NAA

LOW BONSOR DRESSING MILL

ARCHAEOLOGICAL COMMUNITY LANDSCAPE AND BUILDING SURVEY

LOW BONSOR DRESSING MILL,
CONISTON, CUMBRIA

prepared for

The Lake District National Park Authority

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LOW BONSOR DRESSING MILL, CONISTON, CUMBRIA
COMMUNITY ARCHAEOLOGICAL LANDSCAPE
AND BUILDING SURVEY

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LOW BONSOR DRESSING MILL, CONISTON, CUMBRIA
COMMUNITY ARCHAEOLOGICAL LANDSCAPE
AND BUILDING SURVEY

Summary

Northern Archaeological Associates (NAA) and John Pickin Archaeology (JPA), working together with local volunteers, undertook an archaeological landscape and building survey of the remains of Low Bonsor mill, a 19th-century ore dressing mill associated with Coniston copper mine. This work was commissioned by the Lake District National Park Authority (LDNPA) as part of the Heritage Lottery funded Coniston Copper project, a two-year scheme aimed at engaging the local community in the history and conservation of the areas' nationally important mining heritage.

Low Bonsor mill is of exceptional heritage significance as a mid-19th century multi-phase, mechanised ore dressing and processing site. The site covers an approximately 2.55-hectare area located at the head of the valley, on the east bank of the Levers Water Beck, and forms part of the Scheduled Coniston Copper Mine Complex. It was one of two dressing mills in operation at the mine by the mid-19th century; Paddy End mill on the west side of the valley and Bonsor (named after the ore rich Bonsor vein) on the east side. Operations at the Bonsor mill were originally focused at the upper mill site, located on a terraced area to the rear of the present-day Coniston Coppermine youth hostel. However, by 1850 the mill had extended south to meet the escalating demands of production.

Low Bonsor was designed as a secondary processing mill, which refined material that had already gone through the initial process of sorting and crushing at Upper Bonsor. The dressing floors were spread across three terraced areas, with stamp mills situated on the upper terrace for pulverising the ore, jigging and buddling on the middle terrace for refining, and finally a series of slime ponds at the southern end of the site to extract even the finest particles from the remaining waste. The dressing mill was in operation continuously for around 70 years, undergoing at least three key phases of development, before finally being abandoned in the late 1890s. Unlike the upper mill, Low Bonsor was not reused and rebuilt in the early 20th century, contributing to the archaeological preservation of the site.

Archaeological evidence of many of the key aspects of the copper-ore processing were identified during the community survey, including: transporting the ore (from the upper mill); stamping the ore (evidence of three stamping mills); dressing the ore (a jigging house and

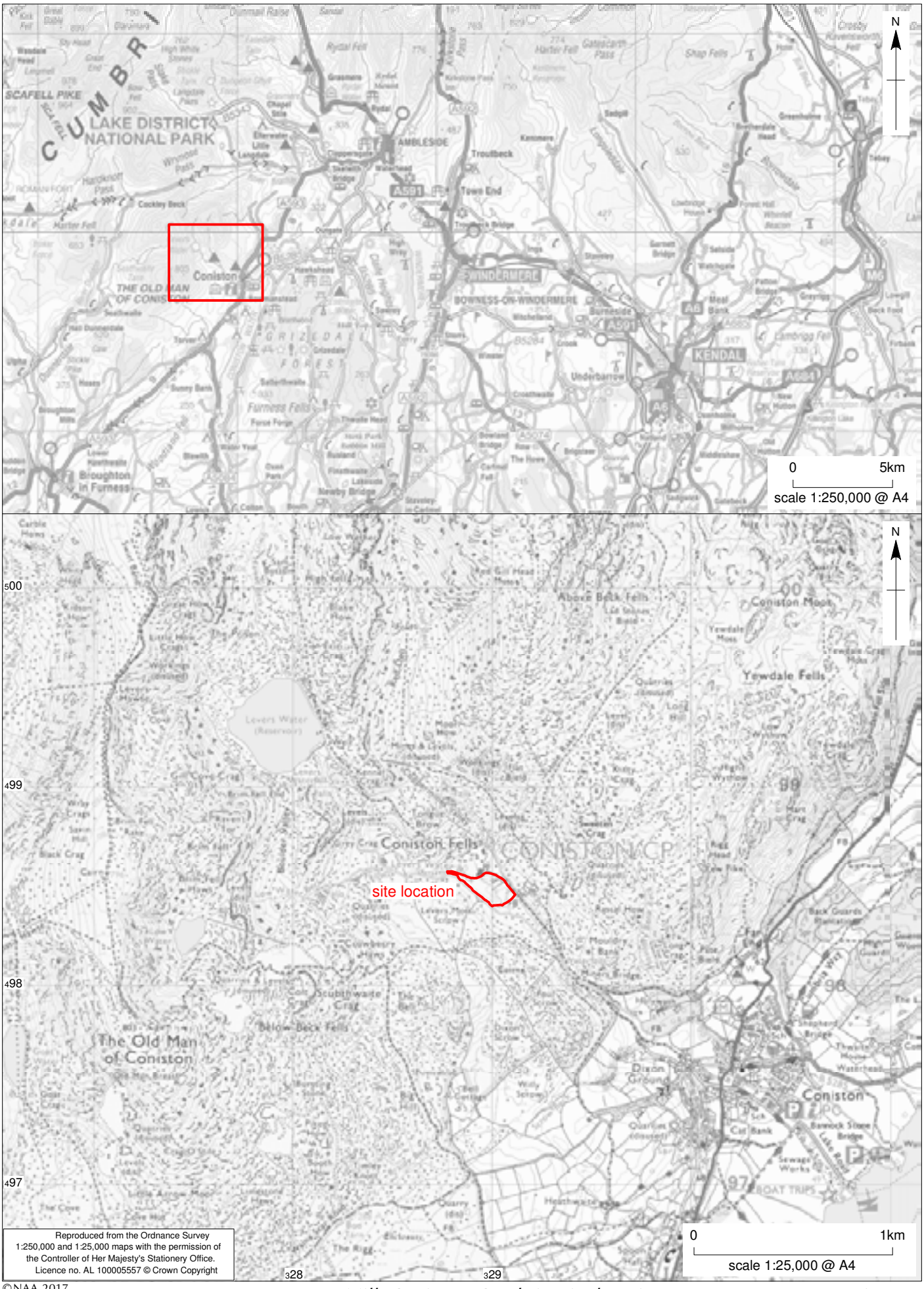
remains of buddles); final concentration of the ore (settling ponds); managing waste (slime ponds); water management (leats and launder piers); and the remains of a nationally unique copper smelting site built by Thomas Warsop in 1893. In addition to the visible surface remains, there is also high potential for the preservation of sub-surface archaeological remains, particularly at Stamping mills 1 and 3, the copper smelter, and the jigging house and buddles.

The aim of the community survey was twofold. Firstly, to engage local volunteers in the history and conservation of the site through providing practical, hands-on training, and secondly, to prepare a detailed analytical survey (Historic England Level 2/3) of the surface earthworks and structures to inform a subsequent programme of stabilisation. Topographic, earthwork and building survey were included in the project to provide a comprehensive record of the complex. The focus was on ensuring the volunteers received a firm grounding in traditional survey skills—plane table, tape and offset—which could be easily transferred to other sites. The use of aerial drones, global positioning systems (GPS), reflectorless total station theodolites (REDM), and rectified photography were also demonstrated.

A series of recommendations have been made based on the results of the survey, which are intended to enhance and conserve the exceptional heritage significance of the mill. These include proposals to improve public interpretation of the site and the potential for a phase of targeted community excavation to improve understanding of the construction and operation of the complex.

Acknowledgements

NAA would like to thank all the volunteers for their enthusiasm, dedication and good humour, even during the often-taxing weather conditions of a Lakeland spring! As ever, we are also indebted to the members of CATMHS for their continued support of the project, in particular Warren Allison, Mark Simpson, and Ian Matheson, for sharing their information and research material. Thanks also to the staff at the Cumbrian Record Offices and Armitt Museum and Library for all their support and patience. CBA North and the Archaeological and Architectural Society of Durham and Northumberland again loaned us their plane table and alidade, although we have finally now purchased our own shiny new table, and to the Barrow Mountaineering Club for continued use of their climbing hut. Finally, we owe a big round of thanks to Eleanor Kingston and her colleagues at the LDNPA for all their assistance, dedication, guidance and support throughout the duration of the fieldwork and beyond.



Low Bonsor Mill, Coniston, Cumbria: site location *Figure 1*

1.0 INTRODUCTION

1.1 Northern Archaeological Associates (NAA) and John Pickin Archaeology (JPA), working together with local volunteers, undertook an archaeological landscape and building survey of Low Bonsor mill (NGR NY 2902 9852), a 19th-century ore dressing mill associated with Coniston copper mine (Fig. 1). This work was commissioned from the Lake District National Park Authority (LDNPA) as part of the Heritage Lottery funded Coniston Copper project, a two-year scheme aimed at engaging the local community in the history and conservation of the areas' nationally important mining heritage.

Figure 2: *detail of Bonsor Mill and dressing floors. The Low Bonsor mill project area is highlighted in red, the Upper Bonsor Mill site in yellow. Based on image extracted from Google Earth.*

Brief Description

1.2 The Low Bonsor dressing mill forms part of the Coniston Copper Mine Complex, which covered approximately 56 hectares of mineral rich Lakeland fell to the north-west of the village of Coniston (Fig.1). Mining on a commercial basis in the area began in the Elizabethan period and was strictly controlled by the Company of Mines Royal, which was established to provide minerals for royal ordnance. The remains of these early workings can still be seen today in the form of deep open stopes visible

across the fellside.

1.3 Following a period of decline in the early 16th century, the mines reopened commercial production in the late 18th century and reached a peak in the mid-19th century under the partnership of John Taylor and his mine manager, John Barratt. The mine expanded dramatically during this period, producing in the region of 3000 tons of the mineral each year and employing over 600 people (Holland 1986). To process the ore two mechanised dressing mills were constructed; one at Paddy End on the west side of the mine and the other at the head of the valley on the east side. This became known as the Bonsor mill in reference to the mineral rich Bonsor vein mined in the area. With a plentiful supply of water and good easy access the Bonsor mill rapidly became the focus of dressing operations, eventually leading to the closure of the Paddy End mill in the late 1860s (Lofthouse 1997, 22).

1.4 Ore was possibly being processed in the vicinity of the Bonsor site by the late 18th century but it appears that it was not until the sinking of the Deep Level adit in 1825 that mechanised processing began with the construction of the first dressing mill—the Upper Bonsor mill—soon after. In addition to the installation of ore processing equipment—ore crushers, mechanised jigs, buddles, tailing and slime ponds—the site also housed the main administrative buildings, most notably the mine manager's house and offices (now the Coniston Coppermines youth hostel), store house, saw mill and stables.

1.5 Low Bonsor mill, the focus of the present survey, was built as an extension of the upper mill probably in the early 1830s as production at the mine increased (Lofthouse 1997, 42). It was designed as a secondary processing mill, receiving ore that had already gone through the initial process of sorting and crushing at Upper Bonsor, and was primarily concerned with the later stages of the refining process. Like the upper mill, it was arranged on a series of three terraces; however, unlike Upper Bonsor the site was not extensively rebuilt and reused during the early 20th century, resulting in a relatively well-preserved example of a mid-19th century mechanised dressing floor. The only exception is the south-eastern end of the site, which was reused in the early 1890s by Thomas Warsop, who constructed a short-lived but significant copper smelter on the site that blew down (Holland 1897, 214).

1.6 Today the Low Bonsor mill site contains the extant remains of semi-ruinous revetment walls, buildings, terraces and earthworks associated with the stamp, jigging and

buddling process, as well as slime ponds and an extensive spoil tip along the site's western boundary. All of these features formed part of the 2.55-hectare study area, which was surveyed by local volunteers from the Lake District National Park using a variety of techniques under the guidance of archaeologists from NAA and JPA.

1.7 The following document presents the results of both the buildings and landscape survey and is intended to provide a better understanding of the nature, form, extent, and significance of the surface remains of the 19th-century dressing mill. It focuses on the surviving archaeological evidence but also considers the significance of the remains within the wider context of the copper mine complex. It includes a brief history of the mine and mill, as well as a description of the ore dressing process, an account of the surviving evidence, an assessment of significance and recommendations for future investigation and interpretation. Finally, it culminates in an illustrated site inventory of all recorded archaeological features, which will act as a baseline for future monitoring and inform a forthcoming programme of stabilisation (Appendix 1).

Plate 1: view looking north-east across the north end of Low Bonsor mill with the mine stables (now the Barrow Mountaineering Club hut) in the background.

Project Aims

1.8 The aim of the project was twofold: a) to provide practical, hands-on skills training in

archaeological landscape and building survey to local volunteers; and b) to provide a detailed analytical record of the surface earthworks and structures associated with the Low Bonsor dressing mill. The latter was required to act as a permanent record of the monument and inform a phase of conservation works, which were carried out in April 2017 by Heritage Consolidation Ltd in accordance with a schedule of works provided by Countryside Consultants.

1.9 In achieving this aim, the following objectives, as specified in the original project brief (LDNPA 2017), were identified and met:

- a high-level survey of the dressing mill using a quadcopter or pole cam;
- a GPS topographical survey of the extent of the spoil tips associated with the site (Historic England Level 2);
- a detailed survey of the extant building remains associated with the complex (Historic England Level 2 to 3);
- a plane table survey of the dressing mill and associated features (Historic England Level 3);
- a gazetteer (or site inventory) of all associated features for inclusion on the LDNPA Historic Environment Record (HER);
- a digital photographic record of the site; and
- a narrative report detailing the sequence and development of the processing site.

1.10 Local volunteers were involved in all elements of the survey. Training was focused on ensuring a good grounding in traditional survey skills—the use of a plane table, planning frame, tape and offset—which were easily transferable to the recording of other mining and industrial sites in the area. A range of more modern recording techniques were also demonstrated, including the use of aerial drones, reflectorless total station theodolites, and rectified photography. This ensured a broad understanding of the various types of survey methodology that are available to record a complex industrial site like Low Bonsor mill. The limitations of each method were discussed and illustrated on site.

Project Scope and Limitations

1.11 The survey area comprised approx. 2.55 hectares covering a roughly triangular area to the south of the Coniston Coppermines YHA (NGR NY 2902 9852) (Fig. 1 and 2).

1.12 A 1:500 topographic survey (Historic England 2017, Level 3) was produced of the dressing mill complex using a plane table. A broader landscape survey (Historic England 2017, Level 2) was conducted of the wider area using an aerial drone and GPS. The latter included a record of the extensive waste tip running along the north bank of Levers Water Beck, which marked the western boundary of the site.

Plate 2: *view looking west across the jigging and buddling areas.*

1.13 The building survey was an analytical survey (Historic England 2016, Level 3) conducted using a combination of tape offset, reflectorless total station theodolite (often referred to as REDM), and rectified photography.

1.14 Survey was carried out over a three-week period in March 2017 by a team of local volunteers, supervised at all times by NAA staff and the mining specialist John Pickin (JPA). Conditions varied, with heavy snow causing some delays; however, overall visibility and ground conditions were good with low vegetation cover.

2.0 METHODOLOGY

2.1 All methodologies were in accordance with the following published standards and

guidelines:

- *Understanding the Archaeology of Landscapes: A Guide to Good Recording Practice* (Historic England 2017);
- *Metric Survey Specifications for Cultural Heritage* (Adams *et al*. 2015);
- *Understanding Historic Buildings: A Guide to Good Practice* (Historic England 2016); and
- *Standard and Guidance for the Archaeological Investigation and Recording of Standing Buildings or Structures* (Chartered Institute for Archaeologists 2014).

Documentary Survey

2.2 A great deal has already been written on the history of the Coniston copper mines and no new research was commissioned as part of the Low Bonsor survey. Perhaps the most significant established texts are Eric Holland's *Coniston Copper: A History* (1986) and *Coniston Copper Mines: A Field Guide* (1981), as well as Peter Fleming's *Coniston Copper Mines Rediscovered* (2000) and *The German Copper Mines at Coniston* (2007).

2.3 Both were members of the Cumbria Amenity Trust Mining History Society (CATMHS), who continue to conduct invaluable research into the history and development of the mines. In the preparation of this report, various members of CATMHS were consulted directly, including Warren Allison, Mark Simpson, and Ian Matheson, who kindly made available material from their own research, most significantly a series of important historic photographic that have helped interpret the complex development of the mill. Other primary and secondary source material forming part of the CATMHS archive at the Armitt Museum and Library in Ambleside have also been referenced.

2.4 Archives relating to Coniston are potentially dispersed across at least three of the four Cumbrian County record offices. The Kendal Record office (KRO) holds the main estate records (Rydal Estate Archive), but mining company records documents are also held at Barrow (BRO) and Carlisle (CRO) and possibly at Whitehaven. Within the constraints of the current project, it was not possible to visit all of these, although a short visit was made to Kendal. Material from the Lake District Historic Environment Record (HER) was also made available. In addition, historic photographs were accessed from Aberdeen University and the Museum of Lakeland Life and Industry in

Kendal.

Archaeological Survey

2.5 The archaeological survey comprised topographic earthwork survey and building recording. Each feature, building, complex or discrete area of space was allocated a unique identification number (context number). These incremented in set numbered groups, e.g. smelt area (300), office (420), and any features associated with these elements was ascribed a context number in that sequence, e.g. east wall of office (421). A full list of context numbers is included in the site inventory at the end of this document (Appendix 1).

2.6 A series of control stations were established around the site. This ensured a high level of dimensional accuracy was maintained, in accordance with Adams *et al*. (2015) guidelines. A local reference system was used initially and was later tied into the Ordnance Survey National Grid using an RTK GPS. All heights accord with the Ordnance Survey Newlyn datum.

Plate 3: *volunteers out in all weathers. Plane table survey with the snow-covered Coniston fells in the background.*

Interpretative topographic earthwork survey

2.7 A detailed, analytical and interpretative topographic survey (Historic England 2017,

Level 3) was produced at a scale of 1:200. This provided a record of all features associated with the mill complex, including built structures, water management features, dressing floors, tracks and pathways. The survey was conducted using a plane table, alidade and tapes (a Leica DISTO was tried but did not prove successful). The top and bottom (or other pertinent break of slope) of each feature were recorded and hachured by hand on site.

2.8 Elements forming part of the wider industrial landscape, including spoil tips, finger dumps, the location of levels, tracks, terraces and watercourses, were surveyed using a high-level aerial drone (quadcopter) fitted with a high-resolution camera. The resulting still photographs were orthorectified using control points surveyed in by GPS (Fig. 3). This information was used to prepare a Digital Terrain Model (DTM), which informed both the earthwork and buildings survey.

Building Survey

2.9 A detailed record of all the standing buildings on the site was made using a combination of plane table, taped offset, drawing frame, REDM survey, and rectified photography. With the exception of very ephemeral modern features, all structures were recorded as existing. Structural features of historic significance, such as blocked openings, fixtures and fittings, were annotated as appropriate.

Plate 4: *volunteers using tape and offset to record the office building (420).*

2.10 A photographic record of the site was made using a Canon EOS 6D full frame sensor

21-megapixel camera with 28–200mm 3.5–5.6 zoom lens. All detailed photographs featured a graduated photographic scale of appropriate dimensions. A full catalogue of photographs has been included in the site archive.

3.0 BACKGROUND INFORMATION

Location of the study area

3.1 Coniston copper mine is located on the western slopes of the Coniston Fells, situated approximately 1km north west of Coniston village in the south of the Lake District National Park (NGR SD 28590 98870) (Fig. 1). The remains of a number of copper workings and associated features can be identified scattered across the valley, including extensive spoil tips, semi-ruinous buildings, leats, ponds and levels. Two streams run down from the head of the valley. Red Dell Beck flows down the east side of the valley from its source on Wetherlam, while Levers Water Beck flows along the west side from Levers Water, a glacial tarn expanded by the construction of a dam at the foot of Brim Fell. Red Dell Beck converges with Levers Water Beck, which runs into the village. The highest point in the valley is Coniston Old Man at a height of 801m OD.

3.2 Low Bonsor mill is situated at the head of the valley, on a broad, south facing terraced area to the south of the Coniston copper mine youth hostel. The roughly triangular 2.55-hectare site is bounded on the north and east side by the road leading to the United Utilities Water Treatment works at Paddy End, and to the west by Levers Water Beck, with the remains gradually petering out to the south. The mill is a fine example of a mid-19th century ore dressing plant and includes earthwork remains and various semi-ruinous structures associated with the jigging and buddling process, as well as slime and tailing ponds.

Ownership

3.3 The Coppermine Valley, including the Low Bonsor mill site, is owned by the Fleming family, administered as part of the Rydal Estate. The exception is the 2-hectare area to the north of the youth hostel, which is under the ownership of Mr. Philip Johnson; this includes the remains of the Upper Bonsor dressing mill.

3.4 United Utilities operate a water treatment works on the west side of the valley in the area formerly occupied by the Paddy End dressing mill. Just above this is Brandy Crag Quarry, leased by Rydal Estates to Burlington Slate. This is an active quarry, worked

Low Bonsor Mill, Coniston, Cumbria: orthographic photomontage of the site

Figure 3

intermittently depending on demand.

Designations

3.5 Coniston Copper Mines is a Scheduled Monument (No. 1003055) and is protected under the provisions of the Ancient Monuments and Archaeological Areas Act 1979. The scheduled site covers a total of 56 hectares and includes the remains a range of mining structures encompassing all three dressing mills—Paddy End, Upper Bonsor and Low Bonsor. Scheduling is the only form of legal protection for archaeological sites and is applicable to both above and below ground archaeology, including any subterranean mine workings.

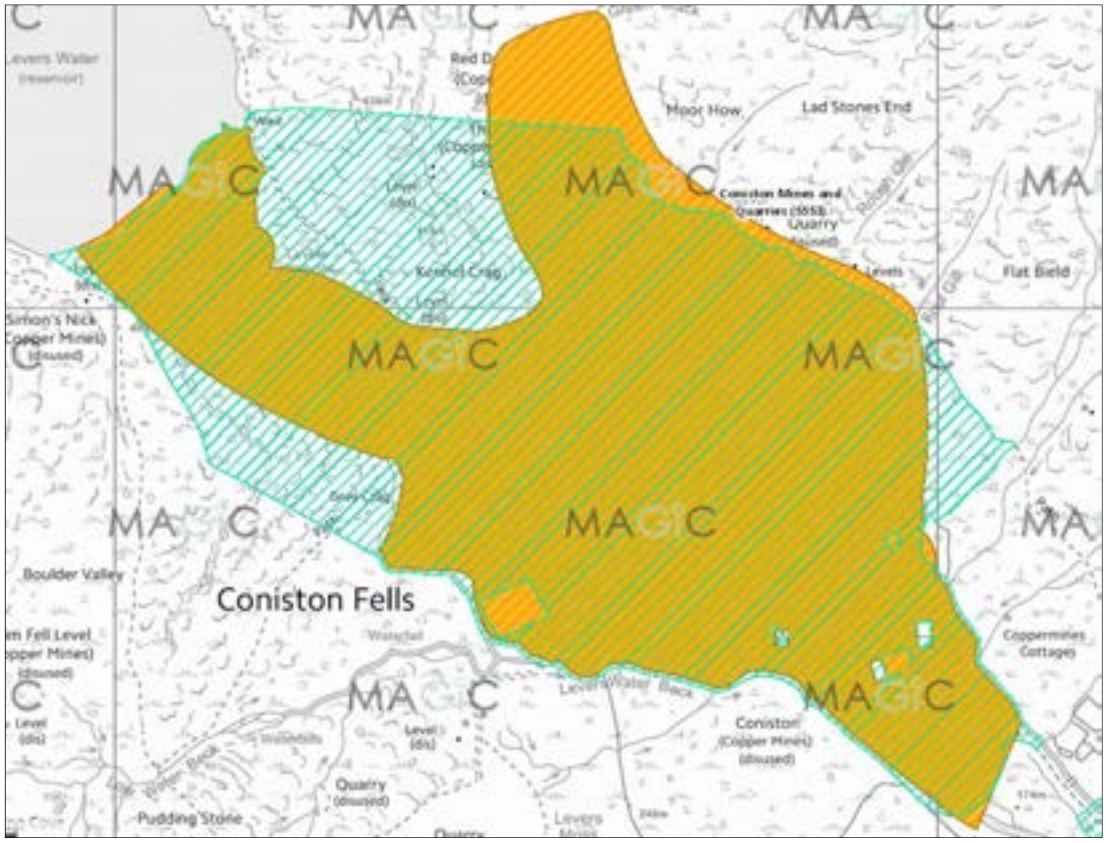


Figure 4: *Scheduled area (in yellow) overlain by SSSI (green striped). Image taken from MAGIC[1], OS produced under copyright licence AL: 100005537.*

3.6 The Coppermine Valley is also a designated Site of Special Scientific Interest (SSSI), in recognition of the geological significance of the area. This is protected under the Wildlife and Countryside Act 1987, as amended by the Countryside and Rights of Way Act 2000.

[1]Natural England (2018) *MAGIC* [Online] Available at: http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx (accessed on 04/01/18)

Geology

3.7 The geology of the region comprises rhyolitic and andesite lava flows, inter-bedded with hardened volcaniclastic dust and ashes of the Ordovician Borrowdale Volcanic Group, formed roughly 450 million years ago (Holland 1981; Adams 1988; Fleming 2007). Subsequent tectonic activity resulted in folding and tilting of the sequence, forming cleaves and faults. Cleaving is most clearly manifest in the numerous slate deposits across the fells, while the faulting resulted in the formation of mineral-rich subterranean fissures, concentrated and transported by hydrothermal fluids. These fissures—or veins—contain a complex mixture of different minerals, including copper, lead, zinc and a variety of other metals.

3.8 The primary suite of minerals found at Coniston are chalcopyrite, arsenopyrite and iron pyrites. Magnetite also occurs at depth along the Bonsor vein. The principal copper ore is a brass-yellow chalcopyrite, a copper iron sulphide ($CuFeS_2$), with over 3000 tons of the mineral being mined and dressed per year at peak production in the mid-19th century. A small amount of the grey primary copper ores (tennantite and tetrahedrite) was also extracted from Paddy End, as well as secondary copper ores, like malachite, which were raised in small quantities near the surface at Levers Water. Cobalt, nickel, lead and iron pyrites were all also mined across the site (Holland 1986; Adams 1988; Bridge 2000; Archaeo-Environment 2010).

3.9 The mineral-rich deposits were divided into two groups by the miners, ore and gangue. Gangue comprised a range of minerals considered to be commercially worthless at the time, including quartz, baryte, fluorite, and calcite. Sometime large bodies of ore were found in a pure state but more generally it was mixed with gangue, necessitating processing and dressing to concentrate the ore (Adams 1998, 12). By the early to mid-19th century this process was largely mechanised with three copper mills operating at Coniston during this period; Paddy End on the west side of the valley, and Low and Upper Bonsor on the east side.

Landscape character and use

3.10 The Coppermine Valley lies on the south edge of the Cumbrian High Fells District (NCA 8), a landscape characterised by *mountain scenery of open fells and craggy peaks separated by U-shaped valleys with a radiating pattern of rivers and lakes.*[2] The

[2] Natural England (2018) *NCA Profile: 08 Cumbria High Fells (NE343)* [Online] Available at: http://publications.naturalengland.org.uk/publication/2229157 (accessed on 02/01/18)

expanse of the open fells is covered by rough grassland, dwarf shrub heaths, peatland, and bracken, with frequent outcropping rock, and screes. This landscape has traditionally provided upland grazing, with the soil drained by narrow gills and streams. However, intensive mining in the 19th century has largely destroyed evidence of the former miner/farmer landscape and the industrial remains surviving today are largely the results of intensive commercial extraction (Archaeo-Environment 2010, 14).

3.11 Off the fells, the more fertile land of the valley bottom features a patchwork of unimproved and semi-improved pasture, punctuated by blocks of woodland. This landscape has traditionally provided upland grazing, the soil drained by narrow gills and streams. Settlement is clustered in small hamlets and farmsteads, many medieval in origin, although the buildings largely date to the 17th and 18th centuries. Buildings are constructed of local stone, being rubble-built with distinctive Coniston green slate roofs.

3.12 Mining and quarrying have traditionally been the key industries of the area, with both leaving extensive archaeological evidence across the Fells. In addition to the collection of mines recorded at Coniston, there have also been important mining remains identified at Tilberthwaite and Greenburn, approximately 3km north-east of the site, and further north at Goldscope and Greenside.

Previous archaeological work

3.13 In August 1983, the Cumbria and Lancashire Archaeological Unit (CLAU) were commissioned by Philip Johnston to undertake a survey of the Upper Bonsor mill in advance of restoration and conversion work (Fig. 5) published in the transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society (Middleton 1985).

3.14 Between 1995 and 1997, the Royal Commission undertook a detailed survey of the Coniston copper mine. This comprised a 1:2500 survey of a 5.5km square area with certain areas enlarged at a 1:500 scale, including both Low and Upper Bonsor mills (Fig. 6). The survey was based on the transcription of aerial photographs enhanced in the field using ground-based survey techniques. An interpretative report was produced to accompany the plans, which includes a description of both of the Bonsor dressing mills (Lofthouse 1997). Features identified in association with Low Bonsor mill were: a tramway (408), leat (407), water wheel (329), smelter (327), washing shed, buddles,

settling ponds and miscellaneous building, none of which had been allocated separate numbers (*ibid.,* 42). Both the RCHME survey and report were used to as baseline information in the current survey.

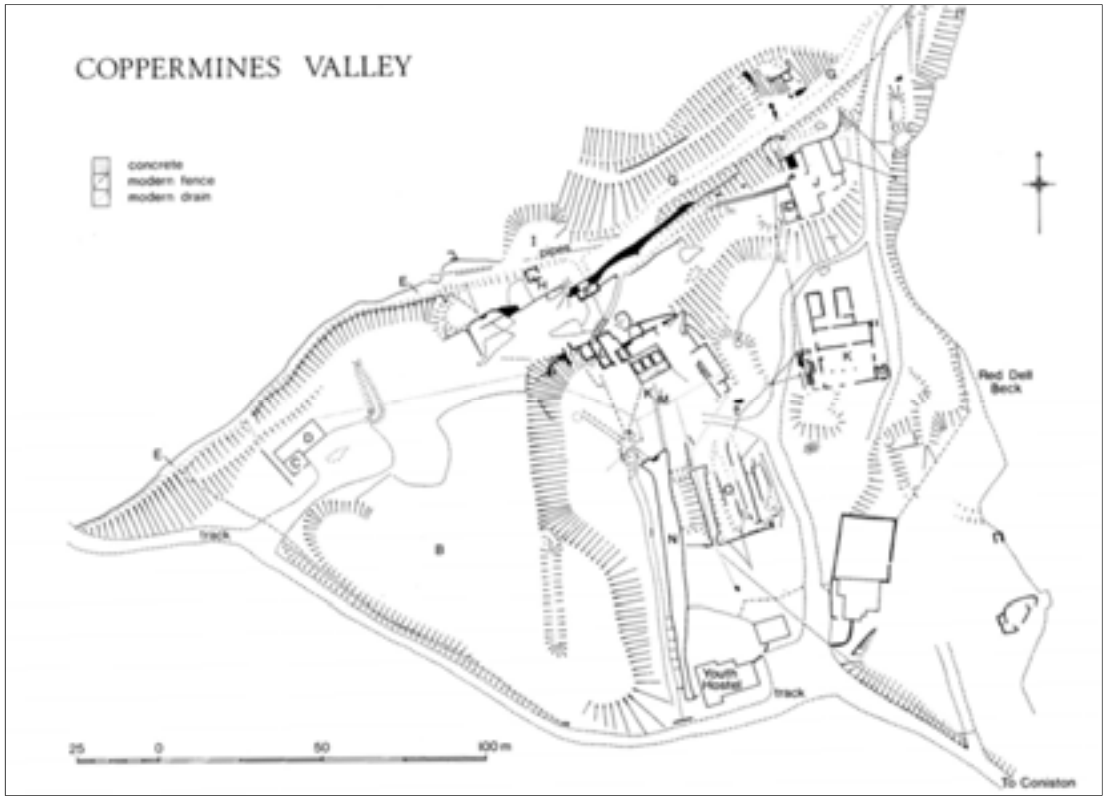


Figure 5: *survey of the upper mill (after Middleton 1985, 274).*

3.15 Following on from the RCHME survey, the British Geological Society (BGS) and CATHMS have been engaged in an ongoing programme of mapping and recording the below ground mine workings, including some conservation of subterranean structures and features.

3.16 In 2006, North Pennines Archaeology Ltd (NPA) completed a rapid archaeological desk-based assessment and watching brief on behalf of United Water Utilities. This was in advance of the extension of the Paddy End Water Treatment Works (NPA 2006). The following year, Oxford Archaeology North (OAN) undertook emergency archaeological recording at Paddy End following damage to the dressing floors caused by a burst water main (OAN 2007).

3.17 In 2010, Archaeo-Environment Ltd prepared a Conservation Management Plan (Archaeo-Environment 2010). This included a site inventory of key features and recommendations for future conditions assessment, consolidation and interpretation. In 2012, Countryside Consultants undertook a full conditions assessment of the

Low Bonsor Mill, Coniston, Cumbria: RCHME Survey

Figure 6

standing structures associated with the mining complex. This culminated in the preparation of a programme of stabilisation and conservation intended to remove the site from the Heritage at Risk register. This work is being completed as part of the HLF Coniston Copper project.

3.18 In July 2012, an archaeological evaluation was undertaken by Channel 4's Time Team. This focused on two areas; the investigation of standing buildings remains around the Simon's Nick stopes at Levers Water and the second at Red Dell Beck. The latter was intended to investigate the hypothesised remains of an Elizabethan stamp mill, used to crush ore, believed to be located in the vicinity of the beck. No trace of the mill was identified (Wessex Archaeology 2016, iv).

3.19 In April 2017, following the community survey, work began on the stabilisation of Low Bonsor mill. This was completed by Heritage Consolidation Ltd and archaeologically monitored and recorded by NAA. The work was informed by the preliminary results of the building and landscape survey. The results of the monitoring are presented in a separate report (NAA forthcoming).

Glossary

3.20 A glossary of technical terms has been included at the end of this document (Appendix 2).

4.0 HISTORY AND DEVELOPMENT OF THE MINE AND MILL

4.1 The story of copper mining at Coniston has been well researched, most notably in Eric Holland's 1986 book *Coniston Copper: A History*, and only a brief summary is given here.

4.2 Copper ores have been mined in the British Isles since the Bronze Age (c.2500–800BC), with several sites dating to this period identified in southern Ireland, central and north Wales and the English Midlands. However, the earliest documented evidence of mining at Coniston dates to AD1599 when the mines, and those at neighbouring Tilberthwaite, were being worked by German miners employed through The Company of Mines Royal.

4.3 Most of the surface exposures of copper were discovered and explored during this period and there was considerable activity on the outcrop of the Bonsor vein in Red Dell and on the vein complex at Back Strings above Lever Water. The ore was hand-

dressed on stone mortars at the mine-head and then crushed in a water-powered stamping mill. A recent evaluation at Cobbler's Level, the presumed site of the stamps, proved inconclusive (Wessex Archaeology 2016) and the location of this early mill remains elusive. The Company of Mines Royal wound down their operations at Coniston in the 1640s, probably because of the political and economic uncertainties arising at start of the Civil War.

4.4 Large scale mining resumed in the 1760s when the Macclesfield Copper Company, under the management of Charles Roe, began deep mining at East and West Bonsor and also on the Paddy End Vein. The location of Roe's dressing mill is unknown. It may have been at the site of the later Bonsor Mill but is more likely to have been at Red Dell Mill which is close to the East and West Bonsor veins and was described in 1824 as an 'old mill'. Roe's mill would have been a water-powered stamping mill.

4.5 There may have been some intermittent work at Coniston during the early 19th century but it was not until 1824 that the next major phase of development began. In that year, John Taylor took out a 21-year lease on the copper mines. As an engineer and agent, Taylor had extensive experience of metal mining, first at the Wheal Friendship (Mary Tavy) mine in Devon and then in Flintshire as mineral agent for the Grosvenor Estates. In 1818, he accepted a new post as mine agent to the Duke of Devonshire, managing the Ecton copper mines (Staffordshire) and the extensive lead mines at Grassington Moor (Yorkshire). At Grassington, Taylor was assisted by the mining engineer John Barratt and together they modernised the mine, installing complex systems of water transmission and importing Cornish crushing and stamping machinery, together with mechanised jigs and buddles. They also introduced new, more efficient systems of management and by the second quarter of the nineteenth century Grassington had become a model and profitable enterprise.

