



**PADDY END
DRESSING
FLOORs,**

**CONISTON
COPPER MINES,**

CUMBRIA

**Archaeological
Survey Report**



Oxford Archaeology North

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SUMMARY

Oxford Archaeology North (OA North) was commissioned by the Lake District National Park Authority, on behalf of United Utilities, to undertake an archaeological survey of the Paddy End Dressing Floors at Coniston Copper Mines, Cumbria (SD 285 992). The dressing floors had been subject to severe erosion caused by the bursting of a water main above them in 2005. The survey was intended to inform the conservation management of the landscape and archaeological resource. The survey follows on from a general historical study of the copper mines by Eric Holland and an archaeological survey of the whole Copper Mine complex by the Royal Commission on the Historical Monuments (England). The present survey was undertaken between March and July 2007 and entailed a detailed topographic survey of the surface remains, and the production of elevations of selected walls to enable their consolidation.

The mining of copper on a commercial basis at the Coniston copper mines began by about 1590 and was controlled by the Company of the Mines Royal; this included exploration of mining adits (levels) at Paddy End, which is one of the principal seams of copper on the Coniston Fells. However, these mines closed in 1620 and mining did not commence in earnest again until the 1760s when the Macclesfield Copper Company raised limited amounts of ore. The main period of activity at Coniston followed the acquisition of the mines by John Taylor, and under the direction of his overseer John Barrett in 1818. This included the renewed exploration of the Paddy End levels, of which there were three: Top Level, Middle Level, and Grey Crag Level. A mill was constructed at Paddy End in about 1830, in order to eliminate the cartage of ores down to the main mill on the Bonsor Dressing Floors (the site of the other mill). The Paddy End mill was erected with ore reception hoppers on a terrace level with Grey Crag Level, and ore was also brought from a hopper at Top Level and down an incline from Middle Level, and was therefore able to process ore from all of the Paddy End levels. An artificial terrace, located immediately below the hoppers, accommodated the main mill building, which was powered by two opposing external water wheels.

By the 1850s the Coniston mines were making returns of £30,000 to £36,000 per annum, but by the 1880s, the industry had sustained a slump and it was only making £2,300 - £5,600 per annum. The Paddy End mill and dressing floors similarly had a short life; as the below ground adits and mines were ultimately extended and able to link into the lower Bonsor adits, so the ore could be taken out at the lower adits and processed at the lower Bonsor Mill. This ultimately led to the closure of the Paddy End Mill in the early 1880s, although working of the Paddy End levels continued until the turn of the century.

The principle aim of the survey was to record those elements impacted by the floods from the burst water pipe. The structure most severely affected was a smithy building, immediately below the pipe burst, and had been partly damaged and filled with rubble. Below this was a series of ore bins, which sustained damage to the upper retaining wall and in addition an area of flagged flooring, in front of the bins, was exposed. The leats below the pipe burst were severely affected as the flow of water tracked along them and the pressure of water burst them open, removing the surrounding material. In some instances, the water erosion has entirely removed sections of the leats.

The main mill building was also adversely affected by the flooding and a number of adjacent leats were exposed and part destroyed. A further terrace, below the mill terrace, was also heavily modified by the water erosion, which was concentrated through an area

of interconnecting stone and wood-lined leats. In addition, an east/west dividing wall was exposed, which had a planked wooden floor flush against its southern edge. A further, lower terrace, that had a previously identified wheel pit, was covered as a result of the floods and there was now longer any evidence of the pit.

The lowest terraces were similarly affected with leats exposed in a substantial gully that had cut through the terraces and these had also sustained localised slumping and deposition from the material displaced from above.

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Oxford Archaeology North would like to thank Eleanor Kingston, archaeologist at the Lake District National Park Authority, for commissioning the project, and for advice and support in the course of the project. We would also like to thank United Utilities for allowing access and for their support in the course of the project. We would particularly like to thank members of the Cumbria Amenity Trust Mining History Society (CATHMS) for providing information on their archive holdings for Paddy End and for assistance at the outset of the project. We would like to thank Liz Jenkins of English Heritage for providing a copy of the RCHM(E) report on the survey of the Coniston Copper Mines which was used substantially in the preparation of the site descriptions and as the base for the overall site survey.

The survey was undertaken by Karl Taylor and Peter Schofield. The report was written by Peter Schofield, and the illustrations were by Anne Stewardson. The report was edited by Jamie Quartermaine, who also managed the project.

1. INTRODUCTION

1.1 CIRCUMSTANCES OF THE PROJECT

- 1.1.1 Oxford Archaeology North (OA North) was commissioned by the Lake District National Park Authority, on behalf of United Utilities, to undertake an archaeological survey of the Paddy End Dressing Floors at Coniston Copper Mines, Cumbria (SD 285 992) (Fig 1). The dressing floors had been subject to severe erosion caused by the bursting of a water main above them in 2005. This had exposed various features of archaeological significance in what is a statutorily protected Scheduled Monument (SM 542). The survey was intended to inform the conservation management of the landscape and archaeological resource and to inform an application for Scheduled Monument Consent to undertake maintenance and consolidation of the monument.
- 1.1.2 The survey follows on from a general historical study of the copper mines by Eric Holland (1987) and an archaeological survey of the whole Copper Mine complex by the Royal Commission on the Historical Monuments (England) (Lofthouse 1997). The latter was an excellent survey, but the Paddy End section was at too small a scale to provide a detailed record of the dressing floors. While it served as an effective base record, there was a recognised need for a new, more detailed, survey to record the site and the new exposures.
- 1.1.3 The survey was undertaken between March and July 2007 and entailed a detailed topographic survey of the surface remains, and the production of selected wall elevations to enable their consolidation. The present report sets out the results of the survey followed by an assessment of the works operation.

2. METHODOLOGY

2.1 PROJECT DESIGN

2.1.1 The survey of Paddy End Dressing Floors was undertaken in accordance with a project design prepared by OA North (*Appendix 2*), which was itself in accordance with a project brief by the Lake District National Park Authority (*Appendix 1*). The primary purpose of the project was to provide an accurate archaeological survey of the Paddy End Dressing Floors, set within their broader landscape context, to inform future management decisions with regard to conservation matters relating to the archaeological and historical content of the industrial landscape.

2.2 TOPOGRAPHIC SURVEY

2.2.1 The detailed survey provided for a full record of all built elements within the extent of the Paddy End study area. This was undertaken by means of total station survey in conjunction with GPS survey. A level 3 survey (*Appendix 2*), equivalent to RCHM(E) level 3, was undertaken of the study area. Survey control was established over the site by closed traverse located using differential GPS and internally was accurate to $\pm 0.03\text{m}$. The base line was located using the GPS and then a closed traverse was established with respect to these primary control points.

2.2.2 **Detailed Survey:** the detail survey was established by a combination of GPS techniques and total station tacheometric survey. The spoil heaps and general topography were recorded by GPS and the detail of the dressing floors and adits were recorded by means of the total station. The tacheometric survey was generated by total station linked to a pen computer running TheoLT software. The data from both surveys was superimposed on the same grid within a CAD system. Plots were generated from the raw data and archaeological detail was drawn up in the field as dimensioned drawings with respect to survey markers. The new detailed survey drawings were produced at 1:500 scale to combine with the existing RCHM(E) 1:2500 general survey of the area (Lofthouse 1997) in the CAD system to provide a wider context for the Paddy End survey.

2.2.3 **Description:** the Paddy End Dressing Floors have already been comprehensively described for the RCHM(E) survey report (*ibid*); however, it was recognised that the new survey had identified elements that were not evident at the time of the earlier survey, or which warranted more detailed description. The descriptive detail from the earlier report was enhanced for each individual feature and descriptions of newly discovered features were added. The detailed descriptions are incorporated as a gazetteer (*Appendix 3*).

2.3 ELEVATION DRAWINGS

2.3.1 A record was created of selected elevations of the surviving walls, using a combination of rectified photography and reflectorless survey instrumentation. The elevation drawings covered some 12m of extant standing walling on the

dressing floors (Figs 7-16). Rectified black and white photography was undertaken using a medium format camera, and also a high resolution digital camera, to record the face of the external elevations. Control for the rectified photography was provided by a reflectorless instrument, which recorded the locations of clearly defined photographic targets. Any distortion within the photographic base image was corrected using Archis software to convert the images to fully rectified images. The corrected images were then incorporated as a raster backdrop within AutoCad and the elevation drawings were drawn up as a vector drawing from the rectified raster base.

- 2.3.2 The final elevation drawings (Figs 7-16) incorporate the drawn outlines of all principal features within the elevations and show all significant stone detail, such as quoins and ashlar stones. The drawings are shown superimposed onto the rectified photographs, which define the individual stones and surface detail.

2.4 ARCHIVE

- 2.4.1 A full professional archive has been compiled in accordance with the project design (*Appendix 1*), and in accordance with current IFA and English Heritage guidelines (English Heritage 1991). On completion of the project, the paper and digital archive will be deposited with the Cumbria County Record Office and copies of the digital data and report will be deposited with the Lake District National Park Historic Environment Record.

3. BACKGROUND

3.1 LOCATION, GEOLOGY AND TOPOGRAPHY

- 3.1.1 The Paddy End Dressing Floors are one element of the Coniston Copper Mines, an area located to the west-north-west of Coniston village in the southern Lake District and situated at the head of Coniston Water. The topography consists of sharply rising ground to the west and north of the lake which forms the western slopes of the Coniston Fells, the highest point of which is Coniston Old Man at 801m OD (Lofthouse 1997).
- 3.1.2 The copper mines are situated in a wide hanging valley (Coppermines Valley) through which Church Beck flows down to Coniston Water. Two smaller streams combine at the head of this valley; the Red Dell Beck which flows down Red Dell from its source on Wetherlam to the north-east, and Levers Water Beck which flows out of Levers Water, which is a glacial tarn that has been expanded by the construction of a dam at the foot of Brim Fell (*ibid*).
- 3.1.3 The area is complex geologically, being on the boundary of Carboniferous Borrowdale Volcanic series rocks to the north and Silurian silt-stones and grits of the Wenlock series to the south (BGS 1971, 97). The rocks are heavily faulted along a general south-east/north-west alignment, and the minerals infilling the faults have produced copper-rich veins that the Coniston mines have exploited (Adams 1988, 147; Lofthouse 1997).

3.2 A BRIEF HISTORY OF THE COPPER MINES

- 3.2.1 A detailed description of the history of the copper mines is provided by Holland (1987); the following is a general summary, concentrating on the area of the Paddy End Dressing Floors and serves to provide a context for the survey. The mining of copper on a commercial basis at the mines began by about 1590 and was controlled by the Company of the Mines Royal; it is known to have been active to at least 1620 and by this date was one of the three most important copper mines in Cumbria (Adams 1988, 146). The early workings were undertaken by German and Austrian miners along with English employees (pickmen). These included shafts, and levels (adits) at Paddy End (Marshall and Davies-Shiel 1977, 142). In 1602 it was reported that Fabian Seydenglans and four English pickmen were working the west end of the mine (Fabian's work); Haukriggs, Gibson and two others were working the middle work; and Christopher Clocker, Martin Moser, John Walker and William Kitchen were working the east end of the mine (Clocker's work) (Holland 1987, 27). In total, the mine was producing 27 kibbles (buckets of roughly 160lb each) of copper ore a week at the time (Donald 1994, 179). Small scale and poorly documented mining took place on the royalty intermittently by individual 'Adventurers' between the mid-seventeenth to early eighteenth centuries and again at the start of the nineteenth century.
- 3.2.2 Proposals were put in place in the 1680s and 1690s between a John Blackwell, who had inspected the old mine workings of The Mines Royal that had closed after 1620, and Sir Daniel Fleming to reopen the mines if mutually acceptable royalty fees were agreed. No mining took place, however, at that date (Adams 1988, 147), and mining did not commence in earnest again at Coniston until the

1760s when the Macclesfield Copper Company under the direction of one of its partners Charles Roe (a wealthy silk industrialist), raised limited amounts of ore in the last half of the eighteenth century (Marshall and Davies-Shiel 1977, 142; Holland 1987, 61). Surviving accounts show that the company raised 904 tonnes of ore for the period between 1767 and 1775. The company concentrated on the eastern end of the mine (away from Paddy End) on the productive Bonsor Vein (Holland 1987, 61). Processing of the ore at this period would have taken place on what was to become the Bonsor Dressing Floors (*op cit*, 62). The Macclesfield Companies interests in Coniston quickly waned after they took over and discovered massive copper deposits at Parys Mountain on Anglesey, where they then concentrated their efforts; by 1795 they had abandoned Coniston (*op cit*, 63-75).

