



BOLTON GILL AND HEBDEN GILL LEAD WORKINGS, HEBDEN

YORKSHIRE DALES

Archaeological Survey Report



Oxford Archaeology North

May 2015

**Yorkshire Dales National Park
Authority**

Issue No:	2014-15/1627
OAN Job No:	L10799
NGR:	SE 026 653

Document Title: BOLTON GILL AND HEBDEN GILL LEAD WORKINGS,
HEBDEN, YORKSHIRE DALES

Document Type: Archaeological Survey Report

Client Name: Yorkshire Dales National Park Authority

Issue Number: 2014-15/1627
OA Job Number: L10799


National Grid Reference: SE 026 653 (Centred)

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CONTENTS

SUMMARY	3
ACKNOWLEDGEMENTS	5
1. INTRODUCTION	6
1.1 Circumstances of the Project	6
1.2 Aims and Objectives.....	6
1.3 Location, Topography and Geology.....	7
2. METHODOLOGY.....	8
2.1 Introduction and Project Design.....	8
2.2 Documentary Study Methodology	8
2.3 Topographic Survey	9
2.4 Structural Assessment	10
2.5 Report and Gazetteer of Sites	10
2.6 Archive	10
3. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND.....	12
3.1 Introduction.....	12
3.2 Documentary Sources and Previous Work.....	13
3.3 Historical Background.....	14
3.4 Map Regression.....	22
4. SURVEY RESULTS.....	24
4.1 Introduction.....	24
4.2 Bolton Gill Side (North Side of Valley).....	24
4.3 Duke's Level.....	28
4.4 Bolton Gill South	32
4.5 Bolton Haw Side	40
4.6 Water Supplies	46
5. CONCLUSION.....	49
5.1 Discussion - History of Extraction	49
5.2 Condition Assessment	53
6. BOLTON GILL COMPLEX STRUCTURAL ASSESSMENT.....	55
7. BIBLIOGRAPHY	69
7.1 Cartographic Sources	69
7.2 Secondary Sources	69
7.3 On line Sources	70
APPENDIX 1: PROJECT BRIEF	71
APPENDIX 2: PROJECT DESIGN.....	78

APPENDIX 3: SURVEY GAZETTEER 85

ILLUSTRATIONS 109

Figures 109

Plates 110

SUMMARY

Oxford Archaeology North (OA North) was invited by The Yorkshire Dales National Park Authority (YDNPA) to undertake a detailed topographic survey of the Bolton Gill lead mines in the Wharfedale area of the Yorkshire Dales (SE 026 653 approximate centre). Following discussions with YDNPA, the survey was expanded to include the Hebden Gill Dressing Floor and the area of Duke's Level, which are both adjacent to Hebden Beck. The survey was undertaken between October 2014 and January 2015 to take account of the vegetation cover. In October part of the site was heavily obscured by bracken, but by January the bracken had died down enabling clear view of the archaeological remains. The site forms part of a much larger scheduled monument (SM 1018333) which includes lead mines, processing works and twentieth century barytes mill which extends between Hebden Beck, Yarnbury and Grassington Moor.

The earliest mining activity within the study area was on the northern side of Bolton Gill, and was characterised by a series of hushes extending down the valley. The date of the hushes is very uncertain, and from a technological perspective could potentially be of any date within the broad range of the fifteenth to the seventeenth centuries.

Across the northern side of Bolton Gill is a small mining landscape comprising two parallel lines of shafts which were serviced by a dressing floor on the lower, undulating ground. The amount of spoil associated with these shafts was not substantial and the implication is that the shafts were not dug to a great depth and the workings were relatively non-intensive; however, they were collectively sufficiently productive to warrant the establishment of a local dressing floor. There are documentary references to the mine operations of William Ridley in 1759, which provides details of the working of up to four shafts; they are not specifically located but believed to be from this area of Bolton Gill.

Across the area of Bolton Haw Side, there is a series of shafts that pre-date the workings of the Hebden Moor Mining company, and these probably correspond to documented coal working throughout the eighteenth century

Duke's Level, at the southern part of the study area, was an extravagant, and ultimately uneconomic, scheme to provide a narrow boat-sized adit to work the Yarnbury veins, and to drain existing mines at Yarnbury (Gill 1983). It was commenced in 1796 underground and extended for almost 2.5km below the shafts at Yarnbury and Grassington Moor, and was only finished in 1830. The ultimate cost of the scheme, spread over 28 years, was £ 33,000 and produced relatively little lead ore as reflected in the small size of the dressing floor, but, a very large sized spoil heap.

The most intensive mining and processing operations across the study area were undertaken by the Hebden Mining company, which was formed in 1854. Its peak of extraction was in 1862, with 410 tons of ore produced, but by 1888 the company had folded. The earliest level to be worked was Top Level which worked Cockbur Vein and was accessed by an adit which has not been identified but probably came out just above the Bolton Gill dressing floor, which was intended to be immediately adjacent to the portal. This area has now been covered by the spoil mound from the higher Engine Shaft (8.1) which has encroached into the area of the adit.

The ore beds worked by the Top Level were found to dip below Bottle Level, and at the eastern limit of the workings were found to be dead and unproductive and so the company

sunk the Bolton Gill Engine Shaft in order to follow the deeper Chance Veins. Engine Shaft comprised two shafts: the Power Lobby shaft (7.2) and an adjacent shaft (8.1) which were seemingly in contemporary use. The two shafts were part of a single mining operation, with the power provided from the Power Lobby shaft (7.2) being used to drain the levels and operate a hoist which extracted the ore and other spoil from shaft 8.1.

The provision of water was fundamental to the mining operation, providing power for the dressing floors, power to drain the lower levels and also to provide power for hoists lifting ore from lower levels. This entailed the establishment of an extensive and sophisticated water system for the area, as the area was not sufficiently endowed with natural water supplies at the right altitudes. Mossy Moor Dam was constructed at some time between 1852 and 1853 which ultimately provided water for the smelt mill at Hebden and Bolton Gill mines. This reservoir had only a limited catchment and it was therefore necessary to transport water along a leat from Bolton Gill over a distance of 1.03km to the dam to replenish it, and then a further leat was necessary to take the water back again, over a similar distance and route, for a water wheel at the Bolton Gill dressing floor.

The Engine Shaft was at too great an altitude to benefit from water from the lower leat (Site 4.1), but another site on Bolton Haw Side was sufficiently low to be able to use the water from the lower leat, and a complex scheme was devised that entailed the use of a large water wheel to power pump rods that transferred the power up to the Engine Shaft. This was documented as a 40' wheel that was 3.5' wide (Gill 1994, 104; Mining Journal 13/07/1889, 808) and fed power to a Power Transfer House from where the pump rods were driven. This pump transfer house also took power from a power cable that ran over a distance of 1.13km from a large water wheel at the Hebden Smelt Mill. An elaborate vaulted lobby was constructed over the Engine Shaft to house a wheel and a balance bob which was used to transfer the power from the horizontal rods to vertical rods.

Although the company continued through until 1888, the lead production dropped off dramatically after 1866 and by 1872 Engine Shaft had been closed and there are no records of lead production after 1873 (Gill 1994, 120). These very extensive mining works were established over a short period of time, mostly within the first five years of the company's formation, and then were in use for only eighteen years.

ACKNOWLEDGEMENTS

Oxford Archaeology North would like to thank Robert White of the Yorkshire Dales National Park Authority for commissioning the project and for support during the project. The survey was funded by Yorkshire Dales National Park Authority through the Yorkshire Dales Monument Management Scheme, in partnership with Historic England. We would also like to thank the landowners and tenants for allowing access to the land. We would like especially to thank Mike Gill for his considerable help and support during the documentary elements of the work, and particularly for the use of unpublished data.

The desk-based research was undertaken by Helen Quartermaine and the topographic survey was undertaken by Jamie Quartermaine. The structural survey was undertaken by Charles Blackett-Ord of Blackett-Ord Conservation Engineering. The report was written by Helen and Jamie Quartermaine, and the illustrations were produced by Anne Stewardson. The report was edited by Jamie Quartermaine, who also managed the project.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

- 1.1.1 Oxford Archaeology North (OA North) was invited by The Yorkshire Dales National Park Authority (YDNPA) to undertake a detailed topographic survey of the Bolton Gill lead mines in the Wharfedale area of the Yorkshire Dales (SE 026 653 approximate centre). A project design was issued by OA North (*Appendix 2*) in response to a written brief from YDNPA (*Appendix 1*). Following discussions with YDNPA, OA North was asked to expand the survey area to the south to include the Hebden Gill Dressing Floor and the area of Duke's Level which are both adjacent to Hebden Beck (Fig 1). The Hebden Gill Dressing Floor had previously been surveyed by the Meerstone Archaeological Consultancy (Roe and Davies 2007), and the present survey was intended to provide new information to enable the monitoring of the condition of the dressing floor. Because it had previously been surveyed there was no requirement to revise the archaeological description and interpretation of the earlier report. Duke's Level to the south of the Hebden Gill Dressing Floor has not previously been surveyed and there was, consequently, a need to provide descriptive and interpretative text.
- 1.1.2 The survey was undertaken between the October 2014 and January 2015 to take account of the vegetation cover. In October part of the site was heavily obscured by bracken, but by January the bracken had died back enabling a clear view of the archaeological remains.

1.2 AIMS AND OBJECTIVES

- 1.2.1 **Management Aims:** the primary purpose of the survey was to inform future conservation management of the industrial landscape on the landholding. An accurate archaeological survey of Bolton Gill and Hebden Gill mining remains was needed to set the complexes within their broader landscape context. The aims of the project as defined in the project design in (*Appendix 2*) are as follows:
- To identify and gather sufficient information to establish the extent, nature, character, condition, quality, date, significance and functional relationships of the surviving archaeological and historical features within the survey area;
 - To provide a basic structural assessment of the standing remains of the Bolton Gill and Duke's Level complexes. The assessment should establish the consolidation needs of features;
 - To provide a detailed, pre-intervention record of the complex;
 - To examine and document any evidence for damage to the complex that relates to either natural erosion, or current land management. Provide consolidation recommendations for the remains, including any ropeway pillars, while considering the needs of any protected species that may be present upon the complex;

- Provide an accessible version of the report, suitable for publication, in an appropriate academic publication.

1.3 LOCATION, TOPOGRAPHY AND GEOLOGY

- 1.3.1 The study area (Fig 1) is centred on the intersection of Bolton Gill and Hebden Beck, and is in Wharfedale, two kilometres to the east of Grassington. Hebden Beck is a tributary of the River Wharfe and is a steep-sided river valley. Hebden Beck valley has steep rises on the east side, but on the west has a less steep slope up to the plateau at Yarnbury; Bolton Gill is on a beck entering into Hebden Beck from the east side. The land is semi-moorland with enclosed lands to the west and the soils are fine loams, and at times are waterlogged, with a peaty surface horizon (NAA 2003, 2). Less than a kilometre to the north are the extensive remains of the Grassington lead mining landscape, and less than a kilometre to the south-west is the Yarnbury mining landscape.
- 1.3.2 In the Grassington area of Wharfedale, are outcrops of the Great Scar Limestone forming the lower valleys. East of the River Wharfe the fells are capped by Yoredale rocks and are overlain by Millstone grit (including mudstone, siltstone and sandstone). Bolton Gill and Hebden Beck are to the north and east of Grassington, where there are extensive lead ore veins. The Grassington lead ore veins can be seen as three groups; one at Grassington Moor, a second at Yarnbury with the third at Hebden Beck (English Heritage 2014, list.english-heritage.org.uk). The veins at Yarnbury extend below Bolton Gill; the Hebden Beck vein extends along the line of Hebden Beck north from Hebden village and cuts into Middle Moor and Mossy Moor to the east and the Mere to the west.
- 1.3.3 The site forms part of scheduled monument SM 1018333, which includes multi-period lead mines, processing works and a twentieth century barytes mill in an extensive area that extends between Hebden Beck, Yarnbury and Grassington Moor.
- 1.3.4 ***Hebden Gill and Hebden Beck:*** there is an apparent conflict between the historical and current names for the mining landscapes adjacent to the present day Hebden Beck. Both the dressing floor and the mine have historically been called the Hebden Gill Dressing floor and the Hebden Gill Mine; however, the stream on the current OS mapping, as well as the first edition OS 6" to 1 mile and 25" to 1 mile mapping, is called Hebden Beck. For the purposes of the present report it is intended to remain consistent with earlier documentation, therefore the historic mining landscapes will still be called Hebden Gill, but where the topographic feature is being referred to it will be called Hebden Beck. It is hoped that this will not cause undue confusion.

2. METHODOLOGY

2.1 INTRODUCTION AND PROJECT DESIGN

- 2.1.1 **Project Design:** a project design was submitted by OA North (*Appendix 2*), in response to a project brief by Yorkshire Dales National Park Authority (*Appendix 1*), and was used as the basis for this investigation. Subsequent to being commissioned to undertake the survey, the study area was expanded so as to encompass the areas of the Hebden Gill Dressing Floor and the Duke's Level. The Hebden Gill Dressing Floor survey had previously been surveyed by Meerstone Archaeological Consultancy (Roe and Davies 2007), and the present survey was intended to provide more detailed mapping to record the condition of the site. The textual description and interpretation of the earlier report did not require any revision and, consequently, there was no requirement to undertake further reporting of this site as part of the present study. The Duke's Level had not previously been surveyed and there was a requirement for gazetteer information and reporting for this site. In all other respects, the project design was adhered to in full, and the work was consistent with the relevant standards and procedures of the Institute of Field Archaeologists, and generally accepted best practice.
- 2.1.2 The work programme was divided into three elements: desk-based research; detailed field survey; and reporting. The survey area was defined as extending between the north-eastern tip of Bolton Gill and the southernmost tip of Duke's Level adjacent to Hebden Beck (Fig 1; *Appendix 2*).

2.2 DOCUMENTARY STUDY METHODOLOGY

- 2.2.1 The aim of the documentary study is to collate new information from various sources, to develop a documentary archive for Bolton Gill lead mines which will inform the Historic Landscape Survey. The desk-based assessment was carried out in accordance with the relevant Institute for Archaeologists and English Heritage guidelines (IfA 2011, *Standard and Guidance for Archaeological Desk-based Assessments*; IfA 2010 *Code of Conduct*; English Heritage 2006, *Management of Research Projects in the Historic Environment* (MoRPHE)) and generally-accepted best practice.
- 2.2.2 **Documentary and Cartographic Material:** the data generated during the desk-based study served as a guide to the archaeological potential of the property, and provided a basis from which historical narratives for the study area could be constructed. An archive search of the full range of potential sources of information was undertaken for cartographic and documentary records relating to Bolton Gill lead mines. A description of all the sources that were consulted as part of this study is presented in *Section 3.2*.
- 2.2.3 The work involved visiting the North Yorkshire Records Office in Northallerton to search for primary records and mapping relating to the property, together with relevant secondary published sources. Relevant documents included plans, maps, copies of articles, photographs, and unpublished manuscripts. In addition, published secondary sources were consulted that assisted in the understanding of past land-use, and industrial activity on the estate. Mike Gill provided

considerable, and much valued, advice as to pertinent information and sources available for the site. OA North has an extensive archive of secondary sources, as well as numerous unpublished client reports on work carried out both as OA North and under its former guise of Lancaster University Archaeological Unit (LUAU); these were consulted where relevant.

- 2.2.4 A search was made of all pertinent records from the Yorkshire Dales National Park Historic Environment Record (HER) databases to establish the sites of archaeological interest already known within the study area. This included a number of client reports on surveys undertaken within the environs of the study area (*Section 3.2*), and also Scheduled Monument records for sites within the study area and environs. A gazetteer of sites was compiled based upon cartographic and the HER data base (Figs 7-20; *Appendix 3*).
- 2.2.5 **Aerial Photography:** aerial photography of the sites was undertaken using an Unmanned Aerial Vehicle (UAV). Additional vertical aerial photography was provided by the YDNP HER.

2.3 TOPOGRAPHIC SURVEY

- 2.3.1 The topographic survey was undertaken principally by a process of photogrammetry and augmented by GPS survey for those areas where the archaeological features were obscured by vegetation.
- 2.3.2 **Survey Control:** a local survey grid was established as control for the photogrammetry using a survey grade Leica 1200 differential Satellite Global Positioning System (GPS). The 1200 series GPS was able to provide real time accuracies of $\pm 0.02\text{m}$. Visible survey control markers were placed on the ground for the aerial photogrammetry.
- 2.3.3 **Aerial Photographic Modelling:** the ground plan of all three areas was modelled by photogrammetry using aerial photographs and corrected photographic texture photographic images for the complexes (Figs 21-4). New aerial photographs were taken using an Unmanned Aerial Vehicle (UAV), a small remote-controlled NAZA F550 UAV with a 16mega pixel Sony NEX5 camera.
- 2.3.4 Photogrammetric processing was undertaken using Agisoft software which provided detailed modelling using an overlap of up to 200 photographs, leading to the creation of a very detailed DTM (Digital Terrain Model) across the site. The photographs were then digitally draped over the model to create an accurate three-dimensional representation of the ground surface. The primary output, however, was an accurate two-dimensional image that was used to provide plan information. In addition, precise 100mm contour information was generated from the primary DTM using ArcGIS, and served to inform the establishment of hachure information for the topographic survey (Figs 4 and 5). Orthophotos were created for the extent of the study area and a selection of these are presented as figures (Figs 25-28).
- 2.3.5 The drawings were created within an industry-standard CAD package (Autocad 2004) and were then enhanced and annotated to show the form and location of all structural features of historic significance.
- 2.3.6 **GPS Survey Mapping:** where topographic features were obscured by bracken a survey grade GPS was utilised to satisfy the Level 3 survey requirements.

Archaeological earthworks were recorded using a Leica 1200 differential GPS. The raw data from the differential GPS was imported into a CAD system and combined with the drawing detail obtained by the photogrammetry; plots were generated to enable the drawing up on site. The archaeological detail was drawn up in the field as a dimensioned drawing on the plots with respect to survey markers. On completion of the field survey, the drawings were enhanced within a CAD environment to produce the final drawings.

- 2.3.7 The survey recorded all pertinent archaeological detail, the internal detail of any structures, the changes between different grades of spoil, and any detail pertinent to the operation of the mines.
- 2.3.8 **Photographic Record:** a digital photographic archive was generated in the course of the field project using a digital SLR camera with 12 megapixel resolution. The photographic record comprises landscape and detailed photography. All photography was recorded on *pro-forma* sheets showing the subject, orientation and date.
- 2.3.9 **Site Description:** a descriptive record of each of the individual built elements and monuments that make up each of the wider mining complexes was created. The data was directly input on site into a palm computer and was incorporated into a Microsoft Access compatible database. The input into the system was guided by a *pro-forma* to ensure uniformity and consistency of input. The archaeological descriptions are for the Bolton Gill Mines and the Duke's Level sites only.

2.4 STRUCTURAL ASSESSMENT

- 2.4.1 A condition survey was undertaken by Charles Blacket Ord of Blackett-Ord Conservation Engineering (*Section 6*). This entailed an examination and compilation of a photographic record of the Hebden Gill site office, the Engine Shaft portal, and the Bolton Gill Dressing Floor structures. The structures were assessed and recommendations were made for their stabilisation, and provide for long term best-practice solutions, and, in a selective instance (dressing floor steps), it has been proposed that the structure be reconstructed.

2.5 REPORT AND GAZETTEER OF SITES

- 2.5.1 **Reporting:** the present report identifies areas of defined archaeology and an assessment and statement of the actual and potential archaeological significance of the material, within the broader context of regional and national archaeological priorities. Information concerning the sites of archaeological interest within the study area has been collated into a gazetteer (*Appendix 3*) and the position of each site is indicated on Figures 7-20.

2.6 ARCHIVE

- 2.6.1 A full archive has been produced to a professional standard in accordance with English Heritage guidelines (1991) and the *Guidelines for the Preparation of Excavation Archives for Long Term Storage* (UKIC 1990). The project archive represents the collation and indexing of all the data and material gathered during the

course of the project. The archive will be provided to the Northallerton Record Office and digital copies will be provided to the Yorkshire Dales National Park Authority.

3. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

3.1 INTRODUCTION

- 3.1.1 The following section presents a summary of the historical and archaeological background of the general area. This has been compiled in order to provide a general context within which to understand the results of the landscape survey.

Period	Date Range
Mesolithic	10,000 – 3,800 BC
Neolithic	4000 – 2,500 BC
Bronze Age	2,500 – 700 BC
Iron Age	700 BC – AD 43
Romano-British	AD 43 – AD 410
Early Medieval	AD 410 – AD 1066
Late Medieval	AD 1066 – AD 1540
Post-medieval	AD 1540 – c1750
Industrial Period	cAD1750 – 1901
Modern	Post-1901

Table 1: Summary of British archaeological periods and date ranges

- 3.1.2 **Summary of Archaeological Remains:** within the study area are the remains of numerous archaeological features associated with lead mining and are part of Scheduled Monument 31331. Towards the southern end of the study area, and on the western side of Hebden Beck, are the remains of the late eighteenth century entrance to the Duke's Level (Site 1; HER MYD 42707), this was an ambitious tunnel built for the drainage of the deeper mines to the north (list.english-heritage.org.uk). Opposite Duke's Level and to the east of Hebden Beck are traces of earlier shallow shaft mounds and adits for coal (HER MYD 42521). Further north and immediately to the east of Hebden Beck are the remains of mines, adit entrances and a dressing floor: Hebden Gill Dressing Floor (HER MYD 36605), and Bottle Level (HER MYD 42397). Just above and to the east of Bottle Level were the Bolton Haw Side coal mines (HER MYD 42969; list.english-heritage.org.uk). West of Hebden Beck and opposite Bottle Level was a stone-built limekiln used to burn limestone into lime either for soil-improvement or for the building trades (HER MYD 15037). From the mid-nineteenth century are the extant ruins of the Bolton Gill Engine Shaft (Site 7; HER MYD 42377; list.english-heritage.org.uk; Gill 1994, 104) at Bolton Gill. This was supplied by power using push rods driven by a water wheel on Bolton Haw Side, and has left the remains of stone footings extending in a line between the two sites (Site 7; list.english-heritage.org.uk; NAA 2003).
- 3.1.3 To the south-east of the study area is Mossy Moor Reservoir (HER MYD 37078) created shortly after 1852, and first documented in 1853 (R White pers comm) but which was not marked on the OS 1:2,500 map until 1891. To the north was New Dam, also post-dating the OS 1852 6" map, but was marked on the OS 1891 25" map.

3.2 DOCUMENTARY SOURCES AND PREVIOUS WORK

- 3.2.1 ***Eighteenth and Nineteenth Century Cartographic Sources:*** the available cartographic sources for the general area include an early plan of 1781 drawn up by S Brailsford to show land holdings on Grassington Moor (Gill 1993b; Sheffield Archives); it is not known, however, if this mapping coincides with the study area. There was an Ordnance Survey 1st edition 1852 map of the study area at a scale of 1:10,560 (Fig 2), and an early detailed plan of the Hebden Moor Mine dated to 1866, which was drawn up by J Varley (Plate 3). There are differences between this drawing and the present day remains (Roe and Davies 2007, 7-8; Figs 10-12) and it may have been that the site was modified subsequent to the preparation of the original drawing. By the time of the OS 1:2,500 map of 1891, the depiction of the site is more in keeping with the present day remains (Figs 10-12; Roe and Davies 2007, 9). A map regression was undertaken of three OS maps: the OS 1st edition map of 1852, and the OS 25 inch maps of 1891 and of 1909, which were examined in detail (Section 3.4).
- 3.2.2 ***Previous Archaeological Work:*** a comprehensive investigation and plan of the lead mines and their workings at Hebden Gill and Bolton Gill has been published by MC Gill in 1994 (Gill 1994) and included listings and a map of the veins worked at Hebden Beck, and where they can be traced (Plates 1 and 2). The account also detailed the history and the operations of the Hebden Moor Mining Company, founded in 1854 but which was closed by 1888. The Northern Mines Research Society also published a paper on the aerial ropeway by Peter Hodge in 1997 (Hodge 1997). The Yorkshire Dales Lime Kiln Survey noted the small limestone kiln on the west of Hebden Beck (HER MYD 15037) (Johnson 2001; 2006).
- 3.2.3 Watching briefs and topographic surveys (NAA 2003) were undertaken during repairs in two areas; the first area was to the south of Bolton Gill and east of Hebden Beck where an uncontrolled flow of water from a drainage level / tail race had eroded a track used as a public footpath, necessitating engineering works to enable the track to be used during work to the Charger level air shaft and to construct a channel to divert the water. The archaeological investigation found the leat and a sett apron, and the remains of seven infilled shafts, the bases for an aerial ropeway, and a wheel pit. The second area of investigation was to oversee works on an exposed drainage or supply pipe and the re-routing of this pipe. In the course of this work, the topographic survey found the remains of four infilled shafts, mining waste and erosion gullies.
- 3.2.4 A survey was undertaken on the dressing floor on Hebden Gill in 2007 in order to define the archaeological remains and their significance (Roe and Davies 2007). The study area for this survey encompassed the nineteenth century dressing floor, and included the entrance to Charger Level; the northern part of the area contained the portal for Bottle Level.
- 3.2.5 In 2009 a watching brief was held by YDNPA during the construction of drainage works at Hebden Beck (HER EYD 7532), where the route of the bridleway above the dressing floors was being eroded by flood water. A trench was excavated through the upper part of the embanked track revealing a layer which comprised waste material from the processing of the lead ore, and included an occasional small fragment of galena (YDNPA pers comm, October 2014).

- 3.2.6 More recent work has been undertaken to the north and west of the study area by Ed Dennison Archaeological Services Ltd on the Beever and Cockbur Lead Mines at Yarnbury, near Grassington (EDAS 2014). This found a complex development of mining activity dating from the workings of hushes and opencuts of the late seventeenth century, the mining of meers and shaft mounds in the eighteenth century to the larger scale mining and dressing operations of the nineteenth century. During the twentieth century the earlier spoil heaps were comprehensively re-worked to glean fluorspar and barytes.

3.3 HISTORICAL BACKGROUND

- 3.3.1 The historical background report below has been largely derived from three main secondary sources, those of Mike Gill published in 1994 and its reply by Peter Hodge in 1997, the work of Roe and Davies in 2007 and the 2014 draft report of EDAS. Data from English Heritage and the Yorkshire Dales National Park Historic Environment Record relating to the study area and its wider environs are also incorporated.
- 3.3.2 ***Prehistoric and Roman Period on Grassington Moor:*** there are the remains of co-axial field systems at the north of Grassington; these included cairns with inhumations which are thought to date to as early as the Bronze Age period (EDAS 2014, 19). South of Mossy Moor reservoir are the remains of two Bronze Age stone circles (HER MYD 4403 and 36949). To the north of the study area the HER cites a complex of up to five sub-circular enclosures from 6m to 10m in diameter, which were perhaps round houses of unknown prehistoric date that were associated with a boundary bank (HER MYD 41767).
- 3.3.3 Roman lead mining has been observed in the Grassington area suggesting that the Roman Road, traced from Bainbridge to Cray or Buckden, may have continued further south as far as Hebden and Grassington (EDAS 2014, 19).
- 3.3.4 ***Hebden Manor:*** Hebden was a planned manorial estate, with eight manorial tofts and crofts established in the years after the Norman Conquest. The northern part of the village may have been a separate, and earlier, hamlet (YDNPA 2006). It was held by the de Hebden family, but in the sixteenth century was inherited by the Tempest family. In 1589 they sold the manor to three freeholders. The lands were held in Trust, by these three freeholders, until their eventual resale to the tenants of the Hebden manor; however the manorial rights, including the rights to the minerals and commons, continued to be held by the three Trustees (Gill 1994, 97). These mineral rights related to the Hebden Royalty or Liberty; at Grassington a barmoot or mining court held jurisdiction over the liberty and this may have been the case in Hebden (EDAS 2014, 13-5). Such an arrangement may have had a bearing on the comprehensive exploitation of the mining seams in the Hebden manor in the later periods.
- 3.3.5 Lead was intensively mined on Grassington Moor from the seventeenth century by the Earl of Cumberland and the Duke of Bolton with the exploitation of the veins increasing during the eighteenth century (EDAS 2014, 20). The south-eastern part of the Cockbur, west of Langan Gill (north of the study area), have 'extensive remains quite unlike those recorded elsewhere' which may have formed part of any early mining works (EDAS 2014, 20-5 - Sites 64, 67, 68 and 69). These comprised spoil heaps, structures and earthworks bounded by an

intermittent and irregular boundary bank. Mining here may have been either by opencast works or hushing operations; on the basis of the documentary evidence, Gill suggests that this area was worked during the early periods. Thus perhaps some of these remains relate to early seventeenth century workings (EDAS 2014, 20 (also citing Roe 2007, 21 and Gill 1993b, 55)).

- 3.3.6 The HER data includes two sites possibly relating to the remains of an early phase of mine working to the north of the study area. To the east of the southern part of the Cockbur mining area, to the east of Hebden Beck, and to the north of the study area (SE 02710 65553), was an area of small and irregularly formed shafts and mounds (HER MYD 52873); these were of a basic, non-intensive character and possibly reflect early workings. Close to the earlier phase of shafts and mounds (HER MYD 52873) was a circular earth and stone bank with abutting enclosure or building on its east side which may have provided accommodation either for miners or for their horses, although it also has been suggested that this was perhaps an Iron Age settlement. The Blue Level Mine, first driven prior to 1735, was also sited west of Hebden Beck (HER MYD 42368/42353 (SE 0264 6537)).
- 3.3.7 To the south of the study area is a site known as ‘the Hush’ marked on the OS 1st edition 1852 1:10,560 map (HER MYD 44324/15193) and which was probably a reference to early lead mining activities.
- 3.3.8 ***Eighteenth and Early Nineteenth Century Lead Mining:*** it is possible that there are the remains of one small area of working on the north side of Bolton Gill, opposite Bolton Gill Engine Shaft (Gill 1994, 99-100). In addition records from the mid-eighteenth century suggest that there was an early mine on Bolton Gill, where, in 1759, a small partnership of seven investors employed three miners. A court case concerning their pay delineates the works that the miners had undertaken including the cutting of sump heads, the sinking of shafts and the driving of horizontal access shafts (measured by the fathom). Unfortunately, the location of these works was not defined but is believed to be on the northern side of Bolton Gill (Gill 1994, 101-2).
- 3.3.9 Also at Bolton Gill in 1802 a Sylvester Petyt was working and in 1838, at the east (higher) end of Bolton Gill, veins were let to a Joseph Hogden (Gill 1994, 103). Mining in the general area of Hebden Beck may have begun as early as the 1840s (information from HER 42969).
- 3.3.10 There was a leat flowing from Bolton Gill (HER MYD 59529; Site 4.2) (perhaps from the same location as the later Bolton Gill Engine Shaft) to the west and then southwards parallel to Hebden Beck. This may have been made in this earlier period of mining and then continued in use through the nineteenth century.
- 3.3.11 As the shafts and levels of the mines on Grassington Moor got deeper and reached the water table, it became necessary to pump out the water or to drain the mines (www.list.english-heritage.org.uk). In 1796 an ambitious project to drain the mines was undertaken by the digging of the Duke’s Level. This formed a tunnel driven from the south-east of Hebden Beck (Site 1), underground, for almost 2.5km below the shafts at Yarnbury and Grassington Moor. The tunnel was originally intended as a canal, for use by narrow boats which could remove ore and waste from the mines (Gill 1983; www.list.english-heritage.org.uk); however, there is no evidence that it was ever used as a boat level (R White pers comm). Duke’s Level was initially dug to a width of five feet x nine feet high (2.8m x

1.6m) (Gill 2004). Because of the substantial size, the progress of excavation was slow and costs were high, so after excavating a length of 1520m, excavation was thereafter continued as a six foot by four foot adit (1.8m x 1.2m). Despite this reduction, it was not until 1830 that it was finished because of the need to work through hard rock, and by that date it was simply functioning as a drainage adit (www.list.english-heritage.org.uk).

- 3.3.12 **Smelting the Lead Ore in the Eighteenth Century:** a smelt mill was recorded as being at Hebden between 1722 and 1732. Two suggested sites were either at the junction of Bolton Gill and Hebden Beck or on the west bank of Gate Up Gill, near the Old Prosperous Mine. From 1737 the lead ore from mines in the Hebden liberty were smelted at Grassington (Gill 1994, 114).
- 3.3.13 **Coal Mining:** during the eighteenth and early nineteenth centuries a seam of coal at Bolton Haw Side was being worked; the coal was used at the smelt mill in Hebden (Gill 1994, 103, 108). Substantial loads were retrieved, and the most that was recorded was some 1346 loads in 1811 (Gill 1994, 108). There was also coal mining at Game Ing Flat, which produced 780 loads of coal in 1812. It should be noted that the loads retrieved were likely to have reflected the man-power available. These coal seams continued to be worked until the 1860s (Gill 1994, 109). The HER includes a site thought to be the earthwork remains of probable coal levels, as well as a small-scale lead mine shaft (HER MYD 42521), to the south-east of the study area.
- 3.3.14 **The Hebden Moor Mining Company:** in 1853 two partners Sigston Winn and Joseph Osborne from Leeds began operations on the mining of Cockbur Vein from the Top Level at Bolton Gill (HER MYD 42383). In 1854 the Hebden Moor Mining Company was founded. The entrance to the Top Level, sited at SE 0296 6543, was just to the north-west of the later installation of the Bolton Gill Engine Shaft, and now the portal for the adit is under the spoil heap of the Engine Shaft. At the portal to this Top Level was a small dressing floor at SE 0289 6537 (Site 9; Gill 1994, 103). To the east was Cook's Shaft which was abandoned before completion (HER MYD 42575 (outside the study area).

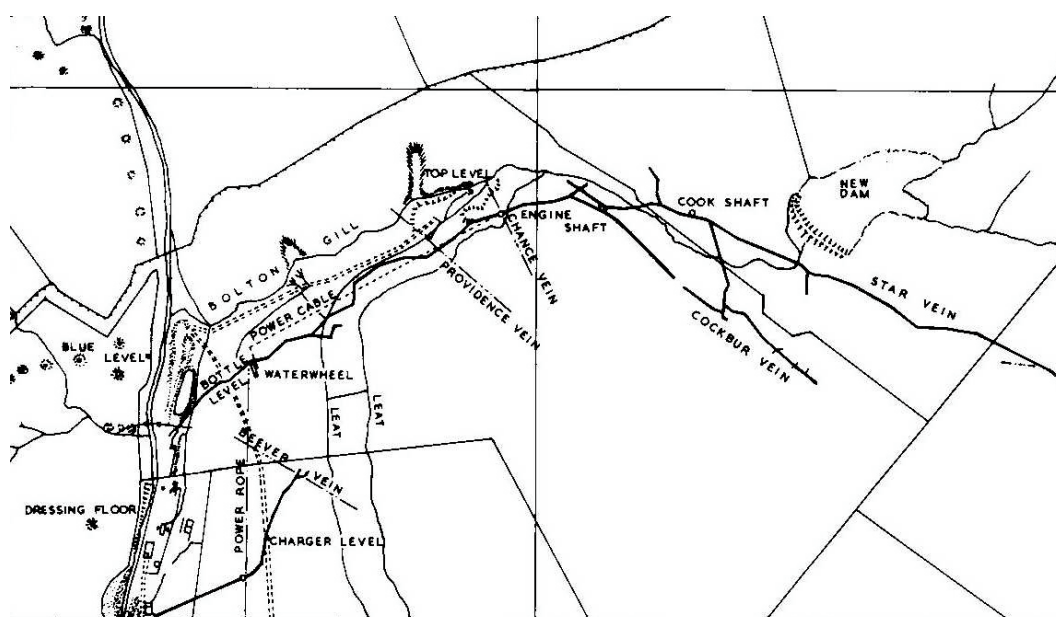


Plate 1: Bolton Gill mines and veins - North (after Gill 1994)

- 3.3.15 During the 1850s the veins most worked were perhaps the Cockbur Vein and Thomas's Vein from the Bottle Level (Site **23**; HER MYD 42397) and, later, the Middle level (Gill 1994, 103-4). It seems that Bottle Level had enough quantities of ore to justify its own dressing floor (Site **24**) close to the portal of Bottle level at Hebden Beck (Gill 1994, 103-4; NAA 2003, 3).
- 3.3.16 The Bolton Gill Engine Shaft (Sites **7** and **8**; HER MYD 42377) was sunk at the junctions of the Cockbur Vein with other veins (Star, Providence and Chance) (Gill 1994, 104), possibly in 1855 (information from HER). This was fitted with pumps and was driven by a water wheel that was 40 feet in diameter, on Bolton Haw Side, where the land was less steep (Gill 1994, 104; Hodge 1997, 150). The stone plinths to the west of Bolton Gill Engine Shaft assisted with the transfer of power from a Power Transfer House on Bolton Haw Side (*Section 4.5*), which was adjacent to the large 40 foot wheel.

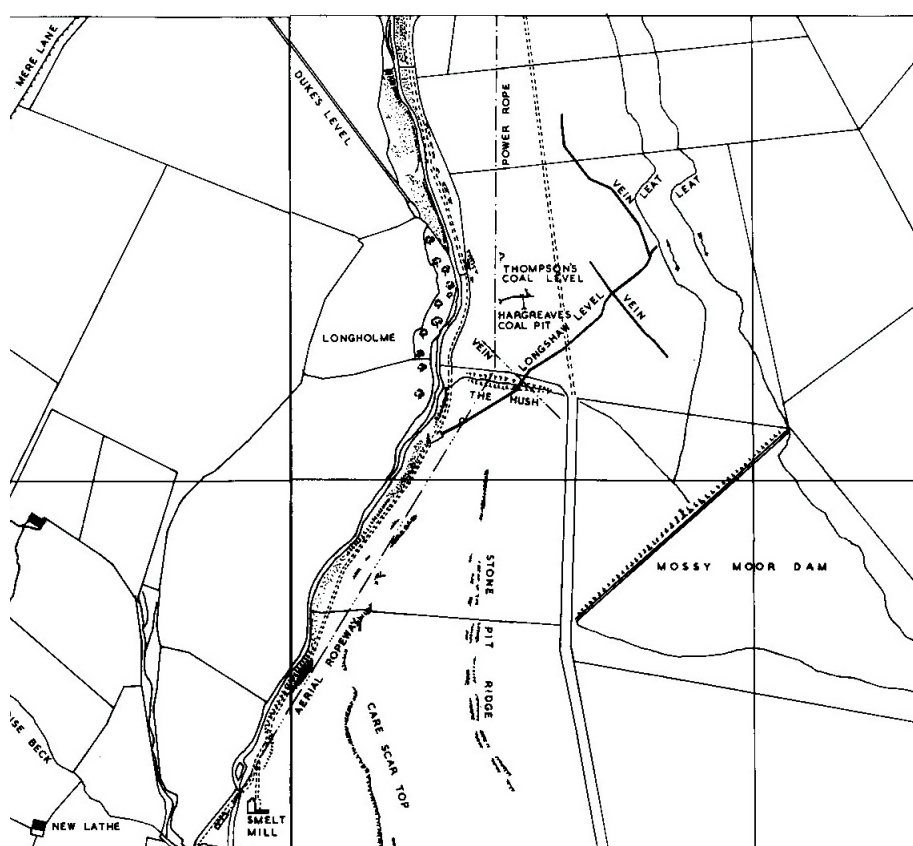


Plate 2: Hebden Beck mines and veins (after Gill 1994)

- 3.3.17 In the 1860s a new level, Charger Level (Site **25**), was being driven from the Hebden Gill Dressing Floor, into Beaver Vein and Longshaw Level was driven into Simpson's Vein but there was little ore to be found (Gill 1994, 106).
- 3.3.18 In the 1870s a further investigation by the Company was to drive a deep level, (referred to as Hebden Horse Level by www.braemoor.co.uk) from the village of Hebden at c 600 feet above sea level to the Star and Cockbur veins, using a new innovation - compressed air drills which were driven by a new wheel. This was partly to assist with drainage (*Section 4.5.11*); however, again there was no ore identified in the veins (Gill 1994, 107; www.braemoor.co.uk).

- 3.3.19 It is evident that substantial efforts were being made to find large deposits of lead ores, and, although ore extraction peaked in 1862 at 410 tons, by 1888 the company had folded (NAA 2003).
- 3.3.20 **Dressing Floors:** on-site processing of the lead ore was at sites known as dressing floors, which may have functioned as both the ore processing plant, where the ore was stored in bouse teams, crushed and then washed, as well as being an administrative centre (www.list.english-heritage.org.uk). Two dressing floors are associated with the mines at Bolton Gill and Hebden Gill; the earlier of these was probably at Bolton Gill (Gill 1994, 103).
- 3.3.21 The greater productivity of the Bottle Level, seems to have led, perhaps in 1854, to the establishment of a larger dressing floor at Bottle Level on the east side of Hebden Beck (Site **24**; HER MYD 36605; HER MYD 42397 and 42969) (Gill 1994, 105; Roe and Davies 2007, 2). Bottle Level could access the Star Vein, Cockbur Vein, and Providence Vein (HER information), and the ore from the level came out from an adit near to the dressing floor. By the 1860s another entrance to the south was created to access Charger Level, which was driven to reach Beever Vein c 1863-1866 (HER MYD 42499).
- 3.3.22 At the dressing floor (Site **24**) there are the remains of leats (Site **26**), and associated buildings such as the site office building, the bouse teams, the tool shop, a circular buddle, a settling pit, hotching tubs, and a possible waterwheel pit alongside a number of other single-celled or two-celled buildings (English Heritage 2014; Roe and Davies 2007, 3, 5; Plate 3). Here there was also a waterwheel (25 feet in diameter), with its small reservoir to the north (English Heritage 2014; Roe and Davies 2007, 4).

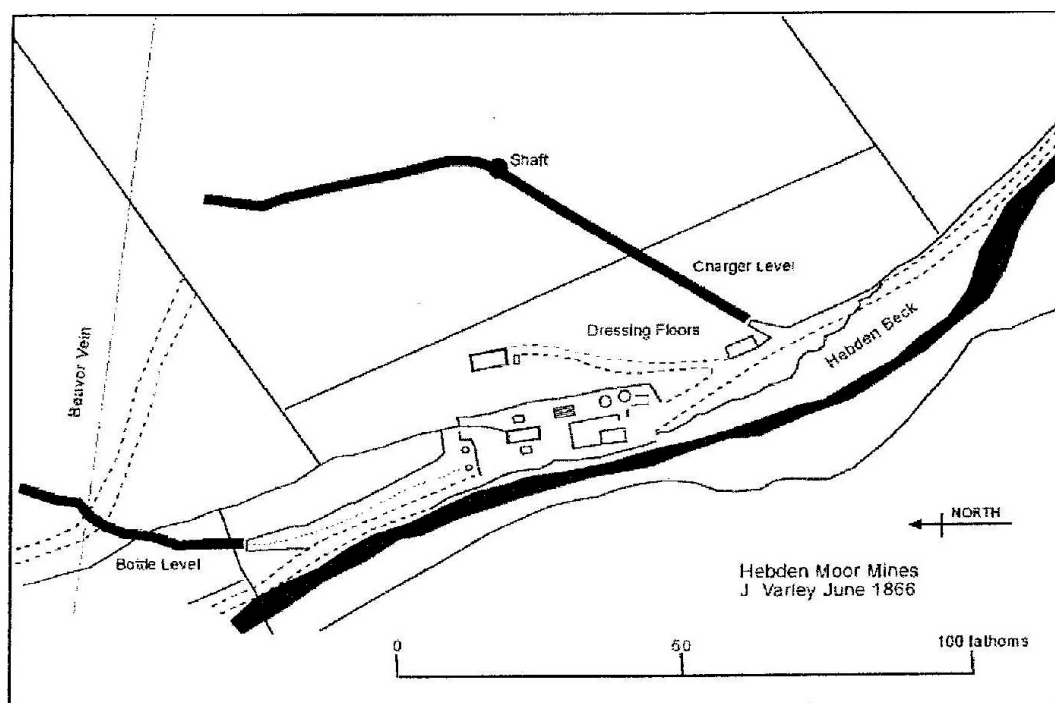


Plate 3: Hebden Gill Dressing Floor from plan redrawn by J Varley 1866

- 3.3.23 Adjacent to the entrance to Duke's level, on the west side of Hebden Beck, was a third small dressing floor (www.list.english-heritage.org.uk; Sites **1.4** and **1.7**), which was intended to service the ores coming from Duke's Level.

- 3.3.24 **Waterwheels and Water Power:** there was a large waterwheel on Bolton Haw Side (Site **18.2**) that was linked to the extant Bolton Gill Engine Shaft to pump water from the levels (Gill 1994, 104) and which was 40 feet in diameter. There seems to have been a second major waterwheel (Gill 1994, 105), 25 feet in diameter, on the dressing floor at Bottle Level on the east side of Hebden Beck and this was intended to drive the crushing rollers. By the time that the mine was abandoned this had been upgraded to a horizontal steam engine with the steam provided by a boiler (Gill 1994, 105). There was possibly a third smaller waterwheel on the Bottle Level Dressing Floor (Roe and Davies 2007, 5).
- 3.3.25 Pumping out the water was clearly a vital part of the operations: an account of 1879 describes the new Hebden Horse Level: *‘.....the Company working the mines on the hills above Hebden [Bolton Gill] had met with a dreadful influx of water. The ordinary methods of pumping had been resorted to without success, although a tremendous amount of steam power had been used in working the pumps; an idea may be formed of the amount of water turned out when it is said that they had six pumps at work - two with pipes of 12 inches in diameter, 1 of ten inches, 1 of eight inches, and two of seven throwing out a ceaseless stream of water. A level shaft was commenced which although entailing an enormous amount of time and expense would soon drain the mine, as the mouth of the shaft although above the bed of the river, was below the lowest level of the mine.*
- 3.3.26 *Two great motive powers are used in working this shaft - air and water. A water wheel 36 feet in diameter works an air compressor, and the compressed air is carried by tubes to the top of the shaft where it operates like steam in working a drill to bore the rock. Dynamite is used to split the rock and the debris is sent to the mouth of the shaft in small wagons.*’ (from an account by John Henry Wilkinson and placed on record by David Joy (www.braemoor.co.uk)).
- 3.3.27 This adit was, reportedly, similar to that at Duke’s Level (*ibid*), and the compressed air drills were installed in order to increase the speed of excavation of the tunnels (Gill 1994, 107). Water was drawn from two dams, the Mossy Moor Dam and the New Dam at the head of Bolton Gill. Mossy Moor Dam post-dated the making of the OS 1852 1st edition map (it is marked on the 1891 OS map), and was first recorded from 1853 when a Mr Mason paid rent on it. Mr Mason had previously bought Hebden textile mill in 1830 and it is probable that the dam was intended to provide a water supply for the mill; however, ultimately it was used by the Hebden Moor Mining Company and provided water for both the Hebden Smelt Mill and Bolton Gill Mines (R White pers comm). The dam was reported to have burst in 1855 (Hodge 1997, 148).
- 3.3.28 Mossy Moor Reservoir had a limited catchment and was in part supplied by a leat (Site **4.2**; 59529) that extended immediately above the Engine Shaft from New Dam. A second leat (Site **4.1**) running parallel to the upper leat fed the water wheel which was beside the dressing floor below the Engine Shaft (Gill 1994, 118).
- 3.3.29 A small reservoir north-west of the portal of Bottle Level, at the west end of Bolton Gill, drew water from at least two sources; the first being from the waste waters of Yarnbury mines with a second leat from the northern part of Hebden Beck. This second leat also fed the main waterwheel on the dressing floor at Bottle Level (Gill 1994, 118) suggesting perhaps a chronological development of

the water supply for the mine. There is possibly a third source of water for the reservoir, from Eller Beck on a (possibly wooden) launder supported by stone pillars (Gill 1994, 118), although it has been suggested that the Eller Beck water supplemented the water from Hebden Beck and did not feed the reservoir (Roe and Davies 2007, 7). The reservoir is *c* 2.7m deep with earth walls and was partially revetted with stone.

- 3.3.30 It seems that there was still insufficient water for powering the mine operations and by 1869 (at the latest) an aerial ropeway from a large water-wheel (45 feet in diameter) on Hebden Beck at Hole Bottom was installed to transfer water power north and upstream along Hebden Beck to a Power Transfer House and then ultimately to the Engine Shaft in Bolton Gill (Hodge 1997, 153) (Plate 4). This was supported by stone-built footings, which are still extant (Site **17**) (Gill 1994, 109-12 and Hodge 1997). Previous discussions (*ibid*) have suggested that the plinths supported an aerial ropeway for transporting buckets of ore, but it is apparent that the construction of the footings would not have been strong enough for such weights and movement imposed (Hodge 1997, 148). Similarly, the 'conduit' at the wall by the Hush would not have allowed the passage of buckets of ore (Hodge 1997, 150). Nor was the 'headworks', at the Hush, a logical place to upload or offload buckets of ore or of coal (Hodge 1997, 151). At the Hush, what was thought to have been the 'headworks' (Gill 1994, 109-112) has also been considered as a turn-wheel consisting of two wheels to change the plane of the pulleys from the vertical plane (to the south) to the horizontal plane (to the north) (Hodge 1997, 151).

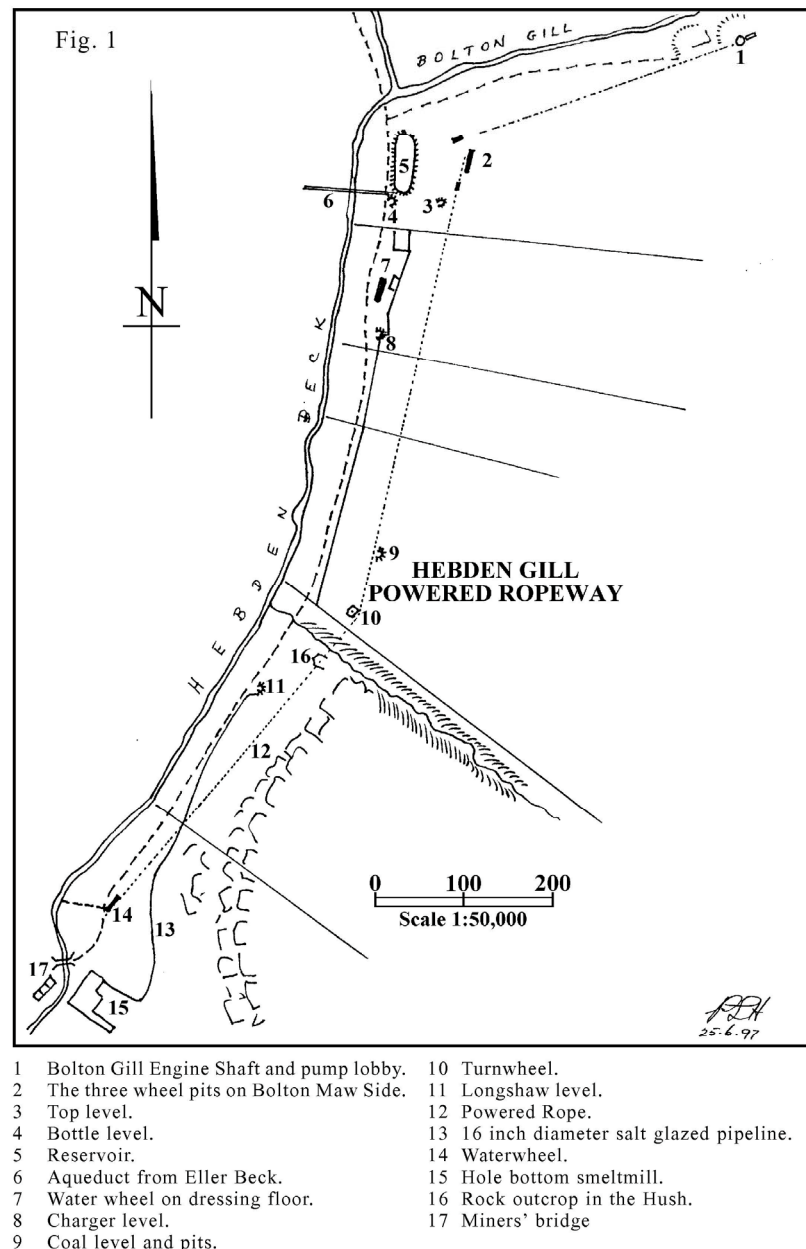


Plate 4: Outline plan of Hebden Gill Powered Ropeway (after Hodge 1997)

- 3.3.31 It has been suggested that when the aerial ropeway was dismantled the scrap metal was used to build a swing bridge at Hebden village, which was later rebuilt in the 1930s to form the present day foot bridge (Gill 1994, 112); however, closer analysis has demonstrated that the bases of the bridge pillars and bolts do not correspond to those used for the aerial ropeway (Hodge 1997, 154).
- 3.3.32 **Infrastructure:** access tracks were built from Hebden village in 1857 (Roe and Davies 2007, 3) and the stone arched bridge over the beck at Hole Bottom was built in the later 1850s (Gill 1994, 106). This was known as the Miner's Bridge.
- 3.3.33 **Nineteenth Century Smelting Mill:** although much of the company's ore was smelted at the Grassington Cupola Smelt Mill (Gill 1993a) for a short period of time, from 1858, lead ore was smelted at Bolton Gill smelt mill which was sited on the east side of the Hebden Beck just north of Hole Bottom on a ledge cut into

the hillside (HER MYD 42381). The lead ores and fuel were perhaps stored on the level ground behind the mill; the mill had a single hearth with the flue leading up the steep slopes to a chimney. It is not known where the water came from prior to the building of the Longshaw Level; however, by 1863 water was drained from Longshaw Level along a series of salt glazed pipes (Gill 1994, 114; Hodge 1997, 151).

- 3.3.34 ***Twentieth Century Works:*** the Grassington Lead Mines Ltd set up an operation to extract barytes from the former mines and spoil heaps on Hebden Beck in 1916. The company was dissolved in 1927 (Gill 1994, 121). During the 1940s Grassington Moor was used as a military training area and firing range (www.list.english-heritage.org.uk).

3.4 MAP REGRESSION

- 3.4.1 ***1st edition 1:10,560 map of 1852:*** the study area was examined on the OS 1st edition map of 1852, which was surveyed prior to the formation of the Hebden Moor Mining Company. A significant feature was the clear marking of Mere Lane and the, then agreed, parish boundary between Grassington and Hebden (See Gill 1994, 115 for a full discussion of boundaries). Mere Lane is curtailed at a sharp corner just west of the crossing point of Hebden Beck but the parish boundary continues on the high ground on the north side of Bolton Gill Side, alongside a curved track. It is noticeable that, to the north of this boundary along Loss Gill Dike, Loss Gill Pasture and to the west by The Duke's New Road, are a number of place names and labels, such as Old Shaft, Crushing Machine, Union Shaft, and Limestone Quarry, indicating considerable mining activity, whereas to the south there are no indications of industrial activity except for one limekiln (at the west end of Bolton Gill) and there were only labels for natural features and the crossing places of Hebden Beck.
- 3.4.2 Further south, and at the south end of the study area, near to Duke's Level portal was Level Hole and Long Holme Lathe. Level Hole was in the vicinity of an east/west water channel running a short distance down the slope into Hebden Beck. It was parallel with The Hush c 200m to the south, and also an east/west water channel flowing into Hebden Beck. Long Holme Lathe is on the footpath to the west of Hebden Beck, on the south-western edge of the study area. To the east of Hebden Beck on the upper slopes was a footpath or track parallel to Hebden Beck with a second path at Level Hole leading north-west to the area of mining at Beever and Ellerbeck.
- 3.4.3 ***OS 1:2,500 map of 1891 (Fig 3):*** by 1891 the map was showing the 'Old Shaft' on the south side of Bolton Gill, and is a testimony to the short-lived nature of the lead mining industry at Hebden Beck. Just west of the 'Old Shaft' were five small square structures, perhaps the stone footings for the aerial ropeway, and further to the west were the remains of a structure with a path on its west side. Two areas of earthworks were apparent.
- 3.4.4 Hebden Moor Lead Mines (disused) was located on the east side of Hebden Beck in an enclosed north/south rectangular area within which were marked the features of the dressing floor, the small reservoir, the entrance to a level, square and rectangular structures and footpaths linking these. Further south was the entrance to another level. To the east of the enclosed dressing floor was another enclosed

field within which was marked an 'Old Shaft' with 'Spring'. South of the enclosure for the dressing floor was another enclosed field labelled Level Hole, perhaps referencing the Level Hole on the 1852 map. At the southern end of the study area was labelled Duke's Level. The track or footpath, from the south to the north, was on the east side of Hebden Beck. The west side of Hebden Beck was steep sided.

- 3.4.5 Also by 1891, Mossy Moor Reservoir was marked with the dam to the north-west and two sluices marked, one at the north-east end and a second one towards the central point of the dam.
- 3.4.6 **OS 1:2,500 map of 1909:** the features mapped in 1909 at Bolton Gill seem not to have changed since 1891. The remains of the mining structures on the dressing floor at Hebden Gill were largely unchanged. The largest north/south rectangular building, which had been roofed in 1891, was by 1909 unroofed. Two of the circular features, previously marked on the 1891 map, were now unmarked and the footpath linking the buildings was no longer apparent.

4. SURVEY RESULTS

4.1 INTRODUCTION

- 4.1.1 The present Level 3 Survey has identified and recorded a range of lead-related industrial landscapes; these include early mining remains adjacent to Bolton Gill, nineteenth century workings on the south side of Bolton Gill, the mining works at Bolton Haw Side, Hebden Gill Dressing Floor and Duke's Level (Figs 6-20). Some of these landscapes had previously been selectively recorded, but it was proposed that all be subject to a detailed survey in this instance to create a single cohesive archaeological record of the overall landscape. The Bolton Gill and Duke's Level remains had never been previously recorded and were recorded in detail from the outset. The mining works at Bolton Haw Side had previously been surveyed by Northern Archaeological Associates (NAA 2003) and it was required as part of the present study to revise the earlier survey to make it compatible with the overarching survey; the earlier survey and interpretation were used as a guide for the present study. The Hebden Gill Dressing Floor and Bottle Level had previously been surveyed by Meerstone Archaeological Consultancy (MAC) (Roe and Davies 2007) and it was required in this instance to undertake new survey work so as to provide a record of the landscape for monitoring and consolidation purposes. It was considered, however, that the description and interpretation of the earlier report (*ibid*) did not need to be revisited and no new description or interpretation for the complex is provided as part of the present study.
- 4.1.2 The description of the separate industrial landscapes is presented in approximate chronological order with the earliest landscapes being described first and the industrial landscapes of the Hebden Moor Mining Company, which was active in the second half of the nineteenth century, being described last.

4.2 BOLTON GILL SIDE (NORTH SIDE OF VALLEY)

- 4.2.1 **Introduction:** the mining landscape on the northern side of Bolton Gill (Bolton Gill Side; Figs 17-19) has a very different character from that on the south, and represents an older and less intensive episode of industrial activity than that on the southern side. Significantly, the earliest Ordnance Survey mapping show (6" to 1 mile 1852; Fig 2) shows no mining remains on this side of the valley, or on any subsequent editions, and the implication is that the mining remains had been abandoned by the mid-nineteenth century. There are two clear episodes of activity; the earliest was a series of hushes and, subsequent to these, was a series of mine shafts and an associated dressing floor. The dating for this episode of mining activity may possibly be provided by the documented court case of 1759 (*Section 3.3.8*) which refers to the cutting of shafts and levels in the area of Bolton Gill.
- 4.2.2 **Hushes:** the earliest episode of activity on the site was seemingly a series of six hushes (Sites **11.1-4** and **13.1-2**; Figs 19 and 20. The easternmost of these (Sites **11.2** and **11.3**) extend approximately north-east/south-west and cut across the line of Cockbur Vein. They are uniformly straight, contain no present day streams and terminate at Bolton Gill; they have exposed large boulders and lines of crag which are extant at the bottom of gullies. Site **13.2** extends above the present edge of the

valley side, and is crossed by a later enclosure boundary (which was first shown on the OS first edition 25" map (1892)). They are up to 17m wide, and over 80m long and reflect the loss of considerable volumes of soil. Hush **11.4**, seems to start just below the line of Cockbur Vein as represented by a line of five mine shafts (Site **12**) and towards the bottom of the hush it approximately coincides with Chance Vein, where it changes direction, then taking a more direct line to Bolton Gill. At the south-western part of the mining landscape were two very straight, parallel, and narrow hushes (Sites **13.1-2**; Plate 5) which extend down the steepest part of the valley side. These approximately coincide with the line of Providence Vein (Gill 1994, 113). Given that the hushes only coincide approximately with the lines of veins documented by later extraction, there exists the possibility that they were as much intended to investigate and identify the veins, as to provide a means of extracting the ore.



Plate 5: Looking down the two straight hushes (**13.1** and **13.2**) at the south-western part of Bolton Gill North

- 4.2.3 Although hushes were worked by the sudden release of large volumes of water, for most them there are no obvious feeder channels or dams surviving immediately upslope of them; the notable exception is hush **11.2**, which was dammed higher up and to the east of the study area. Hushes **11.4** and **11.3** extend through the area of a dressing floor (Site **14**) and there is fine dressing waste extending over the sides of the hush, indicating that the hushes were earlier than the dressing floors. Mine shaft **12.1** has a spoil mound that extends south-west from it and forms a prominent mound down the side of hush **11.2**, again indicating that the hushes predated the mine shafts. Given the tentative linking of the mine shafts to the documented court case of 1759 (*Section 3.3.8*), this would suggest that the hushes were earlier and may even extend into the seventeenth century when this form of mine activity was prevalent in the region (*Section 3.3.5*).

- 4.2.4 **Mine Shafts:** a line of five mine shafts (Sites **12.1-5**) at the north-eastern edge of the Bolton Gill valley is aligned with Cockbur Vein (Gill 1994) (Fig 19). They comprise narrow depressions with sub-circular spoil mounds around the outside, and are between 3.5m and 6.5m in diameter. The largest of these (Site **12.1**; Plate 6) also has a separate finger spoil mound extending downslope from the shaft; however, for the most part, the amount of spoil reflects that the shafts were sunk to relatively shallow depths.



Plate 6: Mine shaft **12.1** looking west

- 4.2.5 A further group of three mine shafts (Site **15.1-3**) was located at the northernmost part of the valley, and were set into the slope of the valley side. They form a north-west/south-east alignment and their locations approximately correspond to that of Chance Vein, which was also exploited by the later Engine Shaft on the opposite side of the valley. They comprise narrow shafts, with mounds of spoil extending out from the valley side, towards the south. The largest of these was shaft **15.3**, which had the greatest amount of spoil. Extending in a line, to the south-west out from shaft **15.3** is a narrow, 6m wide, steep-sided gully, which cuts in a straight line through the undulating valley side. This has left a pair of steep-sided pinacles, and it then terminates where it meets the open valley side. While it is clearly artificial, and seemingly relates to shaft **15.3**, its purpose is not immediately obvious. It does not appear to represent an attempt to follow a vein, as the vein is following an alternative alignment, and it also does not appear to be a leat.
- 4.2.6 **Dressing Floors:** the lines of shafts are either at the top or at the immediate bottom of the steep valley sides, but at the base of the steepest slopes is an area of undulating gentle to moderate sloping land which forms a raised terrace set above the valley floor (Plate 7; Fig 19). Within this largely natural terrain, and located below the lines of mine shafts, are multiple exposures of dressing waste (Site **14.2**), indicative of extensive dressing floors. For the most part, this comprises medium to fine gravel-sized fragments of crushed stone, which would have been

first crushed and then spread across the area for the manual sorting and processing of the ores. These deposits are largely free of turf, indicating that they are rich in lead, or other heavy metals, which would have discouraged the formation of covering vegetation. These deposits extend into the gullies of the hushes indicating that they post-date them.



Plate 7: The area of the Site **14** dressing floors looking east

- 4.2.7 In the middle of the area of dressing floor waste is a single, small, dry-stone structure (Site **14.1**; 3.5m x 2.48m; Plate 8) which is open to the front, and has a low aperture, capped by a lintel, leading to the rear of the building where there is a small artificial hollow. Immediately to the south-east of the structure is a deposit of fine, red-soil dominant, dressing waste. This deposit is distinct in character from the other areas of dressing floor waste, being significantly finer and having the red colour soil. This reflects that the waste is a product of a different ore refinement process and it is probable that the structure accommodated a buddle for the water washing, settling and refinement of the ore. It is possible that the rear aperture allowed a water supply into the putative buddle, necessary for the washing and setting of the ores. There is, however, no indication of a tail race or gully below the structure to reflect the discharge of the water, but it is possible that the process did not use sufficient water to have created a pronounced erosion scar.



Plate 8: The dressing floor (Site **14.1**), with the fine red deposits in front of the putative buddle housing

- 4.2.8 Below the area of dressing floors is a single, pronounced spoil heap (Site **16**) extending south-east and into the floor of the valley. It is largely turf-covered, and would indicate that it is not, for the most part, formed of dressing waste. There is no visible mine shaft immediately adjacent that would have produced this level of spoil, but it is possible that there was a former shaft in the area that may have become buried or obscured by the dressing deposits.

4.3 DUKE'S LEVEL

- 4.3.1 At the southern part of the study area, and on the western side of Hebden Beck, is a large spoil heap (Fig 4), with an adit entrance at its southern end (Site **1**; Figs 7 and 28). This is the outfall for the impressive Duke's Level that was cut for a total length of 2.6km to the north-west to link up with Beevor Shaft at Yarnbury and then Coalgrovebeck; it was started in 1796 and reached Yarnbury in 1820 and Coalgrovebeck engine shaft in 1830 (Gill 1983, 59; Gill 2004, 655). It was initially intended as a canal, such that narrow boats could have been used to transport spoil and ore out once constructed; however, in practice it is unlikely that it was ever intended that the adit should have been flooded for a canal at the driving stage, as it would have made it difficult to work the face (R White pers comm). It was initially five feet x nine feet high (2.8m x 1.6m) (Gill 2004; *Section 3.3.11*) to enable its use as a boat level, but because of slow progress up to a length of 1520m, excavation was thereafter continued as a six foot by four foot adit (1.8m x 1.2m). With the narrowing of the adit it was then not possible for it to have served as a boat level once it was completed, and there is no evidence that it was ever used flooded to enable its use as a canal (R White pers comm). Despite the reduction in size it was not completed until 1830, by which stage it was simply functioning as a drainage adit (www.list.english-heritage.org.uk). It did not produce much ore, but the limited amount that it did produce was processed on a dressing floor adjacent to the adit entrance.

- 4.3.2 **Adit Entrance:** the adit entrance (Site **1.1**; Plate 9) comprised a stone revetted channel (17.5m long and 1.5m wide) extending out from a partially-blocked, arched aperture, which is within a small, dry-stone walled, enclosure (Plate 11). To the east it becomes a subterranean culvert leading a short distance to an outfall where it drains into Hebden Beck (Site **1.3**). Two brick arched walls extend across the open channel and their purpose is unknown, but given the use of brick, which contrasts with the use of stone elsewhere, it is possible that they were not contemporary with the construction of Duke's level entrance, possibly when the level was subsequently used as a water supply (R White pers comm).



Plate 9: Duke's Level Entrance

- 4.3.3 **Spoil Mound:** the large spoil mound is 210m long by 32m wide at its greatest extent and was up to 5m high above Hebden Beck to the east; it potentially comprises very approximately 14,500m³ of spoil (Plate 10; Figs 8-9). The top surface of the spoil mound slopes gently uphill towards the north, with a uniform gradient and there is a 3.0m height difference between the upper surface at the northern end of the spoil mound by comparison with that at the southern end. In part this reflects that the valley floor is rising slightly to the north, but also that the spoil mound is up to 1.4m higher than the valley floor to the north than it is to the south. This in part reflects the amount of spoil extending from the adit, and that there was a need to build up the spoil mound to the north to accommodate the output of the cutting of the adit. While this would evidently have entailed the transport of soil upslope to the far end of the spoil heap, there is no evidence of any extant lifting infrastructure to move the spoil.
- 4.3.4 Hebden Beck is immediately adjacent to the base of the spoil mound and it is possible that some spoil has been washed from the spoil heap into the beck and has been washed away. The extent of any wash away of spoil is difficult to quantify; however, the anticipated volume of the spoil of the cutting of a 2.6km long adit in two sections, firstly of 2.8m x 1.6m size and then 1.8m x 1.2m size would suggest a volume of spoil in the region of 9200m³ to 10500m³. Given that this is less than

the estimated volume of the spoil mound, it is probable that not much of the spoil has washed away.

- 4.3.5 To the south was a curved finger spoil mound (Site 1.2), separated from the main spoil mound by a gully for the sub-terranean outfall channel (Site 1.3). The main spoil mound is a large flat topped mound, with a steep, 5m drop to the beck on the eastern side. The stone extending from the surface is generally large unprocessed material that would have been quarried during the excavation of the level. A track extends across the upper surface of the spoil mounds and continues as a terraced feature along the valley side beyond the northern end of the spoil mound.



Plate 10: The spoil mound of Duke's Level viewed from the north

- 4.3.6 **Dressing Floors:** located on the larger spoil heap, and to the north-east of the adit entrance, are a pair of low mounds (4m and 5m across) (Site 1.4) that comprise non-earthfast deposits of small, fragmented, stone (typically 20mm across) (Plate 11; Fig 8). This material markedly contrasts with the rest of the spoil mound which comprises mainly large blocks. These small localised mounds would appear to be the product of crushing the ore before being further refined, and are an indication of localised dressing.

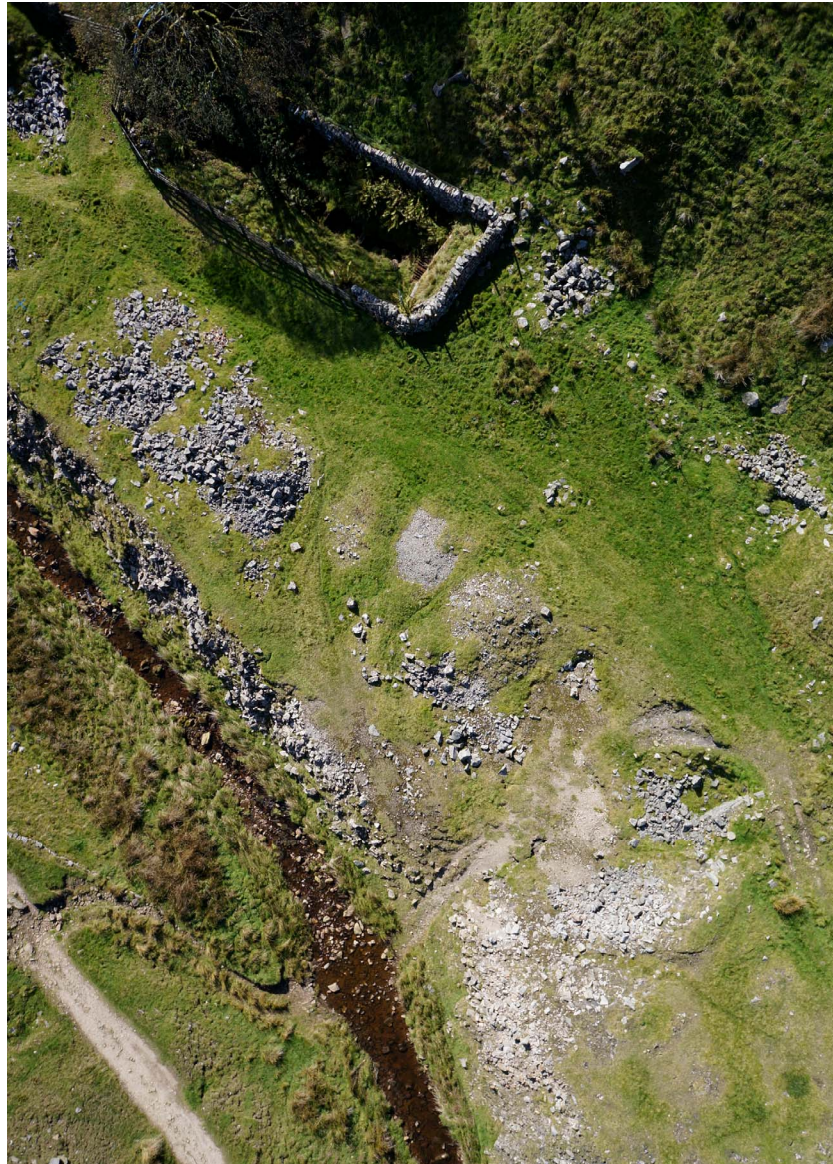


Plate 11: Aerial view of the adit entrance (Site **1.1**) and the dressing floor (Site **1.4**)

- 4.3.7 Adjacent to the mounds of crushed ore, is a hollow (Site **1.7**), which is presently used as a routeway down to a crossing point of Hebden Beck, but originally was a dressing floor. Within the hollow are a series of exposed deposits of fine-grained stone material, which are the finings from the washing of the lead ore. The area of the hollow was edged to the north by a section of retaining wall, which, it is presumed, was intended to define the dressing floor and to retain the spoil heap to the north. The most substantial, extant section of walling is set into the north-western part of the hollow, and has an embanked western edge. Collapsed walling to the south, may represent the ill-defined remains of a small structure (2.5m x 2m), which was potentially the site of a bouse team. The water supply for the washing of the ore may have been from a partly canalised beck, as shown on the OS first edition 25" map (1892), that extends down to the western side of the large spoil mound at a point that is only 19m to the north-west of the putative buddle site.

4.4 BOLTON GILL SOUTH

- 4.4.1 **Cockbur Vein:** a small group of shafts is located on the south side of Bolton Gill, just above the beck and set into the slope, approximately on the line of Cockbur Vein. The largest of the shafts is to the west (Site **10.2**; Plate 12; Fig 20), having a spoil mound that is 13m in diameter and has a 3m deep, central hollow into the shaft (Plate 13). Extending east from this is a line of three further shafts which is parallel to the line of the beck, and is approximately east/west (Sites **10.3-5**). The shafts are relatively small and irregular, and, in the case of Site **10.3**, comprises an irregular hollow set back into the slope rather than a conventional shaft. None of these three shafts has a substantial spoil heap and so contrast with the westernmost one (Site **10.2**) which does. The orientation of this line of shafts is approximately in line with Cockbur Vein, and the implication is that the smaller shafts were trial pits searching for the main lead bearing ore deposit, and that the larger one (Site **10.2**) was the one that managed to locate and exploit it.



Plate 12: Mine shaft **10.2** looking north

- 4.4.2 Immediately downslope from the main shaft, and immediately adjacent to the gill is an artificial, narrow, finger spoil mound. This merges with a terraced track (Site **10.1**) that extends for a distance of 113m, along a line just above the beck, which in turn terminates at a long and extended finger spoil mound adjacent to Shaft **8.1** (Section 4.4.3). The track is variously 1m to 3m in width and is approximately level; in places the line of the track is supported to the north-west by a revetment wall. To create the level terraced track required the import of material as, in places, it stands proud of the slope; it would appear that it was formed from the spoil of the main shaft (**10.2**). The finger spoil mound at the base of shaft **10.2** overlies the line of the track and there are a number of very large stones at the intersection; this would appear to reflect two phases of spoil removal from the Cockbur Vein shafts. The later phase of spoil removal entailed very deliberately transporting the spoil a considerable distance to the area of the Engine Shaft (Shaft **8.1**) along the line of the 113m long track, despite the fact that the spoil could be

dumped more easily closer to the shaft. The implication is that the ore was being transported this distance so that it could be processed at a dressing floor adjacent to the entrance to shaft **8.1**, suggesting that these shafts were broadly contemporary.

- 4.4.3 **Top Level:** the documented Top Level worked Top Grit and Bearing Grit veins and extended north-east from an adit portal in the area of the Bolton Gill Dressing Floor. It was probably started by JS Winn in c1853 and was subsequently worked by the Hebden Moor Mining Company (HER MYD 42397); it was reported as having a small dressing floor in front of the portal (Gill 1994). There is, however, some doubt as to the precise location of the adit entrance; the historical coordinates given for it by Gill (*ibid*; SE 029654) are imprecise and approximate to that of both the Engine Shaft (Site **7.2**) and the lower dressing floor (Site **9.1**). Although there is no surface indication of an adit in this general location, there is a dressing floor (Site **9.2**) and a series of large spoil mounds (Site **9.6**) to the north-west which would appear to have related to an adit in this lower location; it is probable, therefore, that the portal to the adit is underneath the large spoil heap (Site **8.2**; Fig 17), which would appear to have encroached over it.
- 4.4.4 **Engine Shaft:** the Engine Shaft was sunk by the Hebden Moor Mining Company in c 1855 to work the Chance Vein, after the working of Top Level became uneconomic; Engine Shaft was closed in c 1872. There are two elements to the Engine Shaft, comprising the primary shaft (Site **8**) which was used to extract the ore and an adjacent drainage shaft, with a large portal surround (Site **7.2**), which housed rods for pumping lower levels (Figs 17 and 26).
- 4.4.5 **Shaft Site 8.1:** the large shaft **8.1** has a large spoil mound around it (9m diameter), a dressing floor in front of it and a very large finger spoil mound extending out from the floor (Plate 13). It is a well constructed shaft with internally revetted sides to the internal hollow, and an extremely large, partially dressed, stone (size 2.48m x 0.65m) extending over the top of, the now filled, former shaft aperture. The stone was probably the anchor mount for a hoist extending up from the shaft. The shaft has an aperture opening out to the south-west and leading firstly onto a large flat area, with fine dressed material on top and from here to a large finger spoil mound (Site **8.2**). The spoil mound has little turf on it, indicative of a high lead content, and is largely made up of small fragments of crushed ore, and it is evident that the levelled area in front of the shaft has been used as a dressing floor. Just upslope from the shaft are two much smaller excavation hollows (Sites **8.3** and **8.4**) set into the slope; there is little spoil associated with either of these and it is probable that they were trial pits.



Plate 13: The spoil mound (8.2) and shaft (8.1) of Engine Shaft, with the track and spoil mound (10.1) of the Cockbur Vein workings in the foreground

- 4.4.6 The shaft is immediately adjacent to the large Engine Shaft portal (Site 7.2), which has a separate spoil mound (Site 7.1). The portal is constructed into the side of the large Shaft 8 spoil mound, and it is evident that it post-dates the spoil mound 8.2. The covered chamber for the portal (Site 7.2) extends up towards the aperture for the Site 8.1 shaft, but does not block it or overlie it and it is probable that this was intended to enable the continued use of the earlier shaft. Although Shaft 8.1 clearly pre-dated the construction of the Engine Shaft (Site 7.2), it is evident that the two were intended to operate to some extent independently and that there was some overlap in the periods of use.
- 4.4.7 *Pump Rod Portal (Site 7.2)*: the construction of a secondary, adjacent, and separate drain shaft was a major extraction operation and entailed the construction of a large barrel-vaulted portal over the shaft, and power to drain the mine was transmitted over a distance of at least 235m from a Power Transfer House (Site 17.1) on Bolton Haw Side (Gill 1994, 104). There are references from a plan of 1866 (*ibid*) to the use of a power cable connecting the wheel to the Engine Shaft; however, a sale notice refers to 600 yards of 1 ¼" wrought iron pumping rods (*ibid*) and the implications are that the power transfer system switched from a power cable to pump rods over the course of the life of the mine. The rods or cable were supported by a series of stone stanchions, which mostly survive at the eastern Engine Shaft end. A balance bob was mounted within the portal to convert the horizontal movement of the rods to a vertical movement of rods down the shaft (*ibid*).
- 4.4.8 The portal (Site 7.2) is well constructed, comprising a tall barrel-vaulted chamber, which is 7.5m long, 2m wide and 4.49m high from the base (Plate 14). It is of dry-stone construction using partially dressed blocks, with dressed stones for the voussoirs of the vault. The internal walls are constructed on a bedrock bench on both sides and part of the chamber is rock cut (Plate 15). Three steps descend from the entrance to the floor of the chamber and at the western end is a rectangular

depression, possibly a wheel pit, which was 3.5m x 1m in size. Half way up the chamber, and above the wheel pit were a pair of axle mounting holes, presumably to support a wheel. A further pair of axle mount holes were set into the sides of the walled chamber, just below the springers of the barrel, and no more than a metre below the crown of the vault. These are located about a metre to the west of the actual shaft entrance at the eastern end of the chamber; the top of the now capped shaft is square in shape and 1m x 1m in size. There are axle supports directly above the shaft, which almost certainly supported axle mounts for a balance bob, and its distance from the shaft provides some indication of the length of the horizontal arms of the balance bob (Plate 16 for an example of a balance bob). Directly above the mounts for the balance bob is a deliberately-constructed aperture (now blocked) in the crown of the barrel vault; while the purpose for this is not known, it can be conjectured that it was intended to enable the extraction of power from the pump rods to a point outside the portal, possibly to drive a hoist over Shaft **8.1**.



Plate 14: Entrance to the Engine Shaft portal (Site **7.2**)



Plate 15: The tall barrel-vaulted interior of the portal with a wheel pit in the base



Plate 16: An example of a balance bob at the Ystrad Einion Mine (after RCAHMW (www.coflein.gov.uk))

- 4.4.9 Given that there are documentary references to two different types of transmission system (cable and pump rods) and that there are seemingly the remains of two different transfer systems within the portal, it is probable that the power system was changed over the life of the mine. The cable transmission system would have required a large portal to accommodate the wheel, explaining the observed 4.49m height of the portal. It is probable that, in the original scheme, a wheel was powered by a cable and was still in place by the time of the 1866 plan (*ibid*); however, by the time of the closure and sale this had been changed to a pump rod system, using a balance bob to transfer the power into water pumping rods down the shaft. The balance bob system would have taken up much less space than the wheel and may have been a factor in the switching of the power transfer systems.
- 4.4.10 Outside the entrance of the entrance of the portal are two low, revetted, walls defining the approach to the structure (to the north-west it is 2.5m x 1m high; to the south-east it is 3.2m x 1m high). That to the north-west has a large stone mounted on top with a carving, possibly for an engine mount, on its upper side; their purpose is unknown.
- 4.4.11 *Spoil Mound (Site 7.1)*: extending directly out from the portal of the Engine Shaft is a long finger spoil mound (Site 7.1), which is approximately 46m x 21m in size. The pillars for the pump rods are constructed on top of it and clearly post-dated its usage and abandonment. It is comprised of coarse stone material, and, by contrast with other spoil mounds, such as the adjacent Site 8.2 spoil mound, it has thick grass over the top of it. This would indicate that there is not a high lead content in the spoil and the coarse nature of the spoil would indicate that it was not dressing floor waste. This was probably formed from the result of the initial cutting of the drainage shaft (Site 7.2), and then once cut the stanchion supports for the pump rods was constructed on top of the spoil mound. The absence of ore waste and the limited size of the spoil mound reinforces the premise that this shaft only served to drain the lower levels and was not used to extract ore.
- 4.4.12 *Stone Pillars*: six approximately square stone pillars (Site 7.3) extend in a line out from the entrance of the Engine Shaft portal (Site 7.2). They are typically 1.7m x 1.4m in plan and 1m in height, and are constructed of dry-stone, roughly-dressed, field stones (Plate 17). Two of the pillars (7.3c and 7.3d) had a single large ashlar stone on top which has two iron bolts for the securing of the pump rod mounting; and it is possible that other pillars, or all of them, originally had a similar mounting arrangement. One of the pillars (Site 7.3b) was located at the end of the spoil mound (Site 7.1) and, because of movement of the spoil, has collapsed. A further pillar (Site 7.3a) survives 50m from the collapsed pillar and there is no evidence of any other pillars in between. A further two pillars (Sites 7.3i and 7.3h) are located nearer to the Power Transfer House. In between 7.3i and 7.3h is a long artificially terraced earthwork (Site 7.3g) in direct line of sight between the Engine Shaft portal and the Power Transfer House. This is the highest point on the line of sight between the Engine Shaft portal and the Power Transfer House, and to enable a perfectly straight, uniform gradient, line for the mounting of the pump rods, there would have been a need to mount them below the present surface of the terrace by as much as 0.5m to 1m. It is therefore probable that the rods extended through a culvert / tunnel at this point and would explain why there is no evidence for a pillar in this location.



Plate 17: A stone pillar for the pump rods looking west with two bolts extending from a bearing mounting block (Site 7.3c)

- 4.4.13 ***Bolton Gill Dressing Floor (Site 9; Fig 17):*** below the enormous spoil mounds that extend out from the area of Engine Shaft is a dressing floor where the lead ore was processed (Site 9.2; Plate 18). This floor initially serviced ore produced from the Top Level adit, which is believed to be under the 8.2 spoil heap, but the adit was closed and efforts were thereafter concentrated on the Engine Shaft, which then supplied the ore for the floor. There are two areas of dressing floor, an upper floor (Site 9.4) on a flat level terrace on top of spoil mounds and a lower dressing floor (Site 9.1) defined by large retaining walls, with a bouse team for washing ore (Site 9.2) and driven by a water wheel (Site 9.3).
- 4.4.14 ***Upper Floor (Site 9.4):*** on top of a series of spoil heaps was a large flat area (approximately 18m x 9m in extent) extending out to the west from steep valley side. The area has been encroached upon by the large spoil tip - Site 8.2, which was a later phase of working (*Section 3.3.14*). It, and the adjacent spoil mound (Site 9.6), has coarsely crushed ore exposed which is only partially covered by turf, implying a high lead content. It is immediately above a bouse team (Site 9.2) and may have served as a crushing floor for the initial processing of the ore prior to washing and refining on the lower dressing floor, but may also have been the site of an earlier phase of dressing floor. Between the upper and lower dressing floors was a steep slope of fine crushed spoil, and access was afforded between them by a set of 11 ashlar stone steps (Site 9.4a). Because of the fine nature of the spoil base for the steps, on going water erosion has undermined the steps and they have, as a result, toppled to the north-west as a single cohesive structure (Plate 19).



Plate 18: General view of the dressing floor (Site 9) with the spoil heaps of Engine Shaft (Sites 8.2 and 7.1) above looking south-east



Plate 19: The collapsed steps (Site 9.4a) adjacent to the bouse team

- 4.4.15 *Lower Dressing Floor (Site 9.1)*: the lower dressing floor is a rectangular, artificially flat, terraced area (19m x 19m in extent) edged to the south and south-east by large revetment walls, which are still largely intact. Within this terraced are limited exposures of fine deposits of crushed and processed ore, and the adjacent spoil heaps (Site 9.5) have little grass cover implying a high lead content to the spoil. There are few internal features within the area of the floor, suggesting that the processing was undertaken using portable or perishable structures, such as hotching tubs or by manual sorting techniques.
- 4.4.16 At the north-eastern corner of the terraced platform is a 3.8m long x 1m wide revetted, rectangular, hollowed feature (Site 9.3) set into the terrace edge and

raised above the level of the lower dressing floor; it would appear to be a wheel pit.

- 4.4.17 A stone revetted and capped leat (Site **4.1**) converges on the wheel pit and terminates at a stone platform which is 2m away from, and slightly above, the wheel pit; from there the water would have been carried by a timber launder to an over-shot wheel. There may also have been a further source of water extending down from the higher leat (Site **4.2**), though little has survived of any channel or timber launder. This wheel, despite its unusual position would have provided the necessary power for the dressing operations within the extent of walled floor. Water from the leat is likely also to have been transferred from the leat to the adjacent Bowse Team (Site **9.2**) for washing the ore (*Section 4.4.18*).
- 4.4.18 *Bouse Team*: located also at the north-east end of the dressing floor was a large, sub-circular cone-shaped structure (Site **9.2**), that was set into the slope which funnelled down to an aperture through a façade revetment wall, opening out onto the lower dressing floor. A water erosion scar leads out from the aperture across the floor to a gully between two spoil heaps. This structure appears to be a bouse team and is very similar to a structure on the Hebden Gill Dressing floor, whereby ore that was initially crushed on the upper dressing floor, could then be dropped into the funnelled structure of the bouse team, and washed with water provided by a launder from the nearby leat **4.1**. Although not evident from the observed evidence, there would have been a trunk box beneath the aperture, which was a form of buddle and would have caught the fine particles of lead washed down through the bouse team.
- 4.4.19 The crushed and washed ore would then have been further processed, probably by the use of hotching tubs, which were wooden structures and therefore have not survived. These were large sieves which were typically mechanically shaken or jiggled using power from the wheel to allow the separation of the heavier lead-rich ore from the lighter waste. Although there are no surviving remains of these structures, the fine waste from this process is to be found across the surface of the dressing floor and the adjacent spoil heaps (Site **9.5**), which extended westwards out from the surface of the dressing floor. The material within these spoil heaps, extending out from the lower dressing floor, is considerably finer than that of the spoil heaps (Site **9.6**) extending out from the upper dressing floor. Following the final stage of dressing, the refined ore would then have been collected and transported away via the track (Site **2.1**) at the south-west end of the dressing floor.

4.5 BOLTON HAW SIDE

- 4.5.1 Just above the confluence of Hebden Beck and Bolton Gill, and also above Bottle Level, was an area of mining characterised by a series of shafts (Sites **16**, **18** and **19**; Figs 12 and 14), and a large wheel pit, which was associated with a Power Transfer House (Site **17.1**) that exchanged power from a powered ropeway coming up from the Hebden Smelt Mill to a pump rod system that led up to the Bolton Gill Engine Shaft. A tunnel (Site **18.1**) extends out from the wheel pit, which has the appearance of an adit but in practice was probably a tail race. The Power Transfer House took power not only from the large wheel but also from the powered ropeway which was driven by a wheel near the Hebden Smelt Mill.

- 4.5.2 **Mine Shafts:** the earliest mining features within this group is a line of four large shafts extending in a line diagonally up the Hebden Beck Valley side (Sites **19.1**, **19.3**, **16.2** and a shaft outside the study area). These shafts are fairly substantial and have localised spoil mounds in an arc around the shaft; they approximately coincide with the line of the Beever Vein (Gill 1994) and it is possible that they were trial pits to explore the line of the geology, but it is more probable that they were coal shafts and their proximity to the Beever Vein was circumstantial. A further shaft (Site **19.2**) was adjacent to the large Site **19.1** and **19.3** shafts, but was away from the main line of shafts and, although it had a deep circular depression, there was no associated spoil mound.
- 4.5.3 A further isolated shaft (Site **16.1**) is located on the south side of the Bolton Gill valley side. Shaft **16.1** is cut by a leat (Site **3**) extending out from tail race **18.1**, demonstrating that this shaft was earlier than the wheel, the power transfer operations and its associated leat.
- 4.5.4 **Bolton Haw Side Tunnel:** a survey of the tunnel and entrance was undertaken by Northern Archaeological Associates in 2003 (NAA 2003), in advance of the insertion of a new pipe to divert the run-off of water from the tail race.
- 4.5.5 The tunnel (**18.1**) comprised a vaulted, 1.75m high and 1m wide, dry-stone structure, which was floored with sandstone setts (Plate 20). The NAA (2003) survey established that the adit extended for 16.8m into the hill, before turning slightly to the north, and was then blocked 6m further beyond the bend by collapse. This point corresponds with the southern edge of a deep, large depression (16m long by 8m wide and about 1.8m deep), which is interpreted as a wheel pit (Site **18.2**) (Section 4.5.8).
- 4.5.6 In front of the tunnel entrance is a revetted walled channel leading to a plastic pipe, that takes run-off water under the adjacent track (Site **22**). This was evidently modified as part of the drainage works in 2003; the NAA survey, undertaken prior to the works, shows the southernmost wall of this channel, but not the northern wall, which was evidently constructed at this stage. The survey does, however, show a north/south orientated wall extending out from this area, forming the western side of a leat that extends north, following the line of the contours (Section 4.6.3). It would appear that in the original design the run off from the adit was diverted north into the leat, rather than to the west and under the track as it is at present.
- 4.5.7 Extending to the south-west of the tunnel entrance is a finger spoil mound (Site **18.5**), that took the spoil from the construction of the adit. The ramp to allow the movement of spoil from the entrance to the finger mound has been cut by the adjacent terraced track (Site **22**), which was evidently a later feature.



Plate 20: Entrance to the tunnel / tail race (Site **18.1**)

- 4.5.8 **Wheel Pit (Site 18.2):** a wheel pit was documented here as being 40 foot in diameter by 3 foot 6 inch broad and had 16 wooden arms (Gill 1994, 104). The probable wheel pit is 16m (52 feet) in length and could have accommodated a 40 foot wheel. There is a power train, defined by one, and probably two, bearing mounts on the line of a narrow gully, extending between the Power Transfer House (Site **17.1**; *Section 4.5.11*) and the northern end of the wheel pit. This would suggest that the pit accommodated a wheel that would have provided power, via the Power Transfer House, for the Engine Shaft. There is a revetted, walled structure (4.45m long) set into the western side of the chamber, but it does not have evidence of recesses for an axle mount, and although it would seem probable that this was a mounting structure for a wheel bearing it cannot be confirmed. Given that the tunnel extended out from the base of a wheel pit it would appear that it served as a tail race.
- 4.5.9 A very wet, marshy, area extends out from an outfall point of leat **4.1**, characterised by a culvert cap stone. This indicates that the leat is still functioning and subsequent to the abandonment of the mine complex, the water has escaped from it down the slope, into the wheel pit and then out through the tail race. Originally, this would have been the feeder point for a launder that would have driven the large 40 foot wheel.
- 4.5.10 Just above the adit (Site **18.1**), and in-between two ropeway stanchion bases, is a deep hollow (7m x 4.4m), which has a number of large stones in the bottom. Hodge (1997) suggests that this was a bob pit for the powered ropeway, implying that it accommodated gearing for power transfer; however, it is not in the right location for

such a structure, being in the middle of the ropeway line, although it is not clear what function it would have had.

- 4.5.11 **Power Transfer House:** Hodge (1997) provides a convincing argument for the presence of a powered ropeway extending up from the Smelt Mill, beside Hebden Beck, along the line of square stone plinths up to a power transfer structure on Bolton Haw Side (Site 17.1; Fig 1). From here power was transferred along a line defined by further square stone plinths (Site 7.3) to the pump rod lobby of the Engine Shaft (Site 7.2). The documentary records (Section 4.4.7) indicate that initially the transmission from Bolton Haw Side to the Engine Shaft was via a power cable (powered ropeway), but this was changed to power rods over the course of the lifetime of the mine. In the Engine Shaft portal (Site 7.2) there are both the remains of a wheel pit and the mountings for a balance bob which would reinforce this change of power transmission system. At the Power Transfer House there is evidence of a wheel pit for the power cable system but there are no surviving remains for the power rod system and it is not clear if the wheel also drove the pump rods.



Plate 21: The Power Transfer House wheel pit

- 4.5.12 The location of the transfer house was very clearly determined by the topography as it is the only point on Bolton Haw Side where there is a line of sight to the Engine Shaft, and even then there was a need to terrace back the slope at Site 7.3g, and take the line of the later rods through a shallow culvert, to ensure the direct line of sight transfer for the power rods. The power house was evidently formerly a substantial structure, because there is considerable collapse now present within it, but, by the same token, the collapse is obscuring the form of the structure and limits an

understanding of its mechanism. The key element of the structure is a north-east/south-south-west wheel pit (1.5m wide and 6.5m long; Plate 21) which is directly orientated towards the Engine Shaft. It has stone revetted sides and a large ashlar block in the centre, on the south-eastern side, which was probably a mounting block for a wheel axle. There is no evidence of a tail race or head race associated with the wheel and it is to be presumed that, at the point of abandonment, this wheel was not water-powered. A stone plinth (Size 4.5m x 1.5m) extends beyond the north-eastern end of the wheel pit, and follows the same orientation towards the Engine Shaft, but is slightly staggered to the south of the wheel pit indicating that the power take off from the wheel was from the southern side of the axle, which may have driven the pump rods.

- 4.5.13 The line of the power intake from the powered ropeway is very precisely defined by the orientation of the square stone plinths (Site **17.2**; Plate 22), and converges with north-eastern end of the wheel pit and a raised platform above the south-western side of the wheel pit; however, it is not clear how the power from the ropeway was transferred to the wheel or the pump rods.



Plate 22: A square, stone plinth supporting the powered ropeway (Site **17.2**)

- 4.5.14 To the south-east of the wheel pit are further structural remains of the Power Transfer House (Plate 23), and associated with it is a substantial stone with three threaded mounting bolts for a bearing housing (Plate 24). Extending from the bearing housing is a line of kerb stones and thereafter the line of a gully, with banks on either side, that is orientated south-east towards northern end of wheel pit **18.2**. Hodge (1997, 150) reports a second bearing mount along this line, but one was not

observed during the present survey and may be obscured by turf. This power train was either a rotating drive shaft or another line of push/pull pump rods, and would appear to be the power take-off from the 40 foot wheel into the Power Transfer House, which would have had two alternative power supplies; one from the adjacent wheel pit (**18.2**) and the other from the powered ropeway that would have carried power from a wheel at the Hebden Smelt Mill (*Section 4.5.11*).



Plate 23: The Power Transfer House (Site **17.1**) viewed from the north-east



Plate 24: Bearing mount for a drive train leading to the Site **18.2** pit

4.6 WATER SUPPLIES

- 4.6.1 **Bolton Haw Side Leats:** the mining and ore dressing operations required considerable amounts of power, and substantial efforts were undertaken to provide power in the form of drive shafts / pump rods for the Engine Shaft (*Section 4.5.9*). However, efforts were also undertaken to transport water for power purposes over considerable distances via well-constructed leats. Power for the Bolton Gill Dressing Floor was provided by a water supply taken from the base of Mossy Moor Dam, which is 890m away to the south, via a long, well-constructed, leat (*Site 4.1*; Figs 14, 16 and 17) comprising a culvert set into the slope of Bolton Haw Side, with stone capping over the leat. This extends across a gentle slope above the Hebden Beck valley, but then turns to the north-east along the southern, steep side of the Bolton Gill valley. While it is very well defined on the gentle slope of the Hebden Beck section, and has exposed stone capping for much of the length, the Bolton Gill valley section, by contrast, is very poorly defined and is visible only as a straight, slightly terraced, 1m wide, earthwork. This latter terraced section also undulates in height above and below the level line, which would at surface level be unworkable for a leat. It is evident, therefore, that this section has been buried into the ground by as much as 2m in order to provide a slowly descending conduit towards the Bolton Gill Dressing Floor, and hence there is little indication of the structure on the surface. As such, this reinforces how well constructed the leat was and its importance for the operation of the dressing floor. The northernmost section is on the surface and has visible stone capping for the conduit and terminates adjacent to the dressing floor water wheel (*Site 9.3*).
- 4.6.2 Set approximately 11m above this leat is a further leat (*Site 4.2*), which significantly is sloping down towards the south-west; it was observed taking a route parallel to the lower leat and extends between the top of the Engine Shaft and the top of the Mossy Moor Dam; however, it can also be traced intermittently to the east of the Engine Shaft. The form of the leat was very similar to that of the lower leat, comprising a stone-revetted culvert with stone capping. This leat was intended to top up the Mossy Moor Dam, which had only a limited catchment, from Bolton Gill (Gill 1994, 118). Although the leat extended past the Engine Shaft, the line of the leat was essentially determined by the topography, and its proximity to the shaft was essentially fortuitous; it did, however, potentially have a laundered branch that could have provided power for the dressing floor wheel. At the southern end of the leat it terminates above the northern corner of the Mossy Moor Dam. Although this leat was supposed to draw water from New Dam (*ibid*), which was constructed above and to the north of Bolton Gill (Coordinates: 3033 4653), there is no evidence of a leat extending to the dam, and indeed the level of the level leat puts it considerably below the dam. Instead it would appear that the leat was fed by Bolton Gill, which was itself fed by the New Dam.
- 4.6.3 **Bolton Haw Side Leat:** extending out from the Bolton Haw Side tail race (*Site 18.1*; Fig 16) is a similar well-designed leat (*Site 3.2*), being a stone-revetted 1m wide culvert. It has a uniform descending slope, as it tangentially crosses the steep valley side (Plate 25). It cuts across the spoil mound of shaft **16.1**, which was evidently earlier. It terminates at a walled structure (*Site 3.1*) at the point of intersection with the access track for Bolton Gill mine (*Site 2*). The structure forms a platform and is constructed of dressed blocks (Plate 26), which exhibit a

slight curved face. Below the track is a pair of channels (Sites **3.3** and **3.4**) which extend down the slope feeding into Bolton Gill, and the westernmost of these (Site **3.4**) starts at the outfall of a sub-terranean culvert that takes water beneath the track (Site **2.1**).

- 4.6.4 While it is evident that the leat was taking the waste drain water from the tail race (Site **18.1**), it is not obvious what the water was being used for. One possibility is that it was simply diverting the water into Bolton Gill from where it was, at a lower level, fed into the reservoir (Site **29**) by Bottle Level. In which case, structure **3.1** was simply the entrance to a culvert diverting the water underneath the track. The other alternative is that the water was being used to provide a power source on route to the lower reservoir (Site **29**), and would suggest that structure **3.1** was a mounting for a water wheel; however, there are no mining or dressing remains in the vicinity of the platform, and no apparent local need for any power generated.

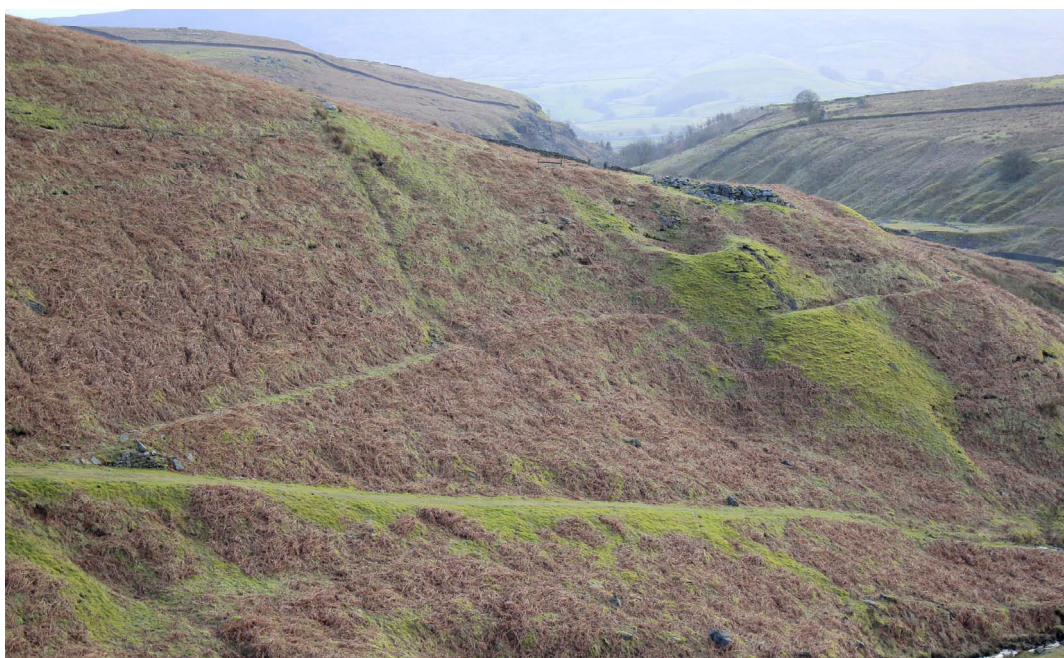


Plate 25: The line of the Bolton Haw Side leat (Site **3.2**) extending across the slope



Plate 26: The platform at the base of the leat (Site **3.2**)

5. CONCLUSION

5.1 DISCUSSION - HISTORY OF EXTRACTION

- 5.1.1 **Early Lead Mining at Bolton Gill:** the earliest mining activity within the study area was on the northern side of Bolton Gill, and was characterised by a series of hushes extending down the valley side (Sites **11.1**, **11.3** and **11.4**; **13.1** and **13.4**; Figs 18-19). Although there are extensive shafts and areas of dressing floor in this area, their remains overlie the hushes and were evidently later features. The hushes would appear, therefore, to reflect the earliest episode of lead working in the valley. The date of the hushes is very uncertain, and indeed from a technological perspective could potentially be of any date within the broad range of fifteenth to seventeenth centuries (Roe 2003, 73). However, there is limited documentary evidence of activity in this area which can potentially provide a *Terminus Ante Quem* for the hushing activity. A documented dispute between the miners and owners of a mine in this area dates from 1759, in which the described activities are of the sinking of shafts and horizontal adits (Gill 1994, 101). Given that the observed mines post-date the hushes, this would suggest that the hushes were earlier than this mid-eighteenth century date.
- 5.1.2 There has been some debate as to whether these features were genuine hushes, that is gullies formed by the use of water to scour away overburden to expose ore-bearing deposits, or alternatively open cut working (Gill 1993b, 55; EDAS 2014). The key distinction between the two is the presence of a dam across the stream feeding into the top of the hush, which would be an indication of a water formed hush. There is certainly a dam feature at the head of the Site **11.2** hush (albeit outside the study area and not recorded as part of the present survey). However, there is no obvious dam above the **11.3** and **11.4** hush features, although there is a small hollow at the immediate head of **11.4**, if it was the site of a pond or basin, it must have subsequently been severely degraded. There is, therefore, some uncertainty as to whether these were formed by water action. It has been argued (EDAS 2014, 69) that hushing can entail the use of a continuous flow in conjunction with open cast working rather than a rapid rush of water to carve the gully. It is therefore possible that hushes **11.3** and **11.4** may have been formed by a combination of open cast working and water washing. Features **13.1** and **13.2** are extremely straight and uniform, and extend directly downslope. Their uniformity is not consistent with either natural formation processes or the combined open cast / hushing approach, which would create irregularities where the open cast working was most intensive. Their form would therefore suggest that these were genuine hushes but it is uncertain where any pond or dam to feed them was located. Although these hushes were very uniform they were also very small and were likely to reflect exploratory working to investigate seam locations.
- 5.1.3 **Eighteenth Century Working:** across the northern side of Bolton Gill is a small mining landscape comprising two parallel lines of shafts (Sites **12** and **15**; Fig 19), both of which appeared to be working Cockbur Vein (Gill 1994), albeit at two different levels; these were serviced by a dressing floor (Site **14**) on the lower, undulating ground. The amount of spoil associated with these shafts was not substantial and the implication is that the shafts were not dug to a great depth and

the workings were relatively non-intensive; however, they were collectively sufficiently productive to warrant the establishment of a local dressing floor. The dressing floor was not mechanised; there was no evidence of the use of water power in this area, and the remains are consistent with deposits from the manual crushing and initial sorting of the ore, and a single buddle which would have further refined the ore. The documentary reference to the mine operations of William Ridley in 1759, provides details of the working of up to four shafts; they are not specifically located but believed to be from the area of Bolton Gill (Gill 1994, 101) and, in that case, most probably relate to this northern part of the valley. There is also a reference to a Sylvester Petyt working in Bolton Gill in 1802 (*ibid*), but it is not evident to what extent the remains reflect the mid-eighteenth century or early nineteenth century working. By the time of the OS first edition map (1852) there was no working depicted in this northern part of the valley.

- 5.1.4 **Bolton Haw Side - Coal Mining:** across the area of Bolton Haw Side, there are a series of shafts that pre-date the workings of the Hebden Moor Mining company (Fig 14). There is a line of shafts, orientated north-west/south-east (Sites **19.1**, **19.3**, **16.2**, and a further shaft just outside the study area) which corresponds approximately with the line of Beever Vein (Gill 1994). These are substantial shafts with large amounts of spoil and were overlain by the workings of the late nineteenth century Hebden Moor Mining company. In addition, there is a substantial shaft to the north of the area, on the southern slopes of the Bolton Gill valley (Site **16.1**). It is documented that there was substantial coal working on Bolton Haw Side throughout the eighteenth century, and a reference to a John Thompson paying duty on 25 loads of coal in 1809 from this area (Gill 1994, 108); further coal was extracted by Thomas Whitaker and Thomas Birch between 1810 and 1812 (*ibid*) amounting to 2658 loads over that period. Further coal was extracted by Anthony Thompson between 1835 and 1842, and it was recorded that the lead ore of Beever Vein was identified in one of Anthony Thompson's pits in this area (Gill 1994, 103). Despite the presence of ore from Beever Vein being identified in this area, it is probable, given the very substantial amount of coal extracted from these shafts, that most or all of the shafts in this area related to coal extraction, rather than lead working.
- 5.1.5 **Duke's Level:** Duke's Level was an extravagant, and ultimately uneconomic, scheme to provide a narrow boat-sized adit to work the Yarnbury veins, and to drain existing mines at Yarnbury (Gill 1983). It was commenced in 1796 underground and extended for almost 2.6km below the shafts at Yarnbury and continued to Coalgrovebeck engine shaft on Grassington Moor, and was only finished in 1830. The scheme had the disadvantage that the outfall for the adit was somewhat remote from the smelting mill and dressing floors which were on the moor at Yarnbury, and necessitated establishing a further dressing floor specifically for the adit (Site **1.7**). Ultimately, the original intention was to excavate a canal sufficiently wide to accommodate a narrow boat, but this proved too expensive and latterly it was narrowed (*ibid*), and could therefore not accommodate the passage of a narrow boat. The ultimate cost of the scheme, spread over 28 years, was £ 33,000 and produced relatively little lead ore as reflected in the small size of the dressing floor, but, a large sized spoil heap (Figs 7-9; *Section 4.3.3*), and reflects the lack of productivity of the adit. Estimates of the volume of the spoil mound are that it contained 14,500m³ of spoil, and the corresponding estimates of how much spoil would have been created from the 2.6km long adit are as much as 10500m³ and is

less than the volume of the spoil mound. This would suggest that the outfall from the adit was more than the output from the cutting of the adit, and may have included spoil from other levels.

- 5.1.6 By the time the adit had reached productive veins, mining technology had improved considerably, providing weight to the arguments of John Taylor, writing in 1837, of the considerable economic advantages of steam powered pumps for draining mines over the more outmoded adits such as Duke's Level (*ibid*). Significantly, some 18 years later than the writings of John Taylor, the argument of pumping water over the cutting of drainage adits had seemingly been won to judge by the use of pumps at Bolton Gill Engine Shaft to drain the lower levels; however water power was here used in preference steam engines and perhaps reflects that the cost of coal did not make steam power economic.
- 5.1.7 **Hebden Moor Mining Company:** the most intensive mining and processing operations across the study area were undertaken by the Hebden Mining company, which was formed in 1854, and its peak of extraction was in 1862, with 410 tons of ore produced, however, by 1888 the company had folded (NAA 2003). It worked the veins on three levels: Bottle Level, Middle Level and Top Level, of which Middle Level was not driven from the surface. The earliest level to be worked was Top Level, which worked Cockbur Vein and was accessed by an adit which has not been identified but probably came out just above the Bolton Gill Dressing Floor (Figs 10 and 11), and the dressing floor was therefore intended to be immediately adjacent to the portal. This area has now been covered by the spoil mound from the higher Engine Shaft (8.1) which has encroached into the area of the adit.
- 5.1.8 Bottle Level was worked from an adit (Site 23; Figs 11 and 13) driven from the area of the Hebden Gill Dressing Floor which provided the main outfall for the ore. This intensive period of working saw considerable investment in infrastructure, with Bottle Level being driven for up to a kilometre from the adit portal, and a large dressing floor was constructed outside the south-western portal to process the ore.
- 5.1.9 The ore beds worked by the Top Level were found to dip below Bottle Level, and at the eastern limit of the workings were found to be dead and unproductive (Gill 1994, 104) and so the company sunk the Bolton Gill Engine Shaft in order to follow the deeper Chance Veins, which extended below Bottle Level (*ibid*). Engine Shaft effectively comprised two shafts: the Power Lobby shaft (7.2) and the adjacent shaft (8.1) which were seemingly in contemporary use; although shaft 8.1 was constructed before 7.2. They had different functions; the Power Lobby shaft (7.2) had a small spoil mound by comparison with that of 8.2, and it contained coarse material that did not have a high lead content, and it had the bases for the pump rod transmission system constructed on top of it. The indications are that the spoil mound was created during the initial sinking of the shaft, and then the shaft was used for pumping the lower levels or providing power for a hoist, but was not used for the extraction of any further material. By contrast, the spoil mound (8.2) that extending out from shaft 8.1 was extensive, and had a high lead content demonstrating that shaft 8.1 was being used to extract the lead ore from lower levels. The two shafts were essentially part of a single mining operation. The fact that the spoil mound 8.2 seemingly covered the lower Top Level adit portal, which was beside the lower dressing floor (Site 9.2), and there was no obvious attempt to keep the portal open. This would indicate that the the Engine Shaft (Site 7.2 / 8.1) replaced and superceded the Top Level adit.

- 5.1.10 *Water Power*: the provision of water was fundamental to the mining operation, providing power for the dressing floors, to drain the lower levels and to provide power for hoists lifting ore from lower levels. Water wheels at Bolton Haw Side and the Hebden smelt mill provided power, transferred by pump rods to the Engine Shaft and vertical pump rods in the shaft pumped the water to higher adits. But this was all dependent upon the establishment of an extensive and sophisticated water system for the area, and reflects that the area was not sufficiently endowed with natural water supplies at the right altitudes. Mossy Moor Dam was constructed at some time between 1852 and 1853 (*Section 3.3.27*) initially to provide water for Hebden textile mill and then ultimately provided water for both the Hebden Smelt Mill and Bolton Gill Mines (R White pers comm).
- 5.1.11 This reservoir had only a limited catchment and it was therefore necessary to transport water along a leat from Bolton Gill over a distance of 1.03km to the dam to replenish it, and then a further leat, was necessary to take the water back again, over a similar distance and route, for a water wheel at the Bolton Gill dressing floor. Although it is possible that water was also supplied to the dressing floor directly from the top leat (Site **4.2**) (which was supplied from Bolton Gill), there are no surviving leats or launders to confirm such a supply. The wheel at the dressing floor was used to power hotching tubs, and the water was then used to wash ore in an adjacent bouse team.
- 5.1.12 The Engine Shaft was at too great an altitude to benefit from water from the lower leat (Site **4.1**), but a lower site on Bolton Haw Side was sufficiently low to be able to use the water from the lower leat, and a complex scheme was devised that entailed the use of a large water wheel to power pump rods that transferred the power up to the Engine Shaft. This was documented as a 40' wheel that was 3.5' wide (Gill 1994, 104; Mining Journal 13/07/1889, 808) and fed power to a Power Transfer House from where the pump rods were driven. This Power Transfer House (**17.1**) also took power from a powered ropeway (**17.2**) that transported power over a distance of 1.13km from a large water wheel at the Hebden Smelt Mill. An elaborate vaulted lobby was constructed over the Engine Shaft to house a wheel pit and a balance bob for the transfer of power down the shaft. Initially it would appear that there was a powered ropeway to transfer the power to the Engine Shaft and the wheel pit in the lobby was required to transfer the power; however, the physical and documentary evidence would indicate that the transmission system was changed to the use of push / pull pump rods that using a balance bob to transfer the power from the horizontal rods to vertical rods.
- 5.1.13 The water used for the Bolton Haw Side wheel was not wasted and an elaborate vaulted subterranean tail race (Site **18.1**) was used to take the water away from the wheel pit. The tunnel for this tail race has been interpreted as an adit (NAA 2003) and while it is possible that the tail race modified an earlier adit, no adit or mine was depicted in this location on the 1866 plan redrawn by J Varley (Plate 3). The outfall from the tail-race tunnel was originally diverted into a leat (Site **3**) which extended down the slope to a point (Site **3.1**) on the Bolton Gill dressing floor road; however, what it was used for is not presently clear. The waste water from this process was then carried by further tail races (**3.3** and **3.4**) into Bolton Gill. The water was then taken off from the beck to feed a further small reservoir (Site **29**) which was constructed over the entrance to the Bottle Level adit portal, and which provided water for the lower Hebden Gill Dressing Floor.

- 5.1.14 **Finalé:** although the company continued through until 1888, the lead production dropped off dramatically after 1866 and by 1872 Engine Shaft had been closed and there are no records of lead production after 1873 (Gill 1994, 120). These very extensive mining works were established over a short period of time, mostly within the first five years of the companies formation, and then were in use for only eighteen years.

5.2 CONDITION ASSESSMENT

- 5.2.1 The condition of the monuments and features were generally good, and although there are some elements of the industrial landscape that have been subject to a slow, on going process of decay, but in other areas this process is more rapid and has the potential to significantly impact the condition of individual features or parts of the site. The condition of individual features are presented as part of the gazetteer (*Appendix 3*). Highlighted below are the sites where there are concerns about their condition.

- **Duke's Level Dressing Floor (Site 1.7):** a trackway extends through the area of the dressing floor leading to a crossing of Hebden Beck; it has been used by vehicles (probably quads) which has resulted in a substantial erosion scar as it extends down the slope of the spoil mound. This has been compounded by water erosion.
- **Routeways onto the Northern Valley Side of Bolton Gill: (Site 5.1/5.2):** a series of historic engineered routeways have continued to be used for modern day wheeled vehicles, resulting in localised erosion. Sections of the historic routeway have survived, but would be vulnerable to erosion if the modern vehicle routes changed slightly.
- **Pump-rod Pillar Bases (Sites 7.3 and 17.2):** a series of pillar bases extending between the power transfer house and the Engine Shaft. They are in variable condition; the four easternmost pillars (Sites **7.3c-f**) are in generally good condition, whereas Pillars **7.3b**, **7.3j** and **7.3k** are in a very poor condition. Pillar **7.3b** was constructed on a spoil heap, which afforded only poor foundations, and it is now only a mound of collapsed stone. Pillar **7.3a** is in a poor condition but some of it is still in-situ. A further line of pillar bases extending east from the power transfer house also has a variable condition. Sites **17.2a** and **17.2c** are mostly collapsed and are in a poor condition; whereas **17.2b** is in good condition and stands to original height.
- **Bolton Gill Dressing Floor Bouse Team, Wheel Pit and Steps (Sites 9.2, 9.3 and 9.4):** the bouse team (Site **9.2**) has sustained considerable collapse and is in a poor condition. It has a retaining wall, which is bulging substantially and is in need of consolidation. Adjacent to the bouse team, is the wheel pit area (Site **9.3**) which has also sustained considerable collapse, and is in a poor condition. Being set above dressing floor, it is vulnerable to further decay. Adjacent to the bouse team was a set of steps (Site **9.4**) which were originally into a spoil mound of fine dressing floor waste, which has been subject to water erosion, undermining the steps. They have collapsed as an integral feature

downslope. Consolidation recommendations have been proposed for these elements (*Section 6.6.5*).

- ***Bolton Gill Dressing Floor Spoil Heap (Site 9.5):*** the spoil mound has no vegetation cover and considerable on going water erosion has worn down a gully through it.
- ***Bolton Gill Shaft Access Track (Site 10.1):*** an engineered access track, that leads between the Site **10** shaft and Engine Shaft, has a section supported by a retaining wall, which is in a fragile condition. Sections of the retaining wall have collapsed and there is the potential for these collapsed sections expanding.
- ***Bolton Haw Side Shafts (Sites 16.1 and 19.1):*** a large shaft (Site **16.1**) has substantial erosion scars down its south-west face, and there is animal burrowing set into its top. A further shaft at Bolton Haw Side (Site **19.1**) also has animal burrows extending across the shaft's spoil mounds, exposing dark, coal rich spoil.
- ***Bolton Haw Side Wheel Pit (Site 18.2):*** there is a substantial flow of water out from leat **4.1**, which is extending through the wheel pit and into the **18.1** tunnel. This is resulting in erosion down the sides of the pit and in the floor of the pit.
- ***Hebden Gill Dressing Floor (Site 24):*** the bank of Hebden Gill, adjacent to the dressing floor, has eroded despite attempts to consolidate it. There is a wooden launder sticking out of the river bank, which is rapidly degrading. The main track along the valley floor extends over the slab floor of dressing floor buildings; vehicle and pedestrian traffic is causing erosion to the buildings and exposing the footings of others. There is further track erosion adjacent to the bouse team.
- ***Bottle Level Reservoir (Site 29):*** there is vehicle and pedestrian erosion up the south-west corner of the earthen dam and the southern edge of the dam is degrading. Track erosion also extends across the western side of the reservoir.

6. BOLTON GILL COMPLEX STRUCTURAL ASSESSMENT

Blackett-Ord Conservation Engineering - March 2015

6.1 INTRODUCTION

- 6.1.1 This assessment covers the key elements of the standing remains of these monuments, namely the Hebden Gill Site Office, the mineshaft head and the dressing floor. It forms part of a brief for an Archaeological Survey of the site commissioned by the Yorkshire Dales National Park Authority and being carried out by Oxford Archaeology North.

6.2 MONUMENT DESCRIPTION

- 6.2.1 The Bolton Gill complex is part of the lead mines and processing works and twentieth century barytes mine on Grassington Moor, which is all a Scheduled Monument, and is on English Heritage's Survey of Monuments at Risk. The Engine Shaft was sunk in about 1855 to pump water from about 20m from Bottle Level. The shaft was fitted with pumps, driven by rods supported on stone pillars from a 40-foot diameter water wheel on Bolton Haw, some 600m away.

6.3 STRUCTURAL DESCRIPTION

- 6.3.1 *Site Office:* the Site Office was a two-storey, two-cell building located on the hillside above the water wheel. The external walls are still standing, but somewhat decayed, built of random rubble stone. Collapsed masonry covers the floor internally. There are no windows, doors or other fittings.

6.4 BOLTON GILL ENGINE SHAFT PORTAL

- 6.4.1 The shaft itself has been covered and blocked, but how safe or effective this is not known. Over the shaft and extending a total of about 8m in length is a vaulted chamber, which gave access to the shaft and previously housed the mechanism that converted the horizontal drive shafts to vertical motion to operate the pumps (Plates 35-9). The entrance to the chamber is blocked with a steel security fencing.

6.5 DRESSING FLOOR

- 6.5.1 The dressing floor has a 20m long rubble masonry retaining wall on its south-east side, and a similar wall but in poor condition along its north-east side. At the west end of this, there is a collapsed flight of stone steps, built onto a heap of tailings which is gradually eroding away, taking the steps with it (Plates 40-44).

6.6 REPAIRS AND CONSOLIDATION REQUIRED

- 6.6.1 **Site Office:** the main cause of structural damage to the building has been the removal of stone window and door lintels, and timber decay in those that remain. Stone sills would be most appropriate provided there is not a risk of them being stolen, otherwise the lintels can be replaced in oak or concrete. The masonry walls that are standing are vertical and reasonably safe, but there is inevitably loose masonry on the wall tops (Plates 27-34).
- 6.6.2 For stability, it is recommended that a section of wall that has collapsed down to ground-floor window cill level is rebuilt. It is proposed that the window lintel is reinstated and some masonry above this rebuilt to give some structural continuity in the front wall.
- 6.6.3 **Bolton Gill Engine Shaft Portal:** the only serious issue with the shaft head is a hole in the roof of the vault, approximately 400mm square. The purpose of this is not known, but it appears to be a formed hole and not just a collapse. The hole is blocked by rubble stonework of doubtful structural security, so it is recommended that a steel plate is fixed over the top of the hole, which should then be turfed over.
- 6.6.4 The top of the head wall should be consolidated, and the exposed vault stonework has a single loose voussoir. The vault should be packed with slivers of stone, and pointed from the top with lime mortar. The vault should then be covered with a layer of soil and turf.
- 6.6.5 **Engine Shaft Pump Rod Pillars:** the four easternmost pillars (Sites **7.3c-f**) are reasonably intact, but in order to prevent any further decay, the tops of each pillar should be consolidated by taking off and rebedding the top course of stone. Pillars **7.3b**, **7.3j** and **7.3k** have virtually disappeared and there is insufficient surviving to be able to reconstruct accurately. Pillar **7.3a** could be reconstructed but would need better foundations, and it is considered that complete reconstruction would not be economically justified.
- 6.6.6 **Dressing Floor:** there is a bulging section of the south-east wall about 3m long which should be carefully taken down and rebuilt. Similarly, a section of the north-east wall near the steps should be partially taken down and rebuilt straight.
- 6.6.7 The steps are a collapsed row of stone treads. It is proposed that the only meaningful way of preventing further decay would be to rebuild them with a rubble masonry wall to carry the west side of the treads. This would prevent further erosion.

6.7 SPECIFICATION

- Where mortar is to be used it should be lime mortar, but it is envisaged that the works to the Dressing Floor will be dry masonry construction;
- Wall consolidation should involve ensuring that the present wall tops are not too loose, and if they are, to carefully lift the top stones and rebed them on lime mortar;
- Generally a couple of courses of new stone should be added to the walls where they are below their original level;
- New oak lintels should have a lead tray over them to prevent them being saturated by water in the wall above.



Plate 27: Site Office Front Elevation



Plate 28: Site Office Interior



Plate 29: Office – Right-hand Door Lintel



Plate 30: Office – Left-hand Door Lintel – External

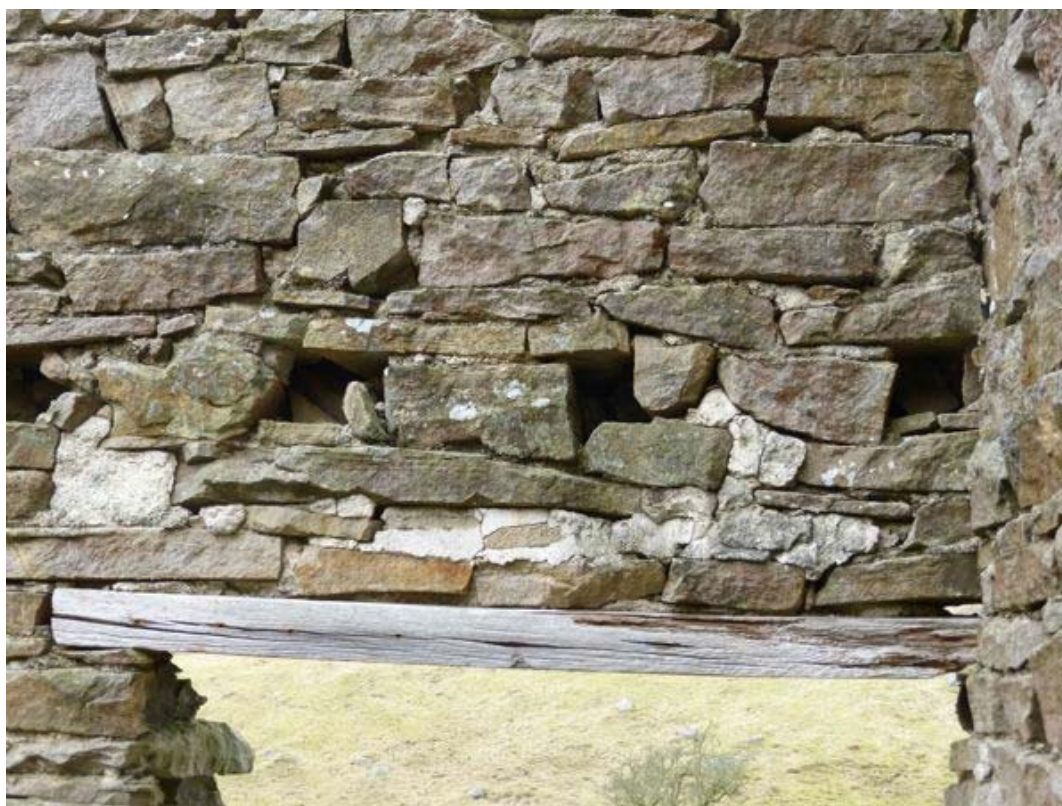


Plate 31: Office – Left-hand Door Lintel – Internal



Plate 32: Office – Interior Left-hand Cell



Plate 33: Office – Inside Front Right Corner



Plate 34: Office – Privy



Plate 35: Engine Shaft Portal - Front Elevation



Plate 36: Engine Shaft Portal - Interior



Plate 37: Engine Shaft Portal - Vault



Plate 38: Engine Shaft Portal - Top of Vault



Plate 39: Engine Shaft Portal - Top of Vault



Plate 40: Dressing Floor – Collapsed Steps



Plate 41: Dressing Floor – East Wall



Plate 42: Dressing Floor – Bulging Wall – (East Side)



Plate 43: Dressing Floor – North Wall



Plate 44: Dressing Floor – Collapsing part of North Wall

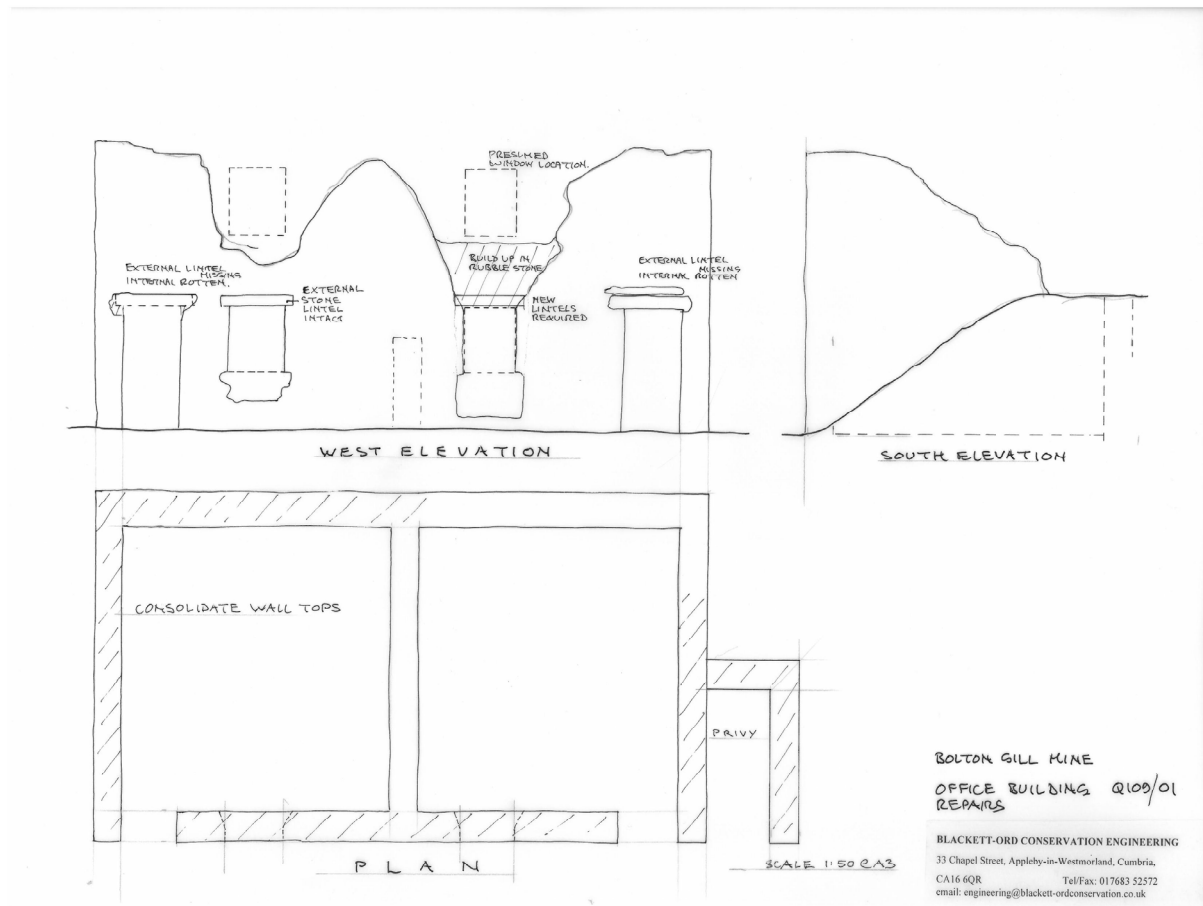


Plate 45: Sketch drawing of office building

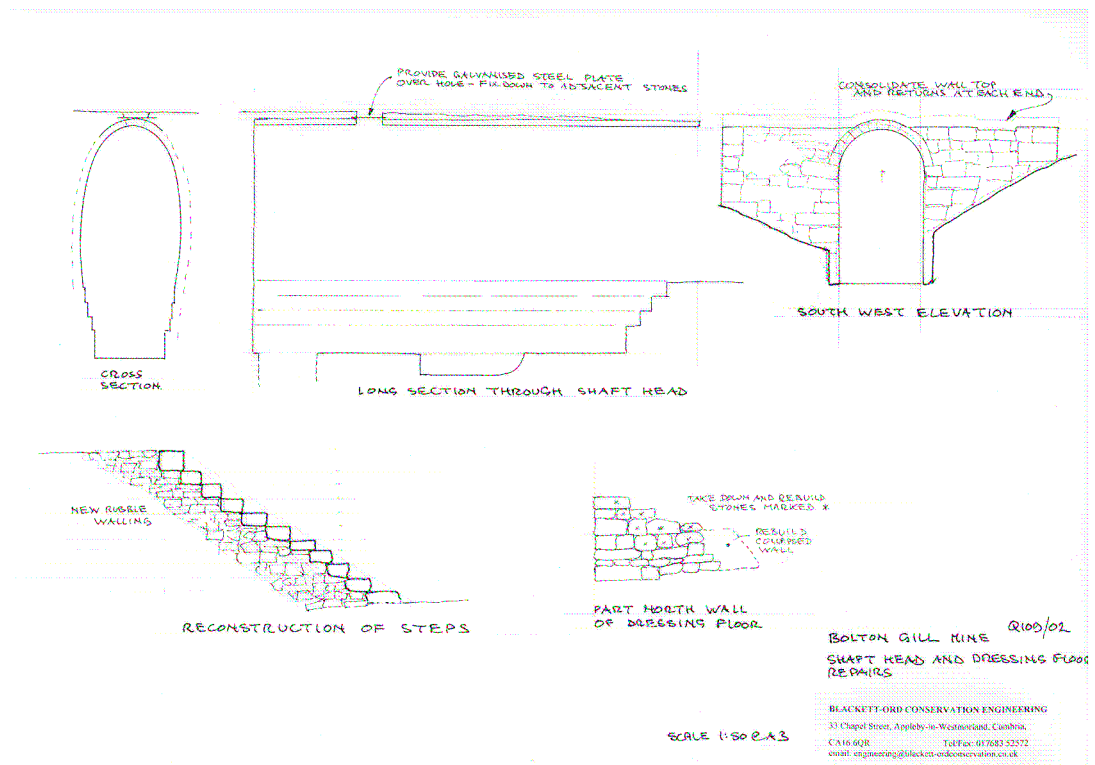


Plate 46: Sketch elevations and cross section through the Engine Shaft Lobby

7. BIBLIOGRAPHY

7.1 CARTOGRAPHIC SOURCES

OS 1st edition 1:10,560 map, 1852

OS 1st edition 1:2,500 map, 1891

OS 1st edition 1:2,500 map, 1909

7.2 SECONDARY SOURCES

Ainsworth S, Bowden, M and McOmish, D, 2007 *Understanding the Archaeology of Landscapes: a guide to good recording practice*, Swindon

Ed Dennison Archaeological Services Ltd (EDAS), 2014 *Draft Report on the Beevor and Cockbur Mines, Yarnbury, Grassington, North Yorkshire: Archaeological and Related Surveys*, unpubl rep

English Heritage, 1991 *Management of Archaeological Projects*, 2nd edn, London

English Heritage 2006, *Management of Research Projects in the Historic Environment* (MoRPHE), London.

English Heritage, 2006 *Understanding Historic Buildings: a guide to good recording practice*, Swindon

Gill, MC, 1983 The Duke's Level, Grassington; A Comment on John Taylor's Views, Northern Mines Research Society, *British Mining*, **23**, 59-60

Gill, MC, 1993a *Yorkshire Smelting Mills, Part 2: The Southern Dales and Lancashire*, Northern Mines Research Society, *British Mining* **48**, Keighley, 132-51

Gill, MC, 1993b *The Grassington Mines*, Northern Mines Research Society, *British Mining* **46**, Keighley

Gill, MC, 1994 *The Wharfedale Mines*, Northern Mines Research Society, *British Mining* **49**, Keighley

Gill, MC, 2004a *Northern Mines Research Society Mining Index*, Keighley, 234

Gill, MC, 2004b Small streams of water: the water resources on Grassington Moor, *Bull Peak District Mines Hist Soc*, **15 - 4/5**, 16-20

Hodge, P, 1997 *Power in Hebden Gill in the mid nineteenth Century*, Northern Mines Research Society, *British Mining* **59**, Keighley, 148-55

Institute for Archaeologist (IfA) 2010 *Code of Conduct*, Reading

Institute for Archaeologist (IfA) 2011, *Standard and Guidance for Archaeological Desk-based Assessments*; Reading

Johnson, D, 2001 and 2006 *Yorkshire Dales Lime Kiln Survey*, unpubl rep

Johnson, D, 2010 Limekilns in the central Pennines: Results of a field survey in the Yorkshire Dales and contiguous areas of north and West, Yorkshire, *Yorkshire Arch J*, **82**, 232-62

Joy, D, 2002 *Hebden: The History of a Dales Township*, Hebden

Monuments at Risk Survey (MARS) 2010 *Survey of Cockbur, Beever and Hebden Gill mining areas*, unpubl rep

Monuments at Risk Survey (MARS) 2010 *Survey of Hebden Gill Dressing Floor*, unpubl rep

NAA, 2003 *Hebden Gill Mine Shaft Repairs, Grassington, North Yorkshire: Topographical Survey and Watching Brief*, unpubl rep

Roe, M, 2003 Lead mining archaeology in the Yorkshire Dales, *Landscapes*, **4.1**, 65-78

Roe, M, 2007 *Grassington Moor lead Mines Assessment*, Meerstones Archaeological Consultancy unpubl rep

Roe, M, and Davies, A, 2007 Meerstone Archaeological Consultancy, *Hebden Moor Lead Mine Dressing Floor, Report of rapid survey to define the nature, condition and significance of the archaeological resource*; unpubl rep

SCAUM (Standing Conference of Archaeological Unit Managers), 1997 *Health and Safety Manual*, Poole

UKIC, 1990 *United Kingdom Institute for conservation: Guidelines for the preparation of archives for long-term storage*, unpubl rep

YDNPA, 2006 *Hebden: Conservation Area Appraisal*, unpubl rep

7.3 ON LINE SOURCES

Archaeology Data Service Bolton Gill Smelt Mill, 2014 accessed 10 October 2014

English Heritage 2014 List of Designated Monuments, list.english-heritage.org.uk, accessed 10 October 2014

Hebden Horse Level at Braemoor Server, 2014 <www.braemoor.co.uk> accessed 19 October 2014

APPENDIX 1: PROJECT BRIEF

YORKSHIRE DALES NATIONAL PARK AUTHORITY

SE029653

1. SUMMARY

This document provides a specification for an archaeological survey of the Bolton Gill engine shaft complex, part of the extensive, though somewhat misnamed scheduled monument, *Multi-period lead mines and processing works and 20th century barytes mill on Grassington Moor*, in Hebden and Grassington civil parishes, North Yorkshire and for the development of consolidation and management recommendations for the surviving structural remains within the survey area.

The project will be informed by a new non-destructive archaeological survey and structural assessment of the lead mining and processing remains. The survey is required to inform the future management of the complex.

The survey work will be commissioned by the Yorkshire Dales National Park Authority through the Yorkshire Dales Industrial Monuments Management Scheme funded by English Heritage.

2. INTRODUCTION

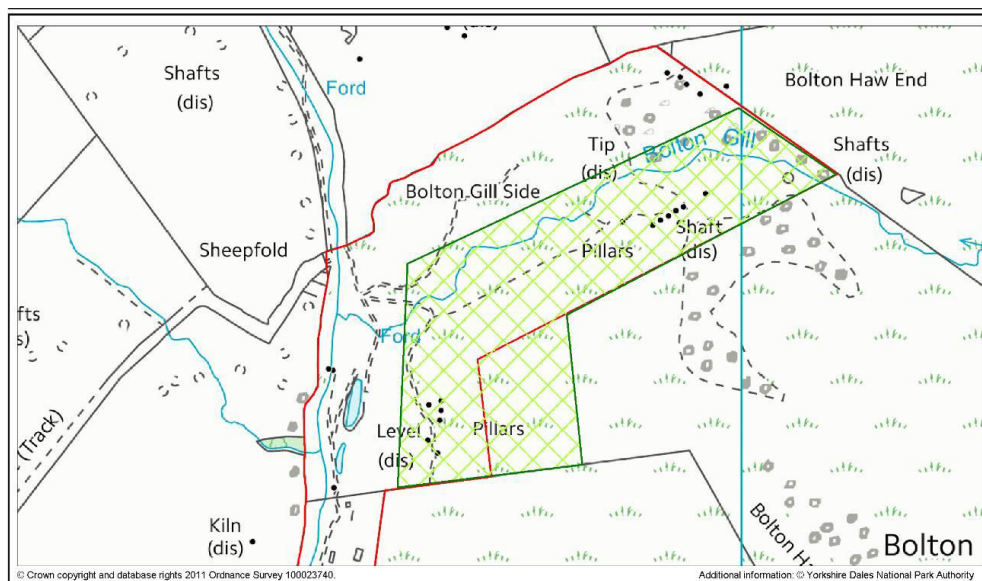
The Bolton Gill complex remains form part of the *Multi-period lead mines and processing works and 20th century barytes mill on Grassington Moor* scheduled monument which is identified as at High Risk on English Heritage's Monuments at Risk Survey. Survey and some consolidation works have been carried out over most of this monument but as yet no detailed work has been undertaken on the Bolton Gill complex (with the possible exception of some minor consolidation work by the Earby Mines Research Group in the 1970s) A detailed record will form the basis for developing management proposals and may be the most appropriate form of protecting the archaeological interest of the site if full consolidation is not likely to be cost effective.

3. MONUMENT DESCRIPTION

The Bolton Gill engine shaft is believed to have been sunk by the Hebden Moor Mining Co. in c1855 to pump water from about 10 fathoms from Bottle level. The shaft was fitted with pumps driven by rods, supported on stone stanchions from a 40' diameter waterwheel on Bolton Haw Side some 600 yards away. The arched pump rod lobby at the shaft top held a balance bob from which the rods in the shaft were hung. Below the shaft is a small dressing floor. The complex is briefly described in Gill (1994, 104)

4. LOCATION

The survey area, shown below outlined in grey, includes the core part of the Bolton Gill complex.



The survey area lies on the edge of a large grouse moor, parts of which are also used for sheep grazing. The vegetation is a mixture of rough grassland and heather moorland.

5. OWNERSHIP

The mining remains and mineral rights are privately owned.

The prospective contractors are required to indemnify the owners and tenants against any loss, damage or claims which may be made as a result of their entering the complex for survey purposes and accept liability for any personal injury loss or damage sustained due to the state of the complex whether occasioned by negligence or otherwise.

6. ACCESS

There is no vehicular access to the site. 4WD survey access may be arranged to the Beaver mine complex on the opposite side of the valley (SE023658 c900m) or to near the Hebden dressing floor area (SE026649 c600m). The survey area is CROW access land. Ground nesting birds such as grouse are very vulnerable to disturbance, especially during the breeding season. It is all too easy to inadvertently harm a bird or its young. If an adult bird is disturbed and leaves the nest, especially if it is prevented from returning to the nest, eggs or chicks may quickly chill and die. There are no grouse butts in the immediate vicinity of the site.

7. PREVIOUS ACTIVITY

As noted above the complex has been described by Mike Gill (1995, 99-108). The Hebden Moor Lead Mine dressing floor in Hebden Gill was the subject of a rapid survey to define the archaeological resource by Roe (2007, YDNPA HER SYD12892) and the Tail Race on Bolton Haw Side was surveyed by NAA in advance of civil engineering works by Yorkshire Water (2003, YDNPA HER SYD12716). The powered ropeway is discussed in British Mining 59, 1997.

8. AIM OF WORK

The aims of the project are to:

- i) Identify and gather sufficient information to establish the extent, nature, character, condition, quality, date, significance and functional relationships of the surviving archaeological and historical features within the survey area;

- ii) Provide a basic structural assessment of the standing remains of the Bolton Gill complex. The assessment should establish the consolidation needs of features.
- iii) Provide consolidation recommendations for the remains, including any ropeway pillars, while considering the needs of any protected species that may be present upon the complex.
- iv) Examine and document any evidence for damage to the complex that relates to either natural erosion, or current land management, drawing up a list of recommendations towards the 'ideal management' of New Mill.
- v) Provide a detailed, pre-intervention record of the complex.
- vi) Provide an accessible version of the report, suitable for publication in an appropriate academic publication.

A costed method statement for a new instrument survey of the archaeological and historical features together with a detailed description and photographic record and report and preparation of structural assessment and consolidation recommendations is required. This survey may be undertaken at a variety of levels. It is recommended that contractors make a preliminary visual inspection of the area to familiarise themselves with the extent of the archaeological remains, the nature of the terrain and the scope of the work.

9. SCOPE OF WORK

9.1 Topographic survey

A new, detailed instrument survey, accurate at 1:500 scale, is required of the principal area affected by industrial activity, together with detailed plans, accurate at 1:50 scale, of individual key structures and built features. The leats and pillar system may be surveyed at a larger scale with more detailed records being made of individual features where appropriate.

This should be reproduced as a general, hachured, site plan or plans at 1:500 scale showing the archaeological remains, together with sufficient topography to enable them to be readily located. This is to include the mapping of any boundary walls and coarse vegetation differences which may reflect previous activity on the site and differences in the exposed surface detritus. A detailed vegetation survey is not required. The survey work should include detail of any recent or intrusive material that has been deposited on the site, if any.

Detailed surveys are required of the engine house and dressing floor features and at least one representative pillar.. These are to be planned at ground level at 1:50, or at another scale appropriate to show the detail of the specific structures or features. Phased drawings of significant elevations of the built structures are required at 1:50 scale. Elevations can be based on rectified photographs or rectified digital imagery where appropriate. Drawings should show all significant architectural and structural features but stone by stone drawings are not required.

It is possible that the survey may identify other features requiring more detailed survey and which would also warrant consolidation; a decision on this will be made at the progress meetings.

Drawn records should be presented as wet ink plots on standard 'A' size matt surface stable polyester film sheets (Minimum thickness 75 microns) with appropriate grid marks, height values, compass points and information panel incorporating title, drawing number, keys, credits, date etc. Line thicknesses and point sizes should be chosen to allow for ease of duplication and reduction. Where appropriate drawing conventions should follow the general guidelines given in *Understanding historic buildings: a guide to good recording practice* (English Heritage 2006) and *Understanding landscapes: a guide to good recording practice* (English Heritage 2007) as appropriate.

Scanned versions of survey drawings are acceptable instead of wet ink plots but no use should be made of CAD methods for the generation of repetitive architectural features or detail.

9.2 Structural Assessment

A conservation accredited structural engineer or architect should inspect and report on the structural condition of all significant standing structures. This should also include the immediate surroundings to identify factors which could indicate a risk to any foundations. The structural

assessment should include recommendations for the protection and consolidation of the surviving structures together with ball park estimates of the costs of such work. Detailed specifications are not required at this stage.

9.3 Photographic Survey

An external photographic record should be made of all elevations of the structures and other features from vantage points as nearly parallel as possible to the elevation being photographed (within the constraints of the site), together with close up photography of significant detail. The contractor should ensure that all visible elements of each elevation are recorded photographically; this may require photographs from a number of vantage points. A general external photographic record should also be made which includes oblique general views of the structures and features showing them in their setting.

The general photographic guidelines given in *Understanding historic buildings: a guide to good recording practice* (English Heritage 2006) should be followed. Each photograph should normally be provided with a scale and the use of an identifier is recommended for detailed views.

Photographs should be used to show not only the structures' appearance but also to record the evidence on which the analysis of their historic development is based.

Digital imagery, rather than conventional film photography, is acceptable for the photographic recording although medium resolution images (2mb+) are required as a minimum. Unedited images should be archived, preferably as tiff files, as well as any processed images. A full image catalogue is required as part of the archive.

9.4 Written Accounts

A structured gazetteer of numbered site components should be made to include a summary description and preliminary interpretation of extant remains (eg location, dimensions, plan, form, function, date, sequence of development), mention of relevant documentary evidence and assessment of current condition and threats. Proforma record formats should be used: examples of the proposed format should be submitted with the method statement.

9.5 Samples and Loose Finds

No sampling work is intended as part of this project. Any vulnerable loose finds should be reported to the Senior Historic Environment Officer of the Yorkshire Dales National Park at the earliest opportunity. Any recommendations for sampling and material analysis should be made in the report.

9.6 Documentary Research

New documentary research has not been included in this Project Brief as historical and documentary research has been undertaken by NMRS members, principally Mike Gill.. Such information as is known to the Yorkshire Dales National Park Authority will be made available and provision should be made, and identified in the method statement and costings, for the incorporation of any appropriate information supplied by Mr Gill.. Contractors should allow for contact with Mr Gill. Copies of the 1st edition and 2nd edition OS 25" maps can be provided. The Yorkshire Dales National Park Authority has digital vertical aerial imagery, and a number of oblique available to view, some of which are available to reproduce.

10. PRODUCTS

10.1 Archaeological Survey Report

Two hard copies of an illustrated and typed report should be provided no later than eight weeks after the end of on-site work or such longer period as may be agreed in writing with the National Park Authority. Reports should be bound and A4 in format, unless otherwise agreed. A .pdf copy of the final report should also be supplied.

The report should assemble and summarise the available evidence for the monument in an ordered form, synthesise the data, comment on the quality and reliability of the evidence and how it might need to be supplemented by further work. It should include the following based on the processes outlined in 9.1 - 9.6.

Executive summary

Name of client.

Contents list

An outline of the project plan and research objectives.

A brief summary of any previous works on the site and immediate background.

Hachured earthwork survey

Detailed drawn sections, plans and, where appropriate, drawings and photographs of artefacts and other detail.

Written and graphic descriptions of stratigraphic units stating data acquisition levels.

An inventory of any finds.

Copies of appropriate archive drawings and photographs of the site before, during and after intervention.

Statement of methods used with reasoned explanation of any departure from standard procedures and details of any particular constraints under which the work was carried out.

An account of the overall form and development of the site and of the evidence supporting interpretation (including any specialist contributions)

Summary of significance of findings.

Notes and bibliography.

List and key to drawings and photographs.

Copy of the brief and the approved project design or method statement as well as an indication of any departure from this.

Names of staff involved and the parts played by each with the dates of fieldwork.

Acknowledgements.

A summary of the results should be prepared for publication in *British Mining*, *CBA Forum* or other appropriate journal or monograph as agreed with the Senior Historic Environment Officer of the Yorkshire Dales National Park Authority. A presentation at a day school on the historic environment of the Yorkshire Dales may be required.

The Yorkshire Dales National Park HER is taking part in the *Online Access to Index of Archaeological Investigations* (OASIS) project. The overall aim of the OASIS project is to provide an online index to the mass of archaeological grey literature that has been produced as a result of the advent of large-scale developer funded fieldwork. The archaeological contractor must therefore complete the online OASIS form at <http://ads.ahds.ac.uk/project/oasis/>. Contractors are advised to contact the YDNPA HER prior to completing the form.

The successful contractor is to license the Yorkshire Dales National Park Authority for unrestricted use of all survey material, drawings, photographs and other products of the project on payment of the final invoice. Information and plans etc resulting from the project (suitably acknowledged) may be used by these organisations in research reports, or any similar publications, for use in any interpretative or publicity material as well as being made available through the HER and its derivatives.

10.2 Structural Assessment Report

The report will describe the structural condition and adequacy of all the built structures inspected, and will identify any structural problems or concerns, suggest their probable cause, current active status, continuing threat and level of urgency. The report should include a photographic record of the structural defects.

The report will then recommend appropriate measures to rectify any structural problem/s. Where repairs/remedial works, or further investigations are recommended these recommendations should, where appropriate, include a range of alternative options with a 'best' option based upon good conservation principles and sound practicality.

This may be incorporated in the archaeological survey report or attached as an appendix.

10.3 Consolidation recommendations

These should identify all work necessary within the site to protect, secure and consolidate the monument and enable surviving features to withstand natural erosion and a low level of agricultural grazing and visitor activity. The concept to be followed for the industrial remains is "consolidate as found" rather than restoration and rebuilding although recently collapsed /vandalised pillars may warrant rebuilding and proposals are needed for these. Elsewhere if limited rebuilding is proposed as necessary to ensure the stability of the consolidated monument this should be fully justified. It is anticipated that the proposed works, unless specified otherwise, will require the use of traditional methods of building using traditional materials and should normally be reversible.

This may be incorporated in the archaeological survey report or attached as an appendix.

10.4 Survey Archive

The Contractor shall be expected to properly order and index the full archive record (paper, magnetic and plastic media) for the project in line with the standards set by the National Archaeological Record and to deposit the archive with the Yorkshire Dales National Park Authority. The archive should consist of the following:

Copies of relevant documentary material arranged to date sequence:

Bibliographic sources

Cartographic sources

Pictorial sources

Survey control information:

Diagram showing traverses and control network

List of coordinates of control points and traverse stations

Digital survey data

Set of Field and Final Ink Drawings:

Digital Photographs: Provided on CD or DVD.

Written accounts/pro formae gazetteers:

Site components

Individual contexts

Structured catalogues and indices:

Documentary material

Field and final ink drawings

Photographs

Project Management Records:

10.2 Structural Assessment Report

The report will describe the structural condition and adequacy of all the built structures inspected, and will identify any structural problems or concerns, suggest their probable cause, current active status, continuing threat and level of urgency. The report should include a photographic record of the structural defects.

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Digital Photographs: Provided on CD or DVD.

Written accounts/pro formae gazetteers:

Site components

Individual contexts

Structured catalogues and indices:

Documentary material

Field and final ink drawings

Photographs

Project Management Records:

APPENDIX 2: PROJECT DESIGN

1. INTRODUCTION

1.1 PROJECT BACKGROUND

- 1.1.1 An archaeological survey and structural assessment of Bolton Gill Lead Mines is required to inform the future management of the site (the site is a scheduled monument). The survey is being commissioned by Yorkshire Dales Industrial Monuments Management Scheme, funded by English Heritage.
- 1.1.2 There are two elements of the project the first entails the survey of the Bolton Gill Mine complex, and the second is the re-recording of the lower dressing floor, which has previously been recorded by Martin Roe (Meerstone Archaeology). The dressing floor will be surveyed but not reported on as the earlier survey provides an adequate interpretation. In addition there is a requirement to record Duke's Level which is on the west side of the gill, but has not been subject to earlier survey and will need to be surveyed and also reported on.
- 1.1.3 There is a requirement to undertake a structural assessment of the mine buildings, but also the mine shop, which is adjacent to the dressing floor and comprises a decayed two storey building.

1.2 HISTORICAL BACKGROUND

- 1.2.1 The Bolton Gill engine shaft is believed to have been sunk by the Hebden Moor Mining Company in c 1855 to pump water from a depth of about 10 fathoms and used a drive shaft driven by a 40' water wheel on Bolton Haw Side. This enabled the driving of Bottle Level to work Cockbur Vein. For a time the mine produced moderate amounts of ore, but the company's other levels, further down the gill, proved that the veins there were barren. A deep level, driven from the village of Hebden, was intended to prove the veins at their eastern ends, but it was given up (Gill 1994, 104).

1.3 OXFORD ARCHAEOLOGY NORTH

- 1.3.1 **Knowledge of Rural and Upland Archaeology:** OA North has particular and extensive expertise in upland archaeology. Since 1982 we have undertaken 38 major landscape field surveys covering 1007sqkm of uplands across England and Wales, which has comprised the recording of over 21,600 sites and monuments. Few archaeological organisations have a comparable track record and OA North can justifiably claim to be one of the foremost specialists in the field of upland / moorland landscape recording. Since 1984 all the surveys have been directed or managed by the OA North survey manager (Jamie Quartermaine, BA, DipSurv, MIFA) who has ensured consistently high quality and expert approach to the surveys undertaken.
- 1.3.2 The surveys range from basic identification management surveys intended to identify the character and location of the archaeological resource, to the increasingly detailed landscape analysis surveys which enable an understanding of the development of the landscape.
- 1.3.3 **Industrial Landscapes:** OA North has considerable experience of survey and analysis of industrial landscapes in Northern England, in particular lead mining landscapes. Examples include Grassington Moor smelting mill, Sargill smelting mill, Gunnerside Gill mine and Hunger Hill mine in North Yorkshire (LUAU 1994b; 1997a and 1999). Further afield, work has been undertaken at Nenthead, Wythburn and Greenside lead mines in Cumbria (LUAU 1997a; 1998b and OA North 2003), along with the survey of Paddy End dressing floors at Coniston copper mines (OA North 2007); as well as work at Snailbeach lead mines and smelter in Shropshire (LUAU 1990) and Rimington lead mines in Lancashire (LUAU 1998a). OA North is currently undertaking a new survey of the Greenside lead mines in Ullswater using photogrammetric techniques.
- 1.3.4 **Grassington Lead Mines:** OA North's involvement at nearby Grassington lead mines goes back to 1993-4, when we (in our former guise of Lancaster University Archaeological Unit) undertook a scheme of building surveys and an extensive detailed topographic survey (equivalent to EH Level 3

survey) centred on the Lead Smelting Cupola Mill and its surrounding environs (LUAU 1993 and 1994a).

2. AIMS

2.1 The aims of the project are as follows

- i) Identify and gather sufficient information to establish the extent, nature, character, condition, quality, date, significance and functional relationships of the surviving archaeological and historical features within the survey area;
- ii) Provide a basic structural assessment of the standing remains of the Bolton Gill complex. The assessment should establish the consolidation needs of features.
- iii) Provide consolidation recommendations for the remains, including any ropeway pillars, while considering the needs of any protected species that may be present upon the complex.
- iv) Examine and document any evidence for damage to the complex that relates to either natural erosion, or current land management, drawing up a list of recommendations .
- v) Provide a detailed, pre-intervention record of the complex.
- vi) Provide an accessible version of the report, suitable for publication in an appropriate academic publication.

3. METHOD STATEMENT

3.1 THE PROJECT TEAM

- 3.1.1 The project will be under the management of **Jamie Quartermaine** (OA North senior project manager) to whom all correspondence should be addressed. Jamie has been recording industrial landscapes across the north-west since 1986 both as project officer and as project manager. Jamie will undertake the aerial survey, and will also implement the processing of the photogrammetric survey.
- 3.1.2 Following the processing of the survey data, plots will be taken back to the site for draughting. This will be undertaken by **Peter Schofield** BA (OA North Project Officer) who has considerable experience of field survey work, including prehistoric and medieval landscapes, and has undertaken considerable survey work throughout Cumbria and was a team leader on the recent major survey of the Northern Welsh Uplands. He has considerable familiarity with the photogrammetric techniques that are being proposed.
- 3.1.3 **Structural Assessment:** the structural assessment will be undertaken by **Charles Blackett-Ord** BSc CEng FICE of Blackett-Ord Conservation Limited. He is a very experienced structural engineer, and is a fellow of the Institute of Civil Engineers (ICE) and has been specialising in the repair of historic buildings and structures in Northern England since founding the company in 1986.

3.2 SURVEY PREPARATION

- 3.2.1 There is no requirement for undertaking new documentary research, as this has been undertaken by Mike Gill. However, there is a need to acquire a strong understanding of the historical background to the site. This will entail the provision of material held by YDNP and also Mike Gill will be contacted to acquire any information not held by YDNP. YDNP can provide 1st and 2nd edition OS mapping (12500), and it is hoped modern OS mapping also.
- 3.2.2 The historic Ordnance Survey mapping will be scanned, and incorporated into a CAD system and georeferenced onto modern topographic mapping and will serve as the contextual mapping base for the subsequent elements of the programme.

3.3 TOPOGRAPHIC SURVEY

- 3.3.1 It is proposed that a detailed topographic survey be undertaken of the study area to English Heritage Level 3 (Ainsworth *et al* 2007), and will provide for a general topographic survey of the study area and also detailed recording of selected areas and buildings. The output of the whole survey area is required to be at 1:500 scale, but in actuality will be of sufficient accuracy to enable output at 1:100. It is proposed that the wider topographic survey be undertaken using a combination of survey grade GPS, and photogrammetry using aerial photographs taken from a UAV (Unmanned Aerial Vehicle). The detailed survey of the key structures and buildings will be undertaken using a total station.
- 3.3.2 **GPS Survey:** the control for the photogrammetric survey will be surveyed by means of survey grade GPS. The GPS that will be used is a Leica 1200 differential system and uses Ordnance Survey base stations in conjunction with a roving station to correct the raw data with corrections transmitted by mobile phone. The OA North GPS system is capable of accuracies of $\pm 0.02\text{m}$ and provides for an effective means of recording the detail of the features and also establishing survey control.
- 3.3.3 **Topographic Survey:** it is proposed to map the extent of the study area by a combination of photogrammetry and GPS survey; the former will be used to map features that are clearly visible from above and the GPS survey will be used to map features obscured by vegetation.
- 3.3.4 Photogrammetry is a long established technique which has been updated and refined such that it is now an extremely simple, cost effective and very accurate means of recording features and landscapes in three dimensions. It uses aerial photographs taken from a small electrically powered model helicopter (UAV) which has the ability to carry a light weight camera up to altitudes of 200 feet. The advantage of the UAV is that it can take photographs from variable altitudes to suit the level of recording required of the survey; low level photographs provide a very high resolution of ground features sufficient to be able to distinguish pebbles, whereas higher level photographs provide overall control across larger areas. Typically a survey model would entail the use of photographs taken from multiple altitudes, such that there is good ground resolution but which is accurate across a larger area.
- 3.3.5 Survey control is introduced to the photographs by the placement of survey control targets across the site which are located by means of the survey grade GPS. Additional survey points are obtained in order to test the accuracy of the photogrammetric model, which will typically vary from $\pm 20\text{mm}$ to 100mm depending upon the extent of the survey model.
- 3.3.6 The photogrammetric processing is undertaken using Agisoft Photoscan software which provides detailed modelling using the overlap of up to 300 photographs, and creates a very detailed DTM (Digital Terrain Model) across the site. The photographs are then digitally draped over the model to create an accurate three dimensional model of the ground surface. The primary output, however, is an accurate two dimensional image, overlying a DTM, which can be used to generate accurate plans and contours across the extent of the scheduled area. However, the 3D model can also be output as a tool to visualise the site from any perspective and can be viewed in Adobe Acrobat.
- 3.3.7 **Processing the Photographs:** the 3D models will be generated using Agisoft Photoscan Pro software, and will combine the photographs, compute the positions that the images were taken from, generate a 3d mesh, and then the photographs will be reapplied to the 3D mesh as a texture. Prior to initiating the processing, the photographs will need to be prepared, and this will entail the masking out of any background detail still left in the photographs, and then the application of survey control. The end product is a series of 3D models that can be viewed as 2D plans or in 3D within Adobe Acrobat.
- 3.3.8 **GPS / Manual Survey:** following the generation of the photogrammetric plots, they will be taken back to the field so that an experienced archaeologist can undertake a detailed inspection of the site, drawing up by manual survey those parts of the site that are clearly evident on the plots and using GPS survey techniques for those features that are obscured by vegetation.
- 3.3.9 **Detailed Survey:** the engine house and dressing floor features will be surveyed in plan using a total station, and will enable sufficient detail and accuracy for output at 1:50. The total station survey will be generated by EDM tacheometry using a total station linked to a pen computer running TheoLT software. The digital data is transferred onto the pen computer for manipulation and transfer to other digital or hard mediums. The survey data will be accurate to $\pm 0.01\text{m}$.
- 3.3.10 **Elevations:** the elevations of the buildings will also be undertaken by photogrammetry, which would provide the most accurate means of recording elevation detail. The principles of the technique are the same as for the topographic survey, except that the photographs are taken from the ground facing the

elevation, but again a number of photographs from many different positions ensures the best level of accuracy. Survey control is applied to wall by the placement of survey targets onto the wall which are surveyed by total station. A model is created for each elevation using the control and then a 2D photographic textured output from the model is inserted into CAD which can be used to draw up the detail of the elevations.

- 3.3.11 **Drawing Up:** the raw data from the total station and photogrammetry will be inserted into a CAD system, and then plots will be generated to enable the drawing up of the sites within the field. The elevations will include all structural features but will not entail the provision of stone by stone drawings.
- 3.3.12 The archaeological detail is drawn up in the field as a dimensioned drawing on the plots with respect to survey markers. On completion of the field survey the drawings will be enhanced within the CAD environment to produce the final drawings.
- 3.3.13 The survey will record all pertinent archaeological detail. The results of the survey will be superimposed upon the modern OS mapping, the historic Ordnance Survey mapping, the orthophotos from the photogrammetry and the photogrammetric contour data.
- 3.3.14 **Photography:** in conjunction with the archaeological survey a photographic archive will be generated, which will record significant features as well as aspects of the general landscapes. It will be undertaken in accordance with guidelines in the English Heritage guide to recording historic buildings (English Heritage 2006) and will include scale bars and identifiers for general shots. However, photography used to generate the 3D models will exclude scale bars but will include survey targets. This photographic archive will be maintained using a digital SLR camera with 16 mega pixel resolution. The use of a digital camera provides very effective manipulation of photographic images, and these will be used in the report. The photographic record will include detailed coverage of all elevations and all the structures will be viewed from multiple vantage points. Photographs will generally be archived as Tiff files although those used to generate the 3D models will be in JPG format.
- 3.3.15 **Site Description and Assessment:** it is intended to create a descriptive record of the individual elements and components that make up the wider site. It is proposed that the data be directly input on site into a palm computer. The data will be incorporated into an Access 97 compatible database, and will be backed up daily onto a portable computer running Access 97. The input into the system will be guided by a proforma to ensure uniformity and consistency of input, and will provide input for all the relevant fields, and will be compatible with the YDNPA HER. This data will be formatted and topped and tailed within word to produce the gazetteer volume for the survey project. The gazetteer entry will provide a preliminary interpretation, links to relevant documentary or historic cartographic sources and a statement of condition and threats.

3.4 STRUCTURAL ASSESSMENT

- 3.4.1 A Structural Assessment of the Bolton Gill mines will be undertaken by Blackett-Ord Conservation Engineering. This will examine the structural form and condition of all built structures across the site, and will highlight any structural issues, identifying the underlying cause of any deterioration. The assessment will examine the severity of any threats and the urgency for consolidation and repair works. The condition of the structures will be photographically documented and any defects will be fully recorded.
- 3.4.2 The structural assessment report will identify options for repair, monitoring and stabilising of the structural remains, which will include long term best-practice solutions as well as short term expedient options to stabilise structures. Ball park estimates for the conservation works will be proposed, and will include a range of options for stabilisation. The report will be incorporated into the archaeological report and the consolidation recommendations will be linked to the archaeological recommendations.

3.5 REPORT

- 3.5.1 **Digital Presentation:** the survey data would be collated within a CAD environment and would combine the topographic and photogrammetric data. A digital copy of the archive can be provided in

shape file format alongside the final report. Digital photography would be provided, and would be appropriately indexed. PDF copies of all drawings will be provided as well as the base cad files.

- 3.5.2 The survey data would be output as a series of metrically accurate orthophotos covering the study areas and the individual structures. In addition detailed contour plots would be provided for the survey area at an appropriate contour separation.

- 3.5.3 **Reporting:** a report will be compiled for the topographic survey and structural assessment which would present, summarise, and interpret the results of the programme. The reports would consist of an acknowledgements statement, lists of contents, summary, introduction summarising the brief and project design and any agreed departures from them. The reports would include sections on the following:

Report:

Clients name and frontispiece

A concise, non-technical summary of the results;

Contents;

Project aims and objectives;

A description of the project and methodology;

Historical and Archaeological background;

Survey Results;

Assessment of the condition of the historic environment remains;

Structural assessment of the built structures

Bibliography;

Copies of the project brief and project design;

a gazetteer of all identified monuments and historic features;

Illustrations:

A site location plan related to the Ordnance Survey national grid;

Orthophotographs of each of the study areas

Hachure Survey Drawings

Hachure drawings superimposed onto orthophotos

Contour survey drawings superimposed with hachure drawings

Detailed plans and elevations

- 3.5.4 The site mapping would be based upon the CAD base. The report would be accompanied by photographs and historic illustrations illustrating the principal elements of the landscape.

- 3.5.5 **Editing and submission:** the reports would be subject to the OA North's stringent editing procedure and then a draft would be submitted to the client for consultation. Following acceptance of the report three bound copies of the report would and a PDF copy would be submitted.

- 3.5.6 **Output:** two hard and one digital copies and of the reports would be submitted to the client, and a bound copy of the reports would be submitted to the Yorkshire Dales National Park Authority. Each report would be illustrated by a selection of prints and maps.

- 3.5.7 **Publication:** a summary of the results of the survey will be placed in the public domain by submission as a journal in British Mining, and in a form to be agreed with the Senior Historic Environment Office YDNP. A presentation may be required at a day school on the historic environment of the Dales.

- 3.5.8 **OASIS:** there is a requirement to complete the OASIS online form (<http://ads.ahds.ac.uk/project/oasis/>), which will, on validation by Yorkshire Dale National Park, enter the public domain via the OASIS website.

4. OTHER MATTERS

4.1 ACCESS

- 4.1.1 It is assumed that Yorkshire Dales National Park Authority will obtain access to undertake the survey from land owners and tenants. It is assumed that four wheel drive access will be available to near the Hebden dressing floor (SE 026649).

4.2 HEALTH AND SAFETY

- 4.2.1 **Health and Safety:** full regard will be given to all constraints during the survey, as well as to all Health and Safety considerations. The OA North Health and Safety Statement conforms to all the provisions of the SCAUM (Standing Conference of Unit Managers) Health and Safety manual and the Health and Safety at Work Act 1974. Bespoke risk assessments based upon first-hand site visits are undertaken as a matter of course for all projects, and will be used to identify and mitigate against the potential hazards arising from the project. As part of the initial stages of the project an overarching Health and Safety management plan will be created and reviewed throughout the course of the preparatory stage until the project is implemented. After this the review process and daily monitoring will take place on site. A detailed Risk Assessment and Method statement will be produced in conjunction with YDNPA, with individual focus on the survey area, highlighting the specific risks and issues associated with the site.

4.3 INSURANCE

- 4.3.1 The insurance in respect of claims for personal injury to or the death of any person under a contract of service with the Unit and arising in the course of such person's employment shall comply with the employers' liability (Compulsory Insurance) Act 1969 and any statutory orders made there under. OA carries an appropriate level of insurance for covering liabilities on major projects. These are currently Employers Liability Insurance (£10,000,000 any one occurrence), Public Liability Insurance (£10,000,000 any one occurrence), Professional Indemnity Insurance (£5,000,000 any one claim and in all) and Contractors All Risks Insurance (£1,500,000).

4.4 PROJECT MONITORING

- 4.4.1 OA North would inform the YDNP Park of all significant developments, and any potential departures from the agreed programme would be discussed and agreed with them prior to implementation. The project would be monitored by the Senior Historic Environment Officer. He would be informed at least two weeks in advance of the dates for the proposed fieldwork and would be notified in the event of significant findings. A site meeting will be arranged to discuss the programme and all aspects of the site.

5. RESOURCES

BOLTON GILL SURVEY

Task	Resources
Project Preparation	3 days (PO)
Site Meeting	1 PM
Photogrammetric /Instrument Survey	4 man days (PO and PS)
Photogrammetric Processing	1 day (PM)

Draughting	7 PO
Reporting	8 PO

DRESSING FLOOR SURVEY

Task	<i>Resources</i>
Photogrammetric Survey	5 man days (PM, PO and PS)
Photogrammetric Processing	1 day (PM)
Draughting	7 PO
Reporting	4 PO

PM = Project Manager

PO = Project Officer

APPENDIX 3: SURVEY GAZETTEER

Site no.	1
Site name	Duke's Level
HER no.	42707
NGR	40268 46482
Designation	Scheduled Monument 1018333
Site type	Lead Mine: Level
Period	Eighteenth to Nineteenth Century
Significance	High
Sources	OS 1st edition 6" map, 1852; Gill 2004, 655; Gill 1983, 59
Description	Duke's Level was begun as a 'Boat Level' in 1796. It was driven about 9ft high by 5ft wide until it was nearing Cupola Shaft when John Taylor reduced it to the normal size (c 6 ft x 4ft). It reached the Coalgrovebeck Engine Shaft in 1830 at a depth of 72 Fathoms.
Feature No.	1.1
NGR	402634 464792
Type	Adit Entrance
Photo Ref	IMG0144.jpg - IMG0154.jpg
Sources	OA North Survey 2015; Gill 2004; OS 25" 1st edition map (1891); OS 6" 1st edition map (1852)
Description	A stone-revetted channel extending out from a partially-blocked, arched, adit entrance. There is presently a considerable flow of water draining out from the adit. The channel is 17.5m long and 1.5m wide, and then becomes a subterranean culvert, which diverts to the south-east through a steep sided gully to an outfall into Hebden Beck (Site 1.3). The present arch from the adit is partly blocked but it is not certain if that was an ancient blocking or a more recent one. There is a water-filled chamber, topped by an iron grill, immediately in front of the adit entrance. It is above the flowing water channel, and is full of 'still' water indicating that there is no connection with the water flow extending beneath it; it is of an unknown purpose. Two brick arched walls extend across the open channel. There is an enclosure of dry-stone walls extending around the adit entrance, which are depicted on the OS 1st edition 25" map (1891), but not on the OS 6" 1st edition map (1852). Two brick arched walls extend across the open channel and their purpose is unknown, but given the use of brick, which contrasts with the use of stone elsewhere, it is possible that they were not contemporary with the construction of Duke's level entrance, possibly when the level was subsequently used as a water supply (R White pers comm).
Condition:	Good: it is currently protected by a fence, preventing stock and visitor pressure. The surrounding walls are intact and in good condition
Feature No.	1.2
NGR	402659 464772
Type	Finger Mound
Photo Ref	IMG0132.jpg
Sources	OA North Survey 2015; Gill 2004; OS 25" 1st edition map (1891)
Description	A finger spoil mound extending out from the adit entrance (Site 1.1), which then bends to the south to follow the line of the beck. The mound defines the southern edge of the gully that carries the subterranean channel out from the adit to its Hebden Beck outfall. The mound is in places 4m high (with respect to the base of the gully). It is overlain by a field boundary dry-stone wall. It is composed of large stone blocks.
Condition:	Good: it has limited turf cover and its north-east side has historically been disturbed by the modification of a conduit to a concrete water outfall.
Feature No.	1.3
NGR	402663 464781
Type	Adit Outfall
Photo Ref	IMG0137.jpg; IMG0199.jpg
Sources	OA North Survey 2015; Gill 2004; OS 25" 1st edition map (1891)

Description	Extending out from the adit entrance is a steep-sided gully, with substantial spoil mounds on either side. There is a subterranean culvert within the gully, and the entrance to this can be seen at the western end of the open channel in Site 1.1 , comprising a stone-capped culvert, which is 0.4m below the base of the gully. However, the water has presently been diverted through an immediately adjacent modern concrete water management installation, and through this the water from the adit outfalls into Hebden Beck. There is no outfall shown on the OS 25" OS map (1891).
Condition:	Moderate: the original conduit has been modified to accommodate the construction of the modern concrete water management installation.
Feature No.	1.4
NGR	402645 464807
Type	Spoil Mound / Crushing Floor ?
Photo Ref	IMG0137.jpg
Sources	OA North Survey 2015; OS 25" 1st edition map (1891);
Description	A part of the larger spoil mound which extends between the outfall for Duke's Level (Site 1.3) and Site 1.7 . Its southern end forms the northern edge of the outfall gully. It has a steep slope edging Hebden Beck, and extends to the north up to a routeway gull that drops down to a ford that crosses Hebden Beck (Site 1.7). It has an irregular upper surface comprising small mounds of mainly larger material, but at the northern end, adjacent to Site 1.7 , are two mounds of markedly smaller-sized material (the southern most was 4m across and the northernmost was 5m across) and were potentially the spoil from the initial crushing of the ore. A further stage of dressing was undertaken in Site 1.7 , where there are further deposits of finer material.
Condition:	Moderate to good: the spoil mound and crushing floor is partially turf covered, and those areas without turf reflect the high concentrations of lead within the material on the crushing floor.
Feature No.	1.5
NGR	402626 464803 - 402602 464938
Type	Dry-stone wall
Sources	OA North Survey 2015; OS 25" 1st edition map (1891); OS 6" 1st edition map (1852)
Description	A section of decayed dry-stone wall at the western edge of the Duke's Level spoil mounds, and is shown on the OS 1st edition 25" map and the 1st edition 6" map. Duke's Level spoil mound is almost entirely contained between this wall and the beck, and it was probably an ownership boundary which has, to an extent, constrained the extent of the spoil deposition. It crosses over the northern end of the spoil mound, and this section obviously post-dated the spoil mound, but appears to follow a similar line to the present one on the 1852 map. It is to be presumed that this section of the boundary wall was rebuilt over the top of the spoil mound after it had been completed, but it is probable that the original boundary pre-dated this element of the spoil mound.
Condition:	Poor: the dry stone wall is in a poor condition and survives mostly as a degraded line of collapsed stone.
Feature No.	1.6
NGR	402625 464865
Type	Spoil Mound
Sources	OA North Survey 2015; OS 25" 1st edition map (1891); OS 6" 1st edition map (1852)
Description	A large, flat-topped spoil mound which has large and small stone material on the surface. There are mounds of large stones at the eastern side of the spoil mound. It has a steep slope on its eastern side adjacent to Hebden Beck. The northern edge of this section of spoil mound is defined by a small gully cutting into the eastern side of the mound. There are areas of crushing floor deposits near to the dressing floor (Site 1.7)
Condition:	Moderate to good: the spoil mound and crushing floor is partially turf covered, and those areas without turf reflect the high concentrations of lead within the material on the crushing floor. There is limited track erosion on its western side.
Feature No.	1.7
NGR	402630 464825
Type	Retaining Wall and Dressing Floor

Photo Ref	IMG0135.jpg
Sources	OA North Survey 2015; OS 25" 1st edition map (1891); OS 6" 1st edition map (1852)
Description	A section of retaining wall that edges the southern side of spoil mound 1.6 . It has a possible continuation to the east and is adjacent to a routeway holloway through the spoil heaps that leads to a ford crossing of Hebden Beck. There is a low bank extending out from boundary wall 1.5 and there is a possibility that this was a continuation. Immediately to the south of the wall is a deposit of finely-processed material, which, significantly, has no grass growing on it and which was almost certainly caused by the lead-rich nature of the waste material. The material is markedly finer than the piles of crushed ore spoil to the south (Site 1.4) and would appear to be the output from ore dressing. The retaining wall would appear to define the northern edge of the dressing floor.
Condition:	Moderate to poor: a trackway extends through the area of the dressing floor leading to a crossing of Hebden Beck; it has been used by vehicles (probably quads) which has resulted in erosion as a substantial scar as it extends down the slope of the spoil mound. A further north/south track erosion scar has caused damage immediately to the west of the dressing floor.
Feature No.	1.8
NGR	402630 464825
Type	Spoil mound
Photo Ref	IMG0135.jpg
Sources	OA North Survey 2015; OS 25" 1st edition map (1891); OS 6" 1st edition map (1852)
Description	This is the northern end of the spoil mound, which has steep sides dropping to the north and to the east, directly above Hebden Beck. It is separated from 1.6 by a small gully through the spoil mounds, and which may be an artificial distinction. Wall 1.5 extends over the top and was evidently constructed after the completion of the spoil mound. The top surface of the spoil mound has a mixture of small and large stone material. There is a small section / mound of spoil extending from the north-west end of the main mound and, as a routeway uses this line, there is a possibility that the small section of spoil was used to provide the foundation for part of the track.
Condition:	Moderate to good: the upper surface of the spoil mound is in moderately good condition apart from a substantial track scar, where a quad track crosses wall 1.5 . There is a small gully that has eroded down the eastern slope of the spoil mound; however, this has grass growing at its base and does not necessarily reflect recent erosion. There is some slippage of the spoil mound at its northern edge dropping to Hebden Beck.

Site no.	2
Site name	Bolton Gill
NGR	40273 46528 - 40288 46537
Designation	Scheduled Monument 1018333
Site type	Access track for Bolton Gill Mine
Photo Ref	IMG0184-5.jpg
Period	Nineteenth Century
Significance	Medium
Sources	OS 25" 1st edition map (1891); Gill 1994
Description	A terraced track (Site 2.1) leading down from Bolton Gill to the area of the Bottle Level and the Hebden Gill Dressing Floor. It is terraced into the slope and is 2.5m in width; it has a slightly undulating surface, and a uniform descending slope. It is a substantial earthwork and has evidently been built up with quarry waste. Adjacent to it is a small, spoil mound (Site 2.2), which may reflect the tipping of additional material from the track.
Condition:	Moderate: the western section of the track is in reasonably good condition. The eastern section, however, has a series of scars along its upper surface where the covering turf has been lost, and this is particularly noticeable where it crosses the line of a beck.

Site no.	3
Site name	Bolton Gill

NGR	40275 46560 - 40278 46541
Designation	Scheduled Monument 1018333
Site type	Leat
Photo Ref	IMG0180-3.jpg
Period	Nineteenth Century
Significance	High
Sources	OS 25" 1st edition map (1891); Gill 1994, 113
Description	<p>A leat (Site 3.2) extends across the slope from the area of Bolton Haw Side (Site 18.1). It has a uniform, descending slope, as it tangentially crosses the hillside. It is 1m wide and 0.3m deep; at the north-west end it is revetted with stone on the northern side and there exists the probability that the rest of the leat was also stone revetted.</p> <p>It terminates at a walled structure (Site 3.1) at the north-eastern end of leat 3.2. Structure 3.1 is formed of dressed blocks, which exhibit a slightly curved face. It is immediately adjacent to the access track for Bolton Gill mine (Site 2), but there exists the possibility that it pre-dated the track in its present form. Below the track is a pair of channels (Sites 3.3 and 3.4) which extend down the slope feeding into Bolton Gill. The westernmost of these (Site 3.4) starts at a hollow set into the slope of the hillside, which was possibly an outfall for a subterranean culvert. The second (Site 3.3) cuts the westernmost channel and follows a slightly different route but ultimately converges with the first before feeding into the gill. A 2m wide bank defines the northernmost edge of the channel and forces it to converge with Site 3.4.</p> <p>The function of the leat is uncertain. One possibility is that this took the waste water from the outfall of the subterranean channel at Bolton Haw Side and diverted it across the slope into Bolton Gill, from where it could then, at a lower level, be fed into the reservoir by Bottle Level. The structure at the track (Site 3.1), would therefore have been the entrance to a culvert diverting the water underneath the track. Another possibility is that this was the mounting for a water wheel, but this does not explain what the wheel was used for.</p>
Condition:	Good: there is uniform turf cover over the extent of the leat. The southernmost end was damaged when the outfall for the Site 18.1 tail race was modified in 2003

Site no.	4
Site name	Bolton Gill
HER	MYD 59529
Designation	Scheduled Monument 1018333
NGR	40284 46529
Site type	Leats
Period	Nineteenth Century
Significance	High
Sources	OS 25" 1st edition map (1891); Gill 1994, 113
Description	A pair of leats (Sites 4.1 and 4.2) that extend across the slope of Bolton Haw Side between Mossy Moor Dam and the Bolton Gill Mines, and, in the case of Site 4.2 , to Bolton Gill.
Feature No.	4.1
NGR	402898 465360 - 40290 46440
Type	Leat
Sources	OA North Survey 2015
Description	An irregular, narrow, linear terraced feature set into the slope of Bolton Haw Side, which undulates above and below the level. It is no more than 1m wide, and has the appearance of a sheep trod; however, at its eastern end it is represented by the exposed line of a stone-capped culvert, and it is evident that this was a leat. It can be traced from aerial photographs as extending between Mossy Moor Dam and the Bolton Gill Dressing Floor; it follows a shallow sloping line down towards the dressing floor demonstrating that it was providing water for the documented wheel at Bolton Gill.
Condition:	Moderate to good: the leat is mostly sub-terranean and survives on the surface as a narrow terrace that has been adopted as a sheep trod. There is limited erosion on the surface, but the underlying leat/culvert is mostly undisturbed.

the western section of the track is in reasonably good condition. The eastern section, however, has a series of scars along its upper surface where the covering turf has been lost, and this is particularly noticeable where it crosses the line of a beck.

Feature No.	4.2
NGR	40295 46537 - 40300 46450
Type	Leat
Photo Ref	IMG0198.jpg
Sources	OA North Survey 2015
Description	A well-defined leat, forming a narrow, linear terraced bank set into the slope of Bolton Haw Side. The slope is uniform and at the eastern end, particularly, there is an exposure of a stone-capped culvert; however, there are occasional indications of the stone capped culvert along its length confirming that it survives as a buried culvert. From aerial photographs it very visible, extending from Mossy Moor Dam to the Engine Shaft; however, it is also visible as a subtle feature extending towards Bolton Gill to the east of Engine Shaft. Mike Gill (1994) reports that this was a feeder leat for the Mossy Moor Dam taking water from the New Dam. This is confirmed by the observed evidence as it is apparent from the contour data that there is a gentle slope dropping down towards the west, and the leat ultimately ends up at the northern corner of the reservoir, above the dam, and was therefore feeding into the dam rather than drawing from it. The leat extends very close to the southern side of the Engine Shaft (Site 7.2), but no direct, extant connection. It is probable that there was a timber divert channel from this point providing an alternative water supply for the wheel on the dressing floor below.
Condition:	Moderate to good: the leat is mostly sub-terranean, but there are substantial sections, particularly to the south, where the capping stones are exposed. Almost all of the capping stones are still in situ.

Site no.	5
Site name	Bolton Gill
NGR	40270 46530 - 40294 46549
Designation	Scheduled Monument 1018333
Site type	Access tracks
Period	Nineteenth Century
Significance	Medium
Sources	OS 25" 1st edition map (1891); OS 6" 1st edition map (1852)
Description	The lines of ancient and modern access routes onto the moor on the north-west side of Bolton Gill. These tracks reflect continued use for farming activities subsequent to the abandonment of the mines, and the lines have been substantially modified in places. Many of them are merely erosion scars, but one (Site 5.2) is clearly an engineered route and was probably created for the mining operations on the north side of Bolton Gill.

Feature No.	5.1 / 5.2
NGR	40268 46530
Type	Access Track
Significance	Medium
Sources	OA North Survey 2015; OS 25" 1st edition map (1891)
Description	The line of an engineered holloway that extends around the southern side of the spur at the northern side of Bolton Gill. It is cut into the slope to produce a uniform gradient, and then emerges onto the top of a spur. Further on there is a divert, where a modern erosion scar continues the line up the spur, whereas the western diversion is an engineered gully (Site 5.2), and has a uniform ascending gradient and a uniform 2m width. It has two very distinct ruts in the base of the gully. Site 5.2 is the historic line of the access track, and was substantially engineered into the slope to ensure a uniform gradient. It has little recent erosion and is clearly not an access route that is currently used. It is shown on the 1891 OS map, but not on the 1852 6" map (the latter has a different line for the access route (Site 5.4). The eastern divert line is modern and currently used by quads.

Condition:	Poor: this historic, engineered trackway has continued to be used through to the present for wheeled vehicles, and this has resulted in localised erosion. Fortunately the modern line of the track has diverted away from an old section of the track (Section 5.2) which is presently in good condition.
Feature No.	5.3
NGR	40269 46532
Type	Access Track
Sources	OA North Survey 2015
Significance	Low
Description	A further line of access route (Site 5.3) and extends a round the south side of a small knoll. It is, for the most part, an erosion scar and reflects recent vehicle usage (mainly quads). Its line is not shown on the historic OS mapping.
Condition:	Poor: this is a section of trackway which has been adversely affected by quad traffic; however, it was not necessarily an early route line.

Site no.	6
Site name	Bolton Gill
NGR	402876 46534
Designation	Scheduled Monument 1018333
Site type	Adit and Spoil heap
Period	Nineteenth Century
Significance	Medium
Sources	OA North Survey 2015
Description	A small spoil mound and a possible adit located just above the main access track (Site 2). It is not shown on the OS mapping and it is displaced away from the line of nearby Providence Vein, and may therefore have been an unsuccessful trial.
Feature No.	6.1
NGR	402874 465339
Type	Spoil heap
Sources	OA North Survey 2015
Description	A spoil tip extending out from the location of a revetted stone structure (Site 6.3), which was possibly the entrance to an adit. The spoil mound is ill-defined and does not have much spoil in it, by comparison with other shafts in the valley; it is 13m x 9m in size.
Condition:	Moderate to good: the spoil mound has thick grass and bracken vegetation over it and there is little indication of modern erosion.
Feature No.	6.2
NGR	402874 465339
Type	Gully
Sources	OA North Survey 2015
Description	There is a small gully (Site 6.2) upslope from the spoil heap, which was possibly enhanced by hushing activity as it has an artificial character.
Condition:	Moderate: this is an erosion gully just up from the spoil heap. It is presently wet ground and has thick vegetation. Although it has been subject to working and water erosion in the past there is little indication of recent erosion.
Feature No.	6.3
NGR	402899 465342
Type	Possible Adit
Sources	OA North Survey 2015
Description	Just up-slope from the spoil mound (Site 6.1) is a small outcrop face 3m across, with a distinct hollow / gully immediately in front of it. There is a number of upright stones protruding on either side, and one large stone. Given its proximity to the spoil mound and the gully in front of the outcrop face there is the probability that this was the collapsed portal of a small, exploratory adit.

Condition: Moderate: this a possible adit which has suffered erosion in the past causing collapse of the probable portal, but relatively little erosion within recent years as indicated by the vegetation cover.

Site no.	7
Site name	Bolton Gill: Engine Shaft
HER no.	42377
NGR	40293 46536
Designation	Scheduled Monument 1018333
Site type	Lead Mine: Engine Shaft
Period	Nineteenth century
Significance	High
Sources	Gill 2004, Northern Mines Research Society Mining Index, 234; Hodge 1997
Description	A mine shaft which was sunk by the Hebden Moor Mining Company in <i>c</i> 1855 and was closed in <i>c</i> 1872. It comprises a large stone-built chamber over the shaft (7.2), a dedicated spoil mound (7.1) and a series of stone pillars (7.3) which supported a drive shaft that brought power to the site for pumping and driving a hoist. Adjacent to this power lobby shaft was a further shaft (Site 8.1) which was also part of Engine Shaft.
Feature No.	7.1
NGR	402953 465381
Type	Finger Spoil Mound
Sources	OA North Survey 2015
Description	A finger spoil mound extending out from the entrance of the Engine Shaft (7.2). The stone material is coarse and there is dense grass over it, which would suggest that there is not a high lead content in the spoil (other spoil mounds here have thin or no grass cover). This was evidently the spoil from the cutting of the shaft. It is 41m x 2m in size. The pillars for the pump rod lobby (drive shaft) are constructed on top of it and clearly post-date its formation.
Condition:	Good: the spoil mound has a thick protective turf deposit over it and has limited the impacts of erosion.
Feature No.	7.2
NGR	402934 465366
Type	Shaft Surround (Engine Shaft)
Photo Ref	IMG0189-92.jpg
Sources	OA North Survey 2015
Description	A covered shaft entrance, with elaborate revetted walls forming a tall, barrel-vaulted portico to the shaft. It would have provided a roof over the shaft entrance and housed wheels for transferring power into the shaft. There is a rectangular indentation for a wheel base in the centre of the structure's interior. The portico is constructed of dry-stone, partially dressed blocks, with dressed stones for the voussoirs of the vault. The internal walls are constructed on a bedrock bench on both sides and part of the chamber is rock cut. Inside the entrance are three stone steps dropping down to the floor of the chamber. Outside the entrance of the entrance arch are two low, revetted walls defining the approach to the structure (to the north-west it is 2.5m x 1m high; to the south-east it is 3.2m x 1m high). That to the north-west has a large stone mounted on top with a carving, possibly for an engine mount, on its upper side. Behind the facade, and on top, is an irregular mound, with evidence of the crown of the barrel vault protruding through the grass cover.
Condition:	Moderate to Good: the vaulted portal is generally in good condition, but there is a need of limited consolidation. In particular the exterior of the vault is exposed and needs to be covered by soil and turf. There is some limited erosion of the earth cap over the vault at its eastern end. This is addressed further in the structural assessment report (Section 6.4).
Feature No.	7.3
NGR	402945 465376 - 402880 465336

Type	Stone Pillars for pump rod lobby
Photo Ref	IMG0186-88.jpg; IMG0190.jpg; IMG0193-7.jpg
Sources	OA North Survey 2015
Description	<p>A series of nine stone pillars, and two possible stone pillars, that supported a drive shaft (pump rods) which extended from Bolton Haw Side to the entrance of Engine Shaft (7.2). The pillars are typically 1.7m x 1.4m in plan and 1m in height, constructed of dry-stone, roughly-dressed field stones. They all had large ashlar stones on top (typically 0.8m x 0.5 in plan); however, these now only survive on pillars C and D. Set into the ashlar blocks were two iron bolts for supporting the drive shaft mount. Five of the pillars (B-F) are located on top of, and post-date, the spoil heap (7.1) for the engine shaft. Pillar B is almost entirely collapsed and would have been located a metre to the south-east. There are no foundations visible, however, in the anticipated location. Pillar A is located 43m away from the previous pillar in the line (Pillar B) and is significantly lower than those on the spoil mound and it is possible that it supported a timber tower to bring it to the same height of the others.</p> <p>Directly in line between the engine house and power transfer structure is a levelled terrace set into the slope (7.3g; 402822 85705) which clearly had to be reduced to enable a line of sight, and therefore also the line of pump rods, between the two. This is the highest point on the line of sight between the Engine Shaft portal and the Power Transfer House, and to enable a perfectly straight, uniform gradient, line for the mounting of the pump rods, there would have been a need to mount them below the present surface of the terrace by as much as 0.5m to 1m. It is therefore probable that the rods extended through a culvert / tunnel at this point and would explain why there is no evidence for a pillar in this location.</p>
Condition:	Moderate to Poor: the four easternmost pillars (Sites 7.3c-f) are reasonably intact, Pillars 7.3b, 7.3j and 7.3k have virtually disappeared. Pillar 7.3a is in a substantial state of decay but could be reconstructed

Site no.	8
Site name	Bolton Gill (Engine Shaft)
HER no.	42383
NGR	402969 465391
Designation	Scheduled Monument 1018333
Site type	Lead Mine: Top Level
Period	Nineteenth century
Significance	High
Sources	Gill 2004, Gill 1994; Northern Mines Research Society Mining Index, 240; Hodge 1997;
Photo Ref	IMG0246.jpg
Description	A large shaft and associated spoil mound adjacent to the Power Lobby shaft (Site 7.2). The two shafts were essentially part of a single operation with shaft 8.1 being used to extract ore and 7.2 being used to drain the lower levels.
Feature No.	8.1
NGR	402969 465391
Type	Mine Shaft
Sources	OA North Survey 2015
Description	<p>A large circular mine shaft, with spoil mound around the outside. The internal edge of the shaft is internally revetted, and there are presently large stones collapsed into the present base. A very large stone (size 2.48m x 0.65m), which is crudely dressed, extends across the top of the shaft and may have been intended to support a hoist. The entrance to the shaft opens out to the south-west, and there is a hollow, immediately beyond the edge of the shaft, which has a 0.5m drop down to the floor to the south-west and may have served as a loading ramp for the spoil to be transported to the spoil heap (Site 8.2). The hollow is between this mine shaft and the mound for the stone surround of the Power Lobby (Site 7.2), and is an indication that this shaft was still in use when the Power Lobby was constructed. Both shafts have separate spoil mounds and appear to have had different functions, despite their proximity. There is a large flat area in front of the shaft and the spoil mound has small, crushed fragments of ore and there is a possibility that this area was used as a dressing floor at some stage in its use.</p>

Condition:	Good: the turf and bracken over the shaft is largely undisturbed and there are few indications of any recent erosion.
Feature No.	8.2
NGR	402945 465387
Type	Finger Spoil Mound
Sources	OA North Survey 2015
Description	A finger spoil mound extends south-west out from the entrance of the Shaft 8.1 . It comprises a mixture of large blocks and fine crushed material. It would appear, therefore, that there was a process of basic dressing being undertaken on the floor adjacent to the Shaft 8.1 . The spoil mound has been cut into by the surround for the Power Lobby (Site 7.2), and it is evident that the spoil mound pre-dates the Power Lobby.
Condition:	Moderate: the high lead content of the spoil means that there is little or no vegetation over the spoil mound. Where visitors have climbed up the spoil mound there has been erosion and the main erosion scars are up the face of the spoil mound and in the gully between Site 7.1 and 8.2 spoil mounds.
Feature No.	8.3
NGR	402977 465388
Type	Possible shaft
Sources	OA North Survey 2015
Description	An artificial hollow set into the slope, which has steep sides and a flat base. It is immediately adjacent to Shaft 8.1 ; it is on the line of Cockbur Vein and was possibly a shaft that was superseded by the Shaft 8.1 . It is 8m x 6m in size. It does not have a large amount of spoil associated with it.
Condition:	Moderate to good: there is generally undisturbed turf and bracken over the shaft and little indication of recent erosion.
Feature No.	8.4
NGR	402969 465377
Type	Possible shaft
Sources	OA North Survey 2015
Description	A small artificial hollow set into the slope, with a hollowed-out base, and a distinct mound on the downslope side. It was possibly an early, small scale, and perhaps exploratory, shaft.
Condition:	Moderate to good: there is generally undisturbed turf and bracken over the shaft and little indication of recent erosion.

Site no.	9
Site name	Bolton Gill: Dressing Floor
NGR	40289 46537
Designation	Scheduled Monument 1018333
Site type	Lead Mine: Dressing Floor
Period	Mid-Nineteenth century
Photo Ref	IMG0252.jpg
Significance	High
Sources	Gill 2004, Northern Mines Research Society Mining Index, 240;
Description	This is a dressing floor, comprising a flat terraced area, edged by retaining walls, which includes a bouse team, and probable water wheel pit, with spoil mounds extending out from two areas of dressing floor.
Feature No.	9.1
NGR	402898 465372
Type	Dressing Floor
Sources	OA North Survey 2015
Description	A rectangular, flat, terraced area edged to the south and south-east by large revetment walls, which are still largely intact. The internal area is artificially flat, and in limited exposures through the turf has fine deposits of crushed and processed ore. There is little grass on the

Condition:	adjacent spoil mounds, an indication that the spoil was lead rich. There are few internal features within the area of the floor, and would suggest that the processing was undertaken using portable or perishable structures, such as hotching tubs or by manual sorting techniques. Moderate: the interior of the dressing floor has little erosion, but there is some limited collapse of the south-west end of the retaining wall, and there is considerable collapse of the bouse team and retaining walls at the north-east end of the dressing floor. There is also a bulging section of the south-east retaining wall which needs repair (<i>Section 6.6.5</i>).
Feature No.	9.2
NGR	402905 465380
Type	Bouse Team
Sources	OA North Survey 2015
Description	A sub-circular hollow, set into the slope with retaining walls to the south-west and north-west. It forms a cone shape, funnelling down to an aperture through the façade revetment wall. It has an exposed stone and earth core, which is putting pressure on the north-west section element of the façade and is now bulging. It is adjacent to a water wheel and the outfall of leat 4.1 and a channel down from the upper leat (4.2). There is also a water erosion scar below the aperture and this leads to a gully between two spoil heaps. The implication is that there was water involved in the lead processing. The form of the structure is consistent with a bouse team, which would have been used for storing lead ore; however, it is probable that it was also used for washing the lead ore. There is a set of steps around the outside of the bouse team, which would have afforded access between the main dressing floor and that above the bouse team. It is 6.5m x 5.1m in size.
Condition:	Moderate to poor: the bouse team has sustained considerable collapse and is in a poor condition. There is a retaining wall, which is substantially bulging and needs to be consolidated (<i>Section 6.6.5</i>).
Feature No.	9.3
NGR	402908 465377
Type	Possible Wheel Pit
Sources	OA North Survey 2015
Description	A long rectangular hollowed feature set into the corner of the revetted wall of the dressing floor. It has steep, formerly revetted, sides and there is a stone-revetted platform structure on its southern side. A leat (4.1), leading from the south-west, terminates at the stone platform and this was possibly a springing point for a short section of launder. There may also have been a launder / channel leading down from the upper leat (Site 4.2) which would have followed the line of the track to the west of the 8.2 spoil mound; however, there is no surviving indication of this.
Condition:	Moderate to poor: the wheel pit area has sustained considerable collapse and is in a poor condition.
Feature No.	9.4
NGR	402900 465385
Type	Steps and dressing floor
Sources	OA North Survey 2015
Description	A series of 11 ashlar steps that are located around the north-western side of the bouse team. They were constructed on top of fine crushed ore material, and on-going water erosion has resulted in the washing away of this fine material and the whole step system has collapsed as an essentially intact entity to the north-west. It was evidently constructed against a structure that was located between it and the bouse team, but there is no indication of any structure here. Above the steps is a large, flat area between spoil heap 8.2 above and spoil heap 9.6 below. The spoil heaps below are largely made of fine crushed ore and it is probable that this area was a dressing floor, where ore was crushed. The ore selected out from the crushed stone would have been deposited in the bouse team and the non-lead material would have been deposited onto the spoil heaps.
Condition:	Poor: the steps comprises a collapsed row of stone treads, and are no longer <i>in situ</i> , and need to be reconstructed.

Feature No. 9.5
NGR 402891 465376
Type Spoil Heap
Sources OA North Survey 2015
Description A large spoil heap extending out from the lower dressing floor and comprises medium and fine stone material, and there is no grass cover over the mound indicating that it is lead rich. The stone material has evidently been crushed and includes material which has also been washed and processed.
Condition: Moderate to poor: the spoil mound has no vegetation cover and considerable on going water erosion has worn down a gully through the spoil mound.

Feature No. 9.6
NGR 402906 465393
Type Spoil Heaps
Sources OA North Survey 2015
Description A series of merged large spoil heaps extending out from the upper dressing floor and comprising medium and fine stone material, but also some larger stones; there is no grass cover over the mound indicating that it is lead rich. The stone material has evidently been crushed but includes some material straight from the mine.
Condition: Moderate: the spoil mound has little vegetation cover and has been subject to water erosion.

Site no. 10
Site name Bolton Gill: Mine Shaft
NGR 403034 465403
Designation Scheduled Monument 1018333
Site type Lead Mine Shaft and spoil heap
Period Nineteenth century
Significance High
Sources Gill 2004, Northern Mines Research Society Mining Index, 240; Gill 1994
Description This is a mine shaft located on the Cockbur Vein, and an access track / spoil mound extending out from it.

Feature No. 10.1
NGR 402955 465397 - 403028 465416
Type Access track and Spoil Heap
Sources OA North Survey 2015
Description A hollow, immediately adjacent to Bolton Gill, is defined and edged by some very large stones. It is just below the shaft **10.2**, and was probably the access point for moving spoil from the shaft. A long track extends from the hollow along a line, following the gradient, adjacent to Bolton Gill. The track is variously 1 to 3m in width and is in places supported by a revetment wall on its northern side. It terminates at a long, but not very high, finger spoil mound near Shaft **8.1**. There are a series of large stones set into the upper surface, which would have restricted the movement of wheeled vehicles.
Condition: Moderate to poor: the track is supported for a substantial section by a retaining wall which is in a very fragile condition. Sections of the retaining wall have collapsed and there is the potential for further collapse extending out from these sections.

Feature No. 10.2
NGR 403034 465403
Type Mine shaft
Sources OA North Survey 2015
Photo Ref IMG0241-2.jpg
Description A deep (3m deep) circular shaft with a large amount of spoil deposited around the main depression. It is set just up from the start of the access route (**10.1**) and between them is a large pile of rocks making the transfer of spoil down to the track awkward. There are many large stones around the interior of the shaft. The spoil mounds are grass covered and there are some large stones within the spoil.

Condition: Moderate to good: there is thick undisturbed vegetation over the shaft which is in a stable condition.

Feature No. 10.3
NGR 403047 465405
Type Mine shaft
Sources OA North Survey 2015
Photo Ref IMG0243.jpg
Description Adjacent to the main shaft is a second, smaller, shaft. It comprises a small hollow which may be a small exploratory shaft. It is surrounded by large stones and there is a small spoil heap around the outside.
Condition: Moderate: there is some limited erosion through the turf cover, but otherwise it is in good condition.

Feature No. 10.4
NGR 403064 465394
Type Mine shaft
Sources OA North Survey 2015
Description To the east of the main shaft and shaft 10.4 is a further shaft / exploration it comprises an irregular extraction into the slope, and does not have a large amount of spoil associated with it. It would appear to be an exploratory shaft.
Condition: Moderate to good: there is thick undisturbed vegetation over the shaft which is in a stable condition.

Feature No. 10.5
NGR 403068 465393
Type Mine shaft
Sources OA North Survey 2015
Description To the east of shaft 10.4 is a further shaft / exploration, comprising a shaft / hollow set into the slope, with a mound of spoil to the front (lower slope). It was probably an exploratory shaft.
Condition: Moderate to good: there is thick undisturbed vegetation over the shaft which is in a stable condition.

Site no. 11
Site name Bolton Gill: Hushes
NGR 4029 4654
Designation Scheduled Monument 1018333
Site type Series of hushes
Period Seventeenth to Eighteenth centuries
Significance High
Sources OA North Survey 2015
Description A series of hushes extending down the northern side of the valley side.

Feature No. 11.1
NGR 402989 46439
Type Hush ?
Sources OA North Survey 2015
Photo Ref IMG0244.jpg
Description A wide area of eroded ground, edged at the up-slope side by a sharply defined, break of slope indicating that the ground has slipped relatively recently. This may be a recent land slippage, or a result of hushing activity. A long linear mound defines the south-eastern side of the scar, and may potentially be a spoil heap; however, there is no obvious shaft upslope from it. Alternatively, it may be a linear line of ground that survived the land slip.
Condition: Moderate to good: there is some limited disturbance of the vegetation cover and reflects that there is only thin vegetation cover over the site.

Feature No.	11.2
NGR	403023 465487 - 402973 465432
Type	Hush
Sources	OA North Survey 2015
Description	A long linear, narrow, straight scar gully extending down the northern side of the valley. It is over 80m long and in places 17m wide, and is extremely deep in places. It has a slightly irregular shape reflecting the erratic nature of soil slippage. Mine shaft 12.1 is close to the line of the scar, and its spoil has extended into the area of gully erosion, indicating that the hush pre-dated the shaft. The enclosure wall cuts across the gully and blocks it, indicating that the hush pre-dates the wall, which was first depicted on the 1891 OS 25" map. It was probably an early element of the mining landscape.
Condition:	Moderate to good: there is thick reed vegetation within the hush indicating that there is still considerable water flow down the hush.
Feature No.	11.3
NGR	402968 465491 - 402946 465418
Type	Hush
Sources	OA North Survey 2015
Description	A long linear, narrow, slightly sinuous scar gully extending down the northern side of the valley. It is over 75m long and in places 9m wide, and is up to 6m deep in places. It has a slightly irregular shape reflecting the erratic nature of soil slippage. It is within an area of dressing floors and dressing waste spoil extends in localised areas into the area of hush gully, indicating that the hush pre-dates the dressing activity. It was probably an early element of the mining landscape.
Condition:	Good: there is uniform vegetation within the hush and little indication of recent disturbance.
Feature No.	11.4
NGR	402943 465486 - 402909 465413
Type	Hush
Sources	OA North Survey 2015
Description	A long linear, narrow, sinuous scar gully extending down the northern side of the Bolton Gill valley. It has a straight line up to a point on the level dressing floor area, and then diverts to the south, and extends around an oval mound. It is over 83m long and in places 10m wide, and is up to 5m deep in places. It extends through an area of dressing floors and dressing waste spoil extends into the area of the hush gully, indicating that the hush pre-dates the dressing activity. It was probably an early element of the mining landscape.
Condition:	Moderate to Good: there is uniform vegetation within the hush, but there are areas of exposed ground near to it.

Site no.	12
Site name	Bolton Gill: Mine Shafts
NGR	4028 4655
Designation	Scheduled Monument 1018333
Site type	Mine Shafts
Period	Eighteenth to Nineteenth century
Significance	High
Sources	OA North Survey 2015
Description	A line of four shafts

Feature No.	12.1
NGR	402973 465464
Type	Mine shaft
Sources	OA North Survey 2015
Photo Ref	IMG0245.jpg
Description	A sub-circular shaft (5m x 4m), with a deep central hollow (c 2.5m deep) and a mound of spoil around it. It has steep internal sides and there is some spoil extending down slope from it in a tongue to the south. This spoil heap overlies hush 11.1 and evidently post-dates it.

Condition:	Good: there is uniform undisturbed vegetation within and around the shaft.
Feature No.	12.2
NGR	402964 465474
Type	Mine shaft
Sources	OA North Survey 2015
Photo Ref	IMG0248.jpg
Description	A sub-circular shaft (3.5m x 3m), with a deep central hollow (c 1.5m deep) and mound of spoil around it. It has steep internal sides. It is a less pronounced feature than 12.1 .
Condition:	Good: there is uniform undisturbed vegetation within and around the shaft.
Feature No.	12.3
NGR	402954 465482
Type	Mine shaft
Sources	OA North Survey 2015
Description	A sub-circular shaft (3.5m x 3m), with a central hollow, but which opens out to the south-east and there is a mound of spoil extending out from here down slope towards the south-west and into the hush 11.3 . It would, therefore, appear to post-date the hush.
Condition:	Good: there is uniform undisturbed vegetation within and around the shaft.
Feature No.	12.4
NGR	402948 465489
Type	Mine shaft
Sources	OA North Survey 2015
Photo Ref	IMG0249.jpg
Description	A sub-circular shaft (6.5m x 5m), with a central hollow (c 1.5m deep), and which has steep sides and a spoil mound around the southern edge.
Condition:	Moderate: there has been some collapse into the shaft and erosion scars around the northern and western internal edges of the shaft.
Feature No.	12.5
NGR	402928 465487
Type	Mine shaft
Sources	OA North Survey 2015
Photo Ref	IMG0250.jpg
Description	A sub-circular shaft (3.8m in diam), with a central hollow (c 1.5m deep), and which has steep sides, but with slight spoil mound to south.
Condition:	Good: there is uniform undisturbed vegetation within and around the shaft.

Site no.	13
Site name	Bolton Gill: Hushes
NGR	13.1: 402865 465433 - 402874 465409
NGR	13.2: 402873 465440 - 402880 465408
Designation	Scheduled Monument 1018333
Site type	hushes
Period	Seventeenth to Nineteenth century
Significance	High
Sources	OA North Survey 2015
Photo Ref	IMG0275.jpg
Description	A pair of narrow hushes extending down the northern side of the valley side. They extend down the steepest part of the valley side and are very straight and immediately adjacent to each other. Their straight form confirms that they are artificial and therefore hushes. They are on average 25m x 12m in size.
Condition:	Moderate: generally uniform vegetation across the hushes but there are localised patches of erosion within the bottom of the gully, where grazing and water erosion have combined to impact on the features.

Site no.	14
Site name	Bolton Gill: Dressing Floor Level
NGR	403034 465403
Designation	Scheduled Monument 1018333
Site type	Dressing Floor
Period	Nineteenth century ?
Significance	High
Sources	OA North Survey 2015
Description	This is a dressing floor below a line of mine shafts on the north side of the valley.
Feature No.	14.1
NGR	402938 465464
Type	Dressing Floor Structure
Sources	OA North Survey 2015
Photo Ref	IMG0253-6.jpg
Description	A small rectangular dry-stone structure, standing up to five courses and 0.6m high in the midst of the dressing floor area, and is on a gentle slope area below steep slopes and below a series of mine shafts; this site is to the west of the hush (Site 11.3) that extends through the area. The structure is open to the south, and in the back wall there is a stone lintel defining an aperture leading to a small hollow beyond. A further, very degraded, structure / wall is located immediately to the south-west of the main structure. There is a deposit of very fine, red soil associated with it, which is very different from the other exposed ore deposits on the dressing floor and is an indication that the activity practised here was distinct that at the other dressing floor areas. This structure was possibly a buddle, and would have entailed the washing and processing of the ore. The lintel-covered aperture potentially brought water into the structure from the north. There is, however, no indication of a tail race or gully below the structure.
Condition:	Moderate to Good: the high lead content within the dressing floor waster means that there is little vegetation cover over the dressing floors. The floors are accordingly vulnerable to water erosion. The structure is in goods condition, but there are indications of erosion of turf cover to the dressing floor.
Feature No.	14.2
NGR	402933 465455
Type	Dressing Floor
Sources	OA North Survey 2015
Photo Ref	IMG0257-9.jpg; IMG02573.jpg
Description	A dressing floor area in an area of gentle sloping ground below a line of mine shafts. It comprises exposures of fine stone material, which are not turf covered, implying that the material is lead rich. There is a low, artificial, bank just above it which was possibly a component of the dressing floor. There are further outcrops of fine material to the east, and it is possible that much of this area was used as a dressing floor for crushing and manual sorting of the ore. There are five areas of exposed crushed ore waste, but there may have been further areas beneath the turf.
Condition:	Moderate to Good: the high lead content within the dressing floor waster means that there is little vegetation cover over the dressing floors. Despite the exposure there are few indications of recent erosion within this area of dressing floor. They are, however, vulnerable.
Feature No.	14.3
NGR	402958 465451
Type	Dressing Floor
Sources	OA North Survey 2015
Description	A dressing floor in an area of gentle sloping ground below a line of four mine shafts. It comprises exposures of fine stone material, which are not turf covered. There is a low, artificial, bank just above it which was possibly a component of the dressing floor. There are further outcrops of fine material to the west, and it is possible that much of this area was used as a dressing floor for manual crushing and the sorting of the ore.

Condition: Moderate: the high lead content within the dressing floor waster means that there is little vegetation cover over the dressing floors. There are erosion scars at the upper edges of the dressing floors and the limited turf cover is receding.

Site no.	15
Site name	Bolton Gill: Mine Shafts
NGR	4029 4654
Designation	Scheduled Monument 1018333
Site type	Mine Shafts
Period	Eighteenth to Nineteenth century
Significance	High
Sources	OA North Survey 2015
Description	A line of three shafts

Feature No.	15.1
NGR	402921 465470
Type	Mine shaft
Sources	OA North Survey 2015
Photo Ref	IMG0265.jpg
Description	A sub-circular shaft (3.5m diameter), with a central hollow and a mound of spoil to the south. It is set into the slope, and is at the base of a steeply sloping section of valley side. Adjacent to it is a small hollow, c 1m across.
Condition:	Good: there is uniform undisturbed vegetation within and around the shaft.

Feature No.	15.2
NGR	402909 465477
Type	Mine shaft
Sources	OA North Survey 2015
Photo Ref	IMG0266.jpg
Description	A sub-circular shaft (3.5m diameter), with a central hollow. It is set into the slope, and is at the base of a steeply sloping section of valley side. It is water filled, and has a moderately sloping internal sides.
Condition:	Good: there is uniform undisturbed reed vegetation within and around the shaft.

Feature No.	15.3
NGR	402903 465478
Type	Mine shaft
Sources	OA North Survey 2015
Photo Ref	IMG0268.jpg
Description	A well-defined, mine shaft, with steep sides internal sides and a large spoil mound to the south of the sub-circular shaft (3.3m diameter). It is set into the slope, and is at the base of a steeply sloping section of valley side.
Condition:	Good: there is uniform undisturbed reed vegetation within and around the shaft.

Feature No.	15.4
NGR	402886 4654443 - 402901 465476
Type	Gully
Sources	OA North Survey 2015
Photo Ref	IMG0267.jpg; IMG0271-2.jpg
Description	A gully cut through the hillside converging upon shaft 15.3 . It is straight, relatively level, has steep sides and is in places 6m wide. It cuts through an undulating landscape and has left a couple of steep-sided pinnacles. It terminates to the south-west, where it converges with the open valley side. Its purpose is unknown, but may have been an attempt to follow a vein or for movement of water.
Condition:	Good: there is uniform undisturbed vegetation within the gully.

Site no.	16
Site name	Bolton Haw Side: Mine Shafts
NGR	40275 46526
Designation	Scheduled Monument 1018333
Site type	Mine Shafts
Period	Eighteenth to Nineteenth century
Significance	Medium
Sources	OA North Survey 2015
Description	A pair of large shafts on Bolton Haw Side.
Feature No.	16.1
NGR	402756 465260
Type	Mine Shaft
Sources	OA North Survey 2015
Photo Ref	IMG0359.jpg; IMG00360.jpg
Description	A large shaft (14m x 15m overall) that is set into the southern valley side of Bolton Gill at Bolton Haw Side. It has a large spoil mound extending out from the slope. The leat (Site 3) that extends out from the Site 18 outfall cuts across the spoil mound and evidently post-dates the shaft. It was probably a coal extraction shaft and there is a dark coal rich soil on the spoil heap.
Condition:	Moderate to Poor: there are substantial erosion scars down the south-western face of the spoil mound and animal burrowing immediately above the top of the shaft.
Feature No.	16.2
NGR	402733 465183
Type	Mine Shaft
Sources	OA North Survey 2015
Photo Ref	IMG0369.jpg
Description	A large shaft (11m x 15m overall) that is set into the western valley side of Hebden Beck and is just to the south of the Site 18 adit / tail race. It has a large spoil mound extending west from a 1.7m deep shaft hollow. It extends out from the line of the main track, but does not necessarily post-date it.
Condition:	Moderate to Good: there is uniform vegetation over the spoil mound, but some limited impact of the track onto the edge of the spoil mound.

Site no.	17
Site name	Bolton Haw Side: Power Transfer House
NGR	40275 46526
Designation	Scheduled Monument 1018333
Site type	Engine House and Stanchion Bases
Period	Mid Nineteenth century (c 1869)
Significance	High
Sources	OA North Survey 2015; NAA 2003; Hodge 1997; Gill 1994
Description	A Power Transfer House that took power from the area of the smelt mill beside Hebden Beck at Hebden up to the transfer house on Bolton Haw Side, and also drew power from an adjacent water wheel on Bolton Haw Side (Site 18.2). The power transfer house combined the power from the two sources and transmitted the power, via pump rods, to the Engine Shaft at Bolton Gill. There is a line of stone bases extending south from this Power Transfer House and a further intermittent line of stone bases extending north-east towards Engine Shaft.
Feature No.	17.1
NGR	402750 465249
Type	Power Transfer House
Sources	OA North Survey 2015; Hodge 1997
Photo Ref	IMG0350.jpg to IMG0358.jpg

Description	<p>This is the convergent point of two lines of power transmission cables / rods as defined by lines of square stone support bases; one extending north-east to the Engine Shaft and the other south to the smelt mill by Hebden Beck. A third line extends from an engine mounting stone south-east to a pit which (Site 18.2) which was possibly a large wheel pit and therefore provided additional power.</p> <p>The transfer house has a lot of collapse associated with it, and it was evidently a much higher structure than at present, but this does confuse the interpretation of the structure. The key element is a north-east/south-south-west wheel pit which takes the line of the pump rods towards the Engine Shaft. The wheel pit is 1.5m wide and 6.5m long with stone revetted sides and a large ashlar block in the centre, on the south-eastern side, which was probably a mounting block for a wheel axle. There is no evidence of a tail race extending from the lower south-west end of the wheel pit and no obvious head race. However, there is a take off point from the leat (Site 4.1 at 402784 52119) where potentially a launder could have transferred water to the site, but there was no indication of an earthwork or leat to indicate that there was ever a water supply from here. The line of the power stanchion bases (Site 17.2) converge on the line of the wheel pit (north-east end) and it is to be presumed that the power from this powered ropeway drove the wheel, which then drove the pump rods to the Engine Shaft. There is a stone platform (Size 4.5m x 1.5m) extending in a line beyond the north-eastern end of the wheel pit, albeit slightly staggered, and which presumably supported the mechanism for the pump rods. To the south-east of the wheel pit is a substantial stone with three threaded mounting bolts for a bearing housing, set within a collapsed, but substantial, stone structure. The line of this bearing mounting is taken by the line of a slight gully, with banks on either side (1m width) which extends north-west / south-east towards a large rectangular pit (Site 18.2). Although not observed during the present survey Hodge (1997) reports a further bearing mount, similar to the first, on the line of this narrow gully. This would appear to confirm that power was being transferred, potentially via a drive shaft, between pit 18.2 and the Power Transfer House. Hodge interprets this pit, as a large wheel pit, in which case it was feeding power to the Power Transfer House.</p>
Condition:	Moderate to Good: there is considerable collapse associated with the structure, but this reflects decay in antiquity. The vegetation cover over the structure is largely undisturbed indicating that the site has not been subject to recent disturbance.
Feature No.	17.2
NGR	402745 465225 - 402743 465171
Type	Stone Stanchion Bases
Sources	OA North Survey 2015; Hodge 1997
Photo Ref	IMG0361.jpg
Description	A square plan stone stanchion base following a line that extends south from the Power Transfer House (Site 17.1). They are at varying separations, from 9m to 18m, and continue beyond the survey area. They are in varying states of collapse, but stone base 17.2b, second to the south from the transfer structure, is the most intact. It is 1.5m x 1.5m in plan and 1.8m high. It comprises dressed blocks with a very large dressed stone on top which evidently supported the superstructure for the power rope. There were a series of bolt holes (but no bolts) set into the eastern side of the stone.
Condition:	Poor to Good: the condition of the pillars varies considerably; 17.2a and 17.2c are mostly collapsed and are in a poor condition; whereas 17.2b is in good condition and stands to original height.

Site no.	18
Site name	Bolton Haw Side: Putative tail race / Wheel Pit
HER no.	42969
NGR	40270 46520
Designation	Scheduled Monument 1018333
Site type	Lead Mine / Tail Race
Period	Nineteenth century
Significance	High
Sources	Gill 1994; Northern Archaeological Associates 2003; YDNPA 2009; Hodge 1997)

Description	<p>The key aspect of the feature is a long tunnel extending into the hillside and linking with a large open, elongated pit, which is interpreted as the documented wheel pit on Bolton Haw Side. As such, the tunnel was probably a tail race. There also exists the possibility that it was formerly an adit, but which was modified as a tail race; however, the spoil out from the tunnel has dense vegetation over it and there is no indication that it had higher levels of lead.</p> <p>The south-eastern part of the overall complex was surveyed in 2003 by Northern Archaeological Associates. A new drainage pipe was installed out from the tunnel in 2003 when a watching brief was undertaken.</p>
Feature No.	18.1
NGR	402736 465212
Type	Tunnel entrance
Sources	OA North Survey 2015; Hodge 1997; Gill 1994; NAA 2003
Photo Ref	IMG0364-7.jpg
Description	<p>The tunnel entrance was a vaulted dry-stone structure which was 1.75m high and 1m in width, and was floored with sandstone setts. However, it was inspected in 2003 (NAA 2003) and was found to continue for 16.8m into the hill, before turning slightly to the north, and then was blocked 6m further beyond the bend, corresponding with a collapsed chamber / wheel pit (Site 18.2). The tunnel at the entrance was modified in 2003 to divert the water draining through the tunnel underneath the access track, and this entailed lifting the slabs and installing a concrete splitting chamber (NAA 2003). It is presently gated and no access was available at the time of survey. In front of the entrance is a walled structure comprising retaining walls intended to divert water out from the entrance to a pipe that extends under the track. The pipe was plastic and was presumably inserted in 2003; photographs taken in 2003 show the southernmost retaining wall but not the northern wall and this latter wall was evidently constructed as part of the drain enhancement works. The plan of the site produced by NAA (2003) prior to the modification of the entrance shows a north/south wall, extending out from the east/west revetment wall which would have diverted water along the leat; there is no longer a surface indicator of this wall.</p> <p>The spoil from the tunnel extended in a line out from the slope (Site 18.5) and had straight barrow access between the portal and the spoil heap, but this is now cut by the main track (Site 21), and presently there is a spoil mound surviving in front of the adit portal. Extending off from the northern side of this walled area in front of the adit was a leat (Site 3), which formerly diverted the water draining off through the tunnel / tail race.</p>
Condition:	Good: the tunnel is in a good condition, but this reflects that it was subject to consolidation works in 2003, and there are no indications of recent erosion.
Feature No.	18.2
NGR	402759 465226
Type	Putative Wheel Pit
Sources	OA North Survey 2015; Hodge 1997; Gill 1994; NAA 2003
Photo Ref	IMG0346-8.jpg
Description	<p>A wheel is documented at the site as being 40 foot in diameter, 3 foot and 6 inches broad and with 16 wooden arms (Gill 1994, 104). The size of the wheel corresponds with an elongated hollow, orientated approximately north/south, which has a dry-stone structure set into its westernmost side; it is 16m long (51 feet) by 8m wide and is about 1.8m deep. The exploration of the adit by NAA (2003) revealed that the tunnel (18.1) extended into the southern end of this pit and they reported the start of a chamber and collapse beyond. There are the remains of revetment walls against the eastern side of the hollow and it is possible that this is part of the mounting for a wheel bearing at the side of a large pit. There is a subtle gully (1m wide), which has considerable buried stone work within its base, which had at least two bearing mounts on top of it, and which extended between the Power Transfer House (Site 17.1) and the pit. Significantly the line of this power train is perpendicular to the line extending off to the Engine Shaft; the gully for the power train stops at the northern edge of the hollow. The structure set into the western side of the hollow is 4.45m long and at least 1.7m wide and survives as a three-sided structure; however, there is the possibility of a return wall surviving as degraded foundations. There is no evidence for an axle mount within the wall, but such an element may have been removed on abandonment of the mine complex. Presently water drains into the hollow from the slope above, and this was probably the line of</p>

Condition:	a former launder which extended out from leat 4.1 . The water presently sinks through a hole through the floor of the present hollow into the tunnel (tail race) beneath. Moderate to Poor: there is a substantial flow of water out from leat 4.1 , which is extending through the wheel pit and into the 18.1 tunnel. This is resulting in erosion down the sides of the pit and in the floor of the pit.
Feature No.	18.3 and 18.4
NGR	402736 465233 and 402739 465241
Type	Spoil Heaps
Sources	OA North Survey 2015; NAA 2003
Description	Two spoil heaps extending out from the slope and opposite the wheel pit (Site 18.2). The southernmost (Site 8.3) is 13m x 10m in size and that to the north (Site 8.4) is 8m x 6m in size. The top of the spoil heaps are above the adit entrance (Site 18.1) and are derived from it.
Condition:	Good: there is uniform undisturbed vegetation over the spoil mounds.
Feature No.	18.5
NGR	402726 465199
Type	Spoil Heap
Sources	OA North Survey 2015; NAA 2003
Photo Ref	IMG0370.jpg
Description	A finger spoil mound extending out from the tunnel / tail race 18.1 . It is 16m x 11m in size and is linked to a bank of spoil extending along the side of the slope. The ramp between the spoil mound and the portal of the adit has been cut by the construction of track 22 , which clearly post-dated the tunnel.
Condition:	Moderate to Good: there is uniform undisturbed vegetation over the spoil mound.
Feature No.	18.6
NGR	402745 465210
Type	Extraction Hollow?
Sources	OA North Survey 2015; NAA 2003; Hodge 1997
Photo Ref	IMG0362.jpg
Description	A deep hollow (7m x 4.4m) set above the 18.1 tunnel, and which has a number of large stones in the bottom. It has a drain feeding into it from the east. It is in line with the ropeway stanchion bases. Hodge (1997) suggests that this was a bob pit for the powered ropeway; however, it is not clear how this would have worked or indeed would have been necessary.
Condition:	Moderate to Good: there is uniform undisturbed vegetation over the spoil mound.

Site no.	19
Site name	Bolton Haw Side: Mine Shafts
NGR	40270 4652
Designation	Scheduled Monument 1018333
Site type	Mine Shafts
Period	Eighteenth to Nineteenth century
Significance	High
Sources	OA North Survey 2015
Description	A pair of large shafts in the area of Bolton Haw Side (Site 18).
Feature No.	19.1
NGR	402705 465229
Type	Mine Shaft
Sources	OA North Survey 2015
Description	A large shaft (12m x 12m) that is set into the western slope of the Hebden Beck valley below the 18.1 adit. It follows a line of shafts (Sites 19.1 , 19.3 and 16.2) and was presumably following the line of a seam. It has a substantial spoil mound extending out from the slope, but only a small depression corresponding to the shaft.
Condition:	Moderate to poor: there are animal burrows extending across the shaft's spoil mounds and dark, coal rich soil exposed.

Feature No.	19.2
NGR	402707 465246
Type	Mine Shaft
Sources	OA North Survey 2015
Description	A deep shaft (5m x 4m x 1.7m deep) but which has little spoil associated with it. It is set into the western slope of the Hebden Beck valley below the 18.1 tunnel. It is just to the south of the line of shafts (Sites 19.1 , 19.3 and 16.2).
Condition:	Moderate to Good: there is uniform undisturbed vegetation over the spoil mound.

Feature No.	19.3
NGR	402711 465212
Type	Mine Shaft
Sources	OA North Survey 2015
Description	A large shaft (8m x 7m) that is set into the western slope of the Hebden Beck valley below the 18.1 adit. It follows a line of shafts (Sites 19.1 , 19.3 and 16.2) and was presumably following the line of a vein. It has a moderate-sized spoil mound extending out from the slope, but only a small depression corresponding with the shaft.
Condition:	Moderate to Good: there is uniform undisturbed vegetation over the spoil mound.

Site no.	20.1
Site name	Bolton Gill Side: Meer Stone
NGR	402840 465476
Designation	Scheduled Monument 1018333
Site type	Meer Stone
Period	Eighteenth to Nineteenth century
Significance	Medium
Sources	OA North Survey 2015
Photo Ref	IMG0378-80.jpg
Description	A marked stone set into the present day dry-stone wall, and is located at a break in the wall. It is annotated AWR and probably corresponds to the initials of the owner. The wall is a nineteenth century dry-stone construction on top of an earlier boundary marker comprising large upright stones and boulders. Adjacent to the carved stone is a much larger up-right stone which has a series of carved lines, but which do not appear to form letters,
Condition:	Good: the stone is relatively unweathered and the wall surround is in good condition.

Site no.	20.2
Site name	Bolton Gill Side: Meer Stone
NGR	402840 465476
Designation	Scheduled Monument 1018333
Site type	Meer Stone
Period	Eighteenth to Nineteenth century
Sources	OA North Survey 2015
Photo Ref	IMG0382-3.jpg
Description	A marked stone set into the present day dry-stone wall, and is annotated FF; this probably corresponds to the initials of the owner of the land and adjacent mine workings. The wall is a nineteenth century dry-stone construction on top of an earlier boundary marker comprising large upright stones and boulders. This stone is one of the upright boulders that marked the boundary prior to the construction of the dry-stone wall.
Condition:	Good: the stone is relatively unweathered and the wall surround is in good condition.

Site no.	21
Site name	Bolton Gill: Mine Shaft
NGR	402978 465485
Designation	Scheduled Monument 1018333

Site type	Mine Shaft
Period	Eighteenth to Nineteenth century
Significance	Medium
Sources	OA North Survey 2015
Description	A small mine shaft above the valley, but following a line of shafts on the valley side (shafts 15.1 to 15.3). The shaft is 9m x 5m in size and 1m deep, and the spoil mound is on the south-western side.
Condition:	Moderate: there is generally undisturbed vegetation over the spoil mound, but occasional indications of surface erosion.

Site no.	22
Site name	Bolton Haw Side: Track
NGR	402737 465286 - 402742 465178
Designation	Scheduled Monument 1018333
Site type	Mine Track
Period	Nineteenth century
Significance	Medium
Sources	OA North Survey 2015
Description	A track leading up past and beyond the Bolton Haw Side tunnel (Site 18). It is built on top of the spoil from the tunnel and also is cut into it, separating the adit from its spoil heap. It is evidently a later construction but has also been subsequently maintained. Works to control the flow of run off water from the adit were intended to limit water erosion to the track.
Condition:	Moderate: the track was converted for vehicular use in 2003, and since then has sustained water and vehicular erosion.

Site no.	23
Site name	Hebden Gill: Bottle Level
HER no.	42397
NGR	402665 465181
Designation	Scheduled Monument 1018333
Site type	Lead Mine: Level
Period	Nineteenth century
Significance	High
Sources	Gill 2004, MARS 2010
Description	Perhaps started before the Hebden Moor Mining Company's formation (probably by W.S. Winn <i>c</i> 1853) and was closed <i>c</i> 1872. The level was intended to reach Star Vein, Cockbur Vein and Providence Vein. Further details can be found in the Meerstone Archaeology Consultancy report.
Condition:	Moderate: the adjacent bank of Hebden Gill has been eroded despite attempts to consolidate it. There is water retained in front of the portal and the adit entrance is in a stable condition. There is some track erosion just above and to the west of the recessed adit entrance.

Site no.	24
Site name	Hebden Gill: Dressing Floor
HER no.	36605
NGR	40265 46508
Designation	Scheduled Monument 1018333
Site type	Lead Mine: Dressing Floor
Period	Nineteenth century
Significance	High
Sources	MARS 2010; Meerstone Archaeological Consultancy 2007; Joy 2002; MARS 2010, <i>Survey of Hebden Gill Dressing Floor</i> .

Description	The dressing floor at Hebden Gill contains the remains of the site office building, the bouse teams where the ore was stored before being processed, alongside a tool shop and at least one wheel pit. To the north was a small reservoir. To the north and south were Bottle Level and Charger Level. Further details can be found in the Meerstone Archaeology Consultancy report.
Condition:	Moderate to poor: the adjacent bank of Hebden Gill has been eroded despite attempts to consolidate it. There is a wooden launder sticking out of the river bank and is degrading rapidly. The track over the slab floor of dressing floor buildings and vehicle and pedestrian traffic is causing erosion to the buildings and exposing the footings of others. There is erosion where the track extends past the bouse team. The presence of lead ore is restricting vegetation growth in the northern part of the dressing floor and water erosion is adversely affecting this part of the site.

Site no.	25
Site name	Hebden Gill: Charger Level
HER no.	42499
NGR	402646 465003
Designation	Scheduled Monument 1018333
Site type	Lead Mine: Level
Period	Nineteenth century
Significance	High
Sources	Gill 2004, 394
Description	Driven towards the Beever Vein by the Hebden Moor Mining Company between 1863 and 1866; it does not appear to have produced any ore. Further details can be found in the Meerstone Archaeology Consultancy report.
Condition:	Moderate to good: the portal of the adit is in generally good condition. The interior could not be inspected because there is a grill over it. There is uniform, undisturbed vegetation in front of the adit and over the ground above it. There is now water draining from it.

Site no.	26
Site name	Hebden Gill: Leat
HER no.	55782
NGR	40262 46518
Designation	Scheduled Monument 1018333
Site type	Lead Mine: Leat
Period	Nineteenth century
Significance	High
Sources	YDNPA; Meerstone Archaeological Consultancy 2007
Description	Earthwork remains of a leat c 28m in length flowing from Eller Beck to the dressing floor.
Condition:	Moderate to good: the leat comprises an earthwork leading from Eller Beck, which is in good to moderate condition. The line of the leat is continued as a wooden launder (no longer extant) supported by two stone pillars which are in good condition.

Site no.	27
Site name	Hebden Gill: Limekiln
HER no.	15037
NGR	402612 465210
Designation	Scheduled Monument 1018333
Site type	Limekiln
Period	Post-medieval
Significance	Medium
Sources	OS 1st edition 6" map, 1852; D Johnson, 2001 and 2006 Yorkshire Dales Lime Kiln Survey

Description	Limekiln almost completely robbed but some relict masonry comprising the facing of large squared millstone grit blocks indicative of a small kiln. A cart track winds up and around the kiln.
Condition:	Poor: the limekiln has been substantially robbed over the last fifteen years (Johnson 2001) and there is little remaining beyond the earthwork features.

Site no.	28
Site name	Hebden Gill: Stepping Stones
HER no.	15038
NGR	40262 46502
Designation	Scheduled Monument 1018333
Site type	River crossing: stepping stones
Period	Post-medieval
Significance	Medium
Sources	OS 1st edition 6" map, 1852
Description	Stepping stones
Condition:	Poor: the documented location of the stepping stones is on a former line of the stream, and is presently under a spoil heap.

Site no.	29
Site name	Hebden Gill Bottle Level Reservoir
NGR	402672 46520
Designation	Scheduled Monument 1018333
Site type	Reservoir
Period	Post-medieval
Significance	High
Sources	OS 1st edition 25" map, 1890; Gill 1994; Roe and Davies 2007
Description	Earth-walled reservoir which is located above and to the north of the Bottle Level adit portal. It is partially faced with stone and is about 2.7m deep. The north-western sided is composed of waste from the Bottle Level, and the northern end of the dam tapers through to a shallow cutting. It was probably supplied from Bolton Gill. Further details can be found in the Meerstone Archaeology Consultancy report.
Condition:	Moderate to Poor: there is vehicle and pedestrian erosion up the south-west corner of the earthen dam and the southern edge of the dam is degrading. Track erosion extends across the western side of the reservoir. The interior of the dam is earthfast and stable

ILLUSTRATIONS

FIGURES

- Figure 1: Site location
- Figure 2: Ordnance Survey First Edition 6" to 1 mile map, 1852
- Figure 3: Ordnance Survey First Edition 25" to 1 mile map, 1891
- Figure 4: Contour model of the southern part of the study area - Hebden Beck
- Figure 5: Contour model of the northern and eastern part of the study area - Bolton Gill
- Figure 6: Detailed figure location plan
- Figure 7: Detailed Plan - Duke's Level South
- Figure 8: Detailed Plan - Duke's Level Middle
- Figure 9: Detailed Plan - Duke's Level North
- Figure 10: Detailed Plan - Hebden Gill Dressing Floor South
- Figure 11: Detailed Plan - Hebden Gill Dressing Floor West
- Figure 12: Detailed Plan - Hebden Gill Dressing Floor East
- Figure 13: Detailed Plan - Bottle Level South
- Figure 14: Detailed Plan - Bolton Haw Side South
- Figure 15: Detailed Plan - Bottle Level North
- Figure 16: Detailed Plan - Bolton Haw Side North
- Figure 17: Detailed Plan - Bolton Gill South
- Figure 18: Detailed Plan - Bolton Gill West
- Figure 19: Detailed Plan - Bolton Gill North
- Figure 20: Detailed Plan - Bolton Gill East
- Figure 21: Bolton Gill Topographic Survey - South
- Figure 22: Bolton Gill Topographic Survey - North
- Figure 23: Contour model with archaeology interpretation superimposed on the southern part of the study area - Hebden Beck
- Figure 24: Contour model with archaeology interpretation superimposed on the northern and eastern part of the study area - Bolton Gill
- Figure 25: Aerial photograph of Hebden Gill Dressing Floor
- Figure 26: Aerial photograph of Bolton Gill Engine Shaft
- Figure 27: Aerial photograph of Bottle Level
- Figure 28: Aerial photograph of Duke's Level

PLATES

- Plate 1: Bolton Gill mines and veins - North (after Gill 1994)
- Plate 2: Hebden Beck mines and veins (after Gill 1994)
- Plate 3: Hebden Gill Dressing Floor from plan redrawn by J Varley 1866
- Plate 4: Outline plan of Hebden Gill Powered Ropeway (after Hodge 1997)
- Plate 5: Looking down the two straight hushes (**13.1** and **13.2**) at the south-western part of Bolton Gill North
- Plate 6: Mine shaft **12.1** looking west
- Plate 7: The area of the Site **14** dressing floors looking east
- Plate 8: The dressing floor (Site **14.1**), with the fine red deposits in front of the putative buddle housing
- Plate 9: Duke's Level Entrance
- Plate 10: The spoil mound of Duke's Level viewed from the north
- Plate 11: Aerial view of the adit entrance (Site **1.1**) and the dressing floor (Site **1.4**)
- Plate 12: Mine shaft **10.2** looking north
- Plate 13: The spoil mound (**8.2**) and shaft (**8.1**) of Engine Shaft, with the track and spoil mound (**10.1**) of the Cockbur Vein workings in the foreground
- Plate 14: Entrance to the Engine Shaft portal (Site **7.2**)
- Plate 15: The tall barrel vaulted interior of the portal with a wheel pit in the base
- Plate 16: An example of a balance bob at the Ystrad Einion Mine (after RCAHMW (www.coflein.gov.uk))
- Plate 17: A stone pillar for the pump rods looking west with two bolts extending from a bearing mounting block (Site **7.3**)
- Plate 18: General view of the dressing floor (Site **9**) with the spoil heaps of Engine Shaft (Sites **8.2** and **7.1**) above looking south-east
- Plate 19: The collapsed steps (Site **9.4a**) adjacent to the bouse team
- Plate 20: Entrance to the tunnel / tail race (Site **18.1**)
- Plate 21: The Power Transfer House wheel pit
- Plate 22: A square, stone plinth supporting the powered ropeway (Site **17.2**)
- Plate 23: The Power Transfer House (Site **17.1**) viewed from the north-east
- Plate 24: Bearing mount for a drive train leading to the Site **18.2** pit
- Plate 25: The line of the Bolton Haw Side leat (Site **3.2**) extending across the slope
- Plate 26: The platform at the base of the leat (Site **3.2**)
- Plate 27: Site Office Front Elevation
- Plate 28: Site Office Interior
- Plate 29: Office – Right-hand Door Lintel
- Plate 30: Office – Left-hand Door Lintel – External

- Plate 31: Office – Left-hand Door Lintel – Internal
- Plate 32: Office – Interior Left-hand Cell
- Plate 33: Office – Inside Front Right Corner
- Plate 34: Office – Privy
- Plate 35: Engine Shaft Portal - Front Elevation
- Plate 36: Engine Shaft Portal - Interior
- Plate 37: Engine Shaft Portal - Vault
- Plate 38: Engine Shaft Portal - Top of Vault
- Plate 39: Engine Shaft Portal - Top of Vault
- Plate 40: Dressing Floor – Collapsed Steps
- Plate 41: Dressing Floor – East Wall
- Plate 42: Dressing Floor – Bulging Wall – (East Side)
- Plate 43: Dressing Floor – North Wall
- Plate 44: Dressing Floor – Collapsing part of North Wall
- Plate 45: Sketch drawing of office building
- Plate 46: Sketch elevations and cross section through the Engine Shaft Lobby



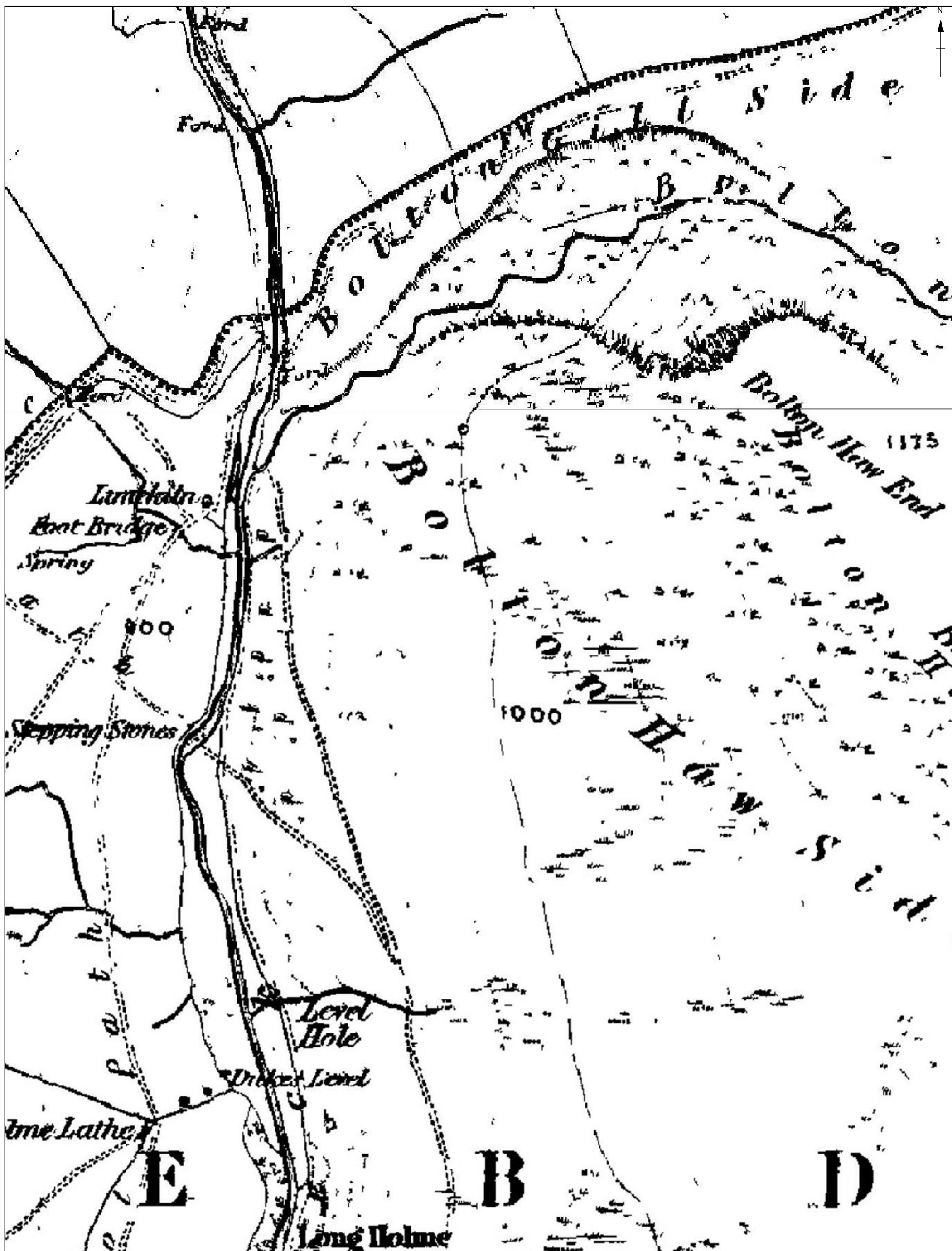


Figure 2: Ordnance Survey First Edition 6" to 1 mile map, 1852

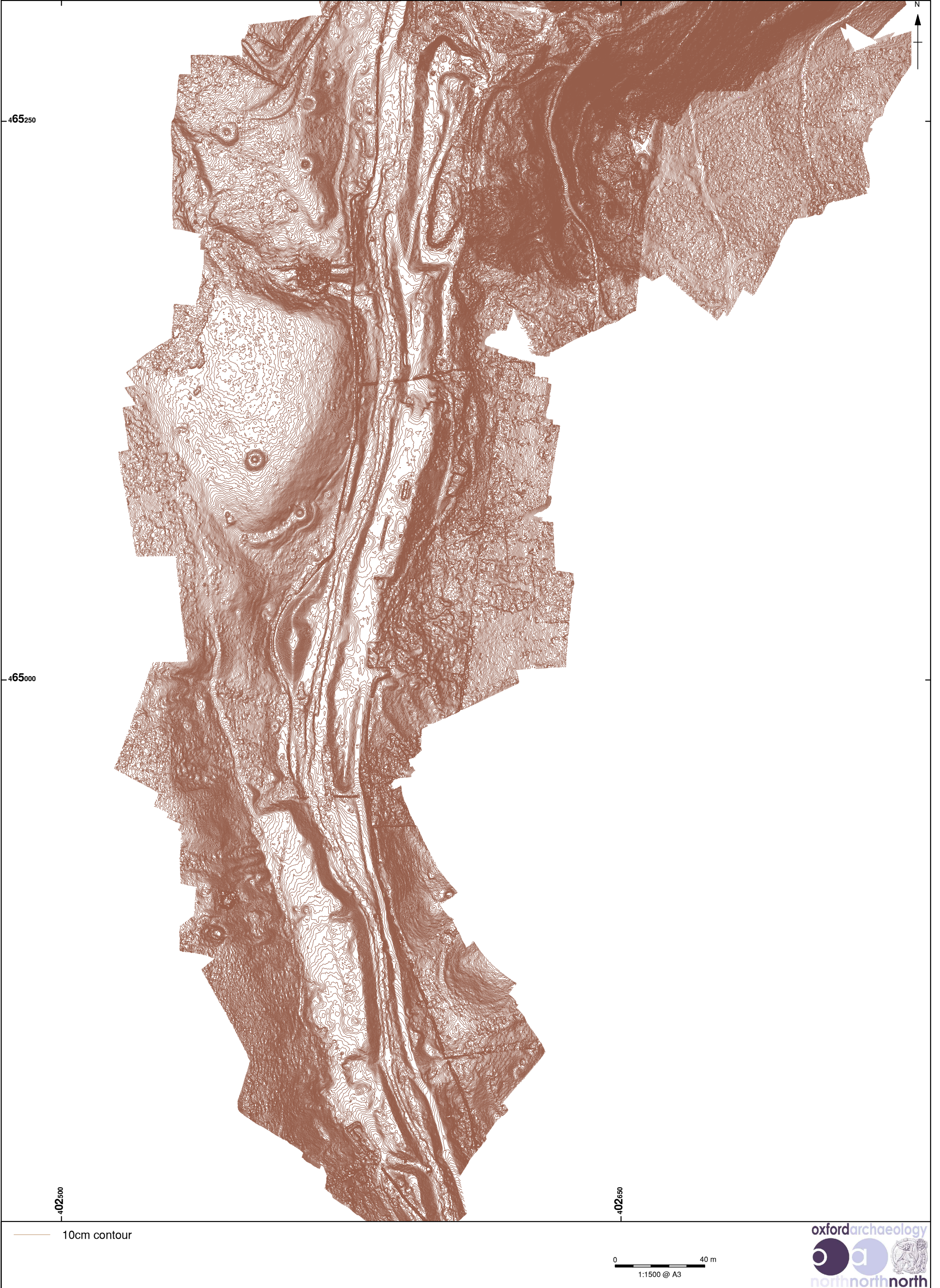


Figure 4: Contour model of the southern part of the study area - Hebden Beck

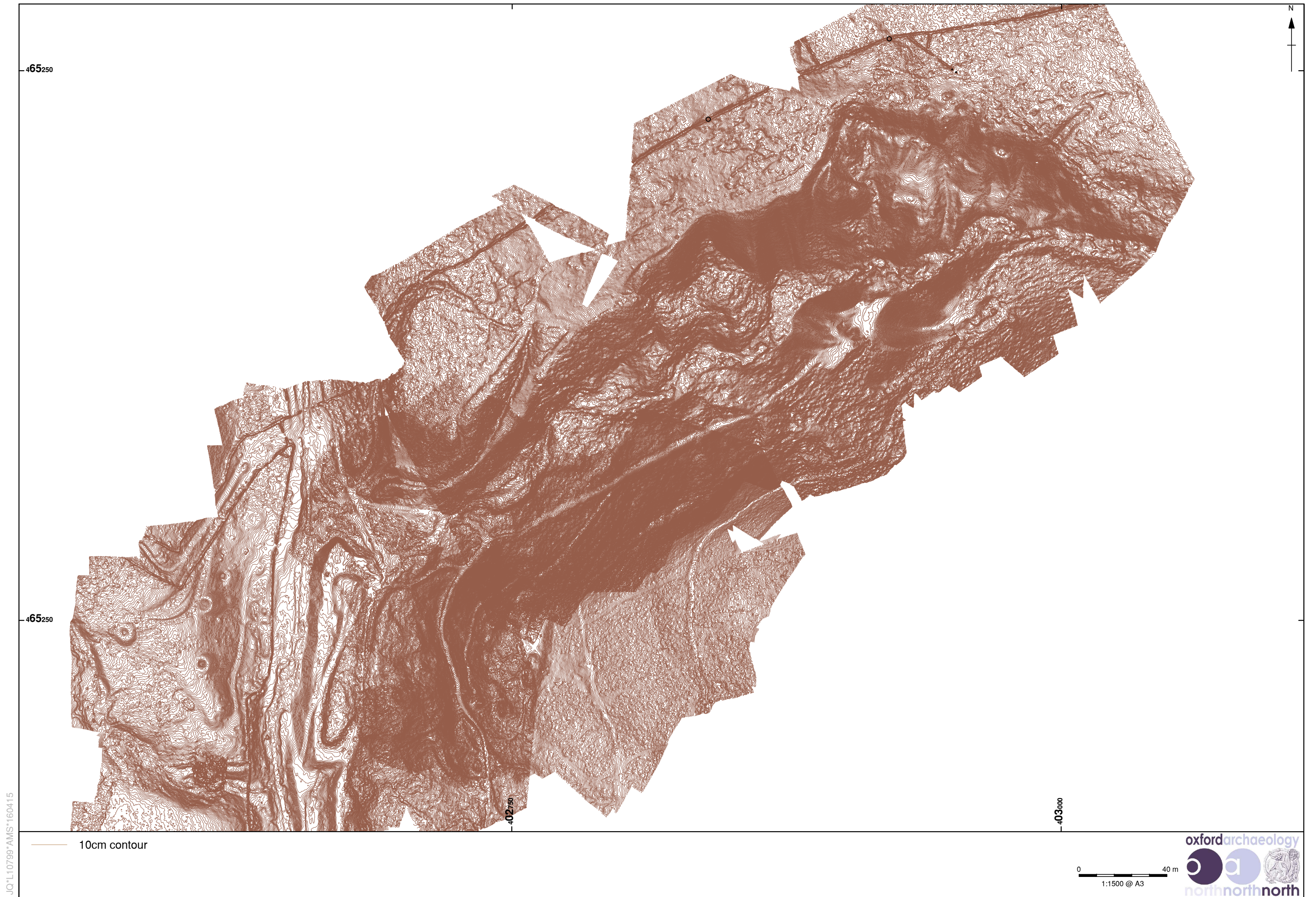


Figure 5: Contour model of the northern and eastern part of the study area - Bolton Gill

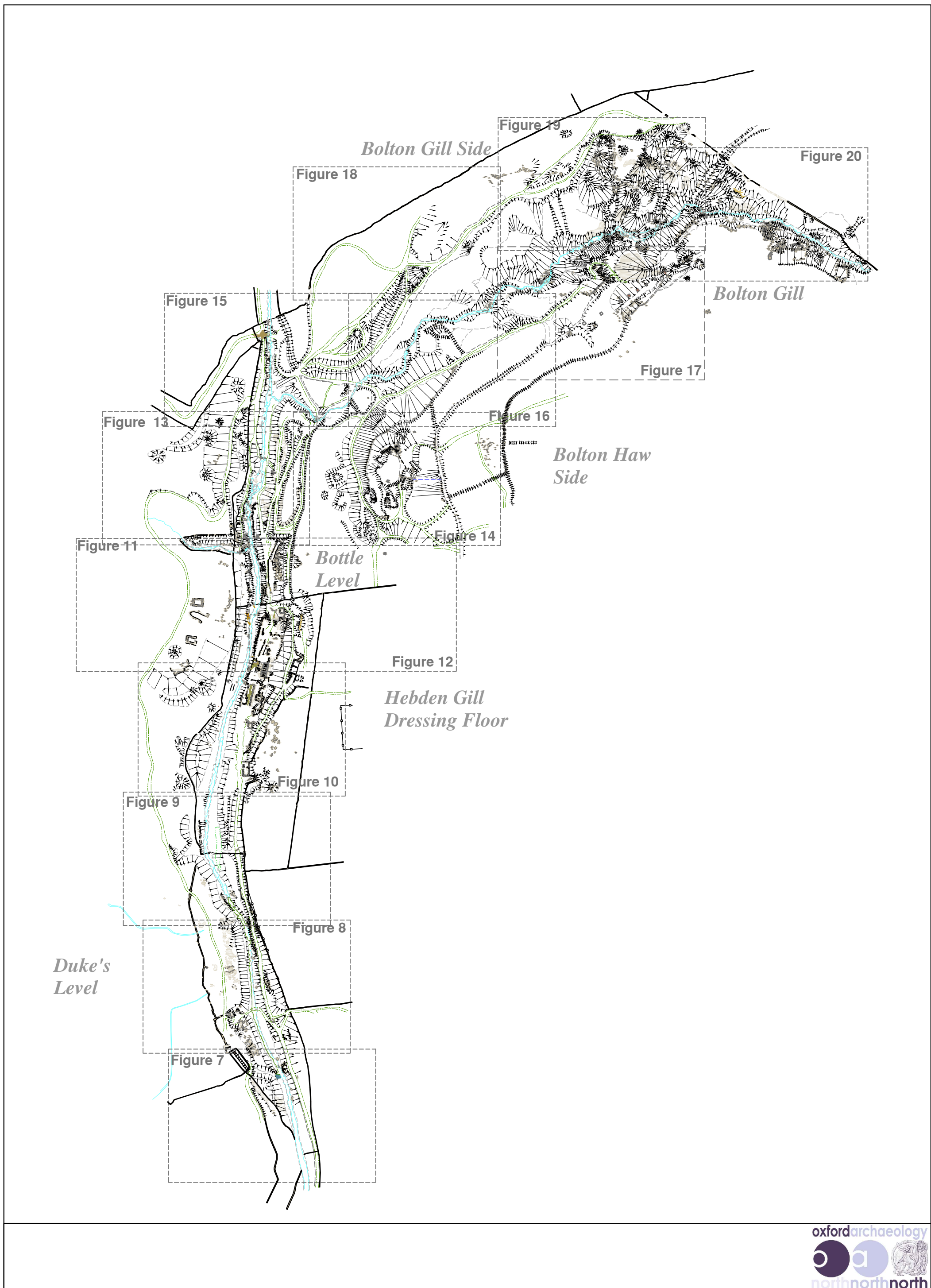


Figure 6: Detailed figure location plan



Figure 7: Detailed Plan - Duke's Level South

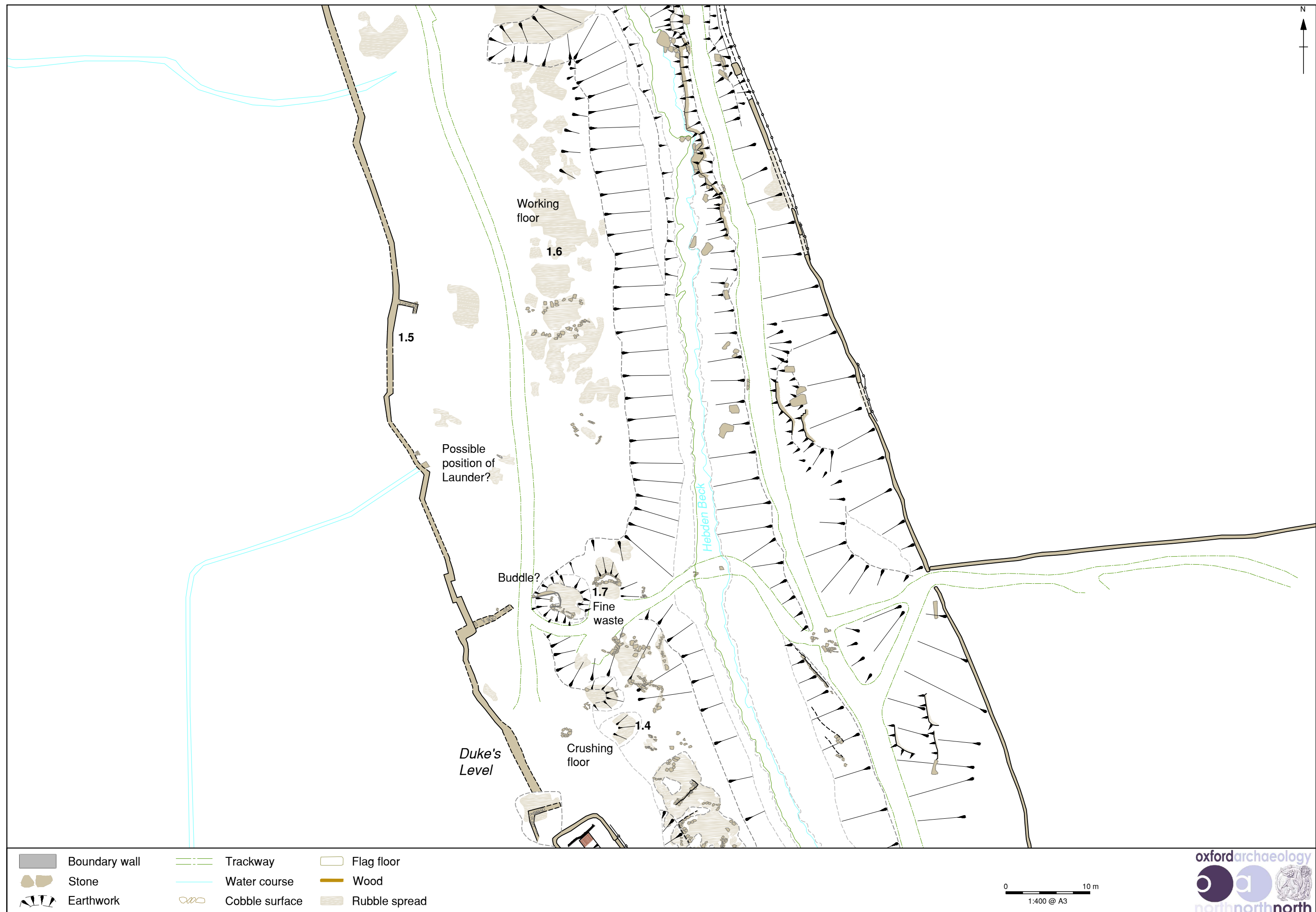
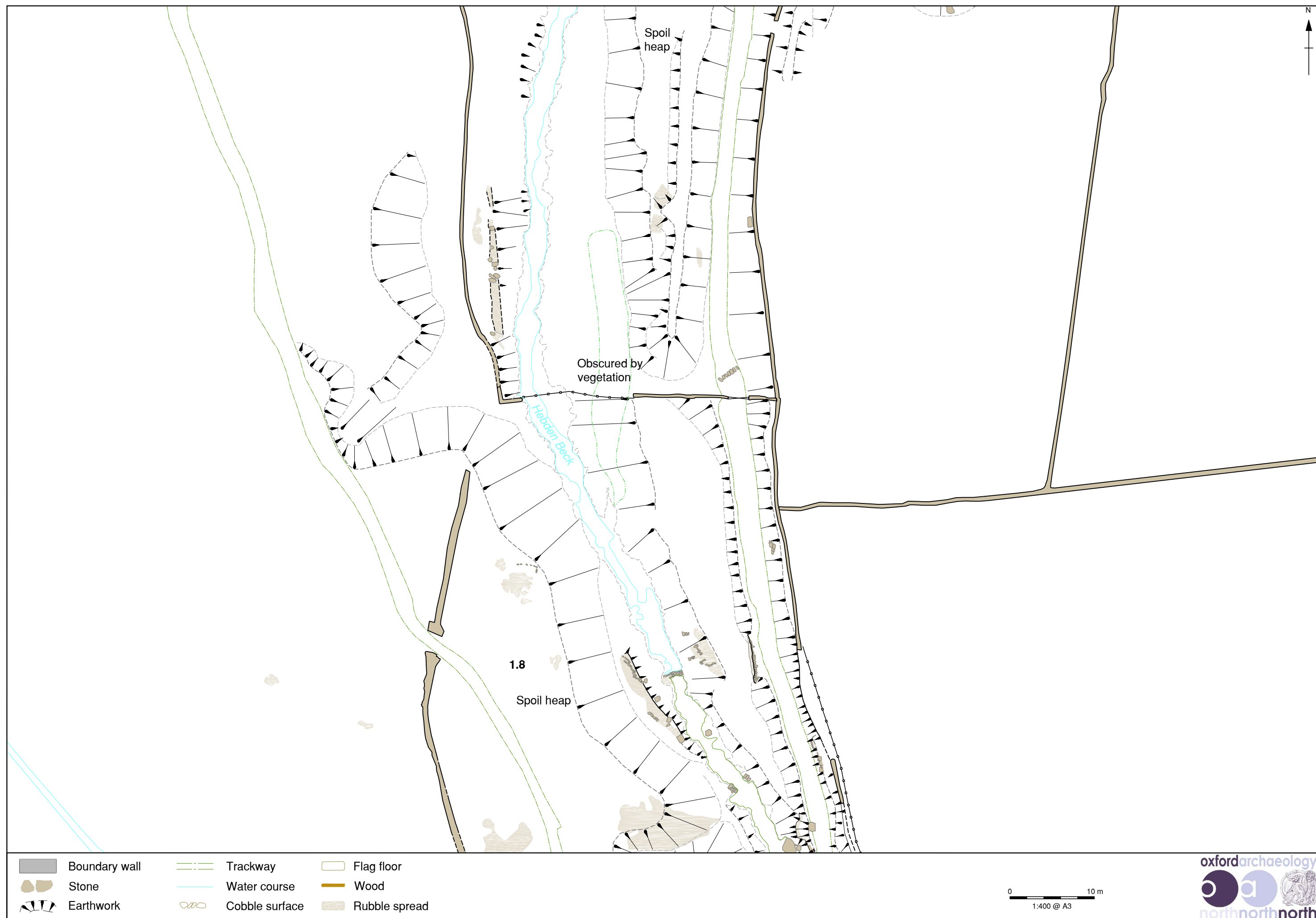


Figure 8: Detailed Plan - Duke's Level Middle



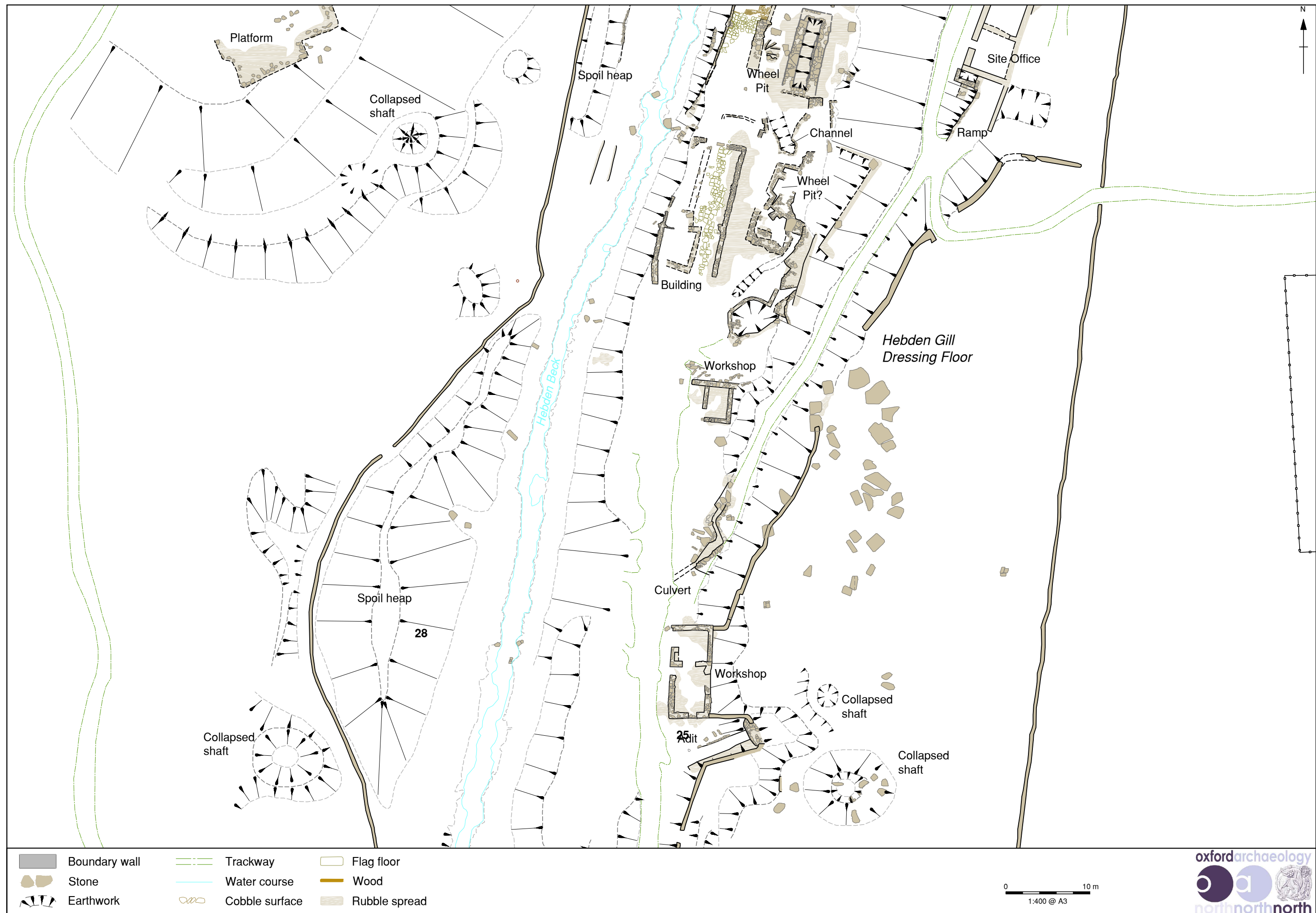
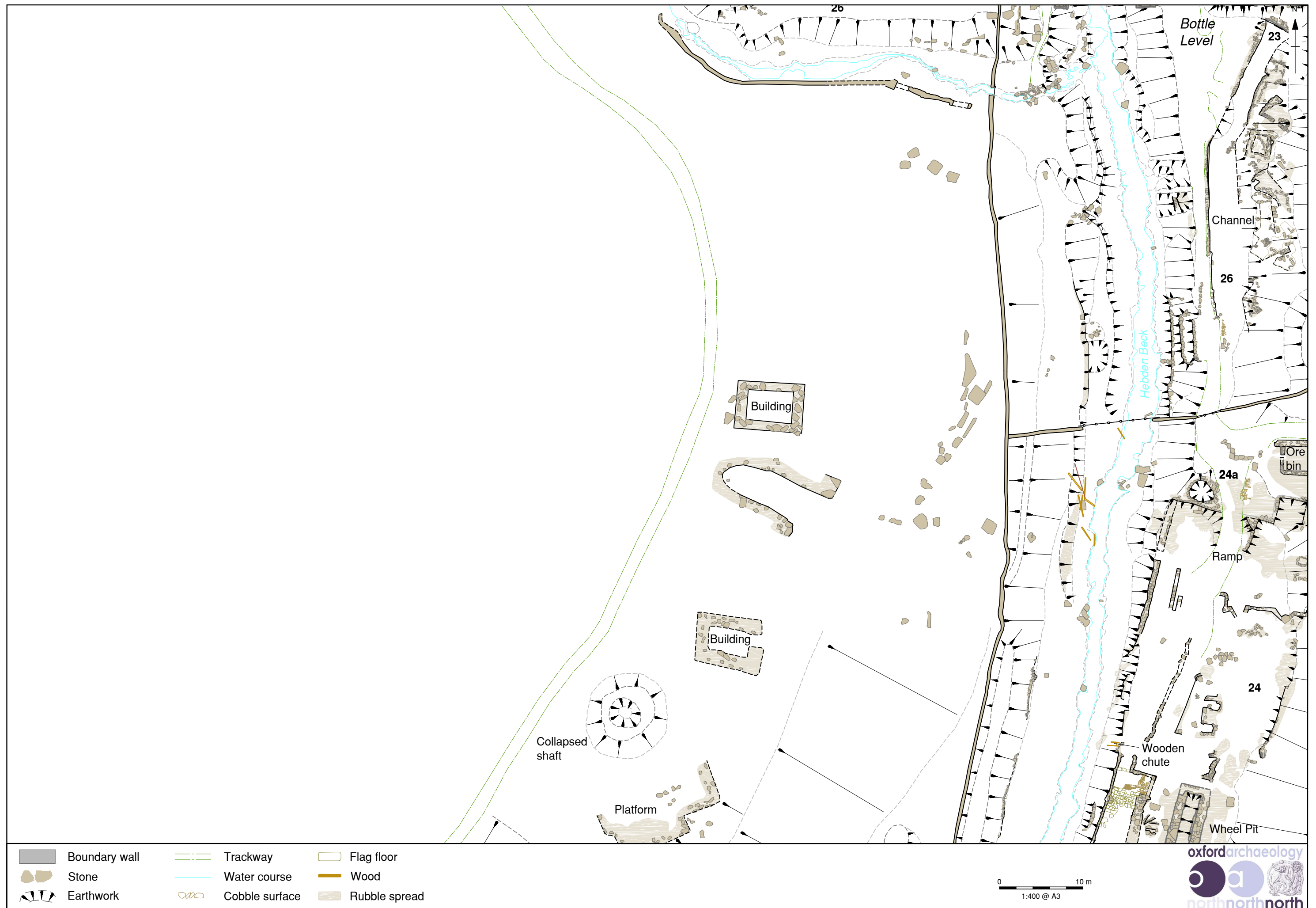


Figure 10: Detailed Plan - Hebden Gill Dressing Floor South



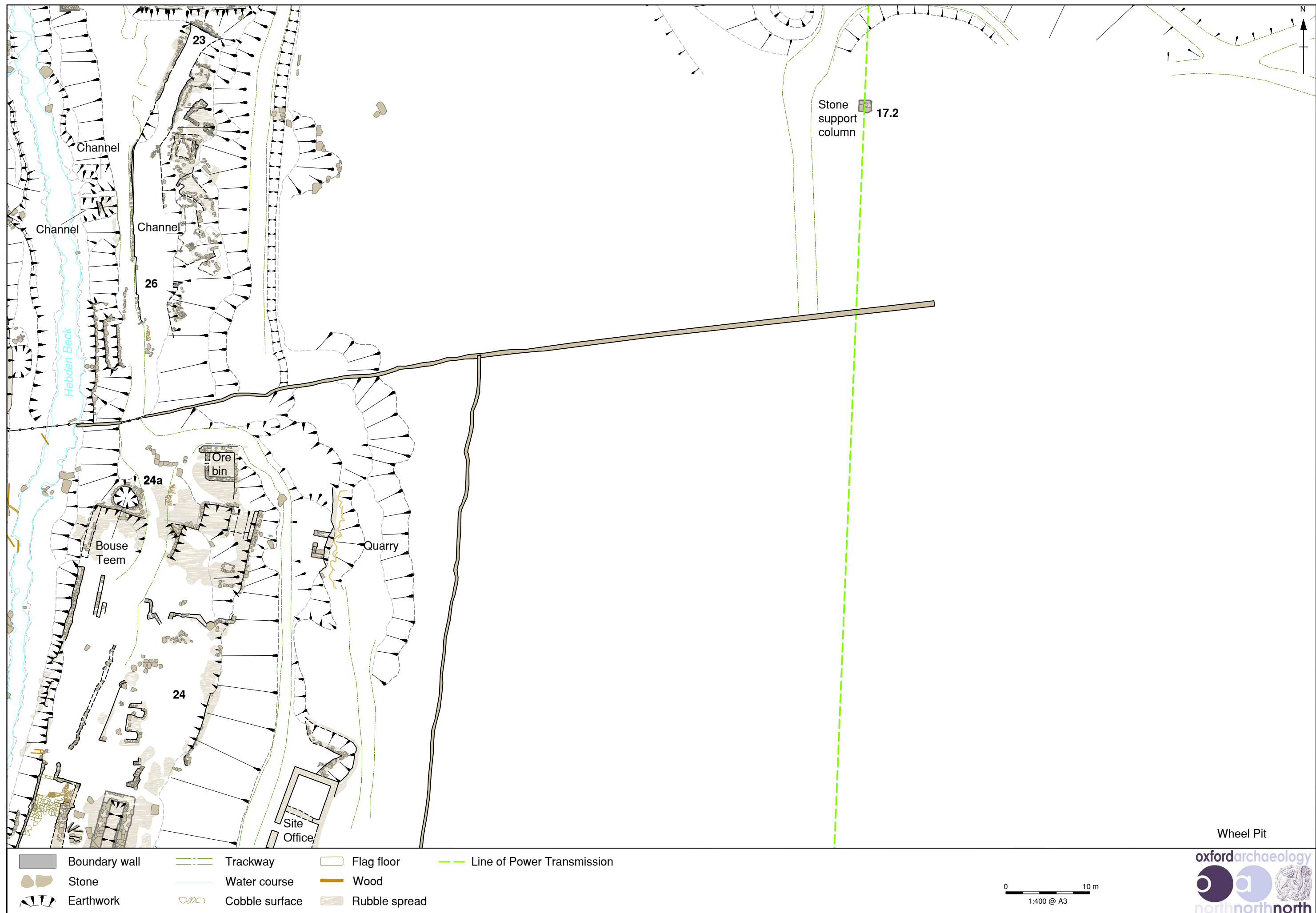


Figure 12: Detailed Plan - Hebden Gill Dressing Floor East

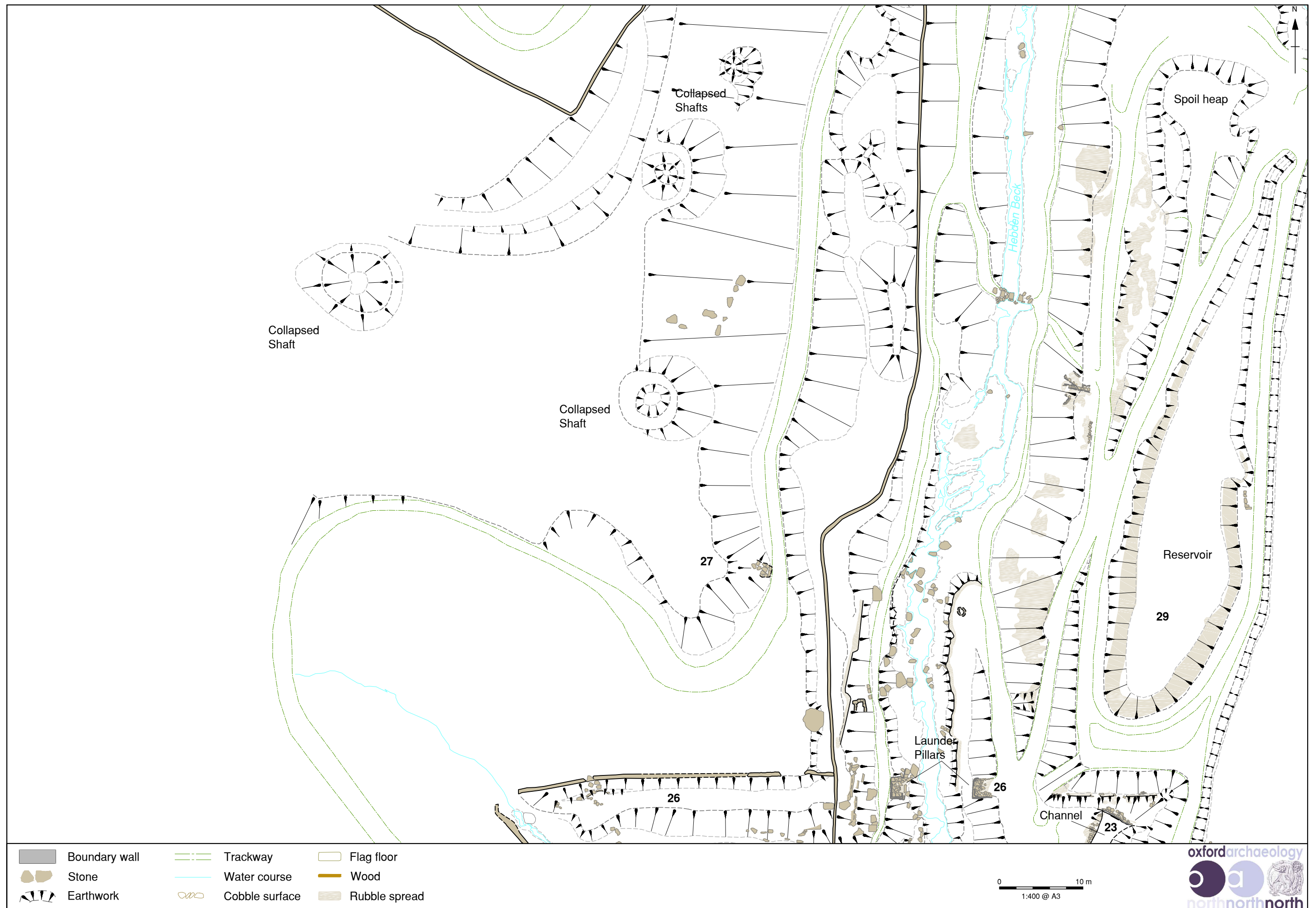
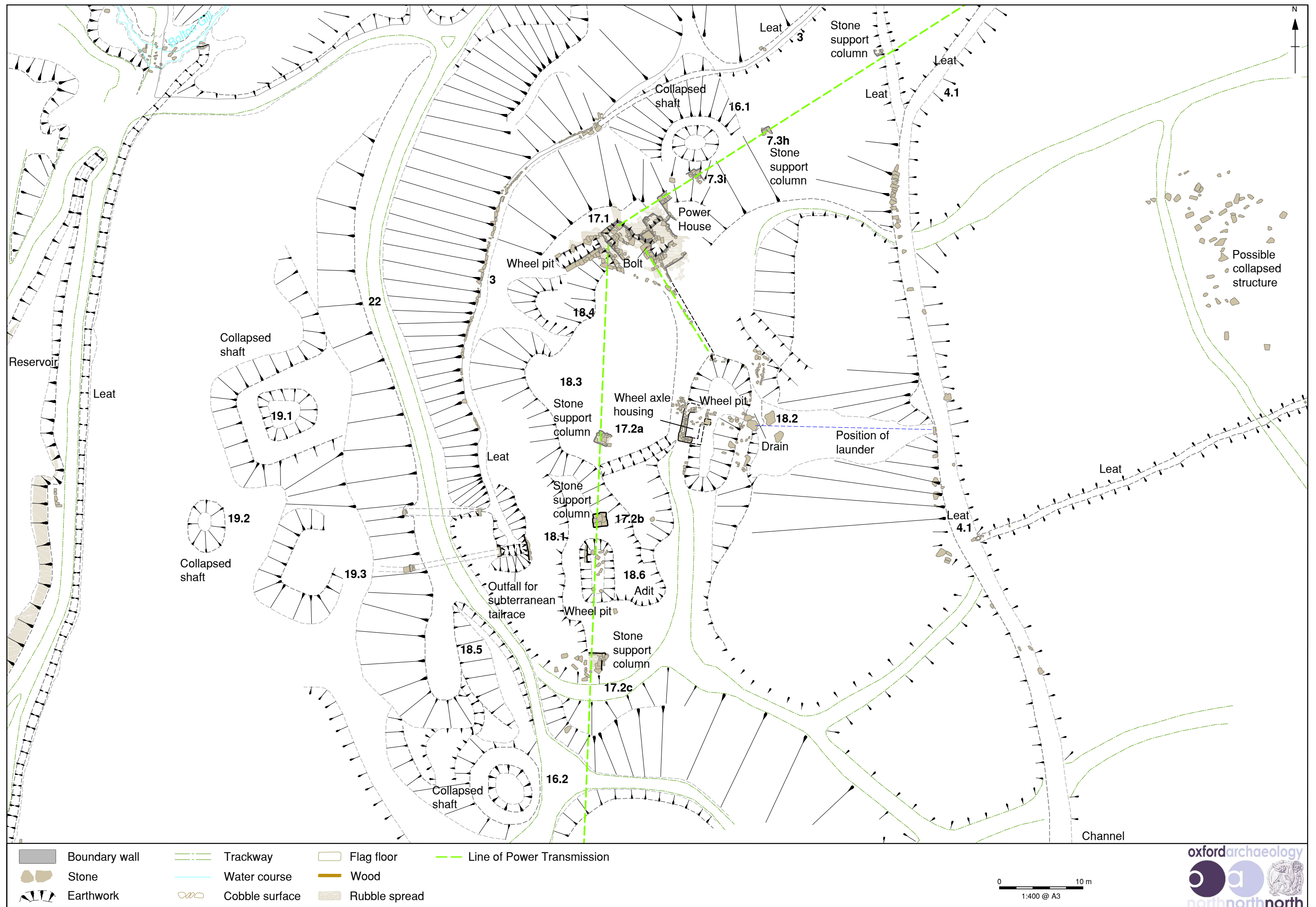


Figure 13: Detailed Plan - Bottle Level South



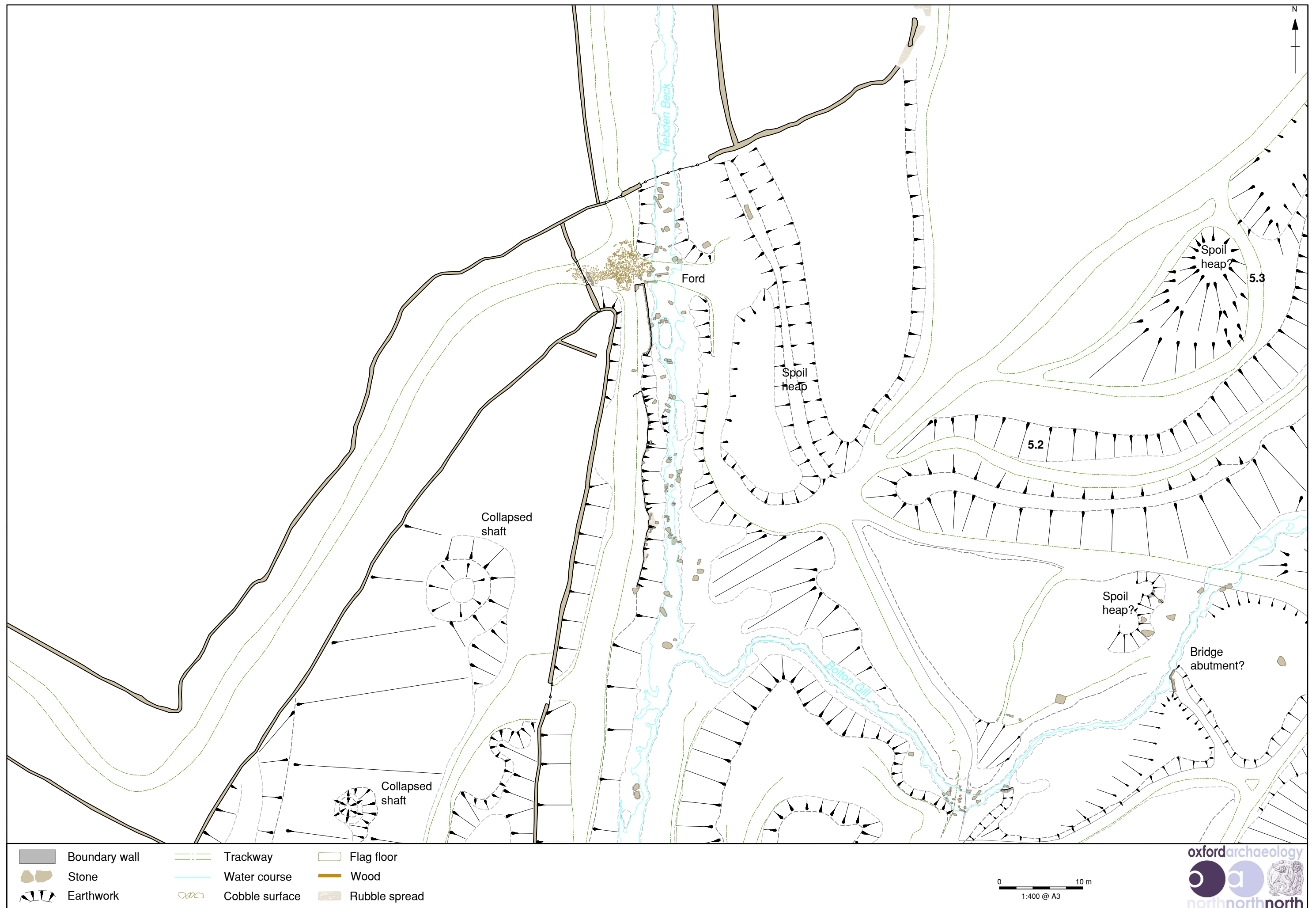


Figure 15: Detailed Plan - Bottle Level North

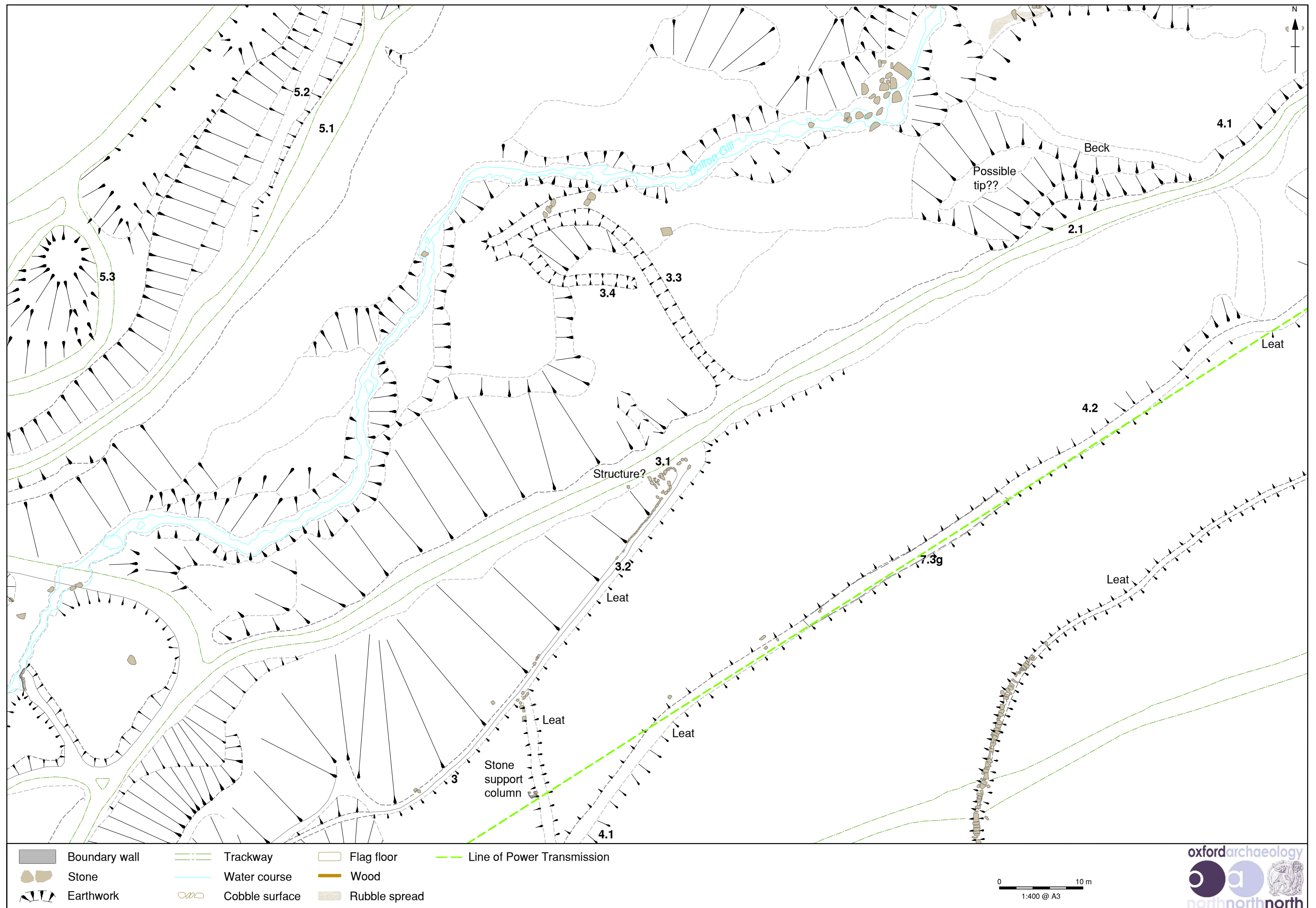


Figure 16: Detailed Plan - Bolton Haw Side North

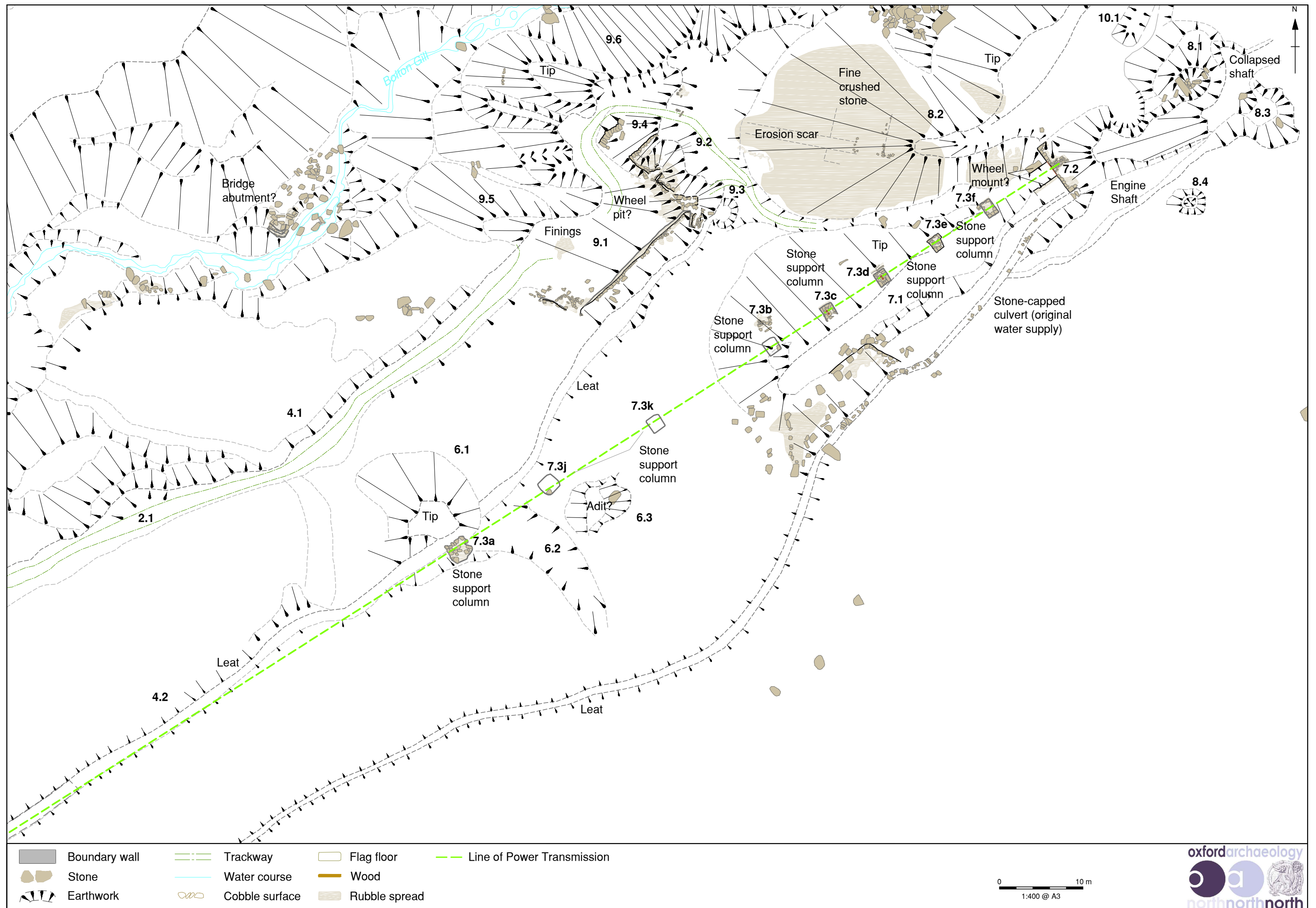


Figure 17: Detailed Plan - Bolton Gill South

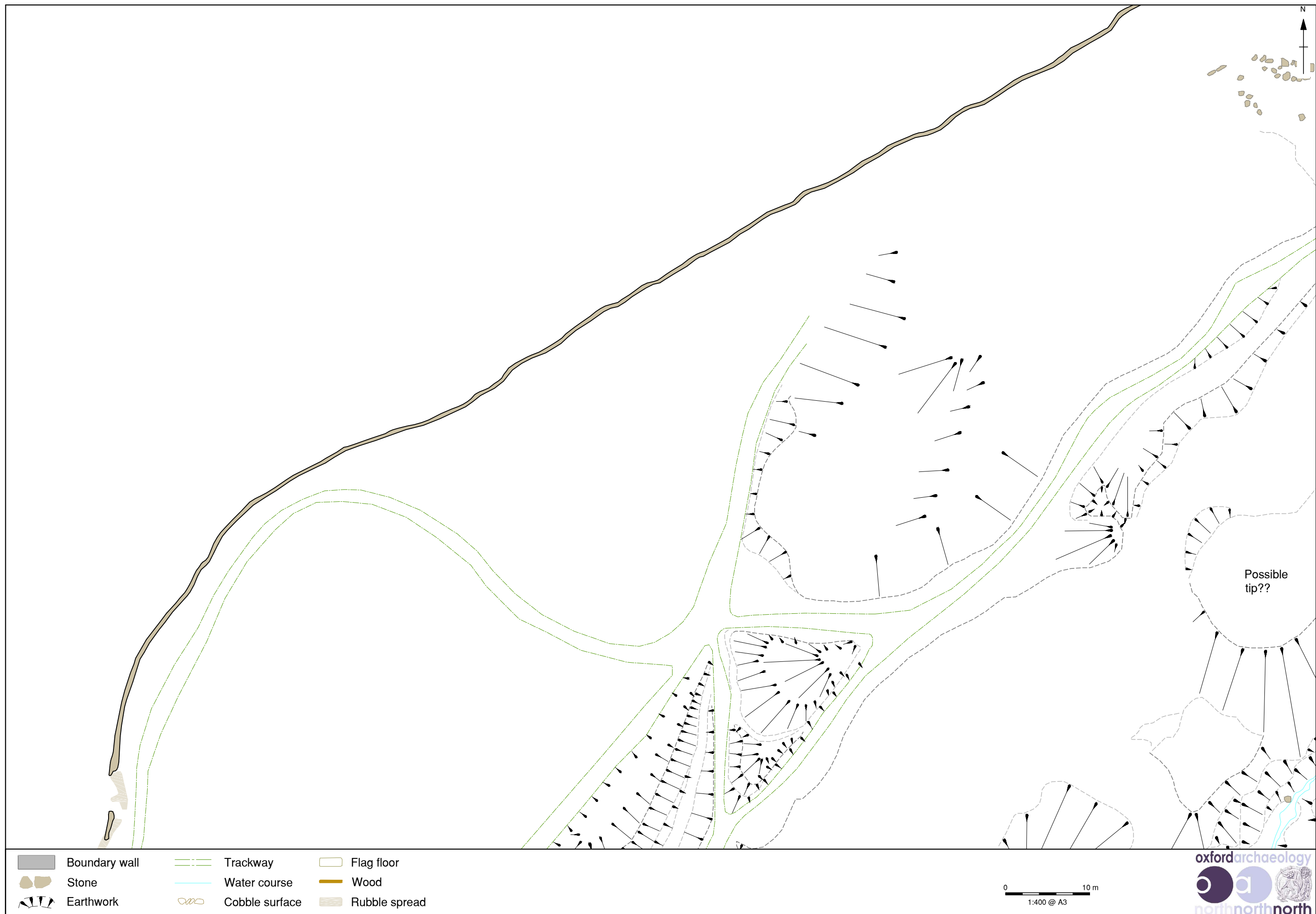


Figure 18: Detailed Plan - Bolton Gill West

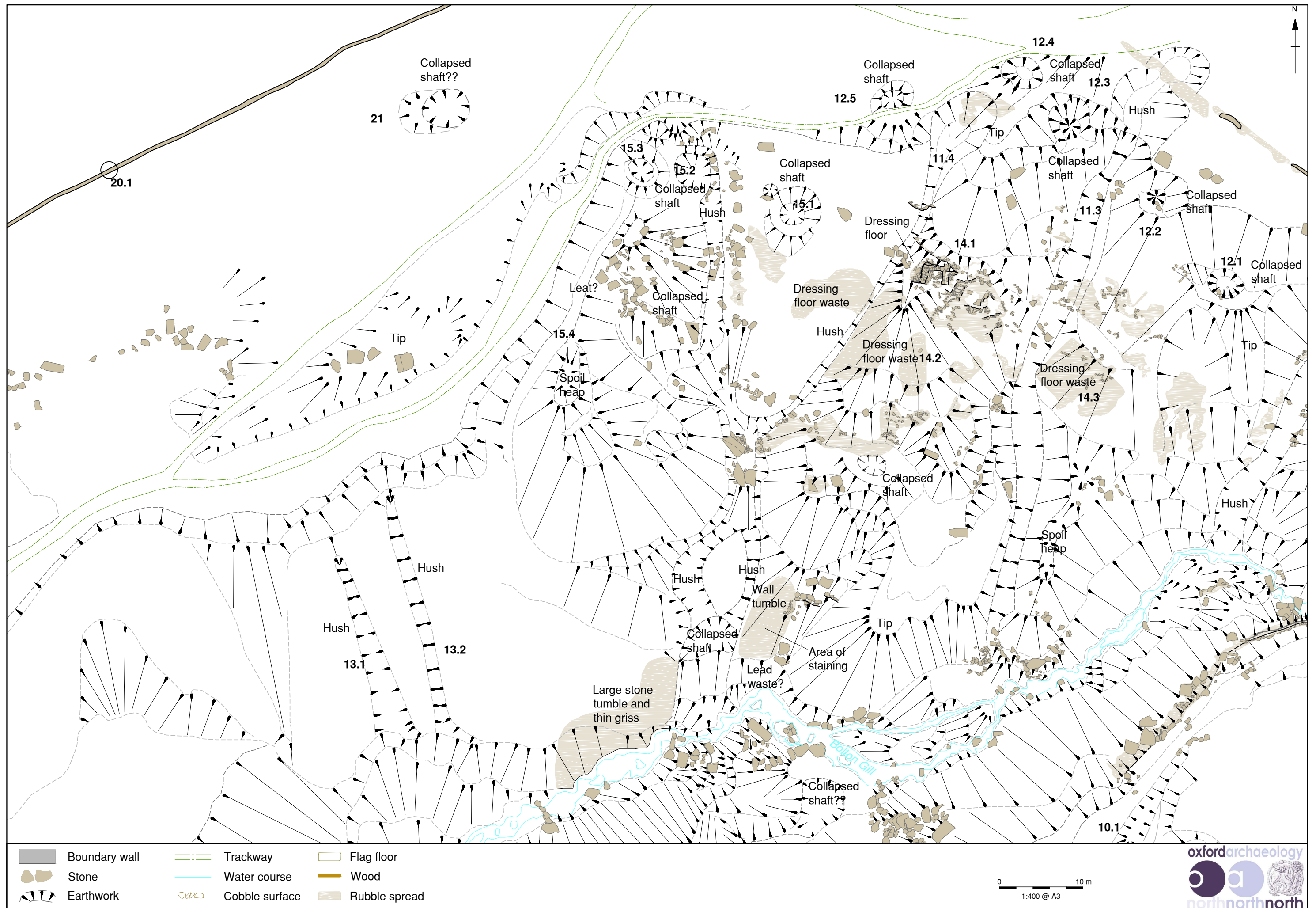


Figure 19: Detailed Plan - Bolton Gill North

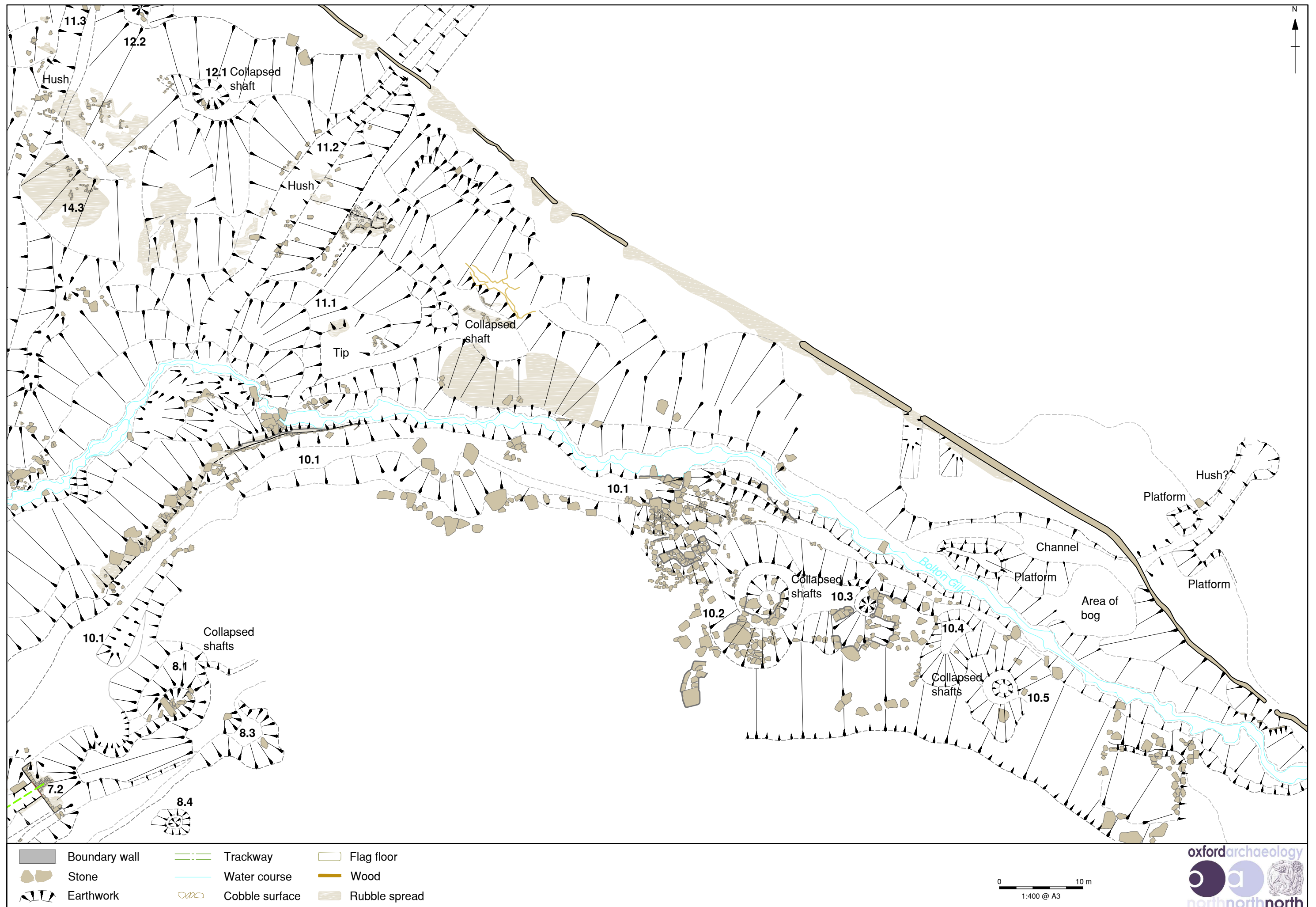


Figure 20: Detailed Plan - Bolton Gill East

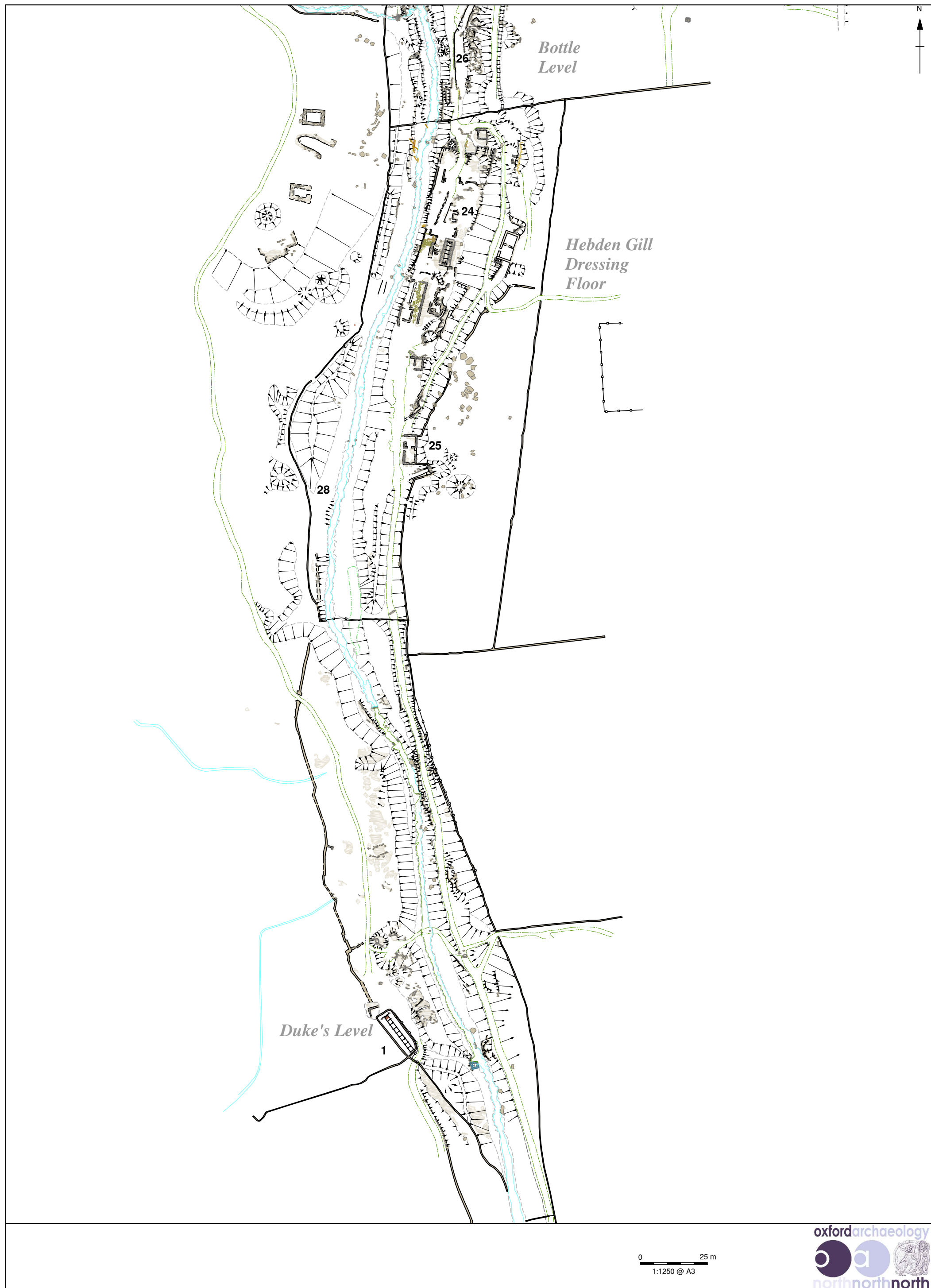


Figure 21: Botlon Gill topographic survey, south

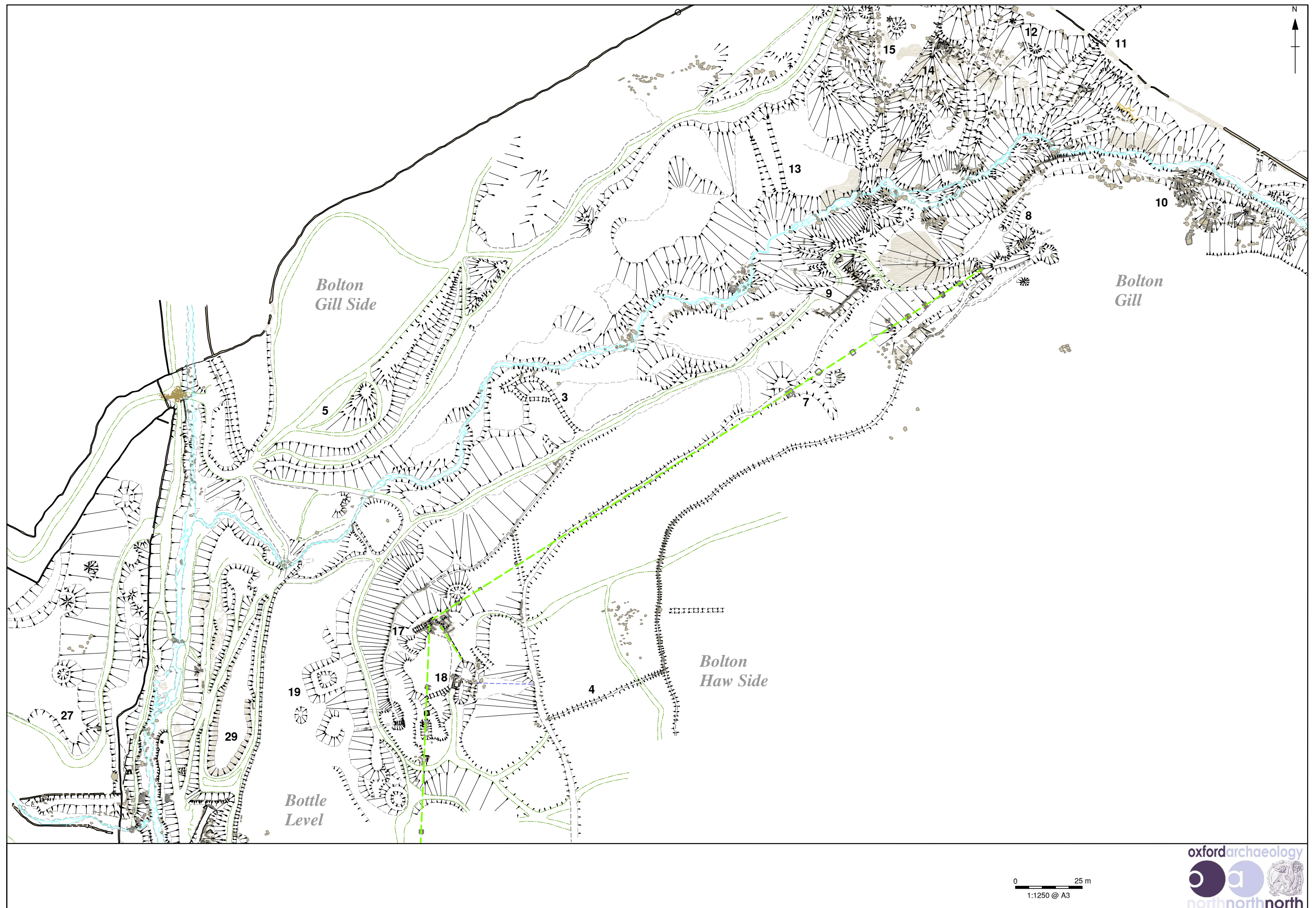


Figure 22: Bolton Gill topographic survey, north

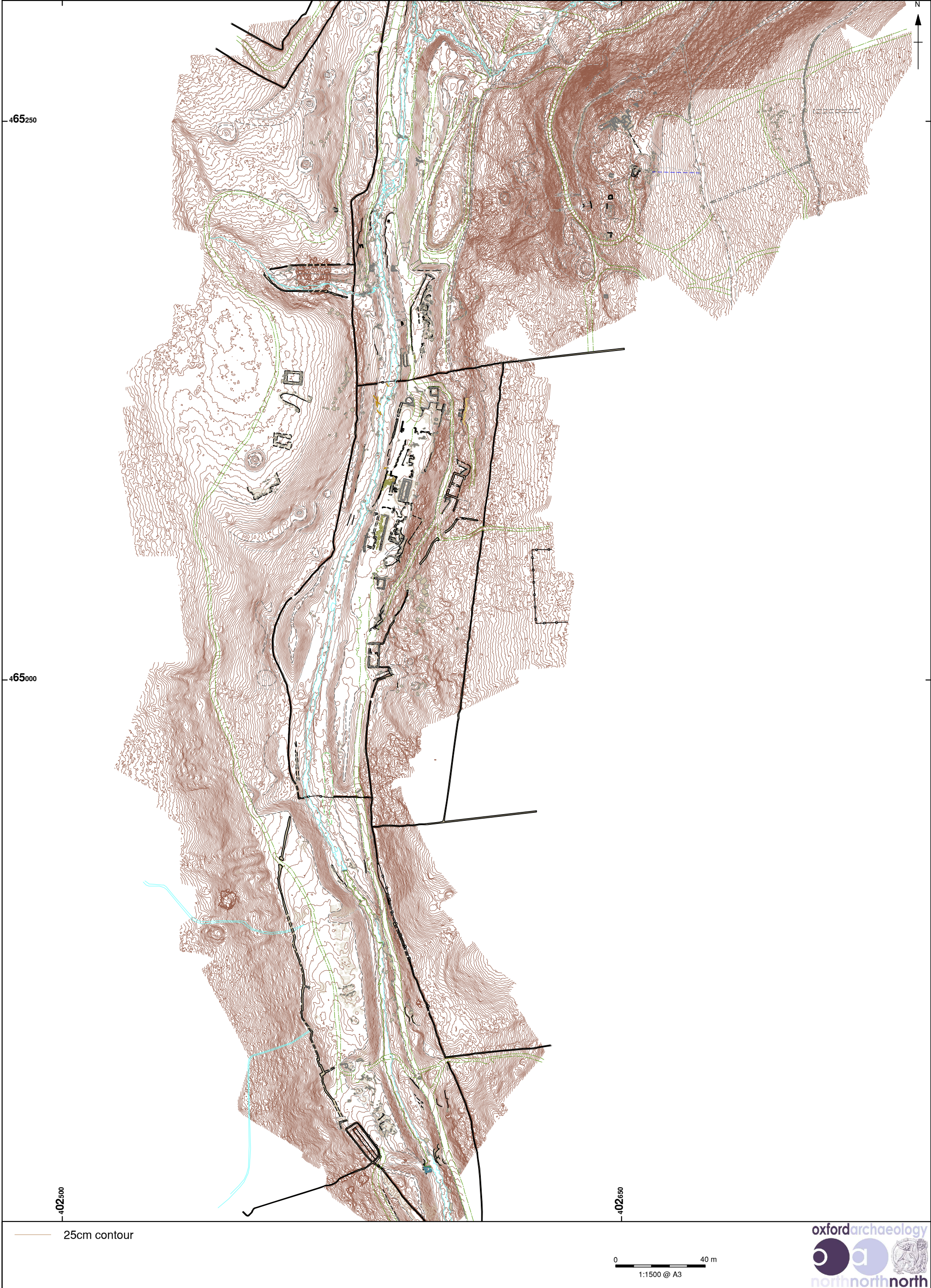


Figure 23: Contour model, with archaeology superimposed, of the southern part of the study area - Hebden Beck

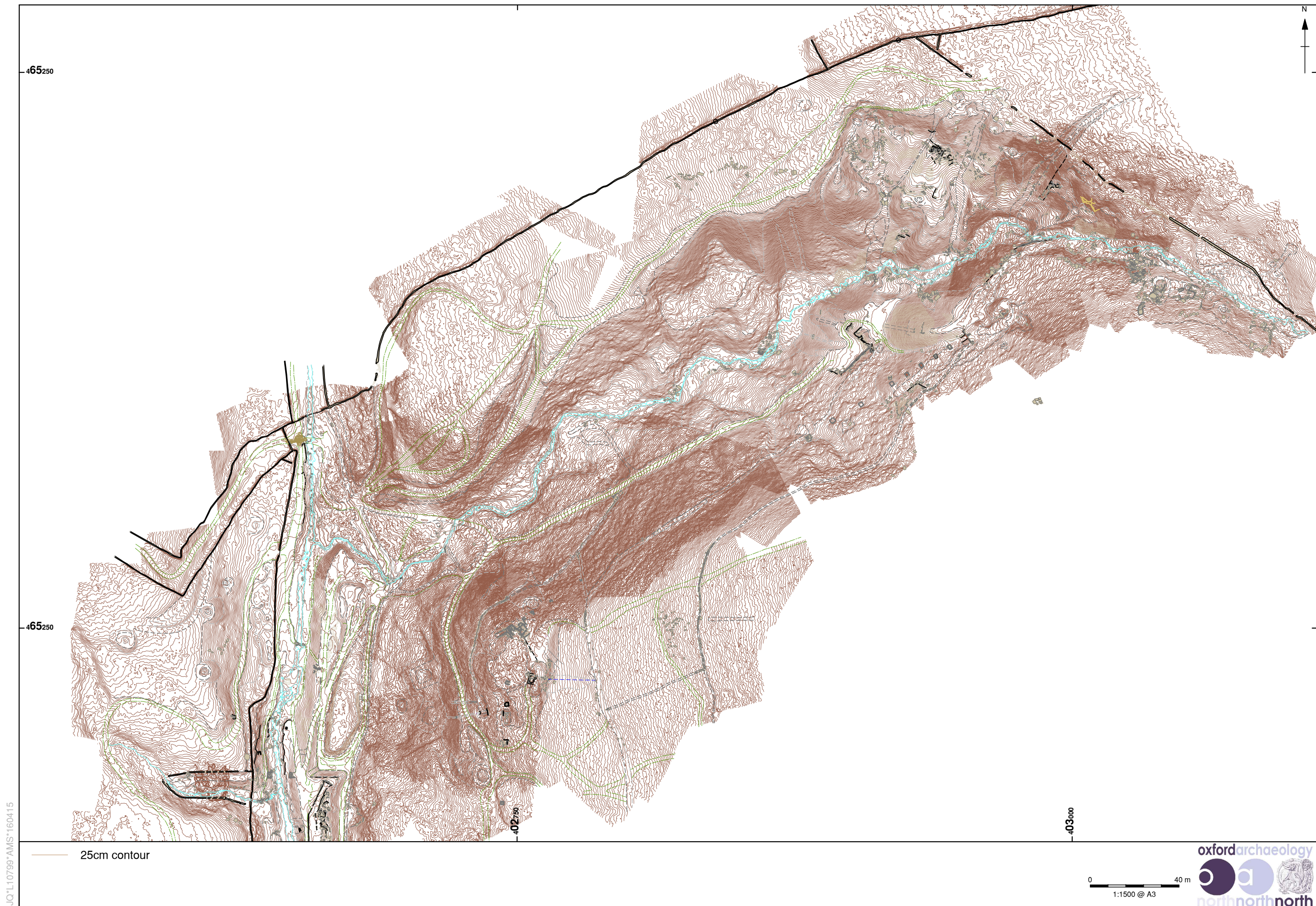
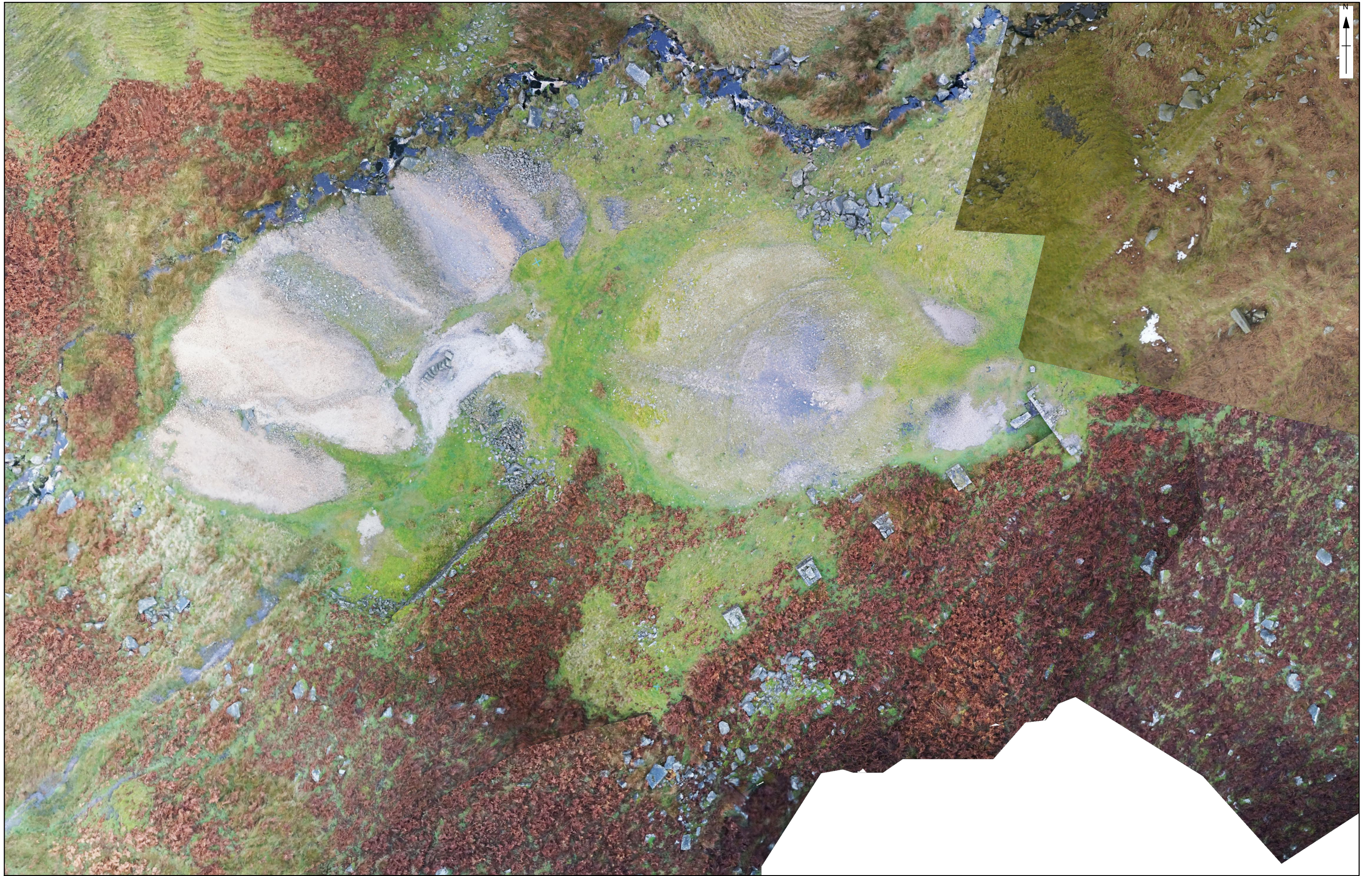


Figure 24: Contour model, with archaeology superimposed, of the northern and eastern part of the study area - Bolton Gill



Figure 25: Aerial photograph of Hebden Gill Dressing Floor



JQ*L10799*AMS*160415

0 10 m
1:300 @ A3

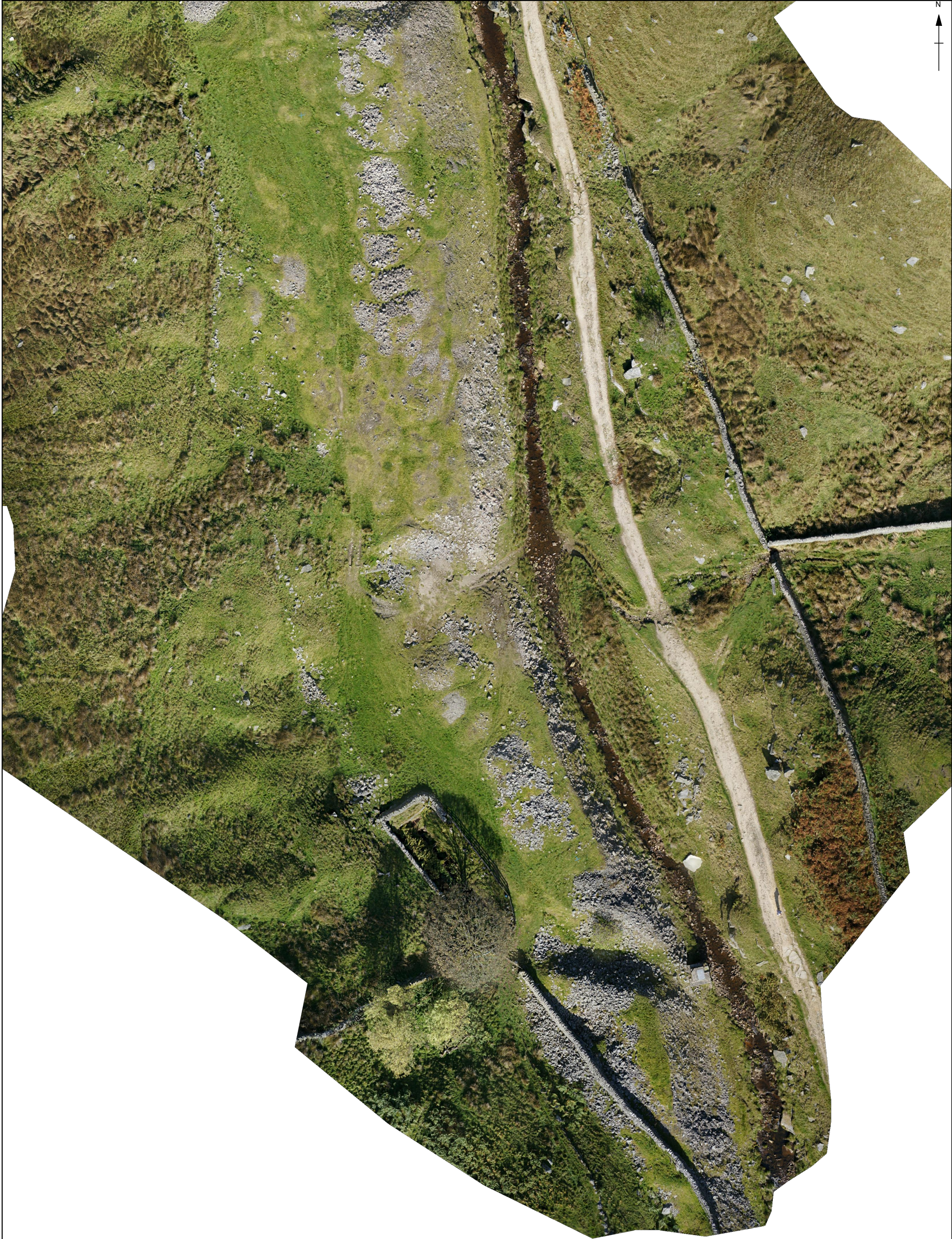
oxfordarchaeology
northnorthnorth

Figure 26: Aerial photograph of Bolton Gill Engine Shaft



0 10 m
1:400 @ A3

Figure 27: Aerial photograph of Bottle Level



0 10 m
1:400 @ A3

Figure 28: Aerial photograph of Duke's Level