



1EW03 - Enabling Works Central AWHe - Survey Report for Topographical Survey of Grim's Ditch Scheduled Monument (C10021) Site Code: 1C19GDMTO

MDL:

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1 Summary of Archaeological Works

- 1.1.1 This report details the survey methodology for the topographical surveying of Grim's Ditch Scheduled Monument, Buckinghamshire, centred on NGR 489129 203572; Figure 1, (henceforth the 'Site'), conducted in December 2020. The Site Code for the investigation was 1C19GDMTO. The Site comprises a single parcel (C10021) covering a total area of 1.83ha.
- 1.1.2 There are numerous lengths of ancient linear earthworks bearing the name Grim's Ditch, in areas as diverse as Dorset, Essex and Leeds, but with most occurrences in the chalk grassland or 'downland' of the Chilterns and the downs of Oxfordshire and Wiltshire. The name is applied to numerous earthworks of unknown provenance, these were often attributed in the early medieval period. The Site is one of several extant sections within Buckinghamshire bearing the name 'Grim's Ditch', stretching north-eastwards across the county, from Bradenham to Berkhamsted. The date of Grim's Ditch is unknown and a key objective of this work, through the HS2 scheme, is to provide further understanding of the date and use of this monument along with its impact on the landscape.
- 1.1.3 The part of the monument at the Site consists of a partly infilled ditch, up to 8m wide and o.9m deep, with an eroded bank of similar width up to o.63m high. The monument extends north-eastward for 150m from the buildings at Cottage Farm, then turns through a 20-degree angle to continue in a more northerly direction for a further 200m.
- 1.1.4 The proposed evaluation was targeted on land required for the main rail alignment, which in this section will be in a cutting, as well as associated engineering works as outlined in the Project Plan (1EW03-FUS-EV-REP-CS03_CL05-009409). A 180m length of the 350m long earthwork monument is within the HS2 construction boundary and therefore may be impacted by the scheme. The topographic survey followed the methodology laid out in the Location Specific Written Scheme of Investigation (1EW03-FUS-EV-REP-CS03_CL05-00001).
- 1.1.5 The segment of the Grim's Ditch Scheduled Monument (List Entry 1021198), that lies within the site, is 145m long and is aligned northeast-southwest and has a visible upstanding bank on the west side of a linear ditch. The coverage demonstrated a continuation to the south of both the negative and positive elements but to the north, beyond the Monument, the area is entirely flat.
- 1.1.6 The results were able to rapidly capture detailed data which can be viewed as either orthomosaic photographic representations or as 3-dimensional models. This preserved the status of the Monument at one given point in time, provides a baseline of information to gauge future changes against.

2 Survey Methodology

2.1 Introduction

- 2.1.1 The topographical survey comprised a photogrammetric survey to be undertaken by Unmanned Aerial Vehicle (UAV) and an array of locational data points to allow the construction of a 3-dimensional representation of the Scheduled Monument.
- 2.1.2The resulting interpretive description of the topography including representative maps and
figures was presented at the Stage 4 HOLD POINT meeting, (16/12/2020: Doc Ref 1EW03-
FUS_IFA-EV-REP-CS03_CL05-009436) in accordance with 5.6.2 of the Project Plan.
- 2.1.3 The topographical survey was conducted in accordance with technical standards as well as Historic England guidelines (Historic England 2015).
- 2.1.4 Final deliverables will be supplied in an Esri format and adhere to standards set out in the HS2 Ltd Cultural Heritage GIS Standard (HS2-HS2-GI-SPE-000-000004).

2.2 Topographic Survey

- 2.2.1 A topographic Survey is the controlled measurement of natural and artificial landscape features (Historic England 2015, 6.1.1).
- 2.2.2 The purpose was to record the Site prior to any excavation works and to place any archaeological features on a location plan. The location, size and objectives of the works are set out in the Project Plan (1EW03-FUS-EV-REP-CS03_CL05-009409) in agreement with the GWSI:HERDS (HS2-HS2-EV-STR-000-000015).
- 2.2.3 All spatial setting out and recording was in accordance with The Ordnance Survey National Grid and Ordnance Survey Newlyn Datum (ODN) as defined by the OS Active Global National Satellite System (GNSS) network and use of a Virtual reference system.
- 2.2.4 An array of points was taken at regular intervals to produce a dense spread across the area to provide an objective topographic record referred to as a digital terrain model (DTM), (Plate 1). In addition, the breaks of slopes of all features were recorded and provided a more subjective topographic record. The data gathering was in accordance with the suggested array distancing as defined by Historic England (2015, 6.2.2).
- 2.2.5 Five Permanent Ground Markers (PGM) were established for the duration of the project shown in Figure 2, as per technical standards. The locations were established using the Trimble Access software on Trimble Tablet on TSC7 controllers and R8s GNSS antennae, calibrated on 16th March and 6th April 2020. The survey used reference stations provided by Ordnance Survey. The OS Net base stations used for the survey was Princes Risborough (E481016.735053, N202913.238152, 145.659487m AOD).

Table 1 List of PGM co-ordinates

Station	Land Parcel	Easting	Northing	Height aOD (m)
STN01	C10021	489169.134	203644.136	197.572
STN02	C10021	489145.449	203630.689	196.411
STNo3	C10021	489135.678	203607.692	195.296
STN04	C10021	489145.449	203630.689	196.411
STNo3	C10021	489120.804	203565.423	192.974

- 2.2.6 At least 3 PGM's were reoccupied during each survey to check the accuracy of the equipment. The survey equipment was purchased or hired from Korec who certified the accuracy of the equipment and performed regular maintenance.
- 2.2.7 All staff using the equipment were appropriately trained and the survey was undertaken in accordance with the sub-contractor's standards for surveying.
- 2.2.8 All archaeological recording was located to a horizontal accuracy of +/-500mm in relation to the detail illustrated in the contract drawing(s). The points at modern ground surface level were surveyed with Real Time Kinematic (RTK) Global Navigation Satellite System (GNSS) equipment or other suitable automated equipment referenced from the PGM's.
- 2.2.9 Surface heights were recorded using RTK GNSS and related to PGMs. Ordnance Survey Benchmarks (OSBM) were not used. Levelling accuracy was within 10 mm/k: where 'k' is the total distance levelled in kilometres.

2.3 Photogrammetric Surveying

- 2.3.1 A photogrammetric survey was undertaken by Unmanned Aircraft System (UAS), which involves the use of an Unmanned Aerial Vehicle (UAV) with a ground control system. The work was carried out in December 2020 and conducted by Adam Stanford RPQ-s, MCIfA, FSA. – CAA PfCO 991, using a DJI Inspire 2 – X4s, with a gimbal mounted camera. This was flown at 66m above ground level to obtain a spatial resolution of 1.64cm per image pixel. The full details are to be found in the Fieldwork Report (Doc Ref 1EW03-FUS_IFA-EV-REP-CS03_CL05-000044).
- 2.3.2 Photogrammetry Images were processed in photogrammetry software to produce a 3D pointcloud with a horizontal density of 232 points per square metre. Data were exported as a raster digital elevation model (DEM) with a 6.56cm/pix spatial resolution and an orthophoto with a o.82cm spatial resolution.
- 2.3.3 The photogrammetric model was referenced by eight ground control points that were distributed around the survey area. The points are visible in the archived aerial photographs and were also surveyed using high accuracy GPS to facilitate georeferencing to OS coordinates. The ground control points provide an error of 16mm.

Table 2 List of photogrammetry survey target co-ordinates

Survey Point	Easting	Northing	Height
GB Amersham =			
control station	499706.6	198584.7	87.674
point 1	489122.6	203578.9	193.69
point 2	489135.5	203620.6	195.891
point 3	489158.1	203658.2	197.648
point 4	489178.9	203634.2	197.372
point 5	489166.2	203594.7	195.947
point 6	489147.5	203550.2	193.609
point 7	489128.1	203512.2	191.462
point 8	489111.2	203547.3	191.611

2.4 Data Processing and Visualization

- 2.4.1 *Directional light shading*: simulated illumination of the terrain surface from a chosen light source direction was applied. This gives the viewer an intuitive sense of the 3D topography for a DEM but can fail to reveal some features that are aligned with the light source.
- 2.4.2 **Ambient Light Shading**: simulated illumination of the terrain surface from a continuous encompassing light source was applied. Illumination of a given point was determined by surrounding terrain and other objects which occlude incoming light. It gives the viewer an intuitive sense of the 3D topography but can fail to reveal subtle features near much larger objects.
- 2.4.3 **Terrain Flattening**: entails constructing a mathematical model that approximates broad-scale variation in the topography. This model surface was then subtracted from the original DEM to produce a new dataset that reflects only smaller scale features.
- 2.4.4 **Relief Visualisation Toolbox (RVT) Processing**: involved the automated manipulation of DEM including further flattening, smoothing and light simulation to highlight subtle features in the landscape.
- 2.4.5 In addition, LiDAR was obtained from DEFRA to illustrate the wider landscape and contextualise the study area.

2.5 Topographic Plans and Profiles

2.5.1 The results of the DTM and DEM can be presented as either a two-dimensional (2-D) or a three-dimensional (3-D) dataset reading as a plan, effectively the 3D version is a 'squashed' view. Views can be altered dependent on the viewpoint, for example either a vertical view or an oblique one can be achieved and displayed.

- 2.5.2 A 'site location plan', indicating site north was prepared at 1:2000. Individual 'area plans' were prepared at 1:1000, 1:600 and 1:500, and show the location of features and remains within the investigation area.
- 2.5.3 A record was made 'in plan' of all features as revealed in the investigation. These plans were normally based on digital survey data (digital planning methods were agreed in advance with the HS₂ Ltd).
- 2.5.4 Profiles were obtained by extrapolating the forms from the objectively recorded points. Profiles were produced at scales of 1:1000, 1:500 and 1:200 at 1:1 ratio, and in order to understand any smaller fluctuations in the profile the profiles were also viewed and produced with a x 10 exaggeration on the Y axis (vertical enhancement).
- 2.5.5 Final deliverables will be supplied in an Esri format and adhere to standards set out in the HS2 Ltd Cultural Heritage GIS Standard (HS2-HS2-GI-SPE-000-000004).

3 Standards and Guidance

3.1 Overview

- 3.1.1 HS2 Ltd has developed a robust suite of technical standards which supports existing archaeological guidance to ensure that works are delivered in a consistent and cohesive manner that reflects the Secretary of State's commitments to the historic environment.
- 3.1.2 To implement the GWSI:HERDS, the sub-contractor complied with and used for the development of historic environment works; the strategies, technical standards and guidance notes set out below in section 3.2.

3.2 References

- 3.2.1 All relevant HS2 standards, guidance and procedures in relation to the production of documents and digital materials were followed. This list is not exhaustive:
 - HS2 Cultural Heritage GIS Specification (HS2-HS2-GI-SPE-000-000004)
 - The BIM documents set out in High Speed Two Phase One Project Requirements Specification (PRS) (HS2-HS2-SA-SPE-000-000008) (section 2.1.4 Information Management).
- 3.2.2 The following documents provided background information:
 - Historic Environment Physical Archiving Strategy (HS2-HS2-EV-STR-000-000018)
 - Historic Environment Digital Data Management and Archiving Strategy (HS2-HS2-EV-STR-000-000019)
 - Historic England, 2015. Metric Specifications for Cultural Heritage, 3rd edition Andrews D, Bedford J and Bryan P
 - Information Paper E8: Archaeology. (LWM-HS2-HY-PPR-000-000042)

- Project Plan for Trial Trench Evaluation at Grim's Ditch Scheduled Monument (AC210/14.) (1EW03-FUS-EV-REP-CS03_CL05-009409)
- Location Specific Written Scheme of Investigation for Archaeological Trial Trenching at Grim's Ditch Scheduled Monument (AC210/14). (1EW03-FUS-IFA-EV-REP-CS03_CL05-000001)
- GWSI:HERDS (HS2-HS2-EV-STR-000-000015)

4 Archive deposition

- 4.1.1 Following completion of the archaeological evaluation, the subcontractor will provide the contractor with the required data, metadata and digital material as specified in the Historic Environment Digital Data Management and Archiving Procedure (C262-ARP-EV-SPE-ooo-ooooo3) and the Historic Environment Digital Data Management and Archiving Strategy (HS2 Ltd, 2015a).
- 4.1.2 The security and stability of the digital archive will be ensured from fieldwork through to deposition.
- 4.1.3 The survey data will be edited to ensure that the archive deposited into the public domain is fit for purpose both as a record of the archaeology removed by excavation and to enhance understanding about the site from which it came.
- 4.1.4 The Fieldwork report will be uploaded to the OASIS database as required by HS2.
- 4.1.5 File-level metadata requirements for spreadsheets and databases are specified in the ADS *Guidelines for Depositors* (2014) Spreadsheets, Databases and Statistics Guidelines. These guidelines include a metadata template that can be downloaded in XLS, ODS and CSV formats.

5 Glossary of terms

5.1.1 The following terms have been used in this report:

- Archaeological contractor INFRA, the organisation undertaking the specific historic environment works for the *Contractor*.
- **Contractor** Fusion; the organisation undertaking the Enabling Works for Area Central on behalf of the Employer.
- **Employer** HS₂ Ltd, the organisation responsible for delivery of HS₂ Phase One Scheme and all terms and conditions, policies, procedures, and payments
- **Evaluation** A form of archaeological investigation involving the excavation of trenches to help determine the character and date of any discovered archaeology
- Generic Written Scheme of Investigation: Historic Environment Research and Delivery Strategy (GWSI: HERDS) the framework for delivering all historic environment investigations undertaken as part of the HS2 Phase 1 programme.
- Location a specific HS2 worksite or group of worksites that are being addressed as a combined historic environment investigation programme of assessment, evaluation and investigation.
- Location Specific Written Scheme of Investigation (LSWSI) specification document assembling one or more Project Plans within an area of land defined primarily for construction programme purposes. The LS-WSIs will be agreed with the Project Manager and would provide a costed and programmed approach to delivering outcomes.
- **Project Plan** specification document for each specific package of activity (e.g. a survey, desk-based assessment, excavation, recoding project). The plans would respond to the Specific Objectives set out in the GWSI: HERDS and be delivered within an agreed budget.
- Works the specific historic environment assessment, evaluation or investigation works at each location.

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		Beilinger PRINCES Balloger PRINCES Balloger Cost C	High Speed Two Grim's Ditch Scheduled Monument C1002 Figure 1. Site location