- 3.2.3 The main period of activity at Coniston followed the acquisition of the mines by John Taylor in 1818, which included renewed exploration of the Paddy End levels. John Taylor's main contribution was to implement the mining in a systematic manner under the experienced Cornish mine captain John Barrett who had been the manager of the Grassington lead mines in Yorkshire (*op cit*, 101); John Barrett ultimately became a partner and the mine owner. Barrett organised the extraction and handling of ores with extensive use of water power and gravity, using systems of inclines and tramways (Matheson 1989, 70). By the 1850s the mines were making returns of £30,000 to £36,000 per annum (Postlethwaite 1913, 118); however, by the 1880s it was only making £2,300 - £5,600 per annum (Holland 1987, 91). The main ore extracted was Copper pyrite although over the years some small amounts of nickel, cobalt and lead were also retrieved (Adams 1988, 147). The mines in their heyday were producing 3,000 tonnes of ore per annum in the 1850s, which declined to around 1,000 tonnes by the mid 1870s. Thereafter production was extremely modest and after 1884 did not exceed over 200 tonnes per annum (*ibid*). The mine became less prosperous because of a slump in the price of copper ore that was caused by the discovery of massive deposits in Chile and South Africa, together with a falling commercial demand after the substitution of iron vessels for copper-sheathed wooden vessels by the Royal and Merchant Navies (Postlethwaite 1913, 119; Holland 1987, 100).
- 3.2.4 **Paddy End:** at Paddy End there were three main levels; Top Level was 96ft above Middle Level, and Low or Grey Crag Level was 180ft below Middle Level. These levels worked on the main lode of Paddy End Vein, where there were a number of additional strong veins and concentrations ('bunches') of mineralised ores present at junctions and intersections of veins, as well as in cross-faults (Holland 1987, 113). A new mill was constructed at Paddy End, in about 1830, in order to eliminate the cartage of ores down to the main mill on the Bonsor Dressing Floors. The mill was erected with ore reception hoppers on a terrace level with Grey Crag Level and Courtney's Cross Cut, and ore was also brought from a hopper at Top Level and down the incline from Middle Level (*op cit*, 114). Paddy End Mill and dressing floors had a relatively short life; as the below-ground adits and mines were extended they ultimately linked into the lower Bonsor adits and the ore could then be taken out at the lower adits and processed at Bonsor Mill. This ultimately led to the closure of Paddy End Mill in the early 1880s. Working of the Paddy End mines nevertheless continued until the turn of the century (*op cit*, 115).

- 3.2.5 By 1875 the mine had been purchased by Thomas Wynn for £3,000, although it was soon sold on to Charles Edwin Day, who eventually lost all his money and closed the mine in 1908 (Adams 1988, 148). Between 1912 and 1915 the French-owned Coniston Electrolytic Copper Company leased the mine to test the feasibility of a patent process to extract copper from the spoil dumps by flotation and electrolysis. This work concentrated upon the Bonsor Dressing Floors rather than the floors at Paddy End (Middleton 1985, 273). No mining was carried out and the venture was a commercial failure. The final investigation of the mines came in 1954 when WT Shaw, on behalf of the McKechnie Brothers, who ran Force Crag, Hartsop Hall and Calbeck Fell Barytes Mines, investigated the workings and found them to be commercially unworkable due to the extensive collapse of the levels (*ibid*).
- 3.2.6 **Processing:** in its heyday in 1858 the mine employed around 700 men underground, and the ore was dressed on the surface by 300 old men and boys and 50 women and girls (Matheson 1994, 9). Initially, processing of the ore was undertaken at the lower Bonsor Mill, but this entailed considerable effort in transport, so a second processing mill was established at Paddy End in about 1830. The ore was processed by crushing using large stamps in the mill and was then sent to settling ponds on the dressing floor terraces. A description of the mine workings in 1858 (Holland 1987) (not necessarily just Paddy End) explained how the mined material was drawn out from underground by horse power at a rate of 8 trips a shift of three iron wagons, each containing two tonnes each. It was then dumped down a screen and sorted into three grades, the oversized lumps were then broken, or ragged by the stronger boys and women using heavy sledgehammers. The grades consisted of firstly the solid chalcopyrite ore, secondly the ‘douse’ or seconds, and lastly the mixed low-grade lots. The solid ore went to the bucking shed where women used heavy hammers (‘buckers’) to beat it over iron plates until the pieces were thumbnail in size, ready for marketing. The seconds were ‘cobbled’ by young women using small seated anvils where they beat the pieces held in one hand with a hammer. Pure ore was then sent to the bucking team. The low-grade material was rendered down to walnut size by the ‘buckers’ and this material was sent through the crushing mill and then to the stamps where vertically placed, iron-shod wooden baulks pummelled the material to fine sand. Next the sand was subject to ‘tubbing’ or ‘jigging’ (which later became semi-mechanical) where the ore would run through six sets of paired water sieves/jigs and it was sieved and agitated in large tubs of water. The material left in the sieve would be ore and the smaller particles would pass through (Holland 1987, 130). The sieves/jigs collected a total of 60 tonnes of jigged ore a week (Matheson 1994, 8). The fine material/slime that had passed through the earlier processes was collected in settling lagoons, and these were periodically emptied by the ‘vanners’. These were men who panned for the fine ore dust using special vanning shovels, in a similar method as panning for gold. In later years the process was replaced by several washings through inclined tables and buddles (Holland 1987, 130).

4. TOPOGRAPHIC SURVEY

4.1 GENERAL DESCRIPTION

- 4.1.1 The present description of the components of the Paddy End Dressing Floors is substantially informed by the comprehensive survey undertaken by RCHM(E) of the entire of the Coniston Copper Mines (Lofthouse 1997). Additional detail has been added to their descriptions, particularly where further erosion has exposed significant archaeological features. The site numbers are those of the earlier RCHM(E) survey and have been reused as appropriate.
- 4.1.2 **The Levers Water Valley:** the valley of the Levers Water Beck divides from the Coppermines Valley in a north westerly direction up to the glacial tarn called Levers Water, which has been substantially enlarged by the construction of a dam (Fig 2). The valley has a concentration of veins, all on a south-east/north-west orientation, of which the Paddy End and Kernal veins were explored by a number of adits, dug from the 1620s onwards. All of the ore mined during this period was processed at the Paddy End Dressing Floors. From 1870 a principle level (Deep Level) that originally served the Bonsor Dressing Floors, was extended to connect to the Paddy End workings under the valley and, subsequently, all the ore was taken out from the area of the Bonsor Dressing Floors; as a consequence the Paddy End floors were closed.

4.2 ACCESS

- 4.2.1 **Access Track 300:** Levers Water valley is reached via Track **300** which heads north-west from the Bonsor Dressing Floors (Fig 3). The track is shown on the 1891 2nd edition Ordnance Survey map (Plate 2) and follows, for the most part, the line of the present day track through Paddy End; however, the track has now been widened and improved by United Utilities to provide access to the dam at Levers Water. One change from its earlier alignment is at the first hairpin bend, which used to turn uphill to the east of the ore reception hoppers (**365**); the track now extends around to the north and the hairpin is to the west of the hoppers (Fig 4).
- 4.2.2 **Access Track 417:** Track **417** served the Top Level adit (**361**); ore was carted down this track to the dressing floors prior to the establishment of a track to Middle Level (**352**) from where the ore could then be transported down by incline **358** (Fig 3). It starts at a junction with Track **300** and extends up the hillside; it crosses Leat **114** over a bridge of stone slabs, measuring 3.6m wide. At the foot of a waterfall the track crossed Levers Water Beck via a bridge, the abutments of which survive; these consist of ramps of earth revetted by drystone walls, measuring up to 1m high. Large boulders in the stream bed mark the position of intermediate supports. A small foot path extends from here, across the steep slope covered by spoil from Top Level to Middle Level; in places this has a low stone revetment on the downslope side.

4.3 WATER MANAGEMENT IN THE LEVERS WATER VALLEY

- 4.3.1 The Levers Water Tarn was the key to supplying sufficient water to the whole of the Coniston mines and the successful damming of the lake became a priority as the mine expanded and the demands from the expanding numbers of water wheels increased. The tarn itself was first dammed in the late seventeenth century (Holland 1987, 221), and this dam was increased in size, faced with stone and fitted with a valve c1820, further increasing the size of the lake (*op cit* 226). In 1972 the lake was taken over by the North West Water Authority (now United Utilities) who further enlarged and strengthened the dam, installing a large stone weir. They also laid a pipeline down to the newly built water treatment works at Paddy End.
- 4.3.2 **Water Treatment Works 366:** in 1972 the then Furness Water Company installed a water treatment works on the valley floor near the confluence of the Levers Water Beck and the Low Water Beck (Plates 7 and 8) (Holland 1987). Although construction of the treatment works itself caused little damage to the dressing floors, works on the pipeline that fed it caused damage to some buildings on the dressing floor terraces. The structures associated with these works consisted of a set of inspection hatches behind the smithy (**363**), and in the valley bottom there was a large buried tank with a landscaped entrance in a concrete wall, measuring 4m high; there is also a fenced enclosure with a large open air tank inside it. It was the water pipeline attached to the inspection hatches behind the smithy that caused considerable water erosion damage to the dressing floors when it burst (Plate 15).
- 4.3.3 **Leat 114:** one of the most impressive engineering projects undertaken in the nineteenth century was the leat that transferred water from the Levers Water Beck to the Red Dell Beck (Figs 2 and 3). This was necessary due to the small size and unreliable flow in the latter stream, especially in the summer months. The increase in activity on the Bonsor vein led to the construction of large water wheels which required a constant supply for pumping and winding. The leat takes water from Lever Water Beck at the foot of a waterfall adjacent to Top Level and extended eastwards around the contour beneath Kernal Crag to join the Red Dell leat system near the Thriddle Incline.
- 4.3.4 The take-off for the leat is a pool at the foot of a waterfall adjacent to the bridge abutments for Track **417** (Fig 3). A rock-cut gully has been blasted out of the side of the stream, measuring 1.5m deep and 1.5m wide; there are iron pins set into the rock at the edge of the gully which probably held in place a wooden superstructure. A second rock-cut gully leads back to the stream as an overflow channel. The leat continues as a ditch, measuring 2m wide by 0.5m deep, on the downslope side of which is a bank formed from the upcast; this is intermittently faced with a stone revetment. Where the leat is crossed by Track **417** it is bridged with a series of stone capstones.
- 4.3.5 The leat has a junction with Trackway **300**; however, the resurfacing carried out by United Utilities has obscured the relationship between these two features. As the leat approaches the lower cliff of Kernal Crag, adjacent to working **350**, it drops 1.5m in height in order to circumnavigate the boulder field below the crag. This step is constructed as a vertical stone wall forming an artificial cascade. There is an angle in the course of the leat, some 100m further on, in order to avoid

boulders. The leat then descends the steep hillside to Red Dell, where the water has worn a deep gully, measuring up to 2m wide by 2m deep. Eventually it flows into the water storage lagoons at Red Dell.

- 4.3.6 **Leat 339:** a particularly impressive feat of above-ground engineering was the leat constructed to carry water from the Red Dell Beck around the hillside to the Paddy End Dressing Floors (Holland 1987, 225). The leat was constructed in the nineteenth century to supply the Paddy End Mill with water, which is likely to have originally come from the Levers Water Beck having been re-routed to Red Dell from higher up via Leat **114**. A take off from a lower point of Levers Water Beck could not be used as the water had been drawn off along Leat **114**, and so the only alternative was to make most efficient of the water by bringing it back along this leat. Leat **339** was then re-used c 1890, after the closure of the Paddy End Dressing Floors, to provide water to a Pelton wheel situated in a sawmill building on the Upper Terrace of the Bonsor Dressing Floors; water was delivered to this via a water drop (**336**) (Holland 1987). The leat is 620m long and extends around the hill approximately along the 270m contour.
- 4.3.7 Where the leat enters the Paddy End Dressing Floors it has been eroded by a small stream exposing timbers. The leat continues across the dressing floor as a ditch, measuring 2.7m wide and 0.7m, skirting the base of the spoilheap from the earlier Gaunt's Level (**342**), Plate 12) but is not visible beyond Track **300**; the leat would have entered the dressing floors at the level of the upper terrace.
- 4.3.8 **Leat 418:** the course of this leat is visible extending from the waterfalls below Grey Crag, to a point opposite the Grey Crag Level entrance (**357**) (Fig 3), and was intended to take water from Low Water Beck to the Paddy End Dressing Floors. The leat has a steep gradient made necessary by the nature of the topography and survives as a V-shaped ditch, measuring 1.3m wide, with a counterscarp bank on the downslope side. The leat is now well used as a path for walkers and is suffering from erosion, especially in its upper reaches.
- 4.3.9 At the mouth of Grey Crag Level the course of the leat is invisible, but from here it crossed the stream to join a leat which took water directly from the stream at this point. It is likely that the leat was carried over Grey Crag Level and the stream in a wooden launder; there is a large iron staple set into the rock at the side of the stream (just upstream of the modern foot bridge) and iron fixings on the opposite bank which mark its position.

4.4 PADDY END DRESSING FLOORS AND ASSOCIATED ADITS

- 4.4.1 The dressing floors are arranged on a series of eight curving terraces extending down the hillside, which enabled the best use of gravity to feed the ore and water for power from one process to another as it was gradually refined (Figs 4-6) (Plates 9-11). Water for the processing was transported by a network of leats which took water from the Levers Water Beck, Red Dell Beck (Leat **339**) and Low Water Beck (Leat **418**, Plate 6). The Paddy End Dressing Floors are portrayed in detail on a mine plan which has been updated throughout the life of the mine (Adams 1988, Plate 5).
- 4.4.2 **The Upper Terrace:** the Upper Terrace extends from Levers Water Beck, at the opening of Hospital Level (**356**), to a junction with Track **300**. The main tramways from Grey Crag Level, Hospital Level and the incline (**358**) all

converged at the north-west end of the terrace and extended up to the tops of the ore hoppers which formed the back wall of the terrace. There are numerous levels which have been driven into the hillside from this terrace, some of which predated its construction.