4.6 Taylor, with John Barratt as his manager, introduced a similar system at Coniston, bringing the failing mine back into production and prosperity. A number of new levels were driven to explore fresh ground, the most ambitious of which was Deep or Horse Level, started in 1825. Deep Level, located on the east side of Red Dell Beck, accessed the Bonsor vein at depth, drained the workings (including Roe's flooded Bonsor East works) and became the principal transport route out of the mine. To process the ore coming out of Deep Level, a new dressing mill, the Bonsor Mill, was constructed on the opposite side of the beck. The mill is likely to have gone into production in the mid-1820s and was followed in the early 1830s by a smaller

dressing plant at Paddy End to treat the ore from new operations on the Paddy End vein. In the 1850s, the mine was returning between £30,000 and £36,000 per annum and employed more than 600 people (Holland 1987).

4.7 The heyday of the mine was in the 1860s, when Deep Level finally reached the Paddy End Vein. All the ore from the various parts of the mine could now be moved underground to Deep Level for processing at the Bonsor mill. This centralised surface operations and led to the closure of the Paddy End dressing mill.

4.8 By the 1870s, production was falling and in 1875 Coniston, together with the mine and mill at Tilberthwaite, was offered for sale by auction. The business was acquired by Thomas Wynne, who brought in a number of improvements, including the use of compressed air for drilling. In 1881, however, the Bonsor vein began producing magnetite—a magnetic iron ore—at the expense of copper and by 1889 the price of copper had dropped so low that underground mining was becoming uneconomic. In 1891, Wynne relinquished his shares in the mine to the engineer and entrepreneur Thomas Warsop, who tried to rationalise and reduce operations. The little copper still being processed mainly came from reworking the tips. As copper continued to slump in price, sand and gravel derived from the waste tips became more commercially viable and by 1899 this was the greatest source of income to the mine.

4.9 In 1911, the Coniston Electrolytic Company was established, a joint Anglo-French venture. The company intended to employ an acid leaching system to extract copper from the dumps at the Bonsor and Paddy End mills and new buildings and processing equipment were erected at the upper section of the Bonsor mill. The operation was brought to a close by the First World War and all work ceased in 1915. The last attempt to rework the mine was in 1954 when some underground exploratory work was undertaken by W. T. Shaw on behalf of McKechnie Brothers, Widnes.

Bonsor dressing mill

4.10 There is no documentary evidence for the mining or dressing of ore at the Bonsor mill site before the 1820s and any archaeological evidence for earlier activity here is likely to have been destroyed by the 19th-century operations. [3]

[3]In August 2017 a typical 16th-17th century mortar stone, used for hand ore dressing, was found within the infill of a 19th-century building at the Upper Bonsor mill during consolidation works. The mortar stone probably came onto the site with mine spoil, but it does raise the intriguing possibility of an early phase of ore dressing at Bonsor mill.

4.11 The dressing mill at Bonsor appears to have been constructed as part of Taylor and Barratt's plan to rationalise and reorganise operations at the Coniston mines. In 1824, the year that the new lease was agreed, stamps were being assembled and by the end of March that same year 40 tons of ore had been taken down from Paddy End ready for dressing. The surface works were the charge of a foreman, Mr Nicholls, and John Barratt had been informed by Thomas Jones, who was erecting the stamps, that 'they is sure to work'. And work they did: by August 50 tons of copper concentrate had been stamped and processed and was ready for market (Holland 1986, 106).

4.12 The full mill was in operation by the early 1830s. A report on the mines was prepared in 1833 by the mining engineer John Leathart (KRO: WDRY/6/4/3/1) which observed:

'On the Bonsor Vein there are three principle levels or adits, the lowest of which is called deep level; near to the entrance of which there are erected a Crushing Mill and the other requisite apparatus for cleaning or washing the ores, with the principle offices below the deep level.'

4.13 Leathart's report also mentions that a second mill was being erected at Paddy End, which suggests that prior to 1833 all the material from the Paddy End vein was being moved to Bonsor for processing (Holland 1986, 112).

4.14 By the 1840s, the mine's dressing floors employed a workforce of between 60 and 90 people, mainly old men, women and children. Most would have worked at the Bonsor mill but some would have been employed at the new Paddy End mill. Operations were overseen by a Head Ore Dresser, Richard Woolcock, who was replaced after ten years by William Latham; after 1856, ore dressing was under the supervision of Latham's son, John. William Latham was paid a salary of £6 per month but the dressers received considerably less, with some of the younger girls on a day rate of between 5d and 6d. By the late 1850s, wages had risen slightly and there was a reduction in the number of female workers (Holland 1986, 84 and 128).

4.15 The original layout of the mill is unknown. As first planned, it may have been confined to the area known today as Upper Bonsor mill and then expanded, perhaps in the 1830s, as Deep Level reached the Bonsor vein and production increased. A detailed account of the mill is contained in A C Gibson's wonderful and slightly eccentric travel guide *The Old Man or Ravings and Ramblings round Conistone*, published in 1849. Gibson was the village doctor and also the surgeon for the mines.

4.16 Describing the first view of the mine and mill from the waterfall above the Miner's Bridge, Gibson writes:

'And now, occupying the upper end of an oblong basin amongst the hills, you see " a little town" of sheds, offices, workshops, and water-wheels, which, with the constant clatter of the machinery issuing therefrom, presents a most extraordinary contrast to the silence and solitude.'

4.17 And after taking the reader on a trip into the mine Gibson explains the dressing process at Bonsor Mill:

'And now, having safely returned to this every-day world, you may examine the processes through which the ore has to pass, before it is fit for the market, for, unlike most other mining, one-half of the work is not done when it is brought above ground. Well, first, you perceive, it is thrown from the waggons into a heap, where water runs over it, and by cleaning the lumps, shews more plainly what each piece is made of. Then from the heap it is raked by men to a platform, or long low bench, along which a number of little boys are actively engaged in picking or separating the richer pieces from the poorer, and it is highly amusing to watch the expertness and celerity with which the imps make the selection, and toss each lump into its proper receptacle. The richest portion is carried at once to the crushing mill, the poorer is thrown into another shed below, to be broken up and further picked, and the mere stones are wheeled off to the rubbish heap. The ore being broken small is thrown into the crushing mill, and passed once or twice through it, being returned to the mill by an endless chain of iron buckets, which dip into the heap of crushed ore below, and, carrying it up, empty themselves into the mill. When ground to the size of coarse sand, the ore is carried to the "jigging troughs," which are large square boxes, filled with water, and having each a smaller box, with a grated bottom, suspended in it to a beam above, and filled with ore, a "jigging" motion being imparted to the grated boxes by water-power. This jigging under water causes the grains of pure ore, which are heavy, to sink and pass through the grating of the inner box, and the particles of spar and rock, which are lighter, to rise to the top, whence they are scooped off and wheeled away to undergo another pounding and washing. The pounding is effected by means of two long rows of stamps or heavy iron-shod pestles, kept incessantly rising and falling in beds fronted with perforated iron plates, and fed with the material, and a flow of water to wash it, when fine enough, through the holed plate. It is, after that, collected to go through the process of "buddling," which consists of laying it on

slanting shelves, at the head of long wooden troughs, also slanting longitudinally, and a limited stream of water being allowed to run through it and wash it slowly off the shelves and down the inclining troughs, the heavier and valuable portion remains at the head, whilst the lighter and worthless portion is washed down to the lower end. All the waste water used in any of the dressing processes is made to flow through a series of large tanks or reservoirs, in which it deposits all the fine particles of ore that may be float pounds' worth of ore is collected annually in the form of slime, and looking like bronze, which with all the other ore is shipped to Swansea to be smelted.'

(Gibson 1849, 89)

4.18 Gibson colourfully outlines the dressing process in the extract above. Ore was brought out of the mine (Deep Level) by wagon and then washed, raked, hand-picked and sorted. Interestingly, Gibson describes this as being undertaken by men and little boys (his 'imps') and there is no mention of girls or women. Material was then crushed, and an elevator used to return any ore that required re-crushing. The resulting 'coarse sand' was then treated in water-powered jigs and taken to 'two long rows' of stamps. The final part of the process is buddling on 'long wooden troughs' with the resulting slime collected in 'ponds and reservoirs'.

4.19 The First Edition six-inch map, surveyed in 1846-48 and published in 1850, is contemporary with Gibson's account and many of the buildings he describes can be identified (Fig. 7). At Upper Bonsor Mill a tramroad can be seen running from the mouth of Deep Level to the ore bins, sorting sheds and crusher house. Water power for the crusher and other processes is supplied by leats from Red Dell Beck and Levers Water Beck and two tramroads run south-west from the ore bins and crusher to the main spoil tip. Against the eastern edge of the spoil tip, a number of buildings and ponds are shown, which were associated with a leat running south-west from the crusher house.

4.20 The long building at the end of the leat may be a stamping mill and the other structures are probably buddle houses. A single tramroad runs south-east, past a building that can be identified as the mine office (now the YHA), towards the lower part of the site and a rectangular building with a central extension, which is most likely another water-powered stamping mill. Immediately south are a series of settling ponds and interlinked water courses; this area probably housed a set of secondary buddles.

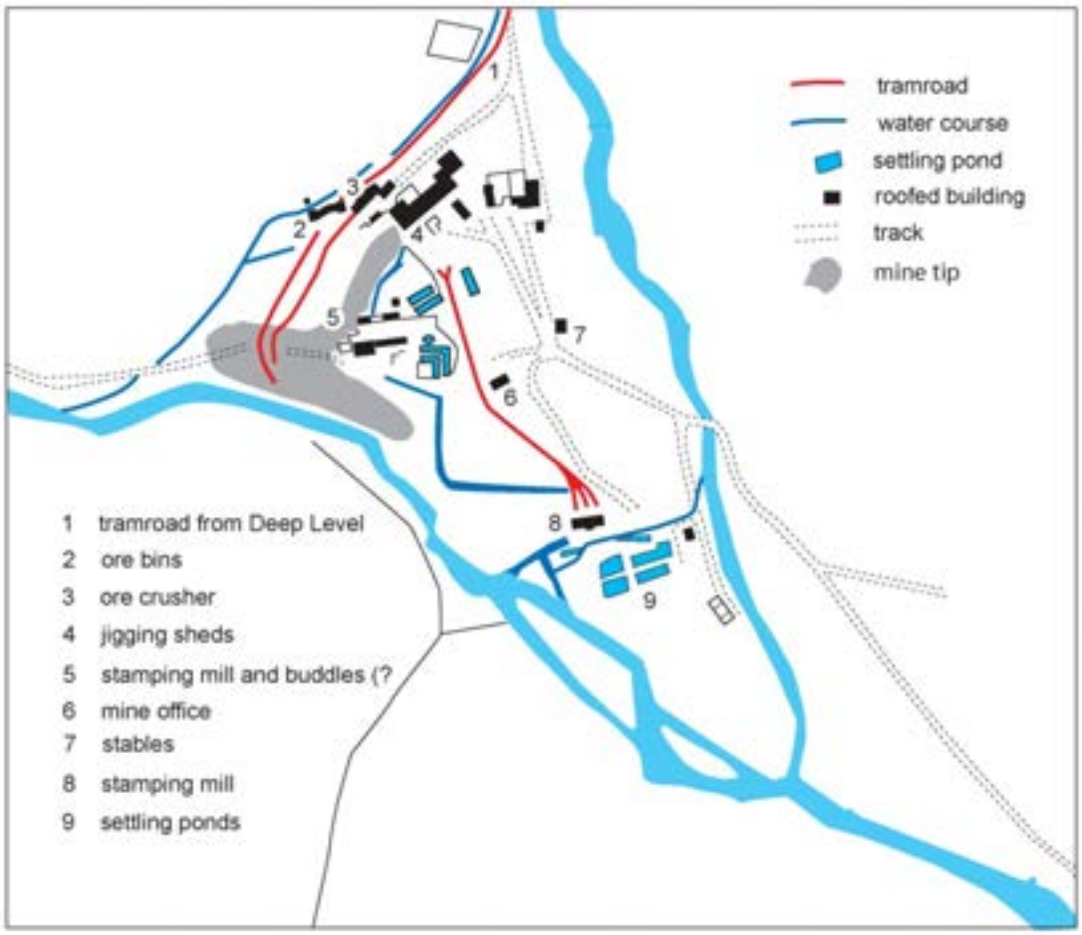


Fig. 7: *plan based on the 1850 First Edition six-inch map annotated to show the location of principal buildings and features at the upper and lower mills.*

4.21 Gibson's description and the First Edition OS map not only provide essential information on the organisation of the mill and the function of individual buildings but also shows that by the late 1840s the whole site was operating as a single integrated unit. Upper Bonsor mill was used for sorting, crushing and jigging and Low Bonsor mill—the area examined in the community survey—housed the stamps, buddles, settling ponds and slime tanks (Fig. 7).

4.22 Further information on the dressing process is contained in an anonymous account held in Ian Matheson's collection, thought to have been written in the 1858 (original grammar and spelling retained):

'The work was drawn out from under the ground by horse power and then it was dressed by men and boy and women and girls which there was 50 women and about 300 men and boys. The copper raised was about 5 or 6 hundert tons a month.

The work was drawn out at the rate of 8 trips a shift with 3 big iron waggons which

held 2 tons each. Then it was dumped down a screen which sized it into 3 sections, then it was sorted into 4 lots. The first was the solid ore which was put out by itself. The next was what was called Douse. It was the second best. The third was a class quartz and copper mixed which had to go through the crushing mill to be ground to a fine sand. Then it taken to the water sives. There was 6 sets of them with 2 sives to every set. Each set of tubs was emptied twice a week and each set of tubs held 5 tons. that ment 60 tons a week of jigged ore. Then it was put into a pile and the solid pile was ground and thrown over it so that they got a average sample. After that it was all turned over and weighed and then carted to Coniston Hall and taken to Nibthwaite by boat and then carted to Ulverston and put on rail and sent to Sent Elens'

4.23 This account is less specific than Gibson's but is still of value as a contemporary source. The figure of 350 men, women and boys employed on the surface is particularly interesting, as the total had dropped to 150 by the time of the Kinnard Commission's 1862 report into working conditions (Holland 1986, 153).

4.24 The highest quality ore was the hand-picked copper pyrites, which was sorted at Upper Bonsor and was around 15 percent copper. The jigged ore averaged about 8 percent copper (Dewey and Eastwood 1925, 63).

4.25 In 1883, during Thomas Wynne's ownership of the mines, Salmon, Barnes and Co. at the Canal Head foundry, Ulverston, were contracted to undertake a major rebuild of the mill. This included the installation of a new water wheel and ball mill—for ore crushing—at Upper Bonsor and the construction of new jigs and two round buddles (Holland 1986, 184); the location of the jigs and buddles is not recorded but they may have replaced older equipment at the Low Bonsor. There were major problems with some of the new plant. The new jigs 'did not work too well' and processing rates were dropping; the old jigs had processed 8 to 10 tons per week with one attendant, while the new ones produced less than 4 tons with two attendants. The purser at the mine, Bennett Johns, had reckoned that a mill treating 100 tons a month would produce a profit but by December 1883 the new mill was only handling up to 50 tons, and that was with it working day and night (Holland 1986, 190-93).

4.26 In 1884, the mine was partially closed down and production at the mill concentrated on sand—fine waste—dressing for the building industry. Some 1,243 tons of sand were produced between September and October 1886, with one of the workers, J Thwaites, paid 10 shillings a week plus 2d a ton. Only a dozen men were employed

at this time (Postlethwaite 1913, 119). This work is likely to have involved the reprocessing of the buddle sands and slimes at the southern end of Low Bonsor mill (Holland 1986, 195). But copper was still being produced and during 1885-86 some 217 tons of copper concentrate were sold for £476; the cost of processing this, however, was £1,048 (Holland 1986, 202)! The 1890 25-inch map OS map (surveyed in 1888) shows the layout of Low Bonsor dressing mill at this time and many of the individual features can still clearly be identified (Fig. 8).

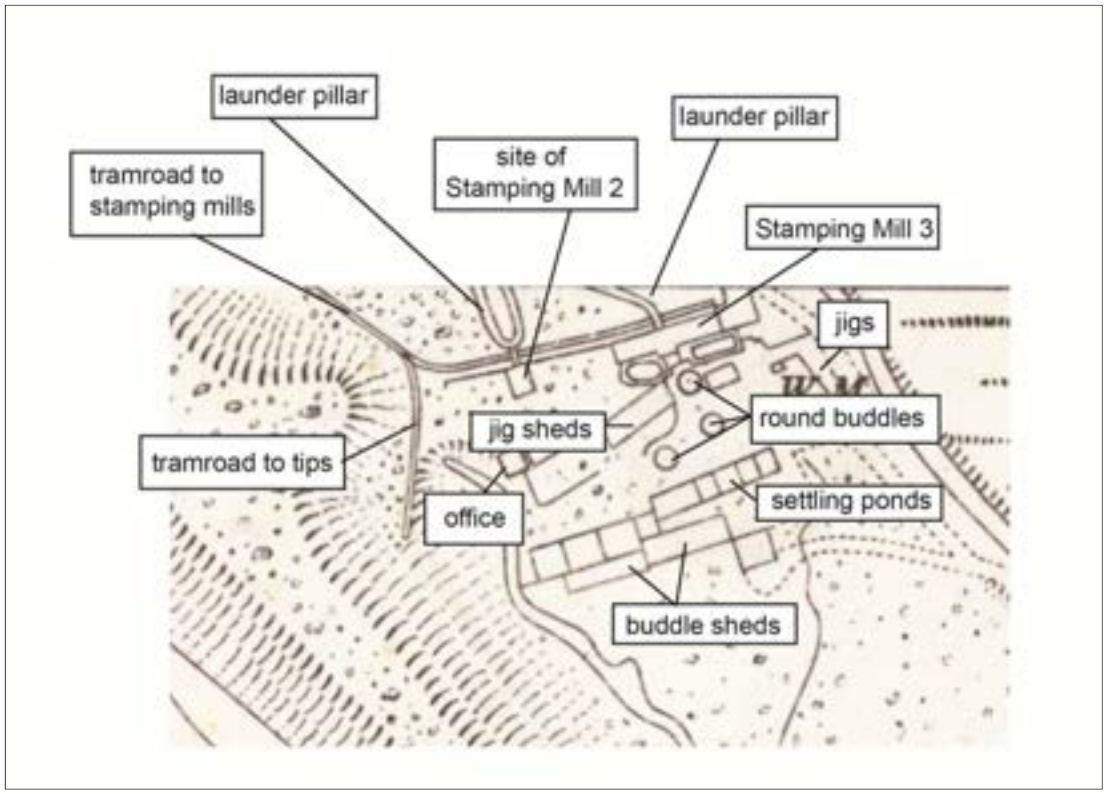


Fig. 8: *Plan based on the 1890 25-inch map annotated to show the principal buildings and features at Low Bonsor mill.*

4.27 In 1891, Thomas Warsop took over the mine and two years later he made an inventory of the plant and equipment at the Bonsor mills. Upper Bonsor Mill consisted of:

- ore sorting shed, measuring 6 feet x 40 feet;
- no.2 Marsden stone breaker, driven by a 21 feet diameter water wheel;
- crushing mill with bucket elevator, powered by a water wheel (22 feet by 6 feet);
- three sets of Greens jiggers;

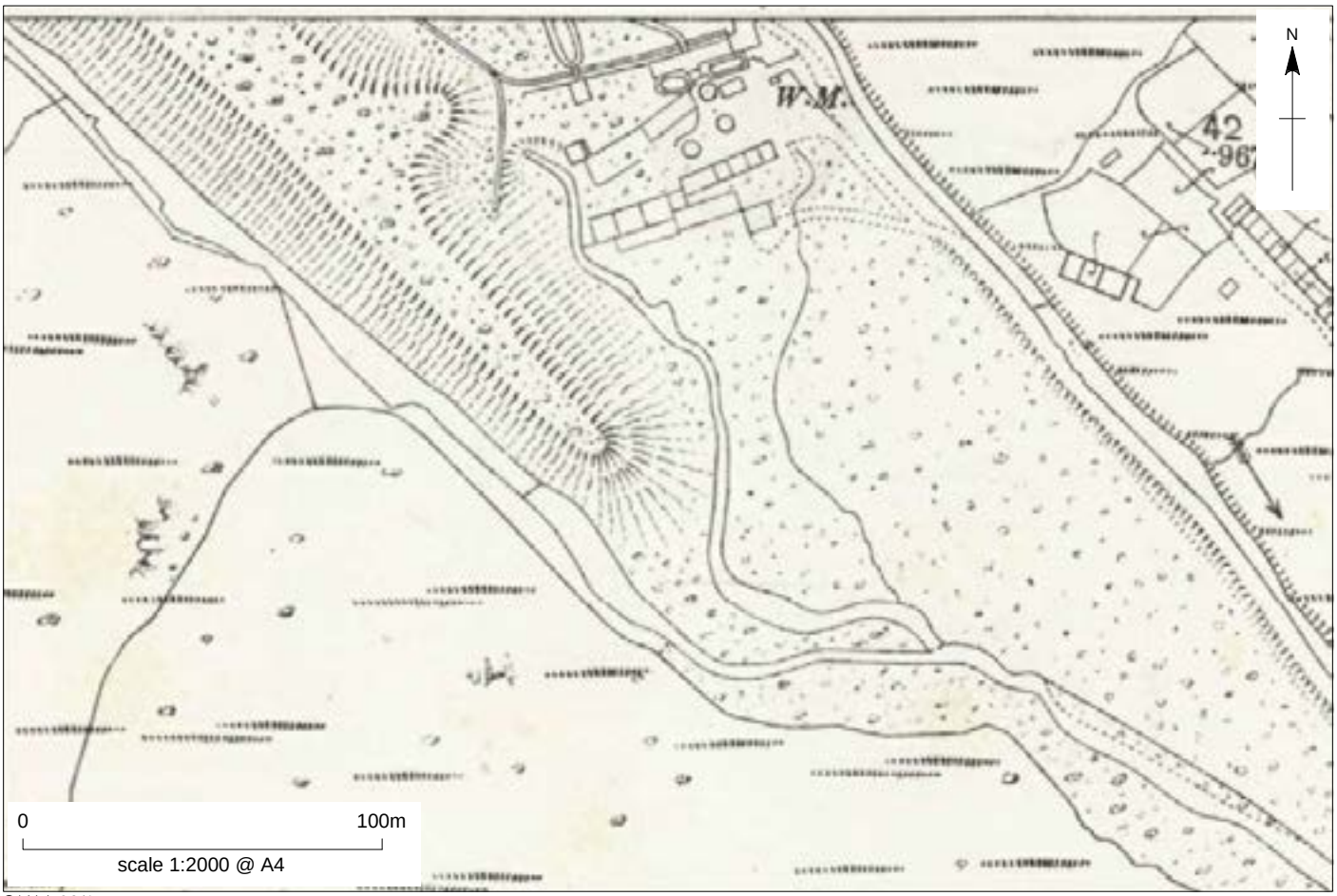
- two buddles and classifiers with their own water wheels and sheds; and
- two sets of jigs driven by a water wheel (12 feet by 2 feet and 6 inches).

4.28 A tramroad, 270 yards (247m) long, connected the upper mill to the lower mill or Lower Floors, which comprised:

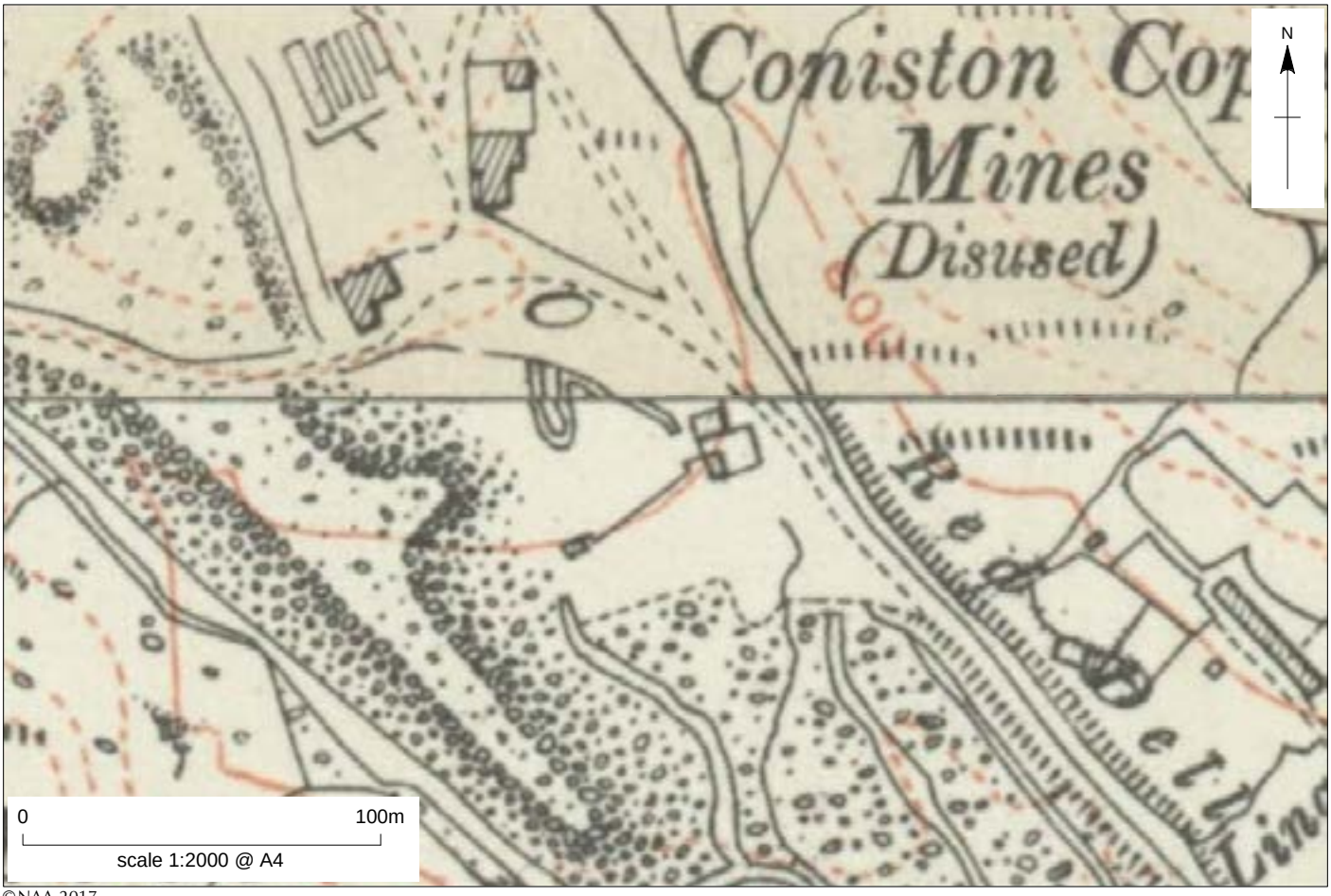
- a 36-head stamp battery and water wheel (16 feet diameter);
- jigs and water wheel (5 feet by 4 feet);
- brush-type washing buddles and water wheel (5 feet by 4 feet); and
- a water wheel (10 feet), the purpose of which is unknown.

4.29 In 1893, the same year as the site inventory, Warsop began the construction of a copper smelter at the Low Bonsor. Previously, all the ore had been sent to Merseyside for smelting, so it would be interesting to know why Warsop decided to erect his own smelter at a time when the mine was in economic decline. No details of the smelter survive but historic photographs (Plates 15) show a small blast furnace blown by the stamping mill water wheel.

4.30 The smelter was short lived and was abandoned after storm damage in December 1894. The dressing floors at Low Bonsor may have been abandoned at the same time; a contemporary photograph (Plate 18) shows the site in a state of near dereliction. After this it appears that all subsequent processing and dressing was confined to Upper Bonsor and the only activity at Low Bonsor mill was the removal of some of the more mineral-rich tip material for reprocessing. The 1913 edition OS map marks the site as disused, with the Low Bonsor mill office (420) as the only building shown standing (Fig. 10).



Low Bonsor mill, Coniston, Cumbria: 1890 25 inch Ordnance Survey map *Figure 9*



Low Bonsor mill, Coniston, Cumbria: 1912 6 inch Ordnance Survey map *Figure 10*

5.0 HISTORIC PHOTOGRAPHS

Photograph 1 (P1)

Title: Old Man from above the mines
Collection: University of Aberdeen, George Washington Wilson Collection
Reference: GB 0231 MS 3792/F2863 559 Stereo.
Date: 1877 or earlier (listed in Wilson's 1877 catalogue).

5.1 Taken by the Scottish photographer George Washington Wilson, Photograph 1 (Plate 5) forms part of the Washington Wilson Collection held at the University of Aberdeen. It is listed in the 1877 catalogue but the frame itself is undated and could be as early as the mid-1860s. The view shows Low Bonsor mill from the east.

Plate 5: *historic photograph 1: Old Man from above the mines. © University of Aberdeen.*

5.2 At the centre left are two wooden buildings (see Plate 6), probably the sheds for the double stamps described by Gibson and also shown on the 1850 OS map (Figs. 7 and 8). Behind the sheds is a masonry pier carrying the tramroad and leat to the stamps. The water wheel, which sat between the two sheds, has been removed, indicating that the stamps were out of use when this photograph was taken.

Plate 6: *detail from P1 showing the Low Bonsor stamps and dressing floors. © University of Aberdeen.*

5.3 In the centre foreground of the photograph is a water wheel with a wooden launder operating machinery in a wooden building (under construction?) to the left; this is a new set of stamps. And behind the building is the gabled roof of another building attached to a water wheel with a masonry launder pier to the right; this is a second stamping mill. In the left foreground are a set of jigs and in the background, is the main waste tip from Deep Level and the upper mill.

Photograph 2 (P2) (Plates 7 and 8)

Title: Waterfall at Coniston

Collection: University of Aberdeen, George Washington Wilson Collection

Reference: GB 0231 MS 3792/F1836 561 Stereo.

Date: 1877 or earlier (listed in Wilson's 1877 catalogue).

Plate 7: *historic photograph 2: waterfall at Coniston. © University of Aberdeen.*

Plate 8: *detail from P2 showing the showing the Bonsor mill complex from the south-east. © University of Aberdeen.*

5.4 This image, also part of the George Washington Wilson Collection, shows the mine complex as viewed from the top of the waterfall on Levers Water Beck and is reminiscent of the "little town of sheds, offices, workshops, and water-wheels" described by A. C. Gibson in 1849. To the left is the mine office and in front are the sheds of the two new stamping mills seen in P1. In the centre foreground is a long single storey building with another building to the left; these structures appear on later photographs and maps and were probably sheds for buddles. At the right-hand side of the photograph are some of the buildings at the upper mill, including the large water wheel for the saw mill.

Photograph 3 (P3) (Plate 9)

Title: Coniston Coal (sic) Mines

Collection: Warren Allison

Date: 1880s

5.5 This photograph, which survives as a hand-coloured lantern slide (Plate 9), was taken from the same vantage point as P1 and shows Low Bonsor mill from the east. In the centre is a masonry launder pier that powered an enclosed water wheel via a wooden launder on timber trestle legs. Flanking the wheel are two timber stamp sheds with open fronts. In front of the nearest shed is a rectangular masonry tank to collect the pulverised output from the stamps.

Plate 9: *historic photograph 3, Coniston Mine c.1880 © Warren Allison.*

5.6 When compared with P1 it shows considerable changes to the stamping mill: the water wheel is larger; the former open leat has been replaced by a high-level launder

and launder pier; there are sheds either side of the wheel suggesting a double set of stamps; structural changes have been made to the area in front of the stamps; and a curving retaining wall has been built against the slope to the right (north-east) of the stamps. The view also shows that the second stamping mill and associated buildings have changed little from the scene in P1. Other points of interest in the view are the tramway shown below the main tip on the left of the image and the presence in the centre of a small wooden cabin built against the tips; this may have been a shelter or toilet for the workmen.

Photograph 4 (P4) (Plate 10)

Title: Coniston Mines and Old Man'

Collection: Unknown; reproduced in Davies-Shiel and Marshall (1976, fig. 102).

Date: 1880–90s

5.7 This view from the south-east is likely to have been taken at the same time as P3, P5 and P6. On the terrace below the front stamping mill is a long, open-sided shed, probably a jigging shed, and in front of this building and the stamping mill are three circular buddles. In the right foreground is the same set of open, water-powered jigs seen in P1 and at ground level to the left is what appears to be a timber running buddle. Further left is a series of rectangular settling ponds, one of which has a paddled kieve or dolly tub next to it, and below these is another long, roofed structure sheltering further buddles. Of particular interest is the light-coloured spoil tip with a tramroad on top located behind and left of the jig house; this tip covers the site of the original stamp mill shown on P1.

Plate 10: *historic photograph 4 of Low Bonsor mill c.1880 (after Davies-Shiel and Marshall 1976, fig. 102).*

Photograph 5 (P5) (Plates 11 and 12)

Title: Unknown

Collection: Museum of Lakeland Life and Industry

Date: 1880s

Plate 11: *historic photograph 5 showing the showing Low Bonsor mill from the south. © Museum of Lakeland Life and Industry.*

Plate 12: *detail of P5 showing probable buddle sheds and stamp mill.*

5.8 This view was taken further to the south than P4 and shows two long, open sheds below the jig house and buddles and a single storey stone building in the centre

foreground. The open sheds appear to be the same as those seen on P2 and are probably sheds for the buddles. This photograph also shows part of the interior of the nearest stamping shed and what may be details of the grates in front of the individual stamps. The photograph was taken by Henry Herbert who was working at Bowness in the 1880s and set up own photography company in 1894.

Photograph 6 (P6) (Plates 13 and 14)

Title: Unknown

Collection: Eric Holland Archive and CATMHS

Date: 1880s

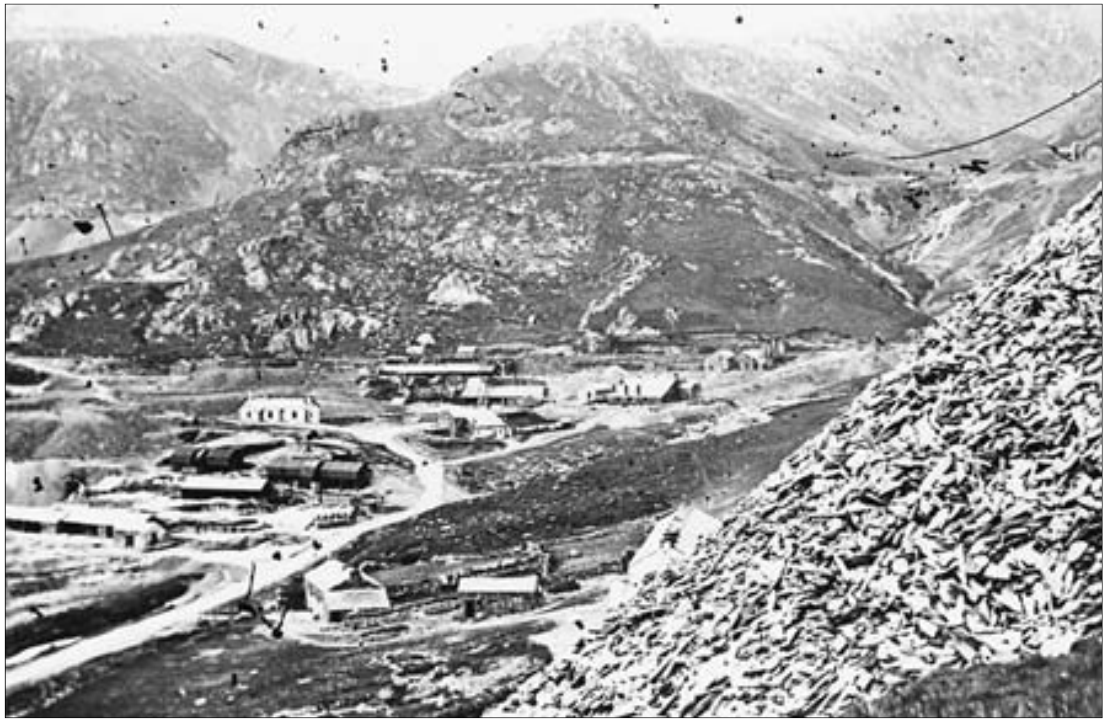


Plate 13: *historic photograph 6, view across the Low Bonsor dressing mill floors taken from the tips below Low Blue Quarry. © CATMHS archive.*

Plate 14: *detail of P6 with mine managers house and office (now the youth hostel) clearly visible.*

5.9 This view across the lower mill dressing mill floors was taken from the tips below Low Blue Quarry. It shows most of the buildings and other features seen on P3–P5 and also shows Upper Bonsor Mill and the other mine buildings.

Photograph 7 (P7) (Plate 15)

Title: Unknown

Collection: Unknown; reproduced in Holland (1986, fig. 51)

Date: 1893-94

5.10 This view taken from the south-east shows Warsop's copper smelter soon after its erection in 1893. The smelter building was constructed against the east side of the former stamping mill and the mill wheel, and remaining stamp sheds are shown in the photographs to the left of the structure. The smelter was a tall gabled building, perhaps clad in timber or corrugated iron, shown resting on large masonry support walls. This image also illustrates the derelict state of the Low Bonsor mill dressing floors by the end of the 19th century.

