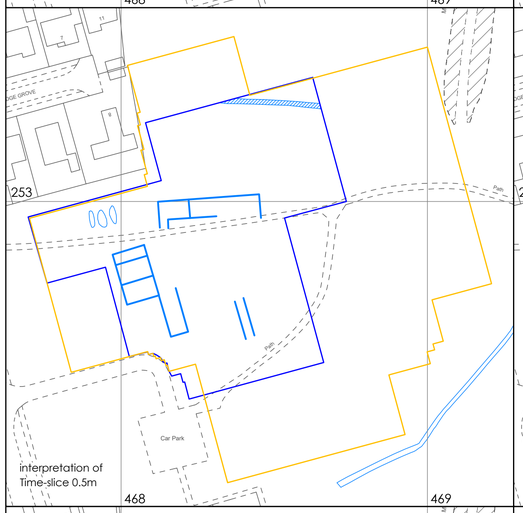


Time-slice 15ns, estimated 0.65m depth

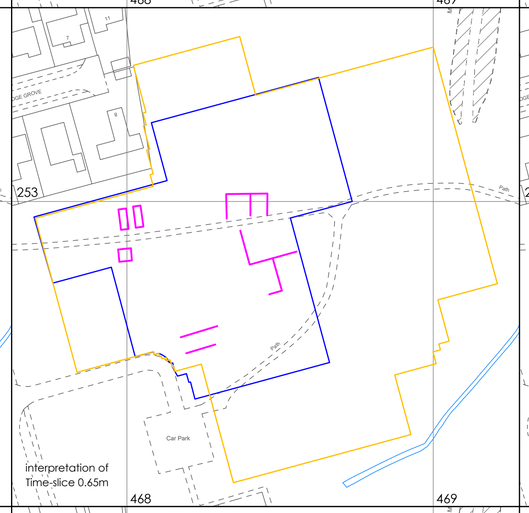
Time-slice 18ns, estimated 0.9m depth

Time-slice 22ns, estimated 1.1m depth

Time-slice 25ns, estimated 1.25m depth



interpretation of Time-slice 0.5m



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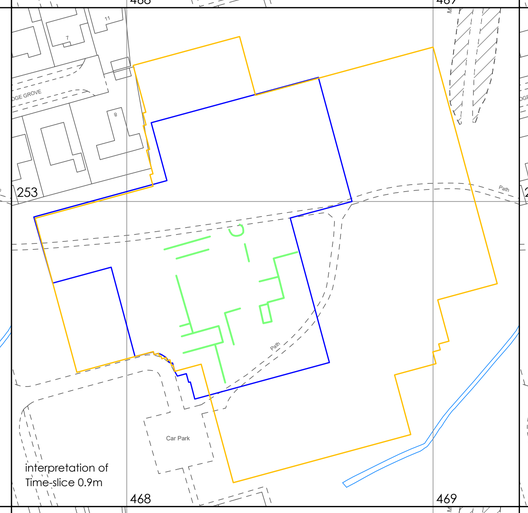
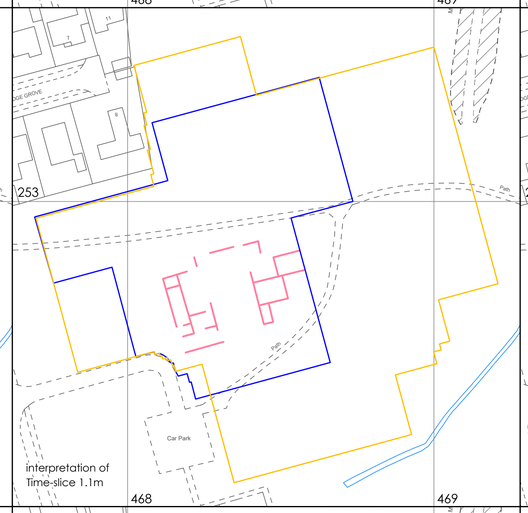
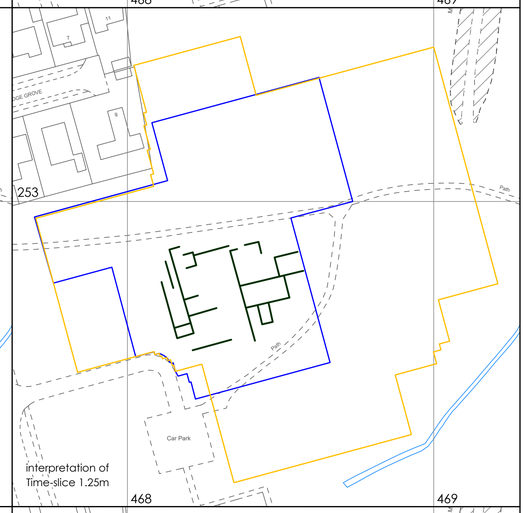