- 4.4.3 *Gaunt's Level 342 (Fig 4)*: Gaunt's Level is a well preserved stone-arched adit entrance, measuring 2m high by 1.2m wide, which has two finger dumps of spoil extending down the hillside from the tunnel. The construction of the adit pre-dates Leat 339 as the course of the leat circumnavigates the base of the spoilheaps. A short pathway, visible as a flat grassy platform, extends from the top of the spoilheap along the contour to the west up to office building 364.
- 4.4.4 *Building 364 (Office) (Fig 4)*: at the junction of Track 300 and the path from Gaunt's Level stands the remains of a two-storeyed stone building (Plate 13); it has a single room to the ground floor, measuring 6.7m by 5.4m internally, defined by walls which stand to 1.9m high. There is a door and a window in the south wall and a window in the east wall; the north-west corner has collapsed. There is a small annexe attached to the rear wall, measuring 2.9m by 3m, which has a door to the east. The building is annotated as an office on a contemporary mine plan (Adams 1988; Plate 5).
- 4.4.5 *Building 363 (Smithy)*: a single-roomed building is revetted into the hillside, and measures 5.6m by 6.7m internally within walls that are now 1.7m high. The west side of a doorway in the south wall survives and there is a blocked door in the east gable wall, to the north of which is a small niche. Against the west wall is a raised plinth constructed of mortared stone, measuring 1.2m high; there are iron fixings projecting from it. The building has been damaged by the construction of some inspection hatches associated with the water treatment works. It is annotated as a smithy on the mine plan (Adams 1988; Plate 5) and the presence of the fixings suggests some industrial process; however, there are no traces of any waste iron or slag. Holland noted that a hearth and wooden anvil stump survived internally (1989, 60); however, the building has been heavily damaged by water erosion from the burst pipeline immediately to the rear and upslope of the structure obscuring any internal remains. Erosion/demolition rubble has covered and displaced both the northern and southern walls of the structure (Plates 14 and 15).
- 4.4.6 *Test Adit 361 (Fig 4)*: west of Building 363 is a test adit dug into the hillside above the upper terrace. The adit is visible as a gully, measuring 7m long, with banks of spoil on either side, that stand up to 1.5m. The adit entrance is now blocked, marked by a circular area of collapse; two stone revetment walls survive on either side, which stand up to 1m high. In front of the gully is a flat platform created by the dumping of spoil which has formed a conical heap, standing 10m high, which extends to the front of the terrace.
- 4.4.7 *Courtney's Cross Cut 360 (Fig 4)*: Courtney's adit is located 30m from the west end of the upper terrace; it was driven c1820 to intersect the South Vein, a north-east / south-west orientated vein just to the north of both Paddy End Dressing Floors and Paddy End vein. It was eventually connected to the subterranean Deep Level by South Shaft (355) which is visible at the surface on the hillside above (Fig 3) (Holland 1987). The adit entrance, which measures 2m high by 1.7m wide, is at the end of a rock-cut gully, measuring 10.7m long which reaches a depth of 4m; a collapse above the adit entrance has been stabilised by a revetment wall, which stands 2.2m high. The spoil from the driving of the adit has been incorporated in

the terrace; however, a finger of spoil projects from the front of the terrace opposite the adit entrance, which has possibly been added to by spoil from the construction of Hospital Level (356) to the west.

- 4.4.8 **Quarry 359 (Fig 4):** to the west of Courtney's Cross Cut is a small horseshoe-shaped quarry cut into the base of the hillside at the rear of the terrace; the quarry may have been the source of stone for the construction of the adjacent incline (358) and Track 300. In addition, there is a further quarry depression surviving to the rear of the Upper Terrace between the smithy and office buildings (363 and 364); it measures 13m long by 7m wide.
- 4.4.9 **Hospital Level 356:** on the east side of the Levers Water Beck, at the base of Incline 358, is an adit entrance, measuring 1.1m high by 1.5m wide. It is at the end of a narrow gully formed on one side by a rock wall, measuring 3m high, and by the foot of Incline 358 on the other. According to Holland (1987, 115) the adit was driven in c1864 and intersected the South Vein and the Paddy End Vein; however, the arrangement of the walls between the incline and the adit, which converge at the tunnel entrance, suggest that the adit is the earlier of the two features. A flanking wall, which extends from the entrance at 45° can be seen to have been incorporated into the fabric of the incline and would indicate that the adit predated the incline. However, Holland references a mine survey carried out in 1833 which describes both the Middle Level and the incline being in operation at this time and would therefore imply that the incline was earlier. One possibility is that Hospital Level re-used an earlier adit, but which is not indicated on any extant mine records. Alternatively, the base of the incline may have been temporarily removed and revetted with this wall to allow for the initial blasting of the level, and then was re-built afterwards; in the latter case it is difficult to see why it was necessary to locate the adit entrance in such an inconvenient place.
- 4.4.10 **Grey Crag Level 357:** located directly opposite the foot bridge on the west side of Levers Water beck, adjacent to a large boulder, and south of Incline 358, is the now collapsed entrance to Grey Crag Level. It remains as a shallow gully, measuring 16m by 5m, at the mouth of which are traces of revetment walls. The rails emerging from the adit crossed the stream on a bridge and the abutments of this can still be seen. The modern footbridge re-uses the abutments which are of drystone construction and stand to a height of 1.6m high. The adit was driven in the early nineteenth century, c 1830, to the Paddy End Vein, and eventually connected to Middle and Top Level (Holland 1987).
- 4.4.11 **Hoppers 365:** it is probable that the spoil from both Grey Crag (357) and Hospital (356) Levels went to make up the terrace alongside Levers Water Beck. Waggons carrying ore-bearing rock travelled along the Upper Terrace to the top of a series of hoppers (365) standing on the terrace below; the mixed ore and rock coming from the mine would have been tipped into these to await processing. The hoppers consist of a massive 'C'-shaped revetment wall, measuring 4.2m high, which is subdivided into two bays. The eastern bay (365b) is the largest, measuring 8m by 24.7m, in the middle of which are two large upright timbers that would have supported a roof or a further subdivision of the hopper (Plate 16). The western hopper (365b) is smaller, measuring 9m by 7m; it has a sloping cobbled floor which extends from the rear wall to a narrow southern wall, 0.6m high, on top of which is a line of large boulders with iron fixings projecting from them. A gap in the centre of the hoppers southern wall seems to have formed a chute down which

the ore was filtered. There is a flat area revetted by a stone wall, measuring 0.8m high, immediately to the south and below the western hopper (**365b**), which forms a shovelling platform. To the south of the shovelling platform and beyond (to the south of) the Track **300** is a further sub-rectangular platform (**365d**), measuring 14m long by 6.5m wide. The eastern ore hopper has suffered slightly from the recent water erosion damage, exposing the top course of the large rear retaining wall, displacing some erosion rubble into the hopper itself below, and exposing a small area of flagged flooring on the front end of the ore bin. Water erosion has also eroded and displaced rubble on the sloping ground on either side of the ore hopper bins and has exposed areas of cobbling along the course of access Track **300** below the hoppers.

- 4.4.12 In front of the hoppers the terrace varies in width due to the slumping of the revetment wall of the terrace below (**369**). The surface is paved with large stone slabs most of which are still *in situ*. Track **300** crosses this surface and a certain amount of damage has been caused by the passage of vehicles where the road surface has worn away. The trackway and slumping has destroyed or covered a building attached to the east wall of the hopper, which is depicted on the Adams mine plan (Adams 1988, Plate 5). The course of a wall is visible in the track's surface (**365a**) to the west of the hopper, which may be the remains of a former building.
- 4.4.13 The initial separation of the rock from the ore was carried out on the Upper Terrace, the waste being carried to the spoilheaps which extend from the western end of the terrace. The flat top along which the tramways to the spoil heaps were laid is now interrupted by a scarp created by the removal of material from the spoilheaps to construct a ramp up which Track **300** now reaches the top section of the Upper Terrace.
- 4.4.14 **Spoilheap 367 (Fig 4):** there are five obvious finger dumps extending from the west end of the Upper Terrace, all of which consist of large rock fragments produced from initial processing or from tunnel driving. The waste heaps have overwhelmed the Levers Water Beck, cutting off its natural channel (Plate 4); the water has subsequently found its way under the base of the spoil and emerges from the base of the heaps to the south. In wet weather water floods around the base of the spoilheaps forming a boulder-filled channel which is normally dry. The force of the water during flood has scoured a crescentic scarp which cuts through the two most north-westerly dumps. The remaining heaps are well preserved, measuring up to 27m high, with a flat top that is typically 2.4m wide. The easternmost waste heaps, where they meet the dressing floor terraces, consist of fine waste which has been dumped from the end of each individual terrace. In places this fine waste is partly overlain by the larger finger dumps. The terraces below the hopper platform were planned and constructed systematically to enable efficient use of the limited space available and to integrate a network of underground leats, many of which have now been exposed by the recent water erosion on the site.
- 4.4.15 **Terrace 369 (Figs 4 and 5):** Terrace **369** is located immediately below the hoppers and is edged to the south by a damaged revetment wall. Several structures have been incorporated into it, and these probably relate to the main mill building (**369a**) which had two opposing external water wheels as shown on the early mine layout drawing (Adams 1988; Plate 5). At the west end of the wall a stone-capped

leat can be seen projecting out of the slope, and paving slabs from the working platform above are slipping down the slope (**369b**). The recent water erosion has exposed the edge of the stone-flagged floor above the leat and fragmentary sections of wooden box leats above the slipped paving slabs (Plates 17 and 18). The leat emerges opposite a large stone plinth, measuring 8m by 5m and 2m high, at its front apron (**369c**). The presence of the leat above indicates that this is probably a machine base for a water wheel or other water powered machinery. Further to the east are two masonry pillars (Plates 17 and 19). The western one, measuring 3m tall, has a stone-lined leat built into its top; the eastern one measures 2.8m high. It is likely that a water wheel was suspended between these two pillars. East of the pillars, but still within the mill building (**369a**), two leats can be seen projecting out of the section. One is stone lined and projects from the top of the section heading in an easterly direction; below this a wood-lined leat, measuring 1m wide and 0.3m deep, covered by sheet iron, projecting forwards to the lower terrace. On either side of the iron sheet-covered wood-lined leat are two collapsed stone-lined leats projecting south in the same direction. To the south of the mill building (**369a**) a small area of cobble flooring has been exposed near to the front edge of the terrace (**369d**).

4.4.16 Four metres to the west of the mill is a sloping flagged floor that descends to the top of a revetment wall which ends at a wing wall which projects outwards for 5m (**369g**); this is probably a hopper for transporting ore down from the terrace above. The revetment wall to the east of here is replaced by a loose slope down which a trackway descends from a junction with Trackway **300**. Adjacent to this track are two curving walls, 2.8m high, forming a hopper (**369e**). The relationship between the hopper and the track suggests it was used for ore delivered by cart, possibly from the Top or Middle Levels. At the eastern end of Terrace **369** are the remains of a settling tank (**369f**) obscured by material from the re-surfacing of Track **300**.

4.4.17 **Terrace 370**: a steep scarp separates this terrace from Terrace **369** and the revetment wall between it and Terrace **371** has collapsed leaving a rocky slope. At the eastern end is a well preserved settling tank (**370a**) (Plate 22). It is rectangular in shape with rounded corners, measures 32m long by 5m wide, and is bounded by a 1m high stone-faced bank. On the downslope side this bank measures 3m wide and has a 4m high revetment wall extending to Terrace **371**. At its western end there is a breach in the revetment wall which may have been a sluice emptying into the tank below; green stained copper sediment is visible in the base of this channel. The supply leat extends along the terrace from the west and splits to supply both this tank and the one below on Terrace **371**. The west edge of the terrace is defined by a short section of walling exposed in Spoil Heaps **367**. The western half of the terrace, surviving as a rocky slope of collapsed material, has been heavily modified by the recent water erosion. The erosion has been concentrated in an area of interconnecting stone- and wood-lined leats which were presumably still intact before the inrush of large amounts of water (Plates 21 and 23). The erosion has exposed at least four stone-lined leats and a wooden box drain. In addition, an east/west running dividing wall has been exposed with a wider planked wooden floor against its southern edge (Plate 24) (**370b**). Fine processing waste has been exposed to the south of the wooden leat, near the edge of the revetted wall, running onto Terrace **371** below.