Plate 15: *historic photograph 7, view of Warsop's copper smelter taken from south-east c.1893 (after Holland 1986, fig. 51).*

Photograph 8 (P8) (Plate 16)

Title: Unknown

Collection: Unknown; reproduced in Holland (1986, fig. 52)

Date: 1894-5

5.11 Photograph 8 is a view of Warsop's copper smelter taken from the south-west immediately after the disastrous gale of December 1894. The roof and side walls have gone but part of the building's iron framed superstructure, including the east gable, remains intact. Within the building are the stack of the blast furnace and its fume catchers and on the bank behind is a wooden building, probably the charge house. The pulley wheels were part of a line-drive system powered by the water wheel seen on the far left and they may have operated a blowing machine for the furnace.

Plate 16: *historic photograph 8, view of Warsop's copper smelter following the disastrous gale of 1894 (after Holland 1986, fig. 52)*

Photograph 9 (P9) (Plate 17 and 18)

Title: Unknown

Collection: CATMHS

Date: 1894-5

Plate 17: *historic photograph 9, view looking north-east of the copper mines complex taken soon after 1894. © CATHMS Archive.*

Plate 18: *details taken from P9 showing Low Bonsor mill.*

5.12 Historic photograph taken soon after 1894, which shows the whole of the copper mines complex soon after the copper smelter was destroyed. It provides another view of the semi-collapsed smelter building and its associated water wheel. Although the shed to the left of the wheel has been removed, the stamps themselves are still clearly in place. The site of the second stamping mill has been cleared by this period, but

water still flows from the now wheel-less launder pier. The dressing floors are in a ruinous condition with all the equipment removed and the stone robbed from the terrace walls.

6.0 INTERPRETING THE ARCHAEOLOGICAL INDUSTRIAL LANDSCAPE

6.1 The following section describes and discusses the archaeological evidence identified at Low Bonsor mill during the community survey. It looks at how the mill operated, including transport, stamping, jigging, buddling, slimes treatment and water supply, and also examines the later copper smelter and the spoil tips derived from Upper Bonsor Mill. Each feature has been assigned a unique identification number (context number), a full list of which can be found in the site inventory (Appendix 1) and are illustrated on Figure 11. Building plans and elevations are referred to within the text as appropriate and inserted within the report.

6.2 The Low Bonsor mill complex comprises three separate landscape units (Fig. 12). The principal part of the complex is the dressing floor itself (Area 1), which includes the supply leats, the tram road and the later stamping mills (Area 1a), jigging, buddling and the early stamp mill (Area 1b), and secondary buddling and slime treatment (Area 1c). In the eastern part of the complex are the remains of a copper smelter (Area 2) that post-dates the dressing floor and to the west, running parallel with Levers Water Beck, are extensive spoil heaps (Area 3) composed of underground waste from the mine and dressing waste from Upper Bonsor mill. These three areas are discussed below as independent parts of the archaeological landscape.

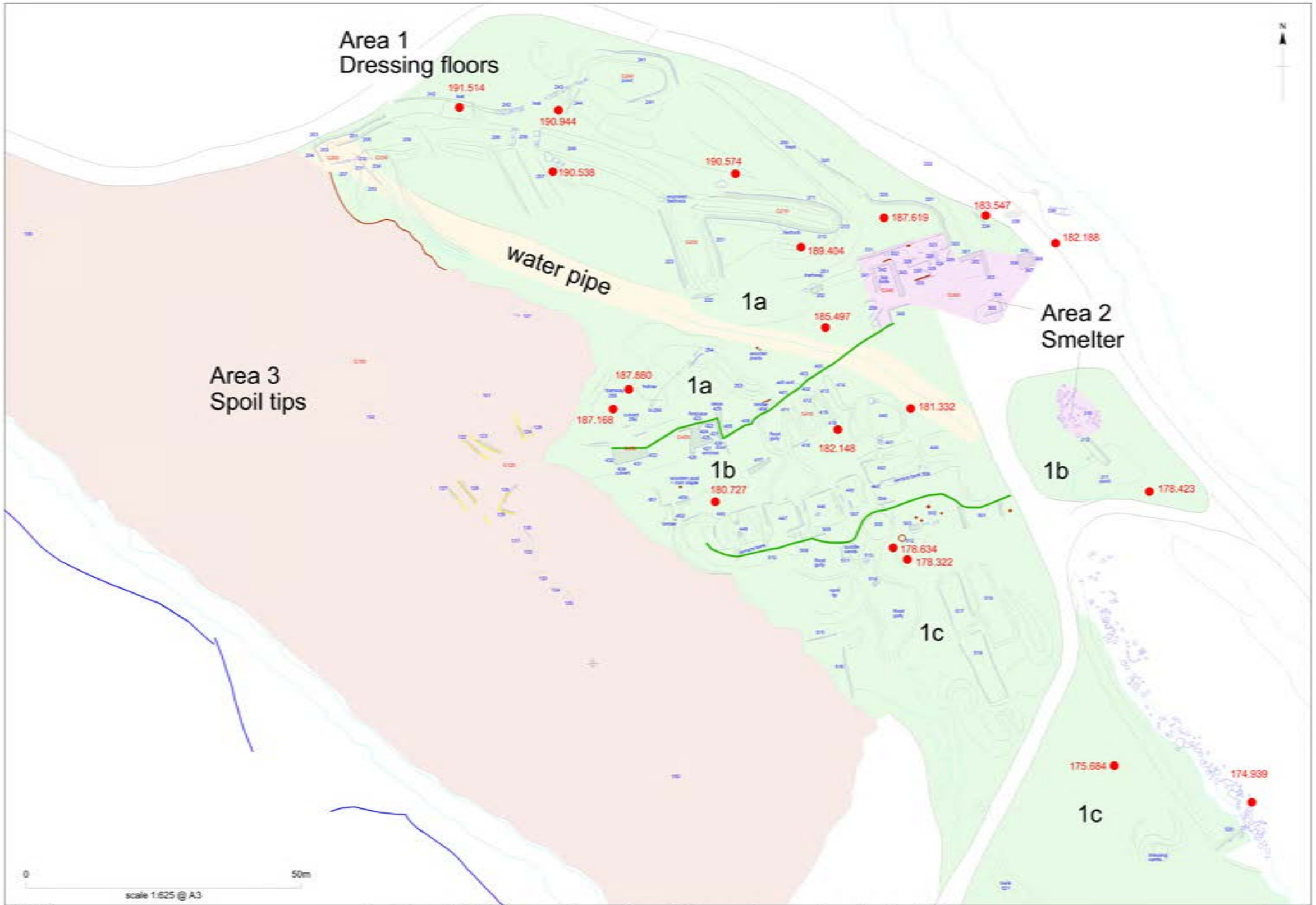
6.3 During the early 1980s, a water pipeline was laid across the Low Bonsor mill site. The excavation of the pipe trench caused considerable damage, especially to the tramroad and two of the stamp mills (Stamping mills 2 and 3) in Area 1a and the buddles in Area 1b. The approximate course of the pipeline is shown in Figure 11.

Area 1: The Low Bonsor mill dressing floors

6.4 The Low Bonsor mill dressing floors are an integral part of the larger Bonsor mill and can only be fully understood as part of this more extensive operation. The upper mill—not included in the present survey—undertook the primary processing of all the material coming out of Deep Level, the mine's lowest level, which included sorting and washing, ragging, hand-breaking, crushing, jigging and probably stamping. The upper mill site also contained ancillary structures such as the mine office, stables, blacksmith's shops and saw mill. Jigged material was transported from the upper mill to the lower mill dressing floors for fine crushing in stamp mills followed by jigging, buddling and settling. As discussed in Section 4, the two mills were worked as part of a single dressing floor from the 1830s until the mid-1890s, after which operations

Low Bonsor Mill, Coniston, Cumbria: topographic landscape survey of the site

Figure 11



Low Bonsor Mill, Coniston, Cumbria: areas discussed in the text, feature numbers and station heights

Figure 12

were confined to the upper mill.

6.5 Most 19th-century ore dressing mills were constructed as a series of tiered, interlinked terraces. This allowed gravity-aided processing, with sorting and crushing at the highest part of the mill and final settling and slime control at the lowest point. The mills at Paddy End and Penny Rigg, both designed by John Barratt as part of the Coniston mines enterprise, are good examples of this type of 'gravity' mill. Upper Bonsor mill, constructed at the bottom of Tongue Brow, was laid out in a similar manner and comprises three terraced activity areas. The top terrace carried a tramway between the entrance to Deep Level and a bank of ore hoppers and also held two supply leats coming into the site from Red Dell Beck and Levers Water Beck. On the second terrace were sorting sheds and a water-powered ore crusher, and the third terrace—effectively the ground at the base of the hill—housed the jigs, buddles and ancillary buildings. However, the lower mill was built on flatter ground south of the mine road and its topography meant that here the various activities—stamping, jigging, buddling and settling—were spread across a larger and more disparate area than is normally found at a typical gravity mill.

Area 1a

Transport

6.6 Material was carried between the upper and lower mills by a single horse-drawn tram road (Fig. 11). The tramroad entered the Low Bonsor mill site from the north-west via a stone-arched tunnel (231), which runs beneath leat (206) and the road. The 1850 OS map shows the tram road running south-east across Area 1a to a set of ore stamps (Stamping mill 1) that have now been lost (Fig. 7). However, its course was destroyed during the construction of the modern water pipeline and no archaeological remains survive. The 1890 OS map (Fig. 9) shows some changes to the original tram road, with the line bifurcating at the south end and one section running south-west to the main spoil tip while the other runs north-east to the new stamp mills (Stamping mills 2 and 3).

6.7 Pipeline construction and flood damage have removed most of the evidence for this later tramroad, but short, truncated sections survive as features (251) and (255). These two features indicate that the tramroad was approximately 1.3m wide and comprised a compact gravel surface. At Stamping mill 2, the tram road appears to have run in front of, and parallel with, retaining wall (331); from this, material could be tipped

(probably via hoppers) down to the back of the stamps.

6.8 Some material was also moved between the upper and lower mills on carts and one of the cartways survives as a 1.5m wide shallow track (257) terraced into the slope south of leat 206. The track crosses leat 206 on a substantial stone slab bridge (208) and its route across the adjacent leat (242) is marked by a short stretch of stone culverting. The southern part of track 257 has been destroyed by the pipeline but on the 1850 OS map it is shown running parallel with, and east of, the tramroad to Stamping mill 1.

Plates 19 & 20: *arched tunnel (231) and surviving fragment of tramroad (251).*

Plates 21: *section of track running up slope from the mine road (250).*

6.9 A second track (250) runs upslope in a south-easterly direction from the mine road onto a flat area above Stamping mill 3 and the later copper smelter. The track, which has been excavated into the slope to the west, is retained to the east by walls 320, 321 and 323. It is not shown on the early historic photographs and may be contemporary with the construction of the copper smelter in 1893. If that is the case, then track 250 was used as an access track, carrying material from the Upper Bonsor mill to the

main trackway

both tunnels pass underneath this trackway

N

coping stones

retaining wall 201

retaining wall 205

leat 206

arch 202 tunnel 203

204

leat 206

arch 231 tunnel 232

234

wall 207

modern water outflow originally a tramway occupied this route

233

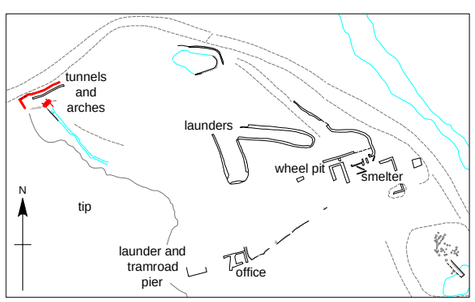
Key

rubble

stones

leat route

probable route of tunnels



0 2m

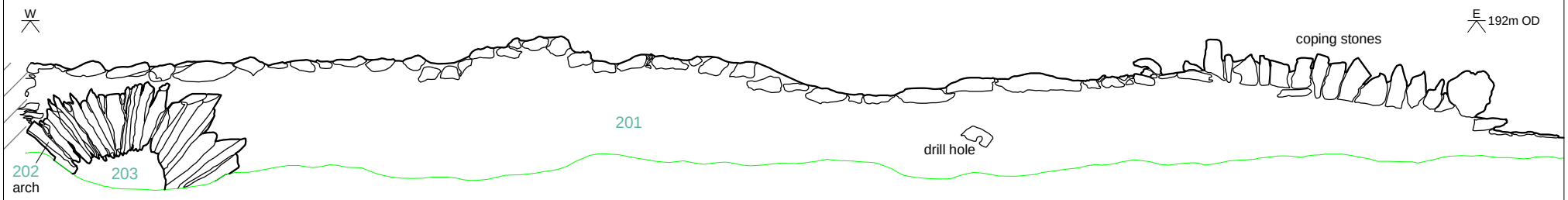
scale 1:50 @ A3

Low Bonsor Mill, Coniston, Cumbria: retaining walls, arches and tunnels

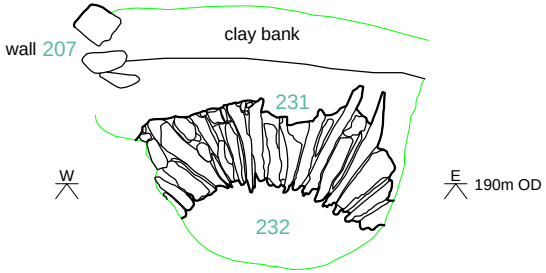
Figure 13

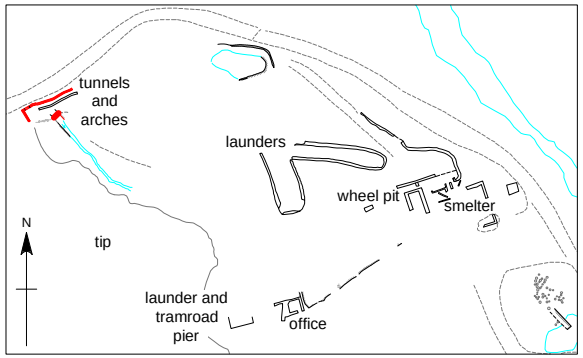
Arches, tunnels and retaining walls - elevations

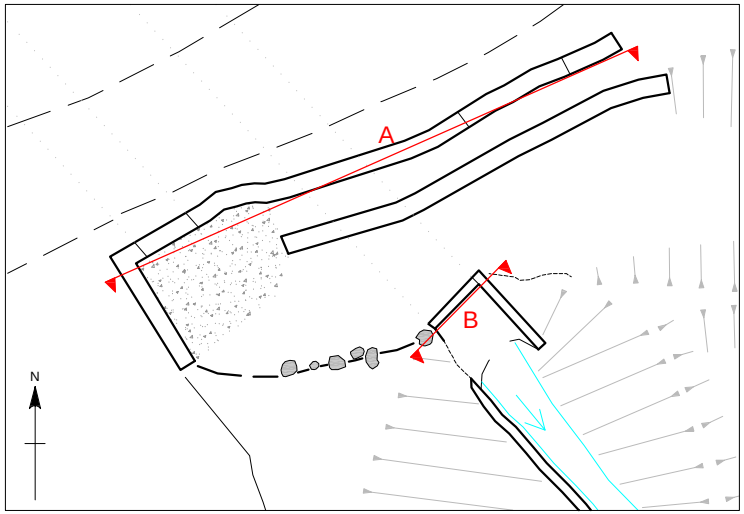
A South-east facing elevation



B South-east facing elevation







0 2m

scale 1:50 @ A4

Key

wall

ground level

Low Bonsor Mill, Coniston, Cumbria: arch and tunnel elevations

Figure 14

loading area or charging platform above the furnace (see 6.67 onwards for further information on the operation of the smelter).

Water management and the leat system

6.10 There are three separate leat systems in Area 1a. The first and earliest of these is marked on the 1850 OS map and carried water from the south-west part of the upper mill to Stamping mill 1 at the lower mill. Both the leat and stamping mill were disused by the 1860s or 70s and were later buried beneath main spoil tip (101). The only surviving feature that may relate to this early leat is a truncated culvert (256) exposed by erosion in the slope behind and above masonry pier 430 in Area 2b.

Plate 22: *leat 206 running east-west across the northern section of Area 1a.*

6.11 The second leat (206), surviving as an obvious earthwork channel running east-west across the northern section of Area 1a, was designed to carry water from the upper mill to Stamping mills 2 and 3 at the lower mill. It was probably constructed soon after Stamping mill 1 was abandoned. The leat survives within the upper mill complex as a broad open channel running parallel with, and above, the tramroad. It is carried under the mine road in an arched masonry tunnel (202 and 203), at which points it runs south-east as an open channel with an upcast bank to the south and, initially at least, a low retaining wall (205) to the north. Leat tunnel 202 has been constructed above, and so clearly post-dates, tramway tunnel 231 (Plate 19). The leat curves slightly to the south, is crossed by track 257 on slab-bridge 208, and bifurcates at its eastern end to form two launder piers (210 and 220) for Stamping mills 2 and 3.

6.12 The third leat (242) starts as a shallow linear feature close to the south side of the mine road, opposite the mine office (youth hostel), and for much of its length runs parallel with leat 206. Where it is crossed by track 257, the leat runs in a slabbed culvert and further east runs down a short slope into a pond (240). Just to the west of the culverted section, a small open drain (244) leaves the leat and appears to cut through—and thus is later than—the north and south banks of leat 206, continuing down slope to the south as a faint linear hollow. Pond 240 is a substantial oval feature, shown on the 1890 OS map (Fig. 9), with a stone embankment along its northern edge. Its function, however, is unclear. It does not appear to be a settling pond and has no obvious association with the water supply to Stamping mills 1 or 2. It has been suggested that it may have been used as a holding pond for the set of water-powered jigs positioned immediately south of Stamping mill 2 (Warren Alison pers. comm.), which are shown on all the historic photographs (see 6.33).

Plate 23: *pond 240, which appears on the 1890 25-inch OS map.*

The stamping mills

6.13 Semi-processed (crushed and jigged) material from the upper mill was taken to Low Bonsor mill for further reduction in stamping mills.

6.14 Stamping mills were probably introduced to England in the 16th century and their basic design changed little over the following centuries. Simple stamping mills comprised a series of vertical timber rods fitted with cast iron bases, which were alternately raised and dropped to pulverise material held in a wooden trough or

'cofer'. The stamp rods were activated by cams on a barrel powered by a water wheel. In front of the 'cofer' was a perforated iron plate, through which a fine pulp of pulverised material flowed into a catch-pit.

6.15 Stamping mills shattered rather than crushed the rock and so produced a much finer material than an ore crusher. They were particularly well suited to reducing the hard pieces of vein stone produced by the jigging process and for treating finely disseminated ore. Stamping mills were fairly common in the Lake District during the 19th century. In addition to those at Bonsor, Barratt also erected similar mills at Paddy End in Coniston, and further afield there were stamps at Greenburn, Driggith, Greenside and Redgill (Shaw 1970, 34). A typical mid-19th century stamping mill is shown in Figure 15.

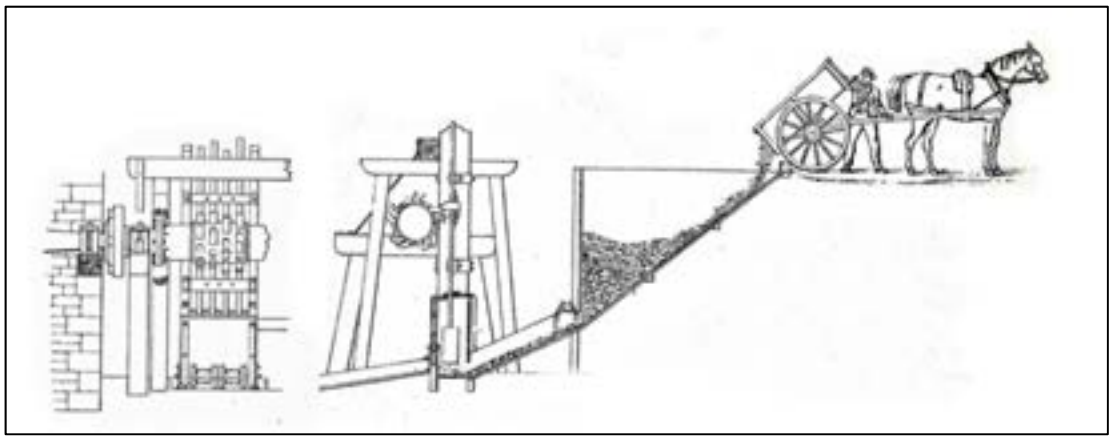


Figure 15: *front (left) and side (right) elevation of a water-powered stamp mill (after Henderson 1858).*

Stamping mills consist of *'... a series of wooden pestles, each fitted with a lump of cast iron, which is lifted to a certain height and permitted to fall upon the material to be pulverised. These pestles or stamp heads are operated by cams arranged spirally on a barrel of wood or cast iron, and to which motion is communicated either by steam or water power. Each pestle or lifter usually makes from 50 to 70 blows per minute. The lower portion of these lifters, where the iron head comes in contact with the mineral to be broken, is enclosed in a wooden trough or 'cofer', fitted both in the front and ends with perforated iron plates. A small stream of water flows continuously into this trough; so that when the stuff operated on is reduced sufficiently small, it is carried through the gratings into a catch-pit, where it becomes deposited by subsidence. The form of the cofer, exit for the stuff, weight and speed of the stamps, and quantity of water employed, should be varied according to the peculiarities of the ore and matrix operated on'.* Phillips & Darlington (1857, 124)

The Bonsor stamp mills

6.16 There appear to have been a number of stamping mills in operation at the Bonsor dressing floors and their locations changed over time. Gibson (1849, 89) describes 'two-long rows of stamps' and Postlethwaite (1913, 118) says that when 'the mine was at its greatest prosperity ... fifty or sixty head of stamps were employed in reducing the poorer ore stuff'.

6.17 The 1850 OS map marks what is probably a stamping mill at Upper Bonsor mill and another (Stamping mill 1) at Low Bonsor mill (Fig. 7). As the main spoil tip grew in size, these mills were abandoned and replaced by two new mills—Stamping mills 2 and 3—at the lower mill. These were built in the 1860s or 70s and replaced an earlier mill (Stamping mill 1) at the western section of Area 1b (Figs. 9 and 12).

Stamping mill 2 (Figs. 16 & 17)

6.18 Stamping mill 2 was located at the south end of a low knoll on the east side of Area 1a, some 30m north-east of Stamping mill 1. The mill appears to have been completely destroyed by the water pipeline and the principal archaeological evidence for its position is the masonry launder pier (220) with its two side retaining walls (221, 222) and its end wall (223). The pier, which connects to the north with leat 206 and launder pier 210, supplied water to the mill wheel at Stamping mill 2 and the comparatively broad dimensions of the water channel suggest that the pier also formed a holding or stilling pond. Holding ponds ensure that there is a sufficient head of water to start a water wheel and a similar pond survives at the Penny Rigg copper mill, Tilberthwaite (NAA 2017).

Plates 24 & 25: *launder associated with Stamping mill 2; retaining wall 223 (left) and grassed over top of feature (right).*

6.19 The south end of the pier (wall 222) is in poor condition and much of the masonry has collapsed, but historic photograph P3 (Plate 9) shows a raised timber launder running

254 retaining wall

N

253
tramway

206
leat

exposed
bedrock

211

210 launder

212

213

exposed
bedrock

220
launder

221

223

222

251
tramway

252
buttress

tunnels
and
arches

launders

wheel pit

smelter

N

tip

launder and
tramroad
pier

office

Key

walls

0 4m

scale 1:100 @ A3

Low Bonsor Mill, Coniston, Cumbria: launder plans

Figure 16

West launder - elevations

C South-west facing elevation

D North-east facing elevation

E South-east facing elevation

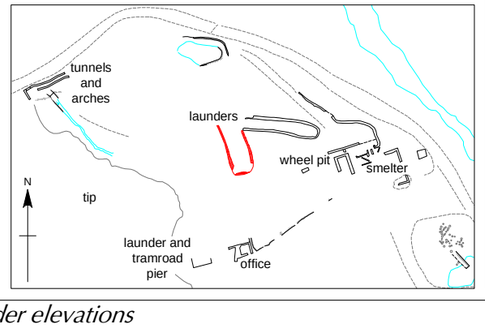
0 2m

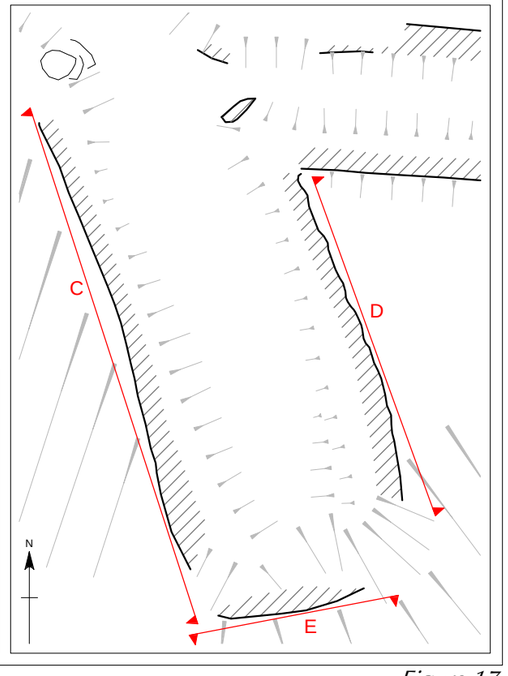
scale 1:50 @ A3

Key

rubble

ground level





Low Bonsor Mill, Coniston, Cumbria: west launder elevations

Figure 17

from the top of the wall to the stamp mill water wheel. This image, together with P1, P2, P4 and P5, show timber walls either side of the wheel; these enclosures, which protected the wheel and reduced loss of water during storms, were in use at many 19th-century metal mines across Northern England (Raistrick and Roberts 1990, figs. 59 and 68). Historic photographs P4 and P5 (Plates 10-12) clearly show the water wheel flanked by the two timber buildings, which housed the stamps, but no internal details can be made out. The 1890 25-inch OS map depicts the launder pier and wheel pit, but the stamp houses are not marked; similarly, no wheel can be seen on P9 (Plate 18). This suggests that the Stamping mill was derelict by the late 1880s.

6.20 Immediately south-east of the presumed site of Stamping mill 2 is a short length of culvert (254), which has been exposed by erosion. The culvert has been destroyed to the north-east but to the south-west it continues as an underground feature with a stone-slabbed roof and may connect with culvert outfall 256. It is likely that the culvert carried some of the outfall water draining from the water wheel at Stamping mill 2. Similarly, linear hollow 253, which runs south-east from the side of culvert 254 towards the Area 1b jigs, may also have carried outfall water from the wheel at Stamping mill 2.

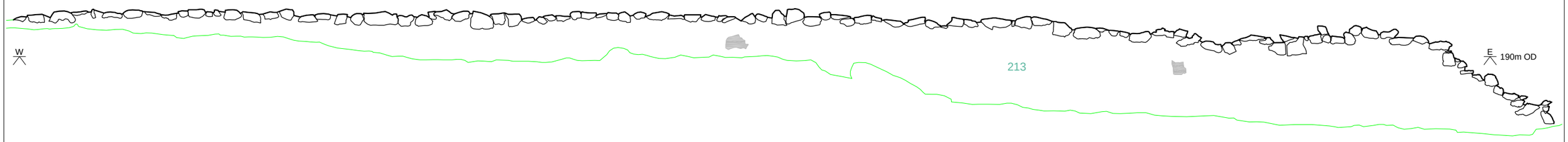
Stamping mill 3 (Figs. 16 & 18-22)

6.21 Stamping mill 3 is located 35m east of Stamping mill 2. The mill is in poor condition and the main surviving features are the launder pier (210) and water wheel pit (340). Pier 210 connects to the west with leat 206 and launder pier 220 but has a much narrower water channel than 220. It is retained by three walls (211, 212 and 213). An area of comparatively flat ground separates the east end of 210 from the top of retaining wall (321) and the stamps wheel pit (340).

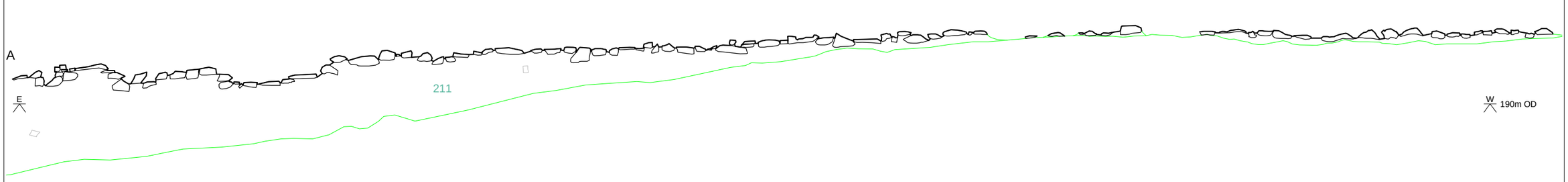
Plates 26 & 27: *launder pillar associated with Stamping mill 3; retaining wall 213 (left) and grassed over top of feature (right).*

East launder - elevations

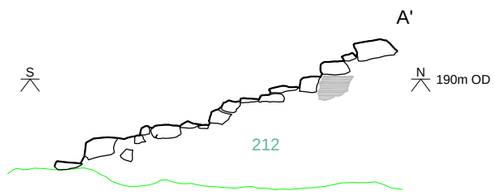
F South facing elevation

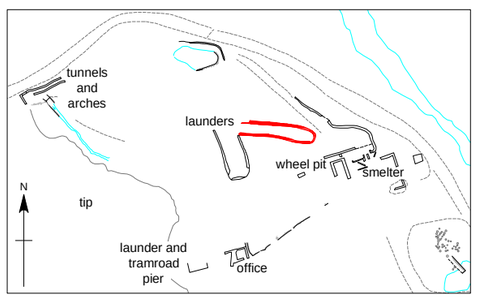


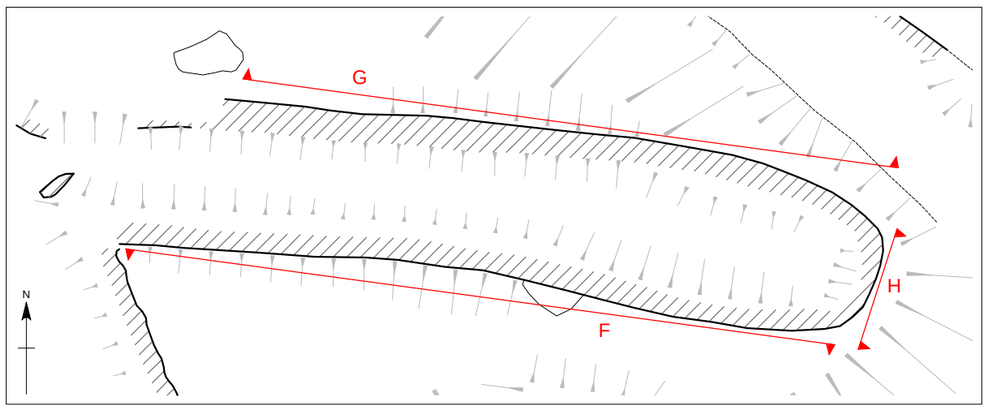
G North facing elevation



H East facing elevation







Key

rubble

aperture

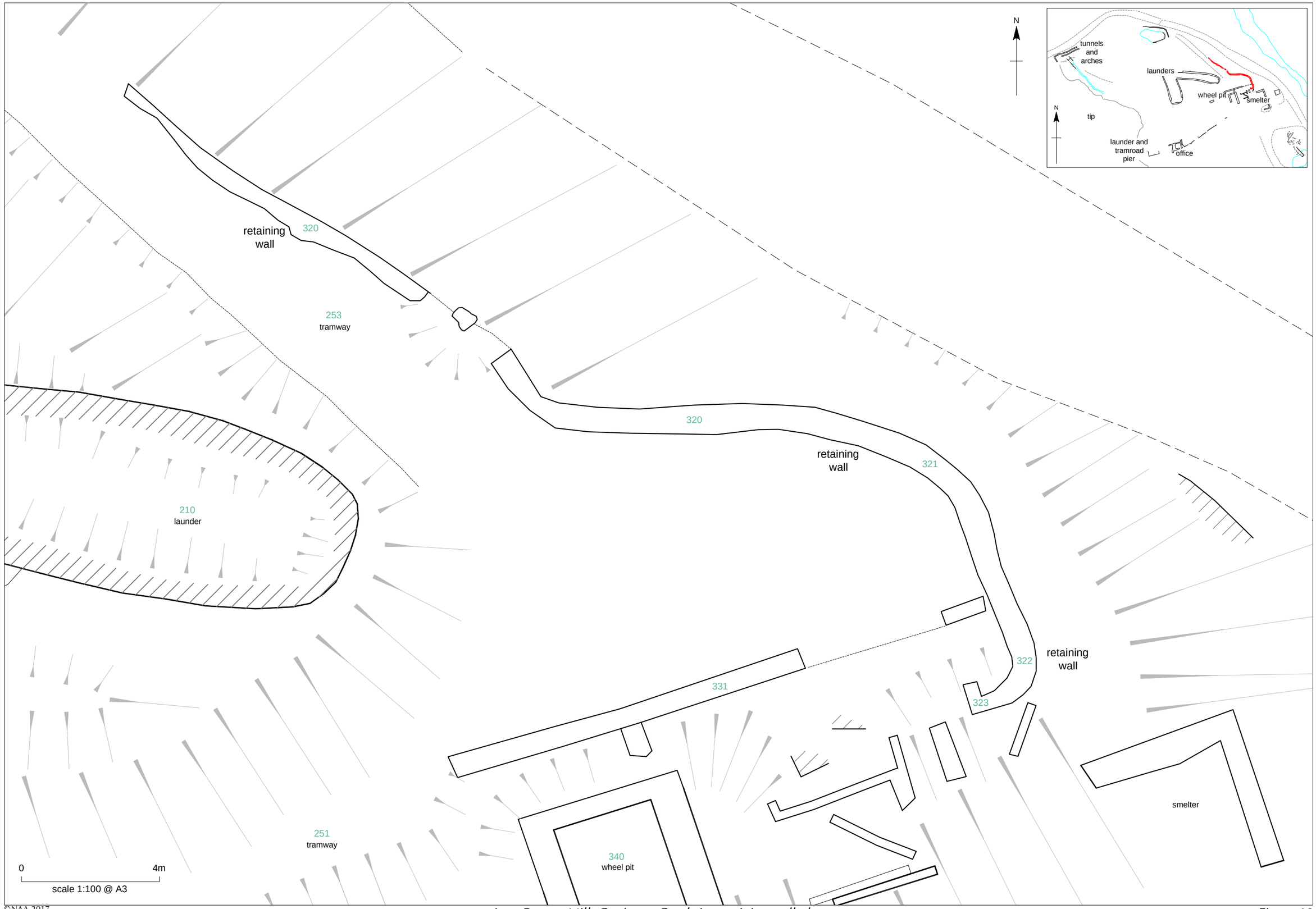
ground level

0 2m

scale 1:55 @ A3

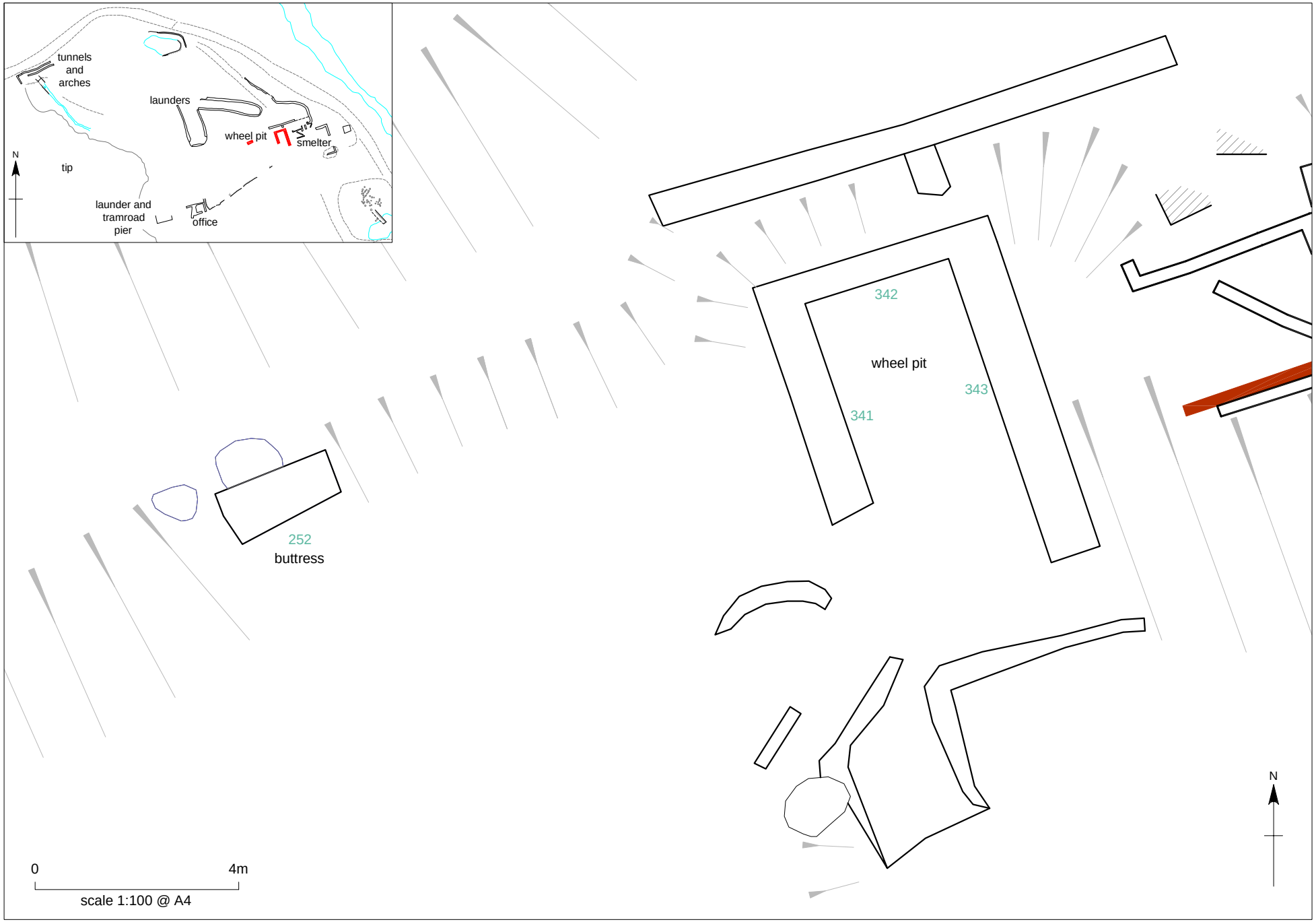
Low Bonsor Mill, Coniston, Cumbria: east launder elevations