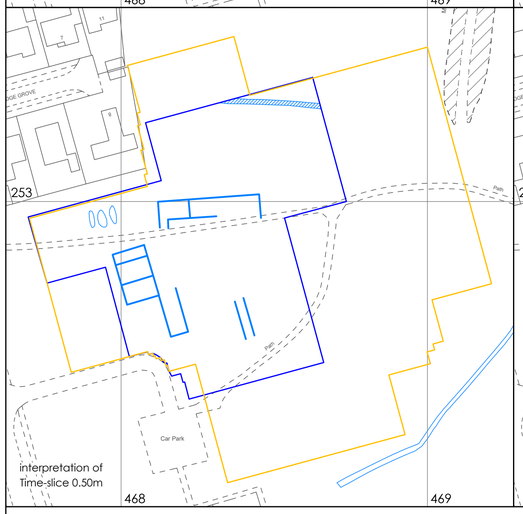
interpretation of Time-slice 0.9m



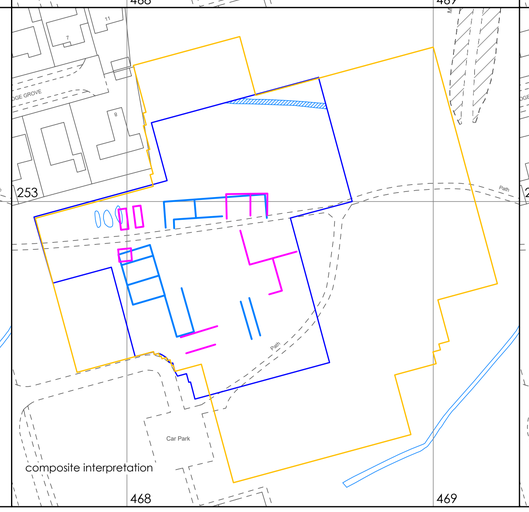
interpretation of Time-slice 1.1m



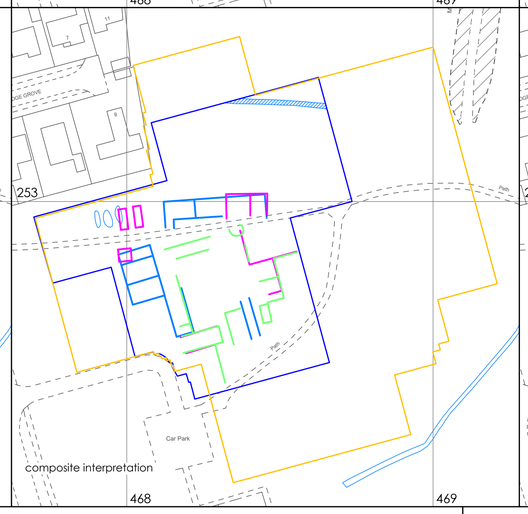
interpretation of Time-slice 1.25m



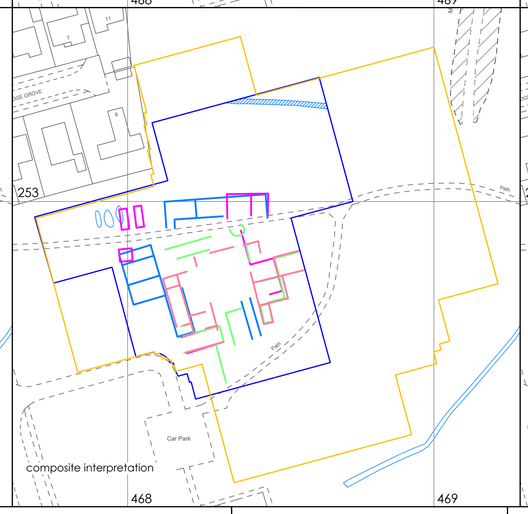
interpretation of Time-slice 0.50m



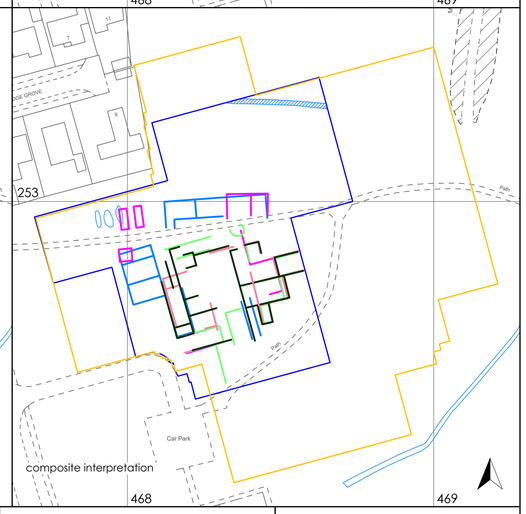
composite interpretation



composite interpretation



composite interpretation



composite interpretation

resistance survey

GPR outline

0 50m

scale 1:1000 for A1 plot

on behalf of Belief in the North-East

HERITAGE FUND

ARCHAEOLOGICAL SERVICES DURHAM UNIVERSITY

Low Grange, Billingham
Stockton-on-Tees

geophysical survey
report 5215

Figure 4: GPR time-slices and interpretations

resistance survey

probable wall

service pipe

land drain

probable recent path

yard / surface

probable former track

ridge and furrow

former field boundary

FROSTERLEY GROVE

MIDDRIDGE GROVE

NEASHAM AVENUE

BANNOCKBURN WAY

Moat

Path

Path

Cowbridge Beck

Car Park

253

252

468

469

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

ARCHAEOLOGICAL SERVICES DURHAM UNIVERSITY

on behalf of Belief in the North-East

HERITAGE FUND

0 30m

scale 1:750 for A3 plot

Low Grange
Billingham
Stockton-on-Tees

geophysical survey
report 5215

Figure 5: Archaeological interpretation