- 4.4.18 **Terrace 371:** this terrace extends from a flat platform which is shared with terrace 372, adjacent to the waste heaps. Extending along the rear of the terrace an intermittent revetment wall (371a), measuring up to 0.8m high, ends in the west at a steep eroding slope. Projecting from this slope are the remains of a wheel pit and supply leat. The wheel pit was previously partially visible, measuring 4m long by 2.3m wide (Lofthouse 1997) (371b); however, recent water erosion has infilled it completely and has covered the ground to the west of the wheel pit with erosion rubble (Plate 25). A patch of grease from the axle of the wheel is visible on the eastern wall of the wheel pit at 3.2m from the end, which gives an approximate diameter for the wheel of 6m. A small wood-lined drain survives on the east side of the eastern wall of the wheel pit. A large capstone marks the position of the supply leat (371c) which projects from the scarp immediately above the wheelpit; it measures 1.4m wide by 0.7m high, and has a stepped stone-lined floor (Plate 26). The leat originates from the machine base/wheel pit on Terrace 369. A small wood-lined leat also projects from the section and extends eastwards. The wood leat is constructed of sawn timber and fixed together without nails to form a box section; the gaps are plugged with a felt-like material which is preserved due to waterlogging. From the wheel pit (now filled) (371b) an intermittent sloping revetment wall (371f) extends west to the end of the terrace. Immediately to the west and east of the wheel pit (371b) are two short stubs of walls that may be associated with structures depicted on the early mine layout drawing (Adams 1988; Plate 5). The eastern structure has a dump of fine tailings waste surviving in the corner.
- 4.4.19 The east end of the terrace holds a large rectangular settling tank (371d), measuring 14m long by 4.3m wide; a sluice connects it to the tank above (370a). There is also a stone-capped drain (371e) running in front of the settling tank. A trackway extends from the end of the terrace to a junction with Track 300.
- 4.4.20 A complex network of small wooden leats cross the Terrace 371 dressing floors. The collapse of the revetment walls between the terraces corresponds to the paths of the leats through them, and reflects the frost shattering action of the water that still runs through them.
- 4.4.21 **Terrace 372 (Fig 5):** as already noted the west end of this terrace is shared with the terrace (371) above. In front of the wheel pit (371b) is an unusual feature that is interpreted as a reservoir (372a) (Plates 27 and 28). The feature is an oval hollow, measuring 10m by 5m and 1.5m deep, and the sides are lined with battered stone revetment walls. At the southern end the walls narrow to form a gap, 1.4m wide, where two stone pillars, 1.3m high, support the wooden uprights of a sluice gate. From the base of this sluice, which is level with Terrace 373, a wood-lined leat and a small wooden box drain (372b) extend southwards. The water supply for the reservoir comes from a buried leat probably extending from the wheelpit above. The passage of water has worn a deep channel in the stone revetment to the east of the reservoir (Plate 29), which in places is constructed of limestone; the presence of limestone, which is not a local rock, is unusual. The terrace extends from here as a flat platform, measuring up to 12m wide, bounded by the revetment walls of the terraces (371 and 373) above and below. The eastern end of the terrace contains the fragmentary remains of a further settling tank (372c), which is mostly in-filled and covered in erosion debris (Plate 30), and there is a banked leat running into it, from the west, along Terrace 372 (Plate 31).

- 4.4.22 **Terrace 373 (Fig 5):** Terrace 373 is a narrow curving platform which extends from the base of the reservoir (372a) on Terrace 372. The outflow (372b) from the reservoir runs across the terrace over a stone-flagged cascade from where it has worn a large gully extending down onto Terrace 374 and through its retaining wall; a small wooden leat also projects from the base of the sluice and extends to the south-east. In the side of the water-worn gully a third wooden leat can be seen in section, which is filled with sludge and finings; this possibly indicates that finings and sludge were transported around the site using a strong flow of water in the now buried leat. The recent water erosion has also revealed a stone-capped drain (373a) running roughly north/south at the base of the eroded gully. The terrace has been covered by slumping and erosion from above, and in the western part of the terrace water erosion has cut through the front edge of the retaining wall onto the Terrace 374 below.
- 4.4.23 **Terrace 374 (Fig 6):** this comprises the lowest level of the dressing floors and occupies gently sloping ground on to the valley floor, and was described by Holland as the terraced slime settling beds (1987, 227). At the western side of this area is the continuation of the water-worn gully from reservoir 372a; it extends down the slope to the top of an unusual series of walls which stand at the head of a shallow ditch that extends to the east (374a). The walls form a small edge, 1.4m high, for the water to cascade over; masonry fragments on either side of the edge suggest that there may have been some machinery established here (Plate 32). A photograph taken before the construction of the United Utilities tank shows that there were three similar stone-built cascades; however, these have now been destroyed (Holland 1987; Plates 7 and 8). The dams were probably for trapping sediment to avoid polluting Levers Water Beck. At the east side of the terrace are a series of square settling tanks or slime pits (374b-e), and only traces of four of these tanks now remain (Plate 33). The largest tank (374d), which measures 8m by 5.5m within stone and earth banks standing up to 1m high, has a sluice in its south side. To the south-east of this is a second smaller tank (374e) with a well preserved stone-lined sluice in its southern side. Some 20m to the west is a third tank (374c); it is badly preserved with only one small section of walling visible. The position of a fourth tank is suggested by an oval hollow at the western edge of the area (374b), although no walling is visible. A network of stone-capped leats run between the tanks; and their course can be traced on the surface. The eastern end of the terrace contains a natural boulder field, on the western edge of which is a short section of embanked leat (374f) which runs from north-west to south-east. The leat only survives for a short section as the southern end is destroyed by the construction of the water works (366). This may relate to part of the 'Old Mill Race' (Plate 4) which fed out of Paddy End Dressing Floors and east down to Bonsor Mill (Plate 6). The western edge of this terrace area is bounded by the base of the Spoil Heaps 367. A concave area in the slope of the heaps indicates that an amount of spoil has been removed from the spoil heaps; a modern (post-treatment plant) track leads to this point.

4.5 THE UPPER LEVERS WATER VALLEY

- 4.5.1 **Incline 358 (Fig 3):** the incline was constructed in the early nineteenth century to transport ore from Middle Level down to the Paddy End Dressing Floors (Holland 1987). It extends from the entrance of Hospital Level 356, across the Levers

Water Beck and ascends the opposite valley side parallel to the foot of Grey Crag. It was a self-acting tramway that relied on the weight of a full waggon descending to pull an empty one back up the slope. Holland's reconstruction (1987, 176) suggests that there was a single track with a passing place in the middle. The masonry at the foot of the incline is well preserved and extends up the side of the stream. The relationship and phasing between the Hospital Level and the incline is described above (*Section 4.4.10*). The walls of the incline foot are of drystone construction, standing to a height of 1.2m, which form a ramp 4.5m wide. Levers Water Beck was crossed a section of bridge but the stream has washed away most of the walls of the bridge abutments, but enough masonry survives to identify their positions; the bridge was almost certainly constructed in wood as there is no indication of an arch. From here the incline extends up the hillside to the foot of Grey Crag. The lower section is 28m long and survives as a 6m wide platform capable of taking a double set of rails. The ramp is of earth and stone contained within sloping stone walls, that stand to a maximum height of 2.5m on the downslope side. The top section is 45m long and survives as a narrow, 2.5m wide, terrace which could only have taken a single set of rails. Erosion from above has partially obscured the top section and in the upper reaches the downslope side has now collapsed away.

- 4.5.2 At the top of the incline is a rock-cut platform, measuring 6m by 10m. Three timber uprights protrude from the platform, and these presumably held the drum around which the cable ran, and its braking mechanism. Ore was transported to this platform for loading into the trucks via an ore chute which descended from Middle Level.
- 4.5.3 **Middle Level 352 and Ore Chute (Fig 3):** Middle Level was dug in the early nineteenth century and worked the Paddy End vein; it eventually connected with Top Level (351) and Grey Crag Level (357) (Holland 1987, 114). The entrance to Middle Level is at the extreme north end of Grey Crag at the end of a rock-cut gully; the adit is now blocked by scree from above. A wooden-lined shaft, dug by mine explorers to gain access, has also been overwhelmed by scree but remains of the wood indicates its location. Spoil from the adit has been tipped down the valley side to the stream below. The ore-bearing rocks were transported to the top of the incline via an ore chute which descended the side of the cliff. Several large metal pins project from the rock face, and mark the position of a wooden platform level with the adit mouth which leads to the top of the ore chute.
- 4.5.4 The ore chute was constructed by blasting a wide sloping terrace out of the cliff face, and creating a steep ramp, 10m long by 3m wide; wooden planks were held in place with iron pins that formed the downslope side. The floor of this rock-cut section has been worn smooth by the constant tipping of the ore. The lower section curves away from the cliff, becoming a steep channel formed by the cliff on one side and a revetment wall, standing up to 1.5m high, on the other; there are traces of wooden plank flooring visible beneath the grass.
- 4.5.5 **Top Level 351:** this was an early nineteenth century level dug to investigate the old seventeenth century workings below Simon's Nick. Access to the adit was made via two tracks; one is now a footpath leading from the top of the incline near Middle Level and the other is a well made cart track (417) which branches off Track 300. The level enters the hillside at the foot of the scree coming from the Simon's Nick workings. Continuing falls of scree have covered the adit

entrance although a shallow gully marks its position and two walls flanking the rail bed are still visible, measuring 0.3m high. In front of the adit is a flat grass-covered platform which is formed by the top of a large spoilheap, measuring 40m high. A large finger dump extends out from the platform in a northerly direction; it has a flat top suggesting that it was dumped from rails. The construction of a later shelter cuts off access to the finger dump, which may have been the result of the initial driving of the adit. The structure is an open fronted enclosure, measuring 2.1m wide by 2.5m long, within stone revetment walls standing up to 0.6m high. In front of the building are the remains of some wooden flooring at the head of a very steep scree slope, which is composed of small copper-stained rock fragments. It is possible that this represents an ore chute which delivered processed ore down to the incline for transport to the dressing floors. Prior to the construction of the incline, ore was taken from Top Level via a cart track (417) which connected with Track 300. A small path descends from the Top Level platform down to a flat area beside the foot of a waterfall on the Levers Water Beck; here a bridge crossed the stream (*Section 4.2.2*).

- 4.5.6 **Hospital Shaft 353:** this shaft was dug circa 1865-70 to connect Hospital Level (356) on the Paddy End Vein with the subterranean Deep Level, prior to this connection ore was winched up the shaft. The entrance to the shaft is located in the stream bed 75m upstream from the Hospital Level (356). The entrance is overwhelmed by scree although a number of projecting timbers mark its position; there is a slot cut out of the bedrock at the side of an adjacent waterfall which is probably a rebate for the timber super-structure of the shaft head. South of the shaft the scree and spoil coming from Middle Level have obscured a number of features which can be seen in section where the stream has eroded the bank. A wall, measuring up to 1.2m high, and paved surfaces can be seen, in amongst which are some copper-rich sediments and layers of fine gravel which resembles waste from crushing. It is not known why ore processing should have been carried out on site at the shaft head instead of being taken to the dressing floor, and presumably was a short lived interim measure.
- 4.5.7 Holland describes the use of a water wheel at this site which supplied power for winding in the shaft; such a wheel could also have provided power for crushing machinery (Holland 1987, 159 and 226). Features in the stream bed support the notion that there was a water wheel here, such as the remains of a weir and supply leat. The weir is visible opposite the shaft as a right-angle of large square boulders standing up to 1.3m high; in front of this are the remains of a spillway of cobbles set into the stream bed. A rock-cut channel can be seen at the crest of the waterfall, which may have been the take-off for the supply leat. It is by no means certain that this wheel supplied the power to wind in the shaft as there is evidence for an overhead winding mechanism operated from another wheel elsewhere in the valley c 1877. Given the presence of crushed spoil it is possible that a small wheel at the shaft head provided power for this secondary processing. Further to the south is a platform adjacent to the stream which is revetted by a low stone wall, measuring 0.2m high, on which are the remains of a structure. The foundations, which form a square measuring 4.2m by 3.8m, are barely visible due to scree falling from above; it is likely that both the platform and building are associated with the workings at Hospital Shaft.
- 4.5.9 **Test Excavation 354 (Fig 3):** opposite the foot of the incline on the north side of Levers Water Beck a rock-cut gully with a tree growing out of it marks the

position of a trial excavation. The working consists of a square niche, measuring 5m by 2.5m, cut out of the hillside with two dwarf walls which project away from the edges of the cut to a small spoilheap.

- 4.5.10 **South Shaft 355 (Fig 3):** in 1866 South Shaft was a timbered shaft originally sunk from the level of Courtney's Cross Cut (360), in order to exploit South Vein. However, the shaft was subsequently extended upwards to the surface to allow winding cables which, according to Holland (1987), ran overground from the water wheel at Hospital Shaft (353) (*op cit*, 226) (Fig 3). The position of South Shaft can be seen at the surface as a circular depression, 6m in diameter and 1.5m deep, which has been blocked with pieces of iron and wood (Fig 3). Around the lip of the shaft top, on the downslope side, is an apron of spoil. Extending away from the shaft to the east is a trackway cut into the slope which connects to Trackway 300. There is an intermittent revetment wall on the downslope side that is up to 0.4m high.

4.6 OVERHEAD WINDING MECHANISMS AT PADDY END

- 4.6.1 There was a complex series of overhead winding mechanisms supporting the shafts at Paddy End. A lack of field evidence for these overhead systems does not in itself bring their existence into question; the use of wood, re-use of machinery, and the short-lived nature of some of the mine structures all effect the survival of remains relating to these mechanisms.
- 4.6.2 **Winding in South Shaft:** South Shaft (355) was extended to the surface so that winding could be carried out directly. Holland (1987, 226) states that the water wheel at Hospital Shaft (355) provided power for this system, requiring 100m of overland wire-way. Directly on line with the route of this wire are the remains of a masonry pillar, measuring 4m by 4.5m; it has outer boulder walls standing up to 1.7m high and is filled with random rubble. A further 25m towards the shaft is a ridge of bare rock which has a long length of heavy iron chain attached to it, and could be an anchor chain to stabilise the pylon on top of the masonry pillar.
- 4.6.3 **Winding in Hospital Shaft:** evidence for this system comes from a mine section dated 1877 (reproduced in Postlethwaite 1913, 117). It shows a cross section of the Paddy End works with the surface topography, levels and shafts which were operating at that time; the section is 'joggled' to allow the depiction of the levels, shafts and east side of the valley. The drawing seems to show an overhead cable winding in Hospital Shaft which was connected via an intermediate support to a large water wheel on the opposite side of the valley. The water wheel appears to have been situated at about the same height as Grey Crag Level but on the eastern side of Levers Water Beck, and, if the scale is true, at a distance of 274m from the shaft. These dimensions put the position of the wheel in the vicinity of the Paddy End Dressing Floors (the Paddy End mill closed c1879) and the re-use of one of the many water wheels on this site is very likely.