Figure 18



Low Bonsor Mill, Coniston, Cumbria: retaining wall plan

Figure 19

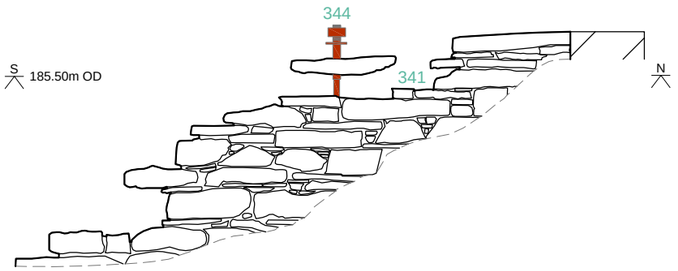


Low Bonsor Mill, Coniston, Cumbria: wheel pit and buttress plan

Figure 20

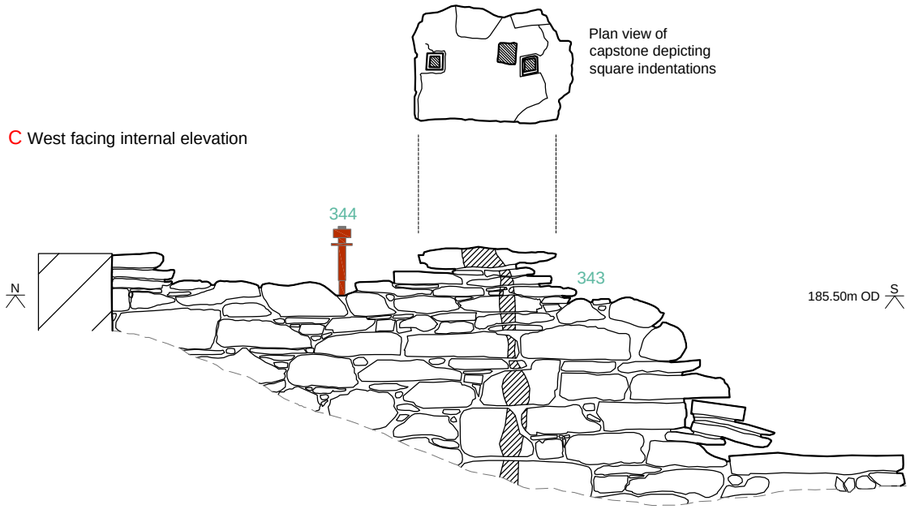
Wheel pit - elevations

A East facing internal elevation

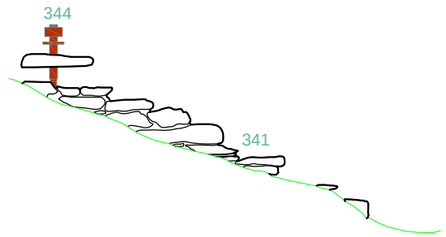


B South facing internal elevation

C West facing internal elevation

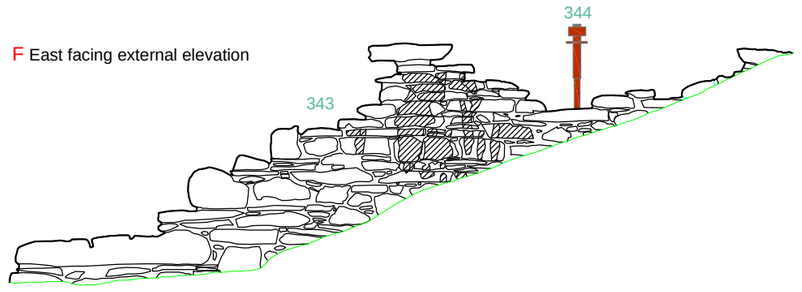


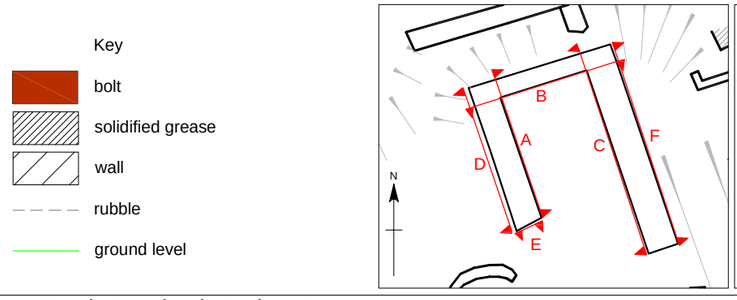
D West facing external elevation

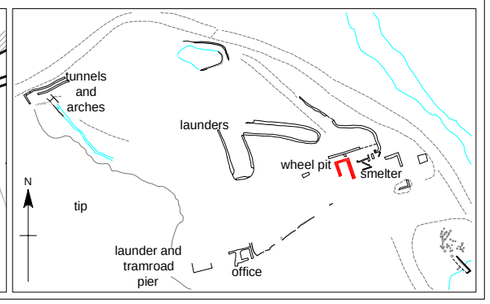


E South facing external elevation

F East facing external elevation







0 2m

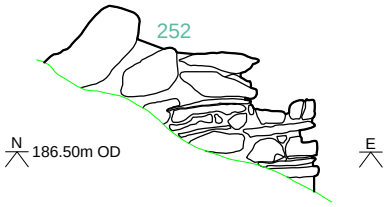
scale 1:50 @ A3

Low Bonsor Mill, Coniston, Cumbria: wheel pit elevations

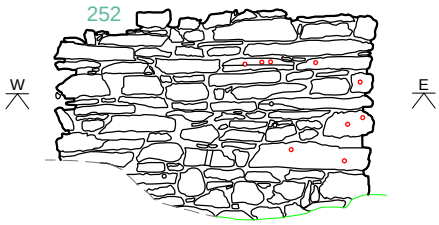
Figure 21

Buttress - elevations

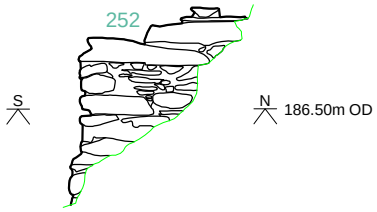
A West facing elevation



B South facing elevation



C East facing elevation

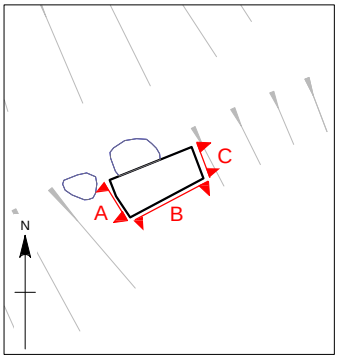


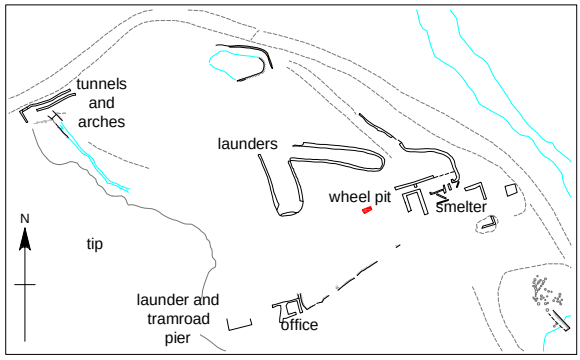
key

drill hole

ground level

rubble





0 2m

scale 1:50 @ A4

Low Bonsor Mill, Coniston, Cumbria: buttress elevations *Figure 22*

6.22 Much of wall 212 has collapsed and there is no archaeological evidence indicating how water was carried from the leat to the wheel. However, historic photograph P3 (Plate 9) depicts a high-level wooden launder leading to an enclosed timber drop box or chute, in front of which is a short, lower level launder and the wheel. The high-level launder was presumably designed to provide sufficient working height as it crossed tramway 251, which ran behind the stamping mill and was parallel with wall 321. Wheel pit 340 is comparatively short but quite wide (6.3m long by 3m wide) and has collapsed, or been destroyed, to the south. This pit probably housed the 16ft (4.9m) diameter wheel listed in the 1891 inventory.

6.23 The construction of the copper smelter building in 1893 destroyed the east part of the mill, although a retaining wall (331), and possibly wall (323), may be contemporary. Much of the west side of the mill has been lost but an oval stone (258), with associated drain immediately south-west of the wheel pit, could have been part of the stamps' catch pit.

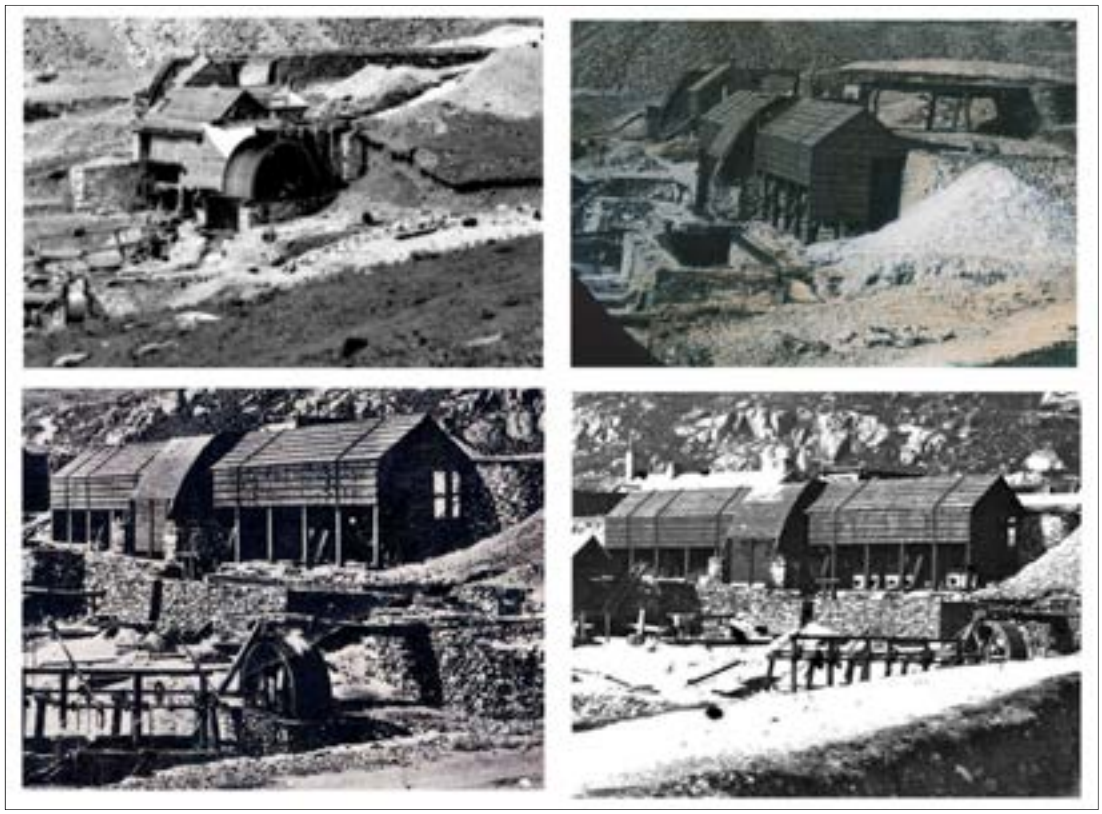


Figure 23: *details of Stamping mill 3 shown in historic photographs: P1 (top left), P3 (top right), P4 (bottom left) and P5 (bottom right).*

6.24 Historic photographs P3, P4 and P5 show Stamping mill 3 in some detail (Fig. 23). The water wheel and stamps sheds are constructed on a stone-revetted terrace and built

against a retaining wall (corresponding with walls 331 and 323). The wheel is completely enclosed in timber casing—to prevent wind blowing water out of the launder—and to either side are the open-fronted stamps sheds. Historic photograph P5 shows a series of box-like structures with central openings inside the east shed and these are likely to be the sizing grates in front of the stamp heads, while P3 shows a large rectangular masonry tank in front of the east shed, possibly one of the catch pits. This photograph also shows a timber launder on the north wall of the tank, which connects with an open leat and powers a small water wheel operating a set of jigs.

6.25 Many of these features are also shown on the 1890 OS map (Fig. 9). Interestingly, however, the earliest historic photograph (P1; Plate 6) shows a completely different layout at Stamping mill 3: there are no stamps east of the wheel; retaining walls 331 and 323 are absent; the stamps to the east of the wheel are covered by two buildings rather than a single shed; there are no catch pit tanks; the unenclosed water wheel is smaller than the wheels shown on later images and is fed from an open-ground level leat; and launder pillar 210 has not yet been constructed. It is also apparent from this image that the buildings at Stamping mill 3 are on a different alignment from those shown on later photographs. These changes in site layout over a comparatively short period (less than 20 years?) show how dynamic the dressing floors were and how quickly plant and buildings could be adapted and rebuilt.

Area 1b: Stamping mill 1 and the jigs, buddles and settling ponds

6.26 A low terrace bank, retained by walls 400, 401 and 405, separates Areas 1a and 1b. Much of the area east of wall 400 has been destroyed by the water pipeline but in the western section of Terrace 2 there is surviving evidence for various ore concentration processes, including jigging, buddling and settling. And further west, close to the main tip, there is some enigmatic evidence for an early stamp mill (Figs. 11 and 12).

The jigs

6.27 The material that had been pulverised in the stamp mills needed further processing or concentration to separate ore from waste and produce a marketable copper concentrate. The first process was called jigging, in which the stamped ore was shaken vigorously in a sieve within a water-filled tub or tank. This process caused the heavier copper ore, known as the 'heads', to sink towards the bottom of the sieve. A mixture of waste stone and copper ore, known as 'middlings', which formed in the centre of the jig-sieve was stamped and jigged again to achieve a finer separation. The material at the top was the waste or tailings which were discarded or mixed with the middlings

and reworked.

6.28 In the early 19th century, jigging was still done by hand in wooden vats, but by the 1820s the brake jig had been introduced, which in its simplest form combined the traditional sieve with a single or double lever (Fig. 22). Brake jigs were first introduced at John Taylor's Wheal Friendship mine in Devon and so it is likely that he—or his protégée John Barratt—would have used similar equipment when the Bonsor dressing floors were being laid out. By the 1830s, attempts were being made to mechanise jigging and some of the most successful experiments were at the Grassington mines, North Yorkshire, where the sieve levers on a bank of brake jigs were linked to a single power source operated by a water wheel. This early work on mechanised jigging at Grassington was carried out by John Barratt and so again there is a strong possibility that similar equipment was soon operating at Coniston.

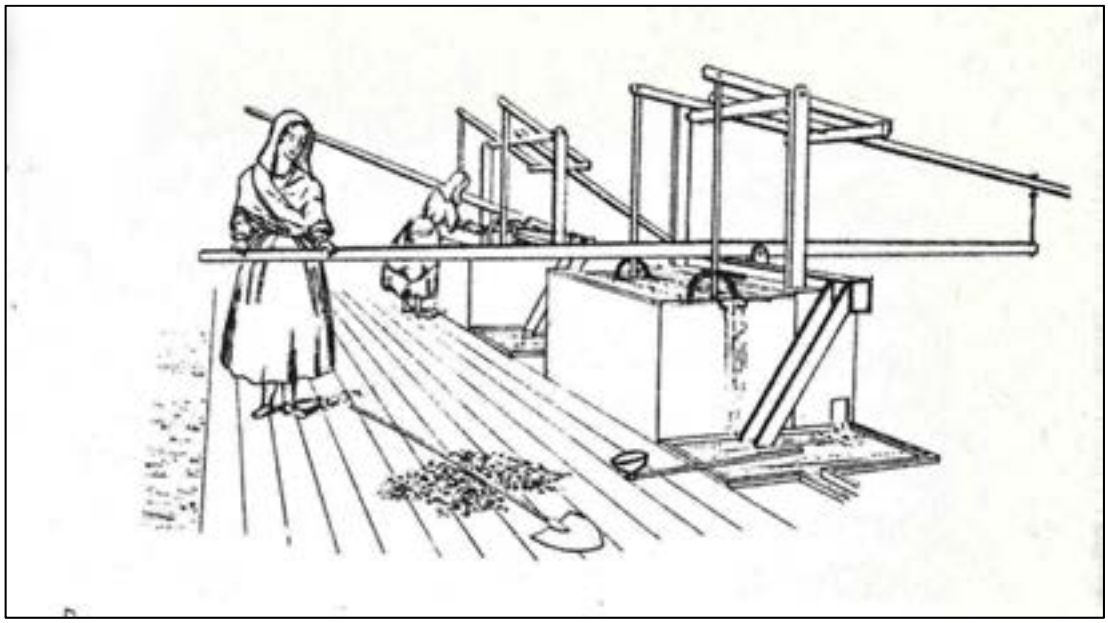


Figure 24: *double lever brake jig. (after Henderson 1858).*

6.29 Various improvements were made to jigging equipment over the next few decades, of which the most important was the introduction in the 1860s of multiple sieves of different sizes. This allowed for much finer separation and greater efficiency. The 1891 inventory shows that jigs of this type—known as Greens jiggers—were in use at the Upper Bonsor mill but unfortunately the jigs at the lower mill are not specified.

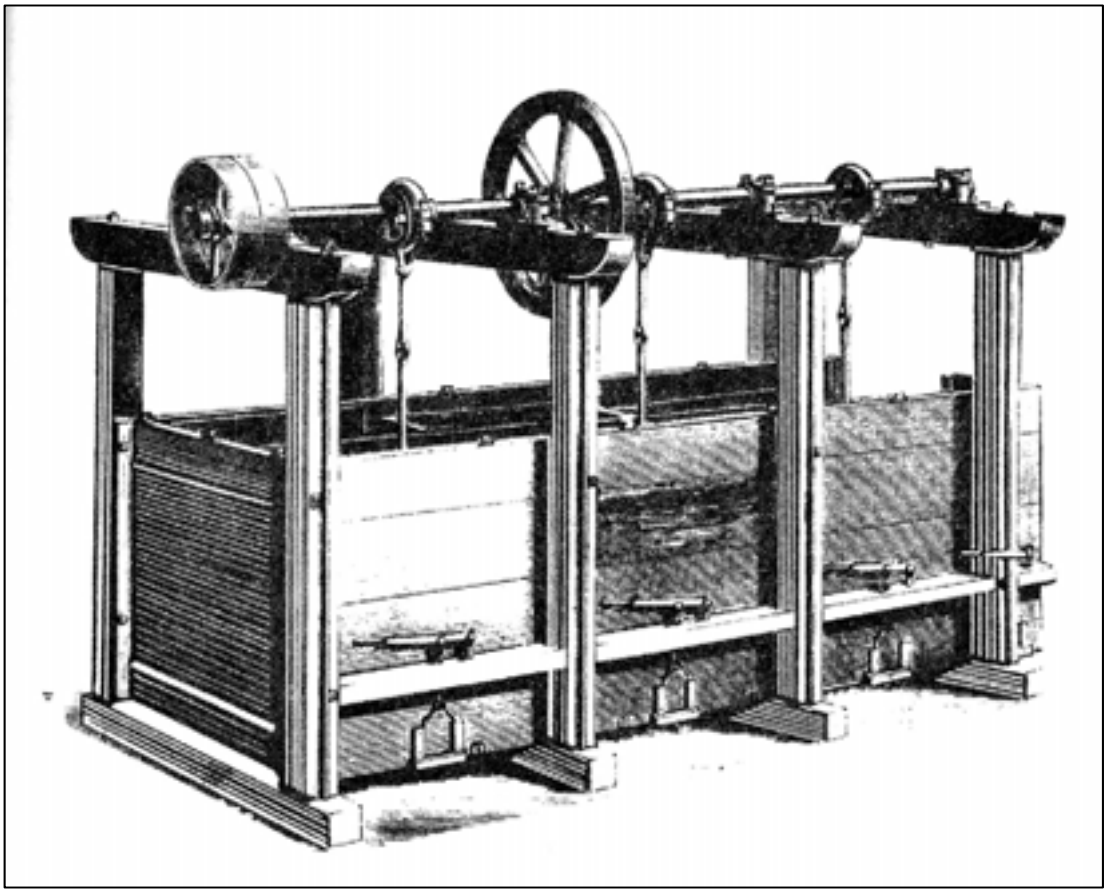


Figure 25: *mechanical jigger (after Hunt 1887, fig. 214).*

6.30 The principal evidence for jigging in Area 1b consists of a series of features associated with 410, a rectangular building platform defined to the north by retaining walls 400, 401 and possibly 405, and to the south by wall 416 and possibly 417 (Fig. 11). The water pipeline has destroyed the north-eastern end of the building platform and a flood gully has disturbed much of the south-western section, so the full extent of the building cannot be reconstructed. On the surface of the platform are a series of shallow, parallel gullies (411-414) aligned north-west to south-east, which appear to be associated with at least two high-level drains or culverts (402 and 403) in wall 400. One of the gullies, 413, is connected to a ground-level culvert (415 and 418) draining south-east towards the settling tanks. The most likely interpretation is that these gullies were drains positioned beneath a set of parallel jig tanks; the two culverts in wall 400 probably held small launders carrying pulp to the jigs from Stamping mill 1 and culvert 415/418 may have been one of a series of drains taking material—perhaps overflow waste—from the jigs to the settling tanks.[4]

[4] A rapid dowsing survey of this area by Warren Allison of CATMHS indicates that there may be a number of sub-surface drains running parallel with culvert (415/418).

6.31 No evidence survives for a water wheel pit at building platform 410 but linear feature 253 may well be a leat or water course. In addition, the timber structure at the gully's south-east end could be the remains of a sluice controlling a small water wheel positioned in the building's south-east section and aligned parallel to jig gully (411). Could this be the location of the 10ft diameter water wheel of 'unknown purpose' listed in the 1891 inventory? Historic photographs P4 and P5 (Plates 10-12) clearly show a substantial timber building with a gabled roof on building platform 410 but no internal details can be seen, and the angle of the view is such that the putative water wheel is hidden.

Plate 28: *jig house platform (410) looking north-west.*

6.32 Historic photographs P1, P4 and P5 show a set of jigs south-east of Stamping mill 3. These are powered by a small wheel, which may be the same as the 5ft by 4ft jigs wheel listed on the 1891 inventory. Their presence on P1 indicates that they were in operation by the 1870s and so pre-date the probable jigs on building platform 410 (Plate 28). Perhaps feature 410 was constructed as a second jigger house to meet a demand for increased processing once the Paddy End dressing mill had closed.

The buddles

6.33 Buddling was the next stage in the classification process and was used to separate fine material, sand and slimes. Early buddles were inclined wooden troughs in which running water washed over a mixture of ore and waste, using differences in their specific gravity to effect a separation. These buddles, known as trunk or hand buddles,

are the sort described by Gibson in his 1849 account of the Bonsor dressing mills (see 5.17) and one can be seen close to the jigs in the foreground of P4 (Plate 10).

6.34 By the mid-19th century, many larger dressing floors were replacing trunk buddles with more efficient, mechanised, round buddles (Fig. 24). This new type of buddle appears to have originated in Cornwall and by the late 1840s they were being used at John Taylor's Goginan lead mines in mid-Wales. The first round buddles consisted of a circular, convex wooden frame. Water and slime fed by a launder to the top of the cone were mixed by a rotating brush or paddle and the material deposited itself in concentric rings, with heavier pieces of ore settling towards the higher part of the frame. The tails, or wastes, at the bottom of the buddle were thrown away but the 'heads' and 'middles' were rebuddled and the 'heads' sent for further processing.

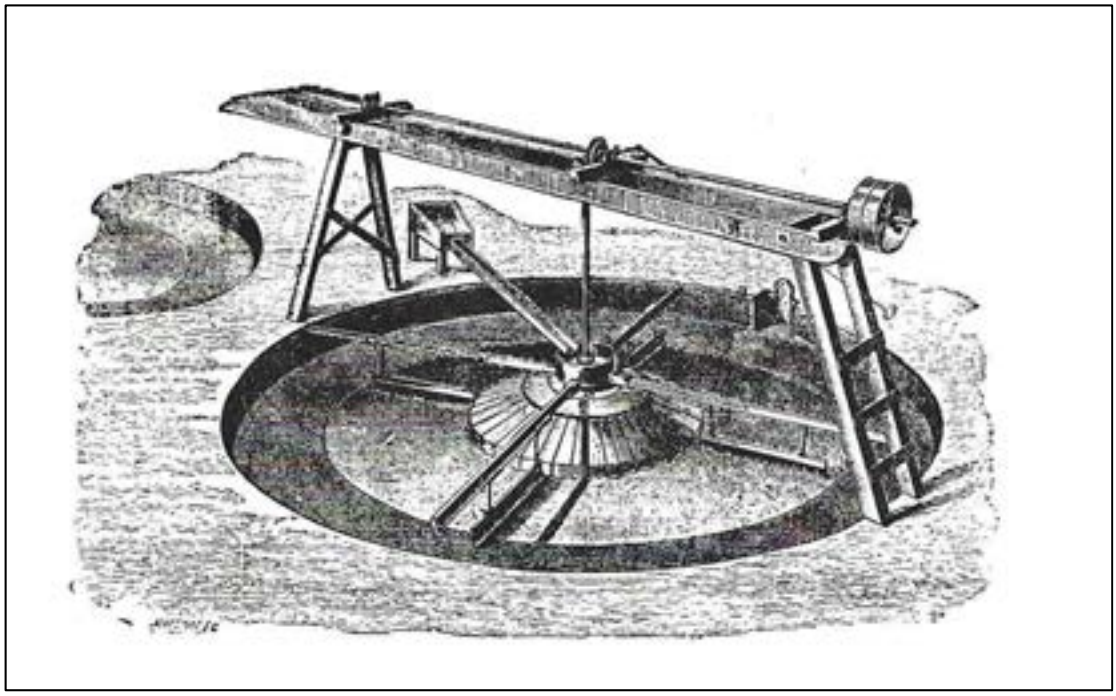


Figure 26: *concave round buddle with rotating brushes (after Davies 1902, fig. 208).*

6.35 The Low Bonsor mill survey found evidence for one round buddle associated with Area 1b and two with Area 1c. The buddle in Area 1b survives as a 6.2m diameter hollow (440) excavated into the bank immediately south-east of building platform 410. A short, culverted drain (441) at the south side of 440 connects with the settling tank (442). The 1890 OS map marks two other circular buddles in Area 1b; one is a few meters north-east of buddle 440 and the other lies immediately in front of the wheel for Stamping mill 2. These additional buddles appear to have been destroyed when the water pipeline was constructed, but their wooden superstructures (the slimes

launders and supports) can be seen on P4. The 1891 inventory lists 'brush-type washing buddles' powered by a 5ft by 4ft wheel at the lower mill.

Plate 29: *hollow associated with circular buddle (440) located in Area 1b.*

The Settling Ponds

6.36 The settling ponds were positioned in front of the jigs and buddles. Buddling and jigging slimes were fed into these pits where, as the name implies, the heavier ore 'settled' to the bottom and the waste concentrated towards the top. The ponds were periodically emptied, the waste dumped, and the bottom layer retreated.

6.37 The settling ponds in Area 1 survive as a group of six conjoined rectangular hollows (442–448) positioned with their south-facing edge on the bank above Area 1c. They are fairly well preserved, although pond 447 has been disturbed by a flood gully. In addition, the construction of the water pipeline has truncated pond 444 and destroyed any further ponds that may once have existed further to the east.

6.38 The best evidence for how the settling ponds operated is seen at pond 442 (Plate 31; Fig. 11). This received material from buddle 440 via culver 441 and had a drain at the south-west corner leading to buddle 505, located below the terrace bank in Area 1c. The pond immediately to the east (444) may have taken material from the buddles shown on the 1890 map that have now been lost and was probably linked with buddle 506. A shallow linear hollow and two timber uprights on the crest of the bank

between ponds 442 and 444 suggests there may have been a launder—perhaps an overflow channel—linking these two features.

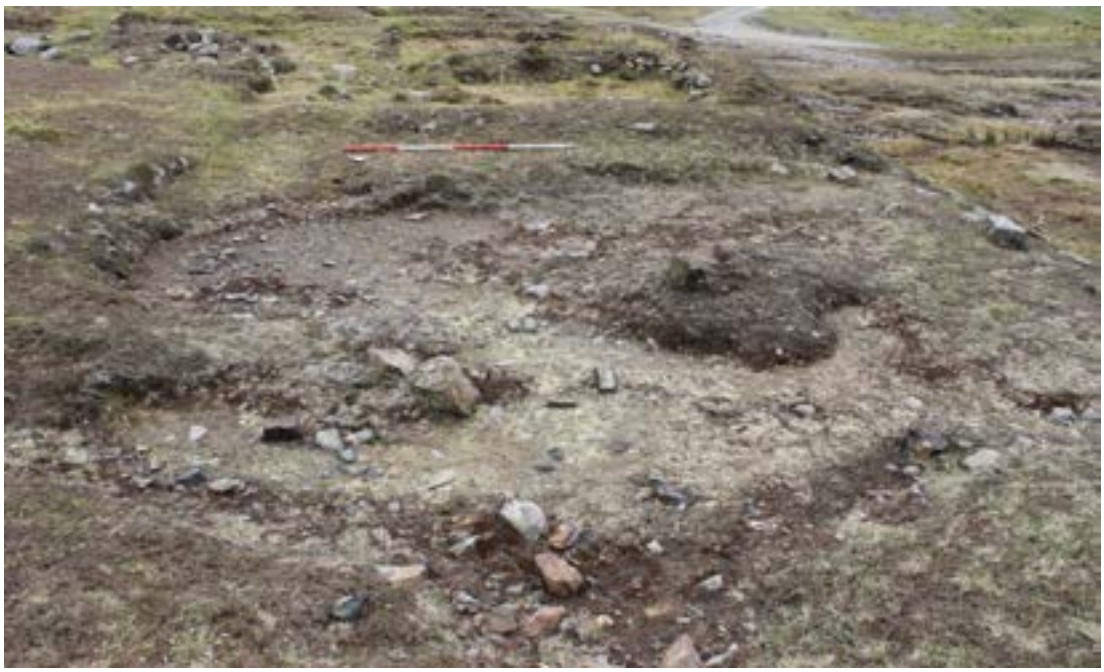


Plate 30: *row of settling ponds in Area 1, looking east, with pond 448 in the foreground.*

Plate 31: *settling pond 442, looking north-west.*

6.39 The other ponds are squarer in plan than ponds 442 and 444. They have been excavated into the terrace above Area 1c, share stone revetted earth bank dividing walls and are open along their southern edges. All have suffered from erosion but

probable drains, leading down to Area 1c, survive at the corners of pond 448 and a fragment of timber launder was recorded at the south-west corner of pond 445. The largest pond is 448, which is unique in having a drain (449) at its north-west corner that flows down slope to the west. Pond 445 appears to have been linked with the jigging area by a culvert (415/418) and it is likely that the other ponds further west were also designed to receive and settle material from the jigger shed.

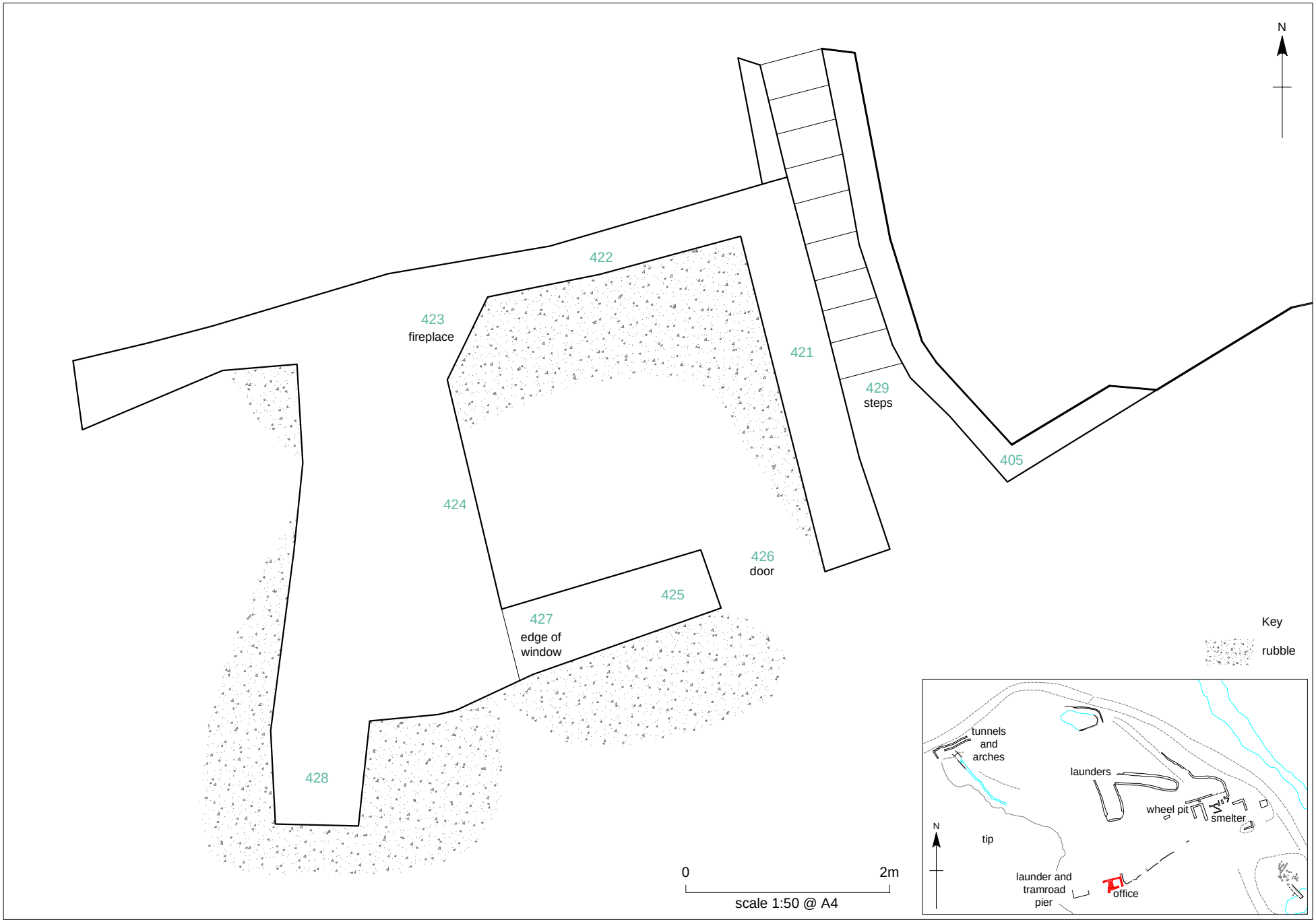
6.40 The more easterly ponds can be seen in the left foreground of historic photograph P4 (Plate 10). The first pond in this view appears to have a free-standing wooden wall at its south end and in front of it is a wooden barrel, probably a hand-operated 'kieve' used for the fine separation of some of the material within the pond.

