NAA

GEOPHYSICAL SURVEY

GRASSHOLME RESERVOIR, COUNTY DURHAM

prepared for
Northumbrian Water Ltd

NAA 20/78
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Archaeological
Associates

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District County Durham
Grid Ref NY 94151 22707
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GRASSHOLME RESERVOIR, COUNTY DURHAM
GEOPHYSICAL SURVEY REPORT

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Disclaimer

The results of geophysical survey may not reveal all potential archaeology and do not provide a comprehensive map of the sub-surface, but only responses relative to the environment. Geological, agricultural and modern responses may mask archaeological features. Short-lived features may not give strong responses. Only clear features have been interpreted and discussed in this report.

GRASSHOLME RESERVOIR, COUNTY DURHAM
GEOPHYSICAL SURVEY REPORT

Summary

Northern Archaeological Associates (NAA) was commissioned by Northumbrian Water Ltd to undertake a geophysical survey of a c.4ha site in advance of a proposed redevelopment at Grassholme Reservoir County Durham, DL12 0PW (Fig. 1; NY 94151 22707).

The geophysical survey aimed to assess the archaeological potential of the proposed development area and to help inform subsequent archaeological mitigation.

Several cropmarks where identified from LiDAR survey data in Area A relating to ridge and furrow, and earthworks of two cairns and a possible enclosure were visible during a walkover of the site. While weak regularly spaced linear anomalies that are likely to be associated with ridge and furrow were identified in the geophysical survey results, there was an absence of anomalies that corresponded with the location of the earthworks. Consequently, it was noted that the cairns and enclosure are composed of a stone material, which, given the results of the survey, does not have magnetic properties that are significantly different from the surrounding soil. If other similar features are extant, they are unlikely to have the necessary properties to be detected by the geophysical survey technique used. In which case, the results of the geophysical survey might be partially inconclusive because they were unable to prove the presence or absence of archaeological remains within the proposed development area. Results have successfully mapped several anomalies considered to relate to agricultural or modern activity or caused by geological or pedological changes in the substrata. Although several trends were identified, a high level of magnetic disturbance across the site has meant interpretation is difficult and it is not known if anomalies are of a geological origin or if they denote infilled features. If the latter, it is unknown if they denote buried archaeological deposits, agricultural activity or are caused by natural deposition processes.

1.0 INTRODUCTION

1.1 Northern Archaeological Associates (NAA) was commissioned by Northumbrian Water Ltd to undertake a geophysical survey across two areas totalling c.4ha in advance of a proposed reservoir redevelopment (upgrading and renewal) at Grassholme Reservoir County Durham, DL12 0PW (Fig. 1; NY 94151 22707).

1.2 This report details the setting (location, topography, geology) and archaeological background of the scheme and sets out the methodology used for the geophysical survey. The interpretation of the geophysical survey was achieved through the analysis of identified anomalies and was aided by a rapid examination of supporting published information. The results of the geophysical survey are discussed below and the interpretations are supported by illustrations. Where feasible, a detailed synopsis of anomalies is provided and, if possible, the features that the anomalies are likely to relate to are suggested.

2.0 LOCATION, GEOLOGY AND SOILS, TOPOGRAPHY

Location

2.1 The overall proposed development area (PDA) comprises c.19.2ha of mixed-use land to the north of Grassholme Reservoir, County Durham, DL12 0PW (Fig. 1; NY 94151 22707). Grassholme Reservoir and Selset Reservoir, to the west, sit in the Lunedale Valley, c.3km south of Middleton-in-Teesdale. The reservoir is owned by Northumbrian Water and is used to supply water to Teesdale and Teesside. The PDA is set in a rural landscape comprising agricultural land used for pasture and small woodlands administered by dispersed farmsteads.

2.2 Two areas totalling were deemed suitable for geophysical survey within the PDA (Fig. 2). Area A totalled c.3.6ha and formed pastureland in the west of the PDA, and Area B comprised c.0.4ha of scrubland in the east of the PDA.

Geology and soils

2.3 The underlying solid geology of the area (BGS 2020) comprises Carboniferous age Yoredale Group Limestones, Sandstones, Siltstones and Mudstones. These outcrop across part of the site but are mostly overlain by more recent, Quaternary age glacial till (Diamicton) and warm stage peats to the west. Carboniferous Pennine Lower Coal Measures Formation and South Wales Lower Coal Measures Formation (undifferentiated) lie to the immediate north-west. The soils in the study area are the

Wick 1 Association being deep, well-drained, coarse, loamy brown earths (SSEW 1983; Jarvis *et al.* 1984, 302).