5. CONCLUSIONS

5.1 IMPACT OF RECENT DAMAGE AND EXPOSURE OF THE DRESSING FLOOR TERRACES

- 5.1.1 **Overview:** the site is scheduled and is nationally important because of its good condition and their exceptional heritage importance (*Appendix 1*), but the remains are fragile and are susceptible to erosion and decay. The impact of the recent erosion, from the floods of the burst United Utilities pipe, has impacted the central section of the Paddy End Dressing Floors. The water has cut down into the subsurface archaeological deposits and structures, using the extant leats as routeways, which have then been severely damaged or destroyed. In extreme cases the water erosion has also impacted upon standing structures, most importantly parts of the smithy building (**363**) and the mill building (**369a**). Lesser impacts have occurred from lateral movement of water along the terraces but this has been limited to superficial erosion on the flat terrace floors and sloping erosion rubble between terraces.
- 5.1.2 **Smithy Building (363):** the Smithy building has been heavily damaged by water erosion from the burst pipeline that was immediately to the rear and upslope of the structure. Erosion/demolition rubble has covered and damaged both the northern and southern walls of the structure (Plates 14 and 15).
- 5.1.3 **Ore Bins (365):** the eastern ore hopper has suffered slightly from the recent water erosion damage, exposing the top course of the large rear retaining wall, displacing some erosion rubble into the hopper itself below, and exposing a small area of flagged flooring on the front end of the ore bin. Water erosion has also eroded and displaced rubble on the sloping ground on either side of the ore hopper bins and has exposed areas of cobbling along this section of Track **300**.
- 5.1.4 **Leats:** the terraces below the hopper platform were constructed so as to enable efficient use of the limited space available and therefore incorporated a network of underground leats. Wherever the leats have remained extant below the area of the recent erosion, the flow of water was often tracked along them and they have been exposed as the pressure of water has burst them open and removed surrounding material. In some instances, the water erosion has entirely removed sections of the leats.
- 5.1.5 **Structures on Terrace 369:** Terrace **369** is located immediately below the hoppers and is defined by a badly damaged revetment wall. On the terrace are several structures, which almost certainly were elements of the main mill building (**369a**), which had two opposing external water wheels as shown on the early mine layout drawing in this location (Adams 1988, Plate 5). As a result of the water erosion in this area, a stone-capped leat has been exposed from the slope at the west end of the mill building (**369b**). The recent water erosion has exposed the edge of the stone-flagged floor above the leat and also fragmentary sections of the wooden box leats above the slipped paving slabs (Plates 17 and 18). Further to the east are two masonry pillars (**369a**) (Plates 17 and 19), east of which are two recently exposed leats projecting from the section. One is stone lined and projects from the top of the section heading east. Below this a wood-lined leat, measuring 1m wide and 0.3m deep, covered by sheet iron, projecting forwards to the lower

terrace (370). On either side of the iron sheet covered wood-lined leat are two collapsed stone-lined leats projecting south. To the south of the mill (370a) is a small area of cobble flooring (369d) that has been exposed near to the front edge of the terrace.

- 5.1.6 **Structures on Terrace 370:** the western half of the terrace, surviving as a rocky slope of collapsed material, has been heavily modified by the recent water erosion. The erosion was concentrated through an area of interconnecting stone and wood-lined leats which were still presumably intact prior to the inrush of large amounts of water (Plates 21 and 23). The erosion has exposed, and partly damaged, at least four stone-lined leats and a wooden box drain. In addition, an east/west running dividing wall has been exposed with a wider planked wooden floor flush against its southern edge (370b) (Plate 24). Fine processing waste has been exposed to the south of the wooden leat near the edge of the revetted wall and spilling onto Terrace 371 below.
- 5.1.7 **Wheel Pit and Terrace 371:** projecting from the upper retaining wall/ slope are the remains of a wheel pit and a supply leat above (371b and c). The wheel pit was previously partially visible, measuring 4m long by 2.3m wide (Lofthouse 1997); however, recent water erosion has infilled it completely and has covered the ground to the west of it with erosion rubble (Plate 25).
- 5.1.8 **Structures on Terraces 372, 373 and 374:** the outflow from the reservoir (372a) on Terrace 372 has run across Terrace 373 over a stone-flagged cascade from where it has worn a large gully extending to Terrace 374 and its retaining wall; a small wooden leat also projects from the base of the sluice of the outflow of the reservoir, and extends to the south-east (372b). In the side of the water-worn gully a wooden leat can be seen in section, filled with sludge and finings, and possibly indicates that such materials were transported around the site using a strong flow of water in the now buried leat. The recent water erosion has also revealed a stone-capped drain (373a) running roughly north/south at the base of the eroded gully. Terraces 372 and 372 have been covered by slumping and erosion from above, and in the west water erosion has cut through the front edge on the retaining wall onto Terrace 374 below. At the west side of Terrace 374 is the continuation of the water-worn gully from the reservoir on Terrace 372.

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APPENDIX 1: PROJECT BRIEF

Paddy End Dressing Floors, Coniston Coppermines

SUMMARY

In 2005 the LDNPA archaeology service was notified that the area known as the Paddy End Dressing Floors had been affected by the bursting of a water main and subsequent wash out. This disturbance had revealed various features of archaeological significance. A programme of archaeological investigation is proposed in order to examine and record the features and deposits exposed and to consolidate the damaged structural remains.

1. LOCATION

The site is located at NGR SD 285 992, in the Coppermines Valley (see Map 1).

2. ARCHAEOLOGICAL BACKGROUND

- 2.1 Copper mining was first recorded at Coniston in 1599 by German miners of the Company of Mines Royal and appears to have continued until the Civil War. The next period of certain activity occurred between the 1760's and 1800's. The C19 was by far the most productive period and has left the majority of surviving field remains. By 1895 mining operations began to decline due to the fall in world prices, etc. The mines closed in 1915 with a brief period of unsuccessful prospecting in 1954. The group forms the most extensive and well-preserved group of copper mining and processing features in England and is of high national importance. Particularly important aspects are: the impressive well- preserved C16-17 workings of the 'Back Strings' near Levers Water; the extensive C18-19 water-powered mining and processing operations of the Bonsor, Red Dell and Paddy End Mines, and the early layout forms of Barratt & Taylors water-powered mechanisation; late C19-20 developments of water turbines and electro- lytic ore processing on the Bonsor Floors (MPP Evaluation).
- 2.2 Various site or components of sites are recorded in the Lake District Historic Environment Record for this area (see Map 1).

HER No	Scheduled Monument No.	Grid Ref. E	Grid Ref. N	Site Type	General Period	Specific Period
2690		329000	498000	Copper Mine	Post Medieval	Unknown
2692	00059	329040	498100	Cairnfield	Prehistoric	Bronze Age
3155		327500	498500	Leat	Post Medieval	Unknown
4154	00542	328500	499200	Copper Mine	Post Medieval	Tudor
18066		327700	498300	Pipeline	Unknown	Unknown
18068		329530	498680	Quarry	Unknown	Unknown
18069		329430	498520	Quarry	Unknown	Unknown
18070		329280	498880	Copper Mine	Unknown	Unknown
18092		327804	498500	Copper Mine	Post Medieval	Unknown
18092		327804	498500	Gunpowder Works	Post Medieval	Unknown

HER No	Scheduled Monument No.	Grid Ref. E	Grid Ref. N	Site Type	General Period	Specific Period
18101		328140	498150	Quarry	Unknown	Unknown
18102		328270	497760	Wall	Unknown	Unknown
18105		327870	497990	Mine	Unknown	Unknown
32547		327973	499608	Ring Cairn	Prehistoric	Unknown
32561		327981	499596	Ring Enclosure	Prehistoric	Unknown

Further details of these sites can be obtained from the Lake District National Park Authority, Murley Moss, Oxenholme Road, Kendal, LA9 7RL. Tel. 01539 792712/Fax. 01539 740822/Email Eleanor.Kingston@lake-district.gov.uk

3. RECENT DAMAGE

- 3.1 In 2005 the LDNPA archaeology service was notified that the area known as the Paddy End Dressing Floors had been affected by the bursting of a water main and subsequent wash out. The LDNPA Archaeologist visited the site to assess the damage and noted that areas of the dressing floor had been exposed and disturbed by this event. This disturbance had revealed various features of archaeological significance.

4. SIGNIFICANCE OF THE SITE

- 4.1 The site is part of Scheduled Monument Number 542, a nationally important and designated site. During the Monuments Protection Programme the site was assessed and recommended that the existing scheduling was affirmed and justified by the 'fragility of remains and exceptional heritage importance' (MPP, Minor Metal Industries, Step 4 Report, Appendix 3, Site Assessments).

5. PROPOSED PROJECT

- 5.1 It is therefore proposed that a project be developed for the Paddy End Dressing Floors to comprise the following programme of work:

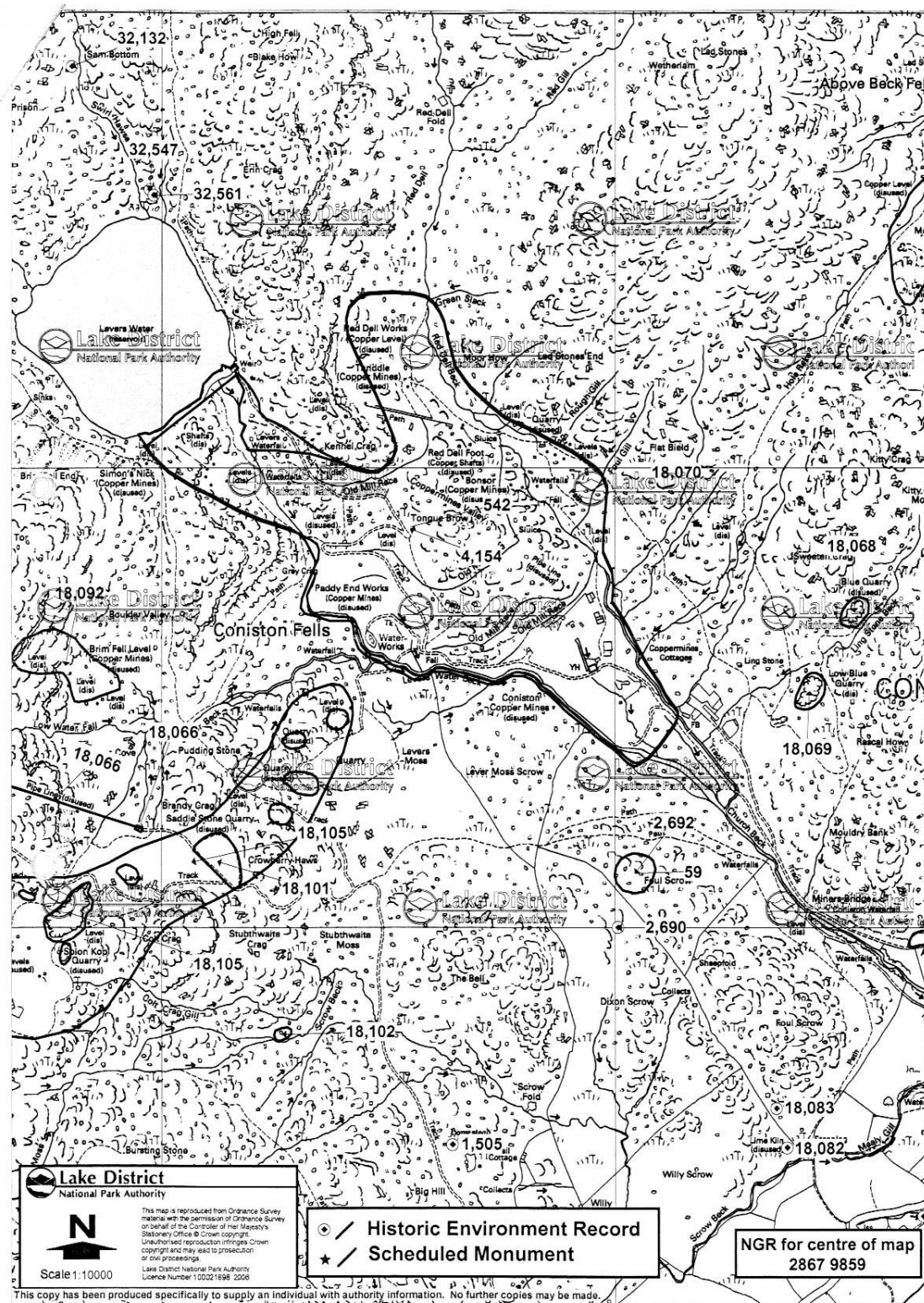
- Level 3 survey (RCHME, 1999) of the remains of the Paddy End Dressing Floors (see area marked on map 2).

The survey will include the recording of any exposed wooden or metal features and the grade of material deposited in spoil dumps in order to determine which processing occurred on different parts of the site. Detailed elevation recording should be undertaken for any standing remains, such as walling.

The Royal Commission on the Historical Monuments of England (RCHME) undertook a survey of the Coniston Coppermines in the 1990s (Coniston Coppermines: 1:2500 Survey: Archaeological Survey Report, RCHME, 1996). The site was surveyed at a scale of 1:2500, with detailed survey areas at 1:500. The Paddy End Dressing Floors were not included at the 1:500 scale and this survey should be undertaken to address this and complement the original survey.

The Cumbria Amenity Trust Mining History Society (CATHMS) has undertaken considerable research above and below the ground in this area. It is recommended that their help be sought during this project. It is proposed that CATMHS has an opportunity to join the survey in order to assist and learn techniques of archaeological investigation and recording.

- 5.2 A project design and costing for this project is invited.