The Office (Figs. 27–29)

6.41 Towards the western end of the main retaining wall (405) there is a single celled building measuring approximately 3.8m by 4.5m. It is assumed that this building functioned as some sort of site office within the heart of the Low Bonsor mill processing area, probably used by the foreman overseeing operations at the dressing floor. It is the only structure that contains evidence for a fireplace (423), a standard sized door (426) approximately 1m wide, and a window (427). In addition, it is entirely constructed out of stone, unlike the stamp and buddle sheds that tended to be constructed partially out of stone, with timber framed structures on top. This is also the only location on site that has purpose-built steps (429), which lead down the outside of the building on its east side. The office is built into a bank, so the steps lead down from the upper terrace of Area 1a.

6.42 The office (420) is of a single-phase construction. This can be surmised from the fact that all of the walls (421–428) are keyed into each other. This includes the extension to the west of the back wall beyond the end of the building, where it acts as an additional retaining wall, and the additional side wall (428), which again extends beyond the front of the building.

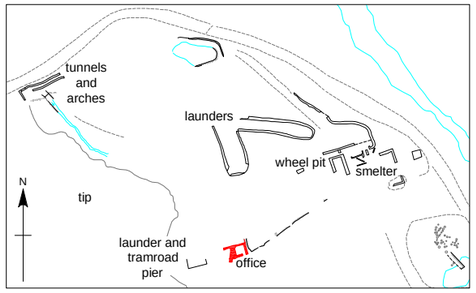
6.43 The whole structure is built into the slope of the site, helping to define the edge of the terrace bank of Area 1. The walls are constructed of coursed random rubble containing alternate layers of slate and river cobbles. The slate and cobbles vary in size, but the former was used to level the courses at fairly regular intervals.



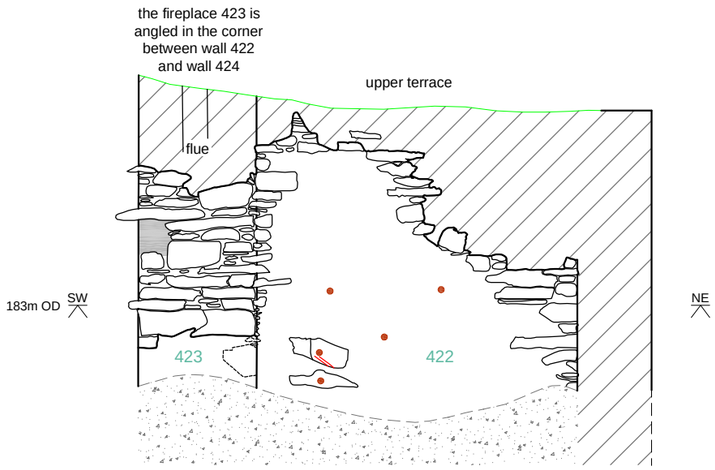
Low Bonsor Mill, Coniston, Cumbria: office

Figure 27

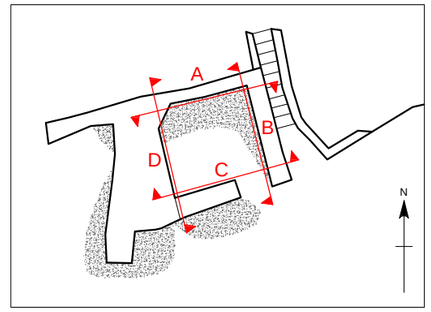
Office - interior elevations



A South-east facing elevation



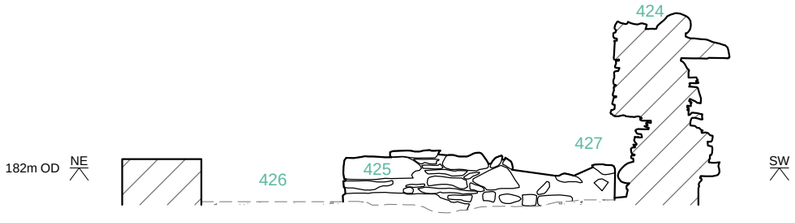
B South-west facing elevation



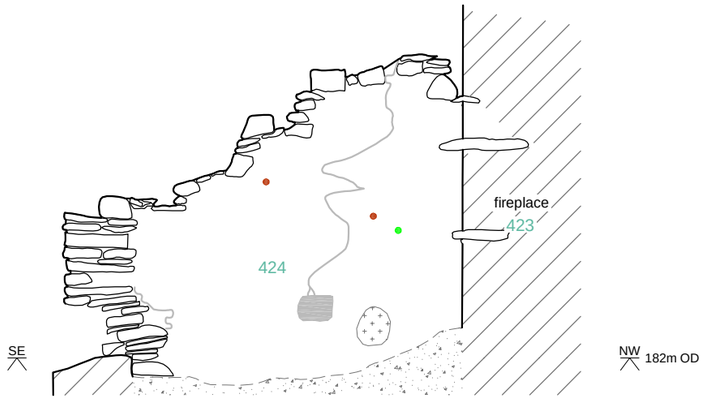
Key

- rubble
- wall
- metal
- wood
- lime plaster
- void
- crack
- drill hole
- ground level

C North-west facing elevation



D North-east facing elevation



the fireplace is angled
in the corner between
wall 422 and wall 424

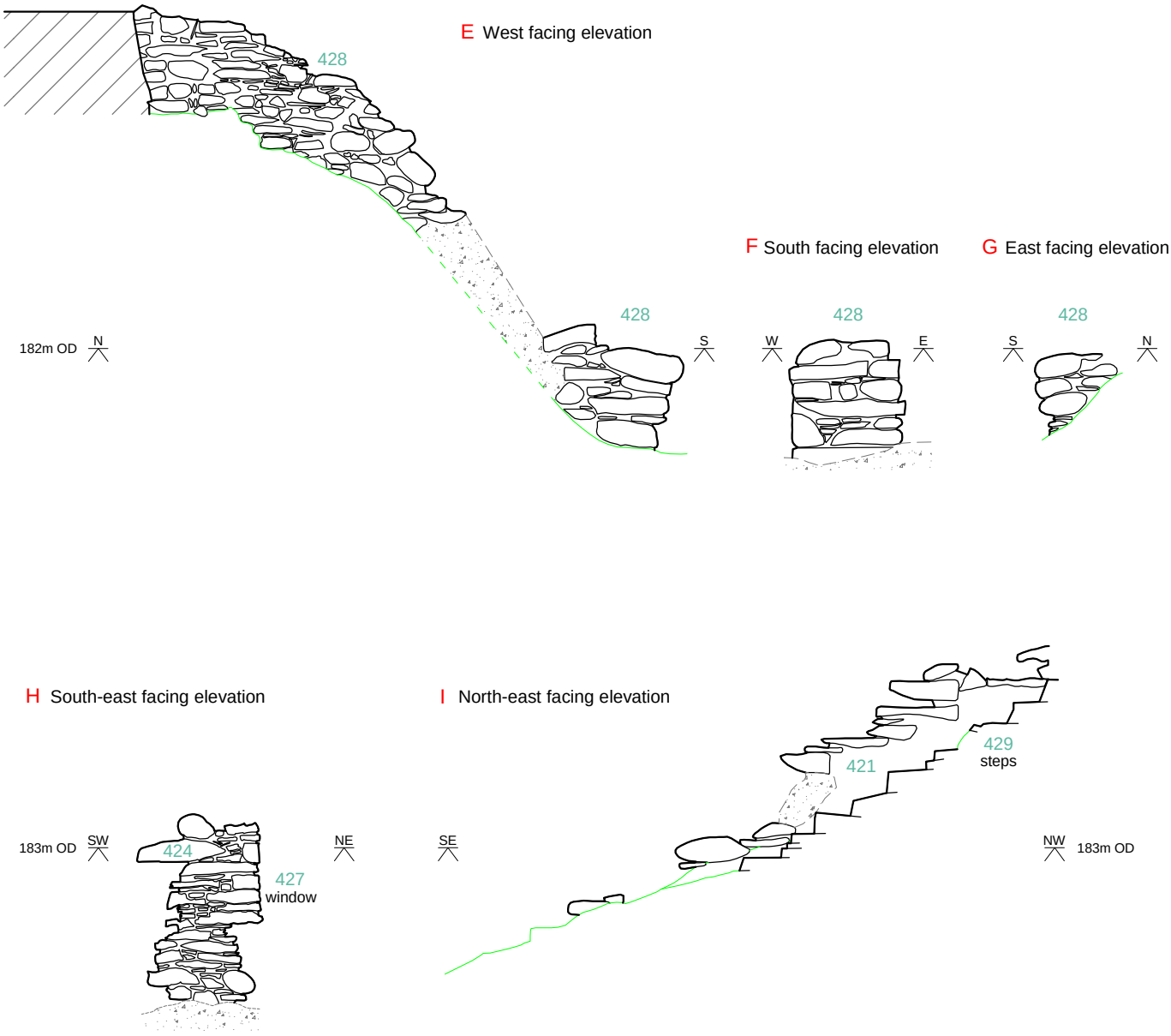
0 2m

scale 1:50 @ A3

Low Bonsor Mill, Coniston, Cumbria: office interior elevations

Figure 28

Office - exterior elevations



Low Bonsor Mill, Coniston, Cumbria: office exterior elevations *Figure 29*

Plate 32: *office building (420) looking north-west, steps visible to the left of the image.*

6.44 The east (side) wall (421) of the building also forms the west wall for the external steps (429) and survives to c.2m in height internally and 0.85m externally. The wall is keyed into the north (back) wall (422), which is built into the slope of the site. Internally, 422 survives to a height of c.2.6m. At the back, it does not currently extend beyond ground level; however, historic photographs suggest that it was originally at least two courses higher than this (see P1 and P9). The back wall extends west beyond what could be considered the end of the building by 2–3m where it acts as a retaining wall.

6.45 Internally, the fireplace (423), which is located in the north-west corner of the building, is keyed into both the back wall (422) and the west (side) wall (424) at an angle. It survives to a height of c.2.8m internally and is c.1m wide. It has a large slate lintel above the fireplace opening. The rest of the chimney stack is constructed of the same material as the rest of the office building. Again, historic photos indicate that, as may be expected, the chimney stack extended up beyond ground level (P1, P4, P5 and P9).

6.46 The west (side) wall (424), as well as forming part of the fireplace (423), is also keyed into the south (front) wall (425). It is also keyed into the additional side wall (428), which again is tied into the back wall (422). The two walls (424 and 428) appear to be bonded together at the northern end, forming a double thickness wall. At the south end they split, forming the additional side wall (428), before diverging slightly to the west and continuing beyond the front of the building for approximately a further 1m.

This can be seen in on the 1890 OS map and in historic photograph P9.

6.47 The additional side wall (428) does not appear to relate to any other structure within the immediate vicinity, so it is suggested that it may have been built to act as a buttress or revetment. An outflow channel is shown on the 1890 OS map that took waste water down to the beck, and this may have posed a risk to the office during peak flow by washing away the bank and undermining the office walls. The real threat of water incursion is clearly indicated on a later historic photograph (P8) taken c.1894, after the dressing mill was abandoned. This clearly shows water cascading down from the upper terrace to the lower terrace within the vicinity of the office. Notably the stones used to build the southern end of the side wall are considerably larger than those at the north end of the wall.

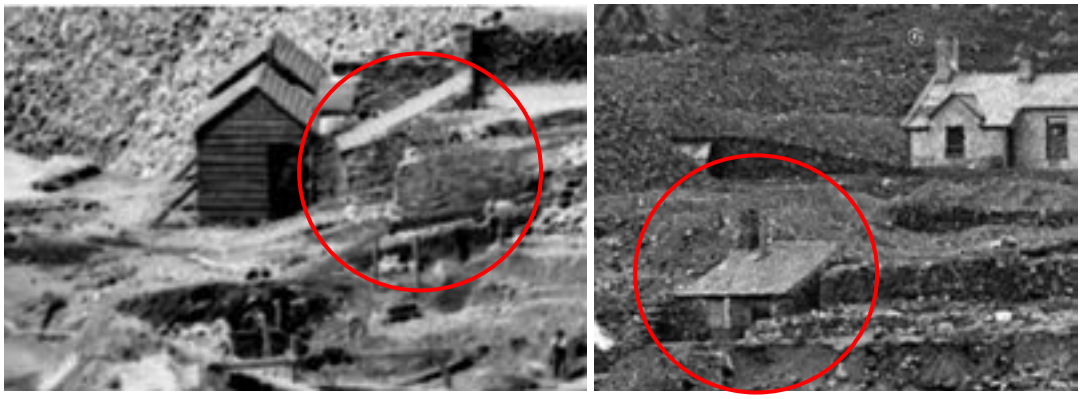


Figure 30: *Low Bonsor mill office (circled in red): extract from P1 (c.1877) showing the office in profile (looking west) and P8 (c.1894-5) showing the front of the building with the mine office (youth hostel) in the background.*

6.48 The west (side) wall (424) is keyed into the south (front) wall (425). The front wall survives to a height of c.0.5m, which is much lower than the other walls. Historic photographs of the structure (P1, P4, P5, P8) show that building had a sloped roof to the front; this means that the doorway (426) and a window (427) would not have had many courses of stonework above, accounting for the poorer preservation.

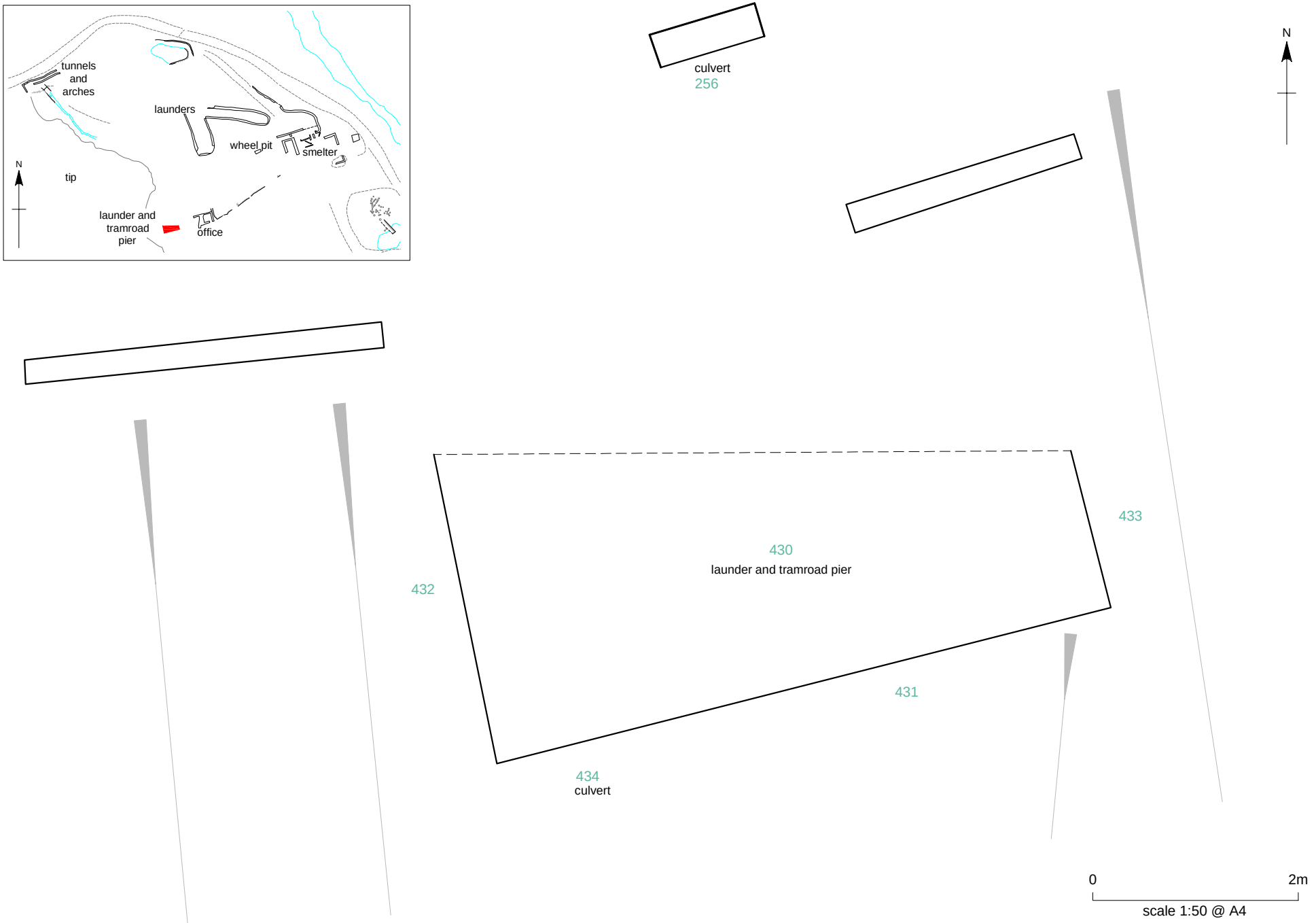
6.49 It is suggested that there was a window at the western end of the front wall, based on the relationship between the end of wall (424) and front wall (425). The bases of both walls are keyed in together and then higher up there is a straight joint which may have formed the west side of a window opening (427). However, it is not possible to deduce the size of the window because of the poor state of survival (the historic photos do not give any clues). The door (426) to the office was located at the eastern end of the front wall (425) and measured c.1m wide. It is not possible to estimate its

height from what survives of the building, but it can be clearly seen in P9, dated c.1894.

Plates 33 & 34: *office west wall (424) and fireplace (423) (left) and view of structure looking west with steps (405) in the foreground.*

6.50 Historical photographs and maps indicate that the office was one of the few buildings associated with the Low Bonsor mill complex that remained relatively unaltered, while the form and layout of the dressing floors changed and adapted around it. It is first shown on the 1890 25-inch OS map as a rectangular structure with steps alongside (Fig. 27). The slightly later six-inch Second Edition OS map of 1892 hints at the presence of the additional side wall (428) protruding beyond the front of the building. The building is shown as extant on the 25-inch 1913 OS maps, while most of the other structures have been cleared from the dressing floor by this period. A photographic postcard dated to 1933 shows that by this point a lot of the structures that were once present across the mill site have been dismantled and the office has lost its roof.

Figure 31: *Low Bonsor mill office shown on 1890 25-inch OS (left), 1892 six-inch OS (middle) and 1913 25-inch OS (right).*



Low Bonsor Mill, Coniston, Cumbria: launder and tramroad pier

Figure 32

Stamping mill 1 (Figs. 31-32)

6.51 The 1850 OS map shows a long rectangular structure in Area 1b set between Red Dell and Levers Water becks. It is connected to the upper mill by a tramroad and leat, and an extension in the centre of the building's south face is probably the housing for a water wheel. The identification of this structure as a stamping mill—Stamping mill 1—is confirmed by P1, which shows two timber sheds flanking a space for a dismantled water wheel (Plate 35). Behind—north of—the stamping mill, the photograph shows a long retaining wall, which is a pier carrying the leat and tramroad to the mill.

Plate 35: *detail of P1 showing the derelict sheds of Stamping mill 1 with launder and tramway pier (430) to the right.*

6.52 Historic photographs P4 and P5 (Plates 10–12) show a tip of light-coloured spoil, possibly jigging waste from Stamping mills 2 and 3 or from the upper mill, which covers the site of Stamping mill 1. This is also shown on the 1890 OS map. But by the early 1890s, when P9 (Plate 18) was taken, the light-coloured tip had been partially removed for reprocessing and a section of wall—probably the tram road and launder pier (430)—has been exposed again.

6.53 The principal surviving evidence for Stamping mill 1 is a large masonry pillar (430) (Plate 36) constructed into the terrace bank some 8m west of the office (420). The pillar comprises a substantial south-facing wall (431), 2.6m high by 5.0m wide, with a small ground-level culvert towards the western corner and a suggestion of timber slots by the eastern and western edges. The two side walls (432 and 433) set into the terrace bank are in a poor condition and the area between wall 433 and the office (420) has been severely eroded by flood action. The top surface of pillar 430

comprises an angular stone fill within walls 431, 432 and 433.

6.54 No features associated with the tramway survive but the truncated culvert (256), located immediately north of 430, may be part of the original water supply system for the stamp's water wheel, which suggests that at this point the leat was carried beneath the tramway. The voids within the face of 431 may be timber slots for a wooden ore hopper, delivering material from the tramway to the stamps, while the small ground-level culvert opening (434) in wall 431 could have taken a water supply to the cofers and sorter grates below the stamp heads.

Plate 35: *stone pier (340); the only surviving evidence of Stamping mill 1.*

6.55 At ground level, in front (south) of structure 430, are the fragmentary foundations of two stone walls (450 and 451), which form a corner to the south-west. The function of these walls is unknown, but they are likely to have been associated with Stamping mill 1. One possibility is that they represent part of a catch pit outside the eastern set of stamps; this interpretation is perhaps strengthened by the presence of a small drain (452) running south from wall 450 that may have carried stamped pulp to a jig or buddle that is now lost. Within the structure formed by walls 450 and 451 are the remains of a substantial wooden post with an iron staple attached to its top. The function of this post is unknown, but it does suggest that there may be a good chance that archaeology associated with Stamping mill 1 survives below-ground in this area, which may include organic features.

Area 1c: buddles and slime ponds

6.56 A badly eroded bank (506–8 and 510) separates Areas 1b and 1c. This may originally have had a stone face that has subsequently been robbed out or removed. Today the only remaining evidence for a retaining wall is a line of boulders (504) and a short length of stone revetment (509). Area 2c was used for the final stage of the dressing process, namely the treatment of the material from the Area 2b settling ponds and buddles.

6.57 Much of Area 2c, especially the northern section, has suffered from erosion and flood damage and many of the features in the area have been truncated or destroyed. However, some fragmentary evidence survives, including round buddles, buddle sheds, a possible ore store and a series of slime ponds.

6.58 A comparatively well-preserved buddle (502) is situated at the base of terrace bank 506. Surviving timbers suggest that it had a diameter of approximately 5.2m with a stone-sided drain on the southern arc leading towards settling pond 517. Some 3m to the west an oval patch of bare ground marks the location of a second round buddle 505, which appears to have been supplied with material from settling pond 442 via drain 443, but little survives beyond a few displaced timber fragments and, to the south-west, a small heap of sand or buddle waste.

Plate 37: *circular buddle (502) in Area 2c with settling ponds (517 and 518) visible in the background.*

6.59 Historic photographs P4 and P5, as well as the 1890 OS map, show two open-fronted timber buildings in front of the terrace bank. The eastern building would have covered buddles 502 and 507, and stone plinth 503 may have been a pad-stone associated with this structure. The other building on the photograph may also have been a buddles shed but no trace of it could be identified during the survey. Set in the ground between buddles 502 and 507 is the rim or top of a wooden-staved barrel (512), probably a 'kieve', which had internal paddles and was used for the reworking and concentration of buddle sands.

6.60 West of buddle 502 are the partial foundations of a rectangular building (501) measuring 2.5m by 6.0m. It is shown on P5 as a stone building with a gabled roof (Plate 12) with a south facing door and a window in the east wall. This building is much more substantial than the other structures on the dressing floors and may have been used as a 'copper house' for the secure storage of fully-processed copper concentrate.

6.61 A number of isolated stone walls (515) and culverts (513) are visible in flood gullies immediately south of the Area 3 buddles but cannot be associated with any other features. They indicate, however, that processing took place in this section of the site and much of the ground between here and the buddles appears to have patches of a very degraded cobble surface.

Plate 38: *stone lined culvert (513).*

6.62 Some 9m south of buddles 502 and 505 is a group of three interconnected, rectangular slime tanks (517, 518 and 519). These tanks were used for the final settling and concentration of sands and slimes from the Area 2c buddles and they may have also provided a degree of elementary pollution control by stopping the movement of contaminated material into the beck. Mineral rich slime from the base of the tanks would have been re-buddled, while the remaining waste was dumped; one of these dumps survives by the south-east corner of tank 518.

6.63 Both ponds 517 and 518 are open at their north ends from where drains or timber launders would have run back to the buddles. A gap in the bank at the south-west corner of pond 518 allowed water-borne material to flow into tank 517 and from there to tank 519. A break in the south-east corner may have been a sluice or overflow allowing water—but not slimes—to drain out of the tank.

6.64 There could have been additional slimes tanks further west but the only evidence for these are two walls (515 and 516) that are exposed in a flood gully and partially covered by the main spoil dump (101). These walls might have formed the north-east corner of a comparatively large tank, but it cannot be ascertained whether they are contemporary with tanks 517 to 519 or relate to an earlier phase of the dressing floors.

Plate 39: *earth bank (521) on the east side of Levers Water Beck, possibly a pollution measure to prevent contaminated material entering the stream.*

6.65 The dressing floors, at least in their final form, do not appear to have continued

beyond the slimes tanks. At present, this area has a good ground cover of grass and heather, but late 19th-century photographs show an unvegetated landscape with large areas of exposed sand, waste and presumably toxic tailings. There are two isolated features here that may relate to flood and pollution control. Towards the south-east end of the gully following the former course of Red Dell Beck is an earth and stone dam (520). The dam crosses the gully and would have effectively stopped or controlled run-off pollution from the lower dressing floors during periods of flooding. The remains of a low earth bank (521) on the east side of Levers Water Beck may be another pollution control measure, perhaps designed to separate the dressing floors and the river.

Area 2: the copper smelter (Figs 33–37)

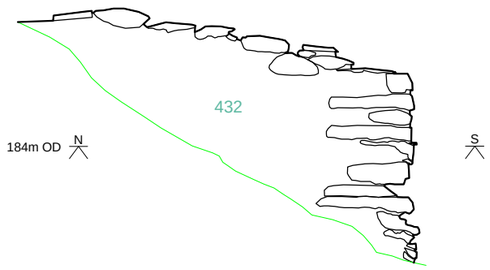
6.66 In 1893, Thomas Warsop demolished the eastern section of Stamping mill 2 and replaced it with a small copper smelter. The smelter was destroyed in a gale in December 1894 and was never rebuilt. There is very little documentary evidence concerning the smelter, although Holland (1986, 211) records that Warsop travelled to France in November 1892 to see one working 'of a type he contemplated putting up' and to learn the operational procedure.

6.67 The standard—and possibly the only—type of copper smelter in Britain at this time was the reverberatory furnace, which was used in association with a roasting furnace to produce a copper matte; successive smelting and roasting of the matte removed iron and sulphur to produce pure copper oxide. Why did Warsop travel to France when he could have studied copper smelting practice closer to home? The answer may be that he was considering using a different type of smelting furnace at Coniston, possibly a blast furnace.

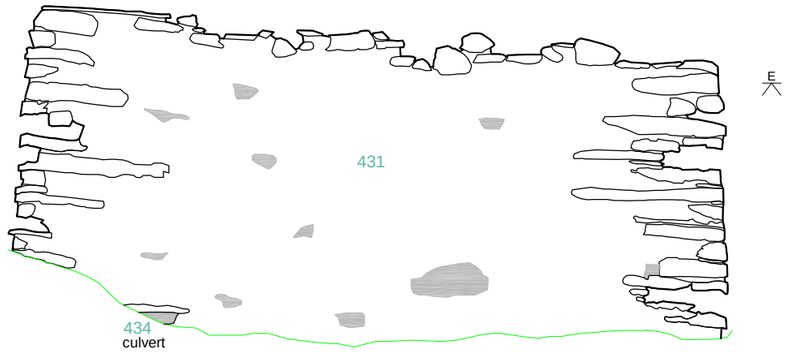
6.68 Historic photograph P8 (Plate 16), taken soon after the 1894 gale, shows the interior of the smelter building and details of the smelting plant can be seen amongst the ruins. The slightly tapered circular metal stack with an expanded base that can be seen in the centre of the photograph appears to be a small vertical blast furnace rather than a reverberatory furnace; this can also be seen in P9 (Plate 18). Both photographs show the furnace stack fully contained within the building and also depict a square-section of horizontal metal pipe connecting the top of the furnace stack with a tall chimney. In addition, there is a large, tapering square-section stack, presumably designed to collect and condense furnace fumes and reduce the effect of pollution. A short, free standing stack on a masonry base is shown located outside and south-east of the

Launder and tramroad pier - elevations

A West facing elevation



B East facing elevation

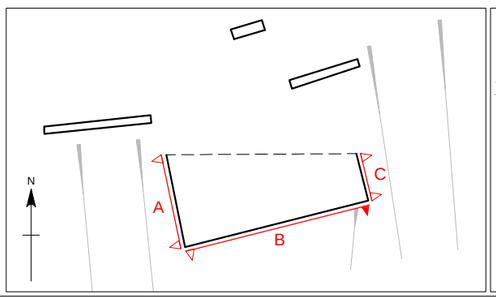


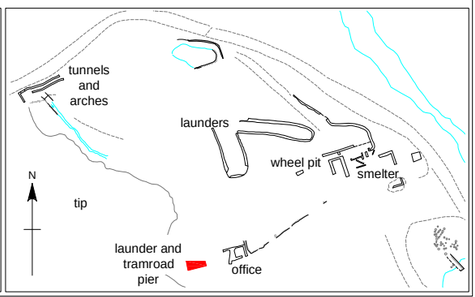
C South facing elevation

Key

void

ground level





0 2m

scale 1:50 @ A3

Low Bonsor Mill, Coniston, Cumbria: launder and tramroad pier elevations

Figure 33

N

angled wall
329

309

308

smelter stack

306

307

301

302
recess

303

326

324

328

325

angled wall
330

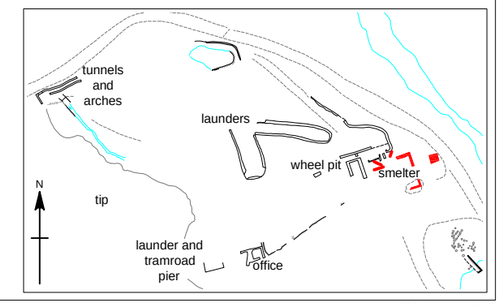
sloping wall with
recessed timber
333

340
wheel pit

main smelter
building

304

305



0 4m

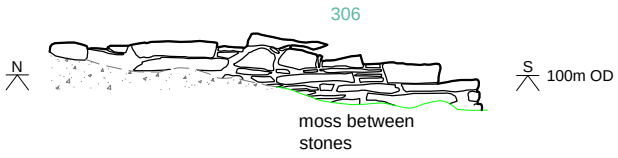
scale 1:100 @ A3

Low Bonsor Mill, Coniston, Cumbria: copper smelter area plan

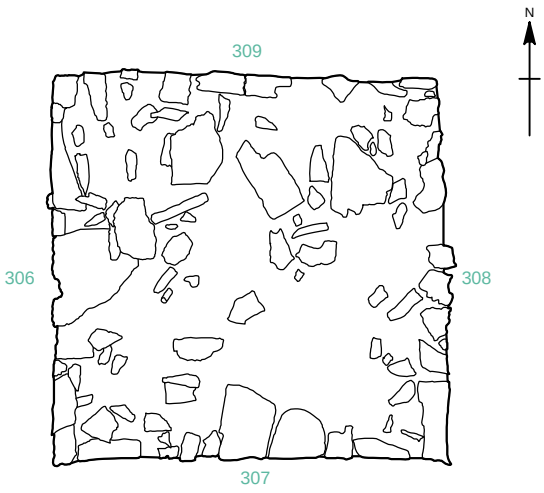
Figure 34

Buttress - elevation and plan

A West facing elevation



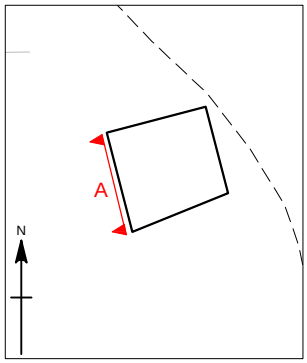
B Plan

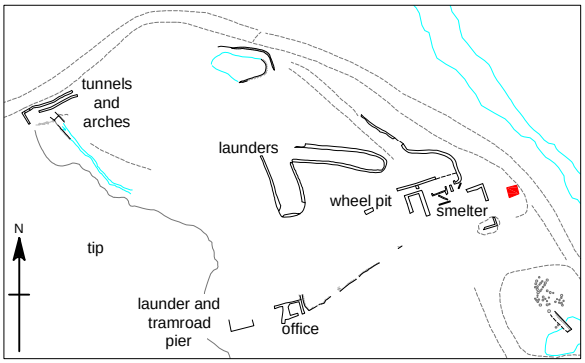


Key

rubble

ground level





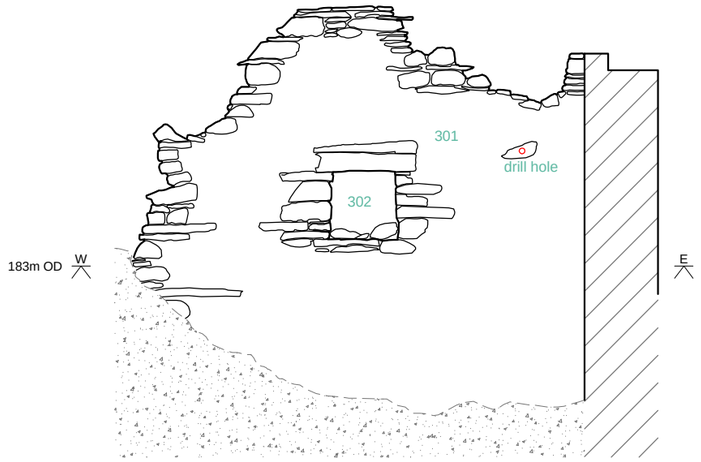
0 2m

scale 1:50 @ A4

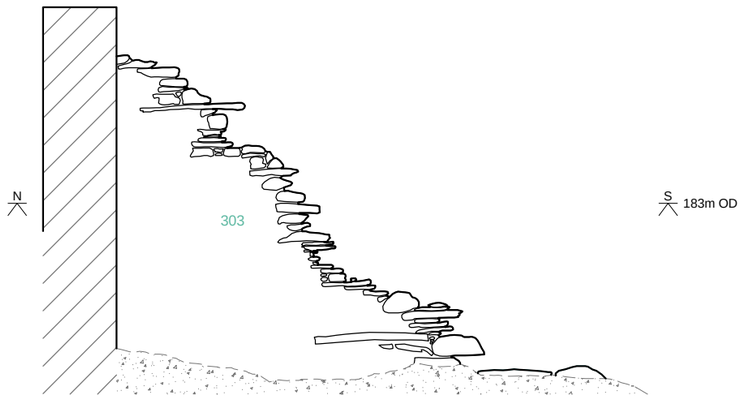
Low Bonsor Mill, Coniston, Cumbria: buttress elevation and plan *Figure 35*

Smelter building - elevations

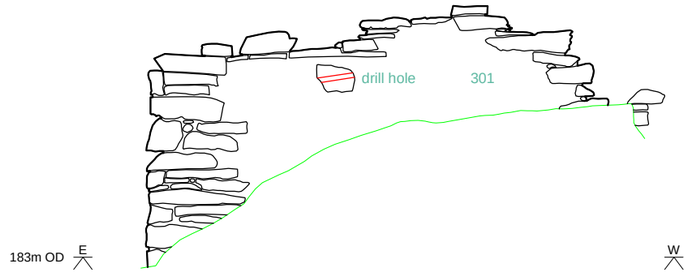
A South facing elevation



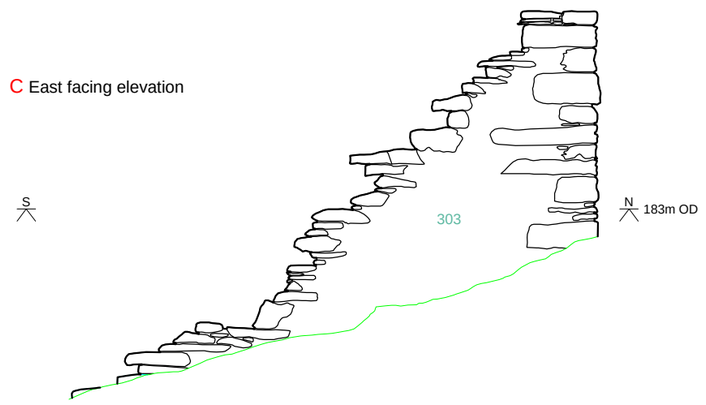
B West facing elevation

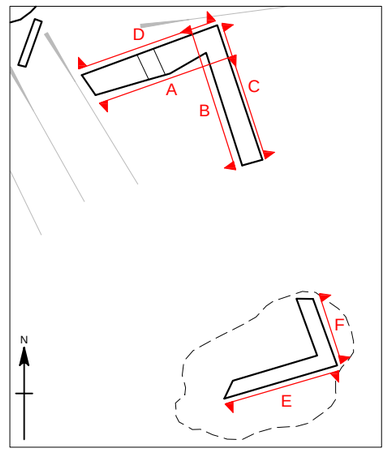


D North facing elevation



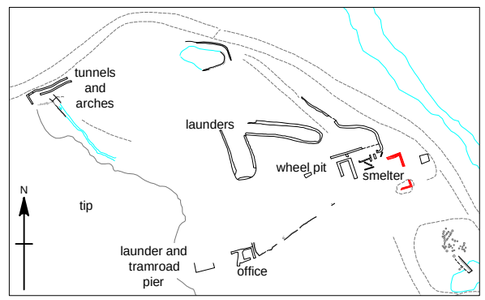
C East facing elevation





E South facing elevation

F East facing elevation



0 2m

scale 1:50 @ A3

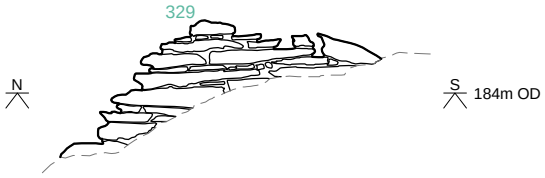
Low Bonsor Mill, Cumbria: smelter building elevations

Figure 36

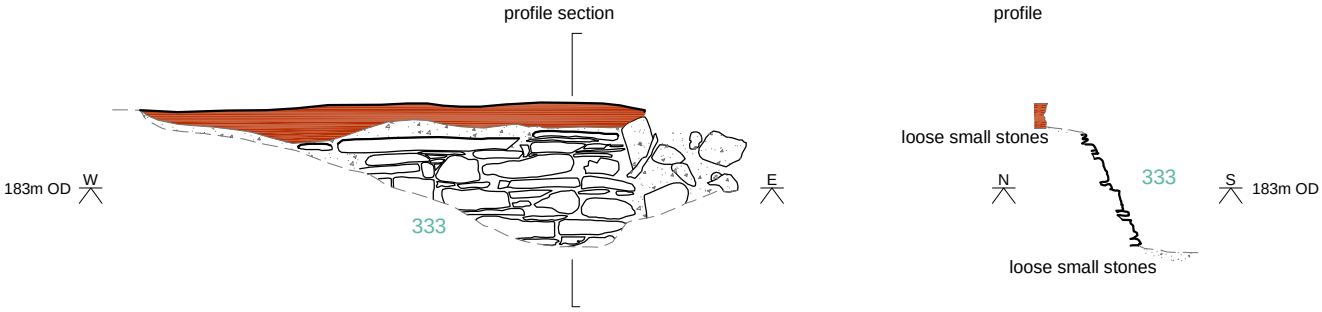
Smelter support - elevations

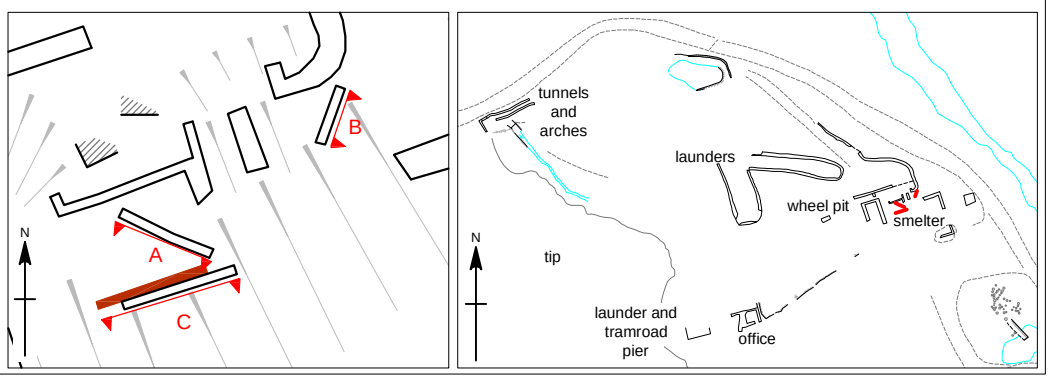
A South west facing elevation

B South east facing elevation



C South facing elevation and profile





Low Bonsor Mill, Cumbria: smelter support elevations *Figure 37*

building, which presumably was also part of the furnace flue system.