Topography

2.4 The site lies between two river valleys that have a general downward slope to the east. Consequently, there is a high level of natural topographic variation across the site. The highest elevation is in the west of the PDA and is recorded at c.290m above Ordnance Survey (aOD) and the lowest elevation is situated in the east of the scheme at 250m aOD.

3.0 ARCHAEOLOGICAL AND HISTORICAL BACKGROUND

3.1 This section summarises archaeological background details in the Written Scheme of Investigation for the scheme's archaeological mitigation works that are considered pertinent to the current phase of investigation (NAA 2020).

3.2 No prehistoric sites or findspots have been recorded within 1km of the Grassholme site. There is an abundance of sites dated between the Mesolithic and Iron Ages periods along the banks of the River Tees, suggesting that the region was widely populated during the prehistoric periods. This coupled with the limited number of archaeological studies in the immediate environs of the site, suggest that the absence of recorded sites of an early prehistoric date cannot be used to suggest the area was scantly populated during these periods.

3.3 No Roman or early medieval sites or finds are recorded in the Historic Environment Record (HER) within a 1km radius of Grassholme Reservoir.

3.4 Although Grassholme is not documented in medieval census records, many of the nearby settlement have medieval origins and feature in the *Domesday Book* of 1086 (Mickleton and Romaldkirk), the Early Yorkshire Charters of AD1161–1167 (Middleton-in-Teesdale) and the Pipe Rolls of 1196 (Eggleston). Numerous earthworks survive in the hinterland of the site relating to agricultural and leisure-based activities: former deer parks, West Park and Thringarth Park, both lie directly to the north of the PDA; a series of sub-square and sub-circular earthworks are located to the west of the PDA that are suggested to represent 'stack stands' or stone barns for hay and livestock; and numerous regimes of ridge and furrow have been identified from aerial photographs and LiDAR survey data including a section which is located in the east of Area A (Fig. 6).

3.5 During the post-medieval period there was a significant rise in mineral extraction in the region, and several 18th- and 19th-century sandstone and limestone quarries are recorded in the HER, from aerial photographs and historic maps. The 1856 OS map records a limestone quarry directly to the north-west of the PDA, and Carl Beck sandstone quarry is shown to the north of the PDA. Maps from the 19th and 20th centuries demonstrate the continued rural nature of the area in which the PDA lies. Since the late post-medieval period, historic maps have included details of the land-management processes by recording an abundance of sheepfolds, springs and troughs.

3.6 Grassholme Reservoir was built between 1901 and 1914 by Walter Scott & Co. for the Tees Valley Water Board. A temporary railway line ran to the east of the reservoir, joining the North Eastern Railway's Teesdale Branch to the north-west of Mickleton Station, and was used to bring in material for the construction of the reservoir. Although the railway was dismantled in 1915, when the reservoir had been completed, the remains of a siding, embankments and cuttings can be seen on the ground to the east of the reservoir. Other extant heritage assets associated with the reservoir include the two Grassholme Reservoir valve towers, an observatory, a tunnel and a dam. Grassholme Reservoir is connected to Hury Reservoir by the Grassholme Tunnel which has three observatories along its length. The construction of the reservoir required flooding several farms and the site of Grassholme Mill, which was located c.1km to the west of the development site. A packhorse bridge next to the mill is extant but usually submerged; it is visible when water levels are low.

3.7 Several features – including two cairns (Fig 6: A and B; Plates 1 and 2) and a possible enclosure (Fig 6: C; Plates 3 and 4) – of an unknown origin were identified in the west of the site from LiDAR survey data, aerial photographs and during a site walk over.

4.0 AIMS AND OBJECTIVES

4.1 The aim of the geophysical survey was to map and record potential buried features located within the scheme. Through analysis and interpretation of the results of the geophysical survey, NAA aimed to provide a detailed assessment of the archaeological potential of the scheme, which would inform future archaeological mitigation strategies.

4.2 The objectives of the survey were to:

- undertake a geophysical survey across areas deemed suitable for data collection;
- attempt to identify, record and characterise any sub-surface remains within the survey boundary;

- assess the archaeological significance of identified anomalies; and
- identify possible concentrations of past activity in order to inform the requirement for any further archaeological investigation.