APPENDIX 2: PROJECT DESIGN

**Oxford
Archaeology
North**

September 2006

PADDY END DRESSING FLOOR, CONISTON COPPER MINES LAKE DISTRICT NATIONAL PARK

ARCHAEOLOGICAL SURVEY

PROJECT DESIGN AND SPECIFICATION

Proposals

The following project design is offered in response to a brief from the Lake District National Park Authority. The proposed project involves a programme of survey to record the remains of the Paddy End Dressing Floor, the purpose of which is to enhance the existing archaeological record and enable appropriate management and interpretation strategies to be enacted.

1. INTRODUCTION

- 1.1 Lake District National Park Authority have invited Oxford Archaeology North (OA North) to tender for an archaeological survey of the Paddy End Dressing Floors, Coniston Copper Mines. The proposed programme is intended to provide for the conservation management of the landscape and archaeological resource.

1.2 PADDY END MINES

- 1.2.1 Mining at Paddy End dates back to the second half of the eighteenth century, but the main period of activity on the site reflects its acquisition by John Taylor and the direction of his overseer John Barrett (Holland 1987). Renewed exploration of the Paddy End levels took place after 1818. Initially processing of the ore was undertaken at the lower Bonsor Mill, but this entailed considerable effort in transport, so a second processing mill was established at Paddy End. The ore was processed by crushing using large stamps and then settling in ponds. The mill though had a short life, as the below ground adits and mines were extended they ultimately linked into the lower Bonsor adits and the ore could then be taken out at the lower adits and processed at the Bonsor Mill. This ultimately led to the closure of the Paddy End mill in the early 1880's. Working of the Paddy End mines nevertheless continued until the turn of the century (*ibid*).

1.3 OXFORD ARCHAEOLOGY NORTH

- 1.3.1 OA North has considerable experience of the evaluation, survey and excavation of sites of all periods, having undertaken a great number of small and large scale projects during the past 17 years. One of its particular specialisms is in the sphere of landscape recording and assessment. OA North has the professional expertise and resource to undertake the project detailed below to a high level of quality and efficiency. OA North and all its members of staff operate subject to the Institute of Field Archaeologists (IFA) Code of Conduct.
- 1.3.2 OA North has undertaken a large number of upland landscape surveys for a variety of clients (both private and national agencies such as English Heritage and Royal Commission on the Historical Monuments of England (RCHM(E)) and employs a qualified surveyor (James Quartermaine, BA, DipSurv, MIFA) who has many years experience of the identification and survey of upland landscapes, having worked closely with the RCHM(E) and the Lake District National Park Authority on a number of projects.
- 1.3.3 Since 1982 OA North has been undertaking extensive upland landscape surveys throughout Northern England but mainly in the Lake District. Surveys include the Lake District National Park Survey, the Torver Common surveys (Lake District), Haweswater and Thirlmere estate surveys (Lake District), Lyme Park (Peak District), most of the Forest of Bowland AONB, Lancashire, and a multitude of smaller landscape projects which include the Otterburn Range surveys in the Lake District National Park. OA North has undertaken archaeological field surveys of over 610sqkm of upland landscapes and has recorded over 21,000 field monuments. On the Arnside/Silverdale project, in 1992, OA North was the first archaeological organisation in Britain to use GPS (Global Positioning System) survey techniques and since then has considerably advanced its skills in this area. OA North can therefore claim to be one of the foremost specialists in the field of upland landscape recording.
- 1.3.4 Of relevance to the proposed project OA North has undertaken extensive surveys of industrial landscapes in the Lake District and elsewhere in Northern England. North has considerable experience of the recording of industrial landscapes from both Cumbria and elsewhere in Northern England. Notable examples include the Grassington Lead Mines, the Nenthead lead smelt mill, the Thirlmere lead mines and smelt mill (LUAU 1998), the Greenside lead mines and smelt mill, The Snailbeach lead mines (Shropshire) and smelt mill, and the Keekle coal mining landscape.

1.4 PROJECT DESIGN

- 1.4.1 The following project design specification sets out the objectives of the project, provides a methods statement demonstrating how these can be met, defines the resource implications of the methods statement and links these to a timetable and costings. Details of quality standards and monitoring procedures are also included.

2. OBJECTIVES

- 2.1 The primary purpose of the project is to inform future management decisions with regard to conservation matters relating to the archaeological and historical content of the industrial landscape.
- 2.2 The following programme has been designed to provide an accurate archaeological survey of the Paddy End Dressing Floors, set within their broader landscape context. It is important that the individual sites are not simply viewed as isolated points on a map, but that the archaeological record reflects their group value and their importance to the historical fabric of landscape character areas within the areas.

3. METHODS STATEMENT

- 3.1 The following work programme is submitted in line with the objectives of the archaeological work summarised above. It is divided into three elements, plan survey, elevation survey, and reporting.

3.2 DETAILED PLAN SURVEY OF THE PADDY END DRESSING FLOORS:

- 3.2.1 The detailed survey will provide for a full record of all built elements within the extent of the Paddy End study area. This will be undertaken by means of total station survey in conjunction with GPS survey.
- 3.2.2 **Control:** the survey control will be established by closed traverse using a Leica TC407 total station, and will be located using the Leica 1200 differential GPS. The 1200 series GPS obtains corrections from Ordnance Survey GPS base stations, that are all over the country and are never more than 10km from any site. The corrections are transmitted by mobile phone, and as long as there is a mobile phone signal at the point of survey can provide real time accuracies of +/- 0.03m (at worst with poor satellite coverage the accuracy deteriorates to +/- 0.08m). It is proposed to locate the base line using the GPS and establish the closed traverse with respect to these primary control points. Height control will be established by the same process. Permanent survey control markers will be established over the core survey area to enable the future enhancement of the survey maps.
- 3.2.3 **Detail:** the detail survey will be established by a combination of GPS techniques and total station survey. The spoil heaps and general topography will be recorded by GPS and the detail of the dressing floors and adits will be by total station. The data from both surveys will be superimposed on the same grid within a CAD system.
- 3.2.4 **Total Station Survey:** the total station survey will be generated by EDM tacheometry using a total station linked to a pen computer running TheoLT software. The digital data is transferred onto the pen computer for manipulation and transfer to other digital or hard mediums. The survey data will be accurate to +/- 0.01m. The topographic survey will record all structural components, such as terrace walls and adits where there is a requirement for a higher level of accuracy.
- 3.2.5 **GPS Survey:** a Satellite Global Positioning System (GPS) will be utilised to satisfy the Level 3 survey requirements. GPS uses electronic distance measurement along radio frequencies to satellites to enable a positional fix in latitude and longitude which can be converted mathematically to Ordnance Survey national grid. The GPS is a Leica 1200 differential system and uses Ordnance Survey base stations in conjunction with a roving station to correct the raw data with corrections transmitted by mobile phone. It has already been established that there is good Vodafone reception at the site and consequently the technique will be effective in recording the remains. The accuracy of the OA North GPS system is capable of +/- 0.03m and provides for a quick and effective means of recording the detail of the features. It is proposed that this technique be used to record the spoil heaps, earthwork features and topography which have a lower accuracy requirement.
- 3.2.6 **Drawing Up:** the raw data from the total station and the GPS will be combined within a CAD system, and then plots will be generated to enable the drawing up of the sites within the field. The archaeological detail is drawn up in the field as a dimensioned drawing on the plots with respect

to survey markers. On completion of the field survey the drawings will be enhanced within the CAD environment to produce the final drawings.

- 3.2.7 The survey will record all pertinent archaeological detail, which will include any exposed wood or metal features, the internal detail of the settling ponds, the changes between different grades of spoil, and any detail pertinent to the operation of the dressing floors.
- 3.2.8 Although the survey of Paddy End will be a new survey, it will be combined with the existing RCHME 1:2500 survey in the CAD system to provide a wider context for the Paddy End survey.
- 3.2.9 **Photography:** in conjunction with the archaeological survey a photographic archive will be generated, which will record significant features as well as aspects of the general landscapes. It will record all principal vistas. This photographic archive will be maintained using black and white 35mm film and also using a digital camera with 6 mega pixel resolution. The use of a digital camera provides very effective manipulation of photographic images, and these will be used in the report. The use of photography in this way considerably enhances the usability of a database and greatly assists the analysis of the landscape.
- 3.2.10 **Description:** the Paddy End Dressing Mill has already been comprehensively described for the RCHME survey report, and it is not intended to redo or replace this descriptive record; however, it is recognised that the survey may identify elements that were not evident at the time of the earlier survey, or which warrant more detailed description. Subject to an agreement with English Heritage and the author (Colin Lofthouse 1997) of the earlier report, it is proposed to take a copy of the earlier report into the field and enhance the descriptions of the individual features as appropriate. The descriptive entries will be input directly into a Psion palm computer, for subsequent incorporation into the project report.

3.3 ELEVATION DRAWINGS

- 3.3.1 A record will be created of selected elevations of the walls, using a combination of rectified photography and reflectorless survey instrument. Where possible rectified photography will be taken to provide a basic face on record of the external elevations. The rectified photography will be undertaken by in-house survey specialists and will be undertaken in black and white using a medium format camera. Control for the rectified photography will be provided by a reflectorless instrument, and will record the locations of clearly defined elements of structural detail rather than targets to prevent the need for physically accessing the walls. The photography will be output at an appropriate scale; it will be scanned into a computer and presented as a raster backdrop within AutoCAD. Where there is any distortion within the photographic base, the digital image will be subject to digital correction using Archis software to convert the images to fully rectified images. The corrected images will then be incorporated as a raster backdrop within AutoCAD and the elevation drawings will be drawn up as a vector drawing from the rectified base.
- 3.3.2 The final drawings will show all significant stone detail, such as quoins, ashlar stones, and significant detail, but will not involve the digitising of all stone detail. The elevation drawings will incorporate the drawn outlines of all principal features within the elevations, but will also be superimposed onto the rectified photographs, where appropriate, which will show all the individual stones and surface detail. Drawings can be provided with and without this background detail as required. The initial method of plotting of the external elevations will entail generating a face on view of the rectified photograph and then manually tracing around the detail in AutoCAD to produce a line drawing of the architectural detail in AutoCAD. It is important that the interpretation of the elevation is based on a detail investigation, so it is proposed that a phase of manual enhancement of the drawing be undertaken on site which will be based on the line drawings produced by the plotting process and will provide for a high quality analytical drawing of all elevations.
- 3.3.3 At present the extent of the wall survey has not been defined, so the costs provide for the survey and drawing of a sample 4m long section of wall. These figures can then be used to extrapolate the overall costs once a clearer idea of the survey requirements are known.

3.4 CUMBRIA AMENITY TRUST MINING HISTORY SOCIETY (CATMHS)

- 3.4.1 It is recognised that CATMHS has considerable knowledge about the operation and history of the copper mines and that their experience would considerably contribute to the present survey. It is proposed to initiate a dialogue with the society and provide for the incorporation of their results into the present study.
- 3.4.2 It is proposed that the survey programme incorporate a training element for members of the society in the course of the field survey. Members of the society will be instructed in survey techniques and will be taught how to use the total station; they will be encouraged to take an active involvement in the present survey.

3.5 PROJECT ARCHIVE AND REPORTING

- 3.5.1 **Archive:** the results of the fieldwork will form the basis of a full archive to professional standards, in accordance with current English Heritage guidelines (*Management of Archaeological Projects, 2nd edition, 1991*). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. This archive will be provided in the English Heritage Centre for Archaeology format, both as a printed document and digitally. Digital survey data will be provided in a suitable format for incorporation into the MapInfo Geographical Information System (GIS). A synopsis (normally the index to the archive and the report) should be placed in the Cumbria Sites and Monuments Record.
- 3.5.2 **Digital Presentation:** the survey data will be digitally transferred into a CAD system (AutoCAD) and superimposed with the 1:2500 mapping undertaken by the RCHM(E) by LDNPA. The drawings can be output at any required scale, although the accuracy of generation assumes that the drawings will not be reproduced at scales of greater than 1:500. A digital copy of the archive will be passed to LDNPA on completion of the survey alongside the final report. A copy of each plan will be supplied on polyester film at a standard scale.
- 3.5.3 **Reporting:** the report will identify areas of defined archaeology and an assessment and statement of the actual and potential archaeological significance of the material, within the broader context of regional and national archaeological priorities, will be made. It will incorporate descriptions of the individual features based upon those compiled for the RCHME report on the Copper Mines (subject to agreement with English Heritage). The report will make a clear statement of the archaeological potential of the individual sites within the study area.
- 3.5.4 **Content:** the full report will consist of an acknowledgements statement, lists of contents, executive summary, introduction summarising the brief and project design and any agreed departures from them, methodology, historical background (based on the RCHME survey and the history by Eric Holland (1987), descriptions of principal features (in accordance with *Management of Archaeological Projects, 2nd edition, 1991*), list of archive contents and bibliography. Illustrative material will include location maps, plans and elevation drawings.
- 3.5.5 **Summary History:** the report will be presented on the basis of the results of the field survey, the RCHME survey and the history by Eric Holland (1987). It will examine the factual evidence for the establishment and development of the Paddy End Dressing Floors and adits.
- 3.5.6 **Output:** three bound and one unbound copies of the full report will be submitted to the Lake District National Park Authority. Each report will be illustrated by a selection of prints and maps.