6.69 The type of furnace in the photographs is similar to some of the short stack furnaces used for copper smelting in the late 19th century in America and Australia (Fig. 38). Many of these had an external water jacket or casing which meant there was no need to encase the furnace with refractory or fire bricks. The small number of fire bricks at the Bonsor smelter might indicate the use of a water jacket.

6.70 Historic photographs P8 and P9 also show that the water wheel for Stamping mill 2 was still in use. The two spoked, iron pulley wheels in P8 suggest that the wheel operated a line shaft system, connected perhaps to a blowing mechanism providing the air blast to the base of the furnace. The same photograph also shows a timber building on the bank behind and above the furnace, which is likely to have been a charging house where the ore, fuel and flux were prepared; this building is also depicted on the 1912 OS map (Fig. 10).

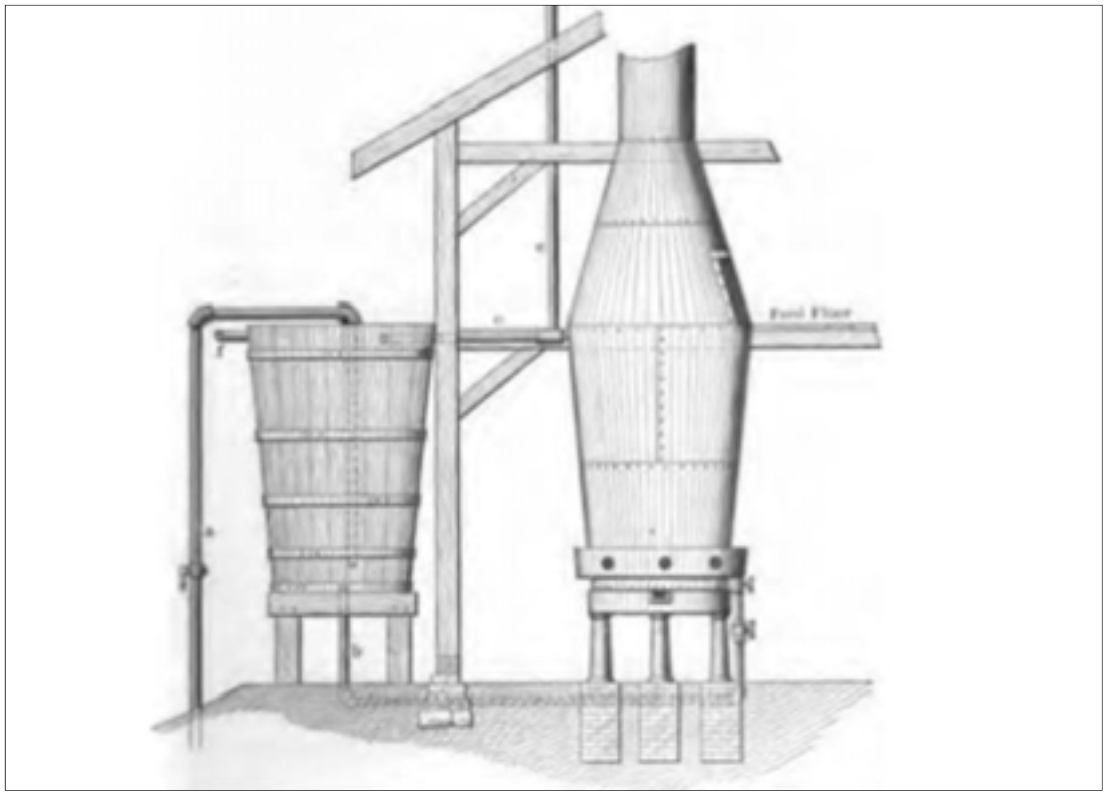


Figure 38: *copper blast furnace with water jacket (after Peters 1911, fig. 21): 'While no one would think of employing such an apparatus as this for any permanent work, its low cost, rapidity of transportation and erection, independence of firebrick and general flexibility may render it invaluable in a remote district' (Peters 1911,119).*

6.71 Historic photograph P7 (Plate 15) shows the exterior of the smelter building soon after

construction and, although no details can be seen of the furnace, it does provide information on the construction of the structure itself. The tall, upper section has timber or corrugated iron walls with a run of eaves-level windows on the south side and a single window just below the gable on the east side. The roof appears to have a raised ventilation ridge. The lower part of the building is constructed from stone and has a series of regularly placed buttresses. No details can be seen of the furnace and fume stacks in P7, but this image does give some idea of the size and relative height of the smelter building. Historic photograph P8 shows that the building's timber or corrugated iron walling was attached to a steel framed superstructure

6.72 The smelter site is in a poor condition and it is hard to reconcile the surviving archaeological features with the structural details shown in P8 and P9. The north-east corner of the smelter building survives as standing masonry walls 301 and 303 and the building's probable south-east corner is marked by ground-level walls 304 and 305. Nothing survives of the remaining stretch of the south wall or any of the west wall. The rest of the north (back) wall has collapsed and any associated features are buried under tumbled masonry although there is an isolated stretch of battered stone wall (333) supporting a horizontal, recessed timber that is close to what may have been the building's north-west corner.

Plate 40: *smelter site (300), looking north-west.*

6.73 Similarly, there is little remaining evidence for the layout of the furnace or any associated plant. The only relevant feature is a rectangular opening (302) in wall 301,

which may have supported, or taken, one of the furnaces flue pipes. The masonry tumble west of wall 301 also contains standard and refractory bricks and it is likely that the latter were used as external lining for the furnace stack or formed part of the furnace heath structure. Immediately south-west of the water wheel pit is an oval feature (258), probably part of a catch-pit for the western part of Stamping mill 3, the interior of which is filled with a mixture of tumbled masonry, mine spoil and burnt or calcined limestone. Burnt limestone has no place in ore dressing or stamping but could have been used as a flux in copper smelting. It would seem that feature 258 was a store for burnt limestone or even used for roasting limestone.

6.74 The area of ground between the back wall of the smelter building and the retaining wall (331) behind the former stamping mill is a rubble and gravel slope with occasional masonry features and is particularly hard to interpret. Wall 331 was originally a terraced retaining wall. Its top section, probably around 2.5m wide with a masonry return (326) at its east end, held a tramway that fed material to the eastern set of stamps. Below this it formed the back wall of Stamping mill 3. The new smelter building was erected with its north (back) wall 4.5m in front of retaining wall 331 and the space in between these two features was backfilled with stone and spoil to form a solid bridge; this also acted as a loading or charging ramp for accessing the first floor of the smelter building. The timber building seen in P7 was constructed on this made ground and, as suggested above, was probably a charging house for the furnace.

6.75 Within the backfill deposit is a group of wall-like features (324–330) that post-date the stamping mill and must relate to the operation of the smelter. They possibly held support structures for the furnace or even have been part of a recess for the furnace stack. The 1913 OS map shows a dog-leg recess in the south-east corner of the 'charging house' and this too may relate to support for the furnace stack or a furnace flue.

6.76 The only other surviving part of the copper smelter is a ground level masonry square formed by wall lines 306–309. This was a support plinth for an external fume stack, which is shown in P8. The masonry square is approximately 3m by 3m and appears to have been constructed from a mixture of slate and river cobbles. It has been built into a slight bank. As a result, its western edge (306) survives to a maximum height of 0.5m, its southern edge survives to c.0.2m and the eastern (308) and northern (309) edges survives only as outlines on the ground.

The Smelter building

6.77 The surviving walls associated with the smelter building (301–305) are of a coursed random rubble construction made up of alternating layers of river cobbles, slate and occasional pieces of quartz. There is some evidence for mortar between the stones. Walls 301 and 303 form the north-east corner of the building. The north (back) wall (301) shows signs of heavy mineral staining and survives to a maximum height of 3.3m internally and 1.85m externally and is 3.7m wide internally and 4.15m externally.

6.78 The wall contains a roughly square aperture (302) c.0.58m wide by 0.55m high and 0.74m deep (the depth of the whole wall). This is situated approximately 1.4m above the ground, although the floor is covered in rubble. The feature has a substantial slate lintel but no sill, and the base appears to slope down from outside to inside, although this may partially be the result of material falling in from outside. The aperture may have been designed to take one of the furnace flue pipes. However, the feature is now blocked from the outside, partly as the result of the amount of material deliberately built up behind the building and partly due to natural slippage. The east gable wall (303) is in a poor state. It survives to a maximum height of 2.6m internally and 2.07m externally and to a maximum length of 3.1m internally and 4.2m externally.

6.79 Walls 304 and 305 form the south-east corner of the building and barely survive. They consist of only a couple of courses of slate with a very large stone perched on top at the corner. This large stone and a large slab of slate below it look like quoins. These are similar to those seen at the corner of walls 301 and 303. The walls survive to a maximum height of 0.5m. Wall 304 is 2.47m long and wall 305 is 0.77m long. This corner of the building may have survived in part due to the amount of rubble present.

6.80 The small amount of the smelter building that survives clearly demonstrates that it was of a single-phase construction and did not reuse walls from earlier structures. Walls 301 and 303, and walls 304 and 305 are keyed in together at the corners and externally display substantial quoins. Wall 303 is in line with wall 304 and therefore suggests that the east gable end was approximately 12m wide externally. The gap between 303 and 304 is approximately 4.8m. This may correspond to the location of a wide opening that can be seen on P7, which was taken in 1894 soon after the smelter was built. It shows that the opening was offset to the south and was not central within the gable wall, which would correspond with what can be seen on the ground today.

6.81 Although nothing survives of the western gable wall some observations can be made. Historic photographs (P7 and P8) show that the smelter building was rectangular and that there were two spoked, iron pulley wheels within the structure, which were run off the water wheel located outside of the structure. The length of the building could therefore not have been more than 16m and was in fact probably closer to 13m. The photo of the smelter building after the storm damage (P8) shows the presence of a standard-sized door within the western gable wall.

6.82 Possibly associated with the smelter building are a series of short wall-like features (324–330), which have been built into the backfilled area. It is thought that they may have held/helped support structures for the furnace or formed part of a recess for the furnace stack. It is unlikely that they formed part of a hopper system, as the furnace was charged from above and not at ground level.

Plates 41 & 42: *wall 324 (left) and 325 (right), which post-date the stamping mill and are probably associated with the copper smelter.*

6.83 The recess (326) created by walls 324 and 325 was approximately 1m wide and 1.6m deep. It could either have been used as a hopper or as a support for one of the furnace stacks. Walls 324 and 325 were identical in their construction and made up of alternating layers of slate and river cobbles. They were both built into the bank of waste material. Both walls are approximately 1m high and 2m long. The brick lined chute recorded by the RCHME in 1997 can no longer be discerned.

6.84 Wall 328 is aligned east-west along the bank of waste material. It appears to act as a retaining wall and may have been associated with the timber structure that can be seen on the bank above the smelter building in the historic photo from 1894 (P8). Retaining wall 328 butts up against wall 325 and is again of a coursed random rubble construction. However, it is not as neat as 324 and 325, and the layers appear to tip down towards the east. The large stones at the western end of this wall are suggestive

of quoins, or at least a definite terminus to the length of the wall, which is approximately 3.5m long and 1.25m high.

6.85 There are two walls (329 and 330) that were built at different angles to everything else in this area. Wall 329 is found to the east of the area, above the smelter building. It is possible that 329 was perhaps built as a retaining wall to stop material from the bank slipping down and filling in more of the space behind the smelter building, enabling the flue to pass unhindered through aperture 302.

6.86 Wall 330 is located at the west end of the area and appears to lie partly within the smelter building. It is crossed where the two spoked, iron pulley wheels were operating and may have formed part of the associated gantry. The two angled walls (329 and 330) have been constructed in slightly different ways. The first (329) has been built entirely of substantial pieces of slate and stands c.0.54m high and 2.1m long. At one point it may have butted up against the curved wall 322. Wall 330 is of a random rubble construction consisting of small pieces of randomly coursed slate and river cobbles. It stands c.0.8m high and measures 2.2m long.

Area 3: the spoil tips

6.87 Extensive spoil tips make up much of the north-west and western part of the survey area (100) (Fig. 11). These tips are an extension of the Bonsor mill tips and are composed of material from the Upper Bonsor mill, including unmineralised rock discarded during the initial sorting process, waste from the crushing mill and waste material from primary crushing and jigging. The 1850 OS map shows the tip as covering a comparatively small area on the north side of Lever Water Beck. It also depicts two tramroads running onto the tips from the ore bins and crusher at the upper mill (Fig. 7). The spoil tip appears to have expanded rapidly in the latter half of the century. Historic photograph P1 (Plate 6), taken in the 1860s or early 1870s, shows the tips extending as far south as Stamping mill 1 at Low Bonsor mill and P5 (Plate 12) shows the tips had reached their current size and extent by the late 1880s.

6.88 The main tip (101) has a flat top and maintains a constant height along its length. The top of the tip is at the same level as the upper mill crushing house and it is apparent that the vast majority of tip material is waste from the sorting and crushing process. However, the tip is a complex feature that was begun in the 1820s and continued to be built up over the next 70 years or more. Tramroads ran south-west from the Upper Bonsor mill ore bins and crusher house and must have begun by tipping waste down

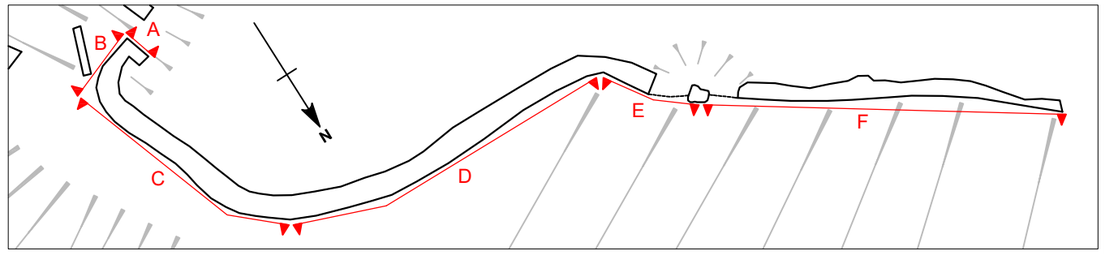
slope on the east side of Levers Water Beck. Once this area was filled the tramroads were realigned to the south-east and the tip was progressively extended parallel with the beck. As the tip increased in size, it encroached on some of the building of the upper mill as shown on the 1850 OS map (see Figs. 7 and 8) and by the 1880s the tip had extended to cover Stamping mill 1 at Low Bonsor mill (Fig. 9). As discussed above, the changes in layout at the lower mill appear to have been largely in response to the challenges posed by the ever-growing spoil tip.

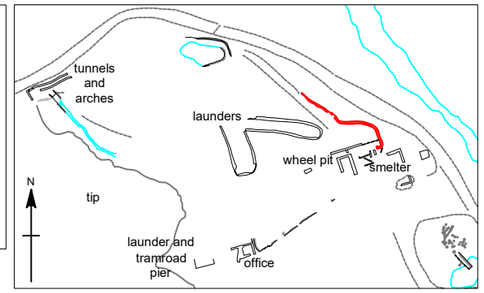
6.89 Much of the central area of tip 101 has been destroyed by quarrying but parts of the original surface survive at the north-west end, where there are traces of two parallel, curved gullies marking the location of tramroads. The tip tramroads are likely to have been temporary affairs that were moved and relocated as tipping progressed. The south-east part of tip 101 is the best-preserved section of the feature. The top is a level area, around 10m wide, and there are surface traces of three tramroad gullies: two leading towards the southern, along the edge of the tip, and the third running along the tip's central axis.

Plate 43: *pack wall (122) in tip 102, looking east.*

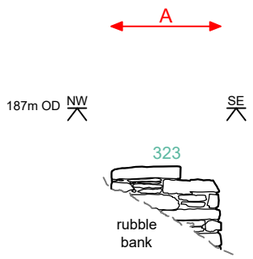
6.90 On the central, east-facing side, tip 101 overlies a smaller spoil dump (102). The difference between the two is not immediately apparent, but tip 101 is composed of regularly-sized, orange-stained rock with an average diameter of 20cm, while the material comprising tip 102 is more irregular in size and features grey-brown coloured rock. Tip 102 also contains a number of dry-stone revetment walls and associate linear

Retaining wall - elevations



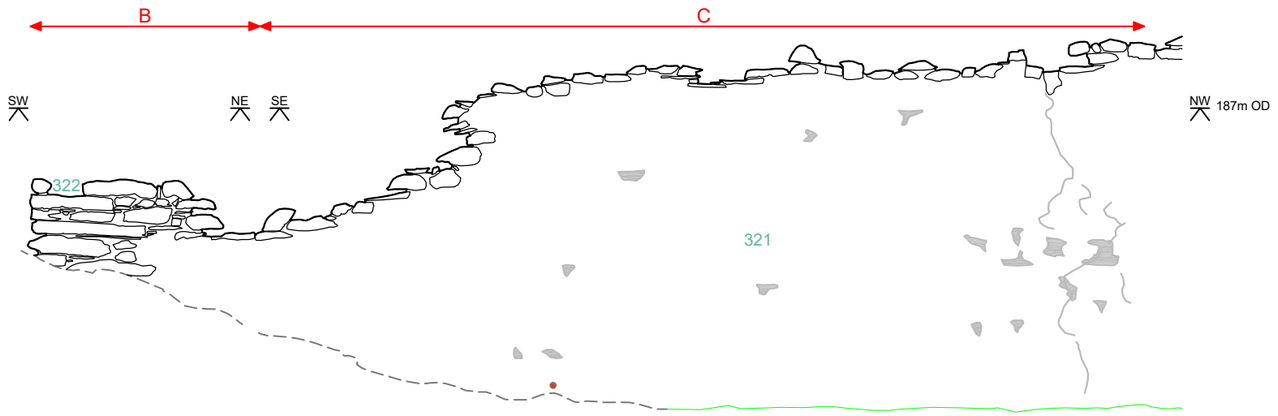


A South-west facing elevation



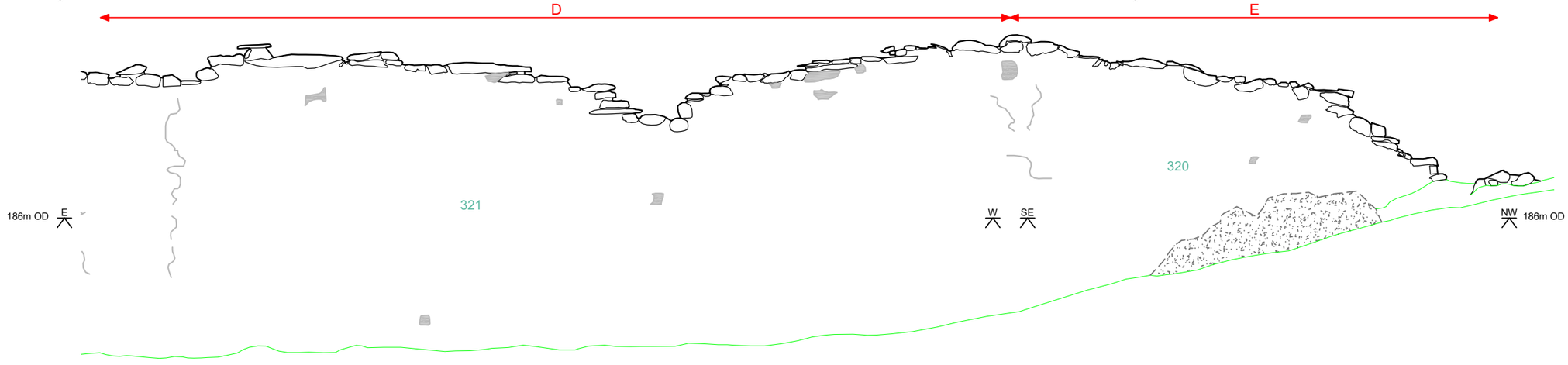
B South-east facing elevation

C North-east facing elevation

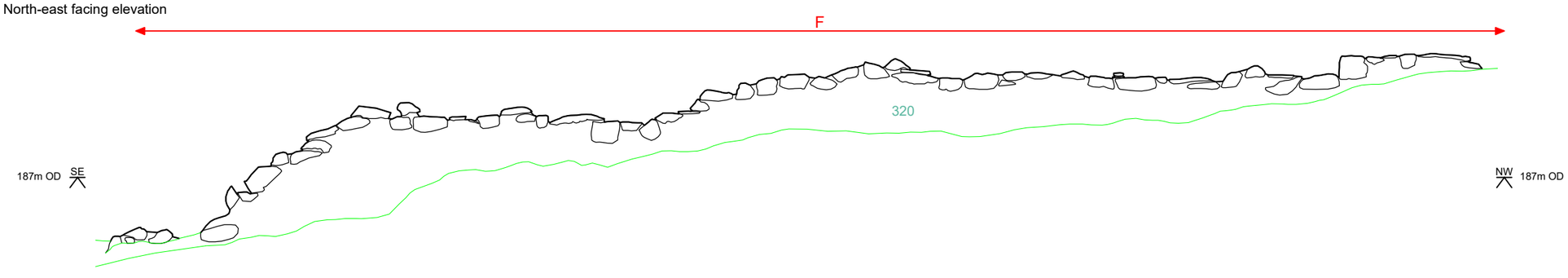


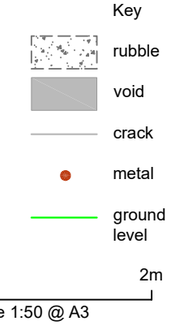
D North facing elevation

E North-east facing elevation



F North-east facing elevation





Low Bonsor Mill, Coniston, Cumbria: retaining wall elevations

Figure 39

depressions. The function of these is not clear and, while some may be the remains of shelters or sunken tracks, it seems that most are simple revetment walls forming the sides and ends of small, individual tips. One interpretation is that these small, walled tips relate to the activities of particular work gangs or 'tributers' who were employed in a particular part of the dumps and needed to mark-out their working areas. Unfortunately, quarry 103 has removed much of tip 102 and the original extent of these intriguing walled dumps is unknown.

6.91 Some of the historic photographs of Low Bonsor mill show an additional tip in front of tip 102 that covered the site of Smelting mill 1. By the 1890s (see P9), this had been partially removed, presumably for reprocessing by Thomas Warsop. The nature of this lost tip is unknown, but it may have been jigging waste from the upper mill, which was reworked for its sand content.

6.92 A large part of the central area of tip (101) has been removed by quarrying. The quarry (103), which covers an area of 17m by 70m and has an average depth of 2.5m, has been dug into the tip from the south side of the mine road. Postcard views of the youth hostel building taken in the 1930s show the tip here as intact, so the quarrying is likely to have been a post-war activity, perhaps to provide aggregate for building or road-making.

7.0 PHASING

7.1 The community survey, combined with an examination of historic maps and photographs, shows that Low Bonsor mill was a dynamic industrial landscape that underwent a number of significant changes during its comparatively short working life. The dressing mill was in operation continuously for around 70 years; therefore, the phases outlined below should be seen as part of a pattern of change rather than specific episodes of construction and redevelopment. The suggested dates are only provisional.

Phase 1 (1825–1860)

7.2 The principal activity at Low Bonsor mill during Phase 1 was the operation of Stamping mill 1 and its associated dressing floors. This involved the construction of a leat and tramroad from the upper mill, the erection of the stamping mill and the building of buddles and settling ponds. The 1850 OS map provides the main evidence for the layout of the lower mill during this phase of operation but much of the physical evidence has been buried by the main spoil tip (101) or destroyed during the

rebuilding of the settling ponds and secondary buddles in Phase 2.

ID Nos.	Surviving Archaeological Evidence Phase 1
231 -234	the tramway arch and associated features in the north-west part of Area 1a
257	cart track from the upper mill
400 (G)	group—the presumed launder and tramway pier at Stamping Mill 1
256	truncated culvert, possibly part of the water supply system to launder pillar (400) and Stamping mill 1
450-52	wall and drain features possibly relating to one of the stamping mill's catch pits

Phase 2 (1860–1880)

7.3 This phase saw a major rebuild and extension of Low Bonsor mill and many of the surviving structures identified and recorded during the community survey relate to this phase. The principal activities or events include:

- the construction of leat (206), which carried water from the upper mill to the new stamping mills at the lower mill;

- the construction of Stamping Mills 2 and 3 and the abandonment of Stamping Mill 1. This may not have occurred at the same time and there is some evidence—historic photograph P1—to suggest that Stamping Mill 3 was built first and then rebuilt (see Phase 3 below); and

- the extension of tip (101) to its current size and the consequent need to move the course of Red Dell Beck to the east.

ID Nos.	Surviving Archaeological Evidence Phase 2
206	leat carrying water from the upper mill to the new stamping mills at the lower mill
220	launder pillar, associated with Stamping mills 2 and 3
340	wheel pit associated with construction of Stamping mills 2 and 3
251-52, 254	tramroad and possible culvert associated with construction of Stamping mills 2 and 3
253	water course associated with Stamping mills 2 and 3
101	expansion of main spoil tip

Phase 3 (1880–1890)

7.4 This phase saw a gradual reduction in operations and is marked by:

- major rebuilding of Stamping Mill 3, attested to by historic photographs. Surviving launder pier (210) and retaining walls (31), (321) and (323) belong to this phase;
- the abandonment of Stamping Mill 2, shown derelict on the 1890 OS map; and
- probable changes to the water supply system, including the construction of pond (240) and leats (242 and 243).

ID Nos.	Surviving Archaeological Evidence Phase 3
210	launder pier associated with rebuilding of Stamping mill 3
311,321,323	walls associated with rebuilding of Stamping mill 3
340	wheel pit associated with Stamping mill 3
251-52, 254	tramroad and possible culvert associated with stamping mill
240	pond associated with construction of new water supply
242-43	leats associated with construction of new water supply

Phase 4 (1890–1900)

7.5 This phase includes the abandonment of the Low Bonsor mill dressing floor, the demolition of many of the dressing floor buildings and structures, and the construction of the copper smelter at the site of Stamping mill 3. The removal of some tip material for reprocessing at the upper mill occurred during this phase.

ID Nos.	Surviving Archaeological Evidence Phase 4
301-307	structural evidence of smelter building
322-324	retaining wall sections
310	copper slag blocks securely dated to 1893-94
251-52, 254	tramroad and possible culvert associated with construction of Stamping mills 2 and 3
253	water course associated with Stamping mills 2 and 3
101	Expansion of main spoil tip

Phase 5 (1900–modern day)

7.6 This is the post-abandonment phase. The principal surviving feature from this phase is quarry (103), which was probably dug in the immediate post-war period to extract

stone for road building. The later water pipeline, which caused so much destruction at the Low Bonsor mill site, also belongs to this phase.

8.0 STATEMENT OF SIGNIFICANCE

8.1 The heritage significance of Low Bonsor mill derives from a wide range of values and perspectives, encompassing not just the physical fabric of the mill but also its setting, use, traditions, local distinctiveness and ability to bring together local people and communities.

8.2 The following section updates and expands an earlier assessment made as part of the 2010 Conservation Management Plan (Archaeo-Environment 2010). It considers the significance of the mill according to four high level themes as set out in *Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment* (English Heritage 2008):

Evidential Values: the potential capacity of the mill to yield primary evidence about past human activity (layout, rarity, group value, extent of survival, etc.).

Historical Values: the potential of the site to advance the historical narrative—the connection between the present and the past through association with people, events and aspects of life.

Aesthetic Values: the potential for people to derive sensory and intellectual stimulation from a place through design, art, character and setting.

Communal values: the potential for the site to bring people together through collective experience or memory.

8.3 The 2010 Conservation Management Plan studied the whole of the Coniston copper mines complex. The Plan recognised that the significance of the mines varied spatially across the site, particularly with regard to evidential and historic significance. The mining complex was therefore divided into a number of zones of significance, of which Low Bonsor mill zone was classed as being of considerable value to the overall significance of the Coniston Coppermine site and the associated Upper Bonsor mill of exceptional value. This was largely based on the preservation of surface evidence and the degree of historic understanding of both mill sites (Archaeo-Environment 2010, 92). However, the work undertaken as part of the community survey has added considerably to an appreciation of Low Bonsor mill's evidential and historical values

and, as such, it should now be considered as being of **exceptional** value to the significance of the scheduled mining complex.

8.4 Overall, Low Bonsor mill is considered to be of exceptional significance as a multi-phase mechanised ore dressing and processing site, which operated as an integrated unit with the adjacent upper mill. The Bonsor mill was the principal—and after the 1870s the only—processing plant for the Coniston copper mines and the history of the mines and mill are intrinsically linked. There are also important historic and evidential parallels with the nearby Tilberthwaite mine—which was often worked by the same companies operating at Coniston—and with the Greenburn mine to the north-east, as well as Goldscope mine in the Newlands Valley, and smaller workings like Long Work and Dale Head in the Newlands Valley and Hay Gill and Carrock End in the Caldbeck Fells. These all form part of the Cumbrian group of mines, which constitute the largest group of copper mines outside of Devon and Cornwall and had a substantial impact on both the historic development of the region and the character of the surrounding landscape.

8.5 There are other processing mills at Coniston, including the large water-powered mills at Paddy End and Red Dell, a putative stamping mill at Cobbler's Level, and a number of hand-dressing sites around Levers Waters and Red Dell. There is also the well-preserved mill at Penny Rigg, Tilberthwaite, which was designed by John Barratt and worked as part of the broader Coniston enterprise. These sites all have substantial archaeological remains and provide comparative and chronological contexts for Low Bonsor mill. Upper Bonsor mill contains evidence for primary processing—transport from Deep Level, ragging and sorting, ore crushing and jigging—and shares fundamental evidential and historical values with Low Bonsor mill.

8.6 The site includes evidence for a number of key aspects associated with copper-ore processing. These processes include: transporting the ore (from the upper mill); stamping the ore (evidence of three stamping mills); dressing the ore (jigging house and remains of buddles); final concentration of the ore (settling ponds); managing waste (slime ponds); and water management (leats and launder piers). There is also a nationally unique copper smelting site and evidence in the form of an extensive spoil tip for the management of primary waste from the mine and upper mill. A number of these features can be assigned to particular phases in the development of the mill and this provides a relative site chronology, which could be tested by future documentary and archaeological research. In addition to the visible surface remains, there is also

high potential for the preservation of sub-surface archaeological remains, particularly at Stamping mills 1 and 3, the copper smelter, the jigging house and the Area 3 buddles.

8.7 The historic values of Low Bonsor mill contribute significantly to the significance of the site. Of particular importance in this respect are the various primary source documents held in the CATMHS archive at the Armitt Museum and Library in Ambleside, as well as those held in the Cumbrian Archives at Whitehaven, Kendal, Carlisle and Barrow. The archive project being undertaken as part of the Coniston Copper project, especially the ongoing cataloguing of the Eric Holland collection held at the Armitt, will allow greater access to such material in the future and aid further research into the history and development of the site.

8.8 The mill has close connections with the life and works of the mining engineers John Taylor and John Barratt. Low Bonsor mill, as part of the broader mining complex, incorporates a number of the advances—in particular ore stamping and jigging—which were brought by Taylor and Barratt from the Devon and Cornwall ore fields and later refined at Grassington. There are also important links with later owners, especially Thomas Warsop, whose ill-fated attempt at blast furnace copper smelting is of particular note.

8.9 The site's historic value is increased through the survival of a number of mid and later 19th-century photographs. These images illustrate the type of equipment at the mill and also show subtle changes in the site's layout that cannot be recovered by archaeological survey alone. Photographs of working Victorian dressing floors are extremely rare and these images are a unique record of copper processing in Cumbria and provide an interesting contrast with the few surviving images of other operational dressing floors such as Ecton in Staffordshire and some of the copper mines in Cornwall and Devon.

8.10 The ruinous nature of the site and the extensive spoil tips, combined with the other vestiges of abandoned mining, all contribute to the site's aesthetic value and unique sense of place. The lower mill is the first part of the Coniston copper mines complex seen by most visitors as they walk up the track from the village. The sudden appearance of a deserted industrial landscape surrounded by the beauty of the Coniston fells is unexpected and inspired Alfred Wainwright to write:

'This hollow among the hills presents a surprising scene of squalid desolation, typical of the dreary outskirts of many coalmining towns but utterly foreign to the Lake District, and it says much for the quality of the encircling mountains that they can triumph over the serious disfigurement of ugly spoil tips and gaping wounds and still look majestic.'

(Wainwright 1960)

8.11 Wainwright was also fascinated by this 'scene of squalid desolation' and, writing some years before industrial archaeology became popular, said there was 'good fun and absorbing interest' to be had in exploring the site.

8.12 The lower mill is frequently visited by walkers, drawn to the site by its ruinous and slightly alien appearance. Being so close to the track from the village, it is easily accessed and, for many visitors, is their first introduction to the area's industrial heritage. The site is also used and enjoyed by those staying at the Coniston Coppermines Youth Hostel, the adjacent Barrow Mountaineering and Ski Club hut and the self-catering units at Upper Bonsor mill. In addition to the more casual visitor, the mill has considerable communal value for mining enthusiasts and industrial archaeologists and in recent years has been studied and recorded by members of CATMHS. Its relatively easy access means that the mill is also regularly visited by geologists and mineralogists and is a particularly popular site for undergraduate earth sciences field trips.