5.0 METHODOLOGY

5.1 The geophysical survey was undertaken as a gradiometer survey using the Bartington Grad601-2 dual magnetic gradiometer system with data logger. The readings were recorded at a resolution of 0.01nT, and data was collected with a traverse interval of 1m and a sample interval of 0.25m. All recorded survey data was collected with reference to a site survey grid comprising individual 30m x 30m squares. The grid was established using Real Time Kinematic (RTK) differential GPS equipment and marked out using non-metallic survey markers. All grid nodes were set out with a positional accuracy of at least 0.1m as per guidelines (CIfA 2014; Schmidt *et al*. 2015) and could be relocated on the ground by a third party. The base lines used to create the survey grids are shown on Figure 2 and further details are available in Appendix A.

5.2 The processing was undertaken using Geoplot 3.0 software and consisted of standard procedures. For details of the processing steps applied to collected data, see Appendix B.

5.3 On the greyscale plot (Figs. 3, 4 and 6), positive readings are shown as increasingly darker areas, and negative readings are shown as increasingly lighter areas. Figure 5 shows an XY-trace plot of the date.

5.4 Several earthworks and standing remains were identified while NAA was on site and from aerial photographs and LiDAR survey data. A transcription of these features is overlaid on the geophysical survey results on Figure 6.

5.5 Interpretation of identified anomalies is generally achieved through analysis of anomaly patterning and increases in magnetic response, and is often aided by examining supporting information (including, but not limited to, historic maps, LiDAR survey data, aerial photographs, geophysical survey data and excavation results in the direct hinterland of the scheme). The interpreted data uses colour coding to highlight specific readings in the survey area (Fig. 7).

Surface conditions and other mitigating factors

5.6 The site was bounded by stone walls and metal fencing and, at the time of the survey, the majority of the areas contained rough pasture.

5.7 As specified in the risk assessment, no work was carried out near water sources.

5.8 Areas containing steep slopes, excessively uneven terrain and overgrown vegetation were considered unsuitable for survey.

5.9 Areas affected by above-ground features that were likely to have a high magnetic susceptibility, such as metal fencing, were avoided when possible while surveying to minimise the potential for their magnetic responses to impinge on the results and to mask potential buried features.

6.0 GEOPHYSICAL SURVEY RESULTS

Area A

6.1 There is a high level of magnetic disturbance in the west of Area A of unknown origin. It was noted during the survey that there were many rabbit holes in this part of the site; an archaeological watching brief to the east of Area A encountered varying soil horizons including a band of gravels. It is therefore plausible that magnetic disturbance is caused by pedological or geological changes in the substrata exaggerated by soil and gravel displacement caused by burrowing animals.

6.2 Several trends of a weak and diffuse nature were identified within Area A. These generally failed to produce the necessary increases in magnetic response or patterning in order to be interpreted fully, therefore their origin is unknown. It is plausible that some trends may denote buried infilled features, but their location within an area of magnetic disturbance has meant a tentative interpretation applies, and it is equally plausible they are geological in nature. If trends are caused by infilled features, it is not possible to ascertain if they relate to agricultural or archaeological deposits, or natural erosion and deposition processes.

6.3 Several trends composed of negative magnetic values have been identified that correspond with ditches running through the site.

6.4 There are several possible alignments of regularly spaced linear anomalies likely to relate to agricultural activity. Although anomalies lacked the necessary increases in

magnetic value for a conclusive interpretation, they are composed of a broad spacing which is indicative of ridge and furrow. Anomalies identified in the east of Area A correspond with potential ridge and furrow that was identified from LiDAR survey data (Fig. 6).

6.5 There is an area of magnetic disturbance (A1) in the centre of Area A. Given the proximity and similarity in form with nearby earthworks, it is unknown if A1 denotes an infilled feature or relates to a build-up of magnetic debris.

6.6 An area of broad responses (A2) is located in Area A that is plausibly caused geological or pedological changes in the substrata.

6.7 Isolated dipolar and bipolar anomalies are likely to relate to ferrous or modern objects buried in the topsoil; therefore, only those with broad responses have been depicted in the interpretation plots.

6.8 Concentrations of isolated amorphous bipolar anomalies found on the periphery of the survey area are considered to be caused by external interference.

Area B

6.9 Area B contains a high level of magnetic disturbance. Such concentrations of dipolar and bipolar anomalies are generally considered to be of a modern origin and caused by ferrous material in the topsoil. Given the variable soils in the area, including bands of gravels, and the natural topography – whereby Area B sits at the base of a steep slope – it is also plausible that the disturbance was, in part, caused by geological or pedological variations in the subsoil.

6.10 Isolated amorphous bipolar anomalies have been identified that are likely to be caused by ferrous material in the topsoil.

7.0 CONCLUSIONS

7.1 NAA undertook a geophysical survey of two areas totalling c.4ha in advance of a proposed redevelopment (upgrading and renewal) of Grassholme Reservoir, County Durham.

7.2 The results of the geophysical survey identified vast areas of magnetic disturbance within the survey area that are likely to be caused by geological or pedological changes in the substrata and/or ferrous material in the topsoil. The survey did not conclusively identify any buried archaeological features within the PDA. Several cropmarks of ridge and furrow, earthworks of two cairns, and a possible enclosure are extant within the west of the PDA. Although several anomalies associated with ridge and furrow are present, there is an absence of anomalies that corresponded with the earthworks. During the site walkover it was noted that these features were composed of a stone material which is unlikely to have significantly different magnetic properties from the surrounding soil. Consequently, it should be noted that there is a potential for unknown feature(s to be extant that are not composed of properties conducive to a magnetic survey technique, and the results of the survey cannot be used to deduce the presence or absence of archaeological remains. Several trends were identified that may relate to infilled features. If so, it is unknown if they denoted buried features associated with archaeological or agricultural deposits, or instead are caused by natural erosion and deposition processes.

8.0 STORAGE AND CURATION

8.1 At the time of writing this report, the records of the geophysical survey are held by NAA. All material will be appropriately packaged for long-term storage in accordance with national guidelines (CIfA 2014; Schmidt *et al*. 2015). An online OASIS form will be completed within three months of the completion of the project. This will include submission of a PDF version of the final report to the Archaeology Data Service via the OASIS form.

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APPENDIX A

TECHNICAL INFORMATION

GRADIOMETER SURVEY

Magnetic surveys measure distortions in the earth's magnetic field caused by small magnetic fields associated with buried features (Gaffney and Gater 2003, 36) that have either remanant or induced magnetic properties (Aspinal *et al*. 2008, 21–6). Human activity and inhabitation often alter the magnetic properties of materials (*ibid*., 21) resulting in the ability for numerous archaeological features to be detected through magnetic surveys. Intensive burning or heating can result in materials attaining a thermoremanent magnetisation; examples of which include kilns, ovens, hearths and brick structures (*ibid*., 27; Gaffney and Gater 2003, 37). When topsoil that is rich with iron oxides fills a man-made depression in the subsoil, it creates an infilled feature, such as a pit or ditch, with a higher magnetic susceptibility compared to the surrounding soil (Aspinal *et al*. 2008, 37–41; Gaffney and Gater 2003, 22–6). Magnetic surveys can also detect features with a lower magnetically susceptibility than the surrounding soil, an example of which is a stone wall.

LIMITATIONS

Poor results can be due to several factors including short-lived archaeological occupation/use or sites with minimal cut or built features. Results can also be limited in areas with soils that are naturally deficient in iron compounds, or in areas with soils overlying naturally magnetic geology, which will produce strong responses masking archaeological features.

Overlying layers, such as demolition rubble or layers of made ground, can hide any earlier archaeological features. The presence of above-ground structures and underground services containing ferrous material can distort or mask nearby features.

Particularly uneven or steep ground can increase the processing required, or distort results beyond the capabilities of processing. It is also possible in areas containing dramatic topographical changes that natural weathering, such as hillwash, often in combination with intensive modern ploughing, will reduce the topsoil on slopes and towards the peaks of hills, and possibly destroy or truncate potential archaeological features. Conversely, features at the bottom of slopes may be covered by a greater layer of topsoil and so, if buried features are present, they appear faint within the results, if at all.

Over processing of data can also obscure or remove features, especially if they are on the same orientation as the direction of data collection. Consequently, where possible, attempts are made to ensure that data is not collected on the same orientation as known potential features and that data quality is sufficient to minimise the required data processing.

INSTRUMENTATION

The data was collected using handheld Bartington Grad 601-2 fluxgate gradiometers. The Bartington 601-2 is a single-axis, vertical component fluxgate gradiometer comprising a data logger battery cassette and two sensors. The sensors are Grad-01-1000L cylindrical gradiometer sensors mounted on a rigid carrying frame; each sensor contains two fluxgate magnetometers with 1m vertical separation.

The difference in the magnetic field between the two fluxgates in each sensor is measured in nanoTesla (nT). NAA gradiometer data is recorded with a range of ±100nT, which equates to a resolution of 0.01nT. It should be noted that the actual resolution is limited to 0.03nT as a consequence of internal instrumental noise (Bartington Instruments Ltd n.d., 23).

The gradiometer records two lines of data on each traverse, the grids are walked in a zig-zag pattern amounting to 15 traverses. The gradiometers are calibrated at the start of every day and recalibrated whenever necessary.

SURVEY DETAILS

Table A1: survey summary

Item	Survey
Grid size	30m x 30m
Traverse interval	1m
Reading interval	0.25m
Direction of first traverse	N
Number of grids	61
Area covered	4ha

Table A2: baseline coordinates

Item	Survey
gpA	394323.1077 522798.7764
gpB	394353.1077 522798.7764
gpC	394742.5396 523043.4464
gpD	523043.4464 523043.4464

Table A3: site information and conditions

Item	Detail
Geology	Yoredale Group Limestones, Sandstones, Siltstones and Mudstones
Superficial deposits	Devensian Till
Soils	Wick 1 Association
Topography	Highest: 290m aOD/Lowest: 250m aOD
Land use	Agricultural – pasture
Weather conditions prior to and during survey	Overcast

APPENDIX B

DATA PROCESSING INFORMATION

Gradiometer survey data is downloaded using the Bartington Grad 601 software and the processing was undertaken using Geoplot 3.0 software.

Table B1: commonly applied techniques

Process	Effect
Zero mean traverse	Removes stripping that can occur as a consequence of using multi-sensor arrays or a zig-zag data collection method by setting the mean reading for each traverse to zero.
Destagger	Removes stagger in the data introduced through inconsistent data collection pace and often exacerbated through the zig-zag methodology.
Clip	Clips data above or below a set value to enhance potential weaker anomalies.
Despike	Removes random spikes or high readings to reduce the appearance of dominant readings, often created by modern ferrous objects that can distort the results.
Low pass filter	Removes low-frequency waves or broad anomalies such as those caused by strong or large gradual variations in the soil's magnetic susceptibility often caused by geological or natural changes in the substrata.
Interpolation	Used to smooth or reduce the blocky appearance of data by improving the spatial density and increase the quantity of data points in the Y direction.

Table B2: processing steps

Minimal processing	Increased processing
• Zero mean traverse +5/-5 • Destagger	• Low pass filter • Interpolate Y, expand – linear, x2

APPENDIX C

DATA VISUALISATION INFORMATION

FIGURES

The data was used to produce a series of images to demonstrate the results of surveys, which are detailed below:

- Greyscale/colourscale plot – this visualised the results as a shaded drawing with highest readings showing as black, running through different shades to lowest showing as white.
- XY-trace plot – this creates a line drawing showing the peaks and troughs of the readings as vertical offset from a centreline.
- Interpreted plot – through detailed analysis, anomalies have been interpreted and possible features identified. Interpretation drawings are used to show potential features and in particular to reinforce and clarify the written interpretation of the data. Anomalies have been characterised using the terminology detailed in the following section, and have been assigned colour coding outlined in keys found on the relevant figures associated with this report.

MAGNETIC ANOMALIES AND TERMINOLOGY

Table C1: lexicon of terminology

Terminology	Detail
Anomaly	Any outstanding high or low readings forming a particular shape or covering a specific area within the survey results.
Feature	A man-made or naturally created object or material that has been detected through investigation works and has sufficient characteristics or supporting evidence for positive identification.
Magnetic susceptibility	The ability of a buried feature to be magnetically induced when a magnetic field is applied.
Magnetic response	The strength of the changes in magnetic values caused by a buried feature with either a greater or lesser ability to be magnetised compared with the soil around it. Anomalies are considered to have either strong/weak or positive/negative responses. The strength of magnetic response (along with patterning) can be essential in determining the nature of an anomaly, but it should be noted that the size or strength of the magnetic response does not correlate with the size of the buried feature.
Patterning of an anomaly	The shape or form of an individual anomaly.
Thermoremanence	The affect caused when a material has been magnetically altered through a process of heating. Thermoremanent magnetisation occurs when an object or material is heated passed the Curie Point and acquires a permanent magnetisation that is associated with the magnetic field that they cooled within (Gaffney and Gater 2003, 37).

Anomalies can represent different features created by human, agricultural or modern activity, or natural pedological or geological changes in the substrata.

Anomalies interpreted with a 'greater' categorisation are considered more likely to be of the interpreted characterisation; whereas a more tentative interpretation is applied to those with a 'lesser' categorisation as a consequence of weaker increases in magnetic response or the anomaly's incomplete patterning or irregular form.