3.6 CONFIDENTIALITY

- 3.6.1 The report is designed as a document for the specific use of the Client, for the particular purpose as defined in the project brief and project design, and should be treated as such; it is not suitable for publication as an academic report, or otherwise, without amendment or revision. Any requirement to revise or reorder the material for submission or presentation to third parties beyond the project brief and project design, or for any other explicit purpose, can be fulfilled, but will require separate discussion and funding.

4. OTHER MATTERS

4.1 ACCESS

- 4.1.1 It is assumed that LDNPA will obtain access to undertake the survey from land owners and tenants.

4.2 HEALTH AND SAFETY

- 4.2.1 Full regard will, of course, be given to all constraints (services) during the excavation, as well as to all Health and Safety considerations. The OA North Health and Safety Statement conforms to all the provisions of the SCAUM (Standing Conference of Unit Managers) Health and Safety manual, as well as the OA Health and Safety Statement. Risk assessments are undertaken as a matter of course for all projects, and will anticipate the potential hazards arising from the project.

4.3 INSURANCE

- 4.3.1 The insurance in respect of claims for personal injury to or the death of any person under a contract of service with the Unit and arising in the course of such person's employment shall comply with the employers' liability (Compulsory Insurance) Act 1969 and any statutory orders made there under. For all other claims to cover the liability of OA North in respect of personal injury or damage to property by negligence of OA North or any of its employees there applies the insurance cover of £10m for any one occurrence or series of occurrences arising out of one event.

4.4 WORKING HOURS

- 4.4.1 Survey works will be undertaken on the basis of a five day week, within daylight hours only. It is anticipated that because of the use of academic members of staff and volunteers for certain aspects of the project, some works will be conducted during weekends.

5. WORK TIMETABLE

- 5.1 The phases of work will comprise:

5.1.1 *Field Survey*

7 days will be required for the field survey

5.1.2 *Archive and Reporting*

20 days would be required to complete this element.

- 5.1.3 OA North can execute the project within two weeks receipt of written notice.

6. OUTLINE RESOURCES

6.1 STAFFING

- 6.1.1 The project will be under the management of **Jamie Quartermaine BA DipSurv** (OA North Project Manager) to whom all correspondence should be addressed. He will monitor the progress of the project ensuring adherence to all agreed programmes and timetables. He will also provide technical back-up, advice, and will have editorial control over the compilation of the full report. He has many years experience of surveying upland landscapes, particularly in the Lake District and Yorkshire Dales National Parks. In particular he has considerable experience of recording industrial landscapes, which include the Wythburn Lead Mines and dressing floors, the Greenside Lead Mines and smelt mill, the Snailbeach Lead Mines and dressing floors and the Grassington lead dressing floors.

- 6.1.2 The field survey will be led by **Peter Schofield BA** who has considerable experience of field survey work, including prehistoric landscapes, and has undertaken considerable survey work

throughout Cumbria and was a team leader on the recent major survey of the Northern Welsh Uplands. He undertook the recent surveys for the National Trust at Ennerdale in West Cumbria, and also at St Catherines, Windermere. He has recently completed a major boundary survey of an MOD training area, Holcombe Moor, in South Lancashire which has enabled us to develop GIS methodologies for analysing the results of the boundary survey.

- 6.1.3 Advice and consultancy will be provided by **Ian Miller**, who has considerable experience of the recording and excavation of industrial landscapes and was responsible for the analysis and compilation of the report for Greenside smelt mill.

APPENDIX 3: SITE GAZETTEER

Feature Number	300
NGR	SD 2833 9881 to SD 2857 9867
Site Type	Trackway
Source	English Heritage, 1997, OS 1851, OS 1892, OS 1919, Holland 1987, Holland 1989, Adams 1988

Description

The trackway is the only direct route from Coniston village to the Coppermines Valley and, as such it is probably the oldest route in the valley. It winds steeply up from the village as a rough track terraced into the hillside, measuring 4m wide. As the valley floor levels out the track extends on a raised agger, measuring 20m wide at its base and standing up to 4m high, providing a direct approach which is protected from flood waters. The effect of this construction is the channelling of the Red Dell Beck forming Church Beck. The blasting of the section above the Church Beck waterfall and constructing the raised section are probably nineteenth century improvements. Levers Water valley is reached via Track **300** which heads north-west from the Bonsor Dressing Floors. The track is shown on the 1891 2nd edition OS map following the present alignment although the track has now been widened and improved by United Utilities to provide access to the dam at Levers Water. One change from its earlier alignment is at the first hairpin bend, which used to turn uphill to the south of the ore reception hoppers (**365**); the track now extends around to the north.

Feature Number	339
NGR	SD 2857 9875 to SD 2844 9881
Site Type	Leat
Source	English Heritage, 1997, OS 1892, OS 1919, Holland 1987, Marshall and Davies-Shiel 1977, Adams 1988

Description

One of the most impressive feats of above-ground engineering at the mines is the leat which was constructed to carry water from the Red Dell Beck around the hillside to the Paddy End Dressing Floors. The leat was constructed in the nineteenth century to supply the Paddy End Mill with water; this water is likely to have originally come from the Levers Water Beck having been re-routed to Red Dell from higher up via leat **114**. The leat was re-used *circa* 1890 after the closure of the Paddy End Dressing Floors to provide water to a Pelton wheel situated in the sawmill building (**319**) on the Upper Terrace of the Bonsor Dressing Floors; water was delivered to this via a water drop (**336**). The leat is 620m long and extends around the hill approximately along the 270m contour. Where the leat enters the Paddy End Dressing Floors it has been eroded by a small stream which has eroded through the leat exposing timbers. The leat continues towards the dressing floor as a ditch, measuring 2.7m wide and 0.7m, skirting the base of the spoilheap from the earlier Gaunt's Level (**362**) but is not visible beyond track 300; the leat would have entered the dressing floors at the level of the upper terrace.

Feature Number	342
NGR	SD 2847 9884
Site Type	Adit (Gaunt's Level)
Source	English Heritage, 1997, OS 1851, OS 1892, OS 1919, Holland 1989, Marshall and Davies-Shiel 1977, Adams 1988

Description

A well preserved stone-arched adit entrance, measuring 2m high by 1.2m wide, which has two finger dumps of spoil extending down the hillside from the tunnel. The construction of the adit pre-dates Leat **339** as the course of the leat circumnavigates the base of the spoilheaps. A short pathway, visible as a flat grassy platform, extends from the top of the spoilheap along the contour to the west up to Building **364**.

Feature Number	353
NGR	SD 2827 9892
Site Type	Shaft (Hospital Shaft)
Source	English Heritage, 1997, Holland 1989

Description

This shaft was dug circa 1865-70 to connect Hospital Level (**356**) on the Paddy End Vein with Deep Level, prior to this connection ore was winched up the shaft. The entrance to the shaft is located in the stream bed 120m upstream from the footbridge. The entrance is overwhelmed by scree although a number of projecting timbers mark its position; there is a slot cut out of the bedrock at the side of the waterfall which is probably a rebate for the timber super-structure of the shaft head. South of the shaft the scree and spoil coming from Middle Level have obscured a number of features which can be seen in section where the stream has eroded the bank. A wall, measuring up to 1.2m high, and paved surfaces can be seen, in amongst which are some copper rich sediments and layers of fine gravel which resembles waste from crushing. Holland describes the use of a water wheel at this site which supplied power for winding in the shaft; such a wheel could also have provided power for crushing machinery (Holland 1987, 159 and 226). Features in the stream bed support the notion that there was a water wheel here, such as the remains of a weir and supply leat. The weir is visible opposite the shaft as a right-angle of large square boulders standing up to 1.3m high; in front of this are the remains of a spillway of cobbles set into the stream bed. A rock-cut channel can be seen at the crest of the waterfall, which may have been the take-off for the supply leat. Given the presence of crushed spoil it is possible that a small wheel at the shaft head provided power for this secondary processing. Further to the south is a platform adjacent to the stream which is revetted by a low stone wall, measuring 0.2m high, on which are the remains of a structure. The foundations, which form a square measuring 4.2m by 3.8m, are barely visible due to scree falling from above; it is likely that both the platform and building are associated with the workings at Hospital Shaft.

Feature Number	355
NGR	SD 2834 9888
Site Type	Shaft (South Shaft)
Source	English Heritage, 1997, Holland 1989

Description

In 1866 this shaft was sunk from the level of Courtney's Cross Cut (**360**) and was in fact a timbered shaft constructed through open slopes. The shaft was extended upwards to the surface to allow winding cables which, according to Holland, ran overground from the water wheel at Hospital Shaft (Holland 1987, 226). The position of the shaft can be seen at the surface as a circular depression, 6m in diameter and 1.5m deep, which has been blocked with pieces of iron and wood. Around the lip of the shaft top on the downslope side is an apron of spoil. Extending away from the shaft to the east is a trackway cut into the slope which connects to Track **300**. There is an intermittent revetment wall on the downslope side, measuring up to 0.4m high. South Shaft was extended to the surface so that winding could be carried out, thus avoiding the right-angle bend into the tunnel. Holland states that the water wheel at Hospital Shaft provided the power for this system, requiring 100m of overland wire-way. Directly on line with the route of this wire is the remains of a masonry pillar, measuring 4m by 4.5m; it has outer boulder walls standing up to 1.7m high and is filled with random rubble. A further 25m towards the shaft is a ridge of bare rock which has a long length of heavy iron chain attached to it and could be an anchor chain to stabilise the pylon on top of the masonry pillar. While the siting of this pillar would seem to support the idea of winding in the South Shaft it is included in the description by Holland of a system of winding in Middle Level; it is possible that the pillar was re-used.

Feature Number	356
NGR	SD 2831 9885
Site Type	Level (Hospital Level)
Source	English Heritage, 1997, OS 1892, OS 1919, Holland 1989, Marshall and Davies-Shiel 1977, Adams 1988

Description

On the east side of the Levers Water Beck at the base of the incline is an adit entrance, measuring 1.1m high by 1.5m wide. It is at the end of a narrow gully formed on one side by a rock wall, measuring 3m high, and by the foot of the incline on the other. According to Holland (1987, 115) the adit was driven circa 1864 and intersected the South Vein and the Paddy End Vein; however the arrangement of the walls between the incline and the adit, which converge at the tunnel entrance, suggest that the adit is the earlier feature. A flanking wall which extends from the entrance at 45 degrees can be seen incorporated into the fabric of the incline; this would normally demonstrate that the adit pre-dated the incline. Holland references a mine survey carried out in 1833 which seems to describe both the Middle Level and the incline in operation at this time. Possibly Hospital Level re-uses an earlier adit not indicated by the mine

records, or alternatively the base of the incline may have been temporarily removed and revetted with this wall to allow the initial blasting of the level, and was re-built afterwards; in the latter case it is difficult to see why it was necessary to locate the adit entrance in such an inconvenient place.

Winding in Hospital Level: evidence for this system comes from a mine section dated 1877 (Postlethwaite 1913, 117). It shows a cross section of the Paddy End works with the surface topography, levels and shafts which were operating at that time; the section is 'joggled' to allow the depiction of the levels, shafts and east side of the valley. The drawing seems to show an overhead cable winding in Hospital Shaft which is connected via an intermediate support to a large wheel on the opposite side of the valley. The water wheel appears to be situated at about the same height as Grey Crag Level on the eastern side of the stream and if the scale is true, at a distance of 274m from the shaft. These dimensions put the position of the wheel in the vicinity of the Paddy End Dressing Floors.

Feature Number	357
NGR	SD 2829 9884
Site Type	Level (Grey Crag Level)
Source	English Heritage, 1997, OS 1851, OS 1892, OS 1919, Holland 1989, Marshall and Davies-Shiel 1977, Adams 1988

Description

Located directly opposite the foot bridge on the west side of the stream adjacent to a large boulder is the now collapsed entrance to Grey Crag Level. It remains as a shallow gully, measuring 16m by 5m, at the mouth of which are traces of revetment walls. The rails from the adit crossed the stream on a bridge, the abutments of which can still be seen. The modern footbridge re-uses the abutments which are of drystone construction and stand to a height of 1.6m high. The adit was driven *c* 1830 to the Paddy End vein, and eventually connected to Middle and Top Levels.

Feature Number	358
NGR	SD 2830 9886
Site Type	Incline
Source	English Heritage, 1997, OS 1851, Holland 1987, Holland 1989, Marshall and Davies-Shiel 1977, Adams 1988

Description

The incline was constructed in the early nineteenth century to transport ore from Middle Level down to the Paddy End Dressing Floors. The incline extends from the entrance to Hospital Level 356, across the Levers Water Beck and ascends the opposite valley side parallel to the foot of Grey Crag. It was a self-acting tramway that relied on the weight of a full waggon descending to pull an empty one back up the slope. Holland's reconstruction suggests that there was a single track with a passing place in the middle (1987, 176). The masonry at the foot of the incline is well preserved at the entrance to Hospital Level and extends up to the side of the stream. The relationship and phasing between the adit and the incline is described above (see Hospital Level). The walls of the incline foot are of drystone construction, standing to a height of 1.2m which form a ramp 4.5m wide. The Levers Water Beck has washed away most of the walls of the bridge abutments, but enough masonry survives to identify their positions; presumably the bridge was constructed with timbers as there is no indication of an arch. From here the incline extends up the hillside to the foot of Grey Crag. The lower section is 28m long and survives as a 6m wide platform capable of taking a double set of rails. The ramp is of earth and stone contained within sloping stone walls, standing to a maximum height of 2.5m on the downslope side. The top section is 45m long and survives as a narrow, 2.5m wide, terrace which could only have taken one set of rails. Erosion from above has partially obscured the top section and in the upper reaches the downslope side has now collapsed away. At the top of the incline is a rock-cut platform, measuring 6m by 10m; shot holes are visible in the rock face. Three timber uprights protrude from the platform; these presumably held the drum around which the wire ran, and its braking mechanism. Ore was transported to this platform for loading into the trucks via an ore chute which descended from Middle Level.

Feature Number	359
NGR	SD 2833 9886
Site Type	Quarry
Source	English Heritage, 1997
Description	

To the west of Courtney's Cross Cut is a small horseshoe-shaped quarry cut into the base of the hillside at the rear of the terrace. The quarry may have been the source of stone for the construction of the incline (358).

Feature Number **360**
NGR SD 2835 9885
Site Type Adit (Courtney's Cross Cut)
Source English Heritage, 1997, OS 1892, Holland 1989, Marshall and Davies-Shiel 1977, Adams 1988

Description

This adit is located 30m from the west end of the upper terrace; it was driven *c* 1820 to intersect the south vein and was eventually connected to Deep Level by the South Shaft (355). The adit entrance, which measures 2m high by 1.7m wide, is at the end of a rock-cut gully, measuring 10.7m long which reaches a depth of 4m; a collapse above the adit entrance has been stabilised by a revetment wall, which stands 2.2m high. The spoil from the driving of the adit has been incorporated in the terrace; however a finger of spoil projects from the front of the terrace opposite the adit entrance, possibly enhanced by spoil from the construction of Hospital Level (356).

Feature Number **361**
NGR SD 2839 9885
Site Type Adit
Source English Heritage, 1997, OS 1892, OS 1919, Holland 1989

Description

West of Building 363 is a test adit dug into the hillside above the upper terrace. The adit is visible as a gully, measuring 7m long, with banks of spoil on either side, standing up to 1.5m. The adit entrance is now blocked, marked by a circular collapse; two stone revetment walls survive on either side, which stand up to 1m high. In front of the gully is a flat platform created by the dumping of spoil which has formed a conical heap, standing 10m, high which extends to the rear of the terrace.

Feature Number **363**
NGR SD 2841 9884
Site Type Smithy
Source English Heritage, 1997, OS 1892, OS 1919, Holland 1987, Holland 1989, Adams 1988

Description

A single-roomed building which is revetted into the hillside, it measures 5.6m by 6.7m internally within walls 1.7m high. The west side of a doorway in the south wall survives and there is a blocked door in the east gable wall, to the north of which is a small niche. Against the west wall is a raised plinth constructed of mortared stone, measuring 1.2m high; there are iron fixings projecting from it. The building has been damaged by the construction of some inspection hatches to do with the water treatment works. The building is annotated as a smithy on the mine plan (Adams 1988, 148) and the presence of the fixings suggests some industrial process; however there are no traces of any waste iron or slag.

Feature Number **364**
NGR SD 2844 9883
Site Type Office
Source English Heritage, 1997, OS 1892, OS 1919, Holland 1987, Holland 1989, Adams 1988

Description

At the junction of Track 300 and the path from Gaunt's Level stands the remains of a two-storeyed stone building. There is a single room to the ground floor, measuring 6.7m by 5.4m internally within walls which stand to 1.9m high; there is door, and a window in the south wall and a window in the east wall; the north-west corner has collapsed. There is a small annexe attached to the rear wall, measuring 2.9m by 3m, which has a door to the east. The building is annotated as an office on a contemporary mine plan (Adams 1988, 148).

Feature Number 365
NGR SD 2839 9882
Site Type Ore Hoppers
Source English Heritage, 1997, OS 1851, OS 1919, Holland 1989, Adams 1988

Description

It is probable that the spoil from both Grey Crag and Hospital Levels went to make up the terrace alongside the stream. The trucks carrying ore-bearing rock travelled along the upper terrace to the top of a series of hoppers (365) standing on the terrace below. The hoppers consist of a massive C-shaped revetment wall, measuring 4.2m high, which is subdivided into two bays. The eastern bay is the largest, measuring 8m by 24.7m, in the middle of which are two large upright timbers which may have supported a roof or a further subdivision of the hopper. The western hopper is smaller, measuring 9m by 7m; it has a sloping cobbled floor which extends from the rear wall to a wall, 0.6m high. On top of this wall is a line of large boulders with iron fixings projecting from them; a gap in the centre seems to form a chute down which the ore could filter. There is a platform revetted by a stone wall, measuring 0.8m high, which forms a shovelling platform. In front of the hoppers the terrace varies in width due to slumping of the revetment to the terrace below (369). The surface is paved with large stone slabs most of which are still in situ. Track 300 now crosses this surface and a certain amount of damage is being caused by the passage of vehicles where the road surface has worn away. The trackway has destroyed a building attached to the east wall of the hopper, visible on a mine plan (Adams 1988, 148-9). The course of a wall is visible in the track's surface to the west of the hopper; this may be the remains of the building.

Feature Number 366
NGR SD 2849 9865
Site Type Water Treatment Works
Source English Heritage, 1997, Holland 1987, Holland 1989

Description

In 1972 the then Furness Water Company installed a water treatment works on the valley floor near the confluence of the Levers Water Beck and the Low Water Beck (for before and after photographs see Holland 1987, 298). Although the treatment works itself caused little damage to the dressing floors, works on the pipeline feeding it caused damage to some buildings on the dressing floor terraces. The structures associated with the works consist of a set of inspection hatches behind the smithy (363), and in the valley bottom a large buried tank with a landscaped entrance in a concrete wall, measuring 4m high; there is also a fenced enclosure with a large open air tank inside it.

Feature Number 367
NGR SD 2836 9877
Site Type Spoil Heaps
Source English Heritage, 1997, OS 1851, OS 1892, OS 1919, Holland 1989

Description

There are five obvious finger dumps extending from the second terrace, all of which consist of large rock fragments produced from initial processing or from tunnel driving. The waste heaps have overwhelmed the Levers Water Beck, cutting off its natural channel, the water has subsequently found its way under the base of the spoil and emerges from the base of the heaps to the south. In wet weather water floods around the base of the spoilheaps forming a boulder-filled channel which is normally dry. The force of the water during flood has scoured a crescentic scarp which cuts through the two most north-westerly dumps. The remaining heaps are well preserved, measuring up to 27m high, with a flat top 2.4m wide. The easternmost waste heaps, where they meet the dressing floor terraces, consist of fine waste which has been dumped from the end of each individual terrace. In places the fine waste is partly overlain by the larger finger dumps. The flat top along which the tramways to the spoil heaps were laid is now interrupted by a scarp created by the removal of material from the spoilheaps to construct a ramp up which track 300 now reaches the top terrace.

Feature Number 369
NGR SD 2843 9879
Site Type Terrace

Source English Heritage, 1997, Holland 1987, Holland 1989

Description

The terrace is located immediately below the hoppers and is defined by a badly damaged revetment wall; several structures have been incorporated into it. At the west end of the wall a stone-capped leat can be seen projecting out of the slope, and paving slabs from the working platform above are slipping down the slope. The leat emerges opposite a large stone plinth, measuring 8m by 5m and 2m high at its front apron. The presence of the leat above indicates that this is probably a machine base for a water wheel or other water powered machinery. Further to the east are two masonry pillars. The western one, measuring 3m tall, has a stone lined leat built into its top. The eastern one measures 2.8m high. It seems likely that a water wheel was suspended between these two pillars. East of the pillars two leats can be seen projecting out of the section. One is stone lined and projects from the top of the section heading in an easterly direction; below this a wood-lined leat, measuring 1m wide and 0.3m deep, covered by sheet iron, projecting forwards to the lower terrace. Four metres further east a sloping flagged floor descends to the top of the revetment wall which ends at a wing wall which projects outwards for 5m; this is probably a hopper for transporting ore down from the terrace above. From here the revetment wall is replaced by a loose slope down which a trackway descends from a junction with trackway 300. Adjacent to this track are two curving walls, 2.8m high, forming a hopper. At the eastern end of Terrace **369** are the remains of a settling tank obscured by material from the re-surfacing of Track **300**.

Feature Number **370**

NGR SD 2845 9878

Site Type Terrace

Source English Heritage, 1997, Holland 1987, Holland 1989

Description

A steep scarp separates this terrace from Terrace **369** and the revetment wall between it and Terrace **371** has collapsed leaving a rocky slope. At the eastern end is a well preserved settling tank. It is rectangular in shape with rounded corners, and measures 32m long by 5m wide and is bounded by a 1m high stone-faced bank; on the downslope side this bank measures 3m wide and has a 4m high revetment wall extending to Terrace **371**. At its western end there is a breach in the revetment wall which may have been a sluice emptying into the tank below; green stained copper sediment is visible in the base of this channel. The supply leat extends along the terrace from the west and splits to supply both this tank and the one below on Terrace **371**.

Feature Number **371**

NGR SD 2846 9877

Site Type Terrace

Source English Heritage, 1997, Holland 1987, Holland 1989

Description

This terrace extends from a flat platform which is shared with Terrace **372**, adjacent to the waste heaps. Extending along the rear of the terrace an intermittent revetment wall, measuring up to 0.8m high, ends at a steep eroding slope. Projecting from this slope is the remains of a wheel pit and supply leat. A wall has been constructed on a diagonal line across the wheel pit blocking the northern third of it. A large capstone marks the position of the supply leat which projects from the scarp immediately above the wheelpit; it measures 1.4m wide by 0.7m high, and has a stepped stone-lined floor. The leat originates from the machine base/wheel pit on terrace 369. A small wood-lined leat also projects from the section and extends eastwards. The wood leat is constructed of sawn timber and fixed together without nails to form a box section; the gaps are plugged with a felt-like material which is preserved due to waterlogging.

Feature Number **372**

NGR SD 2844 9876

Site Type Terrace

Source English Heritage, 1997, Holland 1987, Holland 1989

Description

The west end of this terrace is shared with the terrace above it. In front of the wheelpit is an unusual feature which is interpreted as a reservoir. The feature is an oval hollow, measuring 10m by 5m and 1.5m deep, the sides lined with battered stone walls. At the southern end the walls narrow to form a gap, 1.4m wide, where two stone pillars, 1.3m high, support the wooden uprights of a sluice gate. From the base of

this sluice, which is level with Terrace **373**, a wood-lined leat extends southwards. The water supply for the reservoir comes from a buried leat probably extending from the wheelpit above. The passage of water has worn a deep channel in the stone revetment which in places constructed of limestone; the presence of limestone, which is not a local rock, is unusual. The terrace extends from here as a flat platform, measuring up to 12m wide, bounded by revetment walls of the terraces (**371** and **373**) above and below.

Feature Number **373**
NGR SD 2845 9876
Site Type Terrace
Source English Heritage, 1997, Holland 1987, Holland 1989

Description

This terrace is a narrow curving platform which extends from the base of the reservoir on Terrace **372**. The outflow from the reservoir runs across the terrace over a stone-flagged cascade from where it has worn a large gully extending to Terrace **374**; a small wooden leat also projects from the base of the sluice and extends to the south-east. In the side of the water worn gully a third wooden leat can be seen in section, filled with sludge and finings.

Feature Number **374**
NGR SD 2846 9875
Site Type Terrace
Source English Heritage, 1997, Holland 1987, Holland 1989

Description

The lowest level of the dressing floor occupies gently sloping ground on to the valley floor. At the west side of this area is the continuation of the water worn gully from the reservoir on Terrace **372**; it extends down the slope to the top of an unusual series of walls (dams) which stand at the head of a shallow ditch that extends to the east. The walls form a small edge, 1.4m high, for the water to cascade over; masonry fragments either side of the edge suggest that there may have been some other machinery here. The dams were probably for trapping sediment to avoid polluting the stream; similar dams can be seen at the Lower Dressing Floors. At the east side of the terrace are a series of square settling tanks. The transcription shows seven tanks in this position although only traces of four now remain. The largest tank, which measures 8m by 5.5m within stone and earth banks standing up to 1m high, has a sluice in its south side. To the south-east of this is a second smaller tank with a well preserved stone-lined sluice in its south-west corner. Some 20m to the west is a third tank; it is badly preserved with only one small section of walling visible. The position of a fourth tank is suggested by an oval hollow at the eastern edge of the area, although no walling is visible. A network of stone-capped leats run between the tanks; their course can be traced on the surface. The western edge of this area is bounded by the base of the spoilheaps (**367**). A concave area in the slope of the heaps indicates that an amount of spoil has been removed from the heaps; a modern (post-treatment plant) track leads to this point.

Feature Number **418**
NGR SD 2831 9885
Site Type Leat
Source English Heritage, 1997, OS 1851, OS 1892, OS 1919, Holland 1987, Holland 1989, Marshall and Davies-Shiel 1977, Adams 1988

Description

The course of this leat is easily visible extending from the waterfalls below the Pudding Stone, under Grey Crag, to a point opposite Grey Crag Level entrance (**357**). The leat has a steep gradient made necessary by the restrictive nature of the topography. The leat survives as a V-shaped ditch, measuring 1.3m wide, with a counterscarp bank on the downslope side. The leat is now well used as a path for walkers and is suffering from erosion, especially in its upper reaches. At the mouth of Grey Crag Level (**357**) the course of the leat is invisible, but from here it crossed the stream to join a leat which took water directly from the stream at this point. It is likely that the leat was carried over Grey Crag Level and the stream in a wooden launder; there is a large iron staple set into the rock at the side of the stream (just upstream of the modern foot bridge) and iron fixings on the opposite bank which mark its position. Adjacent to the revetment wall of the incline (**358**) is a length of wooden trough which is presumably the continuation of the leat as it extends along the terrace.

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