9.0 RECOMMENDATIONS FOR FURTHER WORK

Conservation Works

9.1 Prior to the survey, a conditions assessment on the mill site had already been carried out by Countryside Consultants. Recommendations made in the report were subsequently implemented in a programme of consolidation and stabilisation work, which should ensure the conservation of the site for the foreseeable future, subject to regular monitoring. However, the proximity of the dressing floors to both the beck and the road makes them vulnerable to future damage resulting from flooding or inappropriate use.

Archaeological Investigation

9.2 There is considerable scope for targeted excavation to inform a greater understanding of the layout, operation, preservation and phasing of the mid-19th century dressing

mill and smelter. Key areas for consideration would be:

i. Stamping mills 1 and 3
ii. the copper smelter
iii. the jigging house
iv. Area 3 buddles

9.3 Such investigations could be undertaken as part of a community training excavation, providing that an appropriate risk assessment was undertaken in advance and mitigation measures are put in place. Historic England would need to be consulted in advance of any such proposals and Scheduled Monument Consent (SMC) obtained from the Secretary of State for DCMS.

Interpretation

9.4 Consideration should be given to improving both on-site and off-site interpretation, although care will need to be taken not to detract from the setting of the designated monument. One option may be to house a small on-site exhibition in the youth hostel (permission depending) that tells the history of the Upper and Low Bonsor mills and includes extracts from some of the evocative historic photographs that have come to light during the preparation of this report. Another alternative would be to house the exhibit at the Ruskin Museum, although this is some distance from the site. The preparation of a small illustrated booklet or downloadable guided walk might also be considered.

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Plans and Maps:

1850 First Edition 6-inch Ordnance Survey map - Lancashire Series Sheet IV, surveyed 1848.

1890 Second Edition 25-inch Ordnance Survey map - Lancashire IV.3, surveyed 1888.

1892 Second Edition 6-inch Ordnance Survey map - Lancashire IV, surveyed. 1889.

1913 Third Edition 25-inch Ordnance Survey map - Lancashire IV.3, surveyed. 1913.

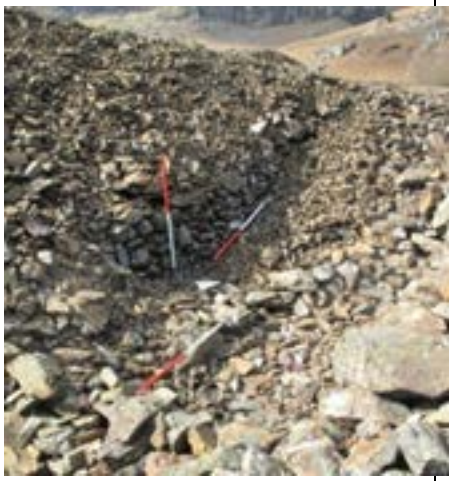
APPENDIX 1: SITE GAZETTEER

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
100 **Group**	**Spoil Tip** - The large tip on the west side of the site, comprising the principal tip (101), a smaller tip (102) centrally located within the north-eastern slope of (101) and an area of modern tip extraction (103).	**High -** considerable historical and evidential value relating to the development of both the upper and lower mills.		High	1820s-1890s	
101	**Spoil tip** - the principal spoil tip, 280m long x 60m wide (max) and c. 16m high, forming a dramatic landscape feature on the west side of the site.	**High** – considerable historical and evidential value relating to the development of both the upper and lower mills.	Seals tip (102) Cut by quarry (103)	High	1820s onwards	
102	**Spoil tip** - an area of distinctive grey spoil exposed on the north-eastern slope of (101) and containing walls (121)- (131) and depressions (132)-(135). The spoil is generally larger and more irregular than the spoil in tip (101).	**Medium** – good evidential value as demonstrates phases of tipping activity.	Sealed by Tip (101) – Cut by Tip extraction area (103) Contains walls (121)-(131) and depressions (132)-(135)	Medium		
103	**Quarry** – a large, shallow quarry (75m x 30m x 2.5m high) where a substantial area of tip (101) has been removed,	**Medium** – good evidential value because it relates to mineral exploitation after the	Tip (101)	Medium	Later 19th century	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	presumably for reprocessing.	mine had closed and thereby adds to the chronological depth of the site as a whole.				
120 **Group**	**Group of dry-stone walls** (121)-(131) built within tip (101), the main spoil tip, centrally located within the north-eastern slope. Most of the walls are probably retaining walls but in certain locations they appear to support trackways and in others they may have been built to create sheltered areas for working. Also, a group of depressions (132)-(135) defined by a narrow ridge to the north-east and areas of rubble between the depressions.	**Medium** - good evidential value because it relates to localised and chronologically distinct activities within the spoil tips. The function, purpose and date of these walls is not entirely clear and there is potential for further research.	Tip (100)	Medium	Late 19th Century	
121	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Facing north-east. 2.0m high and 2.5m wide. Located on its own towards the bottom of the north-eastern edge of the spoil tip.	**Medium** - as above	Tip (100)	Low	Late 19th Century	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
122	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly north-east facing. Maximum height in the middle 1.3m and 4.12m in length. Partially covered with rubble at each end. Opposite wall (123) across a flattened area, 1.5m wide, possibly a trackway.	**Medium** - as above	Tip (100) Wall (123)	Low Medium	Late 19th Century	
123	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly south-west facing. Maximum height in the middle is 0.8m and 8.0m in length. Curves towards its northern end. Has not survived as well as (122), collapsed and demolished in certain places. Opposite wall (122) across a flattened area, 1.5m wide, possibly a trackway.	**Medium** - as above	Tip (100) Wall (122)	Low Medium	Late 19th Century	
124	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly north-east facing. Maximum height 0.7m and 2.7m in length. Partially covered with rubble at each end. Opposite wall (125) across a flattened area, 1.6m wide.	**Medium** - as above	Tip (100) Wall (125)	Low Medium	Late 19th Century	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
125	**Revetment wall stub** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly south-west facing. Maximum height 0.6m and 1.1m in length. Probably longer originally. Opposite wall (124) across a flattened area, 1.6m wide.	**Medium** - as above	Tip (100) Wall (124)	Low Medium	Late 19th Century	
126	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly south-west facing. Maximum height 1.14m and 5.7m in length. Covered in tip material at its northern end. Opposite wall (127) across a flattened area, 2.3m wide. There is a step within this central area on the same alignment as the walls. Areas where stones slope down and back into the wall. (126) appears to form part of the south-western edge of a possible raised trackway.	**Medium** - as above	Tip (100) Wall (127)	Low Medium	Late 19th Century	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
127	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly north-east facing. Maximum height 0.8m and 3.1m in length. Covered in tip material at its northern end. Opposite wall (126) across a flattened area, 2.3m wide. There is a step within this central area on the same alignment as the walls. (127) is cut into the tip material.	**Medium** - as above	Tip (100) Wall (126)	Low Medium	Late 19th Century	
128	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly south-east facing, but it has a curve to it. Maximum height 1m and 3.6m in length. Area of collapsed material between (128) and (129). Roughly at 90 degrees to wall (129). These walls create what could possibly be a work area.	**Medium** - as above	Tip (100) Wall (129)	Low Medium	Late 19th Century	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
129	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly north-east facing. Maximum height 1.4m and 2.8m in length. Area of collapsed material between (128) and (129). Roughly at 90 degrees to wall (128). These walls create what could possibly be a work area.	**Medium** - as above	Tip (100) Wall (128)	Low Medium	Late 19th Century	
130	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly south-west facing. Maximum height 0.6m and 2.6m in length. Opposite wall (131), creating two sides of an area which is blocked at either end by rubble. There is a narrow ridge running roughly north-west to south-east which is just about wide enough to walk along.	**Medium** - as above	Tip (100) Wall (131)	Low Medium	Late 19th Century	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
131	**Revetment wall** - rough, random rubble dry-stone wall constructed from waste tip material. Roughly north-east facing. Maximum height 0.8m and 0.6m in length. Opposite wall (130), creating two sides of an area which is blocked at either end by rubble.	**Medium** - as above	Tip (100) Wall (130)	Low Medium	Late 19th Century	
132	**Depression** - this area contains two short walls at its northern end. The rest of the area is dug out of the tip material. Maximum length 5.3m and width 1.7m and roughly 0.5m in height. There is a narrow ridge running roughly north-west to south-east which is just about wide enough to walk along to the north-east of the depression.	**Medium** - as above	Tip (100) Wall (130) Wall (131) Depression (133)	Low Medium Medium Medium	Late 19th Century	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
133	**Depression** - the area is dug out of the tip material and blocked with rubble at either end. Maximum length 1.2m and width 0.8m and roughly 0.5m in height. There is a narrow ridge running roughly north-west to south-east which is just about wide enough to walk along to the north-east of the depression. A tramway can be seen running up the tip on the 1888 OS map.	**Medium** - as above	Tip (100) Depression (132) Depression (134)	Low Medium Medium	Late 19th Century	
134	**Depression** - the area is dug out of the tip material and blocked with rubble at either end. Maximum length 2m and width 1m and roughly 0.5m in height. There is a narrow ridge running roughly NW to SE which is just about wide enough to walk along to the north-east of the depression.	**Medium** - as above	Tip (100) Depression (133) Depression (135)	Low Medium Medium	Late 19th Century	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
135	**Depression** - the area is dug out of the tip material and blocked with rubble at its north-western end. Maximum length 1.4m and width 0.7m and roughly 0.5m in height. There is a narrow ridge running roughly north-west to south-east which is just about wide enough to walk along to the north-east of the depression.	**Medium** - as above	Tip (100) Depression (134)	Low Medium	Late 19th Century	
200 Group	A group of structures relating to the main track and the movement of water from the upper mill to the Lower Mill.	**High** - demonstrates the relationship between the upper mill and the lower mill and the movement of water down the site.	Retaining wall (201) Arch (202) Tunnel (203) Return wall (204) Retaining wall (205) Leat (206)	Medium High High Medium Medium High	The main track as it is today appears on the 1888 OS map along with the tramway (251) Leat (206) is visible on the 1912 OS map.	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
201	**Retaining wall** - random rubble dry-stone wall constructed from waste tip material. The wall acts as a retaining wall for the southern edge of the main track. It is approx. 14m long and 1.2m high at its maximum height. It is aligned approx. north-east, south-west. At its eastern end it has a series of coping stones, which run for approx. 2.6m. These may have originally existed along the whole length of the wall.	**Medium** - demonstrates the relationship between the upper mill and the lower mill and the movement of water down the site.	Arch (202) Tunnel (203) Return wall (204) Retaining wall (205) Leat (206)	High High Medium Medium High	c. 1888-1912	
202	**Arch** - made up of random sized pieces of slate, which range in height from 0.45 to 0.8m. The arch is approx. 2m wide and 0.9m high. Key stones were observed. Material appears to have been backfilled against the arch. The arch forms a tunnel which allows the continuation of a leat (206) from the upper mill.	**High** - demonstrates the relationship between the upper mill and the lower mill and the movement of water down the site.	Retaining wall (201) Tunnel (203) Return wall (204) Retaining wall (205) Leat (206)	Medium High Medium Medium High	c. 1888-1912	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
203	**Tunnel** - the stone arch (202) forms the front face of a stone lined, arched tunnel, which is approx. 7.65m in length. The tunnel is approx. 1m high by 1.1-1.7m wide. The tunnel channels a leat (206) from the upper mill to the lower mill beneath the main trackway. The leat (206) collected water from a water wheel in the upper mill and transferred it to the Lower Mill where it supplied a further two water wheels.	**High** - as above	Retaining wall (201) Arch (202) Return wall (204) Retaining wall (205) Leat (206)	Medium High Medium Medium High	c. 1888-1912	
204	**Return wall** - short length of random rubble dry-stone wall constructed from waste tip material. The wall is at 90 degrees to the main retaining wall (201). It survives to a length of 2.2m and 0.62m high at its highest point. Wall (204) appears to butt up against wall (201). at its northern end it consists of 4 courses, at its southern end it has been reduced to a single course of stones.	**Medium** - as above	Retaining wall (201) Arch (202) Tunnel (203) Retaining wall (205) Leat (206)	Medium High High Medium High	c. 1888-1912	
205	**Retaining wall** - random rubble dry-stone wall constructed from waste tip material. it survives to 3 courses high	**Medium** - as above	Retaining wall (201) Arch (202)	Medium High High	c. 1888-1912	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	in places. It is approx. 10m in length, but it is missing both ends. It is in a poor condition. This low retaining wall is 1.9m south of wall (201) forming the northern edge of leat (206) once it has left the tunnel.		Tunnel (203) Return wall (204) Leat (206)	Medium High High		
206	**Leat** - large embanked leat taking water from Upper Bonsor Mill to the water wheels at the lower mill stamp mills 1 and 2. Bifurcates at eastern end to form two separate launder piers (210 + 220).	**High** - considerable historical and evidential value as provides information on use of water supply to power dressing floor machinery.	Leat tunnel (203); Retaining walls (201-202, 204-205, 207); Bridge (208); Launder piers (210, 220).	High	Not shown on 1850 OS; shown on 1892 OS	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
308	**Smelter stack - East wall** - of a square stone base which can be seen on a photo dated to approx. 1895, and which appears to have some sort of chimney on top of it (smelter stack/flue) . Only the top of a layer of slate rubble can be seen on this side. It is 2.58m in length. This side is built into a slight bank.	**High** - as above	Wall (306) Wall (307) Wall (309)	High High High	Smelt building built 1893 and destroyed Dec. 1894	
309	**Smelter stack - North wall** - of a square stone base which can be seen on a photo dated to approx. 1895, and which appears to have some sort of chimney on top of it (smelter stack/flue). Only the top of part of a layer of slate rubble can be seen on this side. It is 2.57m in length. This side is built into a slight bank.	**High** - as above	Wall (306) Wall (307) Wall (308)	High High High	Smelt building built 1893 and destroyed Dec. 1894	
310	**Slag** - the remains of the waste material from the smelt. Consists of a concentrated dump of at least 50 pieces of visible slag blocks, some pieces are partially buried, so there may be more pieces that have been completely buried. The slag is in the	**High** – good evidential, historical and interpretive value as only obvious visual evidence for smelting on site. High rarity value.	Smelt area G(300) Pond (311)	High	Smelt building built 1893 and destroyed Dec 1894	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
207	**Retaining wall** - remains of a retaining wall to the south of leat (206) approx. 4.6m long. It is in a very poor state of repair with stones only visible at the surface. Part of this wall can be seen in section just above arch (231).	**High** - demonstrates the relationship between the upper mill and the lower mill and the movement of water across the two sites.	Return wall (204) Leat (206) Arch (231)	High High High	c. 1888-1912	 

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
208	**Bridge** - bridge over leat (206) built from large slate slabs resting on central spine and supported at sides by low retaining walls constructed against t embankment. 2.6m x 4.2m x 0.3m high. Carries track/cartway (257) connecting Upper Bonsor Mill with the BLM stamps.	**High** – good evidential value relating to transport systems at mill.	Leat (206)	High	Not shown on 1850 OS; shown on 1892 OS	
210 Group	**Launder pier** - masonry launder with central leat channel linking leat (206) with wheel pit (340). 28.4 long x 1.50m wide.	**High** - considerable historical and evidential value as provides information on use of water supply to power dressing floor machinery.	Leat (206) Walls (211-213) Launder pier (220) Wheel pit (341-43)	High	Not shown on 1850 OS; shown on 1890 OS	
211	**Retaining wall** - random rubble retaining wall on N side of launder pier (210). 23.3m long x 1.4m high.	**High** - as above	Launder pier (210)	High	Not shown on 1850 OS; shown on 1890 OS	

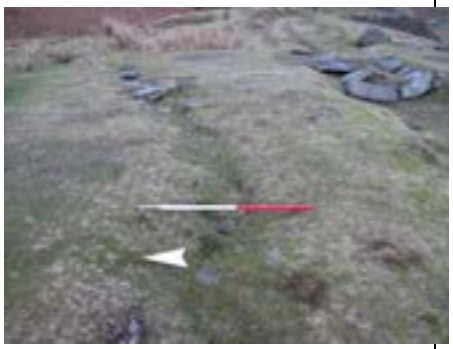
Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
212	**Retaining wall** - random rubble wall at E (end) section of launder pier (210).4.7m wide x 1.5m high. Battered face, slightly convex in plan. Stonework has fallen away from bank behind to reveal leat channel in section.	**High** - as above	Launder pier (210)	High	Not shown on 1850 OS; shown on 1890 OS	
213	**Wall** - random rubble wall on S side of launder pier (210). 22.8mlong x 1.3 high.	**High** - as above	Launder pier (210)	High	Not shown on 1850 OS; shown on 1890 OS	
220 Group	**Launder pier** - masonry launder connecting with leat (206). Central leat channel 4.2m wide x 0.3m deep	**High** - considerable historical and evidential value as provides information on use of water supply to power dressing floor machinery.	Leat (206) Launder pier (210) Walls (221-223)	High	Not shown on 1850 OS; Shown on Historic Photo 1 (pre-1877).	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
221	**Wall** - random rubble wall on E side of launder pier (220). 11.4m x 1.4m.	**High** - as above	Launder pier (220) – element of.	High	As above	
222	**Wall** - random rubble wall on S (end) side of launder pier (220). 4.8m wide x 1.9mhigh. Battered profile with a slight curve. In poor condition, E and W corners collapsed.	**High** - as above	Launder pier (220) – element of.	High	As above	
223	**Wall** - random rubble wall on W side of launder pier (220). 16.6m long x 2m high at S end	**High** - as above	Launder pier (220) – element of.	High	As above	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
230 Group	A group of structures relating to the main track and a tramway which passes beneath it. Arch and tunnel which enable the tramway from the upper mill to pass underneath the main trackway and retaining walls beyond the tunnel showing the initial route of the tramway.	**High** - demonstrates the relationship between the upper mill and the lower mill and the movement of material down the site.	Arch (231) Tunnel (232) Retaining wall (233) Retaining wall (234) Wall (207)	High High High Medium Medium	The tramway (251) associated with these features appears on the 1850 OS map The main track as it is today appears on the 1888 OS map	
231	**Arch** - made up of random sized pieces of slate, which range in height from 0.45 to 0.8m. The arch is approx. 1.7m wide and 1.2m high. Key stones were observed. This arch has been exposed within an area where the land has collapsed. It therefore does not represent the front face of this arch. This can be seen from observing how the stones are not evenly aligned to create a smooth face. They are instead stepped in such a way that would allow further stones to be keyed in when the arch / tunnel (232)	**High** - as above	Tunnel (232) Retaining wall (233) Retaining wall (234) Wall (207)	High High Medium Medium	c. 1850-1888	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	was being built over a wooden forma. Possibly 1-2m may have been lost. A clean layer of clay can be seen above the arch. This clay may have been used to form the bank associated with leat (206). The base of wall (207) can also be seen in the exposed section.					
232	**Tunnel** - the stone arch (231) forms part of a stone lined tunnel. This tunnel, like (203) also runs underneath the main trackway. It is approx. 10.5m in length and at this southern end the opening is approx. 1.2m wide and 1m high. The tunnel is nearly completely blocked at this end due to the land collapsing around it. This tunnel allows the continuation of a tramway from the upper mill to the lower mill.	**High** - as above	Arch (231) Retaining wall (233) Retaining wall (234) Wall (207)	High High Medium Medium	c. 1850-1888	

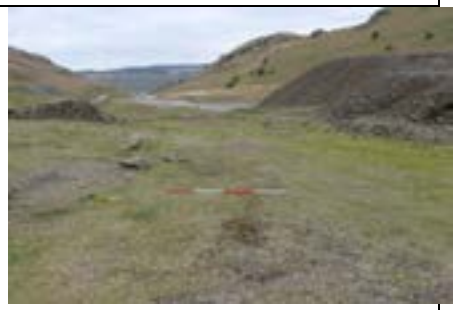
Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
233	**Wall** - random coursed rubble wall approx. 4.5m in length and 1m high at its highest point. This forms the western retaining wall for the tramway. The top of the wall is now very overgrown.	**High** - as above	Arch (231) Tunnel (232) Retaining wall (234) Wall (207)	High High Medium Medium	c. 1850-1888	
234	**Wall** - the eastern retaining wall for the tramway is represented by two stones.	**Medium** - as above	Arch (231) Tunnel (232) Retaining wall (233) Wall (207)	High High High Medium	c. 1850-1888	
240	**Pond** -oval pond or tank constructed into the slope on the W side of the road. 7m x 14.5m. Enclosed by curving bank (241) to N and stone revetment to S. Interior covered with mineralised rock, water-rolled stone and concrete. Leats (242 + 243) enter the pond at the W end.	**High** – good evidential value as its function and date have yet to be established. Potential for further research, thus adding to interpretation and knowledge of site.	Wall (241) Leat (242) Leat (243)	High	Shown on 1890 OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
241	**Bank** - gently curving earth bank, stone faced on both sides, forming N side of pond (241). 15.5m long x 1.3m wide.		Pond (241)	High	As above	
242	**Leat** - Narrow curving leat that can be traced from the road by the YHA to the W side of pond (241); 0.4m wide. Central section covered by collapsed slate slabs, probably one in of track leading to bridge (208) on leat (206). Further E the leat is a stone capped culvert. The W end is now lost. A shallow channel (244), possibly a leat, runs S to leat (206).		Leat (206) Channel (244) Pond (240)		Unknown but post-dates leat (206).	
243	**Channel** - a short linear hollow, probably a leat, 3m long x 0.2m deep, running down slope and joining leat (242).				Unknown but post-dates leat (206).	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
244	**Channel** - a curving hollow, possibly a leat, running S from leat (242). Appears to cut N bank of leat (206) and continues down slope to SE.				Unknown but post-dates leat (206).	
250	**Track** - Grass-covered track running upslope from the road to the level area retained by walls (321 and 323). Partially cut into slope on S side and SE side supported by wall (320).				1890 2nd ed. OS	
251	**Tramway** - Embanked terrace with partial stone revetment on steep SE face, marking line of tramway to BLM Stamping Mill 1; 14m long x 1.3m wide. Runs to SW end of wall (331). Truncated and destroyed to SW by modern water pipeline.	**High** – god evidential value for tramway and transport system and direct association with ore supply to east stamp mill.	Wall (331) Buttress (252)		Shown on 1890 OS	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
252	**Buttress** - random coursed rubble buttress. The front face contains stones with numerous drill holes in them demonstrating the re-use of this material. The buttress is built into a terrace. The front face is approx. 2.1m wide by 1.4m high at its highest point. The buttress helped to support the tramway (251) above.	**High** - helps to demonstrate the re-modelling of the terrace to support the re-direction of tramway (251) to serve the stamping mills.	Tramway (251)	High	1850's OS map	
253	**Channel** - linear gully running N-SE between culvert (254) and walls (401) and (405); width increases to S. Gully appears to have been disturbed, possibly by flood action, but traces of side revetment indicate that this is a constructed feature. It may be water course associated with a putative water wheel in building (410).	**High** – good evidential value as its function and date have yet to be established. Potential for further research, thus adding to interpretation and knowledge of site.	Culvert (254) Wall 401) Wall (405) Building (410), possibly	High	Unknown	
254	**Culvert** - an exposed section of stone culvert missing its capping stones, 4.4m x 1m wide. The culvert has been destroyed to the NE by the modern water pipeline and continues for at least 16.7m to the SW (possibly to	**High** - good evidential value as its function and date have yet to be established. Potential for further research, thus adding to interpretation and knowledge of site. It is	Culvert outfall (256) Gully (253)	High	Unknown	

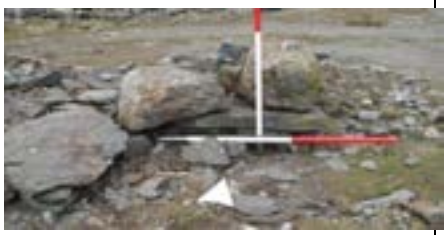
Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	(256)) as an undisturbed underground culvert. Investigations by CATMHS with an underground camera suggest that the underground section is joined by another culvert on the N side after a length of approx. 10m.	likely that this is an early feature, perhaps associated with the water systems shown on the 1850 OS map.				
255	**Tramway** - linear feature, probable tramway, defined by gravel spread demarcated by stone side stones and spoil. Cut to NE by a flood gully and eroded on spoil dump to SE	**High** – god evidential value for tramway and transport system and the formation of the later spoil dumps.			Shown on 1890 OS	
256	**Culver**t - slab roofed outfall for stone side culvert, 1.2m wide (possibly) x 0.3m high. The culvert, which may be part of culvert (254), is exposed in an erosion hollow 1.6m below the top of the bank. It has been destroyed to the S but may have been associated with	**High** - good evidential value as its function and date have yet to be established. Potential for further research, thus adding to interpretation and knowledge of site. It is likely that this is an early	Culvert (254), possibly; Structure (430), possibly	High	Unknown	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	structure (430).	feature, perhaps associated with the water systems shown on the 1850 OS map.				
257	**Track** - faint outline of road or cart track running SE down slope from leat bridge (208). Terraced into slope on E side and built up to W. 25m long x 1.5 wide. Destroyed to SE by modern water pipeline.	**High** – good evidential value for transport system between upper mil and BLM.	Bridge(208)	High	Shown on 1850 OS (so predates leat (206)	
258	**Catch pit?** - oval, pit-like feature with curving stone face to N and straight face to S; 2m x 2.5m. Partially in-filled drain at SW. Interior filled with small angular stones and considerable amount of burnt limestone. Possibly a catch pit for Stamping Mill 3 but limestone suggests association with later copper smelter.	**High** – good potential evidential value for operation of the stamping mill and/or the copper smelter.		High	Possibly shown on 1890 OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
300 Group	**Smelt area** - this area contains a number of buildings (301) - (305) and associated structures(306) - (309) and walls (324) - (330), (333), slag material (310) and a pond (311). The western edge of the area is defined by the water wheel pit G(340).	**High** - demonstrates a very short lived (6 months), but apparently very productive period of the sites history.	Smelt building (301) - (305) Buttress (306) - (309) Aperture (327) Slag (310) Pond (311) Wall (324) Wall (325) Wall (328) Wall (329) Wall (330) Wall (333) Wheel pit G(340)	High Medium High High Medium High High High Low Low Low High	Smelt building built 1893 and destroyed Dec. 1894	
301	**Northern wall of smelt building** - coursed random rubble wall made up of layers of river cobbles and slate and occasional pieces of quartz. Evidence of mortar in places. Built into a bank of what appears to be waste material. Heavy mineral staining on the internal elevation. External elevation contains a stone with a drill hole in it and a brick. The north-east corner is well constructed with large quoins visible	**High** - as above	Aperture (302) Wall (303) Wall (304) Wall (305) Wall (324) Wall (325) Aperture (327) Wall (328)	Low High High High High High High High	Smelt building built 1893 and destroyed Dec. 1894	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	externally. Which demonstrates that the smelt building was built as a single-phase structure and did not necessarily incorporate any existing walls. Internal dimensions: Maximum height = 3.3m Maximum width = 3.7m External dimensions: Maximum height = 1.85m Maximum width = 4.15m					
302	**Aperture** - roughly square opening within wall (301), 0.58m wide by 0.54m high and 0.74m deep (the depth of the whole wall). It is approximately 1.4m above the ground, although the floor is covered in rubble. It has a substantial slate lintel but no sill. The base appears to slope down from outside to inside, although part of this slope may have been created by material falling in from outside. The aperture is blocked from the outside	**Low** - the exact function of this aperture is unclear.	Wall (301)	High	Smelt building built 1893 and destroyed Dec. 1894	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	due to the amount of material that has been deliberately built up behind the building.					
303	**East wall** - coursed random rubble wall made up of layers of river cobbles and slate and occasional pieces of quartz. Evidence of mortar in places. The north-east corner is well constructed with large quoins visible externally. Internal dimensions: Maximum height = 2.60m Maximum width = 3.10m External dimensions: Maximum height = 2.07m Maximum width = 4.20m Depth = 0.60m This wall is in line with wall (304), which may indicate the original length of the whole wall / building. The external length of the wall would be approximately 11.75m.	**High** - demonstrates a very short lived (6 months), but apparently very productive period of the sites history.	Wall (301) Aperture (302) Wall (304) Wall (305)	High Low High High	Smelt building built 1893 and destroyed Dec. 1894	 

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
304	**East wall** - a small section of coursed random rubble wall made up of layers of river cobbles and slate. Forming a corner south of walls (301) and (303). This wall is in line with wall (303). The large stone present probably represents a quoin, similar in size to those seen between walls (301) and (303). Maximum height is 0.42m and width is 2.47m. The area inside these walls is full of rubble.	**High** - as above	Wall (301) Wall (303) Wall (305)	High High High	Smelt building built 1893 and destroyed Dec. 1894	
305	**South wall** - a small section of coursed random rubble wall made up of layers of river cobbles and slate. Forming a corner south of walls (301) and (303). There is a large flat slate slab and a large river cobble at the corner probably representing quoins. Maximum height is 0.42m and width is 0.77m.	**High** - as above	Wall (301) Wall (303) Wall (304)	High High High	Smelt building built 1893 and destroyed Dec. 1894	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
306	**Smelter stack - West wall** - of a square stone base which can be seen on a photo dated to approx. 1895, and which appears to have some sort of chimney on top of it (smelter stack/flue). This part of the structure appears to be well constructed and made up of coursed random slate. It is 2.57m long and a maximum of 0.5m high.	**High** - as above	Wall (307) Wall (308) Wall (309)	High High High	Smelt building built 1893 and destroyed Dec. 1894	
307	**Smelter stack - South wall** - of a square stone base which can be seen on a photo dated to approx. 1895, and which appears to have some sort of chimney on top of it (smelter stack/flue). Very little of this side survives above ground, but it appears to be a mixture of slate and river cobbles. It is 2.60m in length and a maximum of 0.2m high.	**High** - as above	Wall (306) Wall (308) Wall (309)	High High High	Smelt building built 1893 and destroyed Dec. 1894	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	shape of the crucibles within which it cooled and solidified. The conical shaped blocks have flat tops and rounded bottoms. Average length is 0.67m and base diameter is 0.60m. The dump has been disturbed by later road construction.					
311	**Pond** - or flooded hollow, approximately 12.50m south-west to north-east by 7.10m north-west to south-east. The level of the pond goes up and down according to how much rain there has been. Possibly originally part of an outflow channel for wheel pit (340)	**Medium** - the exact function and purpose of this feature is uncertain and as such it may benefit from further research.	Smelt area G(300) Slag (310) Wall (312)	Medium Medium High	Unknown	
312	**Pond wall** - an earth covered wall which has stone revetting along its north-eastern edge. It survives for an approx. length of 6.45m running downhill from the pile of slag (310) and into the pond area (311). It survives to a maximum height of 0.50m. It is buried by the slag at its NW end and it is truncated at its SE	**High** - good evidential value as its function and date have yet to be established. Potential for further research, thus adding to interpretation and knowledge of site. It may in understanding of water supplies on site.	Slag (310) Pond (311)	High High	Unknown	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	end. Possibly part of an outfall channel for wheel pit (340).					
320	**Curved wall** - part of a long coursed random rubble retaining wall (320) - (323) which forms the north eastern edge of track (253) which rises towards the south and forms a terrace above the smelt buildings and the waterwheel. The curved wall increases in height as the track rises and the road continues downhill below. The wall increases in height from 0.2m to 2.1m. This section of wall may have been built after the larger curved section further east (321), (322) and (323) and may have been built after or at the same time as the smelter.	**Medium** - helps to define and demonstrates the development of track (253).	Track (253) Wall (321) Wall (322) Wall (323)	High High High High	c. 1880s - 1890s	
321	**Curved wall** - part of a long coursed random rubble retaining wall (320) - (323). Consisting of layers of flat waste material, slate and river cobbles. It is associated with track (253). At this point it has curved round to retain the northern and eastern edge of a terraced area above the smelt buildings and the	**High** - shows how parts of the site were adapted and changed.	Track (253) Wall (321) Wall (322) Wall (323)	High High High High	c. 1880s	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	waterwheel. The curved wall increases in height as the track rises and the road continues downhill below. The wall increases in height from 2.1m to 3.3m at its maximum height. This part of the wall was present before the smelter was built and can be clearly seen in the photos by Henry Herbert.					
322	**Curved wall** - part of a long coursed random rubble retaining wall (320) - (323). Consisting of layers of flat waste material, slate and river cobbles. This end of the wall appears to have been built into a bank of waste tip material and curves round at 90 degrees to (321) forming part of the front of the terrace. The corner of the wall at its western end contains large flat pieces of slate forming quoins. At this point the wall decreases in height from 1m to 0.7m. This part of the wall was present before the smelter was built and can be seen in the photos by Henry Herbert.	**High** - as above	Track (253) Smelt area (300) North wall of smelt building (301) Wall (321) Wall (322) Wall (323) Angled wall (329) Wall (324) Wall (325) Recess (326)	High High High High High High Medium Medium Medium medium	c. 1880s	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
323	**End of curved wall** - part of a long coursed random rubble retaining wall (320) - (323). This end of the wall appears to have been built into a bank of waste tip material and curves round at 90 degrees to (322) forming the end of this long wall. At this point the wall decreases in height from 0.7m to 0.2m. This end of the wall is made up entirely of slate. As it is keyed into (322) it is likely that this part of the wall was also present before the smelter.	**High** - as above	Track (253) Smelt area (300) North wall of smelt building (301) Wall (321) Wall (322) Wall (323) Angled wall(329) Wall (324) Wall (325) Recess (326)		c. 1880s	
324	**Wall** - forming the eastern side of a recess believed to of housed one of the smelter stacks. Built into a terrace of waste material. Consisting of coursed random rubble predominantly made up of slate. Survives to an approx. height of 1.25m and length of 2m.	**High** - demonstrates a very short lived (6 months), but apparently very productive period of the sites history.	Wall (322) Wall (323) Wall (325) Recess (326) Angled wall (329) Angled wall (330)	Medium Medium High High Medium Medium	Smelt building built 1893 and destroyed Dec. 1894	
325	**Wall** - forming the western side of a recess believed to of housed one of the smelter stacks. Built into a bank / terrace of waste material. The wall	**High** - as above	Wall (324) Recess (326) Wall (328) Angled wall (330)	High High Medium Medium	Smelt building built 1893 and destroyed Dec. 1894	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	consists of coursed random rubble made up of alternate layers of slate and river cobbles. It survives to an approx. height of 1m and an approx. length of 2m. Wall (328) butts up against the outside of wall (325).					
326	**Recess** - created by two walls (324) and (325). The recess is approx. 1m wide and approx. 1.6m deep. It has been built into a bank / terrace of waste material and therefore at present has a sloping base.	**High** - as above	Wall (324) Wall (325)	High High	Smelt building built 1893 and destroyed Dec. 1894	
328	**Wall** - retaining wall built into a bank / terrace of waste material. Coursed random rubble wall with layers appearing to tip downwards from west to east. The wall runs east to west and butts up against wall (325). The wall is approx. 3.5m long and 1.25m high. This may form part of the front wall for a timber framed building present on the 1912 OS map.	**High** - contributes to our ability to phase development on the site.	Wall (325)	High	c. 1890s - 1912	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
329	**Angled wall** - between curved wall (322) and the back of the smelt building (301). Consists of coursed layers of slate built into a bank / terrace of waste material. It is approx. 0.54m high and 2.1m long. At one point it may have butted up against the curved wall (322). Its construction is different to (330). Its exact function is unclear, but it may have been a support of some kind for machinery related to the furnace.	**Medium** - may contribute to our understanding of the layout of the smelt building and its machinery.	Wall (301) Curved wall (322) Wall (324)	High Medium High	Smelt building built 1893 and destroyed Dec. 1894	
330	**Angled wall** - between retaining wall (328) and sloping wall (333). Coursed random rubble wall consisting of slate and river cobbles built into a bank / terrace of waste material. It is approx. 0.8m high and 2.2m long. It is in a very poor condition, but it may have once butted up against retaining wall (328). Its construction is different to (329). Its exact function is unclear, but it may have been a support of some kind for machinery related to the furnace.	**Medium** - as above	Retaining wall (328) Sloping wall (333)	Medium Low	Smelt building built 1893 and destroyed Dec. 1894	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
331	**Long retaining wall** - consisting of coursed random rubble including large flat pieces of slate and large river cobbles. Approx. 10.56m in length survives as a visible retaining wall. It may continue behind collapsed material for approx. another 5.47m to the east. It defines part of the edge of tramway (251) and tramway (255). It is approx. 2m at its highest point.	**High** - shows how the site has been adapted and developed to accommodate the movement of material down it.	Tramway (251) Tramway (255)	High High	c. 1890	
332	**Buttress** - remains of a buttress, surviving only at ground level. It appears to have butted up against the long retaining wall (331). It is approximately 1m long by 0.6m wide. It appears to be of a random rubble construction with some pieces of slate and river cobbles visible. A piece of poorly preserved timber defines its southern extent.	**Low** - date and purpose unknown	Retaining wall (331) Wheel pit (340)	High Medium	Unknown	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
333	**Sloping wall with timber** - possibly a retaining wall, but its exact function is not clear. It is on a similar alignment to the north gable wall of the smelt building (301). It occurs half way down the bank / terrace of waste material. It is approx. 2.25m wide and 0.77m at its highest point. It slopes backwards into the bank. There is a piece of timber set back slightly from the wall, but on the same alignment. It is a coursed random rubble wall.	**Medium** - exact function unknown but may contribute to our understanding of the layout of the smelt building and its machinery.	North wall smelt building (301)	Medium	Unknown	
334	**Wall of three stones** - the possible remains of a wall which is one course high and consists of 3 stones. It is on the edge of the mill area, close to the main track through the valley. It is approx. 2.8m in length.	**Moderate/low** – value reduced because of lack of association with other features.	None	Low	Unknown	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
335	**Trackway culvert** - the top stones of an arch probably for a culvert. Exposed on the surface of the road. Was observed running beneath the main track towards the river where its exit from beneath the track and into the river can be observed within the river bank. Probing through a void between some of the stones suggests a depth of 1.1m.	**High** - good evidential value as its function and date have yet to be established. Potential for further research, thus adding to interpretation and knowledge of site. It may aid understanding of water supplies on site	Culvert (336), possibly.	High	Unknown	
336	**Culvert** - linear hollow between road and beck, blocked culvert outfall . Some side stones survive in bank. Possibly the outfall for culvert (335).	**High** - good evidential value as its function and date have yet to be established. Potential for further research, thus adding to interpretation and knowledge of site. It may aid understanding of water supplies on site	Culvert (335), possibly	High	Unknown	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
340 Group	**Wheel-pit or wheel-housing**. Raised rectangular structure consisting of coursed random rubble stone walls on at least 3 sides. Early images from c.1877 suggest that it may not have had a masonry front wall. The wheel was used to initially power the stamps in the wooden sheds either side of it. Later it was used to provide power for the smelt building (300). The internal dimensions of the pit are approx. 6.3m long by 3m wide. The pit itself now has a sloping base due to it being in filled with rubble and waste material from the terrace behind. The ground is also sloping outside the pit for the same reason.	**High** - well preserved and only surviving on-site example of a waterwheel pit. Value increased by its structural, group and visual association with associated features which allow interpretation of full process of water-powered ore processing.	Smelt group (300) West wall (341) North wall (342) East wall (343) Bolts (344)	High High High High High	1877 photo 1890s photo	 
341	**West wall of wheel-pit** - coursed random rubble wall consisting of slate blocks and river cobbles. Approx. 4.5m long and 1.9m high at its highest point. The wall is approx. 1m thick. The wall contains one bolt (344) which would have originally been centrally located. Well-constructed, but in a poor state as	**High** - reasonable well preserved and is the only one surviving within the lower mill. Value increased by its association with surrounding associated features.	Wheel pit (340) North wall (342) East wall (343) Bolts (344)	High High High High	c. 1877-1888	

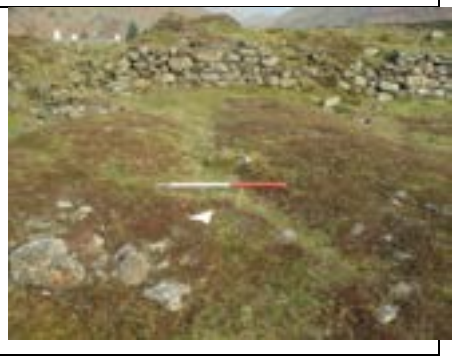
Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	the southern end of the wall has collapsed. The pit has been filled with a large amount of rubble. which makes it difficult to measure the full height of any of the walls. The wheel-pit can be seen on the earliest photos of the site.					
342	**North back wall of wheel-pit** - coursed random rubble wall consisting of slate blocks and river cobbles. Approx. 2.9m long and 0.73m high at its highest point. The pit has been filled with a large amount of rubble. which makes it difficult to measure the full height of any of the walls.	**High** - as above	Wheel pit (340) West wall (341) East wall (343) Bolts (344)	High High High High	c. 1877-1888	
343	**East wall of wheel-pit** - coursed random rubble wall consisting of slate blocks and river cobbles. Approx. 6.5m long by 2.1m high at its highest point. The wall is approx. 1m thick. The wall contains one bolt (344) which would have originally been centrally located. Both the interior and the exterior of this wall have gunk which has run down	**High** - as above	Wheel pit (340) West wall (341) North wall (342) Bolts (344)	High High High High	c. 1877-1888	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	them and solidified. It is thought that this may relate to the greasing of the axle of the water-wheel. There is a cap stone that survives above the gunk on this wall. The cap stone contains three square indentations which could relate either to the support for the water-wheel axle or some other sort of structure running off it. Well-constructed, but in a poor state as the southern end of the wall has collapsed. The pit has been filled with a large amount of rubble. which makes it difficult to measure the full height of any of the walls. The wheel-pit can be seen on the earliest photos of the site.					 

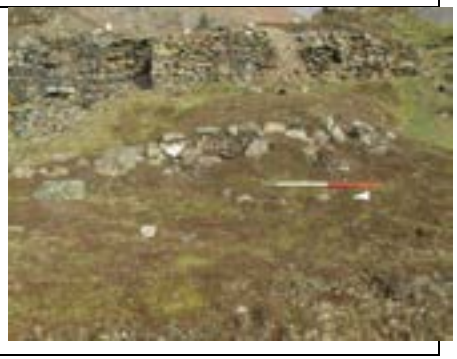
Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
344	**Bolts** - iron bolts on wall head of wheel pit (340). One bolt survives through wall (341) and one survives through wall (342). Originally held horizontal timber members supporting the waterwheel axle. Bolts are 50mm (2in) in diameter with screw thread and nut at top and square iron plate at base below.	**High** - as above	Wheel pit (340) West wall (341) North wall (342) East wall (343)	High High High High	c. 1877-1888	
345	**Retaining wall** - or buttress located to the south of the wheel-pit (340). Coursed random rubble wall consisting of slate and large river cobbles / boulders. It is approx. 2.4m by 2.3m wide and 0.6m high. It is in a very poor state of repair. It can be seen on photos from the 1890s with a ladder lent up against it from the terrace below. It would appear that to the north of this buttress are the possible remains of a tailrace from the wheel-pit which diverted the water to the west.	**Medium** - due to its association with other features.	Wheel pit (340) Wall (400)	High Medium	1880s	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
400	**Wall** - corner of retaining wall, destroyed to NW and SW. Boulder construction. Length NE-SW: 2m; length NW-SE: 2.3m; height 0.55m. Probably a continuation of retaining wall (401).	**Moderate/low** – lacks context and poor relationship with other features.	Wall (401)?	Low	Shown on 1890 OS map	
401	**Wall** - terrace retaining wall and back wall for structure (410). Random rubble construction, including boulders; no evidence for use of mine rock. Incorporates drains (402) and (403). 12.9m ling x 1.5 high.	**High** – good evidential value as surviving example of typical terraced dressing floor retaining wall.	Wall (400)? Drains (402, 403 Building (410)	High	Shown on 1890 OS map	
402	**Drain** - truncated outflow to drain or small culvert in wall (401). Stone slab roof on coursed stone sides. 0.5 wide x 0.2m high. Probably carried material between the now-lost west stamp mill and the jigging area.	**High** – good evidential value for movement of material from stamps to jigs.	Wall (401) Building (410)	High	Shown on 1890 OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
403	**Drain** - probable drain or culvert exposed in collapse behind wall (401). Slabbed roof survives and part of NE side wall. NE side forms vertical joint with outer face o (401). Probably carried material between the now-lost west stamp mill and the jigging area.	Probably carried material between the now-lost west stamp mill and the jigging area.	Wall (401) Building (410)	High	Shown on 1890 OS map	
404	**Timber structure** - damaged timber structure exposed at SE end of gully (253) and spanning gap or break between walls (401) and (405). Two planks , 0.95m and 0.65m respectively, set on vertical timbers to S; planks 0.3m wide and uprights approx. O.12m x 0.08m in section. Possible water management feature (remains of sluice gate?)	**High** – good evidential value for water control, possibly linked to putative water wheel at SW end of building (410)	Wall (401) Wall (405) Building (410) Gully/leat (253)	High	Shown on 1890 OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
405	**Wall** - low retaining wall, random rubble construction using mined rock. 7.2m long x 1.55m high. Corner at SW and short return parallel with steps (429). Damaged to NE.	**High** - good evidential value as surviving example of typical terraced dressing floor retaining wall. Value enhanced by use of mined rock as building material, something that might indicate phased construction.	Steps (429)	High	On 1888 OS map	
410 Group	**Building platform** - rectangular terrace defined to NW by walls (400) and (401) and to SW by wall (416) – damaged to W by flood gully. Series of linear gullies (411-414) within the building's interior. Interpreted as structure for jigs.	**High** – good evidential value as principal surviving example of jig house and therefore fundamental to understanding ore dressing process on site. Good potential for buried archaeology.	Wall (401) Wall (400) Wall (416) Gullies (411 – 414) Drain (418) Culverts 402 and 403)	High	On 1890 OS map	
411	**Jigg drain?** - linear hollow within building 410. 5.8m long; 0.4m wide at SE end and 0.9m wide at NW end. U-shaped profile, 0.25m deep. Parallel to gullies (412-414).	**High** - good evidential value for understanding of dressing process, especially jigging.	Building (410) Gullies (412-414)	High	1890 or earlier	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
412	**Jigg drain?** - linear hollow within building 410. 6.4 m long; 0.9mwide at SE and 1.50m wide at NW; 0.2m deep. Possible connecting drain with (413) at NW end. Parallel to gullies (411 and 413-414).	**High** - as above	Building (410) Gullies (411 and 413-414)	High	1890 or earlier	
413	**Jigg drain?** - linear hollow within building 410. 6.8m long; 0.4m wide at SE end and 0.8m wide at NW end. Irregular profile, 0.1m deep. At SW end connects with drain (415). Parallel to gullies (411-412) and (414).	**High** - as above	Building (410) Gullies (411-412) and (414) Drain (415)	High	1890 or earlier	
414	**Jigg drain?** - shallow linear hollow within building (410), badly eroded and probably disturbed to E by modern water pipeline. . 4.9m long; 0.8m wide and max. depth of 0.1m. Parallel to gullies (411-413).	**High** - as above	Building (410) Gullies (411-413)	High	1890 or earlier	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
415	**Culvert** - entrance to drain or culvert at SE end of jigg drain (413). Appears to run to SE and outfall might be drain (418)	**High** - as above	Building (410) Gully (413) Drain (418)	High	1890 or earlier	
416	**Wall** - low wall, boulder construction, one course high. 3.2m long x 0.3m high. Truncated to SW by flood gully. Probably part of building (410) and may be a continuation of wall (417).	**High** - as above	Building (410) Wall (417), possibly	High	Shown on 1890 map	
417	**Wall** - low wall, random rubble construction, retaining bank to N. 4.6m long x 0.9m wide x 0.3m high. Truncated to E by flood gully. Same alignment as wall (416) but different construction techniques.	**High** – good evidential value for structure associated with dressing process. Function of structure unknown so potential for future research.	Wall (416), possibly	High	?	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
418	**Drain** - probable outfall to stone-slabbed culvert or drain. Possibly outfall for drain (415)	**High** - good evidential value for understanding of dressing process, especially jigging. Aids understanding of movement of jigged material to other areas for further processing.	Drain (415)?			
420 Group	**Office** - a purpose built single phase coursed random rubble structure. Roughly square in floor plan with a fireplace (423) in the north-west corner and evidence for a door (426) and a window (427). Evidence from photos c.1877 and c.1890s, suggest that it had a steeply sloping roof. Apart from the roof it appears to have been an entirely stone built structure, unlike many of the other buildings on the site which appear to have had low stone walls topped with timber structures.	**High** - This structure appears to be one of the earliest surviving buildings on the site. It was probably initially built as an office and continued as such as the layout of the mill changed around it. It is the only building within the lower mill to contain a fireplace.	Wall (421) Wall (422) Fireplace (423) Wall (424) Wall (425) Door (426) Window (427)	High High High High High High High	c. 1877	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
421	**East wall** - coursed random rubble wall consisting of alternate layers of slate and river cobbles. There is a large crack towards its southern end. Internal dimensions: Maximum height = 2m Maximum width = 3.8m External dimensions: Maximum height = 0.85m Maximum width = 4.6m The office is built into a slope which is why the external height is smaller than the internal height. The slope to the east of this wall has been utilised to create a flight of steps (429).	**High** - as above	Wall (422) Fireplace (423) Wall (424) Wall (425) Door (426) Window (427) Steps (429)	High High High High High High High	c. 1877	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
422	**North / back wall** - coursed random rubble wall consisting of alternate layers of slate and river cobbles. Internal dimensions: Maximum height = 2.6m Maximum width = 2.6m (to edge of fireplace) External dimensions: Maximum height = 0.0m Maximum width = 7.2m The office is built into a slope which is why the external height for the back wall in this case is 0m. This also explains why part of the front face of the wall has fallen away, but the back face of the wall has remained in situ as it is embedded in the slope. Likewise, the external length of the wall is much longer than the internal length. This is because it has been used as a retaining wall which continues beyond the west end of the office, it is	**High** - as above	Wall (421) Fireplace (423) Wall (424) Wall (425) Door (426) Window (427) Side wall (428)	High High High High High High High	c. 1877	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	also keyed into the additional side wall (428).					
423	**Fireplace** - the fireplace has been built into the north-west corner of the office, at an angle. It contains a large slate lintel above the fireplace opening. The rest of the chimney stack is constructed from the same material as the rest of the office walls and is made up of coursed random rubble consisting of layers of slate and river cobbles. The top of the chimney has been lost but it can be seen on several of the photos. Maximum height = 2.8m Maximum width = 1m	**High** - as above	Wall (421) Wall (422) Wall (424) Wall (425) Door (426) Window (427) Side wall (428)	High High High High High High High	c. 1877	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
424	**West wall** - coursed random rubble wall consisting of alternate layers of slate and river cobbles. It contains several large cracks. There are no external measurements as the wall has been buttressed by a second external side wall (428). The two walls appear to have been keyed in together at their northern end forming a double thickness wall. At their southern end they appear to have been split, with (424) turning 90 degrees to become wall (425) and wall (428) continuing straight on for another 1m. Internal dimensions: Maximum height = 2.8m Maximum width = 2.7m	**High** - as above	Wall (421) Wall (422) Fireplace (423) Wall (425) Door (426) Window (427) Side wall (428)	High High High High High High High	c. 1877	
425	**South / front wall** - coursed random rubble wall consisting of alternate layers of slate and river cobbles. The front wall does not survive to any great height possibly due to the presence of a doorway and a window at either end, resulting in the wall only having been	**High** - as above	Wall (421) Wall (422) Fireplace (423) Wall (424) Door (426) Window (427)	High High High High High High	c. 1877	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	keyed in to the side walls at its upper levels which have now been lost. Internal dimensions: Maximum height = 0.5m Maximum width = 14.5m External dimensions: Hidden by rubble					
426	**Door** - the door was located at the eastern end of the front wall and this can be determined by the finished nature of both wall (425) and (421). It is approx. 1m wide. It is not possible to estimate its height from what survives of the building. The door can clearly be seen on a photo from c.1894 and its location could be suggested before that from the 1888 OS map.	**High** - as above	Wall (421) Wall (422) Fireplace (423) Wall (424) Wall (425) Window (427)	High High High High High High	c. 1877	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
427	**Window** - it is suggested that there was a window at the western end of the front wall. This is surmised from the relationship between the end of wall (424) and front wall (425). The bases of both walls are keyed in together and then higher up there is what could be described as a straight joint, which would have formed the west hand side of the window opening. It is not possible to suggest any measurements for the size of the window due to its poor state of survival and unfortunately the photos are not clear enough.	**High** - as above	Wall (421) Wall (422) Fireplace (423) Wall (424) Wall (425) Door (426)	High High High High High High	c. 1877	
428	**Side wall** - coursed random rubble wall consisting of slate and river cobbles. The stones are considerably larger at the southern end of the wall. Approx. 2.5m long by 1m at its highest point. This wall can be seen protruding beyond the office in a photo from c.1894. It does not appear to relate to any other structure within the immediate vicinity, so it suggested that	**High** - demonstrates how the site was adapted over time.	Office (420) Fireplace (423) Wall (424) Structure (430)	High High High High	c. 1894	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	it may have been built to act as some kind of buttress to help prevent too much ground from being washed away and undermining the office wall as there is an outflow channel which can be seen on the 1888 OS map taking waste water down to the beck. On one of the photos from c.1894 the equivalent of a waterfall of water can be seen cascading down from the upper terrace to the lower terrace that the office is sat on. The west wall of the office (424) and side wall (428) have been keyed in together at their northern end forming a double thickness wall. At the south end they appear to have been split, with (424) turning 90 degrees to become wall (425) and wall (428) continuing straight on for another 1m.					

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
429	**Steps** - there is a narrow gap between the end of retaining wall (405) and the eastern wall of the office (421). This gap is occupied by a flight of steps made out of slate slabs. They are clearly marked on the 1888 OS map. The relationship between the retaining wall (405), the office (420) and the steps would suggest that they were probably all built around the same time.	**High** - this is the only flight of steps evident across the whole site and therefore suggests the relatively high status/importance of the office building/the people that worked in it as they were not expected to climb up and down a ladder as can be seen elsewhere on the site from photos.	Wall (405) Office (420) Wall (421)	High High High	c. 1877-1888	
430 **Group**	**Structure** - **launder and tramroad pier** - coursed random rubble walls consisting of large pieces of slate and large river cobbles. The size of the stones suggests that this needed to be structurally very strong. Approx. 2.6m high by 5.8m wide by 3m deep. It is built into a slope and the tip is encroaching on its western side. There is a photo from the 1860s - 1870s which suggests that this may	**High** - possible evidence for the management of waste/excess water.	Wall (431) Wall (432) Wall (433) Culvert (434)	High High High High	1850s OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	have been a lauder pier. There is an outflow channel which can be seen on the 1888 OS map taking waste water down to the beck which starts at the approximate location of (430). One of the early 1890s photos shows it completely covered by the spoil tip. However, by c.1894 it is visible again and the equivalent of a waterfall can be seen cascading down over it from the upper terrace to the lower terrace.					
431	**South wall** - coursed random rubble wall consisting of large pieces of slate and large river cobbles. The size of the stones suggests that this needed to be structurally very strong. Approx. 2.6m high by 5.8m wide. At its base towards its western end there is a possible culvert (434).	**High** - as above	Wall (432) Wall (433) Culvert (434)	High High High	1850s OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
432	**West wall** - coursed random rubble wall consisting of large pieces of slate and large river cobbles. The size of the stones suggests that this needed to be structurally very strong. The wall has been built into a sloping bank. Approx. 1.5m at its highest point by 3m wide.	**High** - as above	Wall (431) Wall (433) Culvert (434)	High High High	1850s OS map	
433	**East wall** - coursed random rubble wall consisting of large pieces of slate and large river cobbles. The size of the stones suggests that this needed to be structurally very strong. The wall has been built into a sloping bank. Approx. 2.1m at its highest point by 3m wide.	**High** - as above	Wall (431) Wall (432) Culvert (434)	High High High	1850s OS map	
434	**Culvert** - there is evidence for a possible culvert at the base of wall (431) which suggests that there may have been occasions where water was	**High** - as above	Wall (431) Wall (432) Wall (433)	High High High	1850s OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	filtered down through the structure, rather than allowed to flow straight over the top of it.					
440	**Round buddle?** - oval hollow constructed into slope SE of building (410). 6.2m diameter; 1.2m deep to NW and 0.2 deep to SE. Drain (440) ay S end of hollow connects to settling pond (442). with Area to NE disturbed by modern pipeline so association between (424) and other features cannot be established.	**High** – good historical and evidential value as one of only three surviving round buddles on the site and the only one that can be identified on historical photographs.	Drain (442)	High	On 1890 map	
441	**Drain** - culverted drain with stone sides and stone-slab cap connecting buddle (440) with pond (442). Good condition, with slight disturbance at S end.	**High** – good evidential value for movement of materials in different stages of the ore dressing process.	Buddle (440) Pond (442)	High		

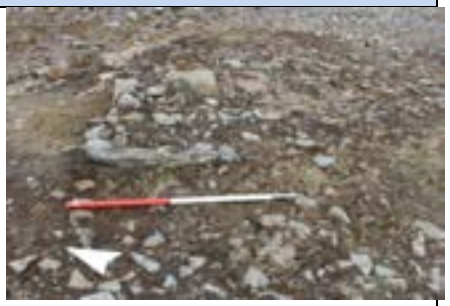
Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
442	**Settling pond** - rectangular pond or tank with internal stone revetment at W end. Drain (440) enters at centre north side and drain (443) cuts through terrace bank at SW corner. Two upright timbers set in bank at SE corner, possibly evidence for wooden superstructure or launder. ,	**High** – good evidential value relating to a specific part of the dressing process (settling). Survival of associated settling ponds adds to group value. Good historical value as feature can be identified on historical photograph.	Drain (441) Drain (443)	High	On 1890 OS map	 
443	**Drain** - large open drain cut through terrace bank at SW corner of pond (442) and leading to buddles (502) and (505). V-shaped profile, 5.8m long and 0.8m wide. Some stone revetment survives on W side. V-shaped profile could be result of erosion.,	**High** - good evidential value for understanding of dressing process. Aids understanding of movement of material between settling tanks and secondary buddles.	Settling pond (442) Buddles (502) and (505) Terrace bank (506)			
444	**Settling pond** - earthwork remains of pond or tank truncated to E by modern	**High** – good evidential value relating to a specific part of	Settling pond (442) Bank (506)	High	On 1890 OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	pipeline.5.6m x 33m x 0.3m deep. Some stone revetment against E and S sides. Shallow hollow on crest of W bank might be drain(?) connecting with pond (442)	the dressing process (settling). Survival of associated settling ponds adds to group value. Good historical value as feature can be identified on historical photograph				
445	**Settling pod** - rectangular pond or tank separated from ponds (442) and (445) by grassed earth banks. No bank to S but this may have been lost to erosion. Length of edge-set timber in SW corner could be evidence for launder. Dimensions: 5.5m 3.5m x 0.5m deep.	**High** – good evidential value relating to a specific part of the dressing process (settling). Survival of associated settling ponds adds to group value.	Bank (507) Ponds (442) and (446)	High	On 1890 OS map	
446	**Settling pond** - rectangular pond or tank separated by earth banks from ponds (445) and (447). Stone revetment on N side and suggestion of double revetment (rebuild?) on E bank. Opening at SW corner might be drain. Some flood damage to NW corner. General dimensions: 5.3m x 4.9m x 0.8m deep.	**High** - as above.	Terrace bank (508) Ponds (445) and (447)	High	On 1890 OS map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
447	**Settling pond** - rectangular pond or tank with stone revetments at NW corner. Badly damaged by erosion from flood gully. General dimensions: 5.9m x 5.1m x 0.8m deep.	**High** - as above.	Terrace bank (508) Terrace bank (509)	High	On 1890 OS map	
448	**Settling pond** - large rectangular pond or tank, most westerly in group. Evidence of central stone dividing wall, so may originally have been two conjoined tanks. Internal stone revetment. Possible drains at SW and NE corners and large rain at NW corner. General dimensions: 8.2m x 5.5m 0.4m deep.	**High** - as above.	Terrace bank (510) Drain (449)	High	On 1890 OS map	
449	**Drain** - broad curving drain, stone revetment on N side, connecting NW corner of settling pond (448) with probable water channel at W side of terrace bank (510). 5.7m long x 1.1m wide x 0.2m deep.	**High** - good evidential value for understanding of dressing process.	Terrace bank (510)	High	On 1890 OS map	

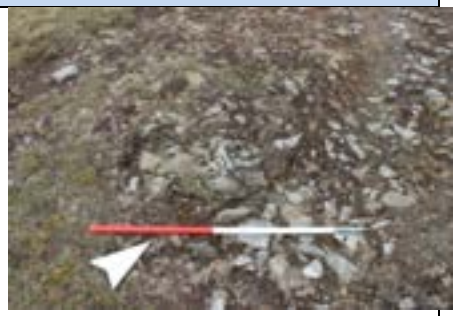
Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
450	**Wall** - slight foundations of stone wall. Damaged or destroyed to E and to W forms a corner with wall (451). Probably the SW section of a larger building. Central section accommodates or is cut by drain (452). 4.9m long x 0.3m wide. Possible catch-pit for Stamping Mill 1.	**High** – good evidential and historical value for early phase of dressing process and understanding chronological development of the mill.	Wall (451) Drain (452)	High	Unknown, but may relate to some of features shown on 1850 OS map.	
451	**Wall** - slight foundations of stone wall. Damaged or destroyed to N and to S forms a corner with wall (450). Probably the SW section of a larger building. Possible catch-pit for Stamping Mill 1	**High** - as above	Wall (450)	High	Unknown, but may relate to some of features shown on 1850 OS map.	
452	**Drain** - short length of drain running S from centre of wall 450 and possibly connecting with the base of drain (449). Fragment of timber upright at S end. Any continuation to S obscured by flood gully. Possible catch-pit for Stamping Mill 1.	**Moderate** – value reduced by lack of functional association with other features. This might be increased by archaeological investigation of surrounding area.	Wall (450) Drain (449)	Moderate	Unknown	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
501	**Building** - rectangular building, approx. 6m x 2.5m. Defined to SW and NE by foundations of 0.6m wide stone walls. To NE building space cut into shallow slope. The front or SE side of the building is undefined, but a series of stone blocks or slabs may be pad stones for timber supports. Out with the SE corner there is the stump of a free-standing timber post.	**High** – good evidential value for the type of building used on the lower part of the dressing floors. Good historical value as the building can be identified on historical photographs.		High	On 1890 OS map	
502	**Round buddle** - three vertical posts, largest 0.1m x 0.1m x 0.35 high delineate the circumference of a round buddle with a reconstructed diameter of 5.2m. The central timber post survives but the N section of the buddle is obscured by slumped material from bank (506). At the S edge of the buddle are two edge-set stones, probably an associated drain.	**High** – good evidential value as one of only three surviving round buddles on the site. Potential for below ground archaeology increases value of this feature.	Wall (503)	High	On 1890 OS map	
503	**Stone structure** - the foundations of a stone plinth, 1.1m x 0.7m immediately SW of buddle (502). Appears to define or retain a discrete area of orange sand (possible buddling waste). The plinth	**High** – good evidential value as only surviving above round feature associated with the structure/s enclosing the buddles. Potential for	Buddle (502)	High	Before 1890	

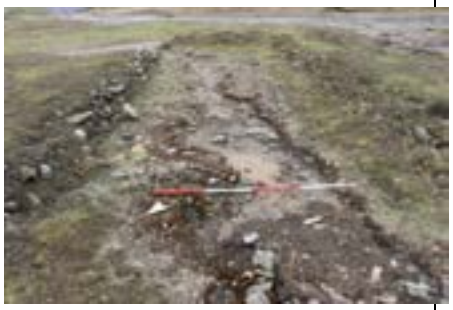
Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	may be a pad stone or support pillar for a building enclosing the buddling area.	below ground archaeology increases value of this feature.				
504	**Wall?** - three large boulders at the base of terrace bank (506) may be the remains of a terrace retaining wall. Combined length of 2.3 m x 0.6m wide. The boulders rest on a ground level course of stone.	**High** – good evidential value for presence of retaining wall/s on the lower terrace.	Bank (506)	High	Before 1890	
505	**Round buddle** - little remains of the buddle identified in the RCHME survey. It survives as an unvegetated area approx. 5m x 6m with some small displaced timber to the NE. To the SW is a concentration of fine sand, probably buddle waste.	**Moderate** - the poor condition of this feature reduces its evidential value. There is however potential for belowground archaeological survival and the feature as group value with the other buddles on site (440) and (502).		Moderate	Before 1890	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
506	**Terrace bank** - angled earth bank forming a terraced edge between the settling ponds (442 -448) and round buddles (502) and (504). The bank may have had a stone retaining wall, surviving as wall (504).	**Moderate** – loss of retaining wall reduces evidential and visual value.	Wall (504)	Moderate	Before 1890	
507	**Terrace bank** - very eroded, battered terrace bank with traces of stone revetment and possible drains/culverts. Forms division between settling ponds and lower buddles. 7m long x 1.9m high	**Moderate/low** - loss of retaining wall reduces evidential and visual value.		Moderate-low	Before 1890	
508	**Wall** - low retaining wall of slate block construction to W of bank (507). Possibly a terrace bank retaining wall.	**Moderate/low** - value reduced by feature's poor quality and un-associated nature.		Moderate-low	1890 or before	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
509	**Culvert** - edge-set stones at base of bank (507) may be outfall to drain or culvert associated with settling ponds above.	**Moderate/low** - poor preservation and un-associated nature reduces value.		Moderate-low	1890 or before	
510	**Terrace bank** - battered earth bank forming terrace edge to S and W of pond (448).	**High** – good evidential value because of is structural association with settling pond (448).	Pond (448)	High	On 1890 map	
511	**Stone structure** - footings for angled, dog-leg stone setting. Function unknown but may retained o enclosed buddling waste from buddle (505).	**Moderate/low** - evidential value reduced because of fragmentary and un-associated nature of feature		Moderate-low	?	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
512	**Barrel** - wooden-staved barrel set in ground SW of buddle (502). Diameter 0.93m; stave width 0.08m x 0.02m. Probably a kieve or dolly tub.	**High** – exceptional evidential value as only surviving example on site of a wooden barrel associated with ore dressing	Buddle (502),probably	High	1890 or before	
513	**Culvert** - two edge set stones (0.7m x 0.12m x 0.15m high and 0.7m x 0.16m x 0.15 high) set 0.4m apart. Exposed in flood gully, probably a truncated drain or culvert.	**Moderate/ low** - evidential value reduced because of fragmentary and un-associated nature of feature		Moderate-low	?	
514	**Stone setting** - three large stone slabs exposed in flood gully. Possibly part of a covered drain or culvert.	**Moderate/low -** evidential value reduced because of fragmentary and un-associated nature of feature.		Moderate - low	?	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
515	**Wall** - low retaining wall, eroded to W by water course. Appears to continue W under main spoil tip. May form a structural unit with wall (516). Possibly part of an early settling or slimes pond. 5.1m long x 0,3m high.	**High** – good evidential value for early (pre-1850s) dressing floor layout.	Tip (100) Wall (516)	High	1850 or earlier?	
516	**Wall** - length of low retaining (?) wall exposed in and partly eroded by water course. May form structural unit with wall (515). Might continue SSE under main tip.	**High** – good evidential value for early (pre-1850s) dressing floor layout.	Tip (100) Wall (515)	High	1850 or earlier	
517	**Settling pond** - rectangular settling or slimes pond, 9.7m x 4m. Stone revetment along internal sides. N end in-turned with 1.5m gap between return walls. Channel/drain connection with pond 519 at SE corner. At S end it is separated from pond (519) by a revetted bank with a 0.7m wide gap .	**High** – good evidential value relating to form and operation of final part of ore dressing process. Good group value because of associated ponds.	Ponds (518) and (519)	High	On 1890 map	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
518	**Settling pond** - settling pond. Rectangular settling or slimes pond, 17.4m x 3.4m, with earth banks (some stone revetment). Separated from pond (517) by flat-topped bank. Low, heather-covered spoil mound to SE may be piled waste from this and the other two ponds.	**High** - as above	Ponds(517) and (519)	High	On 1890 map	
519	**Settling pond** - rectangular settling or slimes pond, 17.4mx 3.4m, forming the lowest or most southerly of a group with ponds (517) and (518). Internal sides are stone revetted. Break in bank at SW corner may be a deliberate drain. The pond appears to have been excavated into a pre-existing spread of sand and dressing waste, perhaps part of the original dressing floor. Rectangular hollows W and SW of the pond may be earlier dressing floor features.	**High** - as above	Ponds (517-518)	High	On 1890 map	
520	**Dam** - earth bank, 8.5m x1.10m, constructed across former course of Red Dell Beck. Stone revetment on	**High** – good evidential value relating to pollution control.		High	?	

Context	Description	Significance	Assoc. with	Contribution to Significance	Date	Photo
	boulder base to S and some stone facing to N. Probably constructed to control/prevent release of slimes into Church Beck. Crescentic heap of fine sand (dressing waste) to SW.					
521	**Dam** - earth bank, 8.5m x1.10m, constructed across former course of Red Dell Beck. Stone revetment on boulder base to S and some stone facing to N. Probably constructed to control/prevent release of slimes into Church Beck. Crescentic heap of fine sand (dressing waste) to SW.	**High** – good evidential value relating to pollution control.		High	?	

APPENDIX 2: A GLOSSARY OF COPPER MINING TERMS[5]

BUDDLE	A device for concentrating ore. In the mid-19th century these most usually took the form of a circular pit with rotating brushes. The tin from the STAMPS was fed into the centre or side of the pit and was graded by gravity, concentrating the heavy ore near the inlet point. These were often mechanically worked. Earlier buddles were trapezoidal in shape and operated manually. A variation used in tailings works to treat sands and slimes was the ROUND FRAME: a freestanding, all wooden, mechanically actuated buddle, whilst a further variation was the dumb buddle, or dumb pit, which was not mechanically operated.
CULVERT	A small tunnel constructed to carry a channel of water.
DRESSING	The concentration of the copper or other ores contained in the rock excavated from a mine. Carried out on DRESSING FLOORS.
DRESSING FLOORS	An (often extensive) surface area on a mine where the various processes of concentration of ore took place – these consisted of crushing or stamping to attain a uniform size range, sizing (particularly on later mines), separation of waste rock, concentration (generally mechanically and hydraulically on tin mines, manually on copper mines), the removal of contaminant minerals (by calcination, flotation, magnetic separation), and finally drying and bagging for transportation to the smelter.
SETT	The boundaries of a mine or mining area.
SPOIL TIP, DUMP	A pile of waste material from a mine, which may contain primary waste (where this could not be disposed of underground), or waste from various stages in the dressing process. TAILINGS LAGOONS stored the extensive slimes from the final stages in the process; in earlier mines these were flushed over cliffs or allowed to wash away in streams or rivers.
FINGER DUMP	A linear dump of waste material from a mine or quarry, flat-topped to allow material to be barrowed or trammed along it, and often equipped with a temporary tramway track.

[5] Glossary adapted from 'A short Glossary of Cornish Mining Terms' citing online reference http://www.cornish-mining.org.uk/story/glossary.htm, accessed 08/01/18

JIG	A large mechanically or hand-operated sieve set in a tank of water in which ore could be separated by waste.
LAUNDER	A wooden trough used to carry water or other liquids; often used to power a waterwheel or to feed water or finely divided material in suspension around a dressing floor.
LEAT	An artificial watercourse, built to carry a supply of water to a mine.
LEVEL	Also known as an adit. A horizontal tunnel (usually driven into a hillside) in order to give access to a mine and used for drainage or the hauling of broken ore. Deeper adits did not necessarily connect to surface and were used to carry water back from distant workings to a pumping shaft.
OPENWORK	A mineral extraction site open to the surface and similar to a quarry, but usually distinguished by its elongated shape and steep sides.
PROSPECTING PIT OR FOSSICKING PIT	A small pit dug in search of minerals, and almost always found in linear groups, often arranged cross-contour, or at right angles to the projected strike of known lodes.
RAGGING	Initial breaking up of sorted ore into uniform-sized pieces using a sledgehammer. Generally done by men or older boys prior to sending material to a mechanised crusher.
SHAFT	A vertical or near-vertical tunnel sunk to give access to the extractive areas of a mine.
STAMP	A mechanical device for crushing ore-bearing rock to fine sand. Heavy, vertically-mounted beams (or later iron rods) carrying cast or forged iron heads were sequentially lifted and dropped onto the prepared ore beneath them by a series of cams mounted on a rotating drum; this usually being driven by a water-wheel or rotative steam engine.
STOPE	Excavated area produced during the extraction of ore-bearing rock. Often narrow, deep and elongated, reflecting the former position of the lode. Where open to the surface, stopes are termed OPENWORK.

TAILINGS	The waste sand and slime from a mine DRESSING FLOOR, not containing workable quantities of mineral.
VEIN	A linear area of mineralisation underground. Sometimes referred to as a seam. Generally vertical or near-vertical, and often extending for considerable distances along its strike.
WHEEL PIT	A structure built to house a waterwheel, often excavated and stone-lined, but sometimes freestanding.