The strength and size of anomalies can vary depending on the magnetic properties of the feature, the magnetic susceptibility of the soil, the depth to which the feature is buried, and the state of preservation.

Table C2: characterisation of anomalies

Characterisation	Detail
Archaeology	
Trends	Weak and diffuse anomalies with an uncertain origin are denoted by trends. It is possible that these belong to archaeological features but, given their weak signatures or incomplete patterning, it is equally plausible that they relate to agricultural features or natural soil formations.
Agriculture	
Ridge and furrow?	Broadly spaced linear anomalies that are likely to be indicative of earlier forms of agriculture, such as ridge and furrow. These often correspond with the location of earthworks visible on the ground or identified on aerial photos or LiDAR survey coverage.
Modern	
Bipolar response (modern)	Positive anomalies with associated negative 'halo' (bipolar) denote features with a strong magnetic response that are likely to be of a modern origin. Isolated bipolar responses of a modern nature are likely to relate to buried ferrous material or objects, such as metallic agricultural debris. If a trend is noted in the alignment or spacing of isolated bipolar responses, it is possible that they are indicative of ferrous fittings or connectors used on non-magnetic buried utilities. Linear bipolar anomalies are likely to be indicative of modern services.
Magnetic disturbance	Areas of increased magnetic response denote areas of disturbance containing a high concentration of dipolar and/or bipolar responses, or above-ground features external to the development area. These are generally considered to be caused by modern debris in the topsoil, although it is possible that the disturbance is in part caused by isolated archaeological material or geological or pedological changes in the substrata.
Natural	
Broad response (geology?)	Broad isolated responses that have an irregular patterning that may be indicative of geological or pedological changes in the substrata. It should be noted that ground water can naturally dissolve or erode porous or permeable bedrock, such as limestone, and create fissures and cracks. Depending on the magnetic susceptibility of the soil it is possible for these fissures to appear as a series of contiguous rectilinear anomalies, often having a similar appearance to archaeological enclosures.

APPENDIX D

OASIS FORM

OASIS DATA COLLECTION FORM: England

OASIS ID: northern1-403691

Project details

Project name	Grassholme Reservoir
Short description of the project	Geophysical Survey
Project dates	Start: 01-09-2020 End: 02-09-2020
Previous/future work	Yes / Yes
Type of project	Field evaluation
Monument type	NONE None
Significant Finds	NONE None
Methods & techniques	"Geophysical Survey"
Development type	Reservoir redevelopment
Prompt	National Planning Policy Framework - NPPF
Position in the planning process	Pre-application
Solid geology (other)	Yoredale Group Limestones
Drift geology (other)	Yoredale Group Limestones
Techniques	Magnetometry

Project location

Country	England
Site location	DURHAM TEESDALE MICKLETON Grassholme Reservoir
Postcode	DL12 0PW
Study area	4 Hectares
Site coordinates	NY 94151 94151 55.24147774749 -2.091997782083 55 14 29 N 002 05 31 W Point
Height OD / Depth	Min: 250m Max: 290m

Project creators

Name of Organisation	Northern Archaeological Associates
Project brief originator	Northern Archaeological Associates
Project design originator	Northern Archaeological Associates
Project director/manager	Matthew Town
Project supervisor	Gav Robinson
Type of sponsor/funding body	Developer

Project archives

Physical Archive Exists?	No
Digital Archive recipient	Northern Archaeological Associates
Digital Contents	"none"
Digital Media available	"Geophysics"
Paper Archive Exists?	No

Project bibliography 1

Publication type	Grey literature (unpublished document/manuscript)
Title	Grassholme Reservoir, County Durham: Geophysical Survey
Author(s)/Editor(s)	James
Other bibliographic details	20-78
Date	2020
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Place of issue or publication	Barnard Castle
Description	blue spine

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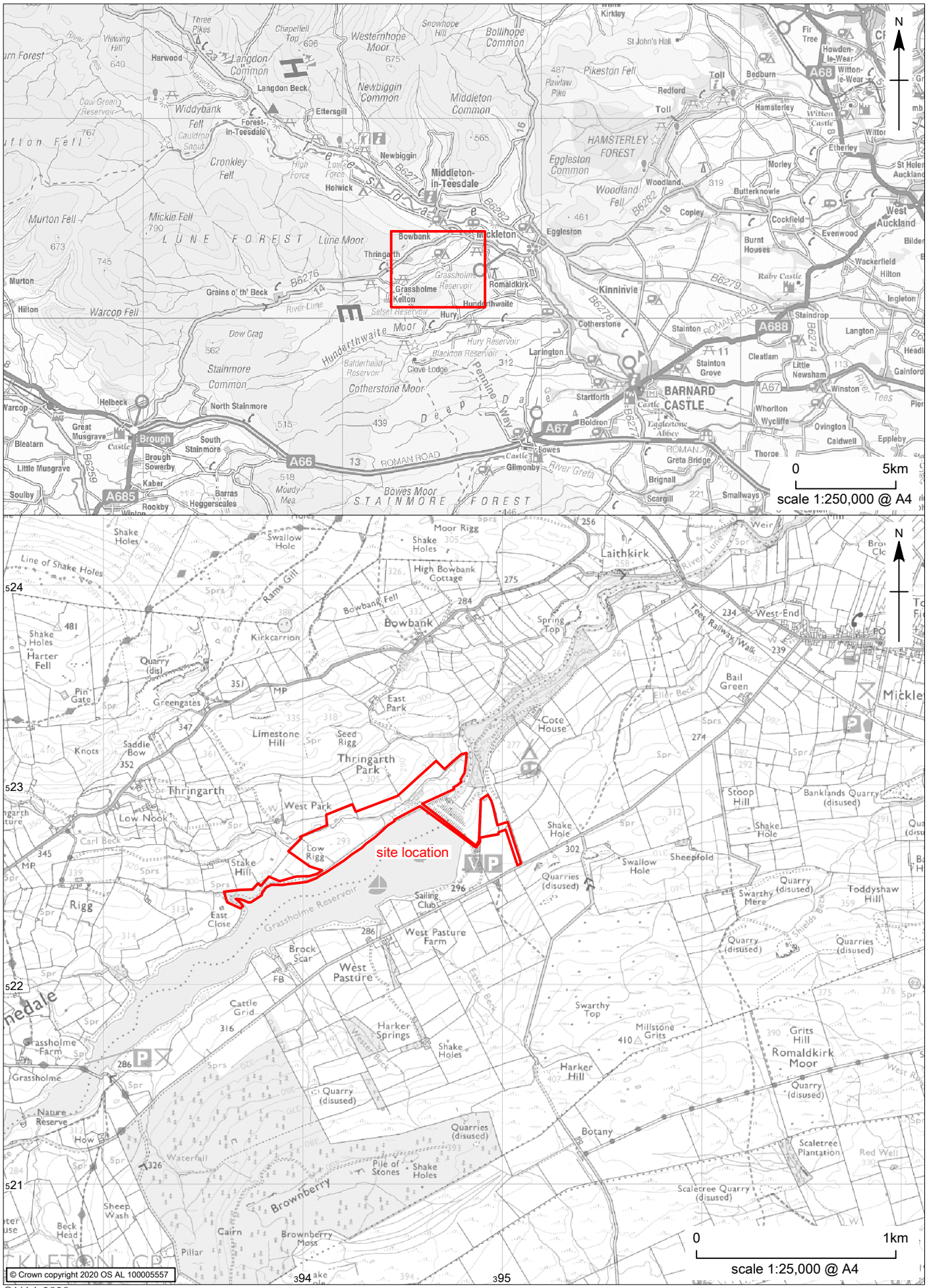


Grassholme reservoir: site location *Figure 1*

NAA
HERITAGE & ARCHAEOLOGY

Area B

gpC

gpD

gpA

gpB

Area A

KEY

geophysical survey baseline

geophysical survey grid

geophysical survey area

proposed development area

N

0 100 m

scale 1:2500 @ A3

Grassholme Reservoir, County Durham: geophysical survey areas

Figure 2

NAA
HERITAGE & ARCHAEOLOGY

Area B

Area A

KEY

proposed development area

N

0 100 m

scale 1:2500 @ A3

5nT

-4nT

Pallette:grey55.ptt

Grassholme Reservoir, County Durham: unprocessed greyscale plots of geophysical survey results

Figure 3

NAA
HERITAGE & ARCHAEOLOGY

Area B

Area A

KEY

proposed development area

N

0 100 m

scale 1:2500 @ A3

3nT

-2nT

Pallette:grey55.ptt

Grassholme Reservoir, County Durham: processed greyscale plots of geophysical survey results

Figure 4

NAA
HERITAGE & ARCHAEOLOGY

Area B

Area A

KEY

proposed development area

N

0 100 m

scale 1:2500 @ A3

XY scale

40 nT

Grassholme Reservoir, County Durham: XY trace plots of geophysical survey results

Figure 5

NAA
HERITAGE & ARCHAEOLOGY

C

A

B

Area A

KEY

proposed development area

archaeological assets

N

0 100 m

scale 1:1000 @ A3

3nT

-2nT

Pallette:grey55.ptt

Grassholme Reservoir, County Durham: archaeological assets overlain on gradiometer survey results

Figure 6

NAA
HERITAGE & ARCHAEOLOGY

Area B

A1

A2

Area A

KEY

trends (positive)

trends (negative)

ridge and furrow?

magnetic disturbance (archaeology?)

bipolar anomaly

magnetic disturbance

broad response (geology?)

edge of geophysical survey

proposed development area

N

0 100 m

scale 1:2500 @ A3

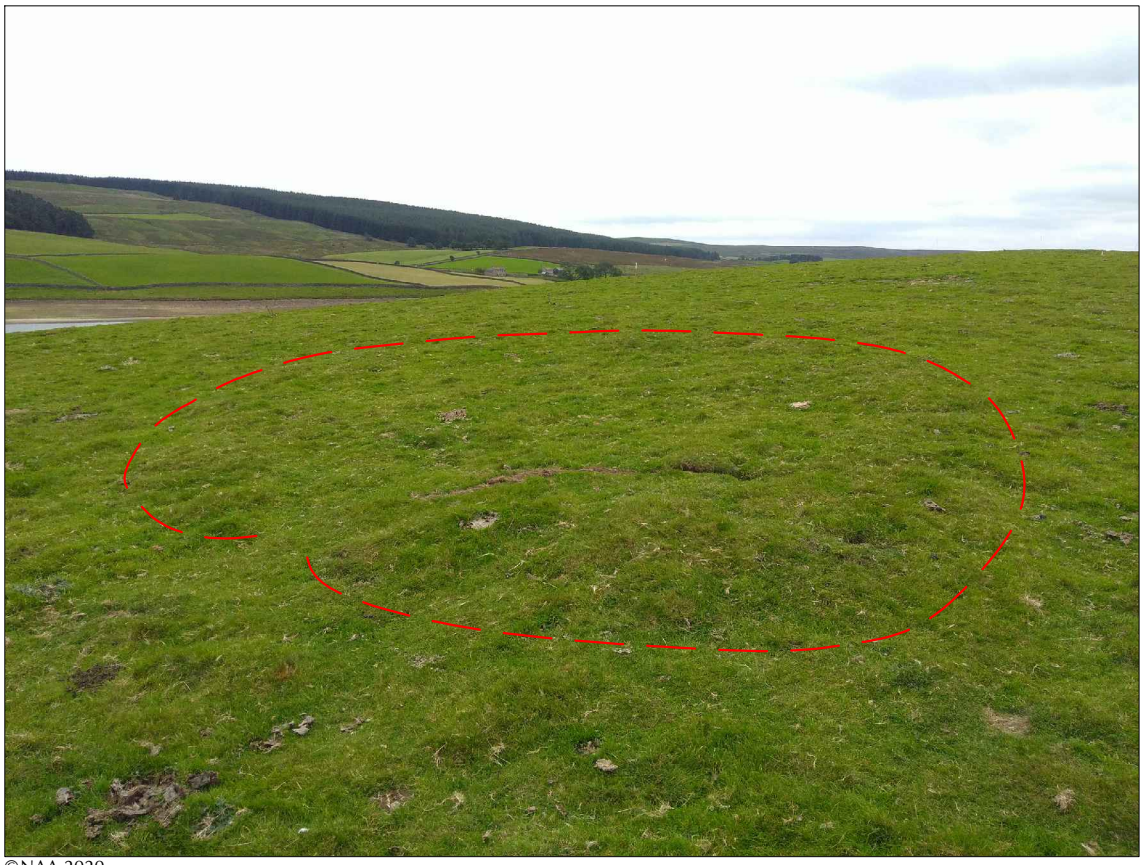
Grassholme Reservoir, County Durham: interpretation of geophysical survey results

Figure 7

Grassholme Reservoir, County Durham: cairn A *Plate 1*

Grassholme Reservoir, County Durham: cairn B *Plate 2*

Grassholme Reservoir, County Durham: possible earthwork C *Plate 3*



Grassholme Reservoir, County Durham: highlighted earthwork C *Plate